DEUTSCHE BUNDESBANK
EUROSYSTEM

International Cash Conference 2014

The usage, costs and benefits of cash – revisited

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Carl-Ludwig Thiele
Dinner Speech on 16 September 2014

Carl-Ludwig Thiele
Board member of the Deutsche Bundesbank, Germany

Ladies and gentlemen,

I am delighted to have the pleasure of welcoming you here in Dresden to Eckberg Palace at the end of the first day of our conference in such a splendid venue.

This is now the second time that we have organised this international cash conference and looking around, I recognise quite a few familiar faces. This is particularly gratifying as this event not least aims to bring together the relatively small international academic community of cash researchers. But I would also like to extend a warm welcome to those of you who are here for the first time this year.

"The usage, costs and benefits of cash – revisited" is the topic of this year's conference. The range of research subjects that fall into this category are as varied as they are topical:

– Why do people still use cash even though there appears to be a greater range of alternatives available every year?
– What is the cost of cash and what benefits does it offer us?
– What is the role of cash in crisis situations?

These are just a few of the topics that we have already touched on or will be taking a closer look at during this three-day conference. I am also pleased to see that international research into cash-related topics has continued unabated since our first cash conference two and a half years ago and that such a wide range of different aspects are still being examined. To name but one example, this year the Deutsche Bundesbank conducted its third consecutive survey of payment behaviour among residents in Germany. The results are due to be published next year. Each time we conduct this survey, we learn more about why banknotes and coins still account for around 50% of sales turnover and four-fifths of all transactions by residents in Germany.

"Cash" is an interesting, but also an important field of research as it faces pressures from many different quarters. On the one hand, there are the commercial banks, card companies and internet companies, which are keen to increase the popularity of cashless payment instruments and payment procedures. In some countries, people have been quick to embrace these innovations, whereas in other countries, people are more reluctant to adopt new payment instruments and procedures. On the other hand, there are a growing number of countries which have restricted the residents' freedom to use cash payments in an attempt to combat money laundering and tax evasion. Such developments in the area of payments mean that consumers are becoming increasingly transparent. Here in Germany, great importance

is attached to the concept of "informational self-determination and data protection", not least by honest citizens, who have absolutely nothing to hide. Using cash is a way of helping people to protect their privacy, or to quote the words of the Bundesbank's former Chief Economist Otmar Issing: "Cash is minted freedom".

In light of these issues, it is important to forge ahead with our research into the usage of cash. It is all too often the case that cash is perceived solely from a cost perspective; an approach which, I might add, is not appreciated by German retailers: in their opinion, cash remains the most cost-effective payment instrument. But rather than focusing on cost, we should place a greater emphasis on the benefits and features that make cash so unique. In addition to the aspect of anonymity that I mentioned earlier, cash enables a payment contract to be fulfilled immediately and without the need for a technical infrastructure. This latter aspect means that cash is a contingency solution when cashless payment is not possible and it is the only means of payment that can be used in certain crisis situations, such as in the event of a natural disaster.

Cash will therefore continue to play a key role in the payments basket in the foreseeable future. I sincerely hope that the research findings presented here at this conference will contribute towards emphasising the role of cash in society today. It is sometimes said that "cash is king", and there is a lot of truth in this saying. On that note, I wish you all a rewarding conference, a lively exchange of ideas and a pleasant evening.

Cheers!

Javier Alonso
Dinner Speech on 16 September 2014

Javier Alonso
Board member of the Banco de España,
Spain

It is a privilege for the Banco de España to participate, as a guest of honour, in this second edition of the Cash Conference, which was organised for the first time in 2012 by the Deutsche Bundesbank. Once again, the Bundesbank has gathered together an impressive panel of cash experts from leading universities and central banks around the world. This is an excellent opportunity for experts to share knowledge and experiences and discuss different viewpoints on the ever-interesting subject of means of payment.

Particular consideration will be given in the Conference to discussing the use of cash versus electronic means of payment, most notably – but not only – credit and debit cards, in light of the emergence of mobile phone payments.

The opportunity to compare different approaches, theories and practices in respect of the role of cash in society will prove mutually enriching for central bankers and academics and their different standpoints. And this all the more so when ideas can be set out and debated in a relaxed atmosphere, free from daily working pressures, against the rich artistic and cultural background provided by Dresden, one of the most beautiful cities in Europe.

The schedule for the three-day conference offers a wealth of subjects relating to cash. Of most particular interest will be the second session on the opening day, in which two central bank representatives will highlight the crucial and practical role cash played during the recent financial turmoil in mitigating the adverse effects of the crisis, and in which two university professors will likely set out a more comprehensive or theoretical approach. And naturally, consideration will also be given to the unpredictable behaviour of the general public and their preference for the use of different means of payment.

In short, the programme is a truly stimulating one, in terms both of the subjects addressed and the participants. We are once again in the most grateful to the Bundesbank. Long may we see the International Cash Conference on our agenda.

Malte Krueger[1] and Franz Seitz[2]
The Importance of Cash and Cashless Payments in Germany: – Overview and first estimates –[3]

Malte Krueger
Hochschule Aschaffenburg, Germany

Franz Seitz
Ostbayerische Technische Hochschule Weiden, Germany

Abstract

This paper analyses cash and cashless payment instruments in Germany. After a description of developments in a national and international context, we will compile a critical literature overview on cost calculations and on the importance of

1 University of Applied Sciences Aschaffenburg, Wuerzburger Straße 45, D-63743 Aschaffenburg, Germany, email: malte.krueger@h-ab.de
2 Weiden Technical University of Applied Sciences and WSB Poznan, Hetzenrichter Weg 15, D-92637 Weiden, Germany, email: f.seitz@oth-aw.de
3 We thank N Bartzsch, M Diehl, E Gladisch, A Müller, H Rittgen, R Rotzler, M Schmudde and C-L Thiele for helpful comments and suggestions Last but not least, we wish to thank M Altmann for his extensive preparatory work for estimating the volume of cash payments.

payments media for different countries. Against the background of the criticism of these studies, we will present an independent and largely "demand-based" approach in Section 3 on the economic significance or cost of cash and cashless payments instruments without conducting a survey of our own. It can be interpreted as an addition to the supply-based cost studies which have predominated in literature up to now. All in all, it accounts for approximately 2% to 2,5% of GDP. However, these figures do not take qualitative factors into consideration.

1 Introduction

A modern and specialised economy, which is based on the division of labour, is increasingly dependent on the effective functioning of large networks. Examples of networks with a marked macroeconomic significance are communication networks (landline and mobile phone networks, post), transport networks (roads, railways, aviation), energy networks (electricity, gas) and the water supply. Not least, these networks also include payment networks.

If the functional capability of any one of these networks is ever impaired, this would have serious repercussions for the economy as a whole. Without electrical energy, the production process would be largely crippled, and consumption possibilities for households would be seriously restricted. Malfunctions in other networks would have a similar adverse impact upon economic activity. This also applies, in particular, for disruptions to payment systems because the real flow of goods and services presupposes that money flows in the opposite direction. If the flow of money stagnates, the real flow of goods and services will follow suit. Not only that, financial markets would also be hugely hampered by problems in payment transactions. This, in turn, would have an adverse impact on the real economy.

Ever since the dawn of money, people have explored the advantages and disadvantages of different forms of payment. However, systematic research on the topic did

not take place until the 1980s.[4] Cost-benefit analyses should concentrate on finding efficient methods of payment and on finding payment systems which offer efficiency both in microeconomic and macroeconomic terms. Consequently, the derived outcomes are both of relevance to policy-making and are of interest to the parties involved in the payment cycle. It should also be noted that the national payment systems are exposed to change through innovations in finance and payment transactions, as well as through changes in the payment habits of consumers. And that is, as we mentioned above, against the backdrop of an industry which is characterised by network externalities (see Leibbrandt, 2004). An efficient payment system is not an end in itself, but a necessary precondition for fostering national and international trade, as well as for the development of an efficient financial system and, ultimately, for the welfare of the economy as a whole.

In the study on the "Costs and Benefits of Cash and Cashless Payment Instruments" commissioned by the Deutsche Bundesbank, we will seek to explore the significance of (cash and cashless) payment transactions for the national economy and to analyse the costs and benefits of cash and cashless payment instruments in Germany. This study is divided into three modules. Module 1 "Overview and initial estimates", which is the subject of this paper, contains (1) a selected description of the volume and of the development of cash and cashless payment transactions with specific reference to Germany, (2) an overview of existing studies on the costs and benefits of cash and cashless forms of payment, and (3) a first assessment of the significance and costs of cash and cashless forms of payment in Germany.[5]

Section 2 presents some facts on the development of cash and cashless payment instruments in Germany, comparing it with other countries on the basis of some

4 Early studies were conducted by Godschalk (1983), Whitesell (1989), Humphrey & Berger (1990), Boeschoten (1992) and Virén (1993), to name but a few.
5 Modules 2 and 3 will explore the costs and benefits of payment instruments in detail.

selected examples. This section is largely descriptive in its focus. In some areas, specific patterns for Germany are noteworthy. Section 3 is devoted to a critical overview of existing studies on the costs associated with payment media. It focuses on cash and card payments. We will then try to quantify the significance of payment transactions and payment media for Germany applying a demand-based approach, without having collected any primary data of our own. In this approach, the focus is on the costs incurred by consumers of payment services (payment service users). Firstly, the costs incurred by consumers reflect their willingness to pay, and thus the benefits of the use of payment instruments, and, secondly, these costs represent revenue for payment service providers. This income must ultimately be sufficient to cover the costs. Consequently, such a demand-based approach also allows to indirectly infer the costs of the payment transactions. The costs incurred by consumers comprise the fees, possible loss in interest income and the cost of providing their own resources (in particular, their own time). In this section, an overall distinction is generally only made between cash and cashless payment instruments. The last chapter summarises the study and draws some conclusions.

2 Trends in payment methods and in payment transactions

2.1 Estimating cash payments

The nature of cash payments makes collecting statistics on the value and number of transactions difficult. Cash is an "offline" method of payment, and a cash transaction is not separately recorded. Many users feel that it is precisely this that makes cash particularly advantageous.

This means that the extent to which cash transactions are used for payments can only be estimated with the aid of indirect methods or on the basis of data collected by means of surveys. In principle, there are three possibilities:

1. Estimation of purchases that are generally settled in cash. As payment cards are in principle also used for these transactions, card transactions are deducted from the total volume and the remainder represents the volume of cash transactions.

2. Estimation of the amount of cash withdrawn from automated teller machines (ATMs) and over the counter. As cash is essentially withdrawn to be used to make subsequent payments,[6] this variable can be used as the upper limit for the volume of payments effected in cash.

3. Surveying of economic agents on their payment and cash procurement habits.

Estimated volume of cash payments: Results of different approaches (€ bn) Table 1

	2008	2009	2010	2011
National accounts	573	566	562	578
VAT statistics	657	627	643	660
Withdrawals	664	660	625	640
Survey (expenditure)	637			538
Survey (withdrawals)	558			
Average	619	635	628	604

Source: Bartzsch et al. (2011a, b), BVH, Deutsche Bundesbank, Federal Statistical Office, and own calculations.

Table 1 provides a summary of the different methods used. The findings based on VAT statistics and on the withdrawals reported by the banking industry are relatively

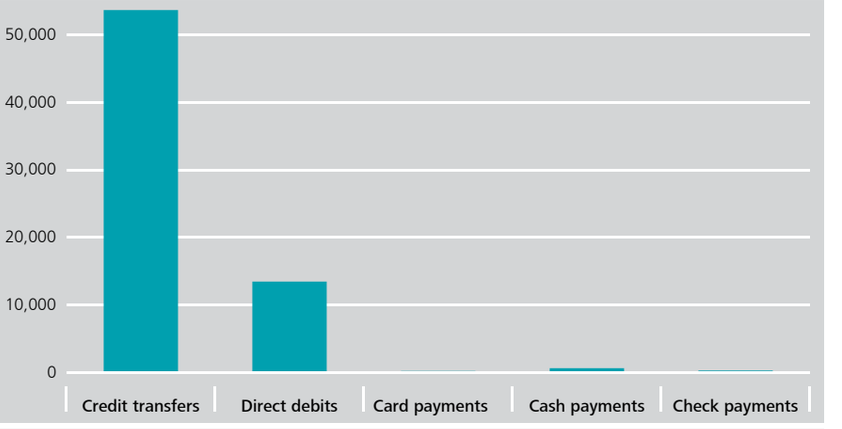
6 For example, the findings on the share of cash using data from the payments diary (Deutsche Bundesbank, 2009a, Chap. IV) according to which the main determinants are transaction-driven could be interpreted in this sense.

high and suggest that the value of cash payments in 2011 is well over €600 billion. The results based on the payments study conducted by the Bundesbank do not reveal a uniform picture, and the estimate on the basis of the national accounts is well under €600 billion. The average value for 2011 is €604 billion. Consequently, sales transacted in cash continue to be significantly higher than sales transacted by card (in 2011 this was about €188 billion according to the Deutsche Bundesbank's payment statistics and €269 billion according to PaySys Consultancy). This difference is even greater when measured in terms of the number of transactions. However, estimates of the number of cash transactions are less reliable than estimates of cash turnover. The number of transactions can ultimately only be estimated on the basis of the estimated turnover. In addition to turnover, an estimate of the average transaction value is also required. The findings of the Bundesbank's survey on payment behaviour can also be used here. The survey reveals an average amount of just under €20. Consequently, our calculations show that an estimated 32 billion cash payments were made in 2011 (equal to about 400 cash transactions per capita and year).

When comparing the principle payment instruments (credit transfers, direct debits, checks, cards and cash), credit transfers are by far the most important instrument in terms of value of transactions (see Fig. 1). However, in terms of the number of transactions, cash is still the most important instrument. In particular, the estimated number of cash transactions (about 32 billion) is significantly higher than the number of card payments, which amounted to around 3 billion transactions according to the payment statistics (see Fig. 2).

Shares of payment media in 2011: Values Figure 1

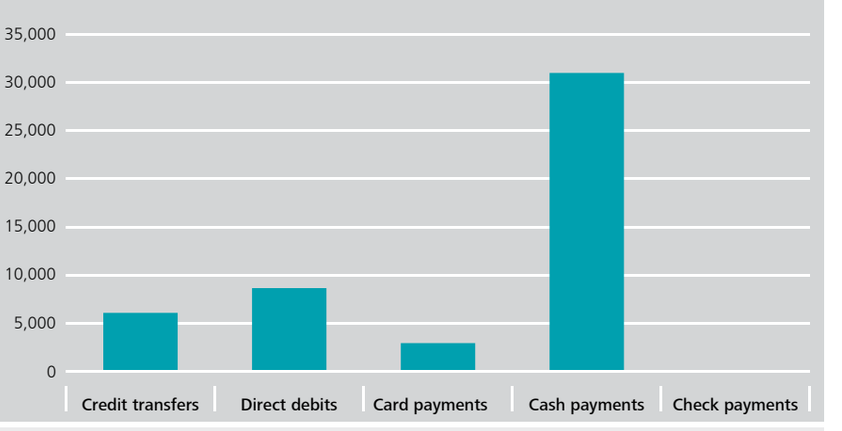
€ billion



Sources: Deutsche Bundesbank and own calculations.

Shares of payment media in 2011: Transactions Figure 2

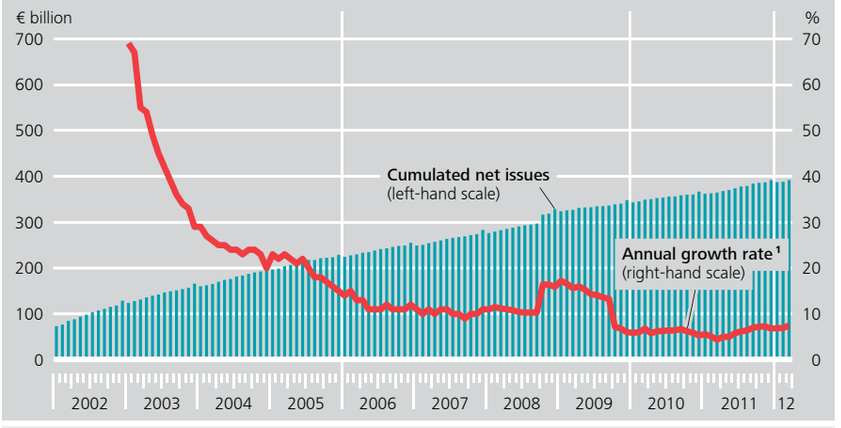
million trx.



Sources: Deutsche Bundesbank and own calculations.

The continued importance of cash is also demonstrated by the evolution of cash holdings over time. The very dynamic trend in cumulated German net issues of banknotes since 2002 is striking in the first instance (see Figure 3).[7] The double-digit growth rates up to the end of 2009 differ significantly from the days of the Deutsche Mark prior to the introduction of euro cash (Bartzsch et al., 2011b, p. 7). If cash holdings in 2012 were simply divided by the number of German residents, this would yield a figure of around €5,000 per capita. This is not in line with experience, however.

Euro banknotes in circulation: Germany Figure 3



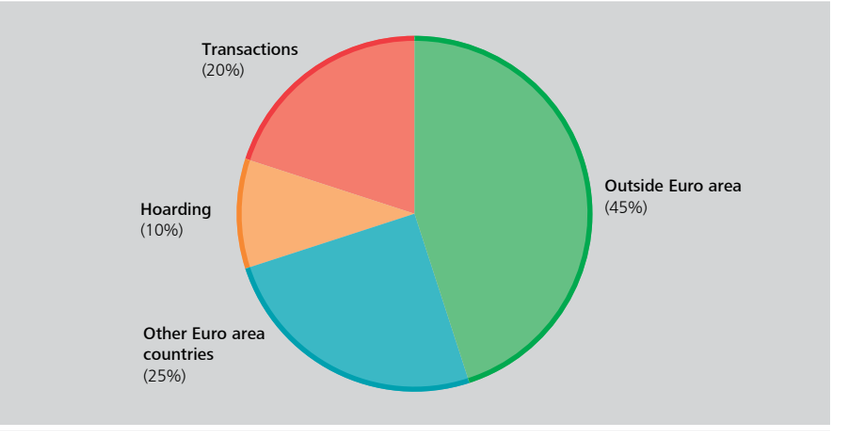
1 Annual rate of growth compared with the previous year.
Source: Deutsche Bundesbank.

The chart clearly shows how the insolvency of Lehman Brothers triggered a surge in the demand for cash. As we will see shortly, the German situation varies significantly, on the whole, from that in other countries both within and outside the euro area. The reason for the high levels of cash holdings is that all of the motives that

7 The net issues are not to be confused with the cash in circulation in Germany, which cannot be determined precisely, especially within the framework of a monetary union.

create a demand for cash are at work in Germany (see Figure 4). Cash is used for transaction and hoarding purposes, and considerable proportions of the notes issued in Germany are held in other euro-area member countries as well as outside the euro area (see also Bartzsch et al., 2011a, b for a detailed account of this). 70% of the German note issues are held outside the country – for transaction and hoarding reasons – with the majority likely to be outside the euro area. Only a small portion of a maximum of 20% is required in Germany for transaction purposes. Hoarding for various reasons accounts for 10%.

Cash motives and German net issues Figure 4

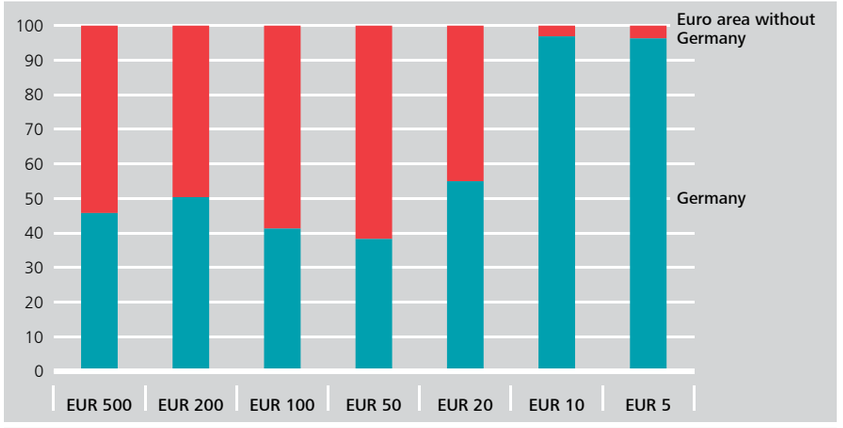


Source: Bartzsch et al. (2011a, b).

Comparing the situation in Germany with the rest of the euro area, it is noticeable that the German share in cumulative net banknote issuance is greater than the German capital share in the ECB for all denominations in terms of both value and quantity. As shown in Figure 5, the share of small denominations is over 90%; the only value under 40% is with the €50 note. The reasons behind Germany's unusual

position in this regard are largely uninvestigated. An initial analysis can be found in Bartzsch et al. (2011a, chap. 5).

Banknotes: German issuance share in terms of quantity (2012) Figure 5



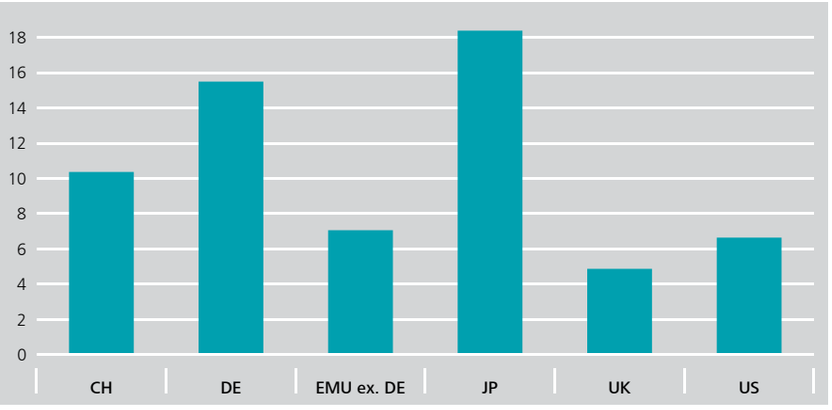
Note: End of February 2012.
Source: Deutsche Bundesbank.

In Figure 6, the cumulative net issue in the euro area relative to GDP is compared with the circulation of cash (which equals the cumulative net issue) in countries outside the euro area (USA, Japan, Switzerland, United Kingdom) in 2011. Surprisingly, this quota is considerably lower in the USA (just under 7%) than in Germany despite the fact that high stocks of dollars are also held outside the country.[8] The highest values are achieved by Germany (over 15%) and Japan (over 18%), even though the Japanese yen is used almost exclusively in Japan. Switzerland is also in double figures at just over 10%. It is likely that all of the motives that create demand for cash also exist for the Swiss franc. At 7%, the figure for the other euro area

8 The Fed estimates that up to 2/3 of dollar banknotes are located outside the country (United States Treasury Department, 2006 and Judson, 2012).

countries is significantly lower than the German equivalent. Only the United Kingdom, with almost 5%, has a quota that lies within the range that one would more or less expect for transaction-related reasons.

"Cash in circulation" in relation to GDP in 2011 Figure 6

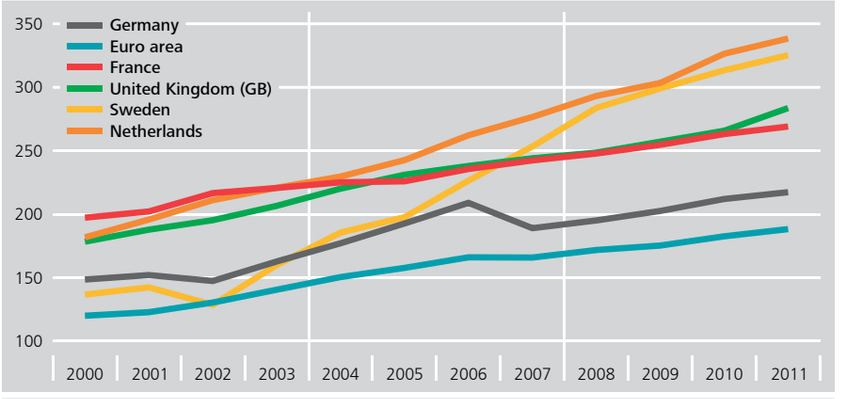


Notes: CH: Switzerland, DE: Germany, EMU ex. DE: Euro area excluding Germany, JP: Japan, UK: United Kingdom, US: USA. The figures for the euro-area countries relate to the cumulative net issue.
Sources: National central banks, ECB.

2.2 Cashless payments

Looking at cashless payment instruments, in 2011, every citizen made approximately 217 cashless transactions, on average. This puts Germany above the euro-area average (see Figure 7). However, cashless payment instruments have been used much more intensively in some countries (most notably in the Scandinavian countries and in the Netherlands). As will be seen later, this is largely due to the fact that Germans use payment cards relatively infrequently.

Cashless payment transactions per capita in selected EU member states Figure 7



Notes: Values for Germany: Statistical break in 2007.
Sources: ECB Data Warehouse and own calculations.

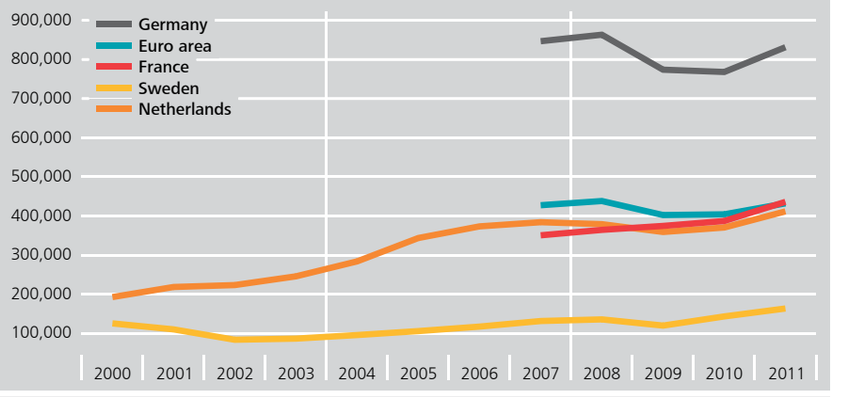
Measured on the basis of the per capita value of cashless transactions, Germany is above-average for all the countries considered (see Figure 8). It should be borne in mind, however, that the statistics on the value of non-cash payments are dominated by high turnover in the B2B area and in the settlement of financial market transactions. In addition, the change in values over time and the large differences between similar countries would suggest that the statistics are not always comparable.

Figure 9 compares the numbers of card payments per capita in the EU in 2002 and in 2010. The values have increased in every country. The highest levels of growth, starting from a low initial level, are evidently in the Baltic states and in Poland. In 2010, the Scandinavian member states of the EU were clearly at the top with almost 200 transactions per inhabitant. Greece was at the bottom end of the scale with only seven transactions. With a score of 33 transactions, Germany is on a par with Malta and Lithuania, just ahead of Italy, but significantly behind France, Austria

and the Netherlands. In comparison with the rest of the EU, growth in Germany has been slower. Outside the EU, the number of card payments per capita in 2010 was 211 in the US, 64 in Japan, 77 in Switzerland, and 4 in China. Therefore, according to these figures and bearing in mind the level of development, the value for Germany is relatively low.

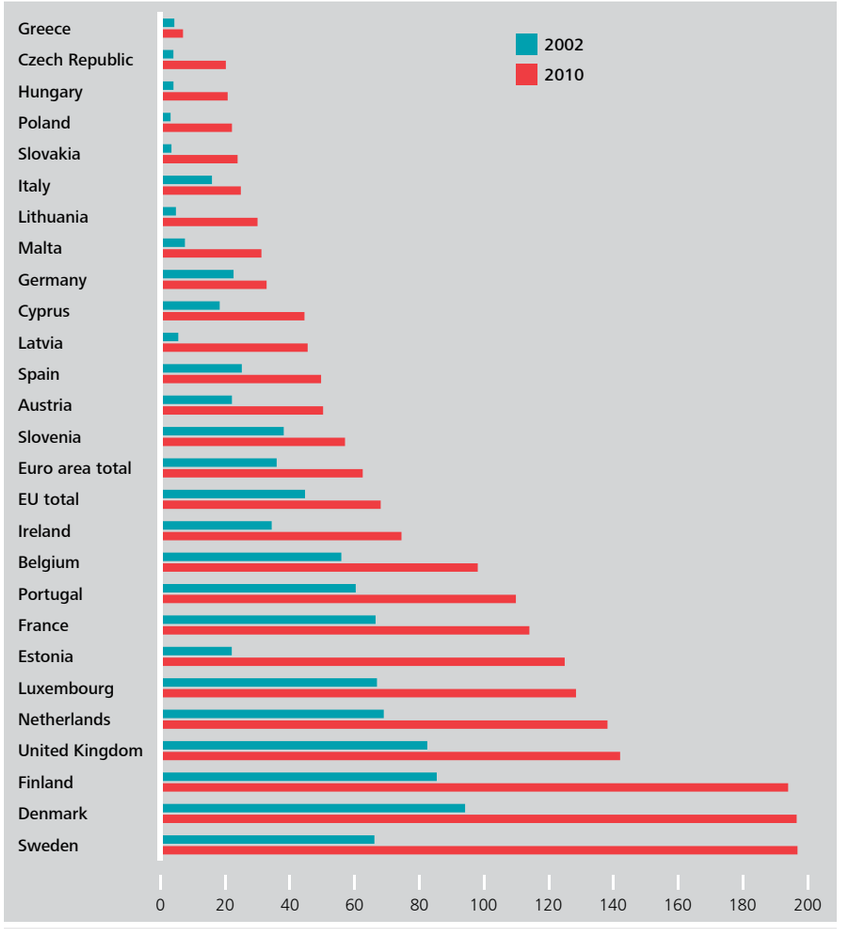
Value of cashless payment transactions per capita in selected EU member states Figure 8

€



Notes: Values for Germany: Statistical break in 2007.
Sources: ECB Data Warehouse and own calculations.

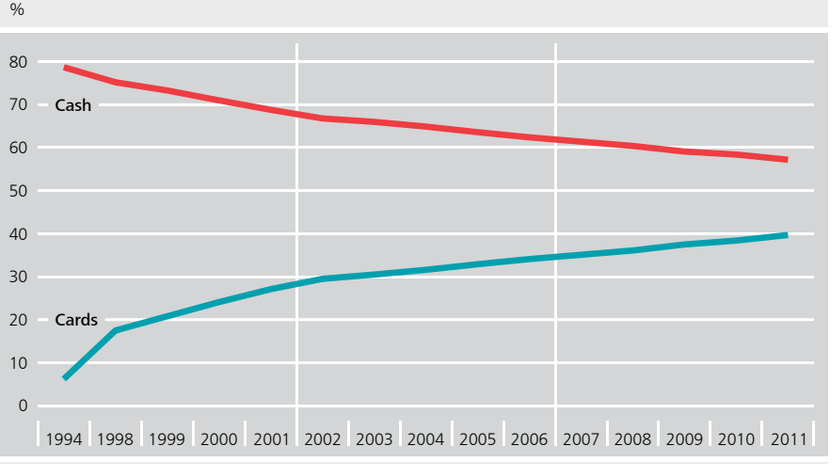
Per capita card payments in the EU Figure 9



Source: ECB.

However, when looking at cards use over time, statistical evidence from the retail sector clearly shows that cards are gaining ground vis-á-vis cash. From 1994 to 2011, the share of cash payments (in terms of the value of transactions) fell from almost 80% to less than 60% while the share of card payments rose from 5% to almost 40% (see Figure 10).[9]

Share of cash and cards in retail trade according to the EHI Figure 10



Source: EHI, own chart.

Direct debits are particularly popular in Germany, and the trend is rising. Based on the number of transactions, Germany is well ahead of most other countries. Only the Netherlands and Austria have comparable figures. This is due to the fact that direct debits in these countries are designed to be especially user-friendly. For example, direct debits are not only used in Germany for many regular payments

9 These figures are in line with survey results of the Deutsche Bundesbank. For 2008 the survey yields a share of cash transactions (in value terms) of 57.9% and for 2011 of 53.1%. See Deutsche Bundesbank (2009a) and (2012).

(telephone billing, insurance premiums, etc.); they are also used for payments at the POS (electronic direct debit, or ELV) and for payments on the internet.

Any regular payments that are not processed by direct debit in Germany are settled by credit transfer, frequently using a standing order. Besides that, the credit transfer is the most commonly used instrument for making larger one-off or irregular payments. This applies not only to payments by households but also by businesses. In particular, credit transfers are also used for payments arising from financial market transactions. This also explains the high value of the transactions which are effected by credit transfer (see Fig. 1).

The comparative data on the use of the different payment instruments have shown that there are significant differences across Europe. While cash is used relatively frequently in Germany, card use is below the European average. However, that does not mean that cashless payment instruments are generally used less frequently here. Credit transfers are frequently used, and Germany is ahead of the rest in its use of direct debits.

3 Cost studies: Overview of literature

It is already clear from the different developments shown in Chapter 2 that one should be careful when comparing payment systems internationally. This applies, in particular, with respect to costs of different payment media. Hayashi & Keeton (2012, p. 1f) conclude following an analysis of different cost studies: "The studies have reached different conclusions …, suggesting that cost rankings can depend on the specific characteristics of a country's payments system and the scale at which a payment method is used in the country. (…) These differences suggest a need for each central bank to conduct its own cost study." In a similar vein, Schmiedel et al. (2012, p. 8) state: "The existing literature shows that, in spite of recent efforts, there

is still only limited knowledge and information available for making valid comparisons of the costs of making payments across European countries."

The more recent studies, many of which incorporate all the parties involved in the payment process, calculate what are known as resource costs.[10] An overview of selected studies, including policy recommendations, is provided by Koivuniemi & Kemppainen (2007), as well as by Hayashi & Keeton (2012). In addition, there are also analyses which only consider individual parties, mainly retailers and/or banks (for example, Banco de Portugal, 2007; Guibourg & Segendorf, 2007) or which analyse costs without consolidation (e.g., Takala & Virén, 2008).

In determining the resource costs, all the costs incurred by the sectors under analysis are added in a first step.[11] The costs which represent a source of income for another sector (fees, interest, etc.), i.e. so-called external costs, are then subtracted.[12] Therefore, only the actual cost (use of own resources: capital, labour, etc.) is calculated for each sector. Examples are the time that it takes households to obtain cash; the task of counting cash by retailers and the removal of cash; the costs to the central bank for the production and processing of banknotes, or the costs to commercial banks of cash deposits and disbursements.

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10 See Ardizzi & Giucca (2013), Banque Nationale de Belgique (2005), Bergman et al. (2007), Brits & Winder (2005), Danmarks Nationalbank (2012), Gresvik & Haare (2009), Humphrey et al. (2003), Nyandoto (2011), PaySys Consultancy (2006), Schwartz et al. (2008), Segendorf & Jansson (2012), Simes, Lancy & Harper (2006), Turjan et al. (2011), Valverde et al. (2008), as well as the multi-country contributions by Schmiedel et al. (2012) and Retail Banking Research (2010). A general critical assessment, taking due account of qualitative factors, benefit aspects and welfare considerations can be found in Shampine (2007, 2009).

11 The term "social costs", which is frequently used synonymously for resource costs, is confusing because it has actually been used for over a century as an established term in public finance, specifically in the area of environmental economics and negative external effects.

12 The use of the term "external costs" contrasts with its use in allocation theory and environmental economics, where it is a synonym for negative external effects.

Different indicators for cash and cashless transactions are calculated in the studies for the purposes of comparison, divided under certain circumstances by sectors. Debit and credit cards are considered most notably in the case of cashless instruments. Other payment media are only included in exceptional cases.

Costs of payment instruments: per transaction Table 2

	Cash	Cards	Debit	Credit
US 2003 $54	**2.18**		**1.07**	1.16
US 2003 $11	0.90		1.00	**0.95**
Austr. 2005 $A50	1.64		0.80	0.99
Austr. 2005 $A10	0.96		0.80	0.99
Australia 2007 ($A)	0.37		0.80	1.22
Germany 2004 (€)	0.36		0.82	2.73
Belgium 1998 (€)	0.56	0.64		
Sweden 2009 (€)	0.78		0.42	1.15
Norway 2007 (€)	1.53	0.74		
Denmark 2009 (€)	0.78		0.36	**3.86**
Hungary 2009 (€)	0.39		0.33	3.59
Netherlands 2002 (€)	**0.30**		0.49	3.59
Netherlands 2009 (€)	0.39		**0.32**	
Italy 2009	0.33		0.74	1.91
EU13 2009 (€)	0.42	0.99	0.70	2.39

Notes: US: Calculation for transactions of 54 and 11 US dollars, respectively; Australia 2005: Calculation for transactions of 50 and 10 Australian dollars, respectively. The annual number relates to the data upon which the study is based. The bold numbers indicate the highest and lowest estimates (in €).
Sources: Our own calculations as well as EU13 in Schmiedel et al. (2012)[13], Belgium 1998 in De Grauwe et al. (2000), Netherlands 2002 in National Forum on the Payment System (2004), Netherlands 2009 in Jonker (2013) (only cash and debit cards), Denmark 2009 in Danmarks Nationalbank (2012), Norway 2007 in Gresvik & Haare (2009), Germany 2004 in PaySys Consultancy (2006), US 2003 in Schwartz et al. (2008), Australia 2005 in Simes et al. (2006), Australia 2007 in Schwartz et al. (2008), Hungary 2009 in Turján et al. (2011), Sweden 2009 in Segendorf & Jansson (2012), Italy 2009 in Ardizzi & Giucca (2012).

13 Countries analysed: Denmark, Estonia, Ireland, Greece, Spain, Italy, Lithuania, Hungary, Netherlands, Portugal, Romania, Finland, Sweden.

The payment costs from which the importance of cash and cashless payments can be inferred can be calculated as

– costs per transaction,
– costs as a percentage of sales,
– costs as a percentage of GDP,
– costs per capita.

Each of these criteria seems plausible at first glance, although they are problematic, most notably in international comparisons. In the case of costs per transaction, for instance, it is important to remember that the transaction amounts vary, which is why it is ultimately not a like-for-like comparison. This inadequacy also affects the costs as a percentage of sales or per euro of sales because the fixed costs per transaction vary between countries and, consequently, the transaction amounts considered also affect the outcome. In order to compare the costs of each payment instrument, it is also necessary to estimate the number or value of transactions. This is extremely difficult with cash, in particular. The costs relative to GDP depend, in their turn, on the degree of development of the respective payment system. And the costs per person and per annum are ultimately markedly determined by the relative usage of each of the payment instruments, as well as by income per person. As Tables 2 to 5 show, the findings vary accordingly between studies and between countries depending on the indicator used. We have only included studies which at least include banks, retailers and, in some cases, consumers, as well as cash and cards as payment instruments.

Costs of payment instruments: as a percentage of turnover Table 3

	Cash	Cards	Debit	Credit	Total
US 2003 $54	4.02%		1.97%	2.14%	
US 2003 $11	7.85%		**8.68%**	8.25%	
Austr. 2005 $A50	3.28%		1.60%	1.98%	
Austr. 2005 $A10	**9.60%**		8.00%	**9.90%**	
Australia 2007	3.16%		1.79%	2.94%	
Germany 2004	1.78%		1.33%	3.09%	1.77%
Belgium 1998	9.00%	1.23%			
Sweden 2009	3.29%		1.09%	2.38%	
Norway 2007	1.67%	1.49%			
Denmark 2009	3.90%	0.99%	0.84%	5.38%	0.85%
Hungary 2009	**0.39%**		2.87%	9.83%	
Netherlands 2002	3.20%		1.11%	3.12%	
Italy 2009	1.07%		**0.54%**	**1.73%**	
EU13 2009	2.3%	1.7%	1.4%	3.4%	

See Table 2 for notes and sources.

The four tables show quite clearly that there is a very wide range in findings, even in the case of estimates for one country (for example, for Australia in 2003 and 2005). Measured in terms of GDP, the cash costs vary from 0.74% in Belgium and Hungary to 0.15% in Norway (see Table 4). And the per capita costs of the payment instruments as a whole (see Table 5) range from €89 in Hungary to over €400 in Denmark. Even among the 13 EU member states of the ECB study, whose figures were collected applying a standardised methodology, the fluctuation range of the social costs of payment instruments varies from 0.42% to 1.35% of GDP (Schmiedel

et al., 2012, p. 35). In addition to differences in methodology, the following factors contribute to this result:

– the intensity with which payment instruments are used,
– the parties to be taken into consideration,
– the types of costs involved,
– specific assumptions made in the calculations (for example, about the extent of cash transactions[14]),
– the valuation of time and
– interest rates used (for measuring opportunity costs).

14 Determining the share of cash transactions is especially important for Germany because the German net issues are not only used to finance domestic transactions; parts of them are also hoarded and are held abroad, both within and outside the euro area (see Figure 4).

Costs of payment instruments: as a percentage of GDP Table 4

	Cash	Cards	Debit	Credit	Total
US 2000					**3.00%**
Australia 2007	0.50%	0.50%	0.10%	0.20%	1.00%
Germany 2004	0.61%	0.12%	0.07%	0.05%	0.73%
Germany 2008 (RBR)	0.63%	0.45%			1.08%
Belgium 1998	**0.74%**	0.10%			0.85%
Sweden 2009	0.26%	0.28%	0.19%	0.09%	0.54%
Norway 2007	**0.15%**	0.24%			0.49%
Denmark 2009	0.27%	0.18%	0.14%	0.04%	0.78%
Hungary 2009	**0.74%**	0.19%	0.11%	0.08%	1.30%
Netherlands 2002					0.65%
Netherlands 2009					0.42%
EU13 2009	0.50%	0.21%	0.11%	0.10%	1.00%
Italy 2009	0.53%		0.04%	0.07%	1.00%
Europe 2008 (RBR)	0.60%	**0.57%**			1.17%
Germany 2011	0.31%	**0.03%**			**0.34%**

Notes: RBR: Retail Banking Research (2010); Germany 2011 based on Kleine et al. (2013); for further comments and sources, see Table 2.

Costs of payment media: per person and per annum (in €) Table 5

	Cash	Cards	Debit	Credit	Total
Australia 2007	139.00		49.23	69.50	257.72
Germany 2004	161.37		18.34	12.90	192.61
Germany 2008 (RBR)	**191.18**	136.39			
Belgium 1998	162.91	22.99			185.91
Sweden 2009	87.11		60.34	28.45	
Norway 2007	92.49	**141.81**	62.37	25.57	295.43
Denmark 2009	141.04	60.79			**403.66**
Hungary 2009	**71.78**		10.76	6.96	**89.49**
Netherlands 2002	131.40		32.20	10.22	
Italy 2009	132.84	117.06	11.15	18.10	250.84
Netherlands 2009					144.88
Germany 2011	97.80	**9.78**			107.58

Notes: RBR: Retail Banking Research (2010); Germany 2011 based on Kleine et al. (2013); for further comments and sources, see Table 2.

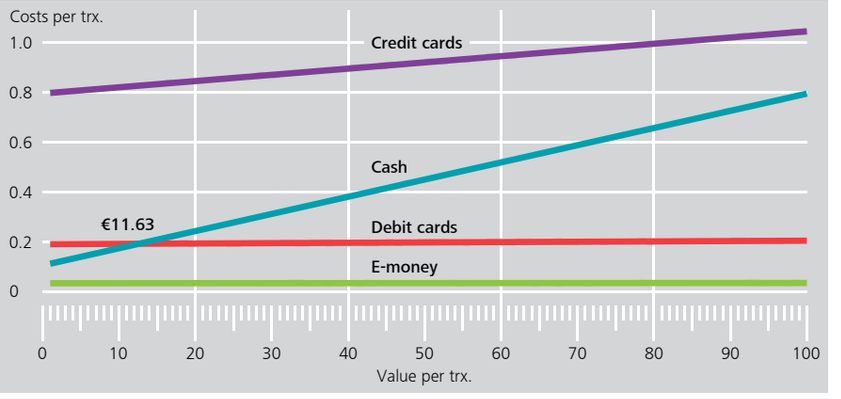
This makes it difficult to perform international comparisons. Therefore, we would strongly advise against extrapolating the findings to a larger group of countries, such as from 13 EU member states to all EU member states, as is done in Schmiedel et al. (2012), for example. Under no circumstances should any conclusions be drawn about the efficiency of a particular payment instrument from one indicator alone. For example, high costs per transaction could actually be attributable to an inherently inefficient method of payment, but could also be due to a high average transaction value or to low usage of economies of scale. In the case of credit cards, for instance, high costs per transaction (see Table 2) combined with high costs per unit of sales (see Table 3) generally indicate that high transaction values are not the only factor that is responsible for this. Network effects and economies of scale are

apparent in all payment media which have to be taken into consideration in the determination of costs and, particularly, in simulations and scenario analyses.

According to the studies, the highest costs of payment instruments as a whole are generally among banks and in the retail sector (see overview in Schmiedel et al., 2012, p. 36). However, figures for the total economy of 3% of GDP for the USA, as reported in Humphrey et al. (2000), could not be confirmed in more recent studies and surely represent an upper limit. Where a distinction is made between fixed and variable costs (for example, in Brits & Winder, 2005; Bergman et al., 2007; Segendorf & Jansson, 2012; BNB, 2005), a large portion of the costs for cashless payment media is attributable to setting up the infrastructure and is, thus, of a fixed nature. In order to undo the effects of different transaction values, the US (Garcia-Swartz et al., 2006a, b) and Australian (Simes et al., 2006) studies use specified standard amounts (see Tables 2 and 3). As high variable costs and relatively low fixed costs are estimated for cash, the relative advantages associated with cash diminish as the value of the transaction increases.[15] It is also apparent in this procedure that the representative standard amounts vary from country to country.

15 Fixed costs include, for example, the acquisition of safes and counterfeit money detectors by retailers, as well as shoe-leather costs for consumers. A distinction is made in the fees for cash-in-transit companies between a fixed and a value-dependent amount. Variable costs would also include interest foregone in the sense of opportunity costs. The classification also depends on the time horizon under consideration.

Comparison between costs for different payment media: the Netherlands Figure 11



Source: Brits & Winder (2005).

The problem of the limited comparability of the indicators presented can be countered by the determination of cost functions for payment media which relate costs to transaction values (see, for instance, National Forum on the Payments System, 2004, Brits & Winder, 2005; BNB, 2005; Turján et al., 2011; Bergman et al., 2007; Simes et al., 2006). The aim is to deduce a break-even point for the transaction value from which a particular payment medium becomes relatively more or less expensive. For that purpose, the costs are divided into fixed and variable costs. The variable costs are subdivided into transaction-dependent and value-dependent costs. In a second step, the variable costs are shown as a function of the transaction value. The case of the Netherlands is illustrated in Figure 11 (National Forum on the Payments System, 2004 and Brits & Winder, 2005). It is apparent that a transaction amount of €11.63 is the threshold from which payment by debit card

is more favourable than a cash payment.[16] Irrespective of the transaction amount, the most favourable payment medium would be e-money, which is rarely used. This is the chipcard-based payment function "Chipknip" (comparable to the "Geld-Karte" in Germany). Credit cards are clearly the most expensive option up to a transaction value of €100. The results depend upon a number of estimates and the assumption that certain costs are fixed. Consequently, there is a risk that the findings will be sensitive to variations in specification, in particular the division between fixed and variable costs.

The resource costs of households are also estimated in some more recent studies (for example, Garcia-Swartz et al., 2006a, b; Gresvik & Haare, 2009; Turján et al., 2011; Danmarks Nationalbank, 2012). Since resource costs do not include fees by definition, these costs essentially comprise the time that households have to spend on the payment process, on procuring cash and on reviewing settlements afterwards. Depending on which of these time costs are taken into account, which time is set, how time is valued, and which other costs of households are considered (e.g. risk-related costs due to acts of fraud and counterfeits), the results vary considerably. For example, the social costs for households amount to 0.05% (of GDP) in Sweden, but to 0.23% in Denmark.[17]

16 This value fell to €3.06 in 2009 (Jonker, 2013).
17 In the study conducted by Segendorf et al. (2012) for Sweden, the time costs of cash for households are estimated with the aid of an inventory theoretic model. Applying a very low rate of interest of 0.27%, this gives rise to time costs of only SEK 20 million in 2009 (approximately EUR 1.9 million). Had the calculation been performed with an interest rate of 2.5% instead, this would have given rise to costs of SEK 170 million (approximately EUR 16 million). According to the study conducted by Danmarks Nationalbank (2012) for the same year, however, the time costs are the key cost drivers at household level. They amount to DKK 1.352bn (approximately EUR 182 million), i.e. almost 100 times higher. These figures were determined by multiplying the time cited by consumers in a survey for withdrawing cash and queuing at POS by an average net hourly wage rate. According to the study, time costs account for almost 85% of the total costs incurred by households in Denmark for cash and cashless payment media. By contrast, time costs for consumers are completely disregarded in the study conducted by Ardizzi & Giucca (2012) for Italy.

The problem can be explained with great clarity in the case of cash withdrawals at ATMs. Initially, it seems plausible to estimate the time spent at the ATM and then to price it accordingly (in the sense of opportunity costs). However, if these costs are actually substantial, it is fairly simple to lower them because higher withdrawal amounts imply fewer trips to the bank. If the same distance is always covered per withdrawal, the costs depend proportionally on the number of transactions effected at the ATM, and the cost minimisation problem is as follows: by selecting amounts which are as high as possible, the overall distance covered, and thus the time, can be kept to a minimum. However, this approach disregards the risk of loss, as well as the fact that people do not often go specifically to the ATM, but rather go because there happens to be one nearby. Still, the revealed preferences of households show that they do not seem to regard the costs associated with withdrawing cash at ATMs as unduly high.[18]

Accordingly, there are two methods in the valuation of the withdrawal process. In the first (for example, Gresvik & Haare, 2009; Danmarks Nationalbank, 2012), the time taken to withdraw cash is simply multiplied by a representative hourly wage rate and by the total number of ATM withdrawals per year. In the second method, an economic model (such as the Baumol Tobin model) is set up in order to determine the costs per cash withdrawal from the number of ATM transactions per person as a means of trading-off opportunity and transaction costs (see, for example, PaySys Consultancy, 2006). Method 1 generally leads to considerably higher costs than method 2. This can be demonstrated with the aid of a simple stylised example for Germany. Applying method 1, we set the net hourly rate at €20 and the time per withdrawal at 3 minutes. The 2.1 billion ATM transactions in 2011 would then correspond to total costs of the order of €2.1 billion. We use the Baumol Tobin model in method 2. Given an average of €450 withdrawn every month, an annual

18 However, depending on the country and region in question, withdrawing small amounts relatively frequently might also be due to fears of loss and theft.

rate of interest of 3% and three withdrawals per month, the model yields costs per withdrawal of €0.063. With the same number of ATM transactions, i.e. 2.1 billion, this would "only" translate into total costs of €132.3 million.

The problems which arise in the valuation of time also occur in other sectors. For example, the wage costs for bank employees must actually be allocated to the individual payment media in the calculations. In retail, the time taken to process the payment at the POS must be evaluated. And it has to be decided whether the removal of cash is done during working hours or on the way home. The study by de Grauwe et al. (2000), for example, put cash removal costs for retailers in Belgium at almost €1.2 billion per annum by assuming 1.5 hours per day and per retailer for removal. All in all, a considerable portion of the costs determined for the banking industry and for retail is made up of wage costs. In this regard, a decision also has to be taken on whether time spent is really opportunity costs. This may be the case in a large supermarket because lengthy payment transactions there would mean that more till operators have to be hired. This, however, is not the case in a small shop with rather sporadic visits by customers. Furthermore, the hourly wage rates used in retail and for households have a significant bearing on the results.

Therefore, serious quantification and valuation problems are associated with the cost studies, in particular if all parties that are involved in the payment cycle are included into the analysis. Moreover, the advantages of individual payment media in the sense of a cost-benefit analysis are normally not taken into account at all (apart from Garcia-Swartz et al., 2006a, b). The lack of transparency of the calculations and of the data basis in some studies is also striking. For instance, the abstract in Retail Banking Research (2009) makes reference to figures for Germany without quoting sources and without any methodological explanations. However, there is no specific reference to Germany in the main text. And in Kleine et al. (2013) reference is made in the majority of cases to unspecified interviews with experts in determining cash costs. In addition, qualitative factors, which often concern the relative advantages (net) of cash, are ignored in virtually all the studies (Garcia-Swartz et al., 2006a, b is once again the exception in some regards).

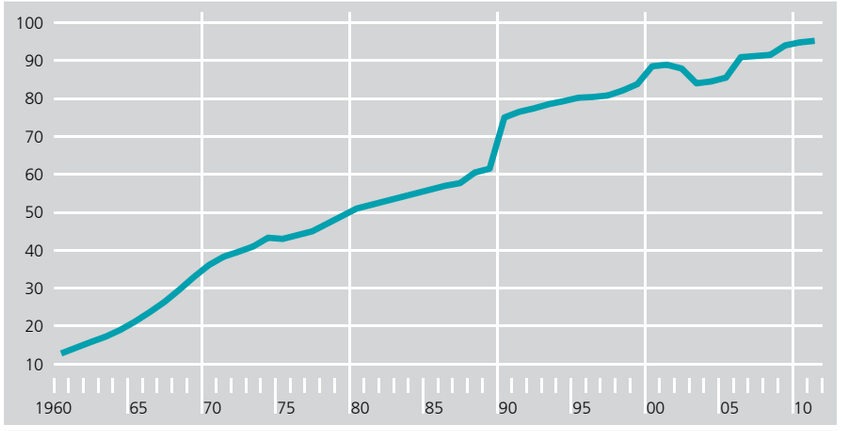
4 The significance of payment media in Germany

4.1 The central role of banks in payment transactions

In the past, the flow of money was largely self-organised. Money was brought into circulation by central banks and/or mints and was then passed on by other economic agents. Cashless payment transactions were initially of little significance to households and small businesses, and were restricted to larger businesses and wealthy people. However, cashless payment transactions started to make progress as cashless wage and salary payments became more widespread between the late 1950s and the early 1970s. This does not mean that cash payments were displaced completely. But the nature of the cash cycle has been completely transformed in the course of these changes. Cash transactions, and in particular the procurement and removal of cash, have become increasingly intertwined with cashless payment transactions.

The number of current accounts in Germany Figure 12

millions

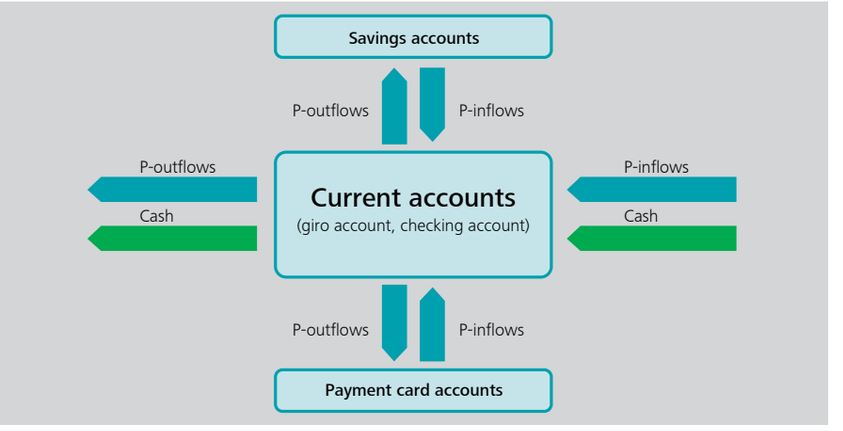


Source: Deutsche Bundesbank and own calculations.

The current account is the mechanism around which payment transactions revolve. There has been a steady rise in the number of current accounts in Germany for five decades (see Figure 12). The key payment flows of households (earnings, transfers, taxes and a large portion of regular expenditure) and of companies pass through this account (see Figure 13). This also applies to the procurement and removal of cash. Any person who requires cash withdraws it from his current account, or anyone who has a high cash income pays it into a current account. Therefore, an autonomous, self-organised cash cycle now only exists to a very limited extent.[19] Despite the diverse range of payment instruments available, there is essentially one integrated payment system with the current account pivotal to it.

19 It would be worthwhile to analyse to what extent risks can be reduced by supporting or safeguarding the circulation of cash during periods of crisis.

The current account as focal point of the payment system Figure 13



Note: P: Payment

The special position held by the current account in payment transactions justifies the special role accorded to banks in ensuring that the payment system functions properly. The banks are the most important payment service providers for private and business customers.

4.2 Costs and revenues in the payments system: the demand-based approach

As in any market, there is supply and demand in the market for payment services (see Table 6). The suppliers are banks and "other service providers", whereby the banks bear the load of the system because of the significance of the current account, which we touched upon above. Remuneration within the payments system represents earnings for the suppliers and costs for consumers. The suppliers, in turn, must meet their expenditure for providing payment transaction services from their earnings. In addition to the remuneration which they have to pay to payment

service providers, consumers are faced with additional expenditure in the form of their own resources of time and real capital (see Table 6).[20]

Consequently, there are two ways of answering the question about costs and about the significance of the payments system.[21]

A. Estimates are made about the costs arising in the production of payment services (see, for example, the overviews contained in Schmiedel et al., 2012 as well as in Koivuniemi & Kemppainen, 2007). This requires a detailed understanding of the cost accounting practices of banks and specialist service providers. Corresponding data are generally collected through questionnaires (and payment diaries) from banks, consumers and retailers, whereby the results hinge greatly on the quality of the questionnaires (see, e. g., Jonker & Kosse, 2009). In addition, the surveys are frequently only conducted once or at irregular intervals due to cost constraints.

B. Estimates are made about the level of expenditure incurred by customers (households, businesses) for payment services. This is based on the idea of estimating the significance (or costs) of payment media by ascertaining users' willingness to pay for payment services. This information can be obtained from the customers on the spending side or from the producers on the earnings side. An analysis of earnings requires that earnings from payment transactions can be separated from other earnings.

20 This is also the case in other markets. For example, when a household goes shopping, he not only has to take account of prices, but also has to allow for his time spent.
21 Unfortunately, determining the value created by the payment system directly is not possible because this value creation is not recorded separately in the national accounts.

Classification of the costs for payment services Table 6

	Consumers of payment services	
Suppliers	**Businesses***	**Households**
Banks	Explicit prices Implicit prices	Explicit prices Implicit prices
Other service providers	Explicit prices for: Secure transport Network operation Acquiring	
Customers' own resources	Own resources (in particular labour) for: Cash handling / Cash deposit Reconciliation / Control	Own resources (in particular time) for: Cash withdrawal Reconciliation / Control

Note: *: Including state agencies.

In both approaches it is also important to consider that the customers, too, incur certain expenses which must also be estimated (for example, the time taken to withdraw cash or the purchase of payment terminals by the retailer). There is great uncertainty and much variation in outcomes in assessing these items.

If banks and other payment service providers only offered payment services, then both approaches would be relatively simple to implement because all revenues or all costs would be assigned to the delivery of payment services. However, both banks and the "other" payment service providers generally offer a whole array of services. Therefore, the costs or revenue which relate to the delivery of payment services have to be isolated. The estimation of the associated costs requires detailed data from the cost accounting of the businesses affected. Any such data are normally not made available to the public and must be collected from the banks and service providers.

The estimation of revenue from payment transactions is straight forward if market prices exist for the payment services (in the form of a "price per unit of quantity").

Revenue can then be assigned to individual services. In annual reports, revenues are frequently classified according to product groups, facilitating allocation to individual fields of business, such as payment transactions. It is more difficult to estimate revenue if services are offered in packages, and/or if a form of indirect pricing takes place. This is frequently the case with banks. Many payment services are offered as part of the current account package and are not billed separately. Instead, there is a flat-rate price and/or implicit pricing through the low interest paid on demand deposits (generally at 0%). Customers dispense with the interest which is offered by interest-bearing assets and rather keep deposits in current accounts as that means that they can benefit from other banking services, in particular payment services. Therefore, the customer pays a "price" for payment services (or for liquidity) in the form of lower interest (liquidity premium).

Consequently, the two most important revenue models in the banking sector are:

– price per service ("commission")
– implicit fee[22]

Method A has largely been used in cost studies conducted up to now. As we have already mentioned above, it requires relatively extensive knowledge of the cost accounting practices of the companies which offer payment services. This knowledge can only be obtained in detail with the cooperation of the businesses in question. Even if these businesses were prepared to do so, an adequate quality of data is often not available, however. Particularly for banks, it is frequently difficult

22 This implicit fee could also be referred to as "seigniorage". Seigniorage is understood to mean gains from money creation. In general, this term is restricted to central bank gains from the creation of central bank money, most notably cash. However, it can also be extended to the money creation gains achieved by commercial banks, which are based on the creation of deposits.

to allocate costs because many of their services are closely tied to the current account, which is a prerequisite for carrying out cashless payment transactions and for the provision of cash alike.

For this reason and because we are not conducting an own survey, we will adopt method B, which we will refer to as the 'demand-based approach'. It can place greater emphasis on data which are routinely published in the annual reports of banks and service providers or which are published in sources which are otherwise freely accessible. An approach which is similar to method B can be found in studies to determine the value-added created by the banking sector (for example, Colangelo & Inklaar, 2010 and Wang, 2003). These studies also assume that there are implicit fees for certain banking services contained in the interest margin.

The earnings differ from the costs by any profits or losses which may arise. Therefore, if one were to estimate costs from the revenue perspective, the costs may be over or under-estimated. Only in a situation of perfect competition would this problem not arise. In reality, the conditions for perfect competition are rarely met. Having said that, as long as there is a certain degree of competition present, the profits are likely to level off at something akin to "normal". However, in order to estimate the significance of the payment transaction in the sense of a willingness to pay for payment services, the approach we have selected is more suitable than method A.

Recording the revenue at a relatively high level of aggregation implies that revenue has to be broken down to individual payment instruments in a second step. If data on costs are collected directly, this breakdown usually occurs automatically. However, even in this case larger cost blocks (such as account or debit card-related costs) frequently also have to be broken down to individual cost units using an appropriate distribution key.

4.3 Determination of the banks' revenue from payment transactions

Determining the gross income is the point of departure for determining the revenue from payment transactions. This is defined as:

Gross income = interest received + commissions received

Subtracting interest paid yields operating income: [23]

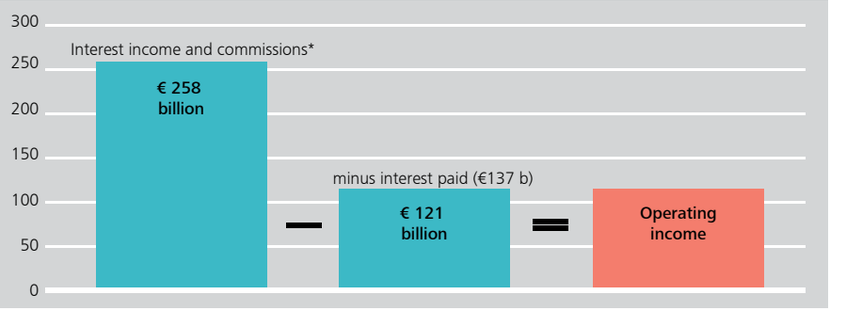
Operating income = gross income – interest paid

Thus, operating income ultimately consists of two components:

– Firstly, commission revenue. This is comparable to revenue in the insurance industry, for example.
– Secondly, the interest margin. This corresponds to the mark-up (on purchase prices) in retailing, for example.

23 In Deutsche Bundesbank (2013) commissions paid are subtracted from commissions received. However, for the present purpose, all commissions paid to non-banks should not be subtracted. Since there are no statistics separating commissions paid to banks and to non-banks, we included gross commissions in operating income.

Operating income of payment transaction banks in Germany (2011) Figure 14



Remark: *: adjusted to allow for loan losses. Relates to the banking sector, excluding real estate credit institutions, building societies and banks with special functions.

Sources: Deutsche Bundesbank and own calculations.

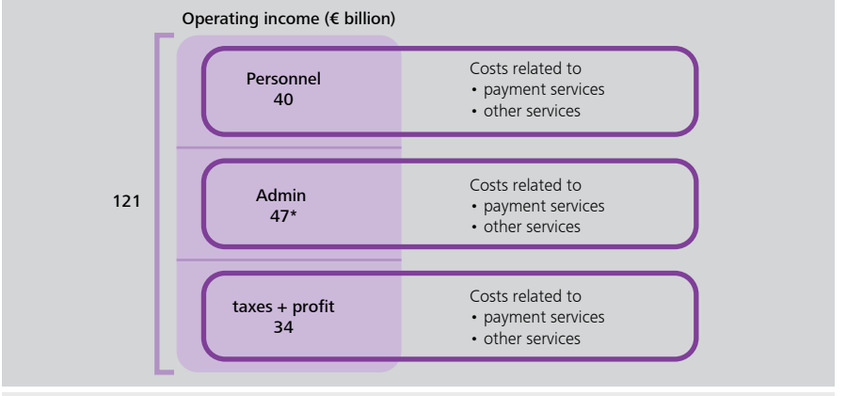
In the Bundesbank statistics, the banking sector also includes the groups "real estate credit institutions, building societies and banks with special functions". However, these banking groups only offer their customers marginal payment services and have no significant demand deposits on the liability side of the balance sheet.[24] Therefore, a narrow definition will be used in this study. We will look solely at private commercial banks, state-owned regional banks, savings banks, central co operative banks and credit cooperatives. They are combined under the term "payment transaction banks" (PT banks).

The total revenue of the PT banks on average in 2011 was €258 billion. €137 billion of this was to be deducted in the form of interest paid, leaving an average of €121 billion (see Figure 14). This corresponds to the operational income of the PT banks.

24 Measured in terms of balance sheet totals, these three groups account for around 20% of the market. However, they only account for 1% of overnight deposits.

The operational income indicates the level of the banks' net revenue. Expenditure for the payments made by the banks has to be financed from the operational income (see Figure 15). They essentially consist of personnel costs, operating expenditure, the outlay for external services, taxes and interest on equity. It may also include profit.

Operating income and offsetting items on the expenditure side (2011) Figure 15

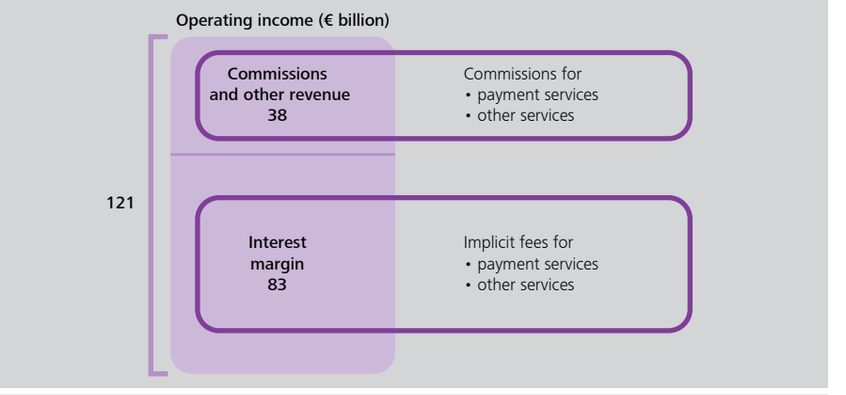


Remark: *: including commissions paid. Relates to the banking sector, excluding real estate credit institutions, building societies and banks with special functions.

Source: Deutsche Bundesbank and own calculations.

The operational income of €121 billion consists of commission (€38 billion) and the interest margin (€83 billion) (see Figure 16). From the customers' perspective, the operational income thus represents remuneration for services provided by the banking industry. Revenue from commission is generated in payment transactions, as well as in other areas of banking. The interest margin can, thus, be interpreted as an implicit fee for payment services and "other services" (portfolio management, debt management, monitoring, etc.).

The composition of operational income (2011) Figure 16



Remark: Relates to the banking sector, excluding real estate credit institutions, building societies and banks with special functions.

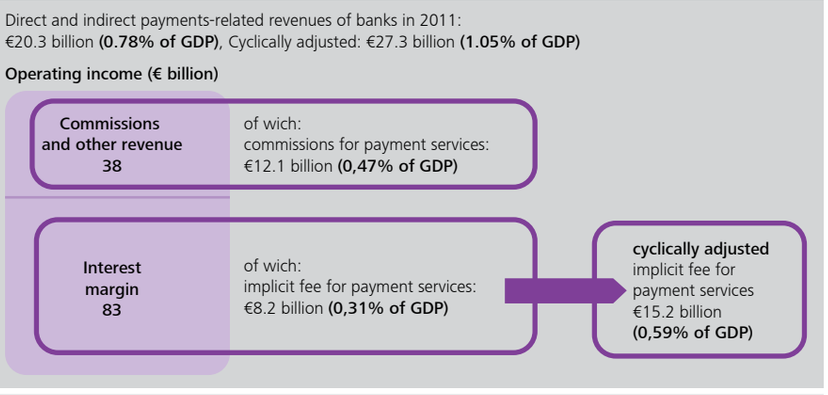
Source: Deutsche Bundesbank and own calculations.

We estimate payment transactions to account for around €20 billion of the entire operational income: €12.1 billion in commission and €8.2 billion in implicit fees (see Figure 17). In other words, businesses and households paid banks €20 billion for payment services in 2011, which equates to 0.78% of GDP. Please note that the implicit revenue fluctuates with the interest level which is currently historically low. After adjusting for this cyclical effect, the estimate of implicit fees would be as high as €15.2 billion. Together with commissions, this amounts to cyclically adjusted revenue of €27.3 billion from payment transactions. This equates to 1.05% of GDP.

At a "normal" rate of interest or taken as an average over an interest rate cycle, the banks' revenue from payment transactions (or the expenditure incurred by their customers) consequently amounts to around 1% of GDP.

Revenue from payment transactions of PT banks

Figure 17



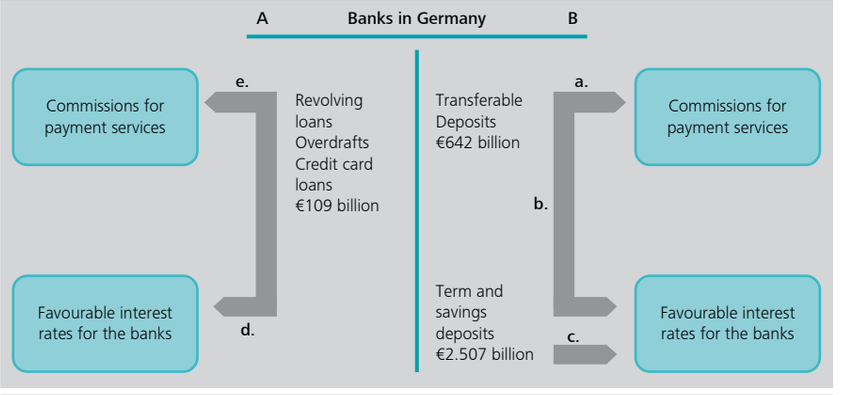
Remark: Relates to the banking sector, excluding real estate credit institutions, building societies and banks with special functions.

Source: Deutsche Bundesbank and own calculations.

When calculating the revenue which can be accredited to payment transactions, the only factors which have been taken into consideration up to now are that transferable deposits generally do not bear interest, and that the issuers therefore receive a form of seigniorage. Additionally, the provision of payment services reduces the "elasticity of demand of customers", whereby the banks are able to increase their interest revenue or reduce their interest costs. This not only applies to current accounts which are usually non-interest bearing; often it is also more convenient for savings and term deposits to be invested with the "house bank". Therefore, a bank with a broad basis of current account customers can also offer savings and term deposits with relatively low interest rates. The same also applies on the asset side. Customers find credit lines that are linked to the current account (or a payment card account) more convenient. Even if the terms are less favourable, they still avail themselves of these credit lines and will not instantly consider changing banks.

Starting points for revenue from payment transactions

Figure 18



Remark: Stocks at the end of 2011.

Source: Deutsche Bundesbank and own calculations.

The analysis above, however, focusses only on commissions for payment services (a. and e. in Fig. 18) and revenues due to low interest rates on deposits (b.). Revenues due to favourable rates for savings and time deposits (c.) as well as revenue due to favourable rates on loans are not considered (see Figure 18).

4.4 Determination of the payment transaction revenues from other service providers

The demand-based approach implies that most payment costs can be deduced from the estimates of banks' payment revenues. This also applies to all costs incurred vis-á-vis third-party payment service providers. Supposedly, these costs are recovered via commissions and interest rate margins. However, payment service users – in particular firms – also contract directly with payment service providers. The revenues of such providers in their business with non-banks therefore also have to be included in the estimate of resource costs. Below, we are focusing on three groups of payment service providers: network operators, card acquirers and cash-in-transit companies (CITs).

So-called "network operators" offer merchants (retailers, hotels, etc.) an array of card payment services. They include transaction services, terminal leasing and related services, risk management in electronic direct debits (ELV), etc.

In order to accept cards from international card organisations, merchants must have a contract with an acquirer. While the acquiring function is performed by the banks themselves in many countries, there are specialised service providers (owned by the banks) which perform this function in Germany.

CITs are important service providers for banks and retailers. They transport cash in the course of the distribution and collection of cash. In addition, they offer further services such as cash preparation, filling automatic teller machines and machine services.

Total revenue of payments-related business with non-bank amounts to approximately €834-984 million or 0.03 to 0.04% of GDP.

Revenues of other service providers in 2011 Table 7

2011*	Network operators[a]	Acquirers[b]	CITS*[c]	Total
Trx. revenue (€ m)	323	211	300 – 450	834 – 984

Remark: *: Included are only revenues for merchants.
a: Based on an estimate of the revenue per transactions and statistics on the volume of transactions.
b: Based on an estimate of the acquirer margin and statistics on the value of transactions.
c: Based on estimates of the Association of German CITs and estimates of one market player.
For more detailed information refer to our study "Costs and benefits of cash and cashless payment instruments" (forthcoming).
Sources: Network operators: Annual reports of easycash GmbH, InterCard AG and TeleCash GmbH & Co. KG; PaySys Consultancy GmbH (2013), as well as own calculations. Acquirers: PaySys Consultancy GmbH (2013), various annual reports and our own calculations. CITs: Nattmann (2009) and BDGW, pp. 4-5.

4.5 Internal expenditure of consumers

In addition to explicit and implicit bank fees, households in particular incur costs in the form of time taken for the payment process and to obtain cash. Most studies do not make estimates of the time taken to perform credit transfers and direct debits, as well as for checking payments and for any complaints, as these factors are difficult to estimate.

One item which is frequently estimated is the time taken to obtain cash. There are two methods of doing this (see Chapter 3).

1. Estimate of the required time and valuation of the time based on an average wage rate.

2. Use of an economic model (cash management model) to estimate costs.

Due to the drawbacks of the first method (see ch. 3), we apply the second approach in the following in order to estimate household's internal cost of obtaining cash.

It permits to draw conclusions about costs from observed behaviour.[25] It takes account of the fact that it is relatively simple for customers to lower the cost of withdrawing cash. They can simply visit the ATM less frequently and withdraw larger amounts each time.

According to the payment statistics, people make about two cash withdrawals at ATMs every month. The average value of each transaction is €155. Together with an opportunity costs proxied by an interest rate, the two figures are sufficient for calculating the cost per transaction, incurred from a customer's perspective. The opportu-

25 However, this method, too, cannot be used without having to make further assumptions. See Baumol (1952) and Tobin (1956) with regard to the theoretical principles.

nity costs measure the costs of holding cash. It may comprise a loss of interest if the bank account is in credit or an interest payment if the bank account is in debit. Therefore, the corresponding rates would be a credit or deposit rate. It should also be noted that cash can get lost. Thus, compared to deposits held in a bank account there is an additional negative return in terms of risk (see Bergman et al., 2007, pp. 9 f).

Estimate of costs of the time taken to withdraw cash at an ATM Table 8

Assumptions (based on payment statistics)				
	Per user per month		All users per annum	
Number of cash withdrawals	2.5		2,100 (m)	
Value per withdrawal	155 €		325.5 (€ b)	
Assumptions for the different scenarios				
Opportunity cost rate (%)	10.17	1.35	20	38.7
Derived estimate				
Transaction costs per withdrawal (€)	0.26	0.03	0.52	1.00
Transaction costs (€ m)	536	71	1054	2040
in % of GDP	0.02%	0.00%	0.04%	0.08%

Notes: Number of users: It is assumed that there are 70 million ATM users. Opportunity cost rate: overdraft lending rate (10.17%), rate of interest on savings deposits with the statutory withdrawal notice (1.35%), penultimate column: Opportunity cost rate, including a risk premium which covers the risk of losing cash. Transaction costs per withdrawal: shoe leather costs. Opportunity costs: lost interest revenue.
Sources: Deutsche Bundesbank, our own calculations.

As there is considerable uncertainty regarding the relevant opportunity cost rate, a number of rates are used (see Table 8): first, we use the average overdraft lending rate in 2010 (10.17%), second, the average savings rate in 2010 (1.35%), and third, an increased rate of 20% to reflect a possible high risk premium. We ultimately also estimate how high the risk premium has to be to allow for time costs as calculated in method 1 (refer to the final column in Table 8).

The behaviour which is observed would only be consistent with costs of €1 per transaction (see ch. 3) if possession of cash is associated with very high interest foregone and/or a very high risk. All told, the opportunity costs would have to be almost 40% (see the last column in Table 8). This appears completely unrealistic given the level of interest and the relatively high level of safety in Germany.

It is more difficult to calculate the costs involved when withdrawing cash over the bank counter. Counter transactions occur much less frequently. However, the average amount of a withdrawal over the bank counter is considerably higher (see also Deutsche Bundesbank, 2010). Based on a volume of 286 million counter transactions, this computes to an average of about 3.5 withdrawals per person and month. This is far in excess of the possible number of irregular large payments. Therefore, the counter presumably continues to be used by some bank customers as their "normal" source of cash (Deutsche Bundesbank, 2010, 6 f).[26] This means that the calculation which has been used for the purposes of estimating the costs of ATM withdrawals can also be applied to a portion of the counter transactions. But there are also transactions for relatively large amounts which only occur sporadically. In these transactions, the amount withdrawn is either used to make a payment in the immediate future or to hoard the money for a variety of reasons. Consequently, the cash management model cannot be applied to this scenario.

However, in order not to disregard the costs which households incur when they withdraw cash at the bank counter, we assume that a counter transaction is twice as expensive for the customer as an ATM transaction. This means that costs are increased by about a quarter.

26 This is likely to be older people, in particular.

Estimate of the time costs incurred by households in obtaining cash[27] Table 9

Ratio of counter trx to ATM trx	0.14
Relative costs of counter trx/ATM trx	2
Costs at the counter (€ m)	150
Costs at the ATM (€ m)	536
Total costs (€ m)	686
as a % of GDP	0.03%

Remark: Based on an assumed opportunity cost rate of 10.2%.
Source: Deutsche Bundesbank and own calculations

If the average debit interest rate is taken as the opportunity cost rate and counter transactions are also taken into consideration, this produces a value of around 0.03% of GDP for the internal costs incurred by households in obtaining cash (see Table 9). Given the fact that cash is also withdrawn for the purposes of hoarding, these costs cannot be attributed fully to payment transactions.

4.6 Internal costs incurred by businesses

Businesses use their own resources to process payment transactions. To a large degree, this is the employees' time. In addition, costs for hardware, software and data transmission also have to be taken into consideration. In the case of cash, this may involve checking and sorting equipment as well as safes; with cashless payment transactions, it may involve terminals or systems for connecting to banking organisations (including card service providers).[28]

27 The costs for counter and ATM transactions were determined separately. Alternatively, a single method could also be applied for all cash withdrawals. This produces slightly higher costs (approximately 0.1% of GDP).
28 Where terminals are leased by network operators to retailers, these costs are included in the network operators' revenue. However, larger retailers, in particular, purchase their own terminals.

Employees' time costs are of particular significance in situations where customers effect payment at the POS. This is the case most notably in shops, restaurants and some other sectors. However, estimating the time cost and, more specifically, according a value to it represent another major problem. These costs are difficult to estimate without conducting a detailed survey. The heterogeneous nature of retail makes this especially difficult. For example, 0.01% of businesses in retail and hospitality account for almost 40% of sales, whereas the three smallest business categories (70% of all firms) only account for less than 7% of sales.

If the costs of the payment transaction are divided into[29]

– fixed costs
– variable costs which are dependent on the number of transactions and
– variable costs which are dependent on the value of the transactions,

the segment for small and medium-sized enterprises is of particular importance for estimating the fixed costs. When it comes to estimating the variable costs, on the other hand, large businesses count almost exclusively.

In situations where large quantities of cashless payments are processed collectively (for instance, payments for electricity, gas, water, telecommunications) or in the B2B sphere, employees' time is of less significance. However, systems have to be implemented for processing the payments and occasionally have to be updated. Once again, business heterogeneity makes extrapolations difficult. This too is due to the fact that the majority of firms are small, and that a large portion of sales are achieved by relatively few, large firms.

29 This subdivision was adopted by the Dutch Central Bank and subsequently in many other studies (see National Forum on the Payment System, 2004).

Given these uncertainties, existing estimates have to be interpreted with great care, especially since some of the estimated totals are very high (see Table 10). Consequently, it is difficult to make a reliable estimate of the internal costs incurred by businesses without conducting an extensive own data collection.

Estimates of the internal costs of businesses Table 10

Study	Region – Year	€ bn	Remarks
Capgemini	EU-16 – 2006	112	Internal costs of businesses (without cash costs)
Derived from Capgemini	DE – 2006	22.4	Estimated share of DE in EU-16: 20%
WincorNixdorf	DE – 2009	8.6	Internal cash costs for retailers
PaySys Consultancy	DE – 2004	3.9	Internal cash costs for retailers
PaySys Consultancy	DE – 2004	6.9	Internal cash costs for retailers (incl. payment time)

Sources: Capgemini (2008), Nattmann (2009), PaySys Consultancy (2006) and own calculations.

4.7 Payments-related costs of the Bundesbank

The estimates of the costs of the payments banks are based on the demand approach. This approach has been chosen because there are hardly any data on payments-related costs. However, in case of the Bundesbank a rough estimate based on published data is possible. Therefore, it is not necessary to analyse payments-related revenues of the Bundesbank.[30]

30 Since issuing cash is not a business that is subject to competition, the demand-based approach is likewise not applicable. The Eurosystem, represented in Germany by the Deutsche Bundesbank, is a monopolist in issuing cash. Therefore, revenues are unlikely to be closely linked to costs.

Total expenses of the Deutsche Bundesbank in 2011 (€ million) Table 11

Staff costs	615
Other administrative expenses	306
Depreciation on tangible and intangible fixed assets	107
Banknote printing	71
Other expenses	209
Total expenses	1.308

Source: Deutsche Bundesbank (2011).

Total costs incurred by the Bundesbank in 2011 amounted to about €1.3 billion (see Table 11). When looking at the breakdown of costs, "banknote printing" is the only category that can be directly counted as costs of cash payments. For all other categories, costs are allocated to payments on the basis of the share of employees in the payments and cash departments.

Overall, the Bundesbank's payment-related costs amount to an estimated €403 million. When interpreting this figure it has to be taken into account that a significant share of the banknotes issued by the Bundesbank are circulating abroad (within the euro area and in non-euro-area countries). In fact, the share of cash that is used for transactions within Germany is much smaller than the stock of cash that has been issued. According to recent estimates, in 2010 only about €110 billion was held in Germany. Of this amount, about €73 billion was held as transaction balances (see Bartzsch et al., 2011a, b). This is equal to 20% of the entire stock of banknotes that has been issued by the Bundesbank. However, transactions balances are likely to account for a much larger share of the Bundesbank's cash-related costs, since banknotes used for payments within Germany are likely to return

much more often to the Bundesbank, causing cash handling costs.[31] Nevertheless, overall, the estimate of €375 million of cash costs of the Bundesbank can be interpreted as an upper bound.

Expenses of the Deutsche Bundesbank related to cash and cashless payments in 2011 Table 12

	€ million
Estimated costs of cash	375
Estimated costs of non-cash payments	28
Total	403
in % of GDP	0.02%

Source: Deutsche Bundesbank (2011) and own calculations.

At least some of the Bundesbank's payments costs are covered by payments-related revenues. Fees that the banks have to pay for Bundesbank services are already indirectly included in our estimate of banks' payments costs. If banks pass these costs on to their customers, they are contained in banks' revenues.

In addition to revenues based on fees, the Bundesbank also has seigniorage income based on the ability to issue non-interest bearing banknotes. For cash users, seigniorage constitutes opportunity costs. Again, as far as banks are concerned, costs are likely to be passed on to customers. Thus, they are included in banks' revenues.

31 It has also to be taken into account that the hoarding of cash (or use of cash abroad) is closely linked to the use of cash as a medium of exchange. After all, it is not conceivable that cash should be used to a substantial degree as a means of hoarding if it could not be used as a means of payment, as well. In this respect, the time horizon becomes important. Sooner or later hoards will be used for payments – thus becoming, once again, transaction balances.

More important is seigniorage income based on cash holdings of non-banks. This income covers the Bundesbank's remaining payments-related costs plus all other costs. Moreover, it provides the basis for the profits earned by the Bundesbank in most years. Thus, these payments-related revenues are not closely linked to payments-related costs.

Overall, payments-related costs of the Bundesbank amount to € 403 million. This is equal to 0.02% of GDP. Of these costs, a maximum of € 254 million is already contained in the costs of the payments banks.

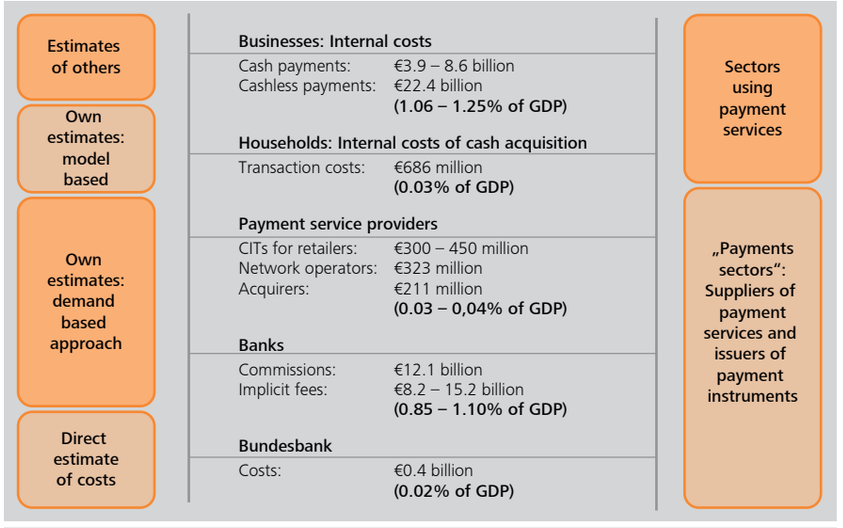
5 Summary, conclusions

Great uncertainty is attached to estimates of the costs associated with the payment system. Due to the many unique aspects of the different countries, we would especially warn against attempts to apply the findings for one country to another without making adjustments. This study does not alter this either. However, there are some areas which are more readily suited to estimates and other areas which can only be determined with a marked absence of precision. The latter include the internal costs incurred by households and businesses.

Figure 19 briefly summarises our estimates. It is easier to make estimates in situations where payment services are offered on the market. The commercial banks are important suppliers of payment services. Depending on whether the current extremely low rates of interest are taken as a basis or the rates are smoothed over an interest rate cycle, the payment services provided by banks are quantified at between €20 and €27 billion (0.78 – 1.05% of GDP). This value is to be regarded as more of a lower limit because payment transactions presumably provide further revenue in the form of preferential loan and deposit terms.

The other suppliers play a much less significant role. This is due in part to the fact that they operate as service providers for the banks, and the banks bill the customers for the costs that the former incur. An estimate of the direct revenue achieved with non-banks by service providers in cash and card payments produced volumes of under €1 billion.

Summary of results Figure 19



Sources: See Chapter 4.

Factoring in findings from external estimates of the internal costs of businesses, we can put the macroeconomic significance of cash and cashless payment media at a figure of at least 2-2.5% of GDP all in all. However, it is important to tread with caution when interpreting estimates of the internal expenses incurred by businesses and private individuals.

Finally, one should observe that cost estimates also ignore a number of quality-related factors, such as the role of cash in monetary policy, questions of data protection or the importance of different payment media in crisis phases (see the end of Chapter 3).

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Jakub Górka[1]
Merchant Indifference Test Application – A Case For Revising Interchange Fee Level in Poland

Jakub Górka
Assistant Professor, University of Warsaw, Poland

Abstract

The paper presents results of an empirical study conducted in Poland aimed at estimating costs of cash and card payments acceptance at physical points of sale and determining the level of interchange fees (IF) in card-based transactions conformant with the merchant indifference test (MIT), also known as the tourist test or the cost-avoided test.

Calculations were based on data obtained from a survey of more than 1000 merchants of all sizes from different branches of economy active in retail trade

1 Jakub Górka, Ph D, Assistant Professor, University of Warsaw, Faculty of Management, Banking and Money Markets Department, e-mail: jgorka@wz.uw.edu.pl ; jgorka@jgorka.pl

(consumer-to-business domain). The sample of companies was statistically representative at national level.

The MIT may currently be considered as a preferred method of IF assessment in the economic literature, as well as by the European Commission. To the author's knowledge, the application of MIT on the basis of primary data from the merchants survey was the first such attempt in the economic literature.

The MIT explores the question whether a merchant would refuse a card payment if he were certain that a non-repeat customer who is about to pay at the cash register had enough cash in his pocket. The test is passed if accepting the card does not increase the merchant's operating costs.

The level of interchange fees in Poland compliant with the tourist test would help accelerate the growth of card acceptance network and make merchants indifferent to the choice of payment method by consumers (cash vs card). The level of IFs in Poland has long remained the highest compared to other countries of the European Union.

Based on the outcomes of cost calculations it can be argued that tiers of interchange fees in Poland should be low – up to 0.2% of a transaction value or even nil.

1 Introduction

Interchange fees (especially collectively agreed multilateral interchange fees, MIFs) have been a focal point of many debates worldwide. The views of payment stakeholders on the role of interchange fees (IFs) and their level are varied. While payment organisations and issuers tend to prefer higher IFs, merchants and acquirers would rather see them low or even non-existing. Payment regulators in all countries, who are authorised to protect consumers and competition, closely monitor the payments market and take under scrutiny the economics of business models in

three and four-party card schemes. It would be hard to find a country among developed and emerging markets where antitrust authority did not conduct any investigation against Visa and MasterCard networks for setting excessive (multilateral) interchange fees or enforcing anticompetitive rules (such as blending, no-surcharge/no-discrimination rule, honour-all-cards rule).

In Poland policy makers felt concerned about high interchange fees which were regarded as one of the main factors that slowed down expansion of card accepting payment terminals and in effect inhibited non-cash circulation development in the country. The need arose to make a study on payment costs with special attention on the issue of merchant service charges and underlying interchange fees.

The article presents selected results of the Polish merchants survey and subsequent cost calculations which were made in the joint research project carried out in the second half of 2012 by:

– the Foundation For Development of Cashless Payments in Poland (FROB),
– the National Bank of Poland (NBP),
– the Faculty of Management, University of Warsaw (WZ UW) [2].

More than 1000 merchants of all sizes from different branches of economy active in retail trade (consumer-to-business domain) were interviewed in the survey. The sample was statistically representative at the national level with the exception of small rural areas.

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2 Millward Brown conducted the survey of merchants. A comprehensive report written by the head of the research project is available on NBP and FROB websites. Górka J (Dec. 2012), Study on Acceptance of Cash and Payment Cards in Poland (in Polish): http://www.nbp.pl/home.aspx?f=/systemplatniczy/obrot_bezgotowkowy/obrot_bezgotowkowy.html http://frob.pl/baza-wiedzy/badania/ The analyses, opinions and conclusions presented in the report are of the author and cannot be treated as a position of any institution involved in the research project.

The project aimed at:

– estimating costs of cash and card payments acceptance at physical points of sale in Poland,
– identifying barriers to the development of non-cash payments (including card transactions),
– defining degree of Polish merchants' openness to potential adoption of innovative payment methods.

An important problem addressed in cost estimations was the assessment of an efficient level of interchange fees in Poland which would help accelerate the growth of card acceptance network and make merchants indifferent to the choice of payment method by consumers (cash vs card). The merchant indifference test (MIT, also known as the tourist test or the avoided-cost test) was used in order to find an appropriate benchmark for the IF level. The MIT may currently be considered as a preferred method of MIF assessment in the economic literature as well as by the European Commission.

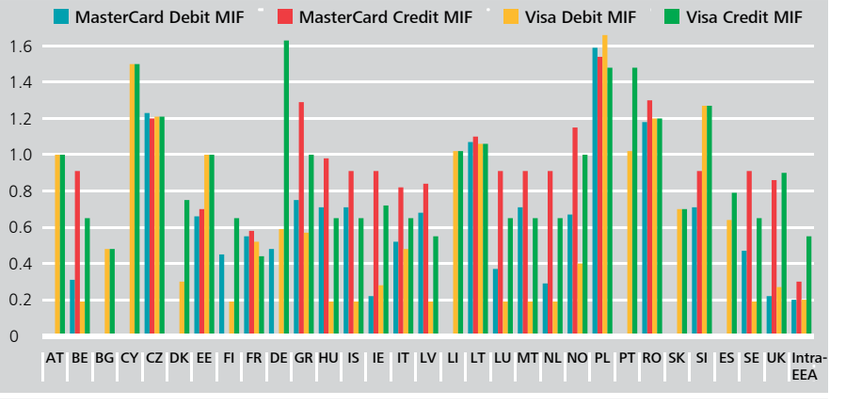
The remainder of the paper is organised as follows: Section 2 provides general background information about interchange fees and a brief literature review; Section 3 describes the methodology used in the survey on merchant's costs; Section 4 presents selected results of the survey; Section 5 gives insight into investigated cost items; Section 6 focuses on cost calculations of cash and card payments; Section 7 introduces the concept of merchant indifference test; Section 8 refers to the application of MIT to Polish data, shows recent dynamics of interchange fees in Poland and discusses regulatory interventions made in Poland and planned on the Pan-European level; Section 9 concludes followed by a glossary of cost definitions used in the study on merchants' costs.

2 Background information and literature review

Interchange fees are charged by issuing banks to acquiring banks for each card payment transaction executed at a merchant outlet. They can be set unilaterally as well as agreed bi- or multilaterally between issuers within a payment scheme. In the latter case they are defined as multilateral interchange fees (MIFs) and take either a form of a percentage fee or combined fee (a fee with both – ad valorem and flat fee components).

Domestic weighted average multilateral interchange fees (MIFs) in Europe Figure 1

%, in 2012



Source: based on EC data (DG Competition).

Domestic MIFs are not set on the same or similar levels across countries and they differ significantly. In 2012 MIFs in Poland stood out as the highest in the EU (the weighted average level of 1.55-1.60%). They were blamed for impeding the growth of payment accepting devices network in Poland and inflating merchants' costs (NBP 2012: 6, Maciejewski 2012: 21). Between 2003 and 2012 the number and value of non-cash card transactions in Poland soared by 635% and 406% respectively, while

the number of payment terminals only by 246%. At the end of 2011 Poland had the second sparsest card payment acceptance network in the EU – 7 005 devices per one million inhabitants, while the EU average at that time was 17 584.

In order to solve the problem by means of a market compromise the National Bank of Poland set up an Interchange Fee Task Force consisting of all major market stakeholders (issuers, acquirers, payment organisations, merchants, consumers, public authorities – Polish Ministry of Finance, Polish Ministry of Economy, Office of Competition and Consumer Protection, Polish Financial Supervision Authority, the central bank itself). The IF Task Force was operating from November 2011 to March 2012 and worked out the so called Programme of Card Charges Reduction in Poland which assumed gradual decreases of interchange fees in the years 2013-2017 (the first decrease to 1.1-1.2%, the last decrease to the European average – at that time 0.70-0.84%). However, mainly due to the opportunistic behaviour of MasterCard, the compromise had failed and the regulatory legislative process was initiated.

Over the last decade the costs of payment instruments were estimated in a number of empirical studies, frequently carried out directly by central banks: the Netherlands (Bank of Netherlands 2004; Brits and Winder 2005), Belgium (Bank of Belgium 2005; Quaden 2005), Sweden (Guibourg and Segendorf 2004; Bergman et al. 2007; Segendorf and Jansson 2012), Portugal (Bank of Portugal 2007), USA (Garcia-Swartz et al. 2006a and 2006b), Australia (Simes et al. 2006; Reserve Bank of Australia 2007), Canada (Arango and Taylor 2009), Finland (Takala and Viren 2008; Nyandoto 2011), Norway (Gresvik and Øwre 2003; Gresvik and Haare 2009), Hungary (Turjan et al. 2011), Denmark (Bank of Denmark 2012), Germany (Krüger and Seitz 2014) and the most comprehensive study of the European Central Bank with the involvement of 13 national central banks from the European Union (Schmiedel et al. 2012). The studies concentrated on retail payments efficiency measured from the perspective of private costs incurred by different entities engaged in the payment process and from the macro perspective of social costs

embracing all parties' private costs after netting out reciprocal transfers of charges. Those studies did not directly deal with the economics of fees, such as the merchant service charge or the interchange fee, which underpin the payment system and guide decisions of payment stakeholders.

However, there is another strand of theoretical economic literature that evolved on the optimal pricing of card payments. First in the early 1980's Baxter built a model of two-sided markets where he argued that contrary to traditional markets there was a rationale behind setting an interchange fee which would balance demand for card services of two distinct user groups: merchants and consumers characterised by different degree of price elasticity (Baxter 1983). Simplified assumptions used in the Baxter model have been relaxed in other papers. Wright (2004) allowed for heterogeneity on both sides of the market. Rochet and Tirole (2002, 2003) proved that with lacking possibility of merchants to surcharge, the actual levels of interchange fees can be higher than socially optimal. An extensive overview of economic literature on interchange fess can be found in Verdier (2009), Börestam and Schmiedel (2011), Bolt (2013).

The pivotal issue raised in the economic literature as well as by antitrust authorities was the adequate level of MIF which would bring both sides on board without creating market failure whereby issuers would be able to extract economic rents through introducing high interchange fees which in turn, via merchant service charges, would be passed on by acquirers to retailers. In such a case instead of positive externalities brought about by active cardholders merchants would face negative ones. All consumers, whatever payment method they used, would have to internalise higher costs of payments through higher prices of goods and services.

Up until ca 2008 in order to determine an appropriate MIF tier a supply side approach was popular taking account of three cost categories (Börestam and Schmiedel 2011: 32):

– processing cost,
– payment guarantee cost,
– free funding cost.

Payment organisations argued that these costs justified the usage of interchange fees by issuers. This reasoning was shared by antitrust authorities, including the European Commission, for some time, but it was later noticed that the supply side approach did not have a good theoretical basis (Wright 2012: 28), because it did not relate directly to those parties of the market whose costs and benefits should be balanced, i.e. merchants and consumers. Furthermore banks and payment organisations tended to inflate their costs without providing compelling justification. Therefore the economists and regulators welcomed a new method of MIF assessment developed by Rochet and Tirole (2007, 2011), which was based on retailers' costs and benefits well internalising the position of consumers (for more on the concept of merchant indifference test see section 7). The new method was considered suitable for the purpose of finding a benchmark for interchange fees, promoting the use of more efficient payment instruments and preventing abuses in the market (Börestam and Schmiedel 2011: 19). It is remarkable that international payment organisations agreed for the tourist test methodology in antitrust proceedings undertaken against them by the European Commission (EC vs. MasterCard 2007, EC vs. Visa 2008 cases) and thus withdrew from pushing for the supply side approach.

While theoretical literature on interchange fee models and methods of their assessment flourished, there was not enough empirical research. Models lacked testing (Leinonen 2011: 12, Börestam and Schmiedel 2011: 18). Only lately have some empirical studies been carried out.

In cases against Visa (2008) and MasterCard (2007) the European Commission conducted simplified MIT-compliant calculations on the basis of data collected in cost studies of the central banks in the Netherlands (Brits and Winder 2005, EIM 2007 – see Pleijster and Ruis 2011), Belgium (Bank of Belgium 2005) and Sweden (Bergman et al. 2007). Pursuant to calculations MIF benchmarks were defined (0.2% for debit cards, 0.3% for credit cards). The EC did not make the calculations public.

In February 2014 the EC announced preliminary results of its study on merchants' costs of processing cash and card payments, which delivered further evidence supporting the MIF benchmarks set earlier (EC 2014). The EC collected data for this study through a commissioned survey of more than 250 large retailers in 10 EU member states accounting for approximately 87% of retail turnover in the EEA. The relevant costs applied in the tourist test included labour, service and payment instrument specific equipment costs.

Other empirical studies were performed prior to the above mentioned study of the EC: the Polish one presented in this paper (2012), and the ones carried out by Layne-Farrar (2013) and Jonker and Plooij (2013).

Layne-Farrar compared the interchange fee suggested by the tourist test with that set by the Durbin Amendment (DA) which capped debit card IFs at 21 cents per transaction plus 5% of the transaction amount in the USA. Layne-Farrar made calculations on a case by case basis for a variety of merchants (quick service restaurants, discount stores, supermarkets, retail gas stores, convenience stores, travel retail stores). She found that what mattered mostly in calculations was the average transaction size and an alternative payment instrument to debit cards. For cash-centric merchants the DA cap seemed to be too high or about right (at venues with higher average transaction sizes) while for merchants who honoured cheques the DA cap looked too low. The results imply that cash, unlike cheques, was still a cost competitive instrument compared to debit cards.

Jonker and Plooij using Dutch cost data for 2002 and 2009 showed that for such countries as the Netherlands, characterised by decreasing costs of debit cards and increasing costs of cash, the tourist test methodology may lead to growing costs for merchants, assuming that MSCs would rise along with interchange fees. The MIT conformant level of MIF would grow from 0.2% to 0.5% of the average debit card transaction value. According to Jonker and Plooij the tourist test is not a universal method of MIF assessment for regulatory purposes in all countries since it is heavily dependent on market characteristics. Moreover, what needs to be further researched is the rate of passing through changes of MIFs on merchant and consumer fee levels.

Using tools of econometric modelling Chakravorti et al. (2009) demonstrated a positive impact of interchange fee reductions on the growth of card acceptance network in Spain, thus positively verifying the passing through effect. Ardizzi (2013) empirically investigated that decreasing of MIFs in Italy led to a shift towards payment card transactions in lieu of cash at points of sale although he could not affirm that a zero MIF level would be optimal for the development of electronic payments. Some economists went a step further proposing to eliminate interchange fees altogether (Gans 2007, Leinonen 2011). Leinonen argued that MIFs make merchants less willing to promote card payments instead of cash. It is not enough to render merchants indifferent by setting MIFs at the tourist test compliant level. Abandoning MIFs in debit card transactions eliminates cross-subsidisation of cash. Leinonen supports the idea of transparent cost-based pricing. In this respect he is accompanied by numerous other economists who are proponents of changing opaque pricing conventions into more transparent ones (De Grauwe et al. 2006, Enge and Øwre 2006, Bergman et al. 2007, Humphrey et al. 2008, Van Hove 2008).

3 Survey methodology

Data in the study on merchants' costs of accepting cash and card payments in Poland were obtained on the basis of a standardised questionnaire comprising well

over 100 detailed questions which were asked in anonymous Computer Assisted Personal Interviews (CAPI) by a professional market research institute.

The survey was carried out in three stages:

1. Stage I – preparation (June – July).

2. Stage II – interviews with merchants (August – September).

3. Stage III – checking and working out the outcomes (October – November).

Apart from work on the questionnaire which was subject to extensive consultations with various market participants (the central bank, commercial banks, acquirers, merchants, consumers), stage I also involved a pilot study, training for pollsters from the research institute and sampling. The sample was selected disproportionately and varied using employment and branch of economic activity criterion. Interviews were held all across Poland (as broken down into 8 macroregions by the Central Statistical Office of Poland, GUS). With the view to ensuring representativeness, the outcomes were weighted with the real structure of business population, based on data provided by GUS and the Polish Classification of Economic Activities 2007 (PKD 2007), reflecting the European Classification of Economic Activities (NACE). The study comprised 7 PKD branches/sections from retail trade and services sector (consumer sale). The businesses were broken down according to employment criterion into small- (employing up to 9 people), middle-sized- (employing from 10 to 49 people) and large enterprises (50 employees and more).

In order to encourage entrepreneurs to provide reliable answers based on financial documents maintained in their companies (invoices, print-outs from sales application, terminal print-outs, contract with acquirer) they were presented a cover letter signed by the parties involved in the project: the National Bank of Poland, Founda-

tion for the Development of Cashless Payments and the Faculty of Management of the University of Warsaw. Before each interview respondents were shown the letter by pollsters. Sometimes the complexity of the study required several contacts with individual businesses to obtain all answers and/or fill out the missing data.

Stage III involved checking the correctness of outcomes (the so called validation), as well as statistical description of respondents' answers and carrying out cost analysis of cash and cards payments based on data obtained in the study.

Pursuant to the study objectives only costs at physical points of sale were estimated, while remote payments were not subject to an in-depth analysis.

According to data of the Central Statistical Office of Poland (GUS) there were a total of 3.9 m businesses in 2011 in Poland. This includes all business entities entered in the REGON register (Register of the National Economy). Depending on the source, the number of active companies on the Polish market was 1.7 – 1.8 m in general, and 1.1 – 1.3 m in the industries covered by the study.

The study sample comprised 1006 companies. Respondents were senior officers responsible or co-responsible for decisions on acceptance of payments methods and related issues (in practice company owners, CFO's, chief accountants, senior managers) who provided their answers with the support of a salesman/cashier. Sample selection involved stratification by:

a. branch of economic activity,
b. size of employment,
c. territorial distribution.

As it was necessary to draw conclusions with regard to branches (PKD sections) and size of employment, researchers opted for a disproportionate sample structure, meaning that the share of companies from specific branches and of specific size did not reflect the real market structure. Proportional sampling would not have provided the right sample size in all of the strata (branch and size of employment).

Studied population size (registered entities) and structure of the study sample by branches Table 1

Branch (PKD section 2007)*	Size of business population**	Percentage share of the branch in the whole studied population	Unmodified n: number of enterprises in the sample proportional to the share of enterprises in the population	Actual n in the sample – realised interviews
G. Wholesale and retail trade, repair of motor vehicles and motorcycles	1 060 041	48%	483	345, including 6 interviews with chains
H. Transportation and storage	252 820	11%	111	111
I. Accommodation and food service activities	122 299	6%	60	116
M. Professional, scientific and technical activities	336 822	14%	141	117
Q. Human health and social work activities	193 265	8%	80	109
R. Arts, entertainment, recreation	67 207	3%	30	111
S. Other service activities	235 720	10%	101	97
Sum	2 268 174	100%	1006	1006

* The sample covered only retailers (B2C transactions).
**Population size of companies registered in the REGON register. Branch structure which was used to weigh the data was based on the structure taken from REGON register, which involved all registered entities. Since no other source was available, it was assumed that the structure of active entities was the same as for all registered companies.

For the total sample of n = 1006 the estimation error was +/-3% with significance level of 95%. Higher share of trade (section G) in the sample was due to a much higher share of businesses from this section in the total population covered by the study, and thus due to the statistical significance of this section as regards the study objectives. The realized sample n=345 provided for a good basis for conclusions, with estimation error of +/- 5.6%. In other branches the share in the sample was similar, which ensured only a slightly higher estimation error (+/- 9%) and a good basis for comparisons between branches.

Sample structure by size of employment Table 2

Strata by number of employees	Share of enterprises of the same size in the total business population	Unmodified n: number of enterprises in the sample proportional to their share in the total population	Actual n in the sample
0-9	90%	905	377
10-49	8%	81	378
50 and more	2%	20	251
total	100%	1006	1006

The strata 0-9 employees and 10-49 employees were of equal size which ensured the same estimation error (+/- 5%). The stratum 50 employees and more comprised 251 companies. Estimation error for this sample was +/-6%

A disproportionate sample structure provided for the possibility of inference pertaining to strata by size of employment. If sampling had reflected the real share of enterprises in the total business population, the analysis would have been impossible for middle-sized and large enterprises.

As regards the territorial breakdown, the study covered enterprises from cities of more than 10 000 inhabitants, which account for ca. 72% of the business population in Poland in the investigated sections. The majority of interviews was carried out in cities above 100 000 inhabitants. The sample was representative for the general population of active companies in the indicated branches of economic activity with the exception of rural areas. Territorial division of the sample reflected the distribution of business entities between 8 Polish macroregions. Stratification was proportional in this case.

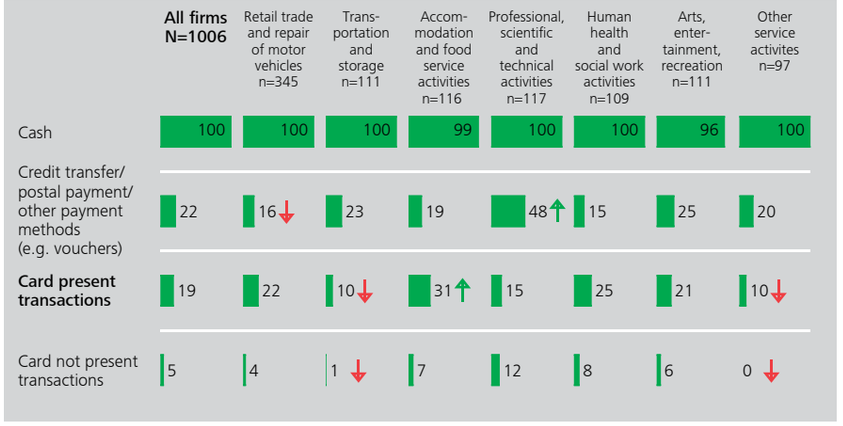
Data from merchant study were weighted using two criteria: company size (measured by the number of employees) and branch of economic activity. The data thus obtained were representative and it was possible to make reliable inferences on the total population of companies covered by the study.

4 Selected descriptive results

The survey delivered many interesting results, some of which are presented below. The sample consisted of 1003 firms accepting cash and 359 accepting cards (card present transactions).

Payment instruments accepted in C2B transactions in Poland Figure 2

%, in 2012



↑↓ Statistically significant difference between the total and a given group of companies.
Source: Survey results, N=1006.

The goal of the study was to estimate costs of cash and card payments in face-to-face transactions at physical locations. It turned out than only 19% of all merchants in Poland were accepting cards in card present transactions.

Comparison of average number of points of sale between all firms and firms accepting cards (2012) Table 3

	Average number of points of sale	Average number of points of sale in small firms up to 9 employees	Average number of points of sale in medium sized firms 10-49 employees	Average number of points of sale in large firms 50 and more employees
All firms	1.07	1.03	1.52	4.65
Firms accepting cards	1.31	1.15	1.73	6.53

Source: Survey results, n=1006.

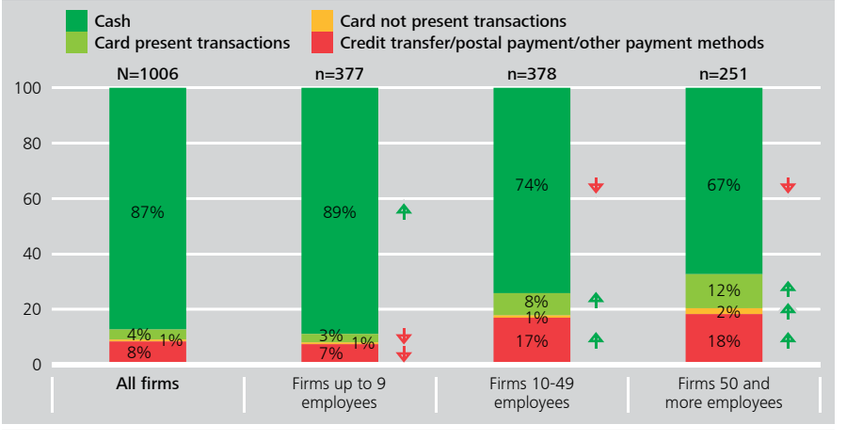
The bigger the firm, the wider was its point of sale network. Companies accepting cards, regardless of their size (small, medium, large):

– had more points of sale,
– were characterised by higher sales and higher number and value of cash transactions

compared to companies which only accepted cash.

Average share of payment methods in the total number of transactions Figure 3

in 2011



↑↓ Statistically significant difference between the total and a given group of companies.
Source: Survey results, N=1006.

According to initial declarations of companies 87% of all transactions in 2011 were made in cash and only 4% with physical use of cards. The share of card transactions rises with the company's size. Companies accepting cards reported higher shares of card present transactions (in total – 71% for cash, 19% for physical use of cards). The declared share of cash in value of transactions was lower than in number of transactions.

After a critical analysis of merchants' declarations, supplemented by additional data and information provided by merchants and external sources it was estimated that in 2011 an average Pole made 326 cash payments with the total value of EUR 2 233 and 26 card payments with the total value of EUR 631. Based on merchant survey data the fraction of cash in the number of consumer-to-business point of sale transactions was 92.6% (7.4% for cards) and 78.3% in value of consumer-to-business point of sale transactions (21.7% for cards).

Cash and card quantitative indicators (2011) Table 4

	All firms	Firms up to 9 employees	Firms 10-49 employees	Firms 50 and more employees
	Cash N=1003 Card N=359	Cash n=374 Card n=67	Cash n=378 Card n=151	Cash n=251 Card n=141
Average monthly value of **cash** payments per one point of sale	€ 5 492	€ 4 282	€ 13 216	€ 25 344
Average monthly value of **card** payments per one point of sale	€ 4 899	€ 3 649	€ 8 437	€ 9 179
Average monthly number of **cash** payments per one point of sale	798	734	1136	1945
Average monthly number of **card** payments per one point of sale	242	181	379	382
Average value of one **cash** payment	€ 6.89	€ 5.83	€ 11.65	€ 13.11
Average value of one **card** payment	€ 20.24	€ 20.15	€ 22.33	€ 24.03

Note: In 2011 the average EUR/PLN exchange rate in Poland was 4.12. The values provided in the table were converted at this exchange rate and rounded.
Source: Survey results, cash n=1003, card n=359.

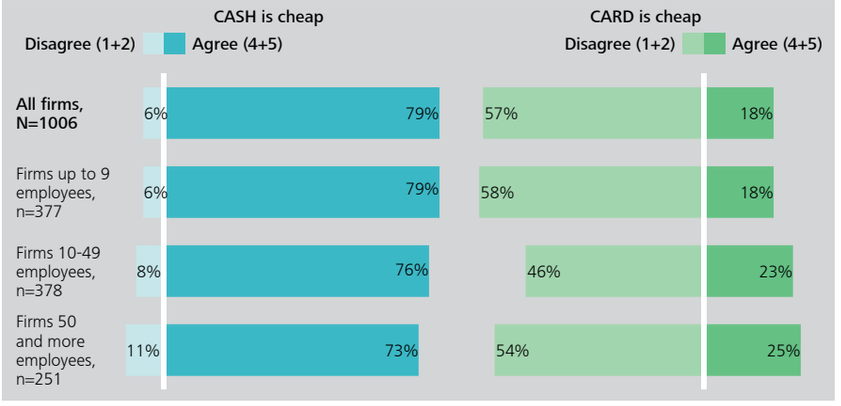
As regards all companies the average monthly value of cash payments per one point of sale in 2011 declared in the survey was only little higher than the average monthly value of card payments, but because of bigger discrepancy between the number of average payments with these two instruments, the average value of card transaction was almost three times higher than that of cash transaction (EUR 20 vs 7). In the case of card payments the average value reported for large companies was exactly the same as in the Polish central bank's statistics, which means

that most card transactions in Poland are made at points of sale of large companies, such as supermarket chains, warehouses or petrol stations.

When it comes to costs 74% of merchants perceived cards as more costly than cash. Only 6% claimed that cash was more expensive than cards.

Perception of cash and card costs Figure 4

in 2012



Question: Do you agree that cash/card is cheap: 1 – strongly disagree, 2 – disagree, 3 – neither disagree nor agree/do not know, 4 – agree, 5 – strongly agree.
Source: Survey results, N=1006.

79% of merchants responded positively to the statement that cash was cheap (with 6% of negative answers), whereas only 18% agreed that card was cheap (and as much as 57% didn't). Bigger companies tended to evaluate cash "cheapness" slightly worse and card "cheapness" slightly better than smaller companies.

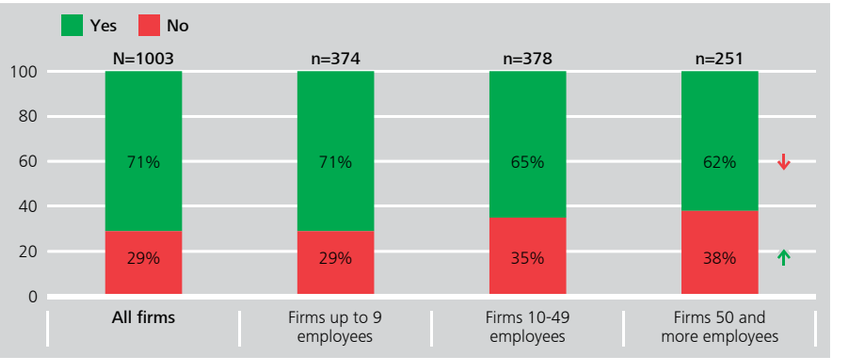
The views on safety and convenience of cash and card payments were more balanced, although the Polish merchants had a visibly better attitude toward banknotes and coins. 72% of merchants rated cash as safe, 66% rated cards as safe, 85% rated cash as convenient, 71% rated cards as convenient. Interestingly

enough large companies appeared to value cards more as a more secure and convenient payment method.

Almost half of all merchants accepting cards preferred when clients paid in cash instead of card, only 4% was of an opposite opinion (the rest of merchants did not express a clear preference towards any of payment instruments). The popularity of cash, especially among small companies, could be explained by a number of factors.

Usage of cash in debt repayment to contractors and employees Figure 5

in 2012



↑↓ Statistically significant difference between the total and a given group of companies.
Source: Survey results, N=1003.

71% of merchants declared that they used cash for clearing some of their obligations to business partners and employees. The share of such answers was significantly lower in large companies (by 9 percentage points).

Another answer corresponded with the above declaration. On average 22% of companies stated, that even though they had current accounts at banks, they neither used those accounts for depositing nor withdrawing cash, because they fully recirculated the whole stock of cash. Many companies asserted that they used cash

either because of their own preferences or expectations of suppliers and employees. According to answers in the survey cash was sometimes the only possible option for business-to-business or wage payments. The survey did not contain any explicit questions about shadow economy, but these answers cast some light as to why cash payments were desired and popular.

75% of all firms acknowledged that they did not perceive fees for cash withdrawals and deposits as excessive. Merchants thus represent the view that the level of those fees in Poland is adequate. Quite a significant number of merchants – 63% – did not believe that accepting card payments would boost sales. On the other hand more than a half of merchants already accepting cards were convinced that this factor had a positive impact on their revenues.

Cash was considered a faster means of payment than cards. 64% of all firms agreed that on average cash transactions take less time than card transactions in a contact mode (with 10% of opposite opinions), 52% acknowledged that cash was also quicker than proximity payments (with 15% of opposite answers). However, significantly less large companies shared the opinion that contactless card payments were slower than cash (42%).

Merchants who stated in the 2012 survey that in a forthcoming year they would not start accepting cards (76% out of the group of merchants not accepting cards, that is about 61% of all merchants), cited a few arguments behind their approach, with the most important ones being:

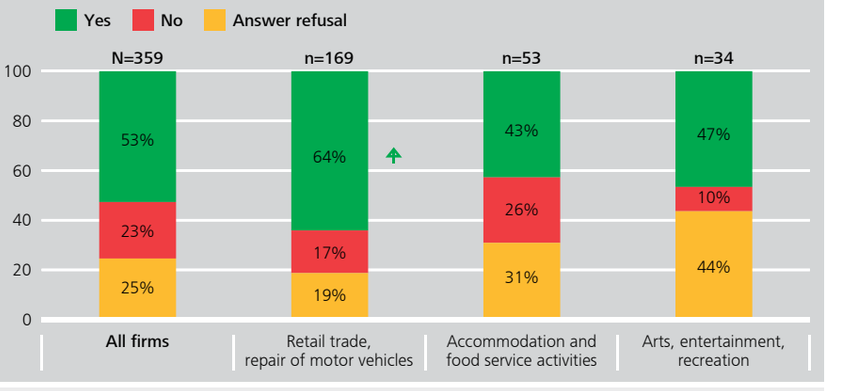
– excessive costs of cards (52% of the subgroup),
– lack of evident benefits from accepting cards (41% of the subgroup),
– lack of interest of clients in paying with cards (30% of the subgroup).

The surveyed merchants declared almost no costs associated with frauds on cash (counterfeiting, theft, robbery). Even if they reported some incidents, they claimed they had not suffered financially as a result. It should be underlined, however, that merchants also declared minor losses on card frauds, which could in effect be considered negligible as well. Macro statistics from external sources confirm that Poland stands out positively in Europe regarding fraud rates on cash and cards.

Issues that companies regarded as important in their decision to start accepting card payments were: various costs of card acceptance, but also the security of payments, considerable number of clients willing to execute card payments, duration of a payment transaction, acceptance of cards by competition.

Rate of blending in merchant service charges Figure 6

in 2012



↑↓ Statistically significant difference between the total and a given group of companies.
Source: Survey results, N=359.

According to declarations of merchants in 2012 53% of them had contracted a blended (single) merchant service charge (MSC) rate for all card transactions. Retail trade and repair of motor vehicles sector featured an even higher rate of blending (64%).

Average level of blended MSC (2012) Table 5

	All firms	Firms up to 9 employees	Firms 10-49 employees	Firms 50 and more employees
Blended MSC	1.82%	1.85%	1.76%	1.70%

Source: Survey results, n=359.

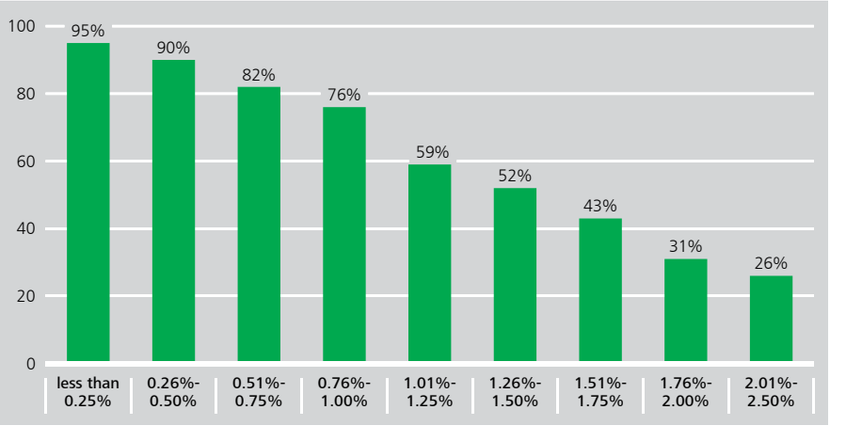
Pursuant to survey results the average blended MSC rate in 2012 was 1.82%. Larger companies reported lower rates of blended MSC rates. Some firms declaring blending (63%) claimed that the fee rate also included a flat component. With regard to all firms a flat fee component amounted to 4.6 eurocents (small companies – 5.1 eurocents, medium companies – 3.6 eurocents, large companies – 1.9 eurocents).

Businesses were also asked about the level of an acceptable and desirable MSC. Two charts below exhibit cumulated acceptance of the MSC in given intervals. The width of intervals (except for the highest one) was set at 0.25 percentage points. The first chart below shows answers for all companies accepting cards, the second – for companies which claimed in 2012 that they did not want to start accepting cards within the next year because of the cost barrier.

The highest increase in the preferences of businesses occurred at the transition level from 1.01% – 1.25% to 0.76% – 1% (a leap from 59% to 76% of companies accepting a given level). Moreover, 82% of merchants already honouring cards deemed a tier of the MSC in the range of 0.51% – 0.76% appropriate and desired. An interchange fee is a component of the MSC. Therefore, in accordance with preferences of businesses its level should be respectively lower by the acquirer mark-up including scheme fees paid to payment organisations. It can be estimated that a tier of interchange fees satisfying 76% – 82% of merchants already accepting cards should have been in the range of 0.5% – 0.75% in 2012. One should note, however, that responses were given at a time when Polish IFs and MSCs ranked highest in the EU.

Acceptable level of MSC – for all companies accepting cards Figure 7

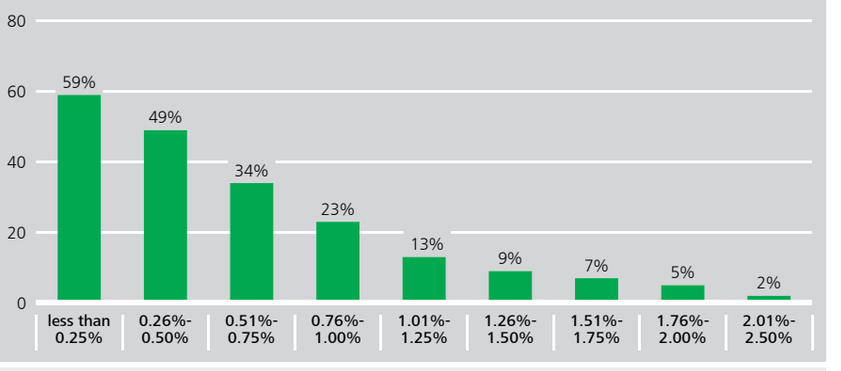
in 2012



Source: Survey results, N=359.

Acceptable level of MSC – for companies not willing to start accepting cards within the next year and perceiving card costs as a barrier Figure 8

in 2012



Source: Survey results, N=212.

In 2012 the price elasticity to MSCs for merchants not willing to start accepting cards and indicating costs as a barrier was much higher than for those who were already at that moment allowing for payments with this instrument. The acceptance level regarding any MSC was low. Only an MSC below 0.5% would encourage half of the surveyed retailers to begin accepting card payments. As a result it could be argued that IFs sufficiently incentivising the expansion of payment terminal network in Poland should be even below 0.25%.

Tests of price elasticity undertaken in the survey proved that every decrease in interchange fees would stimulate the growth of payment card acceptance network, but ceteris paribus highly dynamic changes in number of terminals could only happen when reductions of MSCs (and underlying IFs) were more profound.

High costs of card acceptance and good perception of cash influenced payment habits of Polish retailers. In 2012 almost 30% of all firms accepting cards declared that they offered rebates for cash payments at least from time to time. Large merchants were less willing to do so, only 15% in that group confirmed offering rebates to clients performing cash payments. In most cases rebates were offered occasionally, not permanently, although 30% of retailers in this subgroup said they were frequently inducing clients to make cash payments by offering discounts. On the other hand, Polish firms did not surcharge clients in face-to-face transactions – positive answers to a question about this practice oscillated around the survey's margin of error (1%).

It seems that another practice of Polish merchants was more prevalent – limitations of card payments below a certain threshold value. More than one quarter of companies active in retail trade acknowledged that they prohibited clients from paying with cards when the amount of transaction was too low (in 90% of cases the limit was set at about EUR 5). Unlike rebates, this practice clearly in breach of payment

organizations rules was almost always in place and supposedly must have been accepted by clients.

The internalisation level of different costs was not the same. It appeared that some cost items were disregarded by merchants.

Is float cost in card payments treated as an opportunity cost of lost interest? Figure 9

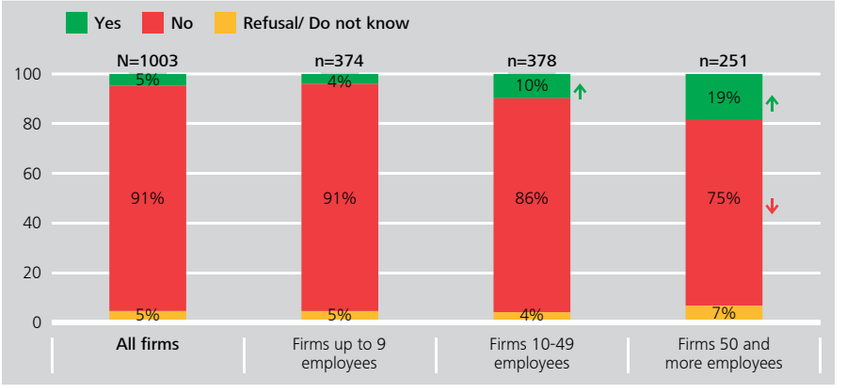
in 2012

Source: Survey results, N=359.

One in five companies did not consider the time between a card transaction at their point of sale and a moment of crediting their bank accounts as an opportunity cost of lost interests on money in float. The awareness rose with the size of company.

Is counting, sorting and packing of cash treated as cost? Figure 10

in 2012



↑↓ Statistically significant difference between the total and a given group of companies.
Source: Survey results, N=1003.

As many as 91% of retailers did not treat cash handling activities such as counting, sorting and packing of banknotes and coins as cost. Among large companies, which had more points of sale (nearly 5 on average) these activities were recognised as cost by 19% of merchants.

5 Cost items investigated

The study distinguished 9 pecuniary cost items and 4 non-pecuniary cost items of each payment instrument (cash and cards). According to the survey results not all cost items turned out to be equally important. Therefore, some of them were not used in basic-scenario cost calculations but they were discussed in additional complementary analyses. Pecuniary cost items were costs associated with charges and tariffs, costs of depreciation, foregone interest (opportunity costs) and financial losses as a result of fraud, counterfeiting or theft (see "Glossary of cost definitions"). Non-pecuniary cost items were related entirely to time costs associated

with labour time of staff employed (front and back office labour costs). Non-pecuniary cost items required conversion into monetary terms by multiplying labour time with average hourly gross wage rate of employees.

Respondents were asked to report for 2011. Questions referred either to one or all points of sale of a company and different time periods. However, all final calculations were made for one month and one point of sale of a representative company (compare information on sampling). The average values were calculated for series of quantitative variables after cutting off top five percentile of outliers on each side of the distribution (together 10% of the most outlying values).

Apart from distinguishing between private/social, pecuniary/non-pecuniary, external/internal costs, it was necessary to make other technical cost divisions. Therefore costs were split into fixed and variable, total and marginal (see "Glossary of cost definitions"). Assuming one year time horizon facilitated defining fixed or variable nature of costs.

In the study credit and debit cards were treated jointly, because from the perspective of merchants this division was not relevant in the cost context and because it was hardly possible. The level of the MSC and the corresponding IF could be the only cost differentiating item between credit and debit cards. Untypically, in Poland IFs for debit card-based transactions were often higher than for credit card-based transactions (especially in the case of Visa cards). It can also be argued that the duration of a payment transaction is important. However, other card distinctions appear to be more significant as regards the duration of a card transaction (such as for example the distinction between contactless/PIN-based/signature-based cards, etc.).

Pecuniary and non-pecuniary cost items of cash Table 6

Pecuniary items		Non-pecuniary items	
cost item	**economic significance for a merchant**	**cost item**	**economic significance for a merchant**
cost of cash open and closed deposits	++	cost of payment tender time (front office)	++
cost of cash open and closed withdrawals	++	cost of cash handling time (back office)**	++
total cost of cash*	+	cost of cash reconciliation time (back office)	+
cost of cash handling equipment	–	time cost of travels to a bank and back (back office)	+
cost of armoured car services (Cash-In-Transit)	+		
cost of counterfeited notes and coins	–		
cost of mistakes in giving change	–		
cost of thefts and robberies	–		
cost of insurance against cash thefts and robberies	–		

* used as a control position, ** counting, sorting, packing, counterfeit checking, preparing cash for cash deposits (open or closed), preparing denominations for cash registers, changing cash in other stores when there is lack of particular denominations of notes and coins at cash registers, possibly time of supplying needed denominations to cash registers in other ways, other time costs.
„+" indicates high significance, „–" indicates low significance

Costs of cash open and closed deposits/withdrawals appeared to be the major pecuniary cost for merchants. Cash open deposits/withdrawals differ in such manner from cash closed deposits/withdrawals that cash is not sorted and securely packaged. Cash withdrawals were generally cheaper than cash deposits for merchants due to lower fees resulting from lower internal bank labour costs. In several Polish

banks cash deposits and withdrawals for firms were free of charge. 22% of companies declared that they did not bear any pecuniary costs of cash deposits and withdrawals, because they used the entire cash stock for paying contractors or employees, or kept it. The declared average share of cash deposited in a bank was 53%.

Only 2% of merchants reported bearing the costs of cash handling equipment (the fraction was higher in large companies). 4% of all merchants used external cash transport services (24% in a group of large companies). Costs of armoured car services were quite significant for merchants who incurred them, but this cost item must have been treated as alternative to time cost of travels to a bank and back. Most of firms in Poland (especially small and medium-sized ones) delivered cash to banks on their own. Therefore, a representative business was regarded as bearing this non-pecuniary cost and not the cost of CIT services.

Polish enterprises did not suffer from counterfeit banknotes and coins. 10% of merchants acknowledged mistakes in giving the change but it turned out that on average it didn't bring them neither losses nor profits. 1% of firms informed about theft and robbery incidents but only 0.2% of firms reported losses due to such incidents. In the remaining cases companies managed to avoid financial consequences because they were protected by insurance or in a different way. 16% of all enterprises (46% of large firms) possessed an insurance policy which covered a wide range of events linked to property losses. For that reason cost of insurance against cash theft could not have been deemed important for a representative business and was negligible.

Costs associated with labour time of employees – front and back office non-pecuniary costs – were important, although not internalised by merchants. Cash handling and tender payment time consumed internal resources of companies.

Pecuniary and non-pecuniary cost items of payment cards Table 7

Pecuniary items		Non-pecuniary items	
cost item	**economic significance for a merchant**	**cost item**	**economic significance for a merchant**
cost of renting payment terminals	+	cost of payment tender time (front office)	++
cost of payment authorisations (telecommunication costs)	+	time cost of payment terminal operations*** (back office)	++
merchant service charge, MSC (including inter-change fee)	++	time cost of contacts with an acquirer service and of disputes with clients**** (back office)	+
other costs**	+	cost of time when a terminal is down due to a breakdown	–
total cost of payment cards*	+		
cost of adjustment to Payment Card Industry Data Security Standards (PCI-DSS)	–		
cost of card frauds	–		
cost of disputes and chargebacks	–		
cost of float (opportunity cost)	–		

* used as a control position, ** costs of: payment terminal service, voice and fax authorisations, revoked authorisations, logo on slips, additional software, change of time of sending files for settlement, for resending files for settlement, for sending monthly statements of card transactions, etc., *** preparing, switching on and off, changing terminal paper rolls, reconciliation, verification of errors, etc., **** calls to an acquirer service due to malfunctioning of terminals (e.g. problems with authorisations), resolving disputes of clients revoking payments and willing to execute chargeback.
„+" indicates high significance, „–" indicates low significance

Also in the case of cards, front and back office time costs proved to be economically significant, but with some exceptions. Situations when a payment terminal was down in a reported year were only declared by 16% of companies.

On the other hand, some pecuniary costs of cards were very high. MSCs constituted the dominant expense for merchants. But also costs of renting terminals appeared to be significant. As regards telecommunication costs many Polish merchants (36%) were still using dial-up terminal types in 2011 and 2012, which generated a variable cost whenever a card payment authorisation took place. However, this type of terminal has gradually been replaced by newer ones and at the same time the usage of high-speed Internet in Poland has increased.

Other costs relating for example to charges for additional payment terminal software, change of time in sending files to clearing and settlement of transactions, logotype on slips, monthly statements of card transactions were of moderate economic significance to merchants. Concerning another indirect cost of cards, only 2% of companies asserted they bore costs of adjustment to PCI-DSS security standards (more in a group of large companies).

Only 3% of merchants informed about cash fraud incidents such as for example the willingness to use or even actual usage of fake and stolen cards. 57% of companies did not declare costs of disputes and chargebacks, although some of large merchants reported considerable losses owing to chargeback. Nevertheless chargebacks appeared to be more a problem in remote transactions, hence corresponding costs could have not been attributed to costs of face-to-face card transactions.

According to survey results in 2011 companies in Poland waited on average almost 3 days for money transfer to their current bank account. However, as shown earlier, merchants were not so much perceiving costs of card float as important in their profit and loss account. In a complementary analysis this card cost item could be

used for comparisons with cost of foregone interest on cash holdings. However, it should be remembered that cash in possession of merchants served transactional purposes to pay back debts to business partners and employees. Merchants held voluntarily about half of their stock of cash and did not deposit it to bank accounts. Analysing opportunity costs of cash compared to deposit money, it is worth noticing that many demand deposits are kept on accounts which are non-interest bearing.

All pecuniary and non-pecuniary cost items were evaluated in terms of their nature. For example costs of renting payment terminal were treated as fixed, merchant services charges were variable linked to value of transaction (percentage fee component) and variable linked to number of transaction (flat fee component). Costs of cash deposits and withdrawals were qualified as variable changing with value of transactions. Payment tender time of cash and card was considered to be fully variable depending on the number of transactions. Some cost items relating e.g. to back office costs of cash posed problems with regard to defining their nature – whether they were fixed, variable by number or value and required an arbitrary expert decision benchmarked to merchants' declarations and different cost studies.

6 Cost calculations of cash and card payments

Calculations of cash and card payment costs were conducted for different cases based on the survey results. Part of them is briefly presented below.

Selected cash and card statistics used in cost calculations (2011) Table 8

	All firms	Small firms	Medium firms	Large firms
Average monthly value of cash payments per one point of sale	€ 5 492	€ 4 282	€ 13 216	€ 25 344
Average monthly value of card payments per one point of sale	€ 4 899	€ 3 649	€ 8 437	€ 9 179
Average monthly number of cash payments per one point of sale	798	734	1136	1945
Average monthly number of card payments per one point of sale	242	181	379	382
Average value of one cash payment	€ 6.89	€ 5.83	€ 11.65	€ 13.11
Average value of one card payment	€ 20.24	€ 20.15	€ 22.33	€ 24.03
Number of cash deposits a month	6.73	6.41	9.11	12.23
Number of cash withdrawals a month	4.05	4.03	4.16	4.70
Average number of employees transporting cash to a bank	1.01	1.00	1.26	1.35
Average percentage of cash deposited at a bank	53%	52%	61%	64%
Percentage of firms declaring the use of an external money transport service	4%	3%	10%	24%
Average time of single travel to a bank and back (in minutes)	23.56	23.78	21.37	23.19
Average hourly gross wage rate of a cashier	€ 2.56	€ 2.50	€ 3.00	€ 3.08
Average hourly gross wage rate of a manager	€ 3.96	€ 3.83	€ 4.82	€ 5.14

Source: Survey results, cash N=1003, card N=359.

Different cash and card statistics served as a basis for cost calculations. It can be easily noticed that the results for all companies are mostly similar to those of small companies. This is due to research assumptions including weighting. In 90% of cases a representative business was a small company employing up to 9 people. The bigger the company, the higher the values of different statistics.

The presented statistics influenced the cost calculations. In the case of cash, pecuniary costs must have been low on average, because of a couple of factors. The declared mean share of cash deposited in bank was 53%. 22% of firms said they did not deposit or withdraw money at all. Only 4% of companies declared they paid a CIT company for transporting their cash. Therefore, initial declarations made by firms in the introductory part of the questionnaire reflected the reality well. Subsequent cost calculations taking into account additional data and information from the survey did not diverge much.

Pecuniary costs of cash according to introductory declarations of companies (2011) Table 9

	All firms	Small firms	Medium firms	Large firms
Declared average monthly cost of cash per one point of sale	€ 5.79	€ 4.89	€ 14.68	€ 24.84
Average cost per one cash transaction	€ 0.007	€ 0.007	€ 0.013	€ 0.013
Average cost per one euro of cash sales	0.11%	0.11%	0.11%	0. 10%

The average pecuniary cost of one cash transaction amounted to about 1 eurocent and 0.1% of cash turnover. The cost per number of cash transactions was a bit higher in large than in small companies whereas in cash sales it was a little lower. The reported cost of cash can be entirely associated with fees charged by banks on cash deposits and withdrawals.

Cost calculations of internal and external cash transport (2011) Table 10

		All firms	Small firms	Medium firms	Large firms
Cost of monthly external CIT cash transport per one point of sale		€ 65.40	€ 63.35	€ 80.50	€ 102.76
Cost of monthly internal cash transport per one point of sale		€ 18.93	€ 18.11	€ 29.03	€ 44.25
Cost of external CIT cash transport	per one cash transaction	€ 0.082	€ 0.086	€ 0.071	€ 0.053
	per one euro in cash sales	1.19%	1.48%	0.61%	0.41%
Cost of internal cash transport	per one cash transaction	€ 0.006	€ 0.006	€ 0.006	€ 0.006
	per one euro in cash sales	0.34%	0.42%	0.22%	0.17%

Costs of both internal and external cash transport turned out to be higher than costs of cash deposits and withdrawals. The cost of own money transport appeared to be about 60% lower than that of an external one judging by its share in the value of sales (0.34% versus 1.19%). In large companies the cost per both turnover and number of transactions was relatively lower than in small companies. Calculations were heavily driven by the number of trips with cash to a bank and back. Especially in the case of external cash transport this factor impacted the level of costs. The calculations did not cover all aspects (such as for example the risk factor or the cost of car depreciation) which could have potentially been taken into account and could have increased the competitiveness of external money transport services. However, cost calculations explain very well why (especially small) businesses preferred to transport cash by themselves.

Similarly to cash also pecuniary costs of cards were calculated.

Calculations of pecuniary card costs – the most representative case (2011) Table 11

	All firms	Small firms	Medium firms	Large firms
Average monthly value of card payments per one point of sale (a)	€ 4 899	€ 3 649	€ 8 437	€ 9 179
Average monthly number of card payments per one point of sale (b)	242	181	379	382
Merchant Service Charge – flat fee component (α)	€ 0.05	€ 0.05	€ 0.04	€ 0.02
Merchant Service Charge – percentage fee component (β)	1.82%	1.85%	1.76%	1.70%
Cost of renting payments terminals	€ 16.17	€ 16.42	€ 15.75	€ 18.05
Cost of payment authorisations	€ 7.36	€ 7.39	€ 6.21	€ 5.39
Other card costs	€ 13.85	€ 12.86	€ 18.13	€ 7.55
Cost of Merchant Service Charge*	€ 91.34	€ 69.13	€ 151.34	€ 157.29
Sum of card costs	€ 128.73	€ 105.81	€ 191.43	€ 188.28
Total average card cost per one transaction	€ 0.53	€ 0.58	€ 0.50	€ 0.49
Total average card cost per one euro in card sales	2.63%	2.90%	2.27%	2.05%
Share of MSC in total card costs	71%	65%	79%	84%
MSC after inclusion of a flat fee component	1.86%	1.89%	1.79%	1.71%

* Calculated on the assumption that a flat fee component, regardless of a company size, occurred in 20% of transactions: $0.2\times\alpha\times b+\beta\times a$.

In this case all major pecuniary costs of card payments were included. The average total cost per one transaction amounted to EUR 0.53 which accounted for 2.63% in card sales. Costs fell proportionally to the size of companies. On the other hand,

the share of the MSC for all businesses was 71% but for larger companies it was higher (84% with regard to firms employing more than 50 people).

It is worth bearing in mind, that in this case businesses represent an average for the whole market (in terms of studied PKD sections of merchants actively selling products and services to consumers). Costs may differ depending on the branch of activity or business size. Some items may not be present at all, while others may be more or less pronounced with a different share in total costs for business.

Beside pecuniary costs of cash and cards, there are also non-pecuniary costs – front and back office costs. Front office costs fully ensue from time of purchase transactions at the cash register. Hence a faster payment instrument is more efficient for merchants, because it accelerates sales and generates lower costs. Payment tender time costs are in 100% variable linked to number of transactions. Back office costs stem from numerous activities necessary to facilitate cash and card transactions. They are more diverse in nature than front office costs.

Comparing costs of front office tender time, cash still ranked better than cards. According to empirical chronometric research conducted in Poland in grocery convenience stores on the basis of 3700 transactions (Polasik and Górka et al. 2013), statistically a standard (not proximity) card transaction lasted about 50% longer than cash transaction (29 seconds for cash vs 43 seconds for a card). The European Central Bank studies confirmed this difference in payments tender time, although its adopted average durations of cash and card transactions were shorter – 22 seconds for cash, 29 seconds for debit card and 31 seconds for credit card (Schmiedel et al. 2012: 34). A measurement of payment time made by the British Retail Consortium produced similar results to the Polish research – 32 seconds for cash, 41 seconds for card (BRC 2012: 4).

The below payment tender times are quantified and presented according to the Polish study but later the European Central Bank's estimations are also applied to further cost calculations.

Front office payment tender time costs of cash and card (2011) Table 12

	All firms	Small firms	Medium firms	Large firms
Tender time of one cash payment in seconds	29	29	29	29
Tender time of one card payment in seconds	43	43	43	43
Total time of cash payments a month per one point of sale in hours	64.27	59.14	91.50	156.64
Total time of card payments a month per one point of sale in hours	28.90	21.63	45.29	45.63
Average hourly gross wage rate of a cashier	€ 2.56	€ 2.50	€ 3.00	€ 3.08
Tender time of cash payments per one point of sale a month*	€ 164	€ 148	€ 275	€ 482
Tender time of card payments per one point of sale a month *	€ 74	€ 54	€ 136	€ 141
Average tender time cost per one cash payment	€ 0.21	€ 0.20	€ 0.24	€ 0.25
Average tender time cost per one card payment	€ 0.31	€ 0.30	€ 0.36	€ 0.37
Average tender time cost per euro of cash sales	2.99%	3.44%	2.08%	1.90%
Average tender time cost per euro of card sales	1.51%	1.48%	1.61%	1.53%

* cost computed by multiplying the average hourly gross wage of a cashier by the monthly tender time of cash/card payments.

Selling merchandise requires accepting a method of payment. It is a sine qua non condition of trade. Payments are an inherent component of sales. However, processing of payment transactions generates high labour costs. According to calculations made under the aforementioned assumptions in 2011 in Poland payments in cash lasted as many as 64 hours and cost EUR 164 per one point of sale a month. Payments with cards, mainly because of lower number of transactions, were shorter – 29 hours and cost EUR 74 but their unit costs were higher compared to cash (EUR 0.31 vs EUR 0.21). Unit costs of cash and card payments, increasing with the size of companies, emerge as a consequence of rising average hourly gross wage of cashiers. On the other hand, due to higher values of card transactions average tender time costs per one euro in sales were much lower for cards than for cash (1.15% vs 2.99%).

Comparison of back office handling costs of cash and cards (2011) Table 13

	All firms	Small firms	Medium firms	Large firms
Average monthly cash handling time* together with cash transport time per one point of sale in hours	13.4	12.6	19.5	24.5
Average monthly card handling time per one point of sale in hours**	5.8	5.5	7.3	9.2
Difference between cash and card handling costs a month in hours	7.5	7.1	12.2	15.3
Average cash handling time cost per one cash transaction	€ 0.061	€ 0.061	€ 0.077	€ 0.061
Average card handling time cost per one card transaction	€ 0.072	€ 0.089	€ 0.069	€ 0.089
Average cash handling time cost per euro of cash sales	0.88%	1.05%	0.66%	0.47%
Average card handling time cost per euro of card sales	0.36%	0.44%	0.31%	0.37%

* counting, sorting, packing, counterfeit checking, preparing cash for cash deposits (open or closed), cash reconciliation, preparing denominations for cash registers, changing cash in other stores when there is lack of particular denominations of notes and coins at cash registers, possibly time of supplying needed denominations to cash registers in other ways, other time costs
** preparing, switching on and off, changing terminal paper rolls, other terminal related service activities, reconciliation of payments and verification of errors, calls to an acquirer service due to malfunctioning of terminals (e.g. problems with authorisations), resolving disputes of clients revoking payments and willing to execute chargeback

A comparison of back office costs pertaining to cash and cards revealed higher consumption of resource costs resulting from banknotes and coins handling. The difference applicable to all firms was 7.5 hours in favour of cards, rising with the size of a company. Time of cash handling also included time of internal money transport (all firms – 4.2 hours, small firms – 4.1 hours, medium firms – 4.7 hours, large firms – 6.5 hours). However, owing to a higher number of cash than card transactions after computing costs on a per transaction basis cash came out as cheaper than cards (6 vs 7 eurocents). Owing to higher value of card than cash transactions, the relation was advantageous for cards in terms of turnover (0.36% vs 0.88%).

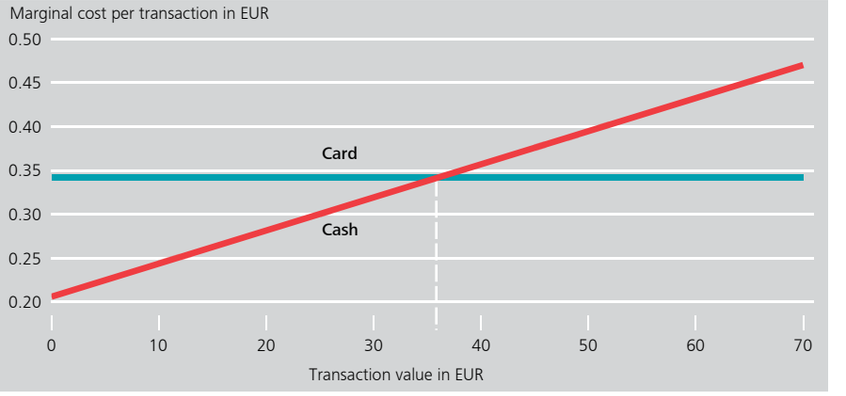
Staff costs were quantified in monetary terms with hourly gross wage rates of salesmen and managers depending on who executed particular activities. An effort was put not to double count the same time.

It should be underlined that in the case of back office activities the compared cost items are different in nature. Back office costs of cash are both fixed and variable, but changing with a transaction value (rather than number). The bigger the value of sales, the more time needed to handle cash. Back office costs of cards are both fixed and variable, but changing with the number of transactions (rather than value). The value of card transaction, unlike the number, does not affect the time of card handling. Due to the role of electronic infrastructure more back office costs of cards are fixed. It was therefore assumed, after benchmarking to opinions of merchants and to other cost studies (Brits and Winder 2005: 43, Bergman et al. 2007: 15-16, Pleijster i Ruis 2011: 20) that 50% of card back office costs was fixed in nature and 50% variable – linked to number of transactions, whereas 30% of cash back office costs was fixed in nature and 70% variable – linked to value of transactions. The cost of cash transport was treated as fixed (later in one of scenarios involving the tourist test application this assumption was relaxed).

Subsequently using the algorithm $\alpha + \beta \times x$ (where α – variable cost per one additional cash/card transaction in euro, β – variable cost per euro of additional cash/card turnover, x – value of cash/card transaction) the marginal non-pecuniary (internal) functions of cash and card from the merchant's perspective could have been set in order to define threshold values.

Non-pecuniary (internal) marginal functions of merchants' cash and card costs – case I Figure 11

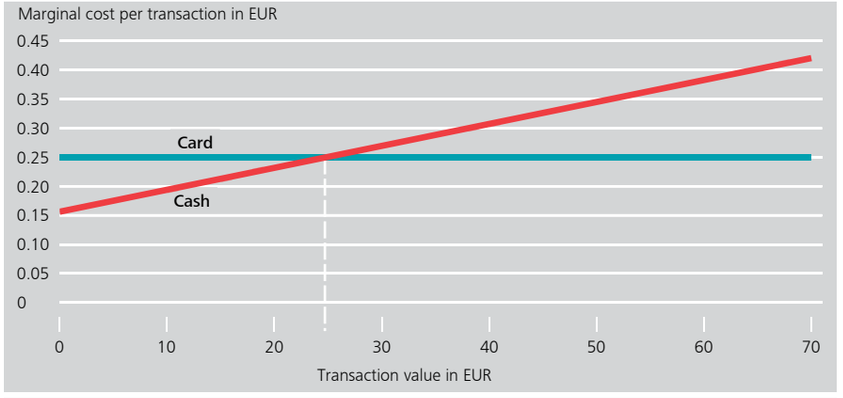
in 2011



Note: Duration of cash payment 29 s., duration of card payment 43 s. (Polish estimations).

Non-pecuniary (internal) marginal functions of merchants' cash and card costs – case II Figure 12

in 2011



Note: Duration of cash payment 22 s., duration of card payment 30 s. (ECB estimations).

The two cases presented above differ between each other only in terms of one input variable – average duration of cash/card payment transaction.

In the first case EUR 36 is a threshold transaction amount at which cash becomes more expensive than card concerning marginal (variable) internal costs of merchants. In the second case the break-even amount is lower (EUR 25). Irrespective of the amount, the marginal cost of card was the same (34 eurocents in the first case, 25 eurocents in the second case). On the other hand, marginal cost of cash increased, because of the positive β parameter of the function (variable costs linked to value of transaction).

Front office costs accounted for a significant share of non-pecuniary costs of merchants. In the first case estimations of tender time costs were based on data from grocery stores (Polish digital chronographic measurements). Extrapolating results

to all branches of economic activity justified adopting the European Central Bank's estimations, which were also used in the tourist test application.

Non-pecuniary internal merchants' costs constitute a fraction of social costs. Pursuant to the above calculations of card costs one could argue that in order to keep convergence between social and external private costs the charged fees, including the merchant service charge, should be set as flat rather than percentage rates. This would be beneficial for retailers as regards transactions of higher value, and quite on the contrary as regards transactions of lower value.

Before the application of the merchant indifference test one can draw brief conclusions regarding levels of cash and card costs in Poland.

After computing pecuniary costs of cash in several scenarios, it turned out that:

- on average cost of cash deposits and withdrawals varied between EUR 0.007 and 0.015 per one cash transaction with an average value of EUR 6.89 (0.1% to 0.21% of cash sales' value – with the lower limit being most representative for merchant population in Poland),
- costs of own money transport were cheaper than the use of an external service provider.
- After computing pecuniary costs of cards in several scenarios, it turned out that:
- the average share of the MSC in all pecuniary costs of a merchant accounted for about 71% and an average blended MSC percentage level was about 1.82% of the payment transaction value,
- average total costs per card transaction with the value of EUR 20.24 ranged between 0.43 and EUR 0.53, corresponding to 2.15% – 2.63% of the card transaction value (with the upper limit being most representative for merchant population in Poland).

With respect to costs of front office tender time, cash still ranked better than cards.

In the case of back office costs of cash and cards, more labour time was used for handling cash than for handling card transactions. However, due to the high number of transactions cash was subject to stronger economies of scale.

Summary of merchants' costs of cash and cards in 2011 Table 14

		cash	card
	Average transaction value	€ 6.89	€ 20.24
a	Average total non-pecuniary (internal) cost per transaction	€ 0.22	€ 0.29
b	Average total non-pecuniary (internal) cost per euro of turnover	3.16%	1.41%
c	Average total pecuniary (external) cost per transaction	€ 0.01	€ 0.53
d	Average total pecuniary (external) cost per euro of turnover	0.10%	2.63%
a+c	Average total cost per transaction	€ 0.22	€ 0.82
b+d	Average total cost per euro of turnover	3.26%	4.04%
	Share of non-pecuniary (internal, social) cost in total merchant's cost	96.94%	34.92%

Merchant survey revealed that in 2011 the average transaction value of card transaction at physical points of sale was almost 3 times higher than the average value of cash transaction (EUR 20 vs 7). Therefore, even though the average total non-pecuniary (internal) cost per transaction for cash was lower than for cards, in percent of turnover the opposite was true – card was cheaper. However, because of high discrepancy in pecuniary (external) costs of cash vs cards, the average total (pecuniary + non-pecuniary) costs turned out to be lower for cash – when measured on a transaction basis and when measured in percent of turnover. Finally, the difference of the share of internal costs to total costs is remarkable: 95% for cash and 35% for cards. This finding can be explained by the fact that fees paid by merchants for card payments were much higher and dominated the costs of cards.

7 The concept of merchant indifference test

The merchant indifference test (MIT), also referred to as the tourist test or avoided-cost test, explores the question whether a merchant would refuse a card payment, if he were certain that a non-repeat customer who is about to pay at the cash register had enough cash in his pocket. The test is passed if accepting a card does not increase the merchant's operating costs, i.e. if its impact on the merchant's profit and loss account is neutral and renders a merchant indifferent to card or cash payments (Rochet and Tirole 2007: 2). In analytical terms MIT can be expressed by means of the following formula (Leinonen 2011: 22):

$$B^m - C^m - MIF^{m0b} = 0 \quad (7.1)$$

where:

B – benefit,

C – cost,

^{m} (superscript) – means merchant,

MIF^{m0b} – MIF resulting in a merchant zero-level benefit

According to Rochet and Tirole (2007, 2011) card payment costs for the seller (a total of C^m and MIF^{m0b}) should not exceed the costs of an alternative payment method (e.g. cash which is the closest substitute and a competitive payment instrument to cards in face-to-face transactions). Merchant's benefit from accepting cards is derived from not bearing costs incurred with regard to an alternative payment instrument. Merchant indifference test thus leads to the estimation of a cost tier at which card and cash costs (or possibly costs of alternative payment methods) level out.

The term "tourist test" and its explanation refer to a research approach. There is in fact no research experiment, nor is there a tourist, a non-repeat customer to be taken into account. The tourist test is aimed at eliminating the negative effects of "business stealing" – in other words "must-take cards", i.e. a phenomenon where

merchants face a prisoner's dilemma. Once they start accepting cards, they are reluctant to stop doing so, even if corresponding fees are high or increasing, because this would deteriorate their position vis-à-vis their competition. Merchants would be freed of the limitations posed by the prisoner's dilemma, if there came a tourist who is a non-repeat customer with sufficient amount of cash in his pocket. Most often in economic practice it is not tourists, but regular customers who shop at the point of sale. Therefore to define the optimum interchange fee level based on the MIT methodology, merchants' operating costs of cash and cards are compared. The benefit of using a card is understood as avoiding the cost of cash. However, costs cover benefits, e.g. speed of card transactions vs. cash transactions. The faster instrument is considered better. In the Polish study cash costs were lower than card costs due to shorter payment time. Other benefits were also captured, e.g. less time engaged in handling card vs. cash, which is the benefit of a card resulting from lower back office costs compared to cash. Possible benefits attributed to 9 pecuniary and 4 non-pecuniary cash and card items were considered. Some appeared to be negligible, therefore there were no grounds to include them in the MIT compliant final calculations based on the representative merchant. This remark applies, among others, to the benefit of payment methods security, measured as cash and cards frauds rate which retailers reported to be low (as confirmed by other data valid for the whole population of businesses in Poland).

There is a range of difficulties associated with the use of a tourist test on the basis of empirical data, one of them being the approach to fixed and variable costs. Total costs of a payment instrument for a merchant include fixed and variable components.

$$TC_n = F_n + \alpha N_n + \beta V_n \tag{7.2}$$

where:

TC_n – total cost of a given payment instrument n (e.g. cash/card),
F_n – fixed cost of a payment instrument n,
α – variable cost per one additional transaction with n,
N_n – number of transactions with n,
β – variable cost per unit of additional sales with n,
V_n – value of transactions with n

Calculations that are conformant with the tourist test should focus on the comparison of variable (and marginal) costs of card and cash payments. Treating fixed costs as irrelevant to the MIT calculations is directly related to the test structure itself. Merchants incur fixed costs (both those applicable to cards, as well as to cash) regardless of whether consumer chooses to pay in cash or with card. They cannot opt to avoid fixed costs of cash which is a legal tender. If they already accept payment cards they cannot evade the associated fixed costs such as e.g. monthly fixed fees for terminal renting.

Therefore, their willingness to accept a card or cash payment is correlated with the level of variable costs.

In practice the division between fixed and variable costs (linked to the number and value of transactions) is ambiguous. It is difficult to calculate non-pecuniary costs of cash and payment cards (which are of time nature and associated with work of employees). However, quantifying those costs with a single wage rate means that cards are treated at par with cash. It may be debated whether internal costs should be handled in the same way as external ones (i.e. charges paid to other entities), since the internalisation level of both cost categories is different, but it seems to be the right assumption as regards MIT. Nevertheless, when calculating the cost of payment instruments one needs to remember about the difficulty posed by lacking

cost transparency, the assumptions made, methods of quantifying non-pecuniary cost items, etc. Macro calculations of payment method costs are always an attempt at estimating the true cost values which are not uniform across all retailers but are made for an average representative retailer.

In order to compute MIT compliant MIF it is necessary to deduct the variable costs of cards from variable costs of cash. It is assumed that variable costs change in a linear fashion hence average variable costs are equal to marginal costs.

$$\text{MIT MIF} = VC_{cash} - VC_{card} = MC_{cash} - MC_{card} \quad (7.3)$$

By rewriting the formula we get:

$$\text{MIT MIF}_{two\text{-}part} = \alpha_{cash} - \alpha_{card} + (\beta_{cash} - \beta_{card})x \quad (7.4)$$

where:

α_{cash} and α_{card} – average variable cost per one additional cash/card transaction,

β_{cash} and β_{card} – average variable cost per one additional euro of cash/card sales,

x – value of transaction

MIT compliant calculations take account of the internal (non-pecuniary) private merchant costs, as well as external (pecuniary) private merchant costs. MIT MIF has a two-part form consisting of an α parameter linked to number of transactions and β parameter linked to value of transactions.

Since the MIT MIF is to be the outcome of calculations, interchange fees must not be treated as an input parameter. An acquiring margin can be the only β card pecuniary cost item (comprising an acquirer's own mark-up and scheme fees paid by acquirers to payment organisations). No other internal (non-pecuniary) costs of

cards are variable by value. Front and back office labour costs of cards are entirely variable by number of transactions or fixed. On the other hand, costs of cash can be either variable linked to number of transactions or to value of transactions. Withdrawal/deposit fees are variable by value, front office tender time costs – variable by number and back office internal (non-pecuniary) costs – fixed, variable by both number and value of transactions depending on the assumptions.

MIT MIF as a two-part function can be computed for every transaction value. However, there are specific transaction amounts which deserve special attention, namely the average transaction value of a cash and card payment and possibly a mean of these two ATVs. Other studies focused on (debit and credit) card ATVs (Jonker and Plooij 2013, EC 2014), however considering the decreasing trend in card ATV and the substitution between cash and cards it is justified to also take a closer look at cash ATV and other transaction amounts.

In 2012 the European Commission decided to make a study on merchants' costs of cash and card payments to better analyse the level of adequate MIFs in the context of competition cases against card associations. In the case against MasterCard (2007) cross-border MIFs were considered to restrict competition and were banned by the European Commission's decision. MasterCard failed to prove their positive effect on the payments market. The General Court upheld the Commission's decision on 24 May 2012. However, the European Commission did not rule out that under some conditions MIFs could create efficiencies.

Capping interchange fees on the tourist test compliant level may promote cost efficient payment instruments, because merchants will not incur excessive costs feeling forced to accept expensive card payments (a must-take cards situation). Retailers embed interchange fees (and MSCs) in the prices of their merchandise, thus burdening all consumers, regardless of their chosen payment method. Consequently, customers who pay cash cross-subsidise those who pay with cards (Börestam and

Schmiedel 2011: 25, 34). On the other hand, customers paying with cards which have lower internal interchange fees cross-subsidise those who pay with more expensive, prestigious credit cards, often tied with a rebate program (debit card payments are seldom rewarded). Capping the interchange fee should broaden the payment card acceptance network, which would be a large benefit to consumers. Consequently, consumer benefits pertaining to rebate loyalty programmes could be reduced, as banks would be able to decrease their attractiveness or even cancel them. Any such disadvantages, however, should be outweighed by the benefits offered by a more widespread card acceptance (Börestam i Schmiedel 2011: 34).

It is pointed out that interchange fees may be a tool for exercising market pressure by banks and card associations, artificially increasing payment card costs, which in turn causes anti-trust authorities to step in (Verdier 2009). The said phenomenon is all the more detrimental to the market, if an increase in interchange fees is not followed by an increased safety of payment card schemes and greater innovation. Another issue often raised in the literature and discussions on interchange fees is competition between retailers. If a seller decides to accept cards to increase the attractiveness of his outlet for customers, he will not consider ceasing it at a later time when faced with continuously raised MSCs, as he will be afraid to lose customers to competition (a must-take cards situation, Vickers 2005, Rochet and Tirole 2007, 2011). The interchange fee, set outside market competition mechanisms and not communicated to payers – consumers, may therefore seriously deform both the payment market, as well as the price signals that determine consumers' choice of a more cost-efficient form of payment.

Consumers are not aware of card costs to merchants because usually they are not steered to cost efficient payment instruments by rebates and surcharges. Therefore, the MIF tier compatible with the tourist test generates benefits to merchants and consumers who can internalise cost savings of merchants through lower retail prices. In the competitive market retailers are expected to pass the benefits of reduced interchange fees through lower MSCs on to consumers. Thus MIFs that are above MIT compliant levels appear not to create efficiencies that would offset possible anti-competitive effects, since it is doubtful that a fair share of excessive MIFs is passed through to the demand side of the payments market (EC decision against Visa 2010: 15-16).

Calculations compliant with the merchant indifference methodology, as the name itself suggests, comprise exclusively the cost items of merchants, but no other payment stakeholders, e.g. commercial banks and card associations. They are not calculations based on social costs of all entities in the payment chain (see "Glossary of cost definitions"). The application of MIT takes account of the internal (non-pecuniary) merchant costs, as well as some external (pecuniary) merchant costs. It is desirable to deduct items of variable nature (depending on the number and value of transactions). In the following point tourist test was applied under the Polish conditions, taking into account merchant discount rate in the ad valorem formula as external (pecuniary) merchant cost, less average market interchange fee in Poland. The MIT MIF is the main outcome variable, the level of which (optimal under the Polish conditions) is deduced. An optimal level is one that equalises the corresponding card and cash costs of a given transaction value on the merchant side and at the same time uses the mechanism of internalisation of merchant cost savings by the consumer (by means of merchandise prices and cardholder charges), benefitting the latter. A MIT-compliant interchange fee should also boost the development of payment card acceptance network.

8 The application of merchant indifference test

A prerequisite to apply the tourist test was to define marginal private merchants' costs of cash and card payments. Survey data served as a basis for calculations. The share of the interchange fee in the merchant service charge was approx. 85% in 2010 according to studies of the National Bank of Poland (Maciejewski 2012: 66). This value was also used for 2011, because with all likelihood it must have been

comparable, since the structure of interchange fees and other market conditions had hardly changed. The acquiring margin along with other scheme fees which acquirers paid to payment organisations was estimated to be at the level of 0.0027 (0.0182 x 85%) or 0.27% by taking the average blended MSC rate (1.82%) declared by companies in the survey. No other pecuniary costs of cards were included. A variable cash withdrawal/deposit cost of 0.2% was adopted (market rate), which is twice as much as the average according to retailers' responses in the survey.

Three scenarios of MIT application were considered, in which the dividing line between fixed and variable back office costs was set differently.

In the first basic scenario (scenario 1), after benchmarking to merchants' opinions and to foreign cost studies it was assumed that 50% of back office card cost was fixed in nature and 50% variable – linked to number of transactions, whereas 30% of back office cash cost was fixed in nature and 70% variable – linked to value of transactions. 100% of front office costs (time of cash and card payments) were treated as variable by number of transactions.

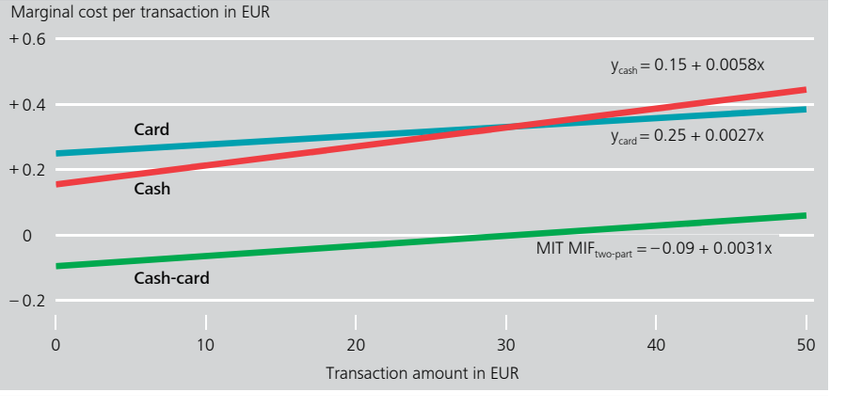
Thus we arrive at marginal cost functions of cards and cash for merchants.

$$y_{card} = 0.25 + 0.0027x,$$
$$y_{cash} = 0.15 + 0.0058x$$

After asking a normative question when applying the tourist test: "what is the level of (multilateral) interchange fee at which card and cash costs will be equal", the two-part MIT MIF function (the first component dependent on the number of transactions, the second one dependent on the value of transactions) was defined:

$$\text{MIT MIF}_{\text{two-part}} = -0.09 + 0.0031x$$

Functions of merchants' marginal cash and card costs and the two-part MIT MIF function (scenario 1) Figure 13



Note: Values were rounded.

FThe point of intersection between ycash and ycard fell on value x equal to around EUR 30. This means that for each amount below EUR 30 the MIT compliant interchange fee would be negative, while for each amount above EUR 30 the interchange fee would be positive (see the function MIT $MIF_{two\text{-}part} = -0.09 + 0.0031x$).

By taking specific average transaction values as arguments of the MIT MIFtwo-part function we get:

1. ATV card (20.24 EUR) => MIT $MIF_{two\text{-}part} = -0.16\%$
2. ATV cash (6.89 EUR) => MIT $MIF_{two\text{-}part} = -1.07\%$
3. Mean of cash and card ATVs (13.57 EUR) => MIT $MIF_{two\text{-}part} = -0.39\%$

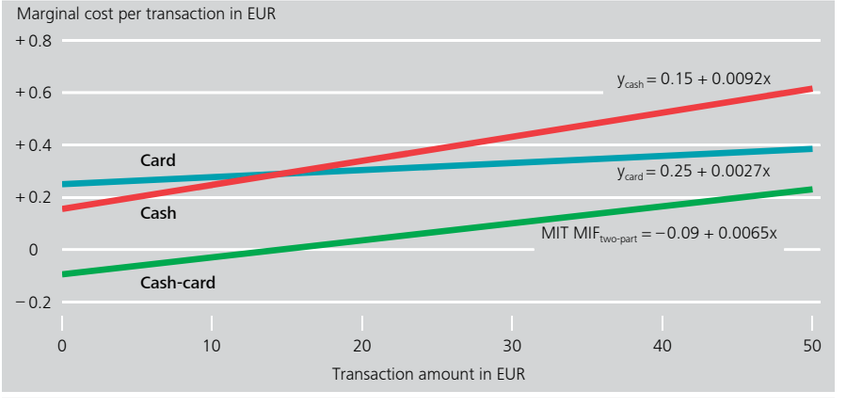
With lower transaction values the MIT conformant interchange fee level would be more negative. The higher the transaction value and the closer to EUR 30, at which

marginal function costs of cash and cards estimated for the purpose of MIT application become equal, the less negative the interchange fee level. Consequently, in line with MIT, the use of the interchange fee would only be justified at levels above EUR 30. With each average payment amount (card, cash, the mean of the two) it is only a negative interchange fee that would make the merchant economically indifferent to the payment instrument chosen by the consumer (cash or card).

In the second scenario (scenario 2) 100% of internal costs of cash transport, which were recognised as fixed earlier on, were included in the (value dependent) variable cost of cash (β parameter).

Functions of merchants' marginal cash and card costs and the two-part MIT MIF function (scenario 2)

Figure 14



Note: Values were rounded.

Positive interchange levels would be justified only when MIT MIF would exceed around EUR 14.

In scenario 2 solving the MIT $MIF_{two\text{-}part}$ function with characteristic values produces following results:

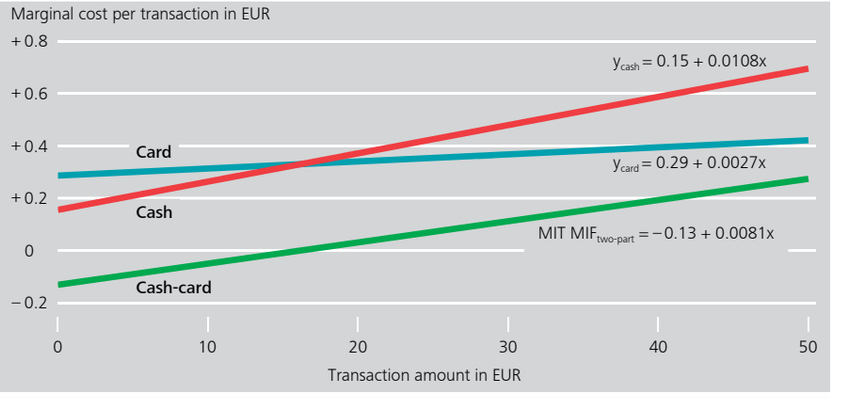
1. ATV card (20.24 EUR) => MIT $MIF_{two\text{-}part} = 0.18\%$
2. ATV cash (6.89 EUR) => MIT $MIF_{two\text{-}part} = -0.73\%$
3. Mean of cash and card ATVs (13.57 EUR) => MIT $MIF_{two\text{-}part} = -0.05\%$

With average transaction value for cards the interchange fee of 0.18% would level out the merchants' costs of card and cash payments.

In the third scenario (scenario 3) not only 100% of cash transport costs were included in MIT calculations, but also 100% of back office cash and card handling costs (100% back office costs of cards – variable depending on the number of transactions, 100% back office costs of cash – variable depending on the value of transactions).

Functions of merchants' marginal cash and card costs and the two-part MIT MIF function (scenario 3)

Figure 15



Note: Values were rounded.

In scenario 3 break even between card and cash functions amounts to EUR 16. Compared to previous scenarios the α parameter as well as the β parameter responsible for the slope of the MIT MIFtwo part function undergo changes, which impacts the calculations.

If we compute outputs of the MIT $MIF_{two\ part}$ function for different ATVs, we get:

1. ATV card (20.24 EUR) => MIT $MIF_{two\text{-}part} = 0.16\%$
2. ATV cash (6.89 EUR) => MIT $MIF_{two\text{-}part} = -1.09\%$
3. Mean of cash and card ATVs (13.57 EUR) => MIT $MIF_{two\text{-}part} = -0.16\%$

Summary of MIT application results (Polish study 2012) Table 15

	Scenario 1	Scenario 2	Scenario 3
Cost functions ($\alpha + \beta \times x$) cost of one additional trx with value of x	$y_{cash} = 0.15 + 0.0058x$ $y_{card} = 0.25 + 0.0027x$ MIT $MIF_{two\text{-}part}$ = $= -0.09 + 0.0031x$	$y_{cash} = 0.15 + 0.0092x$ $y_{card} = 0.25 + 0.0027x$ MIT $MIF_{two\text{-}part}$ = $= -0.09 + 0.0065x$	$y_{cash} = 0.15 + 0.0108x$ $y_{card} = 0.29 + 0.0027x$ MIT $MIF_{two\text{-}part}$ = $= -0.13 + 0.0081x$
Transaction amount where cash costs equal card costs	€ 30	€ 14	€ 16
MIT MIF for ATV card	–0.16%	0.18%	0.16%
MIT MIF for ATV cash	–1.07%	–0.73%	–1.09%
MIT MIF for mean of card and cash ATVs	–0.39%	–0.05%	–0.16%

Note: y – marginal cost, x – transaction amount. Values were rounded.

The outcomes of MIT applied on the basis of the cost data from the Polish merchants' survey in three scenarios proved that interchange levels rendering businesses indifferent to the choice of payment instrument by consumers in any case do not exceed 0.2% even with regard to the average card transaction size.

The test result is an estimate and should be treated as indicative. Calculations are sensitive to α and β changes, as well as to the average card and cash transaction value. α and β were estimated taking into account market conditions in Poland, where cash generated greater effects of scale due to a much higher number and value of payments. Increasing the number and value of card payments, while at the same decreasing the number and value of cash payments would improve (reduce) α of the marginal cost function of cards, and deteriorate (increase) β for cash. Moreover, cash generated benefits pertaining to shorter transaction time, which had quite a significant impact on MIT compliant calculations (and before that on the calculations according to internal non-pecuniary costs borne by merchants). Another cost element which determined relatively low cash costs from merchant's perspective was the level of variable pecuniary costs of cash, i.e. the commission charged by banks with respect to cash deposits and withdrawals. However, this cost item was assumed twice as high as the level declared by merchants in the survey in order to offset high acquiring margin of cards (pecuniary/external cost item linked to the value of transactions) based on estimations of the National Bank of Poland, thus making the calculations more robust to likely reductions of the mark-up owing to the increasing competition between acquirers.

As the cost survey revealed and additional cost calculations confirmed, merchants turned out to be the main group that shouldered the direct burden of financing card turnover in Poland, including payment of an economic rent to banks and card associations, which seemed unjustified under the MIT, also through lack of a credible proof from the perspective of supply-side costs attributable to card turnover.

Cash turnover is subject to powerful effects of scale in Poland, which makes it cheap in terms of unit costs borne by merchants. The situation is different in countries where card turnover is more developed (greater number and value of card transactions, different average card and cash transaction values). In those countries the application of MIT will produce different threshold values that level out the costs of cash and payment cards (see MIT application results of Jonker and Plooij 2013 or Layne-Farrar 2013). The analysis, however, leads to a universal conclusion that there is a need for more transparent business models and new payment systems which will be able to demonstrate to merchants and consumers their cost advantage over the existing systems, and which will exercise a natural pressure to change the functioning principles of the present systems and the size of hidden internal charges.

Modifying MIT with potential benefits provided by card payments to retailers, one could make an attempt at a microeconomic approach which in a way does better in reflecting the competitive edge of retailers who accept cards as opposed to those who don't. The convenience offered by cards may (but doesn't have to) induce consumers to more spending, thus providing for higher sales in the group of merchants who accept cards. The game, however, seems to be a zero-sum game on the level of the whole economy, unless card payments result in the reduction of the savings rate, which perhaps would not be desirable in Poland. Furthermore, the analysis could include a credit variable which is mainly tied with a credit card payment, although it also characterises cash e.g. by means of consumer credits in cash or debit card by means of overdraft. The multiplier effect of debt financing can stimulate economic growth, boosting consumer spending. Debt financing has both its positive and negative sides. The transformation of the Polish society according to the US model (where an average American citizen has five credit cards in their wallet) would not necessary produce positive results. For several years now Polish banks have been involved in the process of cleaning their credit card portfolios, among others due to the poor quality of credit card debt characterised by low

repayment rate. The problem of bad debts kept growing, causing severe losses in the banking sector.

Results of the MIT application in the Polish study conducted in 2012 and relating to data from years 2011-2012 are convergent with preliminary results of the European Commission's study which was made public in February 2014 but relied on data collected in years 2012-2013.

The European Commission (Directorate General for Competition) considered two scenarios for indentifying cost levels and cost nature. Scenario 1 reflected the MIT MIF level referring to a cost change triggered by one additional transaction based on exact data from a large merchants' survey, whereas scenario 2 assumed a 10% decrease in the number of cash transactions over 3-4 years, replaced by card transactions.

Summary of MIT application results (European Commission's study 2014) Table 16

	Scenario 1		Scenario 2		Acquiring margin	ATV
Calculation for **debit cards**	α *	β *	α *	β *	(%)	Card (EUR)
	(EUR)	(%)	(EUR)	(%)		
Cash	€ 0.08	0.13%	€ 0.09	0.20%	0.06%	€ 42
Debit card	€ 0.09	0.01%	€ 0.1	0.01%		
MIT MIF for ATV debit card	**0.02%**		**0.11%**			
Calculation for **credit cards**	α *	β *	α *	β *	(%)	Card (EUR)
	(EUR)	(%)	(EUR)	(%)		
Cash	€ 0.08	0.17%	€ 0.08	0.24%	0.06%	€ 51
Credit card	€ 0.09	0.01%	€ 0.1	0.01%		
MIT MIF for ATV credit card	**0.07%**		**0.15%**			

* without acquiring margin
Source: European Commission (DG Competition), Survey on Merchants' Costs of Processing Cash and Card Payments, Preliminary Results, Brussels, 19 February 2014.

MIT MIF levels computed by the European Commission for average debit and credit transaction values appeared to be very low, even close to zero, which corresponded well with the outcomes of the MIT application to the Polish data. Both studies were similar in many aspects, e.g. targeted types of transactions (only face-to-face payments), cost items covered, method of MIT application. However, they also contained some differences. The scope of the Polish study was restricted to merchant population in Poland, while the scope of the EC's study – to 10 European member states. The Polish study covered more sectors of the economic activity – not only retail trade, hotels and restaurants but also such locations as theatres, cinemas, fitness clubs, medical clinics, public transport, taxis, different services (hairdressers, florists, designers, etc.), bookshops, fitness clubs (altogether 7 sections of

the European Classification of Economic Activities). A representative merchant in the Polish study was rather a small business (see the criteria used for the sample weighting in section 3 "Survey methodology") while in the study of the EC it was a large one (with annual turnover above EUR 20 m). The sample selection influenced average transaction sizes which in the EC's study surpassed those from the Polish one.

The MIT MIF computed in both studies fit in well with the Proposal for a Regulation of the European Parliament and of the Council on interchange fees for card based payment transactions issued in July 2013 introducing caps of max. 0.2% for debit cards and maximum 0.3% for credit cards per transaction (with a possible additional cap suggested by the EP of 7 eurocents per transaction with a debit card for transactions above EUR 35). Besides, the results of MIT application are quite in line with commitments of Visa (2010 and 2014) and MasterCard (2009). Based on the outcomes of MIT MIF calculations one could even argue that limits in the international card associations' undertakings and in the IF Regulation are set too high.

The regulatory pressure in the EU countries (Italy, Hungary, Romania, Spain, United Kingdom) on interchange fees has lately been intensified starting with the Polish Law of 30 August 2013 on Payment Services introducing a uniform cap of 0.5% of the payment value for all cards – both business and consumer cards, which effectively came into force on 1 July 2014. The Law was unanimously passed by the Polish Parliament ending discussions and quasi self-regulatory attempts to decrease the level of interchange fees in Poland, which for many years ranked among the highest in Europe. The Law will be binding in Poland until the Pan-European IF Regulation starts to apply to all four-party card-based transactions.

Interchange fee dynamics – changes of average MIF tiers in card-based payment transactions in Poland (2011-2014) Table 17

Card types and payment categories	2011 and 2012 (before reductions)*	1 November 2012	1 January 2013	1 March 2013	1 July 2014
Visa Debit	1.60%	public admin. 0.2 PLN	1.25%		max. 0.5%
Visa Credit	1.45%	public admin. 0.3 PLN	1.30%		max. 0.5%
Visa Business	1.60%		1.60%		max. 0.5%
Visa Micropayments	1.60%		0.90-1.00%		max. 0.5%
MasterCard Debit	1.64%		~1.11-1.32%	public admin. 0.18 PLN	max. 0.5%
MasterCard Credit	~1.5%		~1.32%	public admin. 0.25 PLN	max. 0.5%
MasterCard Business	1.70%	1.90%			max. 0.5%
MasterCard Micropayments	~0.80%				max. 0.5%

* Weighted average MIF of all card types and payments categories in 2011 and 2012: ~ 1.55-1.60%.
Source: own estimates based on market data

After a failure of the compromise worked out in 2012 by the Interchange Fee Task Force operating under the auspices of the National Bank of Poland issuing banks and payment organisations in fear of regulatory interchange fee reductions decided to lower MIF tiers from 1 January 2013, but those cuts were not regarded sufficient and did not stop the legislative procedure.

The results of the Polish cost study and the MIT application, like that of the European Commission, did not serve as the official basis for setting an IF cap but were quoted as a benchmark by the Polish Ministry of Finance and other institutions. They were made public more than half a year before the decision of the Polish

Parliament and more than a year before the publication of preliminary results of the EC's survey. The Polish study was quoted as the first comprehensive analysis of merchants' cash and card costs in Poland, based on theory and empirical research. It was also the first attempt to assess the optimal level of interchange fees in Poland in a scientific way. Therefore, the results of the cost study served as an important argument in discussions about the justified level of IFs and additional precautions that should be taken in order to increase market transparency and foster competition. The ongoing discussions about interchange fees cover not only the optimal MIF level but also other issues such as: co-badging, cross-border acquiring, blending, honour-all-cards rule, no-surcharge rule and access of non-bank payment institutions to payment accounts and payment systems, which are equally essential for the healthy development of the balanced payments market.

9 Conclusions

The cost survey confirmed a high disproportion between pecuniary costs of cash and cards for merchants. External costs of cards, driven by high merchant service charges including excessive interchange fees, appeared to be the major factor slowing down the expansion of terminal network in Poland and the development of non-cash circulation.

Based on the outcomes of merchants' cost calculations and the tourist test application a conclusion can be drawn that tiers of interchange fees in Poland should be low – up to 0.2% of transaction value and even brought down to zero depending on the transaction value in question. The survey results and subsequent cost calculations clearly show that merchants in Poland are not economically indifferent to the interchange fee level prevailing on the market. Moreover, it was evident from the survey that the level of internalisation of pecuniary and non-pecuniary costs is different. Front office and back office labour costs were not treated in the same way as fees by merchants. Fees paid (pecuniary external costs) were considered more important.

The Polish study was conducted and published more than one year prior to the publication of preliminary results of the European Commission's study on merchants' costs of processing cash and card payments. The studies share many common features but also differ in various aspects. Nevertheless it is notable that the results concerning the tourist test compliant level of interchange fees are fairly similar. The application of the MIT in Poland on the basis of primary data from the merchants' survey was probably the first such attempt in the economic literature.

The results of the MIT application are sensitive to changes of parameters (α and β), as well as to changes of the average card and cash transaction values. Cost calculations of cash and cards relied on data from the survey of Polish merchants. In addition, various assumptions had to be made. Therefore, the results need to be interpreted as indicative and illustrative but not as definite numbers. Costs were computed in different scenarios. Some cost items (e.g. cost of cash and card fraud) turned out to be negligible in Poland, but it must be remembered that in cases of particular companies those cost items may play a bigger role. In Poland, cash generated far greater economies of scale than cards – due to much higher number and value of transactions.

The MIT is a purely demand-oriented approach and does not focus on the supply side. In its unmodified form it involves cost calculation, whereby benefit is understood as avoiding alternative costs of payment with another instrument. Nevertheless, some benefits are also embedded in costs (e.g. payment duration, back office operations, an instrument that is faster or requires less handling time offers bigger benefits, which were quantified in pecuniary terms).

Acceptance of various payment instruments (multi-homing) increases customer satisfaction, as consumers are free to choose their preferred payment method at a given point of sale. It benefits merchants, provided that it does not involve excessive costs.

In the case of payment instruments market, which is a two-sided network market, the application of a skewed pricing strategy does bring the expected results, provided it is not detached from the limits of merchants' price elasticity. The main benefit to card-paying consumers is the possibility of using the card in the broadest possible network of retail outlets. Rebate programs tied with cards and moneyback service are important to consumers, but they need to be interpreted as an extra benefit added to the card's payment function which is the main benefit. Moneyback and rebate programs raise controversies, as they are subsidised by users of cheaper payment instruments.

Price elasticity of retailers in Poland with regard to the size of MSC indicated that a highly dynamic development of payment card acceptance network would only happen with low interchange fee below 0.25% (ceteris paribus). Network development would have also been notably faster than it was at that time with higher interchange fees, but probably it wouldn't have been just as dynamic as with rates falling below 0.25%. On the other hand, merchants who accepted card payments already in 2012 largely seemed to approve of the interchange fee ranging from ca. 0.5% to 0.75% of the transaction value. This level would be satisfactory to 76%–82% of the population of businesses which were selling goods and services in Poland in the retail segment and accepted card payments at the time of the survey (which is when, however, the interchange fees were the highest in the European Union).

A matter for further research is the pass-through pace of interchange fee regulatory decreases in Poland. Their positive effects can only materialise when acquirers lower MSCs thus incentivising new merchants to install payment terminals and reduce cost burdens for those merchants who already accept payment cards. The more frictions on the Polish market and the bigger the inclination of acquirers to keep profits from higher mark-ups in the short term, the later it is to be expected that the card acceptance network will experience a dynamic expansion and consumers will benefit from passing on lower interchange fees to retail prices by merchants.

Drawing on the theory of two-sided markets always leads to the deformation of price signals and internal subsidy mechanisms. It inevitably gives rise to the risk of elevated internal fees which are not subject to the market supply and demand game (both banks and card associations are in favour of high interchange fees). Only transparent transaction fees that embrace cost-based pricing can fully eliminate the negative anti-competition effects. High entry barriers on the payments market and highly profitable business models of four-party card schemes, with lacking cost transparency on the payer (consumer) side hamper competition and innovation, especially when such practices as blending, honour-all-cards rule and no-surcharge rule are in place. Cashless payments can potentially be cheaper than cash. However, it requires much lower margins and less costs.

Glossary

total cost – a sum of fixed and variable costs

fixed cost – cost that does not vary over specific time

variable cost – cost that varies over specific time, e.g. variable cost by transaction value, variable cost by number of transactions

unit cost – cost per single payment transaction, cost per one euro turnover (it is possible to calculate total unit cost, variable unit cost, fixed unit cost)

marginal cost – additional cost that arises due to change in the number of transactions by a unit or change in the value of transactions by one euro

marginal cost calculated as $\alpha + \beta \times x$ (where α = variable cost per one additional cash/card transaction in euro, β = variable cost per one euro of additional cash/card turnover, s = (average) value of a cash/card transaction) – additional cost which arises at the moment of transaction with the value of x euro

pecuniary cost – cost that arises due to payments to third parties in the payment chain, or cost related to a material loss (e.g. theft, fraud), alternative cost (e.g. forgone interest) or depreciation cost; pecuniary cost can be of cash or accrual nature

non-pecuniary cost – time cost associated with labour time of staff employed

internal cost – cost incurred due to consumption of company resources, usually time cost, or possibly depreciation or opportunity cost

external cost – cost associated with charges/fees paid to third parties (cash type cost)

private cost – any external or internal cost incurred by the company

social (resource) costs – sum of internal costs of all parties in the payment chain – the central bank, commercial banks, consumers and merchants, a fraction of social costs is incurred by every party (internal resource cost of that party); in this article calculated only for merchants

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Dario Negueruela
Cash and the financial crises

Dario Negueruela
Director of the Cash and Issue Department,
Banco de España, Spain

1 Introduction

I am delighted to be here today at the Deutsche Bundesbank's Bargeldsymposium. I wish to congratulate the organisers who have conceived and achieved such an interesting programme and a really first-class panel from whom I hope to learn a great deal.

In particular I would like to thank the Symposium organisers, the Deutsche Bundesbank's Cash Department, its Director Mr Helmut Rittgen and the German central bank for being so kind as to invite the Banco de España to the meeting as the guest of honour. And for giving me the opportunity to represent the Spanish central bank, a decision which not only testifies to a friendship of which I find myself unworthy but also demonstrates a high appetite for risk. It is an honour for which I cannot thank you enough and which I shall never forget; I am indeed sincerely grateful.

Von ganzem Herzen möchte ich mich für diese Einladung bedanken –auch auf Deutsch.

Es ist mir eine Ehre, Gast zu sein, und eine noch größere Ehre, Herrn Helmut Rittgen zu meinen Freunden zählen zu können.

Wie sagte Johann Wolfgang von Goethe?

"Leider läßt sich eine wahrhafte Dankbarkeit mit Worten nicht ausdrücken".

The distinguished speakers at the Symposium will cover a wide variety of different matters with great professionalism and in great detail. And I find myself at a distinct disadvantage in comparison with my colleagues from academia who are far more qualified in these matters. But I have no intention of letting down my friends at the Deutsche Bundesbank and I am here today to offer you the best of my knowledge, from the viewpoint of a central bank cash management expert. The following address is only the fruit of personal reflection and of many years' professional experience. Clearly, the views and opinions expressed are my own and do not necessarily coincide with those of the institution I represent. So without more delay, thanking you in advance for your kindness and understanding, let us begin.

2 Cash and the financial crisis

2.1 Crisis of values

Is there any link between cash and the financial crisis?

It is important to point out that the crisis of 2008 began as a crisis of values[1] which first shook the financial markets. It then grew into a full-blown economic crisis and subsequently sent shock waves through the labour market, with serious repercussions on employment and the household saving rate, before finally becoming a demand crisis, exacerbated by a serious liquidity crisis.[2]

The crisis of values was also, and in some cases especially, a crisis of confidence. The crisis of 2008 was a classic example of "anything's possible", "anything goes", "the sky's the limit". The disbelief, amazement and paralysis witnessed at the various peaks of the crisis reflected complete powerlessness, impotence in the face of the unexpected, the unforeseeable, the impossible. At the source of this process was the crisis of moral values, the breakdown of the basic principles of honesty and professional ethics, the lack of rigour in corporate behaviour, the slur on honesty, the predominance of vulgarity, the focus on the quick buck, the idea that "you are what you own", the false prophets, the creative accounting[3] where the new products invented by a financial market in turmoil (options, futures, puts, calls, derivatives, intangibles)

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1 Let us recall the famous phrase of the then French President, N Sarkozy, speaking of "… the need to rebuild capitalism". For a shrewd general insight into the recent social changes, see Tony Judt, "Algo va mal".

2 There is such an abundance, variety and complexity of information on the financial crisis that it comfortably matches what the philosopher Emilio Lledó calls "the huge pool of information" in "La palabra más libre". El País, 22 November 2008. This aside gives me the opportunity to apologise for this personal and necessarily subjective approach, which I trust will avoid that "huge pool brimming with toxic data and confused messages".

3 A term used by Luis Ángel Rojo, the Governor of the Banco de España when the state took control of Banesto, Spain's leading privately-owned bank, to refer to the new and imaginative methods used to value and recognise certain financial transactions, assets and derivatives. For some experts, this may be considered a forerunner of subsequent banking crises.

came to be worth more than productive assets, business organisation, know-how and experience, market share and brand recognition. And in the face of it all, analysts, economists and experts with no answers, ridden with hang-ups and doubts, who surrendered to the market, to bonuses and rates of return, letting market forces wash over them to reach all corners of the globe.

This is probably not the right time or place, nor am I the right person, to embark here on an analysis of the financial crisis of 2008. Suffice to say that it was highly contagious, spreading fast and furious with a huge multiplier effect. What could have been no more than the collapse of several greater or lesser institutions developed into a full-blown financial crisis affecting a great many banks. Moreover, the collapse of basic moral values in the corporate world that was at the source of the crisis was exacerbated by the failings of the regulatory authorities, which had to resort to extraordinary arrangements and unprecedented measures. The severity of the situation warranted measures that in any other circumstances would have aroused suspicions (for example, the FED having to bail out an insurance company). The crisis at several (in some cases leading) international banks, the authorities' decision to allow some of them to fail and the spread of a new and seemingly mortal disease that developed rapidly and for which we were totally unprepared recreated ghosts from the past: "banks can fail"; the biggest, the best-known, the most important bank has a hole in its balance sheet twice the size of its reserves; the best-known managers have forced the biggest institutions into bankruptcy. Meanwhile, state officials, governments, economic experts and regulators seeking urgent weekend solutions (to be implemented over the weekend to avoid market disruption) decided to put huge unprecedented sums of money on the table to bail out fraudulently managed businesses.[4] And at the

4 The popular belief that the cost of the crisis has been very high would not seem to be far wrong. In the summer of 2014 the European Commission published the report on the cost of the capital support provided for the restructuring of the European banking sector in the period 2008-12. The total –over €591,000 million– represents 4.6% of GDP on average across Europe (in some countries, up to 10% and even 40% of GDP). These figures refer exclusively to direct capital support provided to the banking sector.

same time, news reports informed that some of the leading executives responsible for the crisis were going home with their pockets lined (with severance pay, bonuses, pension funds, performance bonuses, etc,) and with broad smiles on their faces. In the end, the impact on the social fabric was devastating in terms of budgetary imbalance. The principle of financial orthodoxy warranted focusing the main policy aim on achieving a balanced budget,[5] through severe public expenditure cuts, mostly in social expenditure at the national level. Some experts showed that the Welfare State was not financially viable and a major decline in income[6] ensued, together with a dramatic and unprecedented rise in unemployment and in social inequality indices.[7]

What is behind all this? In my view, there is an extraordinary breakdown in the principle of social trust.[8] Much of the population has come to believe that many of society's leading figures have shirked their responsibilities, have not been equal to the task, have not kept their promises or upheld their beliefs. They told us that all was well and it was not, so either they had no idea what was going on or it was all a lie. Their behaviour has been most unseemly. Banks collapsed; bank executives were unprepared and acted dishonestly; supervisors were ineffective and failed to comply with their obligations; rights that were once secure are secure no longer; promises were broken and have become worthless; the future is totally uncertain; it seems there is no one in whom we can trust… There is, therefore, a tremendous crisis of confidence.

5 An extreme example of the political consequences of the crisis was the amendment of Article 135 of the Spanish Constitution that was rushed through Parliament in September 2011 (Official State Gazette No. 233 of 27 September 2011, pp. 101931 to 101941.
6 GDP per capita in Spain has retreated 16 years in comparison with the EU to stand, in 2013, at the 1996 level (see Eurostat News Release 96/2014 of 18 June 2014).
7 The increase in inequality is twofold: inequality has risen between countries (see Eurostat News Release No 96/2014 of 18 June 2014) and between social classes (see Eurostat's 2014 Annual Report and "Human Development Reports, Table 3 Inequality-adjusted Human Development Index" of the United Nations Development Programme, 2014). For a general analysis, see the excellent comments by Juan Diez Nicolás in "La globalización y las crisis", ABC, 11-04-2014.
8 Some commentators speak even of a more serious phenomenon: a "breakdown of the social contract", the very foundation of modern society.

2.2 Crisis of confidence

The financial crisis as a crisis of values; the crisis of values as a crisis of confidence in the social fabric. Here some kind of link starts to emerge between the financial crisis and cash, because what is cash but a deposit of trust? What is the basic principle that allows cash to function correctly and grants it its main characteristics? What is it but trust?[9]

International meetings of professionals in the cash management sector discuss the main areas of concern and the list seems endless: technical issues, production, cash handling, communication, security, risks, etc. But there is one concern that is never mentioned because it is so obvious, because it is the first and foremost concern: trust. Cash is based on the trust we place in it; without trust it would not exist. Cash is trust.

The collapse of the world as we had known it for many years and the emergence of the unprecedented, the unacceptable, the extraordinary triggers an inevitable loss of security and of references, it raises doubts and undermines confidence. Confidence in what or in who? In the system, in the social framework, in institutions, executives, leaders, politicians, bankers. And in cash? Not in my view, or at least not yet.

This is a crucial point: to note that the collapse in confidence in institutions, values and leaders did not affect confidence in cash, which continued to be trusted by society at large, thus fulfilling its main obligations and functions.

9 "… trust is the critical Word. It becomes an intimate attribute of money". Peter Praet, "The role of money in a market economy". The same insistence on the concept of trust has also been made by the Chairman of Bundesbak, relating it to the other trust: which must deserve the central bank from its own citizens. Trust is the basis of money … but a currency can only be stable if the citizens has confidence in the central bank's ability to adequately perform their job and keep the prices stable. "This trust, in which central banks have been hard working in recent decades, is undoubtedly your most valuable asset." Dr. Jens Weidmann. Prasidente der Deutschen Bundesbank. Er {Öffnung der Bargeldsymposiums. Frankfurt and Main, 10.10. 2012.

2.3 Cash as a deposit of trust

Cash is trust, and not only because I trust that this piece of paper in my hand is worth what it says it's worth. It is trust because I am not worried, I know that others, my fellow citizens, accept this piece of paper as a store of value. They are prepared to supply me with the goods or services I need in exchange for this piece of paper; they firmly believe that it is worth its face value, and as all the parties concerned believe that the others trust in that value, trust spreads and grows from individual or personal trust to social trust. Not only do I trust in the value of this banknote, I trust that my fellow citizens will maintain their trust in this banknote, that they will value it, accept it and receive it as a symbol of value. This is the mainstay of my trust, because if others were to lose their trust in the value and use of banknotes (cash), then my trust would be worthless and cash would be unable to function. I can accept a banknote without trusting in it because I am convinced that others believe in it, that they will accept it and confer value on it. This is, therefore, the essence: trust, the trust held by others.

In normal circumstances, news that my bank (the bank where I keep my savings, because I trust it) is in difficulties, or that my bank manager (heaven forbid!) is a scoundrel rather than an honest person worthy of my trust, would make me very anxious indeed. What should I do in such a situation? Should I withdraw my money from a bank that arouses such doubts and uncertainties and take it to a safer place? Where? Well, to a different bank, a bank that has a sound balance sheet and that conserves the old values of honesty and integrity. How do I transfer the money, my money, my savings, from one bank to another? By using the normal system for the transfer of funds[10] (I haven't lost confidence in the banking system, just in one person or institution, in one of its agents). I have no doubts about the money itself,

10 Clearly the system is somewhat more complex than this brief summary may suggest. Technical and economic issues relating to electronic transfers of funds (time factors, value dates, costs and fees, etc.) may be important in these transactions to recover funds.

or about the banking system overall. In this case, electronic transfers of funds (by cheque or transfer) between institutions do not reduce the money supply, or the funds held at banks, and nor do they affect the amount of currency in circulation. Accordingly, doubts about the health of one particular bank need not have any impact on cash.[11]

But what if I have lost faith not in one bank but in the banking system overall? If I believe that all banks are in danger? That if the big banks, the "untouchables", the best banks have fallen, who's to say the rest won't follow suit? In this case, it would make no sense for me to take my money to another bank, which would present the same risks and generate the same fear and uncertainty as my traditional bank: "there is no one you can trust". When it is the entire banking system that is called into question, I have no alternative but to take my money out of the system. How? In this case, in cash. I cannot use electronic money which I will never have control over, so cash is the only possibility.[12] And in this case the consequences are very different.

If doubts spread from an individual case to the system overall, from fear to crash, the situation becomes very different, triggering a run on cash as customers rush to withdraw their savings. Accordingly the amount of currency in circulation grows, while bank balance sheets decline. Paradoxically, despite this increase in the

11 This is true in theory, although not always in practice. In recent years we have seen how individual difficulties at one big bank can trigger a sharp increase in the demand for cash, as customers who are suspicious of the institution's electronic transactions choose to withdraw their savings in cash (in Spain, in the case of Bankia, among others).

12 There have been numerous reports in the media on this phenomenon, in many cases extensively illustrated in quite a sensational manner. A recent headline in the Spanish press seemed to indicate immutable trust in cash: "Spanish companies accumulate cash to withstand the financial crisis. At the end of 2011 big companies held a record €40,000 million in cash" (El País, 6 March 2012). Another headline, in this case from the US, took a different stance: "travelers carry more and more money in cash" (New York Times Service, Paris, 24 November 2013). Or alternatively, this report indicating that the crisis was so severe that it was even affecting cash: "Economic crisis triggers unprecedented drop in cash in Spain" (El Confidencial, 10 March 2010).

amount of currency in circulation, liquidity problems appear immediately in view of the shortage of cash at the banks. This translates into delays in payments, affecting trade and exchanges of business and citizens and solvency of credit institutions and tightening credit standards and …, well, you can imagine the rest …[13]

In summary, in my opinion the answer to the initial question about the relationship between financial crisis and cash crisis is neither direct nor clear. Experience shows that through the deepest financial crisis since the crash of '29, the cash, far from being adversely affected, became a safe haven where citizens put their confidence.

3 The role of cash in the economy

3.1 Cash as a lubricant for the economy

There are many interesting ways of analysing the role of money in the economy. My approach here is neither very orthodox nor very original, and it almost certainly has its failings.

Briefly, I see a country's economy like a vehicle that needs at least three things for it to run. First, the engine, which can have more or less power, acceleration, resistance, flexibility, etc., all of which depend (returning to the example) on the size of the country, its raw materials and natural resources, its geographical location, its population, etc., as well as its history, education and culture and its social, labour, legal and cultural institutions.

Second, an engine must have fuel, which continuing with our simile depends on the social and institutional framework that defines a country, its confidence in and

13 Needless to emphasize how easy it is to make news headlines on this topic and contribute to a disproportionate increase in confusion. . Sure you remember some of the following headings, each more contradictory: "Sweden is moving towards elimination of cash" in Svenska Dagbladet (http://www.svd.se/), April 2013; "Israel is moving in the phasing out of cash,".

expectations for the future, its respect for and acceptance of the rules of social conduct, its capacity for innovation and improvement, its view of change and social, technological and cultural progress, its entrepreneurial mindset, its observance of rules, its legal and institutional framework, etc.

Lastly, in order for an engine to run smoothly, a good design, more or less engine power and fuel is not sufficient; it must also be well oiled. And to continue with our simile, money is the oil that lubricates a country's economy, that makes for fluid, smooth, economic and efficient trade, that facilitates confidence and redistribution and that allows specialist sectors to produce increasingly efficient goods, in the knowledge that the technology, productivity or efficiency gains or economies of scale will boost living standards.

It is a very simple example, but it serves to remind us that all three elements are essential for an engine to run smoothly. It is true that there are major differences from one engine to another in terms of power, design and capacity, but it is also true that the best engine may not necessarily run well if it lacks the right fuel, and even then it may not run properly if it is not well oiled.

We should not confuse the role played by each of these elements; all three are essential, but they are not interchangeable and they each have a different role to play.

3.2 Cash as a store of confidence

So cash is essential to lubricate the economy. And it also plays another no less important part: it upholds and strengthens social trust in the development and progress of society; the permanence and security of its acceptance by society make it essential for the evaluation of the outcome of the process of accumulation of work and for the correct functioning of institutions. The guarantee and permanence provided by institutions that are devoted to the production and handling of money, the guarantee of continued and future acceptance of cash by all sections of society

are factors that are essential to society, even though we may be unaware of the role they play. Cash is one of the soundest elements of the social contract by which society is governed. And not just because of the traditional "promise to pay the bearer" on banknotes, but because of the collective awareness of the security of cash, its continued value and its future acceptance by all sections of society. I can trust the value of banknotes as payment for my work because I trust how they are handled and that they will be accepted, I trust their value, their permanence and naturally the promise to pay –the social contract¬– that they represent.

3.3 Quantitative significance

The third aspect I wish to mention is the sharp decline, in relative terms, in the currency in circulation in respect of the weight of personal and familiar wealth[14], of economic and of the overall money supply. And in consequence, the loss of relative importance of cash in the control of monetary policy. One need only ask any central bank cash management expert how concerned they are about the relationship between the currency in circulation and the level of inflation. Most likely they are not at all concerned. Cash management experts are well aware that the success or failure of their work must be measured in terms of efficiency, targets, cost control, improvements in distribution systems, etc. Nowadays, no central bank chief cashier has quantitative limits on banknote issuance, in comparison with just a few years ago.

Cash is no longer the main component of monetary aggregates and, from the standpoint of monetary policy management, its role has changed completely.

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14 The amount of money in circulation is very often connected to GDP and its value is frequently recalled (between 6 and 10% depending on the country). In my opinion this ratio is wrong and not significant. Less frequent and more significant in my opinion, is to see the weight of cash as a part of the national wealth and its relative importance in the distribution between different types of assets that comprise it. It is in this sense that I argue that should be no doubt about the effective weight reduction as a component of national wealth over the last twenty or fifty years, besides the reduction of its importance within the set of monetary aggregates. Phenomenon of long trend that was altered in the last quarter of 2008.

Another singular feature of cash that is rarely mentioned is its atavistic nature and its connection with purely emotional (irrational?) elements of human behaviour. What do I mean by this? Cash has certain special characteristics that link it to feelings and to deep and primitive human sentiments. For many years cash was more than just money. It was a symbol, of power in some cases or simply of social success. In many other cases it was the result of a lifetime's work, of our intelligence and our efforts, of years of dedication and saving so that we could leave our children something that would guarantee them a better future. It was, in a nutshell, a reflection of social progress.

Moreover, especially in rural areas, money has always represented security, a means of defence against future adversity or uncertainty. Housing, land, machinery, … these are all necessary for people to live and work, but they can change in value or deteriorate. But not money; the value of money is guaranteed, it lets you buy whatever you want or need, directly. Money is security for the future[15].

3.4 Cash and monetary policy

So why did we say there may still be good reason to study cash, if it is no longer important the composition of the national wealth, the amount of money in the economy or the control of monetary policy? My answer is this: in view of its symbolic and symptomatic value.

15 That kind of magical character who sometimes have cash and many economists forget, has been stressed more than once recognized by people of recognized standing. Lawrence H Summers, President Emeritus of Harvard University and previous Secretary of the Treasury of the United States said in the presentation of the book by David Wolman, "The end of the Money," that " A World with different and new money will be a different and new world …The lives of Citizens and central bankers alike will be pronfundly altered … ". And extremely graphically, other authors remind us the ancient of the relationship between man and money: "Nach dem zum Haushund domestizierten Wolf durfte das Geld wahrscheinlinch der treueste Begleirter des Menschen in dessen Geschichte sein"."Besides the domesticated wolf, the money is probably the most faithful companion of man on earth" (personal translation). What can not happen in vain, some would say.

Developments in recent years, and specifically the events of the major financial crisis of 2008, clearly highlighted two key trends:

The loss of relative importance of cash as a component of the money supply and its consequent separation from the processes of control of monetary policy.

The conservation and strengthening, where possible, of its role as a "second resort". When institutions fail, when financial money is called into question, when basic guarantees collapse and instability risks multiply, cash once again becomes a safe haven.[16]

What does this mean? It means that cash is both a symptom and a reflection of the crisis situation in society. Political leaders should not underestimate a situation where there is extraordinarily high demand for cash. It is a sign that something quite important is happening, even if there are other factors that conceal the reality from us or that lead us to complex or confused analyses. The strong demand for cash in September 2008 reflects the panic that swept across all sections of society with the visible onset of one of the biggest crises in history. The demand for cash linked to the Bankia crisis in Spain shows that, once a climate of mistrust has developed, even the usual arrangements for electronic transfers of funds become worthless as the public demand their money directly over the counter.

The liquidity injection policy is no longer a cash policy. The speed and the scale of the effect that may be achieved by means of exceptional liquidity injections into the system via the interbank markets cannot possibly be compared with cash measures. Only in certain exceptional cases will cash be a liquidity factor: it is rather a confidence factor, or a factor that makes for flexible and fluid retail payments.

16 I am not saying that it is the "only" safe haven. One need only look to the gold market or the submarkets for diamonds and other valuable assets to see that there are also other safe havens that flourish particularly at times of panic.

Nowadays, there is a totally different explanation for the constraints – and there are¬ constraints – on the use of cash, linked to the fight against money laundering and unlawful or unreported transactions, or to bank protection arrangements. There have been cases of drastic measures taken to ban cash withdrawals at bank branches, but either the impact on image was worse than expected (the infamous "corralito" seen in certain Latin American countries) or the measures were very short-lived and had only a minor impact (the case of the restrictions on cash withdrawals in the Cypriot banking crisis). Essentially, these measures are a reflection of the inability of a country's political and economic leaders to tackle a problem, rather than a solution or a response to the problem.

4 Cash crises

If we had to specify the different types of possible cash crisis we would say that there are four:

1. The first and most fundamental occurs in the event of large-scale counterfeiting of the national currency. For this to take place, the quality of a counterfeit must be so high that it becomes really dangerous. In addition, its scale and dissemination must sow doubt among the general public regarding their ability to distinguish between genuine and counterfeit banknotes. The multiplier effects of rumour, bad news and fear turn this into a socially dangerous phenomenon that must be countered by rapid, forceful decisions, to implement a sophisticated and well-coordinated plan of action to avoid a collapse in confidence. Examples of this type of crisis have occurred in many countries.[17]

17 An indication of just how disastrous the effects of a crisis of this type can be is the fact that major state-sponsored counterfeiting operations have occasionally been instigated in an attempt to drastically weaken the enemy's economy.

In such a situation, the central bank's cash experts must act promptly, offering alternative technical solutions by providing new banknotes, with different security features; withdrawing from circulation, as soon as possible, the counterfeit notes; working with police to tackle the origin of the counterfeiting; coordinating with communications experts the most appropriate confidence and information messages, etc. The aim is not only to prevent the payment system from being affected, but also a possible diversion of domestic demand for cash towards banknotes issued by other states, which may become a generally accepted means of payment within the country. The aim is to show to the public that they are right to trust the issuers of cash, who know how to protect the authenticity of banknotes and successfully combat counterfeiters. Historically there is no lack of examples of this situation.

2. A second type of crisis arises in situations of hyperinflation when money in general (not just cash) suffers a very significant loss of value. The authenticity of banknotes is not called into question, but their utility as a medium of exchange or store of value is, in a situation in which the price mechanism has ceased to be effective as an instrument to ensure the functioning of the economy and the value of goods is constantly changing.

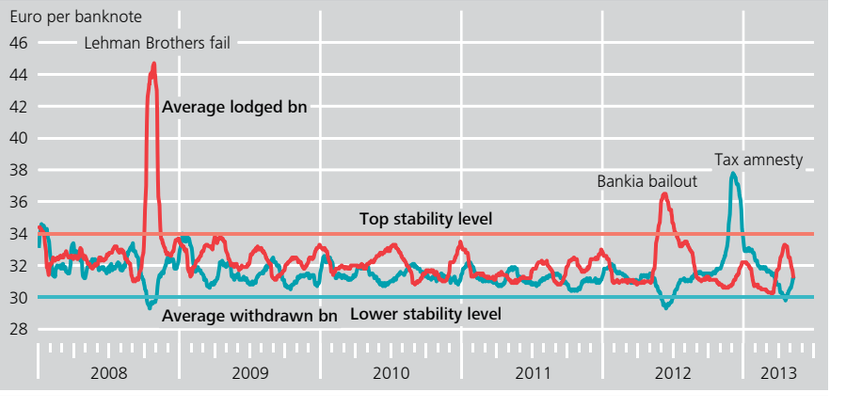
In this case economic measures need to be successfully implemented to repair the situation and restore the necessary price stability to the system ensuring an appropriate set of values for the functioning of the economy.

3. A third type of crisis occurs when a loss of confidence in alternative payment systems leads to an extraordinary increase in the demand for cash, which is sought by the public as a safe haven. This unexpected, exceptional growth in demand forces us to consider the capacity of a central bank to respond to crisis situations and confidence generation processes. This would be the case that we are considering when we analyse the relationship between cash and the 2008 financial crisis. The figures speak for themselves.

Figure 1 shows the enormous increase in the demand for banknotes that the Banco de España experienced at its counters following the bankruptcy of Lehman Brothers (15 September 2008).

BdE withdrawals and lodgements Figure 1
Progress of the average banknote value

Weekly data



When the average banknote value in payment goes beyond €34, there is a warning of possible local crisis. At the same time, the average banknote value in lodgements usually falls down €30.

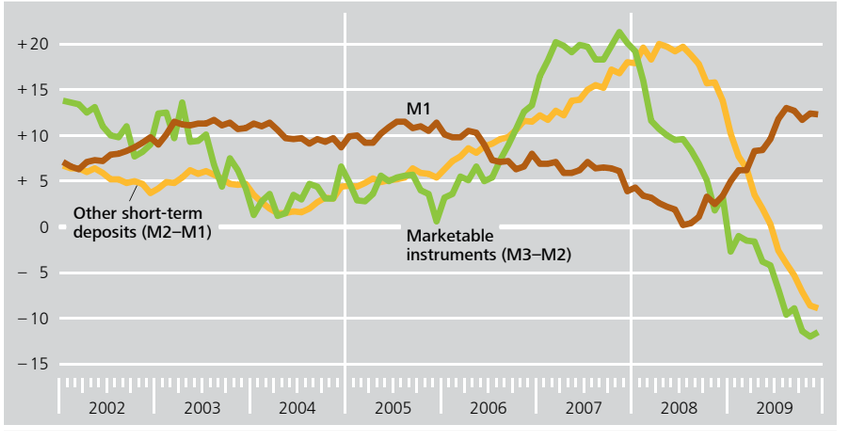
In the aftermath of this and other bankruptcies, "assets on savings accounts were turned into cash, which boosted the value of euro banknotes in circulation by an additional €40 billion"[18], cash clearly playing the role of an alternative to financial saving, as clearly revealed by the European Central Bank reports (chart 2)

18 Section 3 (entitled "Banknotes and coins") of Chapter 2 of the 2009 Annual Report of the European Central Bank, p.130.

Main components of M3

Figure 2

Annual percentage changes; adjusted for seasonal and calendar effects



Source: ECB.

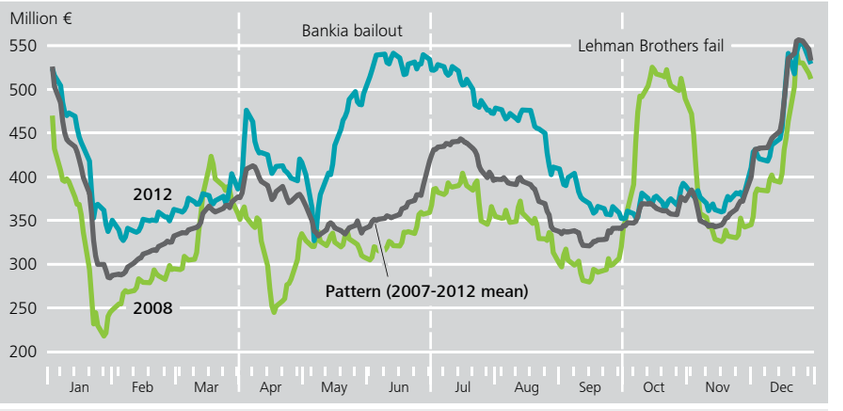
Although these cash crisis situations occur unexpectedly, central banks ought to have tools available to enable them to anticipate their arrival and maintain an active position to mitigate the foreseeable consequences of panic among banks' current account holders:

This type of crisis, which we recognise as the one that has been occurring over the last few years, has led central banks to study new models for analysis, to try to prevent/ anticipate these exceptional situations and to be able to adopt measures to mitigate the attendant risks. Some of these new models are statistical and are based on the ongoing analysis of changes in cash flows (amounts of cash put into circulation and withdrawn by the central bank, distribution by denomination and average banknote value) and their comparison with historical time series. As other central banks, the Banco de España, has also worked on these type of studies (charts 3 and 4).

BdE withdrawals

Figure 3

Annual progression of the day-to-day withdrawal value

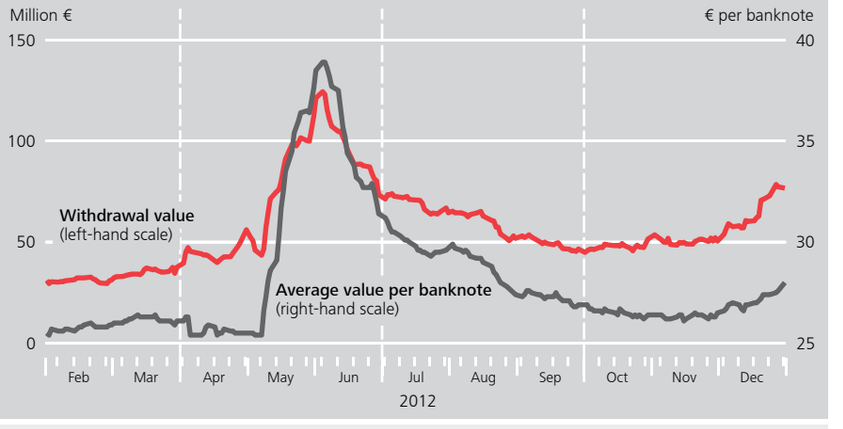


The withdrawals pattern (2007-2012) shows important increases in the day-to-day value of the banknotes withdrawn from the BdE in Christmas, Easter and mid-summer. A sudden change from the pattern could mean that a local crisis is coming.

Bankia withdrawals 2012

Figure 4

Withdrawal value and average banknote value

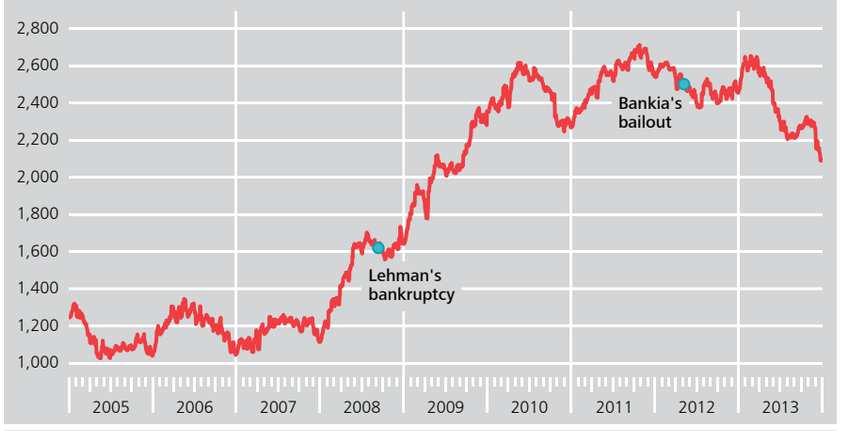


The sharply increase of the average banknote value banknote withdrawn from BdE by Bankia showed the bail-out in advance. This variable usually moves in advance and faster than the withdrawals total value.

Also, the capacity of a central bank to respond to these situations should be based on prudent stock management, which could lead to the holding of a volume of banknote stocks that might seem excessive in good times, but may be meagre in times of crisis. This stock should be divided up among several logistical centres for country-wide distribution, with a centralised real-time information system for the stocks at each point. Chart 5 shows the results of the policies being pursued by the Banco de España, reinforcing the banknote stocks, anticipating some social indicators.

Evolution of banknote stocks Figure 5

in million pieces, daily data



Finally, one of the new risk mitigation measures learnt during this crisis is the recognition of the advantages of a new model of relations and communication with the professional agents involved in cash distribution, such as banks, cash-in-transit companies and other intermediaries. When the time comes, this will allow the means of transport available to distribute cash to be efficiently allocated.

4. The fourth case involves what could be called a perfect storm. This occurs when trust in the issuer is lost and cash loses the basic pillar that provides its justification. There are few solutions to this apart from restoring trust. This is an extreme crisis situation that requires radical action. Fortunately there are few examples of such a crisis.

The latter situation seems far away and is something not normally conceived as possible, thankfully. And we're not here to question this attitude. But it should move us to consider that the media collected more frequent news about the phenomenon of BIT COIN or on the extent in various countries of the so-called "social or solidarity coins," local level but increasingly accepted.

5 Lessons learned

The relationship suggested in the title of this talk between financial crisis and cash crisis does not appear to be evident. Indeed, while the symptoms of the crisis and its effects worsened, there was no loss of confidence in cash. On the contrary, cash has become a safe haven of growing importance. However, that very reaction to cash has led to some unexpected and exceptional increases in demand that have jeopardised the central bank's capacity to respond, forcing cash management systems and cash supply programmes to be reconsidered, in the light of the needs of society. The effects of the financial crisis have been felt by cash, making a far-reaching review of its functions and management mechanisms essential.

At the same time, the crisis has alerted us to the dramatic effects of loss of the fundamental element of confidence – the foundation on which cash is based and also its justification – so that if confidence in the institutions that issue money is ever lost, or a climate of distrust spreads regarding the acceptance by the public of legal tender banknotes, the basic structure of the system would be affected and the situation could not simply be addressed by designing the perfect banknote or reducing levels of inflation.

This twofold relationship between crisis and cash and the complexity of events have enabled some conclusions to be drawn, which must be studied if similar mistakes in future are to be avoided. Some of the main lessons learnt during the crisis in relation to cash are, in short, as follows:

1. Cash is not today a useful instrument for monetary policy management; there are much more appropriate, rapid, effective and efficient mechanisms for providing the system with liquidity.

2. The new situation requires a far-reaching review of the function and responsibilities of cash managers. No longer is it enough to put banknotes into circulation and control their quality. Today, they must also manage quality, use professional criteria to meet society's demand, anticipate problems, promote product innovation and collaboration among participants to develop a cash cycle model that meets the public's needs.

3. The exercise of this new function must take particular account of the importance of cash as a reputational element of central banks' image in society. If trust is the critical element on which cash is based, the solidity of the central bank's image in society is the base that sustains the issuing institution.

4. The review of functions and responsibilities must be based on criteria of management efficiency, neutrality with respect to means of payment and management transparency. There is little sense in saying that the central bank should promote cash because it generates seigniorage, i.e. a profit for the central bank. But equally inappropriate would be for the central bank to decide, in order to boost efficiency and modernity, that electronic means of payments should be imposed on society because cash is expensive. This is a matter on which there are opposing positions, but there is no doubt that this subject is today on the table and gives rise to controversy.

5. Central banks, particularly after the ordeal of the crisis, have an important responsibility today as key managers in crisis situations. It is no longer sufficient to say that they are doing their work well; rather the important thing is to be in a position to respond to emergency situations and to anticipate unforeseeable events or exceptional demands. Quality management and cost savings are no longer enough. Business continuity exercises study the systems that enable an institution or firm to continue to perform its activities when an unexpected event occurs that affects the institution itself; but that is no longer the issue. What is important is being capable of responding to the trust that society places in public managers and of ensuring the functioning of payments systems in order to mitigate the damage that may be caused by natural (earthquakes, floods, etc.) or man-made disasters (attacks, explosions, etc.) that affect society as a whole or part thereof and not just a single company or institution. The reputational element has placed new responsibilities on central banks, as recipients of society's trust.

6. Last, but not least, my personal opinion is that the crisis has served to remind us of the role of cash as a social indicator. Close monitoring of changes in the demand for and use of cash may be a very useful way of detecting more profound changes in the social fabric; it is no longer a question of knowing if we are going to be capable or not of meeting an exceptional demand (that should be a matter of course), but whether we are capable of analysing and interpreting the roots of those deeper social movements from which these cash movements stem.

That's all for today. I really appreciate your patience and look forward to your comments or questions.

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Tom Cusbert[1] and Thomas Rohling
Currency Demand during the Global Financial Crisis: Evidence from Australia

Tom Cusbert
Economic Research Department,
Reserve Bank of Australia, Australia

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1 Authors: cusbertt and rohlingt at domain rba.gov.au
Media Office: rbainfo@rba.gov.au

Abstract

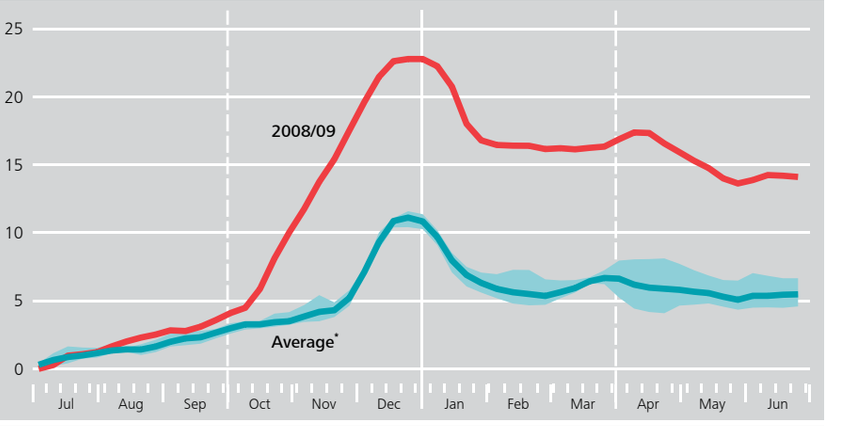
Australian financial institutions remained healthy throughout the global financial crisis and their deposits were guaranteed by the Federal Government. Nevertheless, demand for currency increased abnormally quickly in late 2008, resulting in an additional $5 billion (or 12 per cent) of Australian banknotes on issue by the end of that year. The rise in currency demand began in mid October 2008, around four weeks after the collapse of Lehman Brothers and concurrently with policy responses of the Reserve Bank of Australia (RBA) and the Federal Government. The surge in currency demand did not have any destabilising effect on the banking system – indeed bank deposits also rose during the period. However, the rise in currency demand did raise some issues for the RBA's banknote distribution operations. Traditional models of currency demand suggest a role for interest rate reductions and the Federal Government stimulus payments to households in explaining the increase in currency holdings. We estimate that these factors can only account for around 20 per cent of the observed increase in currency holdings. The remainder of the rise could be due to an increase in precautionary holdings by people concerned about the liquidity or solvency of financial institutions and by financial institutions as a contingency. This is consistent with the disproportionate rise in demand for high-denomination banknotes at this time.

1 Introduction

Late 2008 witnessed an intensification of turmoil in financial markets around the world. As this unfolded, there was a substantial surge in holdings of Australian currency. The increase in total banknote demand in late 2008 was 12 percentage points larger than the normal increase in demand at that time of year, amounting to an additional $5 billion on issue (Figure 1).

Banknotes on issue Figure 1

Percentage change from 30 June



***** Shaded area represents the range for 2004/05-2007/08.
Source: RBA.

History has shown that periods of increased demand for currency can be associated with losses of confidence in financial institutions and even runs on deposits. This paper examines the recent episode of heightened currency demand to further the understanding of the behaviour of the Australian public and banks in times of financial stress.[2] In particular, we look at what drove the surge in currency demand and whether it was of broader significance to the economy. We also consider whether high-frequency currency demand data contain useful real-time information during crises. Understanding currency demand is also important for the role of the Reserve Bank of Australia (RBA) in issuing currency, especially given that it is difficult to increase banknote production at short notice.

2 Currency supplied by the RBA is perfectly elastic so actual quantities of currency in circulation can be thought of as demand.

There were many events in late 2008 both internationally and domestically that are likely to have had an effect on currency demand. Internationally, Lehman Brothers collapsed and financial markets became increasingly turbulent, while several other major financial institutions were placed into receivership or required emergency liquidity measures. In Australia, as confidence fell and the Australian dollar depreciated, there were a number of policy responses: the RBA cut the interest rate on overnight cash sharply; the Federal Government enacted a guarantee of deposits with authorised deposit-taking institutions (ADIs); and the Federal Government announced, and distributed, stimulus payments to households equivalent to 1.7 per cent of annual GDP. At the same time, there was a sizeable increase in the demand for currency.

Traditional models of currency demand focus on interest rates and income as key explanatory variables. Lower interest rates reduce the opportunity cost of holding currency and so make it relatively more attractive. Increases in income tend to be associated with increases in the demand for currency to conduct transactions. An alternative (but not mutually exclusive) explanation for the rise in currency demand in late 2008 is that precautionary demand increased as a result of at least some depositors being concerned about the stability or liquidity of banks during the financial crisis.[3] Also, financial institutions may have increased their precautionary demand for currency in anticipation of rises in demand from their customers. However, bank deposits increased during the period in question, so it is clear that there was no large-scale loss of confidence in the banking sector.

To investigate the relative importance of these factors we estimate traditional models of currency demand and then expand them to include new variables that may be

3 We are using precautionary demand to mean demand for currency as a precaution against difficulties in accessing currency in the future due to a banking crisis. This is a different sense to Keynes' use of precautionary demand to mean a precaution against future requirements for currency to make unexpected transactions.

important during financial crises. We also include transaction cost variables to avoid possible model misspecification. We find that the increase in currency holdings in late 2008 was substantially larger than can be attributed to the normal response to interest rate cuts and the fiscal stimulus payments, and so may have been due to precautionary demand.

The demand for different denominations of banknotes can help to identify the different causes of the increase in currency demand. We posit that precautionary demand for banknotes should result in a disproportionate increase in demand for high-denomination banknotes because they are more likely to be used as a store of value than low-denomination banknotes. This is consistent with the relative rises in currency holdings of different denominations observed in late 2008.

The remainder of the paper is structured as follows. Section 2 provides some background on currency demand in past financial crises, followed by a more detailed description of the Australian experience during late 2008 to early 2009. Section 3 discusses currency data in more detail. Econometric modelling to control for the effects of interest rates and income is presented in Section 4, followed by a conclusion in Section 5.

2 Financial Crises and Currency Demand

2.1 A Historical View

Financial crises can result in depositors losing confidence in financial institutions and withdrawing their money, which can then appear as increased currency in circulation. Banks and other deposit-taking institutions are vulnerable to such withdrawals because they typically retain only a fraction of their customers' deposits in liquid form, investing the remainder in loans whose terms are often longer than those of deposits. In extreme circumstances, this can result in a bank run. Expectations of a bank run can become self-fulfilling because depositors have an incentive

to withdraw their deposits if they believe that other depositors will withdraw their funds (see Diamond and Dybvig (1983) for a theoretical discussion). History has shown that bank runs can quickly turn a liquidity problem into a solvency crisis (see Reinhart and Rogoff (2009) for a review).

Australia, like many countries, has had some experience with financial crises and bank runs. An early crisis occurred in the 1890s, following a property boom associated with lowered lending standards at many financial institutions. As property prices collapsed, depositors became concerned about the solvency of some exposed banks and building societies. Some depositors transferred deposits to more conservative and well-established financial institutions and others withdrew their deposits from the banking system. As a result, the value of currency in circulation increased in 'leaps and bounds' in a short period of time (Holder 1970). Even solvent banks not exposed to the property market faced liquidity problems and became increasingly unable to redeem depositors' claims. At the height of this crisis, half of all deposits in Australia were suspended (Rohling and Tapley 1998). Most deposits were paid back between 1893 and 1901 and did not suffer direct financial losses, although there were 'considerable indirect losses via frozen deposits' (Kent 2011).

In contrast to the 1890s financial crisis, only three Australian financial institutions suspended withdrawals after runs on deposits during the Great Depression. This was because in the years leading up to the Great Depression, there was less speculation in the property market, less rapid credit growth and many financial institutions had become more conservative in their risk-taking due to less competition (Kent 2011).

In more recent history, there was a significant financial crisis in the mid 1970s. Again, the crisis followed a property boom and was precipitated by a liquidity squeeze that led to 'the failure of almost half of the largest 20 finance companies' (Bloxham, Kent and Robson 2010). The crisis was concentrated in building societies and did not involve a noticeable increase in currency on issue.

Another crisis began in 1989, after a combination of high interest rates and a softening commercial property market brought credit quality problems to light. The crisis involved a number of runs on building societies and small regional banks (Fitz-Gibbon and Gizycki 2001). Two larger banks also suffered large losses, but had, or were able to raise, sufficient capital to cover them. The crisis resulted in a steep increase in currency demand in 1990/91. From then until late 2008, Australian financial institutions largely avoided difficulties. There were no out-of-the-ordinary increases in currency demand until the intensification of the global financial crisis in late 2008.

This historical view, as well as international experience, demonstrates that periods of financial instability and losses of confidence in financial institutions can be marked by increases in the public's demand for currency. This suggests that during financial crises, changes in currency demand may provide useful information about the degree of public confidence in the financial system.

2.2 The Global Financial Crisis

The global financial crisis was associated with a substantial increase in currency demand in Australia. While it is difficult to date the beginning of the crisis precisely, money market spreads first began to widen in August 2007 following a series of announcements of losses by financial institutions and the suspension of some bank-sponsored investment funds (Ellis 2009). In Australia, corporate bond spreads also began widening around that time (Figure 2).

In September 2007, there was a depositor run on Northern Rock, a mortgage bank in the United Kingdom (Dodd 2007). This was the first bank run in the United Kingdom since 1866. However, it did not follow the traditional model of bank runs. Rather than occurring prior to official support for the bank, it occurred after Northern Rock sought, and received, emergency liquidity from the Bank of England (Shin 2009).

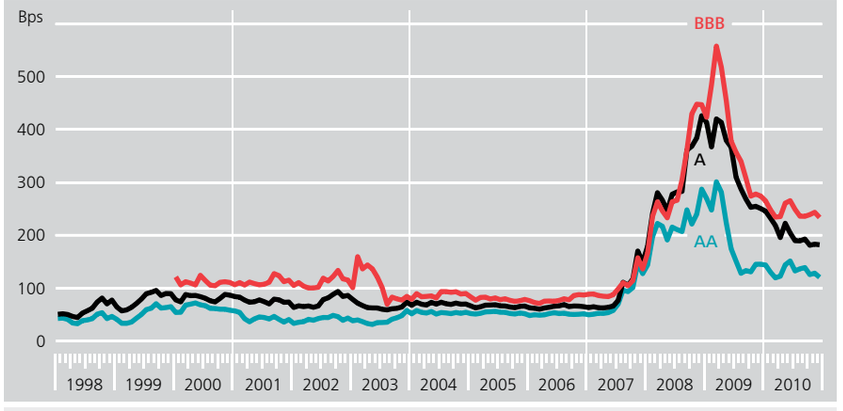
The next major disruption occurred in March 2008 when Bear Stearns suffered a sharp withdrawal of funds. This prompted an injection of liquidity by the US Federal Reserve through JPMorgan Chase, which subsequently announced its acquisition of Bear Stearns (RBA 2008).

The greatest period of disruption followed the announcement of Lehman Brothers' bankruptcy on 15 September 2008 (Edey 2009). Soon after, AIG required emergency support from the US Federal Reserve, and several large banks (e.g. Washington Mutual, Wachovia and Iceland's Landsbanki) were placed into receivership or forced sales. During this period, confidence collapsed, equity prices fell sharply and wholesale credit markets went into a state of serious dysfunction.

Australian corporate bond spreads*

Figure 2

Spreads over government yields



* Corporate bond spreads are a weighted average of senior bonds with remaining maturities of 1 to 5 years, they include financial and non-financial corporates.
Sources: Bloomberg; RBA; UBS AG, Australia Branch.

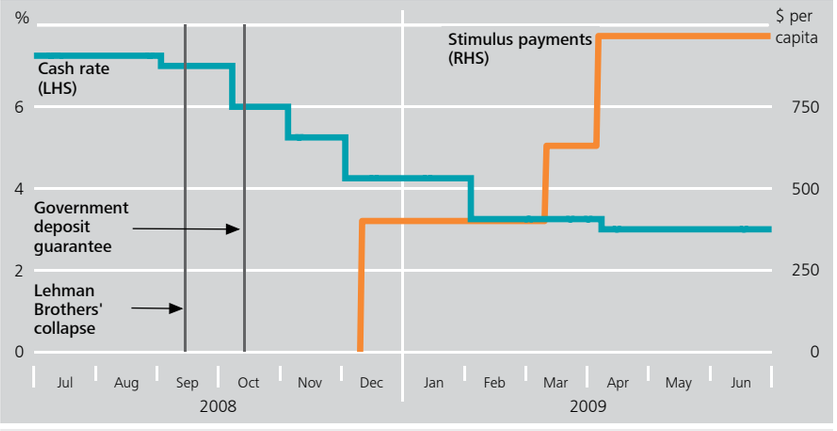
The Australian policy response to the unfolding crisis was prompt. In October 2008, the RBA lowered the cash rate from 7.0 to 6.0 per cent. The easing continued until April 2009 when the cash rate was lowered to 3.0 per cent (Figure 3). As

well as lowering the policy rate, the RBA undertook a range of market operations designed to provide liquidity in the Australian market (RBA 2009a). The Federal Government also announced a series of measures to bolster confidence in Australian financial institutions, including an Australian deposit guarantee scheme, which took effect on 12 October 2008 following the announcement of similar measures in other countries. A wholesale funding guarantee was announced at the same time. Soon after this, the Federal Government announced stimulus payments to be made to households in December 2008. More stimulus payments were announced early the following year (to be paid from 11 March 2009), as well as tax bonus payments that would begin on 6 April 2009. The value of payments to households totalled approximately $21 billion, or almost $1 000 per capita (RBA 2009c).

Monetary and fiscal policy events

Figure 3

Daily



Source: RBA

2.3 Currency Demand in Australia during the Global Financial Crisis

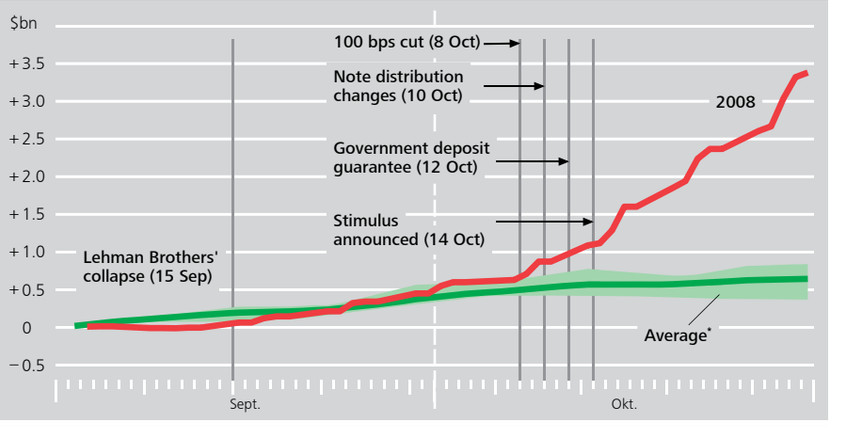
As the global financial crisis unfolded, the stock of banknotes on issue increased dramatically. Figure 4 shows the cumulative increase in banknotes on issue on a daily basis alongside relevant events that occurred at the time. The surge in banknote demand was not an immediate response to the intensification of the crisis around the collapse of Lehman Brothers, suggesting that the Australian public was not immediately concerned. However, the stock of banknotes on issue began rising sharply around the same time as the RBA's 100 basis point cut in the cash rate (on 8 October) and accelerated further upon the Federal Government's 14 October announcement of the upcoming cash payments to households.[4]

Standard explanations of currency demand posit that lower interest rates should cause increases in currency demand but the speed and magnitude of this rise suggests that this explanation is not the full story.[5] The further increases in banknote demand following the announcement of the stimulus payments could be the result of banks stocking up on currency in anticipation of increased cash withdrawals. This might seem overly preemptive given the payments were not to be made until December, but liaison with banks at the time suggests that it was a factor.

4 Single and multi-day changes in this period were 2–5 standard deviations larger than average for that time of year.
5 This is borne out in the modelling results in Section 4.

Banknotes on issue Figure 4

Cumulative daily change in total value



* Shaded area represents the range for 2004-2007.
Source: RBA.

The magnitude of the growth in banknotes on issue suggests a role for precautionary demand that was not immediately apparent in September 2008. Given that this demand appears to have coincided with the policy responses of the RBA and Federal Government, it is possible that there was some adverse signalling effect of these policies.[6] However, it is also possible that the public and policymakers were both responding to the ongoing deterioration in financial conditions over that period; indeed, the deposit guarantee is likely to have limited the extent of the rise in currency demand by providing added confidence in deposits.

Another factor that contributed to the rise in currency demand was a rise in demand from offshore as a result of the sharp depreciation of the Australian dollar seen in this period. Information collected at the time suggests that expatriates,

6 A similar line of argument can be found in Taylor (2008).

tourists and families of international students studying in Australia took the opportunity to obtain Australian currency at what appeared to be a good exchange rate (RBA 2009a). Indeed, foreign banks engaged in currency exchange reported that they were barely able to keep up with the demand for Australian currency. We are unable to quantify this offshore demand, but it may have been a significant contributor to the overall rise in banknotes on issue.[7]

The daily banknotes-on-issue series shows demand in real time, which reflects changes in both household and bank behaviour. These daily data may be useful to monitor in order to inform judgements about whether financial market turmoil is spilling over to the broader economy. The close working relationship between the RBA's Note Issue Department and the commercial banks also yields information on the motivation for banknote demand.

3 Currency Demand Data

To analyse the surge in demand for Australian currency in late 2008 further, it is useful to understand how it is distributed and where it is held. Total currency on issue is made up of banknotes and coins and can be split into currency holdings of the non-bank sector and currency holdings of banks (Table 1).[8] As an illustration, at the end of June 2012 there was $56.9 billion worth of currency in circulation, of which $51.0 billion was held by the non-bank sector and $5.9 billion was held by the bank sector.

7 Previous sharp depreciations do not appear to have been associated with rises in currency on issue, and we find the exchange rate is not significant in a currency demand model (see Section 4.4.2).
8 We refer to ADIs as the bank sector and currency holdings outside ADIs as holdings of the non-bank sector. The non-bank sector includes household, corporate, government and foreign sectors.

Currency on Issue by Type and Holder Table 1
As at 30 June 2012

	$b	Data frequency
Banknotes	53.6	Weekly/daily[(a)]
Coins	3.4	Monthly
Total	**56.9**	**Monthly**
Non-bank sector	51.0	Monthly
Bank sector	5.9	Monthly

Note: (a) Daily data available from 15 May 2008 onwards
Sources: APRA; RBA; Royal Australian Mint

3.1 Currency Holdings of the Non-bank Sector

Currency held by the non-bank sector has trended steadily upward through time, roughly in line with nominal GDP. However, demand for Australian currency by the non-bank sector increased dramatically in late 2008 as the global financial crisis intensified and policymakers responded (Figure 5). Currency holdings of the non-bank sector jumped by 5 per cent in October 2008 (a rise of just over $2 billion). In seasonally adjusted terms, that is 1¼ percentage points larger than the next biggest monthly increase in the history of the series going back to 1959.

The strong growth continued such that the increase in currency holdings over the three months to 31 December 2008 was 8 percentage points higher than the average increase over the same period in the previous four years. This is equivalent to an additional $3¼ billion and was 8 standard deviations above average, so cannot be considered a part of normal volatility. The increase in currency holdings of the non-bank sector was pronounced, but temporary. After a few months of very rapid growth, the currency stock stabilised and returned to trend by around mid 2010.

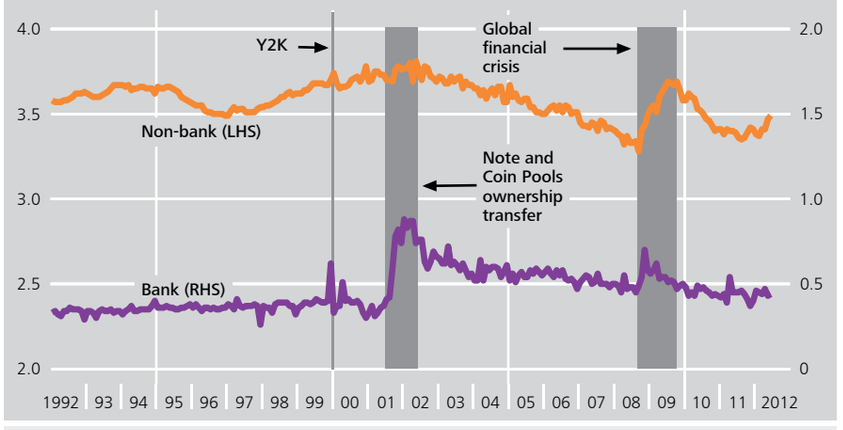
3.2 Currency Holdings of the Bank Sector

Bank holdings of currency are usually fairly stable as a ratio to nominal GDP, although there have been three periods since the early 1990s when this was not the case (Figure 5). Understanding these periods can tell us something about bank behaviour and aids in the econometric modelling of the total currency series (see Section 4).

The first occasion was in preparation for the year-date change at the end of the millennium (that is, 'Y2K'). Commercial banks increased their currency holdings sharply in case they experienced an increase in currency demand from their customers. In the event, the date change was virtually incident free, and the stocks that were built up were not drawn upon (RBA 2000).

Sectoral currency holdings Figure 5

Percent of annual GDP, seasonally adjusted



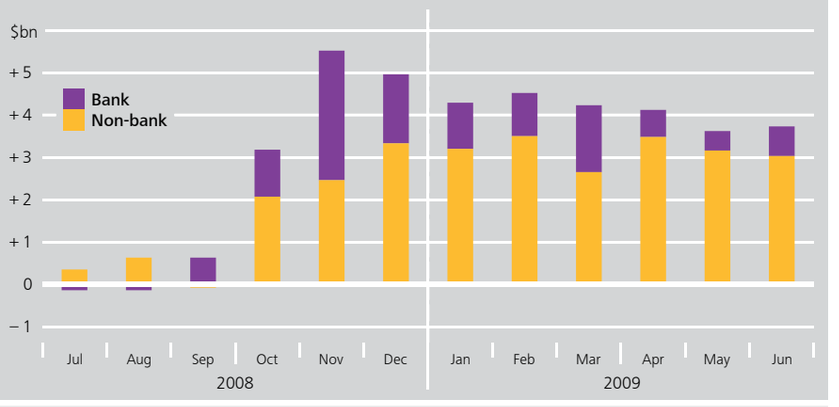
Sources: ABS, RBA.

The second period began in August 2001, when the processing and storage of banknotes was outsourced from the RBA and banknote distribution arrangements were changed such that ownership of the RBA's Note and Coin Pools was transferred to the commercial banks (Carlin 2004). In lieu of the RBA's Note and Coin Pools, commercial banks are allowed to hold verified cash holdings (VCH), which attract interest payments from the RBA. VCH act as a buffer stock between the RBA's contingency holdings of banknotes and the day-to-day needs of commercial banks. The overall result of this change was a step increase in the level of bank holdings, as well as a transitory spike as banks became accustomed to the new arrangements.

The third period was during the global financial crisis in late 2008. This period was different to the previous two periods in that currency demand by the non-bank sector also increased sharply. During 2008/09 there was additional currency demand – that is, growth in excess of average growth in the previous four years – in both the non-bank and bank sectors (Figure 6). The peak in additional currency holdings came in November 2008, with the bank sector accounting for around $3 billion of the $5½ billion in total additional currency holdings.

Additional currency demand Figure 6

2008/09 growth compared to average growth*



* Calculated as the difference between the cumulative growth to date in 2008/09 and the average cumulative growth to date for 2004/05-2007/08.
Source: RBA.

In response to signs of increased demand for currency from the banking sector, the RBA changed operational arrangements on 10 October 2008 to allow interest to be paid on all VCH rather than only on a predetermined limit as had previously been the case. This facilitated banks building up buffers of currency beyond the increase in demand from the non-bank sector in order to be prepared for any further spikes in demand for currency.[9] To some extent this experience echoes the build-up of cash in banks on the eve of Y2K, where banks built up a buffer of currency. However, unlike the Y2K episode, the public did demand additional currency. Such precautionary build-ups of currency by banks are a sensible risk management strategy given the potential for very adverse effects if they are unable to meet the demands of their depositors.

3.3 Banknote Distribution by the RBA

The rise in currency demand in late 2008 was not large enough to have any destabilising effects on the financial system, but it did raise some concerns about the physical provision of sufficient banknotes. The RBA was able to meet the additional demand from its existing contingency holdings of banknotes, and the 2008/09 production schedule was accelerated in case the increased demand for banknotes was sustained. The RBA also temporarily suspended the destruction of unfit banknotes, but these were never used and were subsequently destroyed.

This experience demonstrated that sharp rises in banknote demand have the potential to be disruptive to normal operations. As a result, the RBA has increased its contingency holdings to reduce the likelihood of shortages in the event of a future crisis and has improved banknote distribution to alleviate any logistical problems in periods of heightened demand.

9 There is some anecdotal evidence of large withdrawals from banks at the time (e.g. Taylor and Uren 2010), although withdrawal data show only a moderate increase (see Section 3.5).

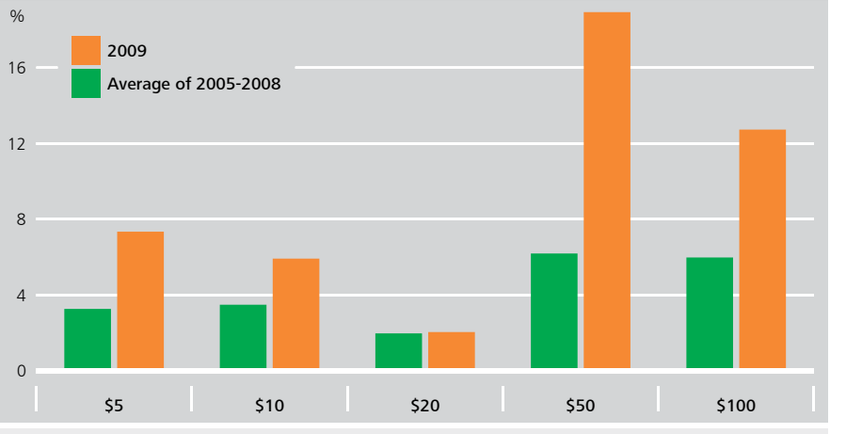
3.4 Banknotes on Issue by Denomination

The daily banknotes-on-issue data are available by denomination. The surge in banknotes on issue in late 2008 was not evenly spread across all denominations, but was most pronounced for high-value denominations (Figure 7). The value of low-denomination banknotes on issue also increased, but the extent of the increase was substantially less.

The difference in growth between low-value and high-value denominations suggests that the rapid rise in banknote demand was driven by increases in the demand for currency as a store of value, rather than increases in demand for transactions. A strong rise in transactional demand would probably have resulted in stronger demand for low-denomination banknotes as merchants would have required them to make change (although it is possible that a brief increase in transactional demand associated with the fiscal stimulus may have resulted in a faster rate of turnover of these low-denomination banknotes).

Banknotes on Issue by Denomination Figure 7

Year-ended percentage change to March



Source: RBA.

In contrast, $50 and $100 banknotes are more likely to be held to store value, so their demand is likely to have been more sensitive to concerns about the stability of financial institutions.[10] The sharp rise in $50 banknotes could be interpreted in either way as they are used in transactions as well as to store value. They are also the most common banknote withdrawn from ATMs, so the government stimulus payments probably contributed to some of the rise in $50 banknotes on issue. Ideally, we would like to consider non-bank currency demand by denomination but data limitations mean that we can only do this for total banknotes on issue.

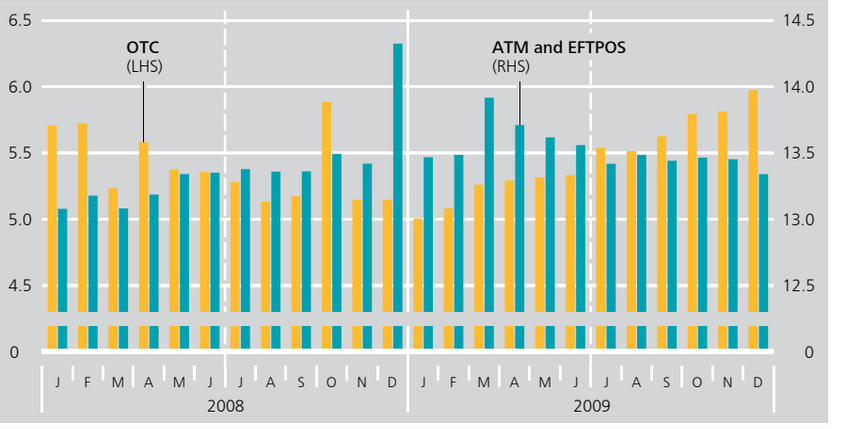
3.5 Withdrawals

Another dimension to currency demand through this period is retail cash withdrawals – that is, withdrawals either in banks over the counter (OTC), from ATMs (automated teller machines) or as cash taken out as part of EFTPOS transactions (electronic funds transfer at point of sale). OTC withdrawals picked up noticeably in October 2008, and were $700 million higher than the level in adjacent months (Figure 8).[11] The increase in the value of withdrawals in October was greater than the increase in the number of withdrawals, which is consistent with a small number of people making large precautionary withdrawals due to financial uncertainty. ATM withdrawals show an $850 million spike in December and another smaller spike in March 2009.[12] These two spikes coincided with government stimulus payments.

10 Foreign demand for Australian currency, for example to satisfy retail foreign exchange demand, is mostly for $100 banknotes as they are the least costly to transport. Some of the increase in demand for $100 banknotes was likely to have been from offshore.
11 The series is fairly volatile, so it is difficult to read much into this monthly movement. Nevertheless, growth in October was 5 standard deviations above average so represents some highly unusual behaviour.
12 The series is multiplicatively seasonally adjusted and December has the highest value of withdrawals, so the spike in December 2008 could be understated by about 10 per cent.

Retail currency withdrawals Figure 8

$ bn, seasonally adjusted



Source: RBA.

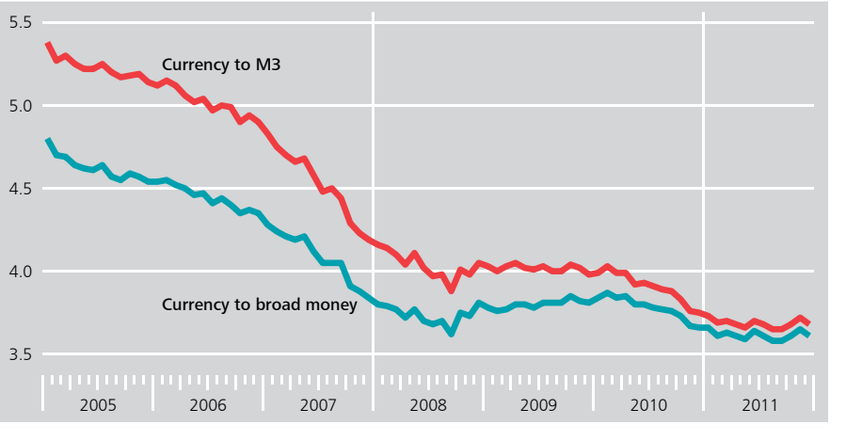
Taken together, the three spikes in the withdrawals data can only account for just over half of the $3¼ billion in additional currency holdings of the non bank sector. However, retail withdrawals are only one way that the total stock of non-bank currency holdings can change. A lower-than-usual flow of cash deposits into banks by households and businesses in late 2008 would also have caused currency holdings of the non-bank sector to rise, all else being equal. These retail withdrawals data do not include corporate or government withdrawals and can only give a partial view of currency flows.

3.6 Deposits

The rise in currency on issue in late 2008 was quite significant relative to the stock of currency. In light of international bank failures at the time, a natural question to ask is whether this additional currency demand in Australia was part of a shift away from bank deposits. Deposits data show this was not the case. Deposits rose over late 2008 (coinciding with the announcement of the Australian Government deposit guarantee on 12 October), suggesting that any concerns that some people may have had about the banking sector were not widely held. The rise in deposits was not as sharp as the rise in non-bank currency holdings at the time, resulting in an increase in the ratio of currency to deposits between September and December 2008 (Figure 9). But the increase in deposits suggests that confidence in Australian banks remained very strong. To the extent that the rise in currency demand suggests that a minority may not have shared in the broader public's confidence in the banking system, this is somewhat surprising given the introduction of the deposit guarantee.

While there is no evidence of any substantive lack of confidence in financial institutions across the community, there were some signs of nervousness among some depositors at this time, with the largest banks gaining market share in the period preceding the guarantee announcement at the expense of some smaller institutions (RBA 2009b). The introduction of the deposit guarantee system quickly quelled whatever depositor nervousness there had been, and deposits grew strongly thereafter.

Ratios of non-bank currency holdings to deposits* Figure 9



* Deposits are calculated as M3 and broad money less currency holdings of the non-bank sector.
Source: RBA.

4 Modelling Currency Demand in Australia

In this section, we estimate how much of the increase in currency demand in late 2008 can be explained by traditional factors (i.e. interest rates and income movements). A large unexplained rise in currency holdings in this period would be consistent with an increase in precautionary demand. We consider banknote demand split by denomination, as well as total currency on issue, to help identify transactional demand compared to store-of-value or precautionary demand. To achieve these aims, we draw upon three strands of the literature: traditional models, transaction cost models and financial crisis models.

4.1 Traditional Models

Most money demand models include income and interest rates as explanatory variables. Income is positively related to money demand because demand for

transaction balances increases in line with income. Interest rates are negatively related to money demand because a higher interest rate increases the opportunity cost of holding money. Early Australian money demand models following this literature include Cohen and Norton (1969) and Stevens, Thorp and Anderson (1987).

de Brouwer, Ng and Subbaraman (1993) explore the sensitivity of Australian money demand relationships to specification changes across various definitions of monetary aggregates, economic activity and interest rates. They find the real long-run demand for currency to be a function of real income and an opportunity cost variable. However, they find the existence of cointegrating relationships to be highly dependent on the definitions of variables.

Lim (1995) establishes a cointegrating relationship between M1, income, the rate of return on money and the rate of return on other assets using an error correction model estimated on Australian data.[13] In contrast, Felmingham and Zhang (2001) only find a cointegrating relationship between a broad definition of Australian money, GDP, interest rate spreads and inflation.

In our model, we use currency holdings of the non-bank sector to represent currency demand, as this series captures the behaviour of the public.[14] We also consider total banknotes on issue because these data allow for separate modelling of demand for different denominations.[15] The changes to banknote distribution in 2001 discussed in Section 3.2 mean that there is a level shift in the total banknotes-on-issue series. We control for this shift using a dummy variable. The changes to distribution arrangements also resulted in a transitory spike in banknote holdings for the three quarters after the change, so we include temporary dummy variables in the affected quarters.

13 In Australia, M1 is the sum of currency plus bank current deposits of the private non-bank sector.
14 Full details of all data series and sources are given in the Glossary.
15 Analysing currency on issue, which includes banknotes and coins, makes no difference to the results.

To capture the opportunity cost of holding currency, we include a composite interest rate for retail deposits. This rate is a weighted average of at-call savings deposit rates and term deposit rates.[16] We use nominal GDP as our income variable, although the results are robust to other measures.

4.2 Transaction Cost Models

We also consider models that explicitly include transaction costs. Models that omit these influences may be misspecified and thus have biased estimates of the effect of interest rates on currency holdings. This method is particularly useful when modelling the determinants of high- and low-denomination currency demand separately because the effects of transaction costs on demand are likely to be different for different denominations.

Baumol (1952) and Tobin (1956) develop inventory models of the demand for currency, in which consumers take into account the cost incurred per withdrawal (including the opportunity cost of time and effort). If withdrawing currency becomes less costly, consumers will withdraw less currency more often and thus hold less cash on average. This idea has been incorporated into empirical models by including the number of ATMs and EFTPOS terminals into money demand models (Drehmann, Goodhart and Krueger 2002; Amromin and Chakrovorti 2009). They find a weak relationship between these transaction cost variables and currency demand.

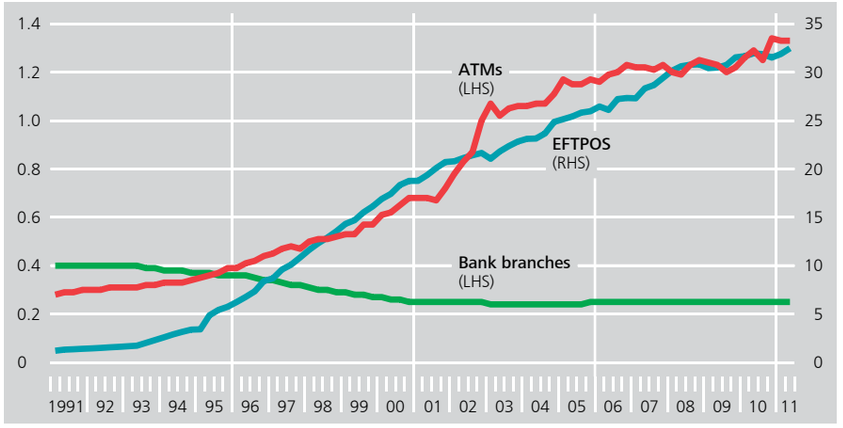
To capture transaction cost effects, we include the number of ATMs, the number of EFTPOS terminals and the number of bank branches per capita. Over the past two decades, ATM and EFTPOS terminal numbers have increased substantially while bank branches per capita have declined (Figure 10). More of these currency access points make it easier to obtain currency, which would tend to decrease the

16 The weighted average deposit rate is highly correlated with the cash rate, especially in the pre-GFC sample. Using the cash rate instead has little effect on most of the modelling results.

average holdings of currency by the public. EFTPOS terminals also allow substitution from cash to debit cards. Working in the other direction, however, ATM providers demand more banknotes to stock the extra machines.

Points of currency access Figure 10

Number per 1,000 residents



Sources: ABS, Australian Payments Clearing Association.

Judson and Porter (2004) find a positive relationship between the share of small businesses and banknote demand across all denominations. Amromin and Chakrovorti (2009) include the ratio of self-employment to total employment in the economy to measure the number of small businesses and they find it to be positively related to demand. They suggest two reasons for this relationship. First, small businesses are less likely to have EFTPOS terminals. Second, small businesses are more likely to undertake the quick low-value transactions that are the most likely to be conducted using cash (see also Emery, West and Massey 2007). We include the ratio of self-employment to total employment to capture this effect.

4.3 Financial Crisis Models

There is some literature on currency demand during financial crises. Bjørnland (2003) finds that currency demand increased substantially during the Venezuelan banking crisis of the mid 1990s, but returned to trend in the long run. Miyagawa and Morita (2009) find a cointegrating relationship between money demand, interest rates, GDP and a 'financial anxiety' variable that holds through the financial crises in Finland and Japan during the early 1990s. The financial anxiety variable – derived from business survey data – accounts for a strong rise in money demand, which the authors attribute to a rise in precautionary balances in those countries during these crises. Khamis and Leone (1999) use Mexican data to find a stable cointegrating relationship between real currency balances, real private consumption expenditure and an interest rate, even during the financial crisis in the 1990s.

Few papers have examined the stability of money demand over the most recent financial crisis. Beyer (2009) uses euro area data and finds a stable cointegrating relationship within a vector error correction model that includes M3 over a sample that includes the financial crisis. The inclusion of a wealth variable is crucial to this stability.

We attempt to capture the effects of the global financial crisis (GFC) on currency demand in three ways. First, we add dummy variables for the three quarters from December 2008 to June 2009 to the baseline model. Second, we introduce confidence, financial market and wealth variables to our model. Finally, we examine whether these wealth variables retain any explanatory power in the presence of dummy variables. We would expect rises in the stock of currency to be associated with declines in confidence and wealth variables, and rises in financial volatility variables. In particular, we look at the NAB business confidence survey, the Westpac-Melbourne Institute consumer sentiment survey, stock market volatility and household wealth. These variables were all affected in a highly correlated fashion during the global financial crisis, but none can be considered to directly measure

households' confidence in the banking system. As a result, at best we can only proxy for the precautionary demand motive.

4.4 Estimating Error Correction Models

Following de Brouwer et al (1993) we model currency demand in an error correction framework to exploit the possible cointegration between currency holdings, GDP and interest rates. We also include ATMs, EFTPOS terminals, bank branches per capita and the ratio of self-employment to total employment in the long-run relationship to form a general error correction model: [17]

$$\Delta c_t = \lambda\left(c_{t-1} - \beta X_{t-1} - \beta_0\right) + \sum_{i=1}^{m} \delta_i \Delta c_{t-i} + \sum_{j=0}^{n} \gamma_j \Delta X_{t-j} + \varepsilon_t \quad (1)$$

$$X_t = \left[GDP_t \;\; DepositRate_t \;\; \frac{ATM_t}{Pop_t} \;\; \frac{EFTPOS_t}{Pop_t} \;\; \frac{BankBranch_t}{Pop_t} \;\; \frac{SelfEmp_t}{Emp_t}\right]$$

where ct is the currency stock in period t, β is a vector of long-run parameters, X_t is a vector of variables including nominal GDP, the deposit interest rate, ATMs per capita, EFTPOS terminals per capita, bank branches per capita, the ratio of self-employment to total employment and β_0 is a constant. All variables except the interest rate are in logarithms. The speed of adjustment parameter is λ, and the parameters for the dynamic terms are δ_i and γ_j. The residual is ε_t. We estimate the model using quarterly data from March 1993.

4.4.1 Non-bank sector currency holdings results

We start with currency holdings of the non-bank sector as the dependent variable. All variables from the cointegrating vector in Equation (1) are significant so were retained, except the self-employment variable because its sign was negative (which goes against its theoretical rationale).[18] Among the dynamic terms, only the first lag of changes in the currency stock is significant so it is the only dynamic term retained.

Focusing initially on the pre-GFC sample, the coefficients on GDP and the interest rate are significant and have the expected signs (Table 2). The elasticity on GDP is not significantly different from unity, suggesting that GDP growth is met with commensurate growth in the currency stock in the long run. The semi-elasticity of the currency stock with respect to the deposit rate is –1.3 per cent. This implies that a permanent 100 basis point decrease in the deposit rate is associated with a $520 million long-run increase in the currency stock, based on the level in mid 2008. The magnitude of the semi-elasticity is broadly consistent with that estimated in de Brouwer et al (1993).

17 The financial crisis variables are omitted at this stage, but are included in Section 4.4.2.

18 Excluding the self-employment variable has no major bearing on other coefficients.

Non-bank Currency Holdings – Error Correction Model Table 2

	1993:Q1–2008:Q2	1993:Q1–2011:Q4	
		Without GFC dummies	With GFC dummies
Speed of adjustment (λ)	–0.23***	–0.26***	–0.23***
GDP_{t-1} (β_1)	1.07***	1.02***	1.00***
$DepositRate_{t-1}$ (β_2)	–0.013*	–0.005	–0.011***
ATM_{t-1} (β_3)	–0.16**	–0.12***	–0.12***
$EFTPOS_{t-1}$ (β_4)	–0.06***	–0.04***	–0.06***
$BankBranches_{t-1}$ (β_5)	–0.59***	–0.50***	–0.55***
Constant (β_0)	4.93**	6.52***	6.39***
Δc_{t-1} (δ_1)	–0.30**	0.15	–0.17
Dummy variables			
GFC (2008:Q4)			0.044***
GFC (2009:Q1)			0.026***
GFC (2009:Q2)			0.015**
Adjusted R^2	0.41	0.31	0.63
Standard error	0.0046	0.0070	0.0048
LM(5) test[(a)]	0.20	0.31	0.23
Chow test (mid sample)[(a)]	0.04	0.26	0.30

Notes: ***, ** and * indicate significance at the 1, 5 and 10 per cent level, respectively
[(a)] p-value of F-statistic reported

The negative coefficients on ATMs, EFTPOS terminals and bank branches are in keeping with theory. That is, by making it easier to access cash (or pay without cash), these variables are inversely related to currency demand. To give some scale to the magnitudes of the coefficients of these variables, a 10 per cent increase in ATMs and EFTPOS terminals per capita is estimated to reduce currency demand by 1.6 and 0.6 per cent respectively. A 1 per cent reduction in bank branches per capita is estimated to increase currency holdings by 0.59 per cent.[19]

Overall, non-bank currency holdings grew by 6 per cent per year on average over the period. Nominal GDP was the main driver, accounting for around 7 per cent average annual growth. The net effect of trends in ATMs, EFTPOS terminals and bank branches was negative and in the order of an average reduction of 1 per cent per year in currency holdings.

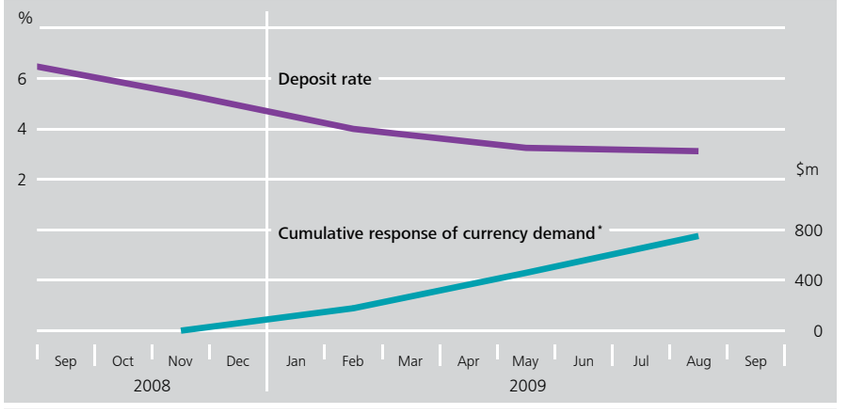
Extending the sample to include the surge in currency during the global financial crisis (but with no dummy variables) leads to some changes in the coefficients. In particular, the interest rate becomes insignificant and the lagged dependent variable changes sign and becomes insignificant. With the inclusion of GFC dummy variables, the coefficient on the deposit rate estimated over the full sample is not significantly different to the pre-GFC sample estimation. The coefficient on lagged currency changes switches back to its original sign, but remains insignificant. No other coefficient estimates are significantly different in the two samples. A Chow breakpoint test at December 2008 rejects the null hypothesis of parameter stability, which is consistent with unusual currency demand behaviour from that point.

We can use the coefficients estimated in the pre-GFC sample to generate estimates of the effects of the changes in interest rates on currency demand. The fall in the deposit rate between the September quarter 2008 and the June quarter 2009 of 343 basis points implies a long-run increase of $1.8 billion in currency demand.

19 ATMs and ETPOS terminals per capita increased on average by 9 and 21 per cent per year respectively between 1993 and 2008. Bank branches per capita have decreased by an average of 3 per cent per year over the same period.

However, the short-run effects are much smaller. The estimated response of currency demand to the changing deposit rate in the late 2008–early 2009 period is around $500 million, only a small fraction of the overall rise (Figure 11).

Estimated response of currency demand to deposit rates Figure 11



***** The response is calculated based on coefficients estimated in the error correction model using the 1993:Q1-2008:Q2 sample.
Sources: RBA, authors' calculations.

The model is less well-suited to generating estimates of the effect of the fiscal stimulus payments on currency demand, although this effect will be captured to some extent through the GDP variable.[20] Overall, the dummy variables suggest that 4.4 percentage points of the 6.5 per cent rise in the December quarter 2008 can be attributed to factors other than interest rates and nominal GDP, and that almost all of the further rises in the March and June quarters of 2009 were unexplained by the model (Table 3).

20 The stimulus payments totalled around 1.7 per cent of annual GDP, but this cannot be directly translated to an increase in transactional demand because the payments were temporary and households could choose to save or spend them.

GFC Dummy Variables in the Error Correction Model Table 3

	Δ Non-bank currency %	Attributed to dummy ppts
December 2008	6.5	4.4 (0.6)
March 2009	2.7	2.6 (0.8)
June 2009	1.8	1.5 (0.6)
Total	11.0	8.5 (1.3)

Note: Standard errors of estimated coefficients are in parentheses

Around 80 per cent of the rise in currency holdings during the global financial crisis, therefore, cannot be explained by the standard explanatory variables, which is consistent with it being an unusual increase in precautionary demand for currency.[21]

4.4.2 Financial crisis models

We now examine whether confidence and financial variables add explanatory power to the baseline error correction model, and compare them to the GFC dummy variables. The results shown in Table 4 show that a number of these variables, when included individually, improve the explanatory power of the model overall. However, they do not improve the explanatory power of the models in the pre GFC sample, and the explanatory power of the variables disappears in the presence of the GFC dummy variables.

21 Given that bank deposits also rose, this could be interpreted as a general increase in demand for less risky assets. However, in estimations of a similar model with household deposits as the dependent variable, GFC dummy variables are not significant (compared with the highly significant dummies for non-bank currency holdings in Table 2). This suggests that the rise in currency holdings in late 2008–early 2009 was more unusual than the rise in deposits.

Financial Crisis Variables in the Error Correction Model Table 4

1993:Q1–2011:Q4

Financial crisis variables[a]	Sign	Additional R^2	
			GFC dummies included
GFC dummy variables	+	0.31	
TWI	–	0.23	0.01
VIX	+	0.14	0.00
ASX volatility	+	0.12	0.00
Business confidence	–	0.09	0.00
Household wealth[b]	–	0.05	0.00
ASX 200[b]	–	0.04	0.01
Consumer confidence	–	0.00	0.00

Notes: [a] Each included separately in the baseline model shown in column 2 of Table 2
[b] Variables expressed in logarithms

4.4.3 Estimation of banknotes on issue by denomination

Separate models of currency demand for different denominations allow us to test whether low-denomination banknotes are less sensitive to interest rates, which would be the case if the demand for these banknotes is driven more by transaction needs. We can also examine whether demand for high-denomination banknotes was more sensitive to the concerns that drove precautionary holdings of cash during the global financial crisis. We estimate separate models using low-denomination banknotes (the sum of five and ten dollar banknotes), fifty dollar banknotes and one hundred dollar banknotes.[22] The denomination splits are available only for

22 Twenty dollar banknotes are omitted due to their changing role over time. In regressions with twenty dollar banknotes, all explanatory variables except EFTPOS terminals are insignificant.

all banknotes on issue, not just non-bank holdings as above, so we estimate a model of total banknotes on issue as well for comparison.

Table 5 shows the regression results. We removed insignificant variables, leaving us with slightly different models for each independent variable.[23] The specification using total banknotes on issue is similar to the non-bank currency holdings specification in Table 2. The insignificant ATM coefficient could be because the extra currency used by the bank sector to stock ATMs offsets the negative effect of ATMs on non-bank sector currency holdings (as in Table 2). Also, the coefficient on the lagged changes in total banknotes is insignificant.

23 The coefficient on the dummy variable for Y2K in the December quarter 1999 is insignificant because the effect is muted by averaging across the quarter.

Banknotes on Issue by Denomination – Error Correction Models Table 5
1993:Q1–2011:Q4

	Total	Low-denomination	$50	$100
Speed of adjustment (λ)	–0.28***	–0.35***	–0.36***	–0.10***
GDP_{t-1} (β_1)	0.88***	0.57***	0.82***	1.14***
$DepositRate_{t-1}$ (β_2)	–0.011***	–0.010**	–0.017***	–0.019*
ATM_{t-1} (β_3)	–	–	0.10*	–
$EFTPOS_{t-1}$ (β_4)	–0.04**	–0.02**	0.08***	–0.22***
$BankBranches_{t-1}$ (β_5)	–0.42***	–	–	–1.05***
Constant (β_0)	9.87***	13.87***	14.45***	–
Δc_{t-1} (δ_1)	–	–	–	0.56***
Dummy variables				
VCH (2003:Q3 onwards)	0.03**	0.11***	0.06**	–0.13***
VCH (2001:Q4)	0.08***	0.12***	0.10***	0.04***
VCH (2002:Q1)	0.04***	0.03***	0.06***	–
GFC (2008:Q4)	0.07***	–	0.12***	0.03***
GFC (2009:Q1)	0.02**	–	0.03**	–
GFC (2009:Q2)	–	–	–	–
Adjusted R2[a]	0.50	0.37	0.49	0.68
Standard error	0.0076	0.0094	0.012	0.0064
LM(5) test[b]	0.12	0.03	0.58	0.13
Chow test (midpoint)[b]	0.95	0.17	0.94	0.54

Notes: ***, ** and * indicate significance at the 1, 5 and 10 per cent level, respectively; '–' indicates the variable was not significant and removed from estimation [a] Not including single quarter dummy variables
[b] p-value of F-statistic reported

The estimated interest rate coefficients are broadly consistent with the theory that demand for larger denominations should be relatively more sensitive to deposit rates. The insignificance of the GFC dummy variables in the low-denomination regression confirms that only larger denominations were behaving unusually in this period. The larger coefficients on the GFC dummies for the $50 banknote regression compared to the $100 banknote regression mirrors the larger rise in $50 banknotes seen at the time.

The rise in high denominations (particularly the $100 banknotes) is consistent with some individuals converting their deposits into currency for precautionary purposes as the events of the global financial crisis made them more apprehensive about holding deposits. The rise in deposits overall, however, seems to suggest that others may have increased their holdings of deposits by substituting out of relatively more risky assets such as trusts or mortgaged-backed securities.

5 Conclusion

The global financial crisis resulted in the failure or near-failure of a number of large financial institutions in many countries, putting financial markets around the world under considerable stress. Although the solvency of Australian banks was not in jeopardy, there was a substantial policy response in Australia due to the potential economic and financial consequences of the global financial crisis for the domestic economy. The Australian policy response included large interest rate cuts, substantial fiscal stimulus packages and the introduction of a comprehensive deposit guarantee scheme. Coinciding with these measures, Australian currency demand rose at an unprecedented pace, resulting in an additional $3¼ billion in currency holdings of the non-bank sector.

Around 20 per cent of this rise can be attributed to the normal response of currency holdings to the lowering of interest rates and the increase in incomes from the

government stimulus. The remaining 80 per cent of the rise may be due to an increase in precautionary holdings in response to uncertainty in the financial sector, which is consistent with the larger increases in demand for high-denomination banknotes. In addition to the rise in currency holdings of the non-bank sector, the banking sector also built up a larger-than-usual buffer of currency holdings to guard against spikes in customer demand. This meant that there was an additional $5 billion of currency on issue in total at the end of 2008.

The rise in currency demand was not large enough to cause any financial system instability. Indeed, bank deposits rose over the period in question. This suggests a degree of robustness in the Australian financial system that was lacking in some other advanced economies. However, the surge did raise some issues for the RBA's banknote distribution operations. The RBA's contingency holdings were tested, suggesting a prudent increase in these holdings as a precaution against any future crises.

It is somewhat surprising that the rise in currency demand occurred around the time that the Federal Government implemented a deposit guarantee. This may reflect the public reacting to the same news as policymakers, but the public may also have had concerns about short-term liquidity even with the deposit guarantee in place.

Data on banknotes on issue are available on a daily basis. Their value as a leading indicator has not been fully established, but they may give a real time sense of household and bank behaviour in a crisis, especially when buttressed by information from banks about the source of banknote demand and the motivation behind it. The data may also give a sense of whether financial market turmoil is spilling over into the broader economy.

Glossary

ASX 200 refers to the S&P/ASX 200 stock market index, from Bloomberg.

ASX volatility refers to the intraday range of the ASX 200 (expressed as a percentage of the midpoint), from Bloomberg.

ATM data are from the Australian Payments Clearance Association (APCA) website. Quarterly data are only available from June 1994 before which only annual data are available. Quarterly estimates are obtained by straight-line interpolation.

Banknotes on issue by denomination refer to the value of issued banknotes outside the RBA. These data are from internal RBA sources and seasonally adjusted by the authors, but are also available from the statistical tables on the RBA website, A6 Banknotes on Issue by Denomination.

Broad money data are from the statistical tables on the RBA website, D3 Monetary Aggregates, series mnemonic DMABMS.

Business confidence refers to the NAB business confidence index available from the statistical tables on the RBA website, G8 Indicators of Spending and Confidence, series mnemonic GICNBC.

Consumer confidence refers to the Westpac-Melbourne Institute consumer sentiment series available from the statistical tables on the RBA website, G8 Indicators of Spending and Confidence, series mnemonic GICWMICS.

Currency holdings of the non-bank sector data are from the statistical tables on the RBA website, D3 Monetary Aggregates, series mnemonics DMACN and DMACS.

Currency on issue refers to the sum of banknotes on issue and coins on issue. Coins on issue data are from the Royal Australian Mint.

Deposit rate data for at-call savings and term deposits are from the statistical tables on the RBA website, F4 Retail Deposit and Investment Rates.

EFTPOS terminals data are from the APCA website.

GDP is seasonally adjusted current price GDP from Australian Bureau of Statistics (ABS) Cat No 5206.0 'Australian National Accounts: National Income, Expenditure and Product', series ID A2304418T.

Household wealth data are available from the statistical tables on the RBA website, B20 Selected Assets and Liabilities of the Private Non-financial Sectors, series mnemonic BSPNSHUFAT.

Population data are from ABS Cat No 3101.0 'Australian Demographic Statistics', series ID A2060842F.

M3 data are from the statistical tables on the RBA website, D3 Monetary Aggregates, series mnemonic DMAM3S.

Retail currency withdrawals data are from internal sources and seasonally adjusted by the authors.

Self-employment is the ratio of self-employment to total employment. It was created and seasonally adjusted by the authors using ABS Cat No 6291.0.55.001 'Labour Force, Australia, Detailed - Electronic Delivery', Table 08. Specifying series ID, the formula to create the series is: (A53534F+A53537L)/A53543J.

RBA cash rate refers to the target cash rate series from the statistical tables on the RBA website, F1 Interest Rates and Yields – Money Market - daily, series mnemonic FIRMMCRTD.

TWI refers to the quarterly average of the daily trade-weighted exchange rate from the statistical tables on the RBA website.

VIX refers to the Chicago Board Options Exchange SPX Volatility Index, from Bloomberg.

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David Barlow
Sectoral holdings of notes and coins in the UK: The effect of the crisis commencing in 2007

David Barlow
Lecturer in Economics, Newcastle University
Business School, Great Britain

Abstract

One consequence of the recent global financial and economic crisis for the UK has been that the share of M1 held as notes has increased, contrary to the trend since the mid-1970s. To investigate this, error feedback equations for the holdings of notes and coins by UK households and by UK non-financial corporations are initially estimated for the period up to 2007Q2 (the quarter prior to the rescue of Northern Rock). The cointegrating relationships yield an income elasticity of near to unit with plausible interest (semi) elasticity. When the functional form for the interest rate is semi-log the equations are found to be stable when the period is extended to include the period since the near collapse of Northern Rock (2007Q3 to 2012Q4). But for the double log specification (constant interest rate elasticity) there is evidence of instability, in particular a considerable reduction in the rate at which money balanc-

es return to equilibrium. Overall the evidence suggests that if we allow for the non-constant interest rate elasticity the behaviour of the holdings of notes can largely be explained by the extraordinarily low interest rates. Inspection of the components of M1 reveals that the impact of the crisis is much more pronounced for bank deposits than for notes. This effect is particularly strong in the household sector for which there has been a large fall in holdings of interest bearing sight deposits and a rise in non-interest bearing sight deposits greater than the increase in holdings of notes and coins.

Introduction

In the UK the 2007 credit crunch became evident to retail bank customers with the run on Northern Rock in September 2007. The Bank of England, like many other central banks, responded to the intensifying economic financial crisis with marked reductions in its base rate over 2008/9 which since June 2009 has been held at an all-time low of 0.5%. With the policy rate close to the zero bound the Bank was compelled to adopt 'extra-ordinary' monetary policy measures, such as 'quantitative easing'.

During this crisis individuals and corporations have significantly reversed a long term trend by increasing the share of M1 that they hold as notes. Can this increase in holdings of notes be explained by a 'standard' money demand function or are additional variables required, such as was the case to account for the effects of financial innovation in the 1970s and 1980s? Given that this changed behaviour coincides with the unusually low interest rate one issue to consider is the specification of the relationship between money holdings and the rate of interest.

The traditional money demand function takes the 'semi-log' form in which all variables except the interest rate are expressed as logarithms. The response of money to a change in the interest rate is then referred to as semi-elasticity, a response to

the percentage point change. If agents respond to the relative change in the interest rate then the interest rate should be measured in logarithms (these specifications are referred to as 'log-log'). In the latter specification the interest elasticity of money demand is constant, where-as in the former it is decreasing as the interest rate reduces. Lucas (2000) argues that on theoretical grounds the log-log specification should be preferred, for example, such money demand functions can be derived from general equilibrium models in which money balances are held to increase leisure time. Chadha et al. (1998) argue that theoretically consistent preferences and transactions technology would lead to a logarithmic interest rate specification.

At moderate rates of interest the two specifications tend to perform equally well. But at low interest rates the performances can vary greatly because the log-log implies infinitely large money balances as the nominal interest rate approaches zero, where-as the semi-log has a finite satiation point. Janssen (1998) for UK M0 reports a marginal preference for the log-log specification. But note that this applies to a period in which the Treasury rate never fell below 4.3%. In contrast since 2009 the Treasury bill rate has not exceeded 1%.[1]

Review

Baumol (1952) and Tobin (1956) provide the theoretical underpinnings of money demand analysis by considering the optimal inventory of money held to smooth the lack of synchronisation between income receipts and spending. These theoretical models clearly apply to non-interest bearing money, and show how the balances of such money held for the transactions motive vary positively with income and the

1 Lucas (2000) uses US M1 data to show plots of the money-income ratio and interest rate that support the log-log specification. However, using more recent data that includes a period of lower interest rates than in Lucas's sample Ireland (2009) presents plots (and econometric evidence) that favour the semi-log specification.

fixed cost of converting bonds into the medium of exchange, and negatively with the return on bonds. These models have strong predictions for values of the interest elasticity, income elasticity and conversion cost elasticity. In particular, the models predict economies of scale. There are, however, many reasons not to expect these strong predictions to hold.[2]

Empirical studies of the demand for notes and coins, either in aggregate or by sector, are much rarer than for broader aggregates such as M1, M3 and M4[3]. Research on M0 is more relevant, as M0 consists of holdings of notes and coins by the household sector and the non-financial corporate sector plus commercial banks operational balances at the Bank of England[4]. Studies of M0 include Hacche (1974), Artis and Lewis (1984), Thomas (1996) and Khadaroo (2003). Janssen (1998) reviews a number of specification issues regarding the demand for M0. Following World War 2 and until the early 1990s the velocity of M0 followed a positive trend. This trend meant that models in which the demand for money depends only upon a scale variable (income or spending) and an interest rate performed poorly. Widely accepted explanations are based upon changes in spending patterns and transactions technology[5] that improve the synchronisation between cash holdings and expenditure that reduced the optimal scale of the cash inventory.

2 One reason is that for those on low incomes the cost of converting income to bonds and then back into money can exceed the interest earned. Also if the timing of agents' income receipts closely matches their spending pattern they may not hold bonds sufficiently long to make bond holding worthwhile. Another reason is that the transaction cost may have a proportional element.
3 See, for example, Hendry and Ericsson (1991) and Ericcson (1998). For sectoral analysis see Drake and Chrystal (1994) and (1997).
4 Until quite recently, household sector holdings of cash accounted for more than 90% of M0. However, the Bank of England ceased reporting M0 from 2006 in anticipation of a significant rise in the commercial banks' holdings of reserves following a change in the way the Bank remunerated reserves. As a consequence of quantitative easing bank reserves now account for about 80% of the equivalent of M0.
5 The increased velocity may also have been due to higher inflation. One reason for this could be lags in the adjustment of the nominal interest rate to expected inflation. A second reason could be the substitution of M0 by durable goods. An additional explanation stems from the positive correlation between inflation and its variability. A number of papers find model performance improves with the addition of inflation. Janssen (1998), for example, incorporates the standard deviation of inflation.

Data and Estimation

The standard long run money demand function, originating from Cagan (1956), is given by:

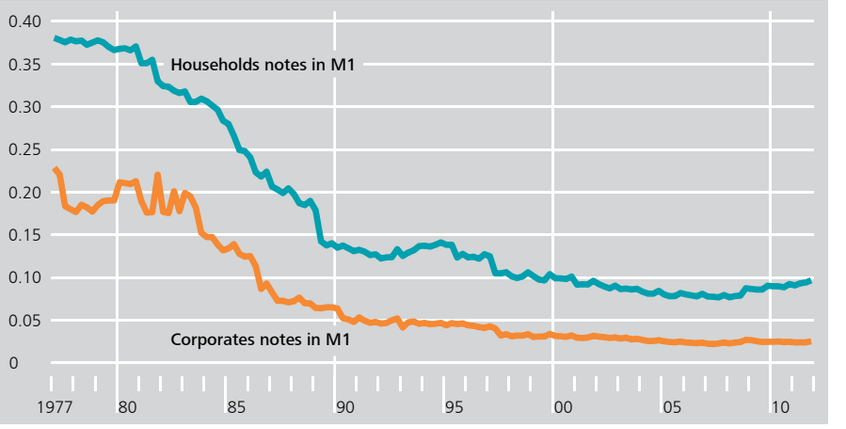
$$m_t = \alpha_0 + \alpha_1 R_t, \quad (1)$$

and the log-log money demand function, based on Meltzer (1963), is given by:

$$m_t = \beta_0 + \beta_1 r_t, \quad (2)$$

Where m is the logarithm of the ratio of money to GDP, R is the interest rate, r is the log of the interest rate, t denotes time, and $\alpha_1<0$ and $\beta_1<0$.

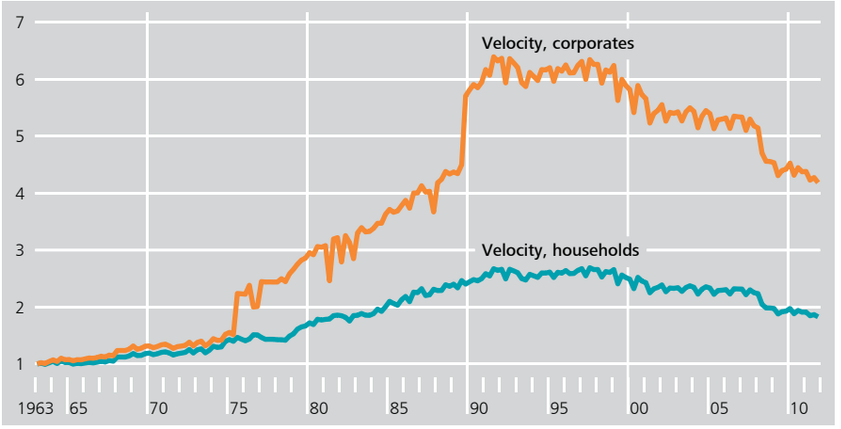
Ratio of notes in M1 Figure 1



The data for money is the holdings of notes and coins by UK households and by the non-financial corporate sector. R is the 3 month Treasury bill rate. Figure 1 plots the holdings of notes and coins relative to M1 for both sectors, and shows that around 2007/8 there is a clear reversal of the tendency for this ratio to decline. The initial estimation period is 1990q3 to 2007q2. The latter period is selected as being the quarter prior to Northern Rock's problems becoming public; the period is then extended to 2012Q4 to test for stability. The starting period is more problematic.

Income velocity of circulation Figure 2

1963 Q3 = 1



For both sectors the velocity of notes exhibits a secular upward trend until the end of the 1980s (see figure 2). A number of papers published over the 1980s and 1990s report that money balances, income and an interest rate require measures

of financial innovation to constitute empirically valid money demand functions[6]. However, there is some consensus that financial innovation in cash management moderated greatly from around 1990[7], as indicated by the income velocity ceasing to rise. Janssen (1998) argues that models of M0 that incorporate measures of financial innovation performed less well once they were applied to data that included the 1990s and that there is evidence that the shift to a lower inflation environment caused a shift in the demand for M0[8]. To avoid the estimates depending upon how these shifts are modelled the estimation period starts at 1990q3[9].

The estimation strategy is to first determine the orders of integration of the data. Then use Johansen's (1988) maximum likelihood procedure to test if equations (1) and (2) constitute cointegrating relationships. If a single cointegrating vector can (5) not be rejected then the values of α_1 and β_1 are calculated using ARDL equations (see Pesaran and Shin 1999), such as 3 and 4 below, estimated over the period to (6) 2007Q2.

$$\Delta M_t = \partial_0 + \sum_{j=1}^{n} \partial_{1,j} \Delta M_{t-j} + \sum_{j=1}^{n} \delta_{2,j} \Delta R_{t-j} + \sum_{j=1}^{n} \delta_{3,j} \Delta Y_{t-j} + \delta_4 (M-Y)_{t-1} + \partial_5 R_{t-1} + \varepsilon_t \quad (3)$$

$$\Delta M_t = \gamma_0 + \sum_{j=1}^{n} \gamma_{1,j} \Delta M_{t-j} + \sum_{j=1}^{n} \gamma_{2,j} \Delta r_{t-j} + \sum_{j=1}^{n} \gamma_{3,j} \Delta Y_{t-j} + \gamma_4 (M-Y)_{t-1} + \gamma_5 r_{t-1} + \sigma_t \quad (4)$$

6 For example, the number of ATMs, the proportion of the population with current accounts and the number of credit cards (see Johnston (1984) and Janssen (1998). Hall et al (1989) and Walton and Westaway (1991) endogenise financial innovation by using a cumulated interest rate. Financial innovation went beyond technology improving access to bank deposits; a further significant innovation was interest bearing sight deposits which increased rapidly over the 1980s from near zero at the start of the decade to almost 80% of sight deposits by the end of the decade. In addition, a change in regulation meant employees could no longer insist on payment in cash.
7 See for example Grant et al (2004).
8 Khadaroo (2003) models M0 using a smooth transition equation in which the transition variable is the quarterly change in the interest rate one year previously.
9 If the estimation period starts earlier there is strong evidence of serial correlation and non-cointegration for whichever interest rate specification is adopted. The study by Chadha et. al. (1998) which uses annual UK data for 1870 to 1994, illustrates the problem of using long runs of monetary data as they report that evidence for cointegration between M0, real GDP and the opportunity cost is 'not overwhelming'.

Where M is the logarithm of holdings of notes and coins deflated by the consumer price deflator, Y is the logarithm of real GDP, *R* is the 3 month Treasury bill rate[10], *r* is the logarithm of R, Δ is the first difference operator, σ and ε are random errors, and t denotes time. The long run interest rate semi-elasticity (α_1) is calculated as $-\delta_5/\delta_4$, and the long run income elasticity (β_1) as $-\gamma_5/\gamma_4$. Notice that though the long run income elasticity is constrained to unity this does not apply to the short run income elasticity[11]. The estimated long run parameters are then used to calculate the corresponding cointegrating residuals, EC1 and EC2, to use in obtaining parsimonious equations from the following general equations that permit contemporaneous responses.

$$\Delta M_t = \partial_0 + \sum_{j=1}^{n} \partial_{1,j} \Delta M_{t-j} + \sum_{j=0}^{n} \delta_{2,j} \Delta R_{t-j} + \sum_{j=0}^{n} \delta_{3,j} \Delta Y_{t-j} + \delta_4 EC1_{t-1} + \varepsilon_t \quad (5)$$

$$\Delta M_t = \gamma_0 + \sum_{j=1}^{n} \gamma_{1,j} \Delta M_{t-j} + \sum_{j=1}^{n} \gamma_{2,j} \Delta r_{t-j} + \sum_{j=1}^{n} \gamma_{3,j} \Delta Y_{t-j} + \gamma_4 EC2_{t-1} + \sigma_t \quad (6)$$

10 Data for balances of notes and coins and for the Treasury bill rate are from the Bank of England. Data for the GDP deflator and GDP are from the US Federal Reserve Economic Data. The estimating equations also include quarterly dummies.
11 If the Johansen test is applied to a vector containing money, income and the interest rate or log (interest rate) rather than the money income ratio then a single cointegrating vector cannot be rejected and the parameter on income is very close to unit. This is in marked contrast to studies (of M0) that cover the 1970s and 1980s in which the unit value is only found when proxies for financial innovation are included.

Results

Using both the Augmented Dickey-Fuller test and the Phillips-Peron test a single unit root could not be rejected for *m, R, r, M* and *Y*. For both sectors the Johansen procedure could not reject a single cointegrating vector[12]. From the estimates of equations (3) and (4) α_1 is calculated to be -4.07 and -5.8 for the household and corporate sectors respectively[13], and β_1 is calculated to be -0.24 and -0.31 for the households and corporates respectively.

The parsimonious error correction equations are reported in tables 1 and 2. For each sector when the parsimonious equations are estimated to 2007Q2, it is difficult to distinguish between the interest rate specifications. All of the equations pass the diagnostic tests for serial correlation, heteroscedasticity, the reset test and the cusum test for stability[14]. Furthermore, the sign on each cointegrating residual is consistent with cointegration, and each is strongly significant from zero.

12 Information criteria suggested using 2 lags of the differenced terms for the household sector and 4 lags for the corporate sector.
13 These values for the semi-elasticity are very similar to those reported by Khadaroo (2003) for M0, who also finds a unit income elasticity. Khadaroo also includes a time trend to control for the effects financial innovation.
14 The results of the unit root tests, Johansen estimation and cusum tests are available from the author on request.

Parsimonious Estimates for Household Sector

Table 1

Households	Semi-log	Semi-log	log-log	log-log
period	90Q3-07Q2	90Q3-12Q4	90Q3-07Q2	90Q3-12Q4
intercept	-1.87 (0.40)	-1.73 (0.37)	-2.13 (0.67)	-0.46 (0.23)
$EC1_{t-1}$	-0.12 (0.03)	-0.11 (0.02)		
$EC2_{t-1}$			-0.13 (0.04)	-0.03 (0.014)
ΔM_{t-1}	-0.31 (0.11)	-0.27 (0.09)	-0.38 (0.11)	-0.31 (0.10)
ΔY_{t-1}			1.07 (0.57)	1.12 (0.34)
Δr_t			-0.06 (0.03)	-0.05 (0.015)
adj. R^2	0.72	0.72	0.74	0.69
LM(5)	0.19	0.28	0.52	0.29
Arch	0.19	0.2	0.38	0.77
Reset	0.22	0.2	0.14	0.53
Chow	0.92		0.28	
n. obs	68	90	68	90

Notes: Numbers in brackets are standard errors, EC1 and EC2 are the cointegrating residuals calculated from the estimates of equations 3 or 4. Δ is the first difference operator, M is the log of notes and coins deflated by the GDP deflator, Y is log of real GDP, r is the log of the interest rate, LM(5) is the Godfrey test for serial correlation of up to the 5th order, Arch is the test for first order auto-regressive conditional heteroscedasticity, Reset is the first order Ramsey reset test, Chow is the Chow forecast test applied to the period 2007Q3-2012Q4 (LM5, Arch, Reset and Chow are reported as probability values), and n. obs is the number of observations.

Parsimonious Estimates for Corporate Sector

Table 2

corporate	Semi-log	Semi-log	log-log	log-log
period	90Q3-07Q2	90Q3-12Q4	90Q3-07Q2	90Q3-12Q4
intercept	-2.88 (0.40)	-2.63 (0.47)	-4.20 (0.61)	-0.37 (0.22)
$EC1_{t-1}$	-0.16 (0.02)	-0.15 (0.02)		
$EC2_{t-1}$			-0.22 (0.03)	-0.02 (0.01)
ΔM_{t-1}	-0.20 (0.07)	-0.17 (0.07)	-0.16 (0.07)	-0.01 (0.07)
ΔM_{t-3}	-0.30 (0.07)	-0.27 (0.06)	-0.26 (0.07)	-0.11 (0.07)
$\Delta\Delta R_t$	-1.37 (0.46)	-0.97 (0.35)		
$\Delta\Delta r_t$			-0.10 (0.03)	-0.09 (0.03)
adj. R^2	0.79	0.77	0.78	0.64
LM(5)	0.12	0.12	0.15	0.09
Arch	0.26	0.59	0.16	0.32
Reset	0.69	0.42	0.74	0.9
Chow	0.66		0.002	
n. obs	68	90	68	90

Notes: See table 1, plus R is the interest rate.

When the period is extended to 2012Q4 major differences become evident. For the corporate sector, the log-log specification fails the Chow forecast test. For both sectors when using the log-log specification a number of parameters values change markedly, in particular the reduction in the absolute value of the parameter on $EC2_{t-1}$ cast doubt on cointegration. But note that for both sectors the semi-log specification does not fail the Chow test and that the parameter estimates change little when the sample is extended.

The parameter values for the log-log specification return to their pre-crisis values when a dummy for period since 2008q3, the quarter in which the crisis intensified as Lehman Brothers failed, is incorporated and interacted with the log of the interest rate. The positive estimated parameters indicate an increase in the intercept and a reduction in the interest elasticity. The p-value for the statistical significance of the dummy and interaction term is 0.01 for both sectors. In contrast, for the semi-log specification the p-values are 0.14 and 0.48 for the households and corporates, respectively.

Conclusion

So long as the interest rate relationship is modelled in the semi-log form there is little sign of instability in the demand for notes and coins in the UK. The increased share of M1 held as notes over the economic crisis is a consequence of the extremely low interest rate. This paper shows that when the sample period includes an era of unusually low interest rates then the choice of functional form of the interest rate relationship is crucial. The superiority of the semi-log specification is consistent with reduced interest rate elasticity of money demand at very low interest rates. To illustrate this, at the mean value of the interest rate (0.05), for the households and corporates respectively, the interest rate elasticity is -0.202 and -0.29, and at the minimum value of the interest rate (0.0036) the elasticity is -0.014 and -0.021.

With regard to the composition of M1 an even bigger change has been the decline in the share of sight deposits paying interest, particularly for household deposits for which the share decreases from about 90% to about 75%. Part of the reason for the increased proportion of M1 held as notes is that for many individuals, and to a lesser degree corporates, the benefits of holding transactions balances within banks decreased.

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Antonia C Settle
Rethinking money theory in light of fragile states: what a globalising world infers for cash use patterns

Antonia C Settle
University of Sydney, Australia

Abstract

Research shows that cash holdings abroad constitute increasing ratios of narrow money amongst key international currencies. This paper is based on research that explores this phenome-non at the international level, focusing on the role herein of monetary instability in peripheral countries. Drawing on studies of money use in developing countries as well as the author's field-work surveys, the paper explores the link between monetary instability and the use of non-local cash and non-money instruments in peripheral countries to draw out a key explanatory variable that tends to be ignored in money demand and savings research. Here a new fluidity in money supply and money demand in a context of greater openness in monetary flows between countries is emphasised. In this phenomenon, the paper seeks to identify the seeds of future trends in money use as financial globalisation reconfig-

ures the relationship between the state and money, producing different but interlinked outcomes for advanced and peripheral countries' money that hinge upon changing patterns of everyday cash use. This poses significant implications for monetary policy in peripheral states that carries through to a better understanding of trends in cash demand for international currencies' monetary authorities. By evaluating the applicability to fragile states of the conception of money embedded in monetary theory, the paper exposes key assumptions that signal a waning relevance of the conception of money to the greater monetary instability of contemporary conditions in fragile states. Here empirical evidence of changing money use patterns strengthen the paper's key hypothesis that monetary instability distorts the regular patterns of money use that economic theory has been built upon, establishing an increasing importance of cash in ways largely unrecognized by money theory. The paper concludes with policy implications and a call for the reevaluation of money theory so as to better account for both the waning of state monopoly over money issue and for the new order of money instability that undermines conventional notions of liquidity and portfolio preference.

Introduction

The international monetary system has been subject to fundamental change since the 1970s; cut free of the gold anchor and exposed to increasing liberalisation that has fed phenomenal foreign exchange market growth amidst staggering developments in broader financial markets. The era has been marked not only by greater currency volatility but by greater frequency of crisis. It is this context in which research finds sharp increases in foreign cash holdings of key international cur-rency, notably the dollar and euro, with changes in holdings correlating with specific political cri-ses, such as the collapse of the Soviet Union, the series of Latin American crises and the recent global financial crisis (Judson, 2012). The relationship between instability and crisis is taken a step further in the present paper, which seeks to explore the seeds of future trends in cash use. Premised

on the stylised fact that open capital accounts breed greater monetary instability, the paper pushes at the boundaries of the savings and money demand literature to examine the possibility of the diversification of everyday portfolios and patterns of cash use in unstable monetary environments being directly linked to monetary instability, amidst a crucial shift in the broader relationship between the state and money. With money theory tightly pivoting around increasingly outdated assumptions that inhibit a better understanding of changing cash use patterns, the paper forges new links between established empirical findings of complex cash use patterns in everyday portfolios in peripheral countries and increasing cash holdings abroad amongst euro and dollar narrow money, proposing the increasing importance of cash in ways largely unrecognised by the literature. Finally, the paper sets the discussion within the broader context of both policy implications for monetary management as well as a deficient theoretical framework that demands reevaluation.

The changing monetary environment

The long march towards the liberalisation of financial flows continues apace. Despite the havoc in financial markets that arose out of the global financial crisis, characterised by contagion effects and unprecedented cross border dimensions to monetary policy, (Brookings Institute, 2013) the momentum unleashed by the break from gold with the collapse of the Bretton Woods exchange rate system shows no sign of abating. Yet these conditions mark a distinctive new era for money, as the capital controls, exchange pegs and interest rate ceilings of decades passed give way to a firm commitment to foreign exchange liberalisation embraced even at the fringes of the global monetary system, where countries like Mozambique, Iraq and Afghanistan have recently reaffirmed their commitment to free foreign exchange markets (IMF, 2012). As the IMF notes, despite the bitter pill of instability and secular decline following the financial crisis, countries continue to roll back restrictions and controls on foreign exchange transactions, responding to havoc in global markets by adjusting exchange rate regimes rather than attempting to restrict foreign flows

(IMF, 2012: 2). Even derivative products, which sit squarely behind the collapse of the global economy in connection with the global financial crisis, have not seen decisive shifts towards greater control by regulatory authorities, either at the fringes nor in financial centres (Senior Supervisors Group, 2012; IMF, 2012). As suggested, these overarching trends represent a long term commitment by monetary and regulatory authorities towards free financial flows. Yet this spells new conditions that are likely to affect cash and cash use patterns at the international level.

Primary here is the issue of monetary instability. Financial liberalisation poses challenges for the management of external assets and liabilities, exposing currencies to impacts of larger and more volatile financial flows and greater inflation pass through with greater trade integration (IMF, 2011) – issues especially prominent for developing countries (Filardo & Lombardi, 2014; Raj et. al., 2008). Indeed international spillovers from monetary policy count amongst the most contentious central banking issues at present (ENS Economic Bureau, 2014; Brookings Institute, 2013) as the maintenance of monetary stability becomes increasingly complicated by forceful subjection of economic and financial conditions to external shocks (Beck et. al., 2013) and by the increasingly volatile and risky character of capital flows as they have trended upwards over the last 15 years (IMF, 2011). Where such monetary instability is combined with a diversification of money-like objects, we may find effects on cash use patterns where agents move in and out of cash, and across different denominations of cash, in ways that were effectively impossible under the restricted environment of the Bretton Woods system.

Here we are faced with a new world of near-monies, not only in the sense of new broad monies, like 'shadow bank money' or bitcoin, but also in the sense of increasing availability of undocumented foreign currency being used outside of its sovereign jurisdiction – beyond both the notional theoretical conception of sovereign money and beyond the regulatory control of monetary authorities. Certainly undocumented foreign cash becomes more easily available with the liberalisation

of financial flows, as Edwina Thompson demonstrates in her study of links between Dubai's deregulated economic zones and Afghan hawala money dealers (Thompson, 2011) and is corroborated by the rising sums of US dollars circulating internationally since the 1990s (Judson, 2012). In the same vein, capital account liberalisation makes tax evasion and capital flight easier (Chowla, 2011), reflecting a fluidity in informal cash movements opened up by the liberalisation of formal flows. As such, financial globalisation delivers greater instability in money, as well as greater availability of non-local cash, which combine to detract from the primacy of domestic currency in the domestic money system. These changes are part of significant changes in money use in developing countries that in ways mirror rising issues relating to traditional regulation and financial innovation in the advanced economies. That is, the increasing availability of foreign cash arises in an environment of major shifts in money and money management as grey zones appear in formerly distinct categories of internal and external, formal and informal, and money and non-money. As Bill Maurer notes in the case of M-Pesa in Kenya, "people are potentially setting in motion new media of exchange, methods of payment and stores of wealth and possible measure of value" that are challenging regulators and our understanding of cash use and the payments system (Maurer, 2012: 600).

The contribution of the present paper is to take a step further the association between political crisis and foreign demand for key currency cash, such as euro and dollar bills, that has been developed in the literature (Judson, 2012). Here instability and crisis is understood as an increasingly common feature of the 21st century, demanding consideration of the impacts of this volatility on cash use: combining new research on state fragility with the new norms of monetary instability produces a picture of international demand for foreign cash trending upwards. Emphasising the key inability of fragile states to mobilise domestic revenue, as well as their greater vulnerability to internal and external shocks, a recent OECD report finds state fragility in middle- as well as low-income countries, proposing that state fragility is on the increase. The report notes that the concentration of the world's

poor, now at a third in fragile states, is set to rise through one half in 2018 to two thirds in 2030 (OECD, 2014: 15). Moreover as the Financial Inclusion Database shows (see Demirguc-Kunt & Klapper, 2012), it is in fragile states that formal banking is at its lowest, suggesting a relationship between state fragility and informal monetary contexts that is likely to endure. These findings raise weak state capacity over money management to a new centrality in exploring future trends in money use as we find ourselves in a world economy increasingly characterised by weak states, volatility and broad informal money markets.

The new monetary environment, then, is a far cry from the relatively discreet national economic units and their sovereign currencies found in the Bretton Woods era. The commitment to free financial flows suggests a future not only of greater monetary instability but also of the greater availability of money-like objects, including undocumented foreign currencies, within individual states. Combined with a shift towards greater state fragility outside of the core key currency countries and emerging economies, a new fluidity in international demand for cash arises.

Demand for foreign cash in less developed states

With instability on the rise, both in terms of monetary volatility and of political and more general economic fragility, attention could fruitfully be focused on cash use trajectories in fragile regions. Here, the surging demand for foreign cash related to incidences of instability found in the literature on international cash demand in the 1990s and 2000s is recast as a permanent state of affairs, not only in "mega crisis" states but in persistent "forgotten" crisis regions (see OECD, 2014: 26), which are tipped to engulf expanding populations in coming decades. Moreover, for international cash demand patterns, it is these regions where capacity over the money system is the weakest, suggesting broad informal foreign exchange markets that cater to growing demand for foreign cash. Here we find both expanding demand and expanding supply. In order to explore the seeds of foreign cash use trends, focus is thus placed on the dynamics that under gird cash demand in regions characterised by instability.

Here, a new literature on money and savings forges a novel path in exploring changing cash use patterns, moving beyond the narrow confines of traditional scholarship on the subject and contributing a more nuanced framework that draws out the complexity of cash management at the household level in the 'majority world' of developing countries. New work on the anthropology of money compliments more orthodox approaches to the study of savings and money demand to develop a complex picture of day-to-day money management by ordinary citizens in poor regions that had not been previously captured in standard household surveys. Here, clues may be found about international demand for undocumented foreign cash, which help us to focus on dynamics of cash use in the growth area of fragile regions. While bouts of political and economic instability are commonly associated with a tendency of the public to shift into foreign currencies as a hedge (Chami et. al., 2007), analysis of such tendencies remains limited by the narrow representation of shifts out of local assets in national accounting schemas, which

do not capture undocumented flows. Here, exchange rate premiums in the so called kerb or black market hint at demand for foreign cash that falls outside official foreign currency accounts and formal outward flows, but still transmit limited information about underlying dynamics.

In exploring the dynamics behind informal demand for foreign cash in developing countries, a useful frame is provided by Collins, Morduch, Rutherford and Ruthven (2009). Collins and her colleagues have here closely tracked daily transactions of a wide sample of poor individuals in India, Bangladesh and South Africa to construct a conception of the 'portfolios of the poor' that challenges a simple reading of hand-to-mouth living by those living on less than $2 per day. This research reveals complex cashflow management strategies that entail high levels of leverage and sophisticated diversification of assets and liabilities through a methodology that looks beyond the standard categories of standard household surveys. The work of Collins, Morduch, Rutherford and Ruthven crucially provides a frame in which to interpret unexplained findings in the more conventional savings literature. For example, a recent major World Bank study of financial inclusion by Demirguc-Kunt and Klapper (2001) using the Global Findex Database finds that the majority of savers in 55 countries use neither formal institutions nor informal money dealers or savings clubs to hold savings. While the Database does not gather the types of data that would allow this puzzle to be explored further (see Demirguc-Kunt and Klapper, 2001: 34), the sophisticated portfolio allocation between formal and informal transactions, and barter as well as monetised assets and liabilities revealed by Collins and her colleagues suggests active hedging strategies that push beyond the traditional categories of the savings literature.

This proposition is supported by work in the interdisciplinary literature. The work of Collins, Morduch, Rutherford and Ruthven presents empirical findings of a level of complexity in day-to-day cash management in developing countries that supports the findings of new anthropological work on money. Here the textbook story of

'primitive' barter being replaced by 'modern' fiat money is complicated by grey areas that challenge earlier notions of a socially embedded economic past and an instrumentalist future of anonymous transactions (Maurer, 2006). This break from simplistic teleologies characteristic of traditional theory corroborates alternative characterisations of active and sophisticated portfolio management in a social economy that bridges 'new' and 'old' worlds through active microeconomic strategies, even at the very fringes of the global economy.

Gaps in the literature

A fuller understanding of the complexity of portfolio management by ordinary citizens of peripheral economies, however, has been stunted by traditional thinking on the role of money in the economy. Theory posits domestic currency as the exclusive form of money within a sovereign territory, ring-fencing domestic currency as the exclusive definition of money applicable to modern states. This limited conception of cash and bank deposits as the definition of money represented in M1, M2, M3 and so on, lays out a road map for the process of monetaisation in developing countries and informs monetary and economic theory, reinforcing the conceptual exclusivity of domestic currency within money management policy and research. This imagined exclusivity of 'domestic currency plus bank deposits' being used as money within a sovereign state is demonstrated in the 'puzzle' of persistent low and even reversing monetisation in some states (McLoughlin & Kinoshita, 2012) and in the savings and money demand literature (Sriram, 2001), which focus on formal interest rates and simplistic proxies for real assets in understanding opportunity costs. Indeed in the World Bank study cited above as well as in the work of Collins, Morduch, Rutherford and Ruthven, the use of both foreign cash and liquid non-money objects is ignored in evaluating how people hold purchasing power. As such, while Collins and her colleagues contribute major advancements in our understanding of how the poor interact economically, they do not manage to entirely overcome a long entrenched bias in thinking about money and savings

that assumes state monopoly over money issue. As noted, Collins and her colleagues do not include foreign cash holdings in their examination, nor properly explore the use of liquid non-money assets that are used, essentially, as money. Nor do they or Demigurc-Kunt and Klapper explore any potential relationship between microeconomic behaviour and instability.

This obfuscation is of elevated importance as money systems shift towards new norms of greater instability as well as the broader availability of foreign cash in informal money markets amidst low levels of formal banking participation. With the frame of the new anthropological literature on money and research, such as that by Collins et. al., demonstrating complex hedging in day-to-day money management by ordinary people in developing countries, the foundational concepts that traditional theory rests upon become increasingly redundant. Liquidity preference, for example, proposes that greater instability will lead to a shift out of bonds and into (local) cash through the financial intermediation of the formal banking sector with the household and business sector. This conceptualization of microeconomic behaviour arises as somewhat out of step with a far more complex reality. That is, the new literature shows us that everyday economic management at the household level certainly does entail complex risk assessments and active strategies of diversification and leverage. But a picture of responses to instability through everyday portfolios feeding into market demand for bank money and bonds is out of step with microeconomic strategies that in fact bridge formal and informal as well as barter and monetised balance sheets. Similarly conventional notions of money demand rest on opportunity costs of holding narrowly defined money vis-a-vis holding formal financial instruments or real assets, proxied at expected inflation. Yet in fragile regions with low banking sector penetration, opportunity costs must be more broadly understood so as to incorporate the myriad of 'own interest rates' that reach far beyond commercial interest rates and across different currencies, largely held as undocumented cash. Taken together, this suggests that ordinary people do actively respond to currency instability but that the range of assets and

liabilities with which they engage extends far beyond the conventional categories of the savings and money demand literature, which assumes that 'money' is local currency and that savings are held in conventional 'money' and financial forms. Thus the use of foreign cash by ordinary people as a hedge against instability in local currency appears a very likely reality. To be clear, the argument here is that even though new research shows that ordinary people in developing countries undertake complex risk assessment and diversification strategies, the narrow notion of the sovereignty of domestic money that permeates traditional money theory continues to inform the savings and money demand literature, which tends not to consider informal liquid assets and foreign cash which may play an increasingly important role in environments of monetary, political and more general economic instability and broad availability of foreign cash in informal markets.

The author's own feild surveys in Pakistan corroborate these propositions. Pakistan is a identified as a "forgotten" (OECD, 2014: 26) or endemic crisis state, characterised by political, monetary and economic instability; low levels of banking participation; a liberalised foreign exchange regime (IMF, 2012); an extremely poor tax to GDP ratio, and vast informal markets in cash and foreign flows. With high levels of volatility in inflation and exchange value exacerbated by exposure to unstable international flows, hedging the decline of the rupee is a daily task for ordinary people and an expansive enterprise for those better endowed. Broad interviews across the social spectrum reveal a distinct and widespread new lack of confidence in the rupee, characterised by an active attitude towards overcoming associated losses involved. This perspective is less an acceptance of state-issued money within a domestic financial realm, as is implied by conventional thinking on money. Rather, attitudes reveal an infidelity to the rupee, which transgresses the implications of standard theory insofar as money balances are commonly and systematically held in undocumented foreign cash and liquid non-money assets, and may be reverted to the rupee for payments purposes. To be clear, these practices largely exclude the banking sector, or include only very temporary depositing of cash in bank accounts, even amongst

the educated and affluent, and reveal a willingness to endure inconvenience and transaction costs in order to actively hedge potential decline in rupee balances. That is, instability breeds active shifts in and out of local currency, which includes undocumented foreign cash as well as liquid non-money objects, that are not represented in formal statistics and are not formally anticipated by theory nor represented in conventional studies of money demand and savings practices. These new practices are not confined to criminals or corrupt elites, but are daily practices of ordinary people and systematic cash-flow management strategies across all strata of the business community.

The changing monetary environment revisited

As suggested above, contemporary monetary conditions are challenging conventional assumptions about money and its relationship to the state at a series of levels, revealing unprecedented new dynamics that must prompt a recasting of theory if it is to understand the very essence of what money is, how it is used and how it can be managed in a rapidly changing global environment.

For advanced economies, central banks are faced with increasing complexity. Micro economic units no longer neatly conform to a national characterisation, with complex webs of transactions crossing through formally discreet jurisdictions. This is posing new dilemmas for the ability of central banks to track financial flows, prompting calls for new forms of regulation that take a system-wide approach, namely macro-produntial regulation, where a micro-focused frame can no longer maintain its former grasp on activity.

Of equal concern in advanced economies is the complexity of new instruments themselves, which produce analogous issues insofar as central banks are at a loss in tracking transactions, values and risks. Crucially, such innovation in financial instruments is of prescient theoretical significance. Here we find a blurring of the

distinct ontological categories of money and non-money assets as the national framing within which these concepts have developed itself blurs under the weight of globalisation. As new financial innovations force regular redefinition of exactly what falls inside and what falls outside of M2 and M3 (Lim & Sriram, 2003), the question of what exactly money is becomes increasingly prescient. Here we find a break with the old money regime in which base money (M0) is structurally linked to broad money (M2, M3 etc), all of which is produced within the remit of central bank control, either directly as in the case of narrow money or indirectly in the case of broad money. Financial innovation instead equates to the production of new near-monies beyond the scope of central bank oversight, and therefore at an unprecedented distance from the state itself. Furthermore, adaptation in central bank techniques to cope with new levels of complexity affirm a complication of the distinction between money and non-money assets. While central banks had traditionally intervened as lender of last resort through loans to compromised banks, the global financial crisis saw new 'unconventional measures' introduced whereby central banks did not deal only in the asset of which the state monopolises production, namely bank reserves and other state money instruments. Abandoning traditional 'treasuries only' policy, the Fed purchased and continues to hold non-money assets, such as mortgage-backed securities. Here the Fed has crucially stepped outside of its traditional domain of money management through dealing in narrow money and Treasuries, and into uncharted waters of money management through dealing in various commercial assets, including those that are not produced even within the regulated banking system; not a lender of last resort within the realm of state money but a dealer of last resort in extensive near-money markets (Mehrling, 2010). This suggests that the traditional conception of money as produced by the state directly, or indirectly by the banking sector yet within the remit of central bank oversight, is being swamped by a new money reality. Here, then, the relationship between the state and money is changed as new near-monies break free from the former state monopoly issue of money.

At the other end of the spectrum, fragile states that sit at the periphery of the global economy face new circumstances not entirely dissimilar to those faced by the advanced economies. Here we find radical instability in the value of money, which, as proposed above, detracts from the monopoly use of domestic tender as money within the sovereign state. Rather we see active hedging strategies even by the poor, who diversify and leverage amongst a score of liquid non-money assets and undocumented foreign cash in financial contexts of broad and deep informality that show no inherent fidelity to the local currency – in fact a conscious interpretation of local currency as a kind of potential liability. This suggests that monetisation in these regions is unlikely to mimic the textbook course, and that with increasing volatility in local currency as well as greater availability of more stable foreign cash, diversification beyond the local currency will only increase.

The analogy with issues facing the advanced economies is that in fragile regions, central banks similarly enjoys only weak powers of oversight and do not fully control money where liquid non-money assets are used as money or where significant informal foreign cash markets cater to everyday cash use by citizens. Moreover while central banks in fragile states continue to attempt to control monetary stability through transacting with financial institutions in narrow money instruments, significant new research suggests that inflationary expectations are pegged not to the central bank's perceived commitment to limiting money supply expansion and adjusting short term interest rates, but rather to non-monetary factors such as electricity prices and wheat subsidies (Abbas et. al., 2014; State Bank of Pakistan, 2013). Again, then, we find that controlling money is no longer an issue of traditional intervention by central banks in money, but that central banks may need to move in non-money realms in order to control even only money, let alone broader goals of growth and stability.

Yet this new money context cannot be captured at the level of theory given the narrow state of money theory at present. Across the economic literature a sense of

money persists that assumes a strong state, a stable currency and the exclusivity of local state money within a sovereign territory. These deeply embedded assumptions are flagrantly challenged by conditions in fragile regions and, given upwardly trending monetary instability as well as political and general economic instability amidst broadening availability of undocumented cash, are only set to become more so. Here the old assumptions associated with liquidity preference, money demand and even monetary policy more generally, appear increasingly redundant as the control of central banks over local currency gives way to cross border impacts and more fluid availability of foreign currencies within a sovereign territory.

For fragile states, this means that monetary policy must be reevaluated. Conceptions of money supply and of money demand must embrace a fluidity in definition that reaches beyond entrenched assumptions of local state money monopoly within sovereign borders. Part of this fluidity lies in the fact that in general, banking systems do not operate in the same way as they have traditionally in the advanced economies. This fact demands nuance when interpreting increasingly accepted views of endogenous money by the central banking community (McLeay et. al., 2014), suggesting that much 'money' in fragile states assumes commodity characteristics rather than the credit characteristics associated with the endogenous money view.

This lesson is reinforced with the important findings published by the IMF in 2012 that monetary policy transmission largely fails in low-income countries. The authors of the report conclude that "it is very hard to come away from this review of the evidence with much confidence in the strength of monetary transmission in low-income countries" (Mishra & Montiel, 2012:24). These findings confirm what has long been known in fragile states, where high spreads suggest a lack of competition in banking sectors which distorts monetary policy transmission while the bulk of the economy in fact operates beyond the narrow remit of the formal system in the significantly less 'sticky' informal economy (see Ahmed et. al., 2012; Choudhary et. al., 2011). In fragile states, the state tends to dominate credit de-

mand, real interest rates tend to be negative, inflation largely beyond the control of the authorities, and formal private credit of minimal aggregate significance. In these conditions the banking system serves more to support government borrowing than to support growth and innovation in the private sector by expanding money supply through interest rate elastic private sector lending amidst sticky prices and wages. Yet added to acceptance that the monetary climate in fragile states is distorted insofar as the banking system is of minimal centrality to the private economy, the fluidity of money itself must be recognised in the authorities attempts to control the money system as well as broader aims of general economic growth and stability. This requires a vast recalibration of monetary policy in fragile states that recognises state money as not the special asset designated by theory but as one of many risky assets.

Finally, the problem of monetary instability might be fruitfully addressed by central banks in fragile states if they are to establish a more conventionally distinct role for local state money within their economy. In developing countries, exchange rate regimes and temporary capital controls are being experimented with in the wake of the crisis (IMF, 2012), reflecting a need for currency stability that clean floats do not allow. These options need to be taken seriously and greater intellectual and policy space needs to be made for coordinated efforts in these regards.

Conclusion

To understand future trends in cash use, then, we must take into account a new kind of fluidity in money availability and use. This fluidity is linked to the greater openness of convertibility as it affects both the demand and the supply side of foreign cash. Moreover these changes arise in a broader context of significant change in the international money system as a whole. With these changes, it is hoped that the narrow confines of money theory will be opened up to a new understanding of the fundamentals of money, which must yet play out in a more

open focus of scholarship that examines money use, savings behaviour and monetary policy. For key currency monetary authorities, a continuation of the surging demand for key currency cash can be expected and forecasting of foreign cash demand must take foreign instability and crisis into account. This is but one step towards a better understanding of why Keynes' reasoning for privileging the state money rate of interest as the 'real' rate of interest now looks increasingly outdated. Perhaps central banks need to monitor multiple 'own rates' of interest – for other state monies, for street lenders, and for staple commodities being used as money alternatives, as part of the remit of monetary policy, even though to do so would be a concession of their own lack of capacity.

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Frank van der Horst and Ester Matthijsen
The irrationality of payment behaviour

Frank van der Horst
De Nederlandsche Bank, Netherlands

Abstract

Despite the efforts that commercial banks have made to promote the use of debit cards and the introduction of new payment methods, the migration from cash to electronic payment methods is not proceeding as quickly as sometimes expected. Why do people pay by cash on one occasion and by bank card on another? How conscious is people's decision-making? How rational are their reasons for choosing one method over another? For policy makers at a central bank it is relevant to have insight into the psychological aspects and effects of payment method choice, because it provides a pointer to the roles that payment methods will play in the future. Also these insights are helpful if an authority wants to promote or discourage a specific means of payment.

DNB has therefore been investigating the psychological aspects of payment method choice. The research had three components: a literature study, a virtual-reality study and a neuroscientific study. The latter two components were innovative con-

tinuations of existing studies, which usually assume a 'rational decision-maker', are quantitative in nature and are questionnaire-based. The virtual-reality study involved the direct observation of (virtual) behaviour, while the neuroscientific research involved the direct observation of brain activity, translated into emotions and automatic behaviour.

The literature study found that, in the vast majority of cases, people do not make conscious, planned decisions; most decisions are the product of automatism and emotion.

The choice of payment method has implications not only for purchase value, but also the purchase type. Transparent payment methods, such as cash, make payment more 'painful' and are associated with lower purchase values and lower levels of impulse buying than less transparent payment methods, such as debit card.

A virtual-reality study for DNB by the Free University of Amsterdam has revealed that there is little scope for manipulating payment decisions; people choose which payment method to use mainly at the checkout and on the basis of habit. People like having cash with them, even if they have no short-term plans to use it.

The neuroscientific study showed that, on balance, paying by cash triggers more positive emotions than paying by debit card. Both debit cards and cash activate automatic behaviour, regardless of whether the subject is making the payment or merely observing it. This automaticity is stronger for cash. Also, in the research, paying by cash was more strongly associated with positive emotions than paying by debit card. More positive emotions on balance and more habitual behaviour for cash are consistent with the fact that most purchases are paid for with cash. However, it remains unclear why, on balance, more positive emotions were measured in connection with cash payments, when such payments are, in theory, more 'painful'.

Older people are more inclined than young people to prefer one particular payment method, whether cash or debit card. Older people who report paying for most things by cash tend to have a stronger emotional preference for cash payments, which is also likely to trigger habitual behaviour. Older people who report paying for most things by debit card have only a slight emotional preference for using their cards and do so primarily out of habit. In young people, such differences in the perceptions of the two payment methods are less pronounced.

One of a central bank's functions is to increase the efficiency of the payment transactions. At present, the focus tends to be on the social cost. One could discuss the need for authorities to take also into account also the following when encouraging the usage of a specific means of payment:

– The choice for a particular means of payment is depending on a variety of implicit respectable motives;
– The transparency of a payment method influences spending behaviour;

Changing payment behaviour is not easy. It is an evolutionary process, especially because payment behavior is to a large extent habitual. The neuroscientific research indicated that behavioural change is most likely to be realised by measures aimed at particular target groups bearing in mind that the choice for a payment method is not (completely) rational.

1 Introduction

Dutch people are more likely to pay cash at the checkout than to pay with a bank card. In 2011, for example, 62% of all purchases were paid for in cash . The year before, the percentage was a little higher (65%); the use of cash is gradually declining and the number of card transactions is increasing. However, the expectation had been that the migration would proceed more quickly. That expectation was based partly on the fact that, in recent years, the commercial banks and others have run publicity campaigns in the Netherlands to encourage people to use their cards more often and for smaller transactions. In parallel, the acceptance of card transactions at the checkout has increased. It is therefore a valid question to ask why most checkout payments are still made in cash and, more generally, what psychological factors play a role in payment method selection.

Do consumers make rational decisions at the checkout or do unconscious factors such as habitual behaviour play a greater role? If the latter is the case, how difficult is it to change firmly established payment habits? Can understanding of such matters ultimately help the central bank and policy makers to perform their roles and realise their objectives? Where cash payments are concerned, answers to such questions are hard to find, because most research assumes that consumers are rational decision-makers, and because the research tends to be more quantitative than qualitative and based on questionnaires rather than the observation of behaviour. This Occasional Study is intended not only to provide an overview of literature in this field, but also to place the findings of the various relevant studies in context.

In addition, DNB initiated two studies, which were carried out in the period from the start of 2012 to March 2013, with the aim of directly measuring the psychological aspects of consumers' payment behaviour. The research methods chosen by DNB were innovative, in the sense that they did not involve the use of questionnaires, as most studies in this field have done. The two studies were as follows:

1. A virtual-reality study, intended to investigate the manipulability of the choice between paying with a bank card and paying by cash. How do certain variables influence payment method choice and what is their impact?

2. A neuroscientific study of the differences in emotional perception between bank card transactions and cash transactions. The research involved three component studies, which addressed the following questions:

a. To what extent is paying by one method, as opposed to the other, the outcome of a habitual process in the brain of the consumer?

b. Do older people and young people differ in their (unconscious) payment method preferences?

c. Does carry cash with you (when one is not particularly intending to use it) generate positive emotions by allaying the fear to end up in a situation where not all payment methods are accepted? Or do the positive emotions stem from the inherent pleasure of being in physical possession of money?

The structure of this report is as follows. Section 2 describes the existing literature that is relevant to answer the question of how people make decisions. Section 3 focuses on literature relating to the effects of payment method choice. Section 4 explains why DNB chose to investigate the relevant issues using unusual research methods. Sections 5 and 6 describe the design and findings of the two studies initiated by DNB. Sections 7 and 8 round off the report with our conclusions and discussion points.

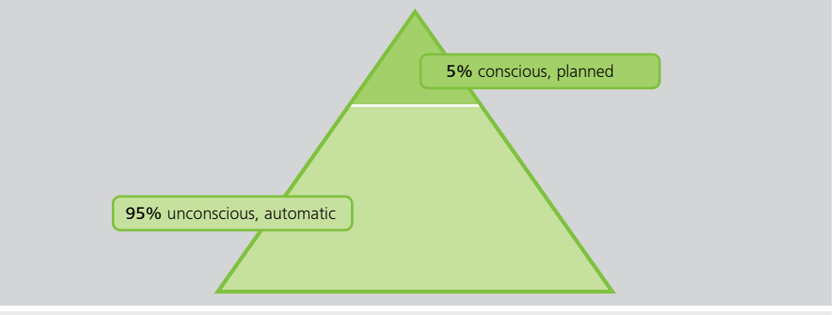
2 Literature Research: How people make decisions

The hypothesis for this Occasional Study is that people's decision to use a payment method to complete a transaction is often made automatically. To what extent do people make decisions'on automatic pilot' and how rational are their choices? Do we decide on the basis of emotions? In short: how do people usually make decisions?

People generally like to believe that they consider rationally before acting. Such beliefs bring a reassuring sense of being in control of one's own actions. In reality, however, human behaviour is influenced by a variety of mental, physical and environmental variables, which we are not usually aware of on a conscious level.

Most researchers support the estimate that only 5% of our behaviour is conscious and planned, while at least 95% is unconscious (figure 1)[1]. Decisions are mostly made based on automatism, emotion, memory, intuition, enviromental cues, and what we have been taught.

Relationship between conscious and unconscious behaviour Figure 1



Source: Bargh (2009)

2.1 Habit

Habitual behaviour is an unconscious process that plays a very important role in the way we make choices. Doing something for the first time requires planning and concentration and involves the conscious appraisal of options. However, if in similar situations a person repeatedly makes the same choice, the person's decision-making becomes automatic; the behaviour becomes habitual. A characteristic of automatic behaviour – things such as washing one's hair or putting on one's coat – is that the ease or success of the activity is not adversely influenced by the simultaneous performance of another activity.

Automatic behaviour is very useful, because paying conscious attention to every activity would take a great deal of effort. Van den Brandhof[3] explains it thus:

'Our brains seek routine and control. If we had to consider every possible combination of garments each morning before getting dressed, we would have a problem. According to Edward de Bono, it would take us 76 years to dress, assuming that we possess eleven items of clothing and spend one minute considering each combination.'

Automatic behaviour is characterised by efficiency, unconscious, unintentional and non-controlled behaviour. It is the product of practice and repetition.

How does one determine whether an event requires attention? The brain filters incoming stimuli, directing some to the conscious mind and some to the subconscious. Broadly speaking: a one-off stimulus is treated as important, but repeated stimuli are normally treated as unimportant. This process is called habituation, and may be seen on an electroencephalogram (EEG) of the brain. When we are exposed to a certain sound, the auditory cortex (the part of the brain that processes sound stimuli) 'lights up'. However, if we are exposed to that same sound at fixed intervals, the brain gradually exhibits less and less activity[4]. After a while, there is barely

any discernible response to the sound. There is no general decline in our state of alertness, though: we simply become accustomed to that one particular stimulus.

Our ability to operate 'on automatic pilot' means that we don't have to pay conscious attention to all our day-to-day activities. However, the things that we do unconsciously are not necessarily the right things. Mechanically dipping into the biscuit barrel while working or watching TV is an unconscious and potentially undesirable activity. An automatic form of behaviour may also be undesirable for the community as a whole, as is the case with paying by means of a less efficient method or with undesired effects.

Changing habits is difficult and requires precision: 'Habits are like a comfortable bed; easy to get into, but hard to get out of.'[5] There is no ready-made method for changing habitual behaviour[6]. Nevertheless, it is known that change is easier to bring about by intervening at times when people are making new assessments. If behaviour then becomes conscious, people can be encouraged to reassess their actions. In such situations, it is important to make the old habit less attractive and the alternatives more attractive. So, for example, information made available when someone is ready to reconsider a form of behaviour may influence that person's willingness to change.

A study by Kosse and Jansen (2012)[7] found evidence to suggest that payment behaviour is partly habitual. First-generation immigrants from more cash-oriented countries are likely to continue paying by cash when they come to the Netherlands. By contrast, the payment behaviour of second-generation immigrants is more or less the same as that of people whose forebears were Dutch.

A 2012 report on research into stimuli by CentERdata and Tilburg University[8] also indicated that interpersonal differences in payment decision-making were to a large extent the product of habit. In a theoretical model, differences in payment

decision-making may be explained by three factors: 1) perceptions of debit card and cash payments (personal 'cost' and social norms), 2) cash withdrawal behaviour (wallet/purse-filling) and 3) habits and automatisms. Data gathered from questionnaire responses indicated that roughly half of the interpersonal differences in payment decision-making were attributable to automatisms and habits. The choice of payment method is not usually a conscious decision; one is not greatly engaged by the process. By way of illustration, an 89-year-old woman was quoted in an article on cashless supermarkets as saying, 'Yes, I know my PIN and I can use my bank card, but I never do. I've always paid cash.'[9]

If people do indeed choose how to pay largely on an unconscious and habitual basis, is it appropriate for a central bank to encourage people to change their habits? And is it actually possible for a central bank to bring about such behaviour change? After all, according to research by Lally et al[10], picking up a simple and desirable daily habit, such as drinking a glass of water at breakfast, takes an average of about 66 days (with a range of 18 to 254 days). The time required to change a habit depends on how difficult the activity in question is and on the individual's level of commitment. In Lally's research, for example, the subjects wanted to effect the relevant habit change. Intentions prove to be a poor predictor of behaviour, especially where a habit has already been formed.

People differ in their ability to change their habits. Whether a person is acting deliberately or on automatic pilot can be determined by observation. The findings of a 2012 study by Amsterdam University[11] indicate that the analysis of magnetic resonance imager (MRI) scans can shed light on a person's ability to modify his or her behaviour. In the study, the subjects were taught to perform a particular activity in response to a stimulus, by rewarding them for successfully performing the relevant task. However, as soon as the subject mastered the task, the 'rules of the game' changed: doing something that had previously been rewarded was punished instead. MRI scans showed that the strength of certain neural pathways determined

how good the subjects were at changing their behaviour. The active neural pathways in subjects who continued to respond automatically to the stimuli, even when it was no longer in their interests to do so, were not the same as those that were active in subjects who were able to adapt their behaviour to the new circumstances.

The research referred to above suggests that habits can be broken by providing appropriate stimuli. Stimuli may in principle be given before, during or (in the form of feedback) after a payment transaction. Generally speaking, however, it appears that stimuli at the point of payment are most effective, because people don't usually decide how to pay until they actually need to do so. Retrospective stimuli appear to have little effect: feedback cannot be acted upon until the next time a payment decision is made, by which time the significance of the message has faded in the recipient's mind.

The effect of newspaper articles about skimming/payment card fraud on the use of the debit card has been investigated and the findings reported in a DNB Working Paper[12]. The conclusion was that – depending on a number of variables, including position in the paper – newspaper articles could influence debit card usage habits, but that the subjects returned to their habitual behaviours after an average of just one day.

2.2 Unconscious influences on behaviour

It is apparent, then, that people often make decisions on automatic pilot. Such habitual behaviour is a very efficient way of using brain capacity. But does it lead to rational decision-making? Are people able to correctly process all the available information, and thus to arrive at the decision that best serves their interests? 'Rational choice theory' is well-established in both economics and social science. The essence of the theory is that a decision-maker chooses the course of action that has the greatest subjectively perceived benefit[13]. In recent decades, however, questions have been raised concerning various assumptions underpinning rational

choice theory[14]. The assumptions in question and the criticism of them are summarised below.

One assumption of rational choice theory is that people are motivated primarily by self-interest. However, decision-making is also influenced by considerations such as fairness and honesty. An example of such influence is given in the following subsection: in an 'ultimatum game', a decision-maker has to strike a balance between rational and emotional considerations in the context of a financial transaction. In the virtual-reality study, one of the manipulating factors was the sympathy that a customer feels for the party who needs to be paid. The study sought to establish the extent to which such sympathy influences payment behaviour.

Another criticism of the rational choice theory is that people don't in reality always seek the best possible outcome, as the theory assumes. Good is often good enough. Nor does everyone seek to fully inform themselves before making a decision. The majority (60%) of Dutch people have not switched health insurers since the new care system was introduced in 2006[15]. Some of those people must consequently be losing out financially, because data published by the Dutch Competition Authority (NMa) indicates that the average person can save as much as 1000 euros or more a year by looking more critically at their insurance and mortgage. Yet the sheer range of choice is too bewildering for many, who choose the first option that they regard as good enough.

People have a limited capacity for rational discounting of the future. Asked whether they would prefer to have 100 euro now or 110 euros next week, most people choose to take 100 euros now. At the current rate of inflation, that does not appear to be a logical choice. However, people asked to choose between 100 euros a year from now and 110 euros in a year and a week, people invariably choose the 110 euros. A week that's a year away is apparently insignificant, but we prefer immediate payment to deferred payment.

Conventional wisdom, and another assumption of the rational choice theory, is that emotion has no part to play in good decision-making. However, emotions are vital to the decision-making process, as explained in the following subsection.

If we consider the future of cash, we find that there are both rational and emotional reasons for paying by cash now and in the future:

Rational reasons:
- It is not always possible to pay electronically everywhere.
- Using cash makes it easier to remain within budget.
- Cash is the fastest way to settle retail transactions.
- A substantial proportion of the world's population has no bank account.

Emotional reasons:
- Cash is the physical manifestation of value.
- Cash is perceived to be a safe haven at times of crisis.
- People trust cash: it has proved itself to be relatively secure against forgery and fraud.
- Privacy: the desire for privacy is rational on the part of people who wish to hide funds from the authorities, but has an emotional basis as well, insofar as many people don't like the idea that their payment behaviour can be monitored.

2.3 Triune brain

To aid understanding of the relationship between rational thought and emotion, the evolution of the brain is considered in this subsection.

According to the triune brain model developed by neurologist Paul MacLean,[16] a person's skull contains not one, but three brains. Each brain is a separate evolutionary layer, formed around the more primitive layers. The three brains – the reptilian brain, the mammal brain and the human brain – evolved in successive phases of human development. In the course of an individual's maturation, his or her brain develops in accordance with the same evolutionary pattern. Thus, the neocortex – referred to below as the human brain – is not fully developed until roughly the twenty-fifth year of life. Each of the three brains is linked to the other two, but each appears to function as an independent system with its own capabilities.

The triune brain Figure 2

Drawing by the author, after Paul D MacLean (1992). The Triune Brain in Evolution. New York – Plenum Press.

2.3.1 Reptilian brain

In evolutionary terms, the reptilian brain is the oldest part of the brain. According to MacLean, this brain is about 500 million years old. The reptilian brain consists of the brain stem, the between brain and the olfactory bulb. The reptilian brain controls physical responses, such as heart rhythm, breathing and balance. It is extremely powerful, almost insuperable. If you burn your hand, you can't help snatch it away from the heat source; if you look towards a light, your pupils inevitably contract; if you try to hold your breath, you can only manage it for a short time. The reptilian complex is instinctive and serves exclusively to facilitate survival. The reptilian brain is permanently active, even when one is in deep sleep.

2.3.2 Mammal brain

The mammal brain or limbic system ('limbus' means 'edge'; the system is located around the midbrain) is the brain's inner layer. It is primarily the site of feelings and emotions, particularly emotions linked to survival, through feeding, fighting, flight and reproduction.[17]

The mammal brain responds to stimuli from the environment. If the mammal sees green grass, it goes to graze; if it sees green grass and a lion, it runs away. The chemical process that drives the decision to run away is what we call anxiety[18]. The mammal brain evolved approximately 200 million years ago.

2.3.3 Human brain

The human brain or neocortex makes up more than two thirds of the volume of the human brain. It is somewhat squashed up and folded in on itself, in order to fit into the available space, making it look a little like a shelled walnut. The human brain is the seat of our consciousness, and the part of our brain that handles planning, language, invention and abstract thinking. The cortex is divided into two halves or hemispheres. The left hemisphere controls the right-hand side of the body and the right hemisphere the left-hand side of the body. The right hemisphere is mainly responsible for spatial awareness, abstraction, musicality and art, while the left hemisphere is more linear, rational and verbal.

The human brain evolved about 500 thousand years ago, making it the newest part of the brain. Despite its greater size, the human brain is less powerful than the mammal brain. If there is a conflict between the mammal and human brains, the mammal brain will normally prevail. Only determined efforts to activate the neocortex offer any prospect of overriding the more primitive yet dominant brain.

An example of conflict between the mammal brain and the human brain is provided by a financial game designed by Werner Güth of Humboldt University in Berlin. The game is what is known as an 'ultimatum game'. A researcher makes a certain sum of money available to two subjects. Subject 1 is invited to propose how the sum should be divided between the two of them. Subject 2 may accept or reject the proposal. If the proposal is accepted, the money is shared out as suggested; if the proposal is rejected, neither subject gets anything. Only one proposal may be made; negotiation is not allowed.

In principle subject 1 may suggest taking 99% him/herself, and giving 1% to subject 2. If the latter turns down the proposal, he/she will get nothing, as will subject 1. A purely rational analysis by subject 2 will lead to the conclusion that acceptance is the most advantageous course of action, because a little is better than nothing. However, subject 2 is liable to be affronted by the unfairness of the proposal, in which case tension will arise between the subject's rational and emotional thought processes. If the latter prevail, the subject will reject the proposal.

Many first subjects who play Güth's game feel inclined to propose a 50:50 split, but some dare to ask more for themselves. However, more than half of the second subjects reject an offer of less than 30%. The response of those subjects goes against the expectation that rational self-interest will shape decision-making regarding transactions with other people. In practice, it seems, many decision-makers also consider the implications for the other person.

Generally speaking, neuroscientific research into the ultimatum game indicates that our financial decisions are the outcome of two-way communication between cognitive and emotional mechanisms[19]. Neurons gather information about 'the views' of cognitive and emotional networks, and weigh them up in order to arrive at a decision. If the calculated neural discrepancy is great enough (i.e. if one option is clearly better than another), a decision is taken. The decisions made by subjects in ultimatum games and the results of brain scans appear to indicate that the neural emotional response to unfairness outweighs the rational (utilitarian) self-interest response. In other words, the human brain and the mammal brain may be in agreement or in disagreement, but the ultimate decision is normally made by the mammal brain.

The mammal brain is not only more powerful than the human brain, but also much faster. It's not often that you meet a bear, but if ever you do, you may be confident that your most primitive brain will immediately prepare your body for action: your heart rate will increase, your eyes will open wide, adrenaline will be released and

sugars will be transported to your muscles. You will already be running before your human brain can think, 'Help, a bear!' Your most primitive brain knows things before you know them yourself. The latter view of the way we function is not new: in the early twentieth century, William James and Carl Lange proposed the counterintuitive theory that physical responses are not the cause, but the result of certain emotions. That theory is often illustrated by reference to old sayings suggesting, for example, that crying makes you sad or that running away makes you scared. Neuroscientific research now enables us to investigate cause and effect more closely.

According to Lamme,[20] it is now generally accepted that conscious perception is subject to a delay of somewhere between 0.2 and 0.3 seconds. That is much longer than the time required for the stimulation of the senses to lead to the activation of the muscles – a process known as the formation of a cortical reflex arc. Conscious perception is a latecomer to the party: by the time it arrives, the action is already in full swing. Lamme therefore refers to the neocortex as a 'babble box', a sort of commentator that merely keeps attempting to make logical interventions.

3 Literature research: Pain of paying

As we have seen, in by far the majority of cases, decision-making is unconscious; people do not always make rational decisions. The way we make financial decisions is no different. That is apparent from, for example, the psychological concept of 'pain of paying', introduced by Zellermayer in 1996[21]. Zellermayer defined pain of paying as 'direct and immediate displeasure or pain from the act of making a payment.' Such pain isn't physical, but 'psychological or hedonistic discomfort associated with making a payment'. Pain of paying may reduce the pleasure of making a purchase, or the prospect of it may persuade us not to make the purchase at all.

There is a positive correlation between pain of paying and the amount spent on a purchase. More surprisingly, research indicates that the payment method used influences the level of pain of paying experienced.

In a series of studies, Chatterjee and Rose (2012)[22] demonstrated that different payment methods were associated with different consumer perceptions of prospective purchases. Consumers who were 'primed' to use credit cards (i.e. by asking them to think of a few other words associated with their credit card) focused more on the product features, whereas those who were primed to use cash were more inclined to consider the cost of the products.

The relationship between payment method and pain of paying is considered in subsection 3.1, while the implications of pain of paying for consumption are covered in subsection 3.2.

3.1 Correlation between pain of paying and payment method transparency

The degree of the pain of paying correlates to the transparency of the payment method. The more transparent the payment method, the greater the pain of paying and the less the payer is willing to spend. According to Soman,[23]the transparency of a payment method is determined by three factors: 1) the salience of the payment form, 2) the salience of the amount paid and 3) the relative timing of transaction and money outflow.

3.1.1 Salience of the payment form

Cash is the payment method that makes it most clear that one is spending 'real' money. Notes and coins are tangible and visible in the payer's wallet or purse. When one pays by cash, one sees the money leave one's possession. Research involving 2300 adult German subjects by the Deutsche Bundesbank in 2011[24] demonstrated that consumers make use of the fact that cash allows one to see at a glance not only what one has available to spend, but also how much one has already

spent. Consumers who want close control over their disposable liquid assets therefore make more purchases in cash, use non-cash payment methods less, withdraw less and retain larger cash balances than other consumers. Consumers who use cash a lot do use bank cards for some transactions. However, the threshold transaction value for using a card is higher amongst such consumers than amongst other consumers. The researchers therefore concluded that it was unlikely that cash would become less important for certain groups of users, particularly those who were short of funds and those who found it hard to process (abstract) information.

3.1.2 Salience of the amount

Payment methods also differ in terms of the extent to which the amount paid is consciously perceived by the payer. Cash payment makes the consumer more aware of the amount than other payment methods. Coins and banknotes prominently state their value and the relevant amount has to be counted out and handed over; the payer then has to pay attention to how much change is received. When paying by debit card, one pays less attention to the amount when checking out. According to the authors of the book Psychologeld (2011),[25] the card user is more focused on entering the correct PIN (code) and making sure that no one else can see it.

3.1.3 Coupling

Prelec and Loewenstein[26] introduced the concept of 'coupling': the link between consumption and payment in the mind of the payer. Direct coupling, as when paying cash or with debit card, is the most transparent. Retrospective payment, as with a credit card, and pre-payment, as with a prepaid card/stored value card or gift voucher, are both much less transparent.

On the basis of interviews, Soman placed the various payment methods in order of transparency by reference to the three factors described above. The most transparent payment method in the list is cash and the least transparent methods are pre-

paid cards/stored value cards (e.g. electronic wallets and gift vouchers) and direct debit.

Levels of transparency of various payment methods Table 1

Payment mechanism	Salience of form	Salience of amount	Relative timing of money outflow and purchase	Transparency
Cash	Very high	High	Concurrent	High
Cheque	Medium	High	Payment after purchase	Medium
Credit card	Medium	Medium	Payment significantly after purchase	Low
Debit card	Medium	Medium	Concurrent	Low
Stored value card	Low	Low	Payment before purchase	Very low
Autopay (direct debit from bank account)	Very low	Very low	Concurrent	Very low

3.2 Influence of pain of paying on consumption

3.2.1 Pain of paying and purchase value

The payment method therefore influences the pain of paying, but how do different levels of pain of paying affect consumption? The relationship has been thoroughly investigated. Pain of paying can diminish the pleasure of purchasing and influences what the buyer is willing to spend on a purchase. If you experience less pain of paying, you spend more without noticing it.

Those findings were made in 2001 by Prelec and Simester[27], who observed that, in an auction for tickets to watch the Boston Celtics basketball team, students from Boston were willing to pay more than twice as much when they had to pay by credit card (little pain of paying) as when they had to pay by cash (more pain of paying). The difference was not attributable to how much cash the students just so happened to have with them, because they did not have to settle up until the following day.

Celtics tickets. Sports fan 4 Figure 3

It was also found that students buying books in a university bookshop by credit card estimated the value of the purchase to be lower than when payment was made by cash. Loewenstein (professor of economics and psychology to Carnegie Mellon University) accordingly concluded that credit cards mitigated pain of paying.[28]

There is less pain of paying when settlement is made after the transaction (as with a credit card) and less still when payment is made prior to the transaction, as with an electronic wallet or a gift voucher. With prepaid transactions, the 'bookkeeper in the payer's head' has long since written off the money, making the payer willing to spend more. This effect is, of course, well known to casino proprietors, who use prepaid chips to disconnect payment from the act of placing a bet. Gamblers are then willing to wager more than if they have to place hard cash on the table.

In 2002, Dan Ariely[29] established that consumption was influenced more by the salience of the payment (as associated with the coupling of payment and purchase) than by the cost. Ariely gave 163 students 45 minutes to read information on four different websites. Three websites had various pages of appealing content (news, scientific information, cartoons), but the students had to pay to view it. The fourth website had free but unappealing content (so unappealing that, in a pilot study, subjects were found to prefer listening to screaming than to reading the content in question). At the outset, each student was given 10 dollars to pay for website content. Each student was also randomly assigned one of five different payment methods: (1) prepayment, in the form of money loaded on an electronic wallet (2) retrospective payment, in the form of settlement at the end of the session (3) simultaneous payment, at the time of opening each web page (4) subscription, allowing unrestricted access to the content and (5) subscription, requiring certain additional activities to access the content.

Subjects who had to pay as each page was opened spent significantly less than the other subjects, and were much more likely to look at the free, unappealing information. The most was spent by the two groups of subscribers, followed by the pre-payers and then the retrospective payers.

3.2.2 Pain of paying and purchase type

As explained above, the payer is more conscious of a cash payment than a card payment. That influences not only how much the payer is prepared to spend, but also the type of purchase the payer is inclined to make. Electronic payment allows more scope for impulse buying.

In a field study, the shopping done by a thousand single-person households over a period of six months was analysed. It was found that people who paid by credit or debit card were more impulsive and more inclined to buy unhealthy food than those who paid with cash. The research observations were interpreted as supporting the hypothesis that, being less painful, paying by card diminished the payer's impulse control. The fact that the same effect was observed in both debit card users and credit card users (even though the debit card users were charged immediately) was seen by the researchers as indicating that the lower level of pain was attributable not to the deferral of settlement, but to the abstract and emotionless nature of the transaction – in other words, to what was referred to in subsection 3.1 as the salience of the payment form.

The effects were replicated in three empirical follow-up studie[30]. In one of the studies, the researchers looked at the influence of the payment method on the number of 'unhealthy' products in the subjects' shopping baskets. The findings supported the hypothesis that card transactions were associated with larger purchases and the consumption of unhealthy foods.

A study of behaviour in a university canteen found that bank card payers bought more unhealthy products than cash payers. Students paying by card bought 10% more calories; they were three times as likely to buy brownies and twice as likely to buy soft drinks as students who paid cash.

Brownie images Figure 4

Your.dictionary.com.

The studies referred to above are known as 'pay cash, eat less trash' studies.

The payer's consciousness of the amount paid also affects other impulses. Dan Ariely[31] performed a study, in which six one-dollar bottles of cola were placed in a number of shared refrigerators in student accommodation units. All the bottles were taken within 72 hours. In several other refrigerators, he left not bottles of cola, but six one-dollar bills. The dollars remained untouched for 72 hours, after which Ariely removed them himself. Ariely interpreted his observations, and the findings of several other similar studies, as evidence for his hypothesis that the more remote 'real money' became, the more lightly people took the idea of cheating. The same principle applies to false accounting and, for example, to submitting fraudulent tax returns.

To sum up, the research presented in this section indicates that transparent payment methods, such as cash, are associated with greater pain of paying, lower purchase values and less impulse buying than less transparent payment methods, such as debit cards.

4 Innovative reseach methods

DNB has sought to add to the existing research and the portfolio of available research methods by carrying out a neuroscientific study and a virtual-reality study into unconscious payment method preferences. As indicated earlier, most of the research conducted to date assumes a rational decision-maker, is quantitative and is based on the use of questionnaires.

As indicated in the previous sections of this report, people do not always make decisions rationally. DNB's neuroscientific study of purchase decision-making therefore focused primarily on the emotions and neural networks, rather than on rational processes. Using functional magnetic resonance imaging (fMRI) technology, DNB

commissioned research into how the (evolutionarily primitive) brain responds to the emotional choice between cash and card. The direct observation of behaviour, rather than the indirect investigation of behaviour via the medium of questionnaires, was also considered to be important. In this section, the added value of the innovative direct observation-based research methods over quantitative questionnaire-based research is considered. In the following subsections, the design, methodology and results of the two studies are described.

4.1 Direct observation

Researchers often seek to establish when and under what circumstances people use different methods of payment by conducting questionnaires or performing counts at the checkout. Such research is useful for determining the personal characteristics associated with particular forms of payment behaviour, but sheds less light on people's motives. As previously discussed, the expectation is that the motivation for payment decisions is largely unconscious. That begs the question: how can one establish what that motivation is?

Clearly, if a person's motives are unconscious, there is little to be gained by asking about them in a questionnaire. A person will often behave a certain way for unconscious reasons, then find a logical explanation for his/her behaviour. The explanation is usually based on common sense, mainly so that the person can believe it him/herself. We shall return to this subject later, but for the moment one example is instructive. In his book De vrije wil bestaat niet (There is no such thing as free will),[32] Lamme cites a study by Nisbett and Wilson, which addressed the following question: 'To what extent are people aware of and able to report on the true causes of their behaviour?' To answer that question, the researchers invited passers-by in a shopping centre to choose the best of four pairs of tights. Afterwards, the

passers-by were asked to explain their choices. In fact, the tights were identical, but that was not apparent to the subjects. The subjects were allowed to examine the tights in any way they liked, including feeling them and smelling them. Because the garments were in fact identical, one would expect rational choice to lead each product getting 25% of the votes. That was not the case, however. The tights on the right-hand end of the line-up were identified as the best nearly four times as often as the tights on the left. The observed effect was attributed to the garment's position in the line-up: the participants moved along the line from left to right, so that the tights on the right were examined last. In psychology, the observed effect is known as the 'recency effect': the thing that a person has viewed most recently automatically has that person's emotional preference and is most readily recalled. The participants were not conscious of that influence on their decision-making, and consequently attributed their choices to one pair of tights being more stretchy than the others, or being of better quality. Such experiments indicate that we are less aware of what actually motivates us than we think.

Which nylons are best? Figure 5

Questionnaires have the added disadvantage that there is always a time lag between the behaviour that the researcher is interested in and the subject answering questions about it. There is, of course, no such time lag when behaviour is directly observed. Devising just the right questions can also be difficult. Questions need to

be formulated in concrete terms and to yield as few answer tendencies as possible. It is well established, for example, that research subjects are inclined to give the answer that they believe the researcher wants, or that is expected of them by society. It has also been repeatedly demonstrated that positive or concurring options or expressions of satisfaction are more likely than the opposite answers. People prefer to say 'Yes', 'Satisfied' and 'True' than to say 'No', 'Dissatisfied' and 'False'[33].

No such drawbacks exist with direct observational studies.

In the first study (the virtual-reality study), the (virtual) behaviour of subjects making payments was observed, and the scope for manipulating payment method choice was investigated.

In the second study (the neuroscientific study), the researchers observed which neural networks were active when a subject made a payment decision. What emotions can be directly registered when a person pays in cash or by debit card? Is it possible to discern whether the subject's decision-making involves automatic or newly learned behaviour?

5 Virtual-reality study

5.1 Virtual-reality study design

Hypothesis

It is expected that payment method choice is a form of habitual behaviour, and therefore cannot easily be manipulated.

Sample

Particpants were recruited by CentERdata out of a representative panel. Total participation was 1.465, consisting of 800 males between ages 16 and 87 (average: 53,6) and 665 females between 16 and 90 (average: 49,3).

Participants were sent a survey, one week after they had finished the virtual-reality game. 1.280 persons (701 males, 579 females) answered the survey.

Scheme

DNB commissioned Martijn Meeter and Daniel de Schreij of the Cognition Department at the VU University Amsterdam to investigate the manipulability of payment method choiceThere are numerous variables that may influence payment method choice, but the researchers concentrated on a small selection for practical reasons. The research involved an online game, in which everyday life was simulated. As indicated in section 2, the direct observation of real-life behaviour is preferable, but that would have been impractical because of the large number of variables at play. One would have to observe an unworkable number of subjects in real life in order to support statistically valid conclusions. Even with the chosen study design, involving nearly 1,300 subjects sitting at their PCs, the number of variables had to be limited. The study's methodology and results are described below.

An introductory text explained to the subjects that they were going to participate in a game, in which they were asked to choose between various healthy and less healthy options. Subjects were not told that the intention was to observe their transactional behaviour, and there was no emphasis on payment decisions in the instructions.

Before starting, subjects were given the opportunity to draw up to 70 euros in cash and to bring their preferred means of electronic payment (debit card, credit card). An on-screen pop-up then asked them to go to a virtual supermarket for their

shopping and to a virtual restaurant for a meal. Once 'inside', they were able to select supermarket products from photographs or restaurant items from a menu. They were then asked how they would like to pay: by cash, debit card or credit card (the options offered were confined to those that the subjects had chosen to take with them).

Each subject therefore made four choices regarding each means of payment:

1. Beforehand: whether to take it to the supermarket
2. Beforehand: whether to take it to the restaurant
3. Whether to use it in the supermarket
4. Whether to use it in the restaurant

Requiring subjects to make more choices was not considered desirable, because it is unlikely that the choice would be mutually independent. The order of the two scenarios – first the restaurant and then supermarket, or vice versa – was determined randomly for each subject.

During the course of the game, a number of variables were manipulated with a view to establishing which factors led to the subject choosing to use a given payment method. The manipulations were concealed in the scenarios introductory text, or integrated into the structure of the game. Since the value of each variable was fixed for the individual subject, the subjects were unaware of the manipulations. The possible motives and the manipulations are described in the following subsection.

The investigated variables were manipulated either by giving the subjects particular instructions before they began the game, or by modifying the scenarios that were presented to the subjects during the game. One variable featured both in the instructions and in the game. All variables were manipulated in the context of both scenarios

(the restaurant and the supermarket). The variables used in the research were selected on the basis of literature research. It was very important that not too many variables were introduced, in order to ensure that the manipulations did not interfere with each other and to prevent the need for an impracticable number of subjects.

Variables adjusted in the introductory instructions

– **Environment:** Some of the subjects were told that, in order to reach their destination, they would need to walk through a rough neighbourhood; no such warning was given to the other subjects. This variable was intended to manipulate the subjects' sense of physical security and possibly influence their inclination to carry cash.

– **Warning about skimming:** Some of the subjects were warned about the need to be alert to the danger of 'skimming'; no such warning was given to the other subjects. This variable was intended to manipulate the subjects' confidence in the payment method and possibly influence their inclination to carry and use a debit card.

– **Budget:** Some of the subjects were told that they had to manage on a small budget and therefore needed to be careful not to spend too much. The others were told that they had an ample budget and could afford to treat themselves. This variable was intended to manipulate the subjects' consciousness of how much they were spending. Its inclusion reflected the fact that it was reported in the literature that people who have to be careful about their spending are more likely to pay cash, because cash provides a better oversight of spending or a greater sense of control.

Variables adjusted during the game

– **Healthiness of the food:** Some of the subjects were asked to buy fruit from the supermarket and the others to buy snacks (crisps or chocolate). In the restaurant, some were asked to buy healthy food and the others to buy junk food. This variable was introduced to investigate whether there was any correlation between the healthiness of the food purchased and the chosen payment method. It was thought possible that there might be an unconscious bias towards the use of certain payment methods to pay for, respectively, healthy and unhealthy products, e.g. because cashless payment facilitates unhealthy impulse buying or because people think more about what they are buying when they pay cash.

– **Sympathy for the person taking the payment:** When they went to pay, some subjects were met by a friendly-looking checkout operator/waiter who made eye contact, while the others encountered an unfriendly-looking person who avoided eye contact. This variable was included to investigate whether the subjects' payment behaviour was influenced by their sympathy for the checkout operator/waiter, and their assumptions about what payment method that person would prefer.

– **Promotion/payment method cost:** This variable had four values:

a. No sign
b. Sign saying 'We accept bank cards for small transactions' (encouragement of card use)
c. Sign saying 'We accept cash for small transactions' (encouragement of cash use)
d. Sign saying '10-cent surcharge for bank card transaction'

This variable was included to investigate whether the promotion of a particular payment method (typically the method preferred by the proprietor) or the imposition of a charge for using a particular payment method (in this case only bank card use) influenced the subject's choice of payment method.

– **Prominence of the payment terminal:** When they went to pay, some subjects were presented with a scene in which no payment terminal was visible, while the others saw a scene with a prominent terminal. This variable was included to investigate whether the visibility of a payment terminal influenced subjects' inclination to pay by card.

– **Price 'roundness':** Some subjects were offered products with 'round-number' prices, while the others needed to pay 'awkward' amounts. The intention was to see whether subjects were more likely to use a card when the amount to pay was not a whole number of euros, in order to avoid a complicated change transaction and/or the inconvenience of carrying a lot of change.

Variables adjusted both in the instructions in during the game

– **Time pressure:** Some of the subjects were told that they had a relatively short time to eat out or do their shopping, because they needed to get back for an important engagement. To maintain awareness of the need to hurry, an on-screen clock remained visible to these subjects while the game was in progress. With each step in the game, the clock moved closer to 2pm (the deadline). The other subjects were not told to hurry or shown a clock. This variable was included to manipulate the subjects' sense of (time) pressure and possibly influence their choice of payment method, if one method was perceived 'quicker' than the other.

Payment screen in the supermarket scenario Figure 6

A week after taking part in the game, the subjects were asked to complete a short questionnaire about their preference for cash or electronic payment methods in real life. A total of 1,280 people ultimately both played the game and completed the questionnaire.

5.2 Results of the virtual-reality study

5.2.1 Carrying and paying

Subjects' decisions about carrying and using the various means of payment are summarised in figure x. By far the majority of subjects chose to take both cash and (a) bank card(s), both to the supermarket (65%) and to the restaurant (70%). Very few subjects took only cash (6% and 5%, respectively) and relatively few took only a bank card (29% and 29%, respectively). Apparently, most people wanted to keep both payment options open for as long as possible. In that respect, the observed

behaviour was consistent with a 2012 study by CentERdata and Tilburg University[34], which found that people often automatically took both a bank card and cash when going out. Approximately 40% of the questionnaire respondents reported that there were circumstances in which they deliberately left either cash or their bank card at home. Cash was typically dispensed with for practical reasons (a card on its own being easier to carry), while subjects were inclined not to bother with their cards mainly if they were not planning to make any large purchases.

In the virtual-reality study, there was a roughly equal split between subjects choosing to pay cash and choosing to pay by card, although card use was marginally more popular. In reality, there is a more marked preference for cash when paying at a checkout, as indicated in the introduction to this report.

Decisions to carry and use the various means of payment Table 2

	Carrying	**Supermarket**		Use
Only cash	6%		Cash	47%
Only debit card (and CC)	29%		Debit card	53%
Both	65%			
Total	100%		Total	100%

	Carrying	**Restaurant**		Use
Only cash	5%		Cash	43%
Only debit card (and CC)	25%		Credit card	3%
Both	70%		Debit card	53%
Total	100%		Total	100%

5.2.2 Directional predictors for the explanation of dependent variables

Not all the investigated variables were found to significantly influence payment method choice. Table x lists only those variables that actually appear to help explain payment method choice. In the table, purple shading indicates a significant influence on the decision in favour of cash/debit card. In other words, the relevant variables help to explain the model. A minus sign in a cell indicates a negative correlation, and a plus sign a positive correlation. Annex 1 presents the outcome of the logistic regression analysis in more detail.

People on tight budgets proved more likely to carry cash, for example. That finding is consistent with the research by the Deutsche Bundesbank, referred to above, which concluded that people use cash partly to help them maintain an overview of their spending.

It is also understandable that people are disinclined to carry cash when walking to their destination in the dark, regardless of whether that destination is a supermarket or a restaurant.

In line with earlier quantitative research,[35] our study found a correlation between income and attitude to cash. The lower a person's income, the more likely he or she is to carry and use cash, either at a supermarket or in a restaurant.

The overall size of the transaction is also linked to payment method choice: the larger the amount to be paid, the more likely it is that the payer will choose to use a card. Again, that finding is consistent with earlier quantitative research.

Another predictable finding is that charging for card use leads to more people paying cash.

More surprisingly, warning people about skimming appears to lead to fewer of them taking cash to a restaurant. According to CentERdata and Tilburg University[36], Dutch people who are nervous about card fraud or street robbery are less inclined to pay by card. We have no satisfactory explanation for the discrepancy between the latter finding and our results, except to speculate that the warning about skimming may have made people consider the area unsafe and therefore disinclined to carry much cash.

Directional predictors for the explanation of dependent variables Table 3

	Supermarket: cash carried	Supermarket: cash used	Restaurant: cash carried	Restaurant: cash used
Budget	–		–	
Walk in the dark	–		–	
Gross income	–	–	–	–
Education	–	–		
Amount payable		–	–	–
Card surcharge		+		+
Age		+		
Promotion of card use				–
Skimming warning			–	
Restaurant first				+
Household includes child			+	
In charge of household finances		–		
AH versus Aldi		–		

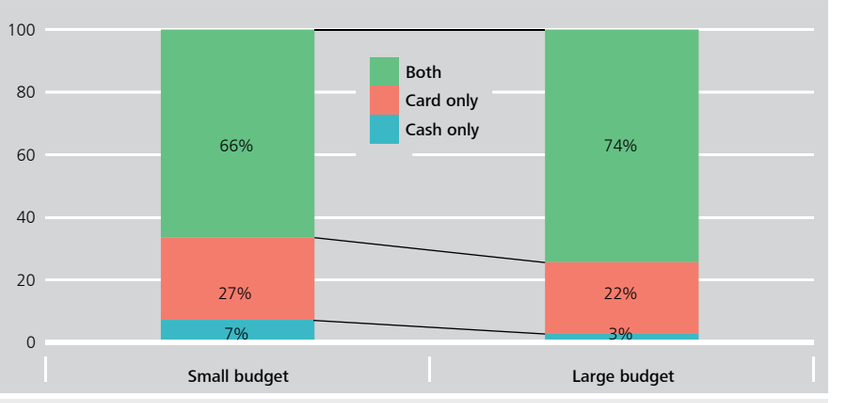
5.2.3 Consideration of two key variables

Two of the variables that influence payment choice – budget and cost – are considered in a little more detail below. In this context, credit cards and debit cards are grouped together, because credit cards are used so little that separation of the findings yields little additional information.

5.2.4 Budget

Subjects with small budgets were more likely to decide to take one particular means of payment with them to a restaurant than those with larger budgets (see figure 8); budgetary pressure was particularly likely to lead to people taking only cash (although the absolute numbers involved remained small). No such effect was observed in relation to supermarket shopping, and the effect on the payment method ultimately used was overshadowed by the effect of the amount to be paid.

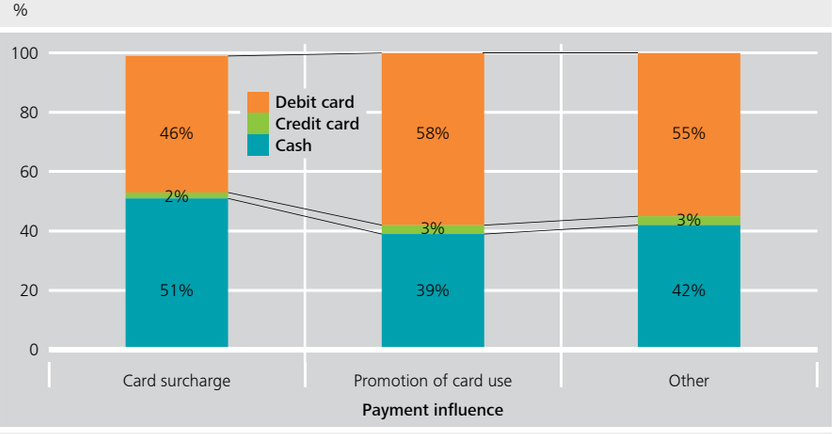
Choice of means of payment carried when going out to eat, as influenced by budget size Figure 7



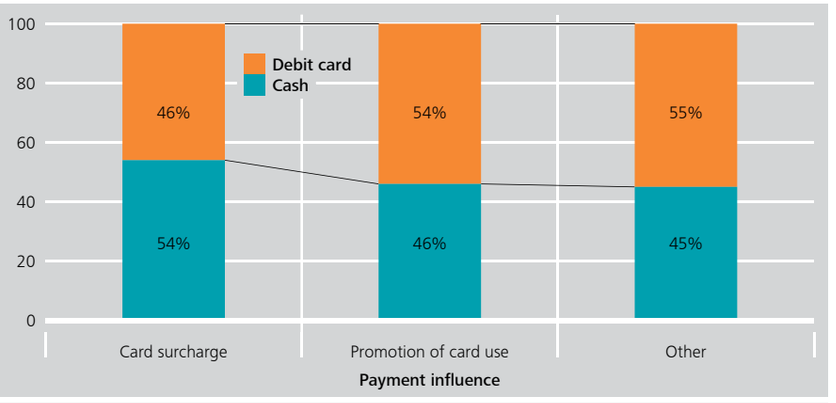
5.2.5 Promotion or card use surcharges

If people are charged to use cards, they are more likely to pay cash than when no surcharge is applied. Conversely, when card use is actively promoted, the likelihood of people choosing to pay by card increases. Such effects were observed in both scenarios (figures 18 and 19) and, contrary to expectation, were unaltered by the apparent friendliness of the checkout operator or waiter.

Payment method used for eating out, as influenced by card use surcharges and by active card use promotion (in the form of signage) Figure 8



Payment method used for shopping, as influenced by card use surcharges and by active card use promotion (in the form of signage) Figure 9

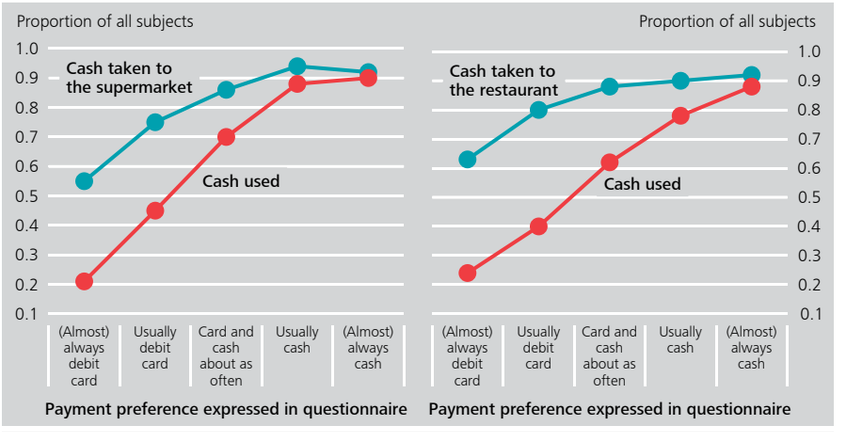


5.2.6 Relationship between questionnaire and game

Presented below are two graphs that illustrate the validation of the research. After a week, the game players were asked about their real-life payment preferences. As figure x shows, the vast majority of people who said that they nearly always paid cash in real life also chose to carry and use cash in the game.

More than half (nearly 60%) of the subjects who reported (nearly) always paying by card also chose to carry cash in the game, but only actually paid cash in 20% of cases. People apparently like having cash with them, probably ‘just in case’.

Relationship between questionnaire and game Figure 10



5.3 Summary of results

The conclusions of the virtual-reality study may be summarised as follows:

- Subjects' (virtual) behaviour is to a large extent determined by habit. Attempts at behavioural manipulation have limited effect (between 15 and 20%).
- A number of variables, such as budget size and income level, influenced behaviour as expected. Other variables, such as price roundness and food type, did not have the expected influence. The 'skimming warning' variable actually had the opposite effect to that expected.
- The promotion of card use and charging for card use did affect behaviour. That implies that the subjects noticed the manipulations. Other manipulations, such as the apparent friendliness of the person taking the money may have simply been too subtle to produce the expected effect.
- Subjects' behaviour in the game was representative of their real-life-behaviour.

6 Neuroscientific study

6.1 fMRI research

In recent years, great advances have been made in neuroscientific research. We can quite literally look inside someone's head while he or she makes a decision or processes information. The techniques involved do, of course, have their limitations. For example, Professor Richard Birke[37] points out that brain scans are expensive and do not produce images of our emotions, but of magnetic responses, which require considerable extrapolation and interpretation.

To perform a neurological scan, one needs a functional magnetic resonance imager (fMRI). This is a very large magnet designed for non-invasive viewing of the brain. An fMRI measures changes in the oxygen levels in the more active parts of the brain. A stimulus, such as an image, film or question, activates part of the brain, whose oxygen use consequently increases relative to adjacent parts of the brain. An fMRI scan is a 3D image showing where and when oxygen-rich blood is present in the brain and therefore which parts of the brain are most active at the time of the scan.

fMRI-scanner Figure 11

In 2006 and 2007, George Loewenstein and his team published two studies concerned with the way people make purchasing decisions and what emotions are involved when making such decisions ('Tightwards and Spendthrifts' and 'Neuroeconomics: How Neuroscience Can Inform Economics')[38]. The studies were based

on the analysis of brain scans, and demonstrated that the parts of the brain that were active during the decision-making were the areas that are responsible for both pleasure and pain. By examining the relevant brain structures, it was possible to predict what choices people would make, before they were themselves conscious of having arrived at a decision.

Neurensics is a research agency that uses the technique mainly to advise companies on the suitability of their advertising. Neurensics claims to be able to identify a so-called 'buy button' in the brain. According to Neurensics, if the 'approach emotions' lust and desire are highly activated and the 'avoidance emotion' anxiety is not, purchasing behaviour is 70% predictable.

The neural tests focus mainly on certain parts of the brain:
- The insula (associated with the anticipation of loss and excessive prices; the insula light up when a person pays a price that he or she considers too high, and shut down if the person thinks he/she has a bargain. Getting a bargain mitigates pain of paying.[39])
- The amygdala (two almond-shaped centres within the limbic system, which are activated by anxiety or aggression).
- The nucleus accumbens (the reward centre, associated with product preference).

Neurensics, to which Professor Victor Lamme of the University of Amsterdam is affiliated, undertook a neuroscientific study for DNB into the emotional perceptions associated with making payments using various methods. DNB first wished to establish, by means of a pilot study, whether the emotional perceptions associated with making payments by cash differed from those associated with making payments by card, because emotions play an important role in determining behaviour. The small-scale study yielded some interesting results, but just as many follow-up questions, a number of which were addressed by a larger subsequent study.

6.2 Pilot study

6.2.1 Hypothesis pilot

Emotions that can be identified by a fMRI-scan in people's brain differ during a cash payment transaction and a debit card payment transaction.

The theory of 'the pain of paying' can be confirmed.

6.2.2 Sample pilot

Participants were 26 Dutch consumers aged between 25-45 years old (13 men and 13 women).

6.2.3 Scheme pilot

The methodology of the pilot study was as follows. Every individual's brain processes are different, so it was necessary to perform calibration tests on the subjects before testing their responses to the research stimuli. The subjects were therefore shown loving or erotic images to trigger their 'approach emotions', or images of mutilation or the open jaws of fierce dogs, from which people have been programmed to flee by countless years of evolution. Using the MRI scanner, it was then possible to determine whether each 3mm x 3mm part of the brain – each 'voxel' – responded positively or negatively to the images. The patterns of voxel activity thus established formed the basis for comparative analysis of the subject's responses to the research stimuli.

Following calibration, the activity occurring in a subject's brain in response to the research stimulus can be recorded. In the context of Neurensics' commercial activities, the stimulus is often a new advert, but in the case of the DNB study, it was making a payment by cash or with a debit card. To deliver the stimulus, three videos were made, each featuring a young woman making a cash or debit card payment in a particular situation (supermarket, filling station and market). The three

situations were selected to allow the influence of the situation to be excluded, after subsequent averaging. The videos were shown to the subjects at random, as they lay in the fMRI scanner, and the location, duration and intensity of the resulting activity patterns were recorded. On the basis of correlation with the responses to the calibration images, the brain structures were then given names (emotions). The following thirteen were identified:

– Positive or approach emotions: desire, lust, expectation and trust
– Negative or avoidance emotions: danger, disgust, anger and fear
– Personal appeal: value, involvement, familiarity
– General impact: novelty, attention

Young woman who makes payments using cash or debit card Figure 12

It is possible to use this method for the analysis of purchase decisions, because the subject watching the video exhibits essentially the same brain activity as if he/she were making the purchase. That is due to the fact that people possess so-called mirror neurons, which 'fire' not only when we perform a deliberate act, but also when we watch someone else perform that act. Observation immediately triggers the same feelings we would have if we were doing the observed thing ourselves. Mirror neurons are located in the premotor cortex and were discovered in the nineties through research with macaque monkeys. It was found that the same neural networks were activated in the monkeys when they watched another monkey eat a banana as when they ate one themselves. It was subsequently established that

the same happens in humans. When a person who watches someone do something, the activity in the watcher's brain is nearly the same as when he or she does that thing personally[40]. The mirroring is clearest when the watcher can imagine him/herself in the actor's shoes and feels empathy for the actor.

6.2.4 Results pilot

The study population of 25 to 45-year-olds were found to experience more positive emotions (on balance) when watching debit card transactions than when watching cash transactions. This resulted in a significantly higher brain quotient (BQ) for debit cards than for cash. The BQ is an expression of the balance between positive and negative emotions, which is vital for predicting consumer behaviour.

In contrast to the main study results presented below, the pilot study results indicate that people should be more inclined to pay by card than with cash, and therefore liable to spend more money when using a card. This observation is consistent with the findings reported in the literature on pain of paying discussed in section 3. One would therefore expect greater use of debit cards than is indicated by the estimates of real-life usage. The researchers suggested that the discrepancy between the anticipated usage levels and actual usage levels is attributable to habitual behaviour and its influence on payment decision-making. That prompted the question: could the 'intervention' of habit be observed on the fMRI scan? Another question promoted by the pilot study was whether the study population was representative of the population as a whole, given that the subjects were aged 25 to 45. The age of the subjects was thought significant because the estimates of actual usage suggest this people in the relevant age group are more likely to use cards than older people[41]. The desire for answers to those questions prompted a follow-up study (the 'main study').

6.3 Main study

6.3.1 Research questions

The research that followed the pilot study was designed to address three questions:

1. To what extent is paying in cash or by card guided by habit, or by unconscious emotions or other determinants?

2. To what extent do different age groups differ in their payment method preferences and to what extent are any differences in emotional preference or in behavioural automation an inherent consequence of aging or merely a generational phenomenon?

3. What motivates the desire to carry cash even when one is not intending to use it?

To investigate these questions, subjects were introduced to various virtual situations, in which there was uncertainty regarding the payment methods to be used.

6.3.2 Sample

In addition to subjects in the pilot study age group (25 to 40-year-olds), the main study involved a group of older subjects (55 to 70-year-olds). In each group, distinction was made between people with a lot of experience of card use and people with little experience, thus creating four distinct groups:

Table 4

	25 to 40-year-olds	55 to 70-year-olds
Little debit card experience	'Young cash users' (n=8)	'Old cash users' (n=9)
A lot of debit card experience	'Young card users' (n=9)	'Old card users' (n=9)

6.3.3 Design of the main study

A ‘mapper’ was developed specially for the study, to determine whether something was a habit. To that end, the brain patterns associated with automatic motor behaviour in each subject were ascertained. That was done by first asking the subjects to perform two motor tasks (pressing four buttons in a particular fixed order) before entering the scanner; the tasks had to be performed repeatedly until the subject could perform them blind. The subject was then placed in the scanner and the brain activity observed during performance of the routine tasks was compared with that observed during the performance of new, previously unlearned tasks. In this way, the researchers were able to map the areas of the subject’s brain activated by automatic behaviour. That in turn allowed the level of automatic motor activity associated with any subsequent task to be measured on the basis of the correlation with between the brain activity pattern for the relevant task and the subject’s automatic behaviour reference map.

Brain activity was triggered by the following:

1. Subjects were shown videos depicting a young woman (for the 25 to 40-year-olds) or an older man (for the 55 to 70-year-olds) paying for something, either with cash or with a bank card, in three different situations.

2. Subjects were asked to play a game, in which they were given virtual cash only, a virtual debit card only, or both means of payment. They then had to make purchases at shops that accepted only cash, only cards or both cash and cards. In some cases, the subject was told about the shop's payment policy immediately, while in other cases the information was not made available until a few seconds after getting to the shop. The delay was introduced to create payment uncertainty, which was considered important in relation to the motives for always wanting to carry cash (as observed in the virtual-reality study). When the subject came to pay, he or she could do one of three things: 1) pay using his/her preferred payment method, where possible; 2) pay cash or by card, that being the only means of payment he/she was carrying; or 3) abort the transaction without paying, because he/she was not carrying the only means of payment accepted by the shop.

Greengrocer

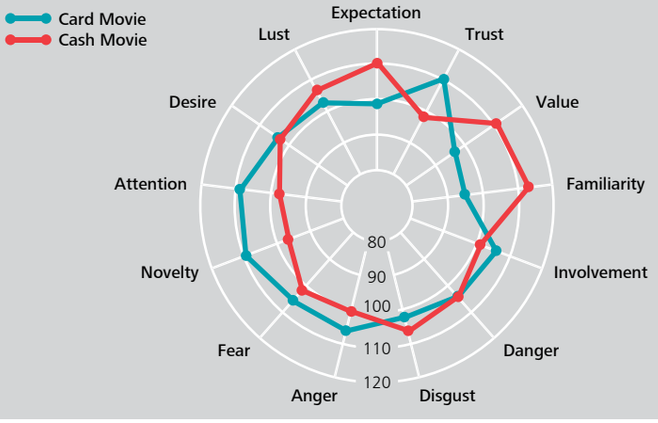
Figure 13

6.3.4 Results of the main study

Emotional differences between the whole groups

When the subjects watch videos of cash transactions, on balance they experience more positive emotions than when they watch videos of card transactions. The following spider's web graph shows that card use has a stronger effect on the attention systems and on the indicators of the activity's novelty or surprise level. The value perception of a card transaction is somewhat lower than that of a cash transaction, but trust in the transaction is higher. Familiarity with cash is greater and, because coins and banknotes prominently state their value, both the perceived (transaction) value and the expectation level associated with cash are higher.

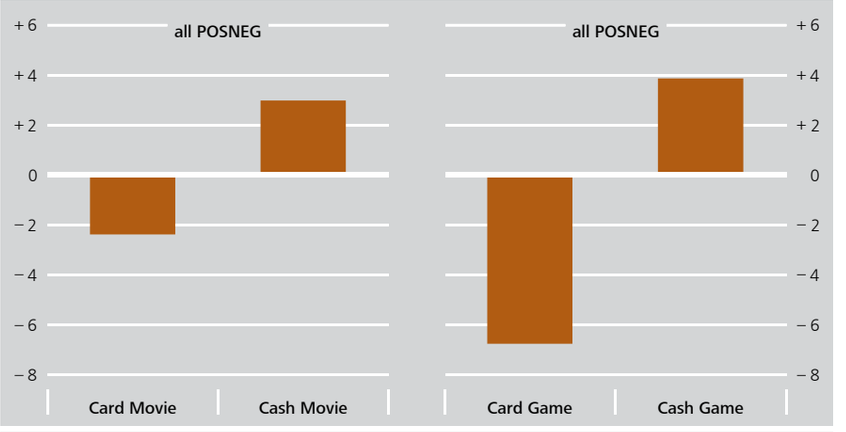
Figure 14



The emotional and motor responses of all subjects collectively are illustrated in the graphs below. Distinction is made between active payment (in the game) and passive payment (watching video clips). The results show a consistent pattern. Weighing the positive responses (lust, desire, trust, value) against the negative responses (fear, anger, disgust, danger) yields a positive-negative balance. As the graph shows, cash payments yield a positive balance, while card transactions yield a negative balance, regardless of whether the subject makes the payments or merely watches a video of the payments.

The latter finding is out of step with the pilot study, in which card transactions yielded a more favourable balance. In the main study, the subjects were told at the outset that the study was concerned with payment behaviour. Because subjects were given instructions and asked to practise relevant game tasks, thus making the payments more relevant to them, the experimental manipulation may have shifted the emotional preference exhibited during passive viewing from debit cards to cash: when we ourselves have to pay, we also perceive cash payments that we view more positively than debit card transactions that we view.

Figure 15

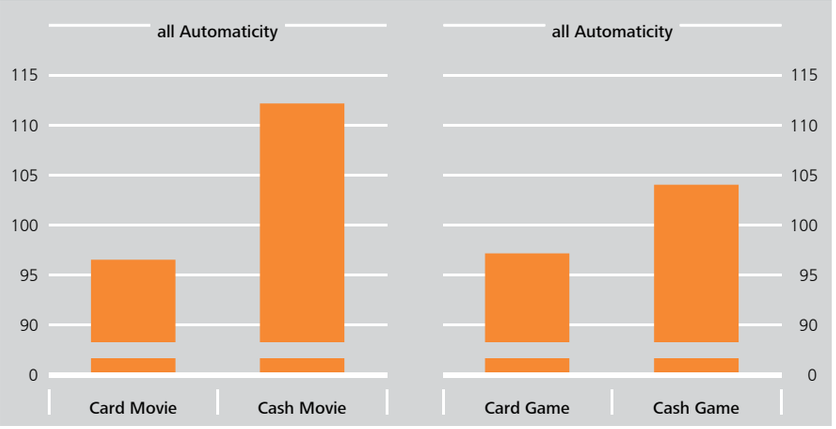


Motor activity differences between the whole groups

The motor activity associated with observing and performing cash or card payments was compared with the activity observed when subjects undertook familiar, internalised activities. The motor activity index for card payments was less than 100, indicating that paying by card was more of a novel motor behaviour than a learned, automatic behaviour.

Stronger automatic behavioural responses were triggered when the subjects watched or made cash payments than when they watched or made card payments; using cash may therefore be regarded as a more habitual activity than using a card. That would seem logical, since formation of the neural networks associated with cash payment is likely to have begun in childhood, when the subjects first started spending their pocket money. The degree of habitualness is less pronounced when the subjects make payment themselves than when they observe payments being made.

Figure 16



Age effects

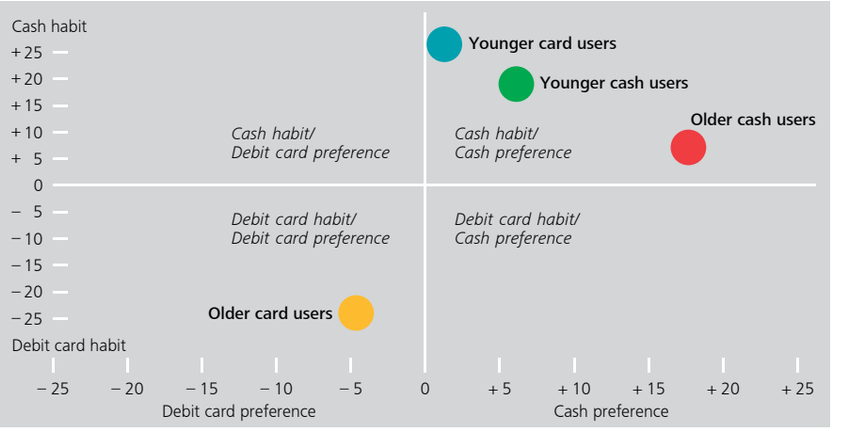
No general generation effect was observed. Not all older people have a strong emotional or motor preference for paying in cash or by card.

Older cash users tend to be more emotionally engaged by cash, while older card users are more emotionally neutral, and more inclined to operate on automatic pilot. However, the strength of the emotional preference for cash seen in older cash users may be due to the subjects merely happening to have a strong innate emotional leaning towards cash. Possibly the prolonged experience that older people have with their preferred payment method makes them habitually and emotionally inclined towards that payment method.

Young cash users also have a stronger emotional bond with cash. Young card users are emotionally more neutral in their payment method preference. Because the

differences in emotional response observed in young subjects are relatively small, it is doubtful that they will ultimately become as marked as those observed in the older subjects. As people who are more familiar with debit cards get older, this group may contract. If that were to happen, one could legitimately say that a generation effect was at work.

Figure 17

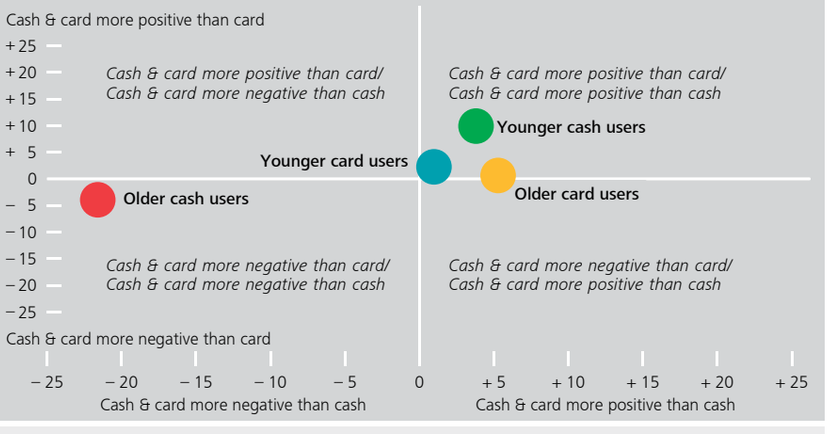


Young people have a stronger motor response to cash than to card use; stronger, even, than that seen in older cash users. Young card users, who are known to make fewer cash payments, appear to have an unconscious wish to spend cash if they have it with them. That is striking, because subjects in the young card user group are people who have indicated that, in reality, they pay mainly by card. Perhaps the subjects in question have a more conscious approach to using cash. They may try to avoid carrying cash and, when they do carry it, they may suppress the urge to spend it, so as to retain enough for when they really need it.

Cash as a backup

All groups display economic rationalism, except for the older cash users. In this context, economic rationalism implies preferring to have both cash and a card to having only one or the other (more available payment options being advantageous). The fact that older cash users do not display economic rationalism may be a response to 'option stress'. Older people who usually pay cash may prefer not to have to make payment method decisions. They would rather carry only a debit card, than carry both card and cash and have to choose between them.

Figure 18



The responses of the various subject groups may be summarised as follows: Table 5

Young cash users	– On balance, response to cash payments is positive – Paying cash is habitual – Fear and disgust only for debit cards
Young card users	– Emotionally more neutral – Paying cash is habitual
Old cash users	– On balance, response to cash payments is positive – Paying cash is habitual – Option stress associated with debit cards & cash
Old card users	– On balance, response to card payments is positive – Paying by card is habitual

Influencing behaviour

Behaviour is best influenced by addressing each target group separately. For example, the research has shown that young people are more susceptible to mirroring and therefore more easily influenced by advertising videos that include payment activity. Older people do not internalise behaviours learned by social exposure; they must use a card personally before the behaviour is internalised. Persuading them to use cards is likely to require a more explicit appeal. Communication may be expected to have more effect if the simplicity and agreeableness of the activity are emphasised.

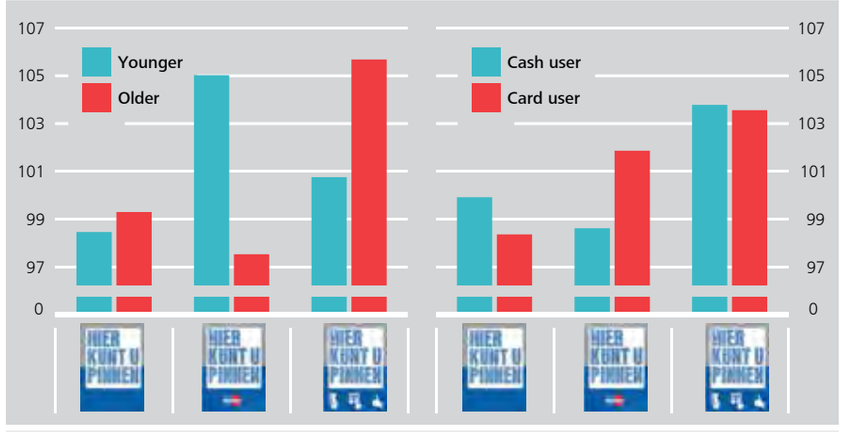
Three information posters were tested to determine their ability to activate subjects' openness to motor action: 1) a poster with the basic message only, 2) a poster also showing the European Maestro logo and 3) a poster also showing three icons that guide the viewer through the payment process without inducing motor stress and that emphasise the convenience of card payment.

Three variants of a poster indicating that debit cards are welcome Figure 19

Debit cards welcome

Young people respond strongly to the Maestro logo, whereas older people do not. Older people respond strongly to the icons depicting the payment activity. The Maestro logo is a visible appeal to the experience that frequent debit card users have. Regardless of experience, the icons depicting the payment process have the strongest activating effect.

Debit cards welcome Figure 20



7 Conclusions

Payment method choice is unconscious

The main conclusion to be drawn from the literature and the two studies commissioned by DNB is that paying in cash or by an electronic method is not the outcome of a conscious choice, but is largely habitual and therefore difficult to influence. Even manipulations such as budgetary constraint, the need to walk in the dark or a surcharge for card use can explain no more than 20% of the variation in the use of cash.

People usually act before they know why. The more primitive part of our brains, which mainly processes our emotions, is more powerful and faster than the part of our brain that evolved more recently, which we use for things such as reflection and planning. Decision-making is more of an emotional process than a cognitive process. DNB therefore commissioned a study in which neuroscientific tests were used to investigate emotional preferences for using cards or cash. The approach had not previously been used to study payment behaviour, and provides new insights based on the direct measurements of brain activity. It is important to bear in mind, however, that brain scans do not provide images of our emotions, but of magnetic responses, which require considerable extrapolation and interpretation.

Cash is associated with more positive emotions and automatic behaviour

On balance, paying by cash triggers more positive emotions than paying by debit card. The observed emotional engagement is consistent with the finding of the virtual-reality study that people like to have cash with them, even if they are not intending to spend it in the near future. Both debit cards and cash activate automatic behaviour, regardless of whether the subject is making the payment or merely observing it. The inherent preference for cash and the automatic behavioural response associated with watching or simulating cash payments, may well explain why the majority of checkout transactions in the Netherlands are made in cash.

Payment method choice influences both purchase values and purchase types

The decision to use a particular payment method is followed by the process of making the payment. According to the literature, that process appears to affect both what people are willing to pay and what they are willing to buy. Cash transactions are more transparent than electronic transactions. The money has to be counted out and handed over; the payer then has to pay attention to how much change is received, and coins and banknotes prominently state their value. That transparency results in greater 'pain of paying ', which in turn deters large purchases and impulse buying. It remains unclear, however, why in the neuroscientific study making cash payments was associated with more positive emotions, when in theory such payments induce more pain of paying.

Age-related differences in payment preferences and habits

An emotional and motor preference for cash payments over debit card payments was observed in all groups of subjects in the neuroscientific study, except for older people who report paying mainly by debit card. Age-related differences were observed both in preferences and in automatism. Young people – even those who claim to pay mainly by debit card in real life – appear to have a stronger unconscious automatic inclination to pay cash. That inclination must therefore be suppressed by members of the group.

Older people differ in their emotional payment method preferences and habits. Older people who reported paying mainly in cash were found to have a strong emotional preference for cash, and to exhibit stronger habitual behaviour responses to cash. Older people who said that they usually paid by card had a (slight) emotional preference for cards and probably use cards mainly out of habit. In young people, the differences in perceptions of the payment methods are less pronounced.

Is it reasonable to believe that payment habits will change with the cycle of the generations? Will the age groups that currently prefer electronic payment methods continue to use them as they grow older and displace today's older people, who tend to prefer paying cash? The results of the neuroscientific study do not provide a clear answer: there is no generalised generational effect involving the use of cash or debit cards.

People of both age groups who usually pay by debit card like to carry cash as well as their cards. Young subjects who say that they often pay cash also appear to enjoy having a card in addition to cash. Older people who usually pay cash appear to enjoy having two means of payment less.

8 Discussion

If a central bank's functions is to ensure the smooth flow of payment traffic and it has a a role in ensuring that payment transactions are secure, reliable and efficient, further insight into the use of different payment methods is very valuable.

One of a central bank's functions is to increase the efficiency of the payment transactions. At present, the focus tends to be on the social cost. Based on this study one could discuss the need for authorities to take also into account the following when encouraging a specific means of payment:

– The choice for a particular means of payment is depending on a variety of implicit respectable motives;
– The transparency of a payment method influences spending behavior.

Changing payment behaviour is not easy. It is an evolutionary process, especially because payment behaviour is to a large extent habitual. The neuroscientific research indicated that behavioural change is most likely to be realised by measures

aimed at particular target groups bearing in mind that the choice for a payment method is not (completely) rational.

Annex 1 Logistic regression Virtual-reality study

Logistic regression is a type of regression analysis used for predicting the chance that a categorical dependent variable happens , using several independent variables. This virtual-reality study contains four dependent variables:

– To take cash to the supermarket
– To take cash to the restaurant
– To use cash in the supermarket
– To use cash in the restaurant.

The table presents the predictors for each of the four dependent variables that cannot be missed to make the best prediction possible for the dependent variable. The 'Wald' statistic, analogous to the t-test in linear regression, is used to assess the significance of coefficients. The Wald statistic is the ratio of the square of the regression coefficient to the square of the standard error of the coefficient and is asymptotically distributed as a chi-square distribution.

The number of stars is an indication for the effect of the individual variable (*=p<0,05, **=p<0,1, ***=p<0,001).

The size of the effect is reflected by the 'B'-parameter, but 'exp(B)' gives a better interpretation. This value shows the powers of changing the odds when a predictor is increased by one step. As an example we use the first and seventh line in the table.

'Constant' reflects the odds if all predictors have value '0'. In that case, according to the seventh line, the odds that a participant takes cash to the restaurant is '4.16 is to 1', which means that there is four times a much chance to take cash to the restaurant than nót to take cash. If the predictor 'budget' changes from high to low (coded as 1), the chance that cash is taken to the restaurant increases with 1.38 (exp(B)). This means that the chance goes from 1.38*4.16= '4.7 is to 1'. If the budget is low, the chance to take cash is almost five times as high as not to take it.

As can be seen from the table the predictor 'gross income' works for all four dependent variables. The higher the gross income, the smaller the chance for carrying or paying with cash, either in the restaurant or in the supermarket.

Some predictors, like the prominence of the payment terminal, time pressure, price roundness or gender appear to have no influence at all.

Table 6

Dependent variable	Predictors	B	Wald	Exp(B)
Restaurant: cash carried	Budget	0.325	5.27*	1.38
	Skim warning	-0.672	7.1**	0.511
	Walk in the dark	-0.839	13.32***	0.432
	Amount payable	-0.012	3.57	0.988
	Gross income	-0.047	3.67	0.945
	Household includes child	0.791	5.3*	2.2
	Constant	1.4	39.39	4.16
Restaurant: cash used	Card surcharge	0.372	3.01	1.45
	Promotion of card use	-3.94	2.82	0.675
	Restaurant first	0.301	5.35*	1.35
	Amount payable	-0.067	124.9***	0.935
	Gross income	-0.118	14.38***	0.889
	Constant	1.11	26.64	3.05
Supermarket: cash carried	Walk in the dark	-0.5	5.36*	0.607
	Education	-0.101	5.64*	0.904
	Gross income	-0.052	4.12*	0.949
	Budget	-0.206	2.7	0.814
	Constant	1.8	59.19	6.06
Supermarket: cash used	Card surcharge	0.361	3.37	1.43
	Age	0.01	6.33*	1.01
	Amount payable	-0.162	28.6***	0.851
	Gross income	-0.118	14.38***	0.889
	In charge of hh finances	-0.326	6.8**	0.722
	AH versus Aldi	-0.156	4.0*	0.789
	Education	-0.121	8.86**	0.886
	Constant	1.24	13.37	3.46

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[41] See footnote 1

Lola Hernández[1], Nicole Jonker[2] and Anneke Kosse[3]
Cash versus Debit Card: The Role of Budget Control[4]

Lola Hernández
Cash and Payment System Devision,
De Nederlandsche Bank, Netherlands

Abstract

Due to the financial crisis, an increasing number of households face financial problems. This may lead to an increasing need for monitoring spending and budgets. We demonstrate that both cash and the debit card are perceived as helpful in this

1 Lola Hernández, phone: +31 (0)20 524 5708, e-mail: l.Hernandez@dnb.nl, address: De Nederlandsche Bank, P.O. Box 98, 1000 AB Amsterdam, The Netherlands.
2 Corresponding author: Nicole Jonker, phone: +31 (0)20 524 2758, e-mail: n.jonker@dnb.nl, address: De Nederlandsche Bank, P.O. Box 98, 1000 AB Amsterdam, The Netherlands.
3 Anneke Kosse, phone: +1 613 782 7116, e-mail: koss@bankofcanada.ca, address: 234 Laurier Avenue West, Ottawa, ON K1A 0G9.
4 The views expressed in this paper are the authors' and do not necessarily reflect those of the Nederlandsche Bank or the European System of Central Banks. All remaining errors are the authors'. We would like to thank René Kurpershoek for linguistic services and Hans Brits, David-Jan Jansen and Robert Vermeulen for helpful comments on earlier versions of this paper.

respect. We show that, on average, consumers responsible for the financial decision making within a household find the debit card more useful for monitoring their household finances than cash. Individuals differ in major respects, however. In particular, low earners and the liquidity-constrained prefer cash as a monitoring and budgeting tool. Finally, we present evidence that at an aggregated level, such preferences strongly affect consumer payment behaviour. We suggest that the substitution of cash by cards may slow down because of the financial crisis. Also, we show that cash still brings benefits that electronic alternatives have been unable to match. This suggests that inclusion of enhanced budgeting and monitoring features in electronic payment instruments may encourage consumers to use them more frequently.

1 Introduction

Many studies have sought to gain insight into the drivers and barriers underlying consumers' payment choices at the point of sale – see for example Kosse (2014) for a summary. Overall, consumers' choice between alternative payment instruments has been found to depend on factors such as the amount of the transaction, the availability of payment terminals and financial incentives. In addition, the payments literature suggests that the use of different payment instruments is strongly related to demographic factors, such as age, education and income.

So far, the literature has largely ignored the impact of budget control on consumers' payment choices. Since the start of the financial crisis in 2008, households' financial situation has deteriorated in many European countries, including the Netherlands. In 2013, the purchasing power of the Dutch declined for the fourth consecutive year. The reasons include rising unemployment, downward pressures on wages and pensions and rising taxes and inflation (e.g. CPB, 2013; DNB, 2013). In order to cope with declining purchasing power, households have had to examine their expenses more closely and make cuts where necessary. Traditionally, Dutch households that need to cut down expenses have been advised by consumer organisations like NIBUD (National Institute for Family Finance Information) to record all their payments in order to realise how much they spend and on what expenses they might save. Also, households are traditionally advised to withdraw a fixed amount of cash for their daily expenditures, to prevent spending more than one could afford. However, with the widespread use of payment cards, almost universal access to internet banking and the introduction of mobile banking apps, Dutch consumers can now use their payment cards or mobile phones to monitor their expenditures.

Given the current financial crisis and the many new options offered by the various innovations in retail payment systems, the question arises to what extent modern technology actually helps consumers to balance their budgets. Another, related question is whether consumers' desire to control their budget affects their choice of payment instrument.[5] As far as we know, the economic literature has paid little attention to these issues. This paper aims to fill that gap by studying consumers' need to control their expenses and budgets in relation to their choice of payment instrument at the point-of-sale (POS). We focus on behaviour at the point of sale and the budgeting role of cash and the debit card, as being by far the most frequently used

5 It turns out that in the UK cash usage rose slightly in 2012, perhaps due to the financial crisis (Payments Council, 2013).

means of payment in the Netherlands (see Hernández and Kosse, 2013).[6,7], In this paper, we try to answer the following questions:

1. How highly do consumers value (instant) insight into their daily finances?

2. To what extent are cash and debit cards perceived to be helpful in this respect?

3. To what degree are consumers' payment choices affected by their views on the use of cash and debit cards in exercising budget and expense control?

In 2012 we polled more than 1,700 Dutch consumers about their budget control needs and perceptions. The resulting rich dataset allows us to assess differences across individuals. In particular, this paper aims to answer our main research questions through focusing on differences based on consumers' financial situation and their degree of financial self-control.

Earlier work on self-control and spending (e.g. Fusaro, 2008; Von Kalckreuth et al. 2011) focuses on consumers' need to control remaining budgets and to have insight into the level of earlier expenses made, without accounting for the possible desire to track individual expenses. One of the novelties of our study is that we

6 We decided to exclude credit cards from our analysis given that in the Netherlands their use is limited. At the point-of-sale, the Dutch use cash most often, with the widely accepted debit card coming in second place. The prepaid card and credit card follow far behind. In 2012, cash was used almost 3.8 billion times representing a value of EUR 47 billion, debit cards were used almost 2.5 billion times (EUR 84 billion), the prepaid card 148 million times, (EUR 0.3 billion) and the credit card 38 million times, representing EUR 4.5 billion in sales. For estimates on cash usage, see Hernández and Kosse (2013), for card usage see National Forum on the Payment System (2013).

7 Consumer expenditures include remote and POS expenditures. In the Netherlands, POS payments account for about half of consumers' total consumption. In this paper we focus on POS payments, which are relatively volatile but are also relatively easy to influence by consumers. This may be important for people with financial problems who need to cut down expenses. Remote payments on the other hand consist to a great extent of recurrent fixed expenditures like housing, utilities or taxes, whose total value is less easy to influence in the short run.

distinguish between three types of consumer need: (i) the need to gain insight into total expenses, (ii) the desire to keep track of the nature of expenses, and (iii) the need for budget control. This makes for a better understanding of the role of budget and expense control in consumers' payment choices at the point-of-sale.

This paper is structured as follows. Section 2 provides an overview of the literature on budget control with special emphasis on its relation with consumers' choice between different payment instruments at the point-of-sale. In section 3, we formulate the main research questions. Section 4 discusses the set-up of the survey used to collect our data, presents descriptive statistics and briefly describes the econometric models used for the in-depth analyses. Section 5 discusses the estimation results and Section 6 summarises and concludes.

2 Related Literature

There is a wide variety of payment instruments available that consumers and merchants can use to pay for purchases made at various points of sale, such as shops, filling stations or restaurants. Most commonly used are cash, debit cards and credit cards. There is a considerable stream of literature examining the drivers and barriers underlying consumers' choice of what instrument to use.[8] Overall, the choice is found to depend on various factors, such as the size of the transaction, the type of merchant and the acceptance of payment instruments by retailers. In addition, the payments literature reveals an important role for consumers' personal traits and perceptions. Finally, a vast number of papers demonstrate that consumers react

8 The many relevant references include Arango et al. (2011), Bolt et al. (2010), Borzekowski et al. (2008), Bounie and François (2006), Carbó-Valverde and Liñares Zegarra (2011), Ching and Hayashi (2010), Humphrey et al. (2001), Jonker (2007), Jonker et al. (2012), Kennickell and Kwast (1997), Klee (2008), Kosse (2013), Kosse and Jansen (2013), Mantel (2000), Rysman (2007), Schuh and Stavins (2010), Von Kalckreuth et al. (2009).

strongly to transaction charges and discounts set by retailers, banks or card companies.

Several studies have paid attention to the role of budget and spending control in consumers' use of payment instruments. Overall, these papers touch upon the broader literature on self-control (e.g. Fisher, 1930; Thaler and Shefrin, 1981), which departs from the concept that consumers have simultaneous desires for "immediate spending of income" and for "long-term planning and investment", and therefore need some sort of self-control to prevent overspending. Overall, two distinct self-control mechanisms are proposed: monitoring one's behaviour, such as expense tracking, and setting clear constraints, such as periodic budgets (e.g. Heath and Soll, 1996; Ameriks et al., 2004). Monitoring expenses and managing budgets requires consumers to somehow recall their expenses, which may not always be easy (Srivastava and Raghubir, 2002; Jonker and Kosse, 2013). In particular, consumers tend to forget low-value payments and payments that have occurred less recently. However, technological enhancements have greatly improved the ability to keep up-to-date records of transactions. In particular, the rapid developments in Internet and mobile technology have enabled consumers to access their bank accounts and to check their balances any time any place. Even more advanced tools are conceivable for the future, such as wallets that grow and shrink to reflect the user's account balance (Kestner et al., 2009). Yet to use such technological innovations consumers need to invest money, as in Internet access or smartphones, and time, as in learning to use the new technology (Von Kalckreuth et al., 2009).

Thus payment instruments may be used as spending control and tracking devices.[9] In the case of cash, a quick scan inside the wallet, recalling the initial content and calculating the difference from the remaining content provides an immediate picture of total expenses made. Payment cards provide for a similar memorisation and calculation mechanism, the difference lying in the need to consult a bank statement. The time frame within which this information is made available varies with the technology used, from almost immediate (mobile phone), to a few days/weeks (paper statements). Cash and payment cards also differ in their capability of providing information on the nature of expenses made. Cash leaves no trace of the type of purchase made, while card transactions are reported individually in account statements. Third, cash and payment cards differ considerably in the way they allow the user to set pre-defined budgets and to monitor the amount left to spend. With cash one may stick to a predetermined budget by withdrawing the amount of money allowed to be spent during a particular period and paying only in cash. This makes overspending impossible. In addition, the remaining budget can be assessed relatively easily by checking the wallet. The use of a payment card, by contrast, requires spending constraints to be set mentally. The card leaves relatively much freedom to spend more than the pre-set limit if the balance in the account exceeds the pre-defined budget. In addition, in order to assess how much money they have left to spend, consumers need to consult their bank statements, memorise their pre-set budget and make their own calculations.

In fact, some studies present evidence that consumers feel a need to restrain overspending and to track expenses and that this influences their choice of payment instrument. In general, both the theoretical (e.g. Feinberg, 1986; Thaler and She-

9 In the standard theory of money and trade, a few papers suggest that, apart from being a store of value, medium of exchange and unit of account, money also serves as a form of memory that helps to keep track of past expenses (e.g. Ostroy, 1973; Lucas, 1980; Kocherlakota and Wallace, 1998; Kocherlakota, 1998; Temzelides and Yu, 2000). These authors fail to take into account, however, that money can be transferred through several different channels, each of which has its own characteristics in terms of providing transparency about past expenses and available funds.

frin, 1981; Ameriks et al. 2004; Raghubir and Srivastava, 2008; Prelec and Loewenstein, 1998), and the empirical literature (e.g. Bertaut et al., 2008; Fusaro, 2008; Borzekowski et al., 2008) argue that the desire for budget and spending control drives consumers away from credit cards. With respect to cash and debit card use, however, the literature draws mixed conclusions. Some papers (e.g. Ameriks et al., 2004; Jonker, 2007; Von Kalckreuth et al. 2011; Arango et al., 2011) suggest that consumers prefer cash as a means to restrain overspending and to keep track of expenses. By contrast, Borzekowski et al. (2008) find that debit cards are also preferred by consumers who want to curb overspending and by those who like to track and monitor their expenses. At the same time, Schuh and Stavins (2010) show an important role of cheques as a book-keeping tool.

In accordance with the traditional self-control literature (e.g. Fisher, 1930), there are various pieces of evidence showing that the need to monitor total spending and budgets differs across consumers. Overall, the desire for monitoring and control is found to be stronger among (i) consumers with a special financial need to do so, such as people of low income and/or low education, people with children, or people facing liquidity constraints, and (ii) consumers who have difficulty monitoring their liquidity, such as people with low commitment power, or those having difficulty remembering expenses or using enhanced tracking tools (e.g. Thaler, 1985; Bertaut et al., 2008; Borzekowski et al., 2008; Arango et al., 2011, Von Kalckreuth et al., 2011). Moreover, there is evidence of a U-shaped relation with age, with the young as well as seniors being more likely to track their expenses well than middle-aged people (Ameriks et al., 2004). This is mainly explained by the wealth effect, with the latter group having the weakest financial incentives to keep track of their expenses.

3 Research Questions

To sum up, the available literature suggests that consumers may use two distinct mechanisms to control their spending, i.e. monitoring and budget-setting. Also, it suggests that cash and debit cards – given their specific characteristics – may each serve as a valuable tool here. The most important differences between cash and debit cards relate to the effort, time, and technology needed to gain insight into total past expenses, their ability to provide insight into the type of expenses made, the way in which a budget can be set and exceeded, and the efforts, time and technologies needed to check what remains of a set budget (see Table 1 for an overview of the main distinctive features). Finally, the literature suggests that individual consumers think differently about the usefulness of each payment instrument as a budgeting tool. In particular, perceptions may differ across two dimensions: (i) the financial need to control spending, and (ii) the individual effort required to do so, in terms of commitment power or mental ability.

Given this background, the aim of this paper is to answer the following key research questions:

(I) What value do consumers attach to budget and spending control?

(II) How well do cash and debit cards perform in this respect?

(III) How does this affect consumers' choice between cash and the debit card?

Overview of distinctive budgeting features of cash and debit card by self-control mechanism Table 1

Self-control mechanism		Cash	Debit card
Behaviour monitoring	Total amount of expenses	Immediate (wallet) Needs calculation/memory	Immediate (mobile) or delayed (paper, computer) Needs calculation/memory
	Nature of expenses	Not possible	Immediate (mobile) or delayed (paper, computer) No need for calculation/ memory
Setting clear constraints	Setting pre-defined budgets	Physically set Low freedom to exceed	Mentally set High freedom to exceed
	Monitoring pre-defined budget	Immediate (wallet) No need for calculation/ memory	Immediate (mobile) or delayed (paper, computer) Needs calculation/memory

Note: 'Immediate' and 'delayed' refer to the time it takes consumers to gain insight into each budgeting need.

We aim to answer the three key questions while assessing potential differences across individuals. In particular, we focus on the role of consumers' financial situation and their ability to exercise self-control. In doing so, we assume that consumers may have three different needs, i.e. the need to know (i) the total amount of their expenditures (TOTAL AMOUNT), (ii) the nature of their expenditures (NATURE), and (iii) the amount left to spend (BUDGET). Based on this, we will address the following sub-questions:

Q I-a: What value do consumers attach to having insight into TOTAL AMOUNT, NATURE and BUDGET?

We start our analysis by examining consumers' views on the importance of each of the three budgeting needs described above. Following the literature, we expect that the relative value consumers attach to knowing the total amount of their expenses, the nature of their expenses and their remaining budgets for POS payments will vary according to individual characteristics. In particular, we expect to find an important role for consumers' financial situation and their level of self-control. Hence the next set of questions:

Q I-b: Does individual consumers' financial situation affect the importance they attach to knowing the TOTAL AMOUNT, NATURE and BUDGET?

In answering this question, we use two measures for the financial situation of consumers: gross monthly household income[10] and the perceived sufficiency of that income. According to the literature, the desire for monitoring and control is found to be stronger among consumers who have the highest financial need to do so, such as people with lower levels of income or those facing liquidity constraints. Therefore, we expect to find a negative relationship between consumers' household income and the extent it covers expenditures on the one hand, and the importance attached to have insight into the TOTAL AMOUNT, NATURE and BUDGET on the other.

Q I-c: Does consumers' degree of self-control affect the importance they attach to knowing the TOTAL AMOUNT, NATURE and BUDGET?

According to the literature, people with low self-control have a stronger need to monitor and control their budget and expenses. We test this theory by using two measures of self-control in financial matters. The first, 'planning', indicates the consumer's self-reported ability to plan his/her expenditures, whereas the second, 'spending', indicates the consumer's self-reported behaviour regarding the way

10 We acknowledge that for the purpose of analysing consumers' views on budgeting and spending issues, it would have been better to consider consumers' net income. Unfortunately, the surveys did not provide insight into the net income of the respondents. Therefore, we use gross income levels.

they spend their money after having paid for food, rent and other necessities (i.e. spending versus saving).

Q II-a: In general, do consumers attach equal value to cash and debit cards as tools providing insight into the TOTAL AMOUNT, NATURE and BUDGET?

With respect to NATURE, we follow Borzekowski et al. (2008) and expect to find a clear perceived advantage of the debit card over cash, as account statements provide detailed transaction information on every individual debit card purchase. Concerning TOTAL AMOUNT, both cash and the debit card are valuable tools, although each has its own characteristics in terms of efforts, delay time and technologies needed (see Table 1). This also holds for BUDGET, where cash and debit cards differ considerably in terms of the way pre-defined budgets for POS payments can be set, exceeded and checked. Again, following the literature, we expect consumers to vary according to their individual traits, and especially according to their financial situation and level of self-control. This leads us to formulate the following sub-questions:

Q II-b: Does consumers' financial situation influence their rating of cash and debit cards as tools providing insight into TOTAL AMOUNT, NATURE and BUDGET?

Based on the conclusions drawn in the literature, we expect low income people and the liquidity-constrained – i.e. the people who have the greatest need to control their spending and budgets – to rate cash above the debit card for providing insight into TOTAL AMOUNT and BUDGET compared to their counterparts. As summarized in Table 1, using cash allows for an immediate check of the total amount of expenses made at points-of-sale and the current status of the pre-set budget, without the use of additional technology, such as a mobile phone or computer. We expect this feature to be valued particularly highly by low income earners and the liquidity-constrained, as they are more likely to be bound to a fixed budget. As a result, they are more likely to have a strong need to quickly check

their past expenditures and the remaining spending possibilities before making a transaction. Also, they are less likely to have the latest (i.e. costly) technologies permitting a current view of their bank balances. Second, we expect low earners and the liquidity-constrained to have the most pressing need to set immutable budgets.[11]

With respect to NATURE, we expect an opposite outcome. Based on the literature, we expect low earners and the liquidity-constrained to have a stronger desire to know exactly how they spend their money and hence on what type of expenses they could potentially save. Therefore, we expect them to perceive the debit card as more helpful here, since, unlike cash payments, each individual debit card transaction is reported in the account statement of the card holder, allowing for a detailed overview of all individual transactions.

Q II-c: Does consumers' degree of self-control affect their rating of cash and debit cards as tools providing insight into TOTAL AMOUNT, NATURE and BUDGET?

Following the literature as summarised in Section 2, consumers with little self-control in spending may be expected to benefit more from setting clear spending limits than people who are in control. Given the limited opportunity to over-spend on POS payments when on a physical cash budget, and given the ease with which the remaining budget can be assessed by checking one's wallet, people with low self-control rate cash above the debit card as a tool for providing insight into TOTAL AMOUNT and BUDGET. By contrast, as people with little self-control are found to have a higher need for budget and expense control, we expect them to perceive the debit card as more useful than cash with respect to gaining insight into NATURE, on

11 Physically setting a predetermined budget is a mechanism employed by consumers to prevent over-spending. It refers to withdrawing the amount of cash to be spent during a particular period and paying all expenses in cash.

account of the available detailed payment history and budgeting possibilities. Due to its anonymous nature, this is not possible with cash.

Q III: Do consumers' views on the budgeting characteristics of cash and debit cards affect consumers' debit card usage?

This question is intended to examine whether consumers' perceptions regarding the ability of the debit card and cash to meet the three budgeting needs affect their choice of payment instrument at the point of sale. Given the evidence found in the literature that consumers' choice of payment instrument is influenced by the need to budget and control spending, we expect to find a positive relationship between the relative helpfulness of the debit card compared to cash. Also, as the existing literature is silent on this topic, we hope to find out which of the three needs has the greatest impact on consumers' payment choice.

Overview of sub-questions and expected outcomes Table 2

Sub-question	Personal characteristic	Total Amount	Nature	Budget
Q I-a: How do consumers rate insight into …?				
Q I-b: Does a consumer's financial situation influence the importance attached to insight into …?	Household income	–	–	–
	Income suffices to cover expenses	–	–	–
Q I-c: Does the degree of consumers' self-control influence the importance attached to insight into …?	Ability to plan expenditures	–	–	–
	Spender vs. saver	+	+	+
Q II-a: Do consumers attach the same value to cash as to debit cards for helping them to gain insight into …?				
Q II-b: Does the consumer's financial situation influence the value attached to cash compared to debit cards for helping them gaining insight into …?	Household income	–	+	–
	Income suffices to cover expenses	–	+	–
Q II-c: Does the consumer's degree of self-control influence the value attached to cash compared to debit cards for helping them gaining insight into …?	Ability to plan expenditures	–	+	–
	Spender vs. saver	+	–	+
Q III: Do consumers' views on the helpfulness of cash and debit cards for gaining insight into …, … and … affect consumers' debit card usage?		+	+	+

Note: Signs in the last three columns denote the expected direction of each outcome

4 Data

4.1 Data collection

In order to obtain a first impression of the degree to which and the reasons why people monitor their budget and expenses, we used some general information on consumers' budgeting habits from the DNB survey on consumers' daily payments at points of sale held in September 2011, see also Jonker and Kosse (2012).

In order to answer the research questions as presented in Section 3 in sufficient depth, we distributed a unique survey among more than 1,700 Dutch consumers in March 2012, the so-called DHS Survey on Budget Control. The respondents were selected from the CentERpanel. This Internet panel, managed by research institute CentERdata, provides an accurate reflection of the Dutch-speaking population.[12] Our survey questions were directed at the panel members aged over 18 who were responsible for the financial decisions made in their household. As a result, the respondents to the survey may differ from the average consumer in terms of socio-demographics, behaviour and attitudes. In the econometric analyses presented in section 5 we therefore use various control variables to correct for any potential biases of this kind. The questionnaire was answered in full by 1,429 individuals, corresponding to an 81% response rate. In addition, we employ data collected by CentERdata on the financial situation of the household, their income and payment behaviour at the point of sale as well as various psychological characteristics such as the respondent's self-assessed level of self-control.

4.2 Variables

Regarding consumers' reasons for wanting to keep abreast of expenses and budgets, the results of the DNB survey on consumers' payments clearly point at different needs. Mentioned most often are: (i) the need to have insight into total expenses (40%), (ii) the need for budget control (35%), and (iii) the need to keep track of the type of expenses (33%), see Table 3. These results confirm our assumptions that these three needs are important, as set out in Section 3, and justify our approach in subsequent analyses.

Reasons mentioned for monitoring or not monitoring expenses and budgets Table 3

Reasons to monitor		Reasons not to monitor	
Insight into my total expenses	40%	I won't be able to stick to it	23%
Need for budget control	35%	Too dull to do/Can't be bothered	22%
To keep track of the nature of my expenses	33%	Because my income exceeds my expenses	19%
Insight into total expenses of my household	14%	It takes too much of my time	17%
To ensure that I'm not short of money at the counter	13%	I don't want to know how much I'm spending	11%
To cut down expenses	12%	I don't want to know the nature of my expenses	6%
Optimising interest revenues by transferring excess balance from current account to savings account and vice versa if the balance on the current account is lower than a certain threshold level	12%	Because my partner monitors the expenses	6%
To check for incorrect debit card payments	11%	Too complicated for me	6%
To avoid overdraft	7%	Other	13%
Other	2%		
Number of respondents	7,122		665

Source: DNB survey on daily payments, September 2011

12 For more information about the CentERpanel, see Teppa and Vis (2012).

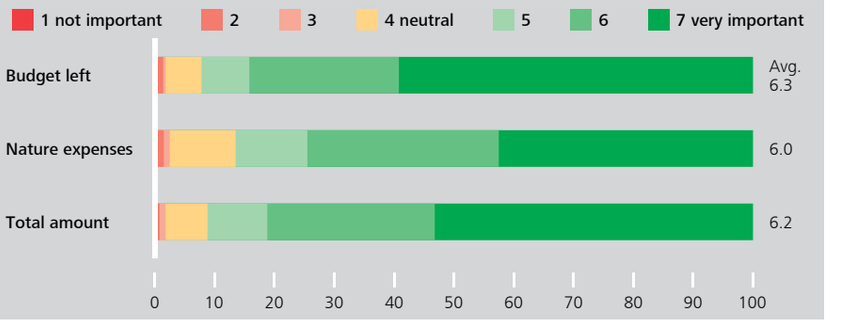
4.2.1 Dependent variables

The DHS Survey on budget control included questions about respondents' personal characteristics, their views on the importance of the three above-mentioned needs, about the roles of the various payment instruments in filling those needs and about their use of different POS payment instruments. These latter three sets of questions form the base of the dependent variables that we use in this paper to answer research questions QI-a to Q III in Section 5.

More specifically, we asked the respondents to indicate on a scale from 1 (very minor) to 7 (very high) how much importance they attach to each of the three needs (see Figure 1). Overall, about 90% of the respondents perceive insight into the three needs as important to highly important, whereas less than 3% consider it to be unimportant. On average, the amount left to spend is considered most important (average score 6.3), followed by the total amount of their expenses (average score 6.2) and the nature of their expenditures (average score 6.0). Before modeling our data, we conducted paired mean comparison t-tests to check for the equality of the importance attached by the respondents to each of the three budgeting needs. As expected, the results point to significant differences between the three needs, see Table 1A in the Annex.

Importance attached by respondents to each of the three budgeting needs (1-7 scale) Figure 1

%



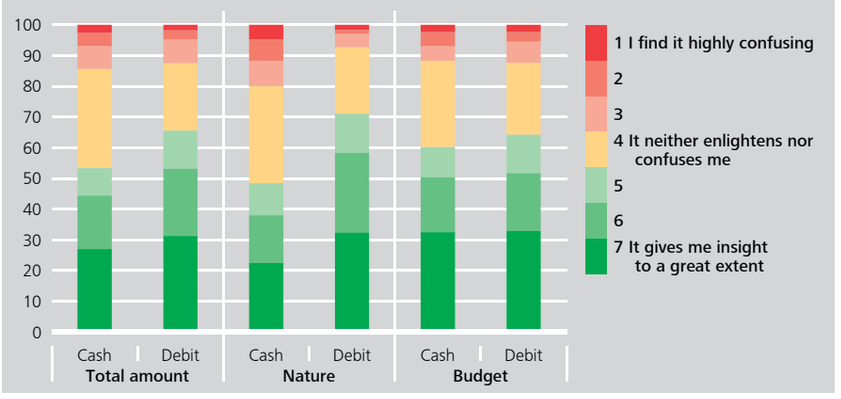
Source: DHS Survey on budget control, March 2012.

Subsequently, we asked the respondents to indicate on a scale from 1 (of no importance) to 7 (highly important) to what extent cash and the debit card allow them to fulfill each of these three needs.[13] Figure 2 presents the perceived use of payment methods in fulfilling the three budgeting needs. The results show that debit cards get the highest ratings for all three needs. However, we used paired mean comparison t-tests to test for the equality of the provided ratings, see Table 2A in the Annex. They show that on average, the respondents attach a higher value to debit cards than to cash when it comes to obtaining insight into the total amount of their expenses and into their nature. However, we do not find any difference in the value attached to cash and debit cards regarding their use for tracking remaining budgets.

13 Although in the remainder of this paper we focus on the ratings given by respondents to cash and the debit card, information about credit cards was collected as well. Average ratings for credit cards were 4.66 (Amount), 4.96 (Nature) and 4.45 (Budget).

Extent to which cash and debit card contribute to fulfil consumers' budgeting needs Figure 2

%



Source: DHS Survey on Budget Control, March 2012.

We constructed the dependent variable CASHMINUSDEBIT which measures the relative helpfulness of cash compared to debit card for each of the three needs. This variable can take on any of three values, from 1 to 3.[14] It takes the value of 1 if the consumer perceives cash as less helpful than the debit card, 2 if he/she perceives cash as equally helpful as the debit card and 3 if he/she thinks that cash is more helpful than the debit card.

The DHS Survey on budget control also included questions on general payment habits, for instance about relative debit card use. Respondents could provide a

14 In an earlier version we used the difference between consumers' rating for cash and the debit card as a measure for the relative helpfulness of cash compared to the debit card. However, this variable could take on 13 values, some of which had zero or only a few observations. Therefore, we decided to simplify the dependent variable and to distinguish between three categories only. The regression results as presented in section 5.2 were robust to this change in specification

score from 1 (never, very rarely) to 4 (very often). It turns out that 1.5% of the respondents use the debit card never or very rarely to make payments, 13% use it every now and then, 32% use it often and 54% use it very often.

4.2.2 Key explanatory variables

In assessing consumers' attitudes towards monitoring and controlling budgets and expenses, we focus in particular on the influence of individual differences in terms of financial situation and degree of self-control, while controlling for other demographic characteristics.

We use two measures for financial situation, i.e. consumers' gross monthly household income (4 categories) and the extent to which a consumer's monthly household income is sufficient to cover their expenses. For the latter measure, we distinguished five levels, ranging from 1 (very hard to get by) to 5 (very easy to get by). The descriptive statistics show that about 13% of the respondents had difficulties getting by, whereas 47% indicated no problems. The remaining 40% found it neither hard nor easy to make ends meet.

With respect to consumers' degree of self-control in financial matters, we also employ two different measures. The first one, called 'planning', indicates the consumers' self-reported ability to control their expenditures, ranging from 1 (very easy to control) to 7 (very hard to control). The average score equalled 2.7, implying that on average the respondents felt fairly in control. The second measure, 'spending', is derived from the question asking about what consumers normally do with the money they have left after having paid for food, rent and other necessities. Here we distinguish between seven levels, ranging from 1 (I like to spend any remaining budget immediately after covering basic expenses) to 7 (I try to save as much as possible). The average answer score turned out to be 5.1, indicating that on average there is a tendency to save. Less than 10% of respondents reported spending all their budget surpluses.

4.3 Empirical methodology

In order to answer the research questions set out in Section 3, we use the ordered probit approach. We estimate several models, where the dependent variables can take on a limited number of positive integer values according to a clear, natural ordering. Multivariate modeling is especially informative as it allows the joint estimation of the effects of different explanatory variables on the dependent variable under consideration. In addition, ordered probit models capture qualitative differences between the levels of the dependent variable. We estimated both the coefficients and marginal effects of the explanatory variables. However, for the reasons of simplicity and clarity, we only present the coefficients in Tables 4–6. The marginal effects are available upon request [15]

The analysis is split up into three parts, each one focusing on one of the paper's key questions (see Section 3). In the first step, we assess the importance attached by consumers to each of the three budgeting needs (n), with $IMPORTANCE_n$ being the dependent variable having a value of 1 (very minor) to 7 (very high).

In the second step, we examine which of the two means of payment are perceived to be most helpful in fulfilling the three needs. We use the variable CASHMINUSDEBIT as described in Section 4.2.1 as the dependent variable.

In both steps, we follow the literature and use a rich set of explanatory variables. We use various consumer characteristics, such as the person's gender, age, marital status, education and urbanisation degree. In addition, we use indicators reflecting the respondent's financial situation and level of self-control. As described above, we use gross monthly household income and the ease with which consumers are

15 The marginal effects of the independent variables have been calculated in terms of the average marginal effect for the respondents in the sample (not as the mean value of the explanatory variables). They are evaluated relative to the corresponding explanatory variable that acted as reference variable.

able to get by as a measure of consumers' financial situation, and 'spending' and 'planning' as indicators of consumers' degree of self-control.

As a third and final step, we assess the impact of consumers' desire for budget- and expenditure control on the use of debit cards. The dependent variable is $DEBITUSE_n$ taking on a value of 1 (never, rarely) to 4 (very often). In addition to the standard demographic variables, we use the respondents' relative assessment of the usefulness of the debit card compared to cash with respect to providing insight in each of three budgeting needs (n). For each budgeting need we constructed two dummy variables. The first is equal to one if the respondent perceives cash as more helpful than the debit card for that particular need and the second dummy is equal to one if the respondent thinks the opposite, i.e. the debit card is more helpful than cash. So in total, there are six dummies related to the relative helpfulness of cash compared to the debit card.

5 Results

5.1 Value attached by consumers' to monitoring their budget and expenses

Note that the estimation results refer to a specific group of respondents, i.e. the financial decision makers within households aged over 18 years. Therefore, in order to correct for the personal characteristics of this group, we estimated several ordered probit models to further assess consumers' views on the importance of each of these three needs. The estimated coefficients are presented in Table 4–6 and discussed in the following subsections.

5.1.1 Effect of financial situation

Table 4 shows that both indicators of consumers' financial situation have a significant impact on their budgeting needs. As expected and in line with the economic litera-

ture, consumers with liquidity constraints tend to attach a higher value to all three budgeting needs under study than their counterparts. Those who find it harder to get by every month are significantly more likely to attach a higher value to tracking the total amount and the nature of their expenses, and their budget left to spend.[16] The average marginal effects indicate that this probability increases by 8, 7.5 and 12.3 percentage points for the respective budgeting needs. The results also show that household income has a significant negative effect on the importance attached to total expenditure monitoring. In terms of magnitude, the likelihood of attaching high importance to total expenditure monitoring decreases by 10 percentage points when household income is high (relative to the 'very low income' reference category).

5.1.2 Effect of self-control

The results also show a significant effect of our two measures of self-control on the value consumers attach to the three budgeting needs. However, not in all cases are these effects as expected. Consumers finding it easy to plan their expenditures are more likely to attach higher value to each need – total amount of expenses, nature of expenses and budget left to spend – while those reporting difficulties in planning their expenses appear to attach higher value only to knowing the nature of their expenses. Also, we find a contrary effect between those reporting to save their budget surpluses (i.e. "savers") and those who prefer to spend them (i.e. "spenders"). The former are significantly more likely to attach higher value to monitoring the amount and nature of their expenses than the latter. Summarizing, the results indicate that people with high rather than low self-control in spending attach relatively high value to tracking their budget and expenses.

16 We are aware of possible causality problems between consumers' ability to get by every month and their views about the importance of controlling expenses and budgets. That is, those attaching higher importance to budget and expenditure control might – as a result – find it less difficult to get by. In order to check for the presence of any endogeneity biases, we have re-run all regressions related to the first and second research question excluding dummy variables indicating whether the consumer's monthly household income is sufficient to cover expenses. The results do not show substantial changes to our conclusion on consumers' level of self-control.

Importance attached by consumers to each budgeting need Table 4

Estimated coefficients of consumers' characteristics. Standard errors are in parentheses

Variables	Total amount of expenses	Nature of expenses	Budget left to spend
Male	-0.144** (0.072)	-0.335*** (0.072)	-0.319*** (0.076)
Married	0.212** (0.086)	0.156* (0.086)	0.067 (0.091)
Age: 35-44	-0.239 (0.157)	-0.127 (0.149)	-0.497*** (0.166)
Age: 45-54	-0.186 (0.154)	0.112 (0.149)	-0.378** (0.165)
Age: 55-64	-0.060 (0.153)	0.176 (0.149)	-0.280* (0.165)
Age: 65+	0.215 (0.153)	0.536*** (0.148)	-0.045 (0.165)
Income low	-0.079 (0.150)	-0.013 (0.147)	0.096 (0.168)
Income medium	-0.088 (0.142)	-0.015 (0.142)	-0.008 (0.165)
Income high	-0.264* (0.147)	-0.134 (0.147)	-0.12 (0.167)
Primary education	0.19 (0.232)	0.286 (0.237)	0.358 (0.250)
Vocational education	0.041 (0.098)	0.012 (0.093)	0.193* (0.102)
College	-0.001 (0.088)	-0.073 (0.086)	-0.002 (0.090)
University	-0.081 (0.104)	-0.162 (0.103)	-0.066 (0.108)

* p<0.1, ** p<0.05, *** p<0.01; *, ** and *** denote significance levels of 10, 5 and 1 per cent, respectively. Reference characteristics are: female, unmarried, age below 34, income very low, secondary education, urbanization degree: intermediate, neither saver nor spender, intermediate ability to plan spending, neither hard nor easy to get by. The direction and statistical significance of the marginal effects are in line with the results presented in table 4, and are available upon request.

Importance attached by consumers to each budgeting need Table 4

Estimated coefficients of consumers' characteristics. Standard errors are in parentheses

Variables	Total amount of expenses	Nature of expenses	Budget left to spend
Urbanization degree: (very) urban	0.078 (0.121)	0.052 (0.117)	0.231* (0.126)
Urbanization degree: high	-0.019 (0.099)	0.03 (0.096)	-0.014 (0.100)
Urbanization degree: slightly urban	-0.099 (0.101)	-0.065 (0.095)	-0.056 (0.103)
Urbanization degree: Rural	0.052 (0.103)	0.075 (0.106)	-0.052 (0.104)
Ability to plan expenditures: very high	0.268*** (0.078)	0.190** (0.076)	0.200** (0.081)
Ability to plan expenditures: very low	0.203 (0.155)	0.477*** (0.181)	0.235 (0.203)
Spending behaviour: Spender	-0.169 (0.152)	-0.408*** (0.158)	-0.051 (0.158)
Spending behaviour: Saver	0.211*** (0.075)	0.284*** (0.073)	0.111 (0.076)
(Very) Difficult to get by	0.222* (0.118)	0.204* (0.109)	0.349*** (0.125)
Easy to get by	0.121 (0.082)	0.101 (0.082)	-0.031 (0.086)
Very easy to get by	-0.115 (0.135)	-0.023 (0.131)	-0.287** (0.139)
No. of observations	1220	1216	1215
Log likelihood	-1408	-1545	-1328
Pseudo R-squared	0.033	0.047	0.039

* p<0.1, ** p<0.05, *** p<0.01; *, ** and *** denote significance levels of 10, 5 and 1 per cent, respectively. Reference characteristics are: female, unmarried, age below 34, income very low, secondary education, urbanization degree: intermediate, neither saver nor spender, intermediate ability to plan spending, neither hard nor easy to get by. The direction and statistical significance of the marginal effects are in line with the results presented in table 4, and are available upon request.

5.1.3 Demographic characteristics

The findings presented above prove to be robust to the inclusion of various demographic characteristics, such as gender, marital status, age and, to a lower extent, education. Overall, females are significantly more likely than men to attach relatively high value to each of the three budgeting needs under analysis. This holds especially for the need to know the nature of expenses and the budget left to spend, where the likelihood of attaching greater importance is 12 percentage points higher for women than for men. Also, persons aged over 65 and those who are married turn out to find it more important than the rest to monitor their spending. The marginal effects indicate that the probability of attaching greater importance increases by up to 20 percentage points for those in the higher age group compared to people below 34 (reference group) when seeking insight into the nature of their expenses, while married people are more likely to attach higher importance to having insight into the amount (+ 8 percentage points) and nature of their expenses (+ 6 percentage points) than singles. Finally, although the effect of education is only significant for those with vocational training, the direction of the results show that the perceived importance of controlling budgets decreases with a person's level of education. This may be related to the negative effect of income which was mentioned before, but may also hint at a potential role of mental ability as discussed by Von Kalckreuth et al. (2009).

5.2 Role of cash and debit cards in fulfilling budgeting needs

In order to compare consumers' opinions on the relative usefulness of cash compared to the debit card in fulfilling their budgeting needs, we constructed the dependent variable CASHMINUSDEBIT which takes the value of 1 if the respondent perceives cash as less helpful than debit cards, 2 if he/she perceives cash as equally helpful as the debit card and 3 if he/she thinks that cash is more helpful than the debit card. We estimated an ordered probit model for each budgeting need. The results are presented in Table 5 and discussed in the following subsections.

Importance attached by consumers to each budgeting need

Table 5

Estimated coefficients of consumers' characteristics. Standard errors are in parentheses

Variables	Total amount of expenses	Nature of expenses	Budget left to spend
Male	-0.280*** (0.070)	-0.276*** (0.072)	-0.204*** (0.070)
Married	0.023 (0.086)	0.046 (0.088)	0.125 (0.082)
Age: 35-44	0.370** (0.187)	0.16 (0.178)	0.233 (0.179)
Age: 45-54	0.480*** (0.177)	0.316* (0.174)	0.422** (0.174)
Age: 55-64	0.446** (0.174)	0.322* (0.169)	0.265 (0.170)
Age: 65+	0.281 (0.173)	0.233 (0.170)	0.000 (0.169)
Income low	0.126 (0.131)	0.122 (0.135)	0.423*** (0.138)
Income medium	0.102 (0.135)	-0.029 (0.137)	0.352*** (0.136)
Income high	-0.11 (0.142)	-0.17 (0.145)	0.106 (0.145)
Primary education	0.016 (0.178)	-0.067 (0.184)	-0.285 (0.182)
Vocational education	-0.086 (0.088)	0.02 (0.089)	-0.208** (0.089)
College	-0.143 (0.093)	-0.193** (0.094)	-0.153* (0.092)
University	-0.349*** (0.114)	-0.370*** (0.117)	-0.162 (0.111)

* p<0.1, ** p<0.05, *** p<0.01; Standard errors in parentheses, *, ** and *** denote significance at 10, 5 and 1 per cent respectively. Reference characteristics are: female, unmarried, age below 34, income very low, secondary education, urbanization degree: intermediate, neither saver nor spender, intermediate ability to control spending, neither hard nor easy to get by. The direction and statistical significance of the marginal effects are in line with the results presented in Table 5 and are available upon request.

Importance attached by consumers to each budgeting need

Table 5

Estimated coefficients of consumers' characteristics. Standard errors are in parentheses

Variables	Total amount of expenses	Nature of expenses	Budget left to spend
Urbanization degree: (very) urban	0.248** (0.116)	0.185 (0.118)	0.182 (0.112)
Urbanization degree: high	0.063 (0.096)	-0.014 (0.094)	0.013 (0.096)
Urbanization degree: slightly urban	0.167 (0.104)	0.198* (0.105)	0.196* (0.104)
Urbanization degree: Rural	0.207* (0.108)	0.161 (0.110)	0.134 (0.106)
Ability to plan expenditures: very high	-0.066 (0.083)	0.003 (0.084)	-0.074 (0.083)
Ability to plan expenditures: very low	-0.035 (0.206)	0.193 (0.194)	-0.086 (0.168)
Spending behaviour: Spender	-0.107 (0.171)	-0.002 (0.171)	-0.072 (0.156)
Spending behaviour: Saver	0.007 (0.072)	0.098 (0.075)	0.144* (0.074)
(Very) Difficult to get by	0.235** (0.116)	0.240** (0.113)	0.209* (0.110)
Easy to get by	-0.071 (0.081)	-0.037 (0.083)	-0.054 (0.082)
Very easy to get by	-0.084 (0.125)	-0.005 (0.130)	-0.038 (0.115)
No. of observations	1178	1178	1189
Log likelihood	-1220	-1149	-1215
Pseudo R-squared	0.039	0.040	0.033

* p<0.1, ** p<0.05, *** p<0.01; Standard errors in parentheses, *, ** and *** denote significance at 10, 5 and 1 per cent respectively. Reference characteristics are: female, unmarried, age below 34, income very low, secondary education, urbanization degree: intermediate, neither saver nor spender, intermediate ability to control spending, neither hard nor easy to get by. The direction and statistical significance of the marginal effects are in line with the results presented in Table 5 and are available upon request.

5.2.1 Effect of financial situation

The estimation results show ample evidence that consumers' financial situation affects their perceptions on the usefulness of cash and the debit card as budgeting tools. First, we find a significant effect for income. Consumers with relatively low incomes are more likely than others to perceive cash as more useful than debit cards. Second, our findings show that consumers reporting difficulty in getting by every month tend to find cash more useful than debit cards for budgeting purposes. Compared to the reference group, the probability that budget-constrained people find cash more helpful is 7 percentage points higher where insight into amount expenses and budget is concerned and 6 percentage points higher for monitoring the nature of expenses. This effect is significantly different from zero at the five percent level for two of the three budgeting needs, i.e. monitoring the total amount and the nature of expenses.

5.2.2 Effect of self-control

The findings for the influence of self-control in spending are not in line with our expectations as presented and discussed in Section 3. We do not find any evidence that people with low self-control attach relatively high value to cash compared to the debit card as a tool for monitoring the total amount spent and the budget left to spend, nor do we find any evidence supporting our expectation that they attach relatively high value to the debit card for monitoring the nature of their expenses. We find some mild evidence that people who differ in spending behaviour also differ in perception as to which payment instrument is most useful; people with a tendency to save ('savers') indicate that they perceive cash as more useful than debit cards in meeting their budgeting needs. The marginal effects show that they are 4.4 percentage points more likely than people in the reference group (neither 'saver' nor 'spender') to perceive cash as more useful for providing insight into the budget left to spend. This result is significant at the 10 percent level of significance. In line with the literature (e.g. Heath and Soll, 1996; Ameriks et al., 2004), these findings show that people who decide to set clear budget limits prefer to use cash as a mechanism to control and monitor their expenses.

5.2.3 Demographic characteristics

The estimation results show that consumers differ significantly as to how useful cash and debit cards are as budgeting tools. Overall, men are significantly less likely than women to perceive cash as more useful than the debit card, irrespective of the budgeting need. Also, the higher educated are more likely to prefer the debit card. Respondents with university and college education prefer the debit card for the insight it provides into the total value and nature of their expenses, while those with vocational education perceive debit cards to be the more useful when tracking their budget left to spend. By contrast, cash turns out to be appreciated most by people from age 35. There appears to be no big difference between consumers living in highly urbanised areas and those living in less urban areas (reference group).

5.3 Perception vs. usage: consumers' payment choice

Table 6 presents the results to our final question regarding debit card use, i.e. whether the relative use of the debit card by consumers reflects their views on the usefulness of cash and the debit card for budgeting and monitoring purposes. The results clearly indicate that it does. The first three columns show the results for each pair of preference indicators for a specific budgeting need. All the indicators have the expected sign and are significantly different from zero at the 1 percent level. The last column shows the estimation results when we include all six preference indicators together as explanatory variables.

The results clearly indicate that consumers do have a stronger preference for using the payment instrument they believe is providing them the best tool for monitoring their expenses and budget.

In every model specification, the two indicators reflecting consumers' preference for either cash or the debit card have a significant corresponding effect on debit card usage.[17] Of all three budgeting needs, debit card usage turns out to be mainly driven by the need to track the total amount of expenses. The results also confirm our findings in Table 1 that consumers regard these needs as non-identical. In accordance with the payments literature, the results also point to a significant effect of various demographic characteristics such as gender, education and income on debit card use. In general, men tend to pay cash relatively often. In contrast, debit card usage increases with income and level of education.

17 Marginal effects show that consumers who prefer cash to the debit card as a monitoring tool are significantly less likely to use their debit card. The results indicate that these consumers are 20 percentage points less likely to be frequent debit card users than those who find cash as helpful as the debit card. This estimated effect holds for both reasons to need insight into the total amount and nature of expenses. Those who prefer cash as a budget tracking tool are 15 percentage points less likely to be frequent card users. The estimated effects are statistically significant at the 1 percent level.

Impact of perceived usefulness on the use of debit cards Table 6

Estimated coefficients of consumers' characteristics. Standard errors are between parentheses

Variables	(1)	(2)	(3)	(4)
Male	-0.142* (0.076)	-0.115 (0.075)	-0.097 (0.074)	-0.166** (0.077)
Married	-0.016 (0.088)	-0.032 (0.090)	-0.02 (0.089)	-0.026 (0.091)
Age: 35-44	0.203 (0.162)	0.166 (0.167)	0.159 (0.167)	0.22 (0.166)
Age: 45-54	-0.006 (0.159)	-0.007 (0.164)	-0.005 (0.165)	0.06 (0.163)
Age: 55-64	-0.006 (0.156)	0.012 (0.162)	-0.011 (0.162)	0.057 (0.160)
Age: 65+	-0.243 (0.150)	-0.197 (0.156)	-0.271* (0.156)	-0.201 (0.154)
Income low	0.125 (0.143)	0.145 (0.142)	0.214 (0.142)	0.212 (0.144)
Income medium	0.433*** (0.147)	0.434*** (0.147)	0.486*** (0.148)	0.485*** (0.149)
Income high	0.497*** (0.151)	0.532*** (0.152)	0.576*** (0.151)	0.561*** (0.152)
Primary education	-0.390** (0.195)	-0.355* (0.196)	-0.468** (0.203)	-0.480** (0.198)
Vocational education	-0.173* (0.093)	-0.143 (0.093)	-0.193** (0.094)	-0.186* (0.095)
College	-0.056 (0.093)	-0.058 (0.093)	-0.06 (0.093)	-0.082 (0.094)
University	0.109 (0.119)	0.172 (0.119)	0.209* (0.121)	0.148 (0.123)

* p<0.1, ** p<0.05, *** p<0.01; *, ** and *** denote significance levels at 10, 5 and 1 percent respectively. Reference characteristics are: male, unmarried, age below 34, income very low, secondary education, urbanization degree: intermediate. Columns 1 to 3 present the results including dummy variables capturing consumers' perceived usefulness to having insight into each budgeting need: Total amount, Nature and Budget respectively. The last column includes results with all three perception dummies. The direction and statistical significance of the marginal effects are in line with the results presented in Table 6 and are available upon request.

Impact of perceived usefulness on the use of debit cards Table 6

Estimated coefficients of consumers' characteristics. Standard errors are between parentheses

Variables	(1)	(2)	(3)	(4)
Urbanization degree: (very) urban	-0.006 (0.117)	-0.039 (0.117)	-0.055 (0.115)	0.007 (0.118)
Urbanization degree: high	0.077 (0.101)	0.033 (0.101)	0.049 (0.102)	0.059 (0.103)
Urbanization degree: slightly urban	0.065 (0.106)	0.041 (0.105)	0.043 (0.106)	0.078 (0.108)
Urbanization degree: Rural	0.04 (0.112)	-0.005 (0.111)	-0.006 (0.112)	0.036 (0.114)
Perception dummy: cash (Amount)	-0.550*** (0.086)			-0.317*** (0.108)
Perception dummy: debit (Amount)	0.359*** (0.083)			0.306*** (0.110)
Perception dummy: cash (Nature)		-0.533*** (0.097)		-0.263** (0.121)
Perception dummy: debit (Nature)		0.243*** (0.077)		-0.031 (0.102)
Perception dummy: cash (Budget)			-0.416*** (0.084)	-0.127 (0.099)
Perception dummy: debit (Budget)			0.343*** (0.085)	0.182* (0.107)
No. of observations	1193	1183	1182	1165
Log likelihood	-1131	-1141	-1135	-1096
Pseudo R-squared	0.068	0.053	0.055	0.073

* p<0.1, ** p<0.05, *** p<0.01; *, ** and *** denote significance levels at 10, 5 and 1 percent respectively. Reference characteristics are: male, unmarried, age below 34, income very low, secondary education, urbanization degree: intermediate. Columns 1 to 3 present the results including dummy variables capturing consumers' perceived usefulness to having insight into each budgeting need: Total amount, Nature and Budget respectively. The last column includes results with all three perception dummies. The direction and statistical significance of the marginal effects are in line with the results presented in Table 6 and are available upon request.

6 Summary and concluding remarks

The current financial crisis has faced increasing numbers of households with financial problems. Understanding how consumers are coping and the effect this has had on their financial behaviour has therefore become increasingly important since the outbreak of the crisis. This study examines how consumers value keeping track of their budget and spending, to what extent they find cash or the debit card more useful as budgeting instruments, and whether this preference affects their payment behaviour. We pay special attention to consumers' financial situation and their degree of self-control in financial matters. To the extent of our knowledge, we are the first to do so. We also add to the literature in that we distinguish between three different forms of budget monitoring: (i) obtaining insight into the total amount spent, (ii) monitoring the nature of expenses, and (iii) tracking the amount left to spend. In our analyses we focus on consumers' budgeting behaviour at the POS including the respective roles of cash and debit cards. For our empirical analysis, we use information from a one-off consumer survey held in March 2012 among 1,700 respondents.

Our results indicate that the need for budget control among the Dutch is high. More than 90% of our respondents indicate a need to keep abreast of their budget and spending. They consider it most important to be aware of the amount left to spend, followed by the total amount and the nature of past expenses. The results also indicate that they regard these needs as different, which supports our choice to assess them separately.

Regarding the influence of consumers' financial situation, we present evidence that people who are struggling to make ends meet indeed have a higher need for keeping track of their expenses as well as their budget. We also find that respondents in the highest income class attach significantly less value to having insight into the level of their spending than others. However, we find little evidence that people

with low self-control attach higher than average value to keeping track of their spending and budget. We only find that typical 'spenders' tend to value insight into the nature of their expenses more than do 'savers'. On the contrary, the results mainly show that people with a high degree of self-control attach a relatively high value to having insight into their spending and budget. These results are robust to the inclusion of other personal characteristics such as gender, age and education.

Second, our results reveal that, on average, our respondents rate the debit card above cash for providing insight into total spending and the nature of their expenses. Yet, both payment instruments are perceived as equally useful for checking the amount left to spend. Although overall, the debit card is regarded as the better expense monitoring tool, we find that the most vulnerable consumer segments (e.g. those with low incomes or financial difficulties) consider cash to be more useful.

Finally, we show evidence that budget control plays a significant role in consumers' choice between payment instruments at the point-of-sale. Our results demonstrate that consumers are inclined to pay with the instrument they perceive to be most effective in tracking their budget and monitoring their expenses. This effect is strongest for the device people find most useful in tracking total spending.

In sum, our results suggest that the ongoing substitution of cash by cards may potentially slow down during a financial crisis, as the number of households with financial problems rises. Such a change in behaviour has already been detected in the United Kingdom. The latest findings by the British Retail Consortium (2012) and the UK Payments Council (2013) show an increase in cash usage in the UK between 2011 and 2012. In particular, the British Retail Consortium found that households facing financial problems began to use cash more often whereas their total spending declined. Our results show that due to the deterioration of consumers' financial situation, the need for monitoring the amount of money left to spend on a day-to-day basis has grown, for which purpose cash is considered to be most useful.

Similarly, our findings show that for particular groups of consumers, cash brings benefits that the current electronic payment instruments have not yet succeeded to provide. As electronic payment instruments are generally found to be less costly for society than cash (see e.g. Jonker 2013, or Schmiedel et al., 2013 and references therein), potential cost savings could be realised if the use of electronic payment instruments were to increase further. Here, our results suggest an important role for product innovation. The fact that cash is still preferred by certain consumer segments for its ability to provide immediate and accurate information on, in particular, the remaining budget left to spend, the use of electronic payment instruments may potentially be encouraged further if they included enhanced budgeting and monitoring features.

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Annex

Paired t-test: Consumers' rating of budgeting needs

Table 1A

Variable	Mean	P-value
Total amount	6.238	Ha: mean(diff) !=0
Nature	6.016	Pr(T>t) = 0.0000
diff	0.222	
Total amount	6.236	Ha: mean(diff) !=0
Nature	6.296	Pr(T>t) = 0.0499
diff	-0.060	
Total amount	6.014	Ha: mean(diff) !=0
Nature	6.296	Pr(T>t) = 0.0000
diff	-0.282	

Paired t-test: Consumers' rating per instrument

Table 2A

Variable	Mean	P-value
Total amount (cash)	4.966	Ha: mean(diff) !=0
Nature (debit)	5.270	Pr(T>t) = 0.0000
diff	-0.305	
Total amount (cash)	4.665	Ha: mean(diff) !=0
Nature (debit)	5.451	Pr(T>t) = 0.0000
diff	-0.785	
Total amount (cash)	5.181	Ha: mean(diff) !=0
Nature (debit)	5.239	Pr(T>t) = 0.3194
diff	-0.058	

Kim P Huynh and Helmut Stix
Reports of the death of cash have been exaggerated[1]

Kim P Huynh
Bank of Canada, Canada

Helmut Stix
Oesterreichische Nationalbank, Austria

Abstract

Many have predicted and espoused the view that cash is increasingly disappearing as a payment instrument. More recently, Rogoff (2014) has argued that there are increasingly strong arguments for phasing out cash – in particular for large denomination notes. Against this background, this short article presents some facts by summarizing recent findings from Bagnall et al. (2014) who provide comparative evidence on consumers' use of cash in seven industrialized countries. Moreover, we discuss complementary evidence which help us to understand some of the findings. The presented evidence shows that cash is still used extensively for payments

1 The views expressed in this paper are those of the authors. No responsibility for them should be attributed to the Bank of Canada, the Oesterreichische Nationalbank, or the Eurosystem.

– particularly for low-value transactions. In some European countries such as Austria and Germany, cash even dominates consumer payment choices for all transaction values. With regard to the drivers of payment instrument use a very robust pattern is found across countries.

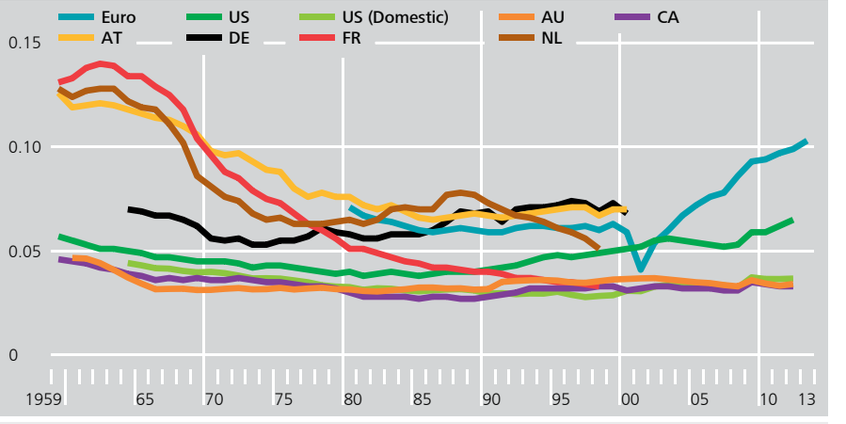
Introduction

From an aggregate perspective, Figure 1 depicts the surprising resilience of cash in the 21st century for a select group of industrial countries. In most of these countries, the ratios of currency-in-circulation (CiC) relative to nominal GDP generally declined at least through the 1980s or even early 1990s. Since then, however, these ratios have remained relative constant or even increased. Likely, the CiC ratios for the United States (US) and the euro area (euro) have increased considerably because of strong foreign demand for the dollar and the euro (see Fischer, Köhler, and Seitz 2004 and Judson 2012). However, even the estimated domestic U.S. currency ratio has increased since 2000 and its behavior is similar to that of the ratios in the other non-euro countries.

Persistent holding and use of cash in these industrial countries during the spread of electronic alternatives highlights a dire need for an updated comparative study of payments. However, evidence on consumer holding and use of cash is difficult to obtain from available statistical sources. An alternative is to resort to survey data which are more informative. However, results cannot easily be compared across countries due to difference in surveys methods and measurement. Bagnall et. al. (2014) attempts to fill this gap by comparing the payment choices of consumers in the seven industrial countries portrayed in Figure 1 using a unique and growing data source. The data are collected from large-scale payment diary surveys conducted in Australia (AU), Austria (AT), Canada (CA), France (FR), Germany (DE), the Netherlands (NL), and the United States (US). Consumer payment diaries feature rich information on individual payments collected over a fixed number of days paired with detailed information on

the characteristics of individual consumers. Payment diaries require consumers to record their transactions, so they should provide more accurate data than surveys, which rely on consumer recall. The granularity of the data makes it possible to harmonize measurement, the definition of socio-economic variables and payment types.

Ratios of currency in circulation to nominal GDP Figure 1



Source: Figure 1 of Bagnall et al. (2014).

Background of the data

– The coverage of the data includes all personal payments of respondents made either at the point-of-sale (POS), for remote purchases, or in-person to other persons. Recurrent transactions (e.g., rent, utility bills) are excluded. The sample consist of consumers who are 18 years or older.
– The diary data provide rich information on cash holdings, expenditures by payment types, and respondent demographics.
– The survey data match consumption expenditures (surprisingly) well.

– The structure of transactions, i.e. the number of transactions or the average amount spent per day, is very similar across countries.
– The typical consumer payment is rather small in value. 50% of all payments are lower than 11 to 22 PPP-adjusted US dollar.
– The median consumer uses only 2 payment instruments, including cash, over the diary period.

Importance of payment instruments

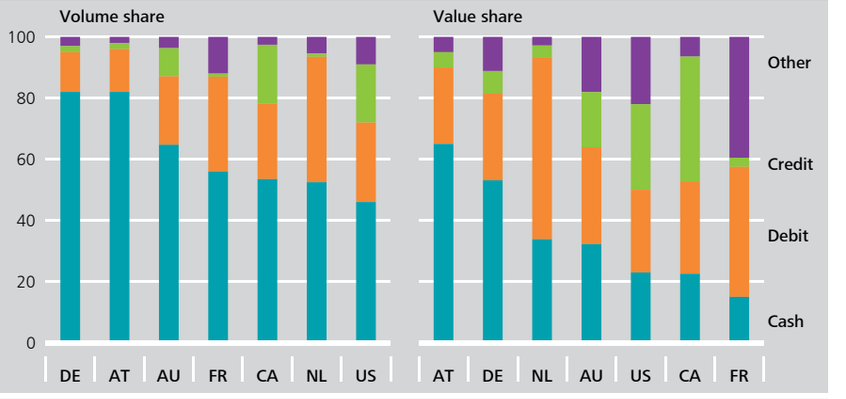
– Figure 2 shows that between 46% and 82% of the number of all payment transactions are conducted by cash.
– In value terms, differences across countries are accentuated. For AT and DE, cash dominates (more than 50%); in CA, FR, and US, cash payments account for only about one-fourth of the value of transactions.
– The composition of noncash payments varies substantially across countries. For AU, CA, and US, credit cards are more important, while they are of only minor relevance for the European countries considered, where debit cards are the chief electronic means of payment. Checks remain an important payment instrument for FR and are a component of the other category for US alongside prepaid cards.

Moreover, there are substantial cross-country differences in average cash balances which are largely in line with cash usage intensities across countries. The average cash balances for AT (148 USD) and DE (123 USD) are two-times greater than those in other countries (from 51 for NL to 74 USD for US).

A difficult and still unanswered question is what causes these large cross-country differences in the use of cash. Bagnall et al. (2014) progress in this context by showing that ownership of payment cards does not explain the strong differences – they range from 86% in Austria and 88% in the US to 100% in the Netherlands. Merchants' acceptance is likely to play a role as does the ease of obtaining cash.

Payment instrument shares in terms of volume (left) **and value** (right) Figure 2

%



Source: Bagnall et al. (2014).

However, the payment diary-data are not sufficient to identify the drivers of cross-country differences. Instead, we utilize the full power of the micro data to determine the drivers of cash use across individuals within the same country. Respective regression analyses have been conducted for all seven countries. A number of robust patterns emerge that are common across countries.

Robust patterns of payment instrument use across countries

The harmonized micro data allow us to discover who uses cash, for which kinds of purchases, at which locations, and for what value of payment. These data may help us determine why cash is used and whether or not it is likely to continue to be used in the future.

Fact 1: The use of cash decreases with transaction size.
In all countries, cash is predominant for the smallest 50% of transactions. For the largest 25% of transactions, the use of payment instruments is very heterogeneous across countries.

This goes hand in hand with consumers' positive assessment of the "ease-of-use" of cash in Bagnall et al. (2014). Moreover, a study that has recorded the time it takes to make payments suggests that cash is a significantly faster payment method than traditional payment cards (Polasik et al., 2013). As contactless payments are as time-efficient as cash, it remains interesting to watch how this and other technologies that focus on small value transactions (e.g. iPay) will replace cash for smaller value transactions.

Fact 2: Cash usage varies across types of purchases and venues.
This is a very robust finding with cash being used most in restaurants and bars (except France). It is notable that this can also be observed in countries that have a high card acceptance for this type of spending. This is an indication that consumers differ in their payment behaviour depending on the spending location, which is not only to be explained by levels of card acceptance and transaction sizes.

As a case in point, Bagnall et al. (2014) look at gas station transactions for which card acceptance is very high and the typical expenditure value is roughly equal in size across countries. If acceptance and transaction sizes were important factors driving payment behaviour, one would expect to find fairly equal levels of cash usage in gas stations across all countries. Indeed, results suggest that cross-country differences in cash usage are significantly smaller at gas stations than for all expenditures; however differences across countries still prevail.

Fact 3: Higher usage of cash is associated with lower levels of card acceptance at the point-of-sale.
The results of Bagnall et al. (2014) clearly indicate that a higher acceptance of payment cards has negative impact on the use of cash. Reversely, this suggests that part of the cross-country differences in cash use is attributable to card acceptance. Direct survey evidence from AT, CA, and DE shows indeed that CA has the highest card acceptance across all transaction values. In all three countries the acceptance of payment cards is much lower for small value transactions than for large-value transactions.[2] This fact fits well with the finding that cash is mainly used for smaller-value transactions.

Apart from the direct channel of lower card acceptance on cash usage, there is an indirect channel that operates through cash balances. Huynh, Schmidt-Dengler and Stix (2014) use detailed payment diary data from Austrian and Canadian consumers to test how card acceptance affects cash demand. Results confirm a substantial impact of card acceptance on the demand for cash.[3] How does the payment behavior of consumers respond to higher cash balances? Theoretical literature has put forward that higher cash balances induce consumers to spend the cash (Bar-Ilan and Marion, 2013; Alvarez and Lippi, 2013a). Empirical support for this hypothesis is provided in Eschelbach and Schmidt (2013). Further, Briglevics and Schuh (2014) formulate a discrete choice dynamic programming problem and shows that the amount of cash on hand is a strong predictor of payment choice.

On a general note, these results illustrate the complexity of the payment market where almost all decisions are endogenous: The use of cash depends on cash holdings, cash holdings depend on merchants' card acceptance, merchants' card acceptance depends on the use of cash, etc.

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2 This evidence is derived from a survey question on how consumers perceive acceptance. Thus, it reflects a subjective assessment subject to bias.
3 Bounie, Francois and van Hove (2014) look on the other side of the market. Their findings suggest that the decision of merchants to accept payment cards depends on preferences of consumers.

Fact 4: Cash use varies across socio-demographic groups

Results suggest that, in all countries, cash usage decreases with education and income. The role of age is of interest because one could argue that the enduring importance of cash could be due to habit persistence. Our results reveal that "older" people use significantly more cash than younger people except for US, where younger individuals use more cash than older individuals. Nevertheless, the large differences across countries cannot be explained by the differences in the socio-demographic structure across countries.

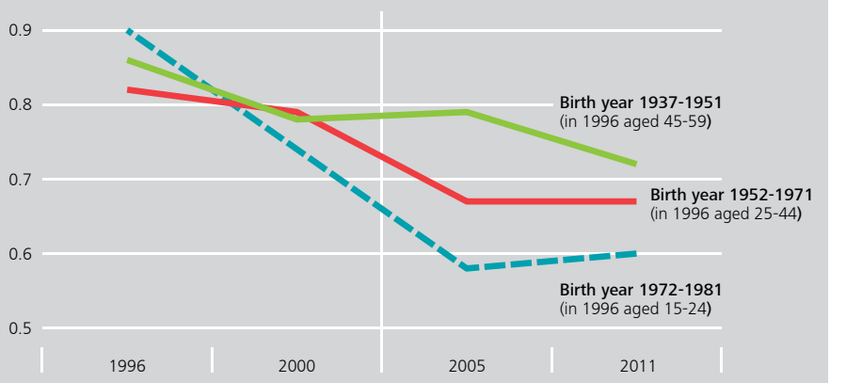
What explains why cash use depends on socio-demographic characteristics? We think that the way consumers pay is to a significant extent driven by behavioral patterns. For example, von Kalckreuth, Schmidt and Stix (2014) show that cash is used as an expenditure monitoring tool by households who have tight budgets and/or who have difficulties in keeping an overview of their expenses (if several payment instruments are used). As tight budgets and difficulties in keeping an overview of expenditures are correlated with education and income, their model is in line with the observed pattern. The usefulness of cash for monitoring follows from one feature of cash that is unique among payment instruments: A glance into the wallet gives an immediate signal about the remaining budget. An important message from this model is that there are heterogeneities: For some consumers card payments are cheaper, for others cash payments.

One of the most cited reasons for persistent cash use is habit persistence, which however is very difficult to identify in cross-sectional data. To assess the importance of this behavioral channel, we can resort to evidence from AT which has a relatively long history of payment diaries—the first diary took place in 2006. Figure 3 which shows cash use by birth cohorts (Mooslechner, Stix and Wagner, 2012), shows that cash use has declined for all cohorts. The existence of habit persistence is corroborated in as far as cash use has declined by about 30 percentage points for young cohorts and only by 14 percentage points for older cohorts. This difference is sizeable,

however, it is not large enough to assign habit a predominant role in explaining why cash decreases only sluggishly in AT and DE. Moreover, we would not assign habit persistence an important role in explaining cross-country differences as this would necessarily rest on the presumption that German consumers display more habit persistence than Dutch consumers, for example.

Share of cash payments by age cohorts (Austria) Figure 3

Cash share in % (in value terms)



Note: The figure shows the cash share in value terms derived from four Austrian payment diaries. The first diary was in 1996 and the last in 2012. Note that differences to the values reported in Bagnall et al. (2014) may arise to different definitions.
Source: Mooslechner et al. (2012).

Fact 5: The extent of cash holdings is likely to affect cash use.

Regressions that are presented in Bagnall et al. (2014) support the notion that cash is used when cash balances are high. Caution is warranted regarding the true size of the effect, however, as we think that there is an effect into the opposing direction: Cash use also influences the amount of cash held in the wallet. Structural models of payments and cash holdings (Alvarez and Lippi, 2009 and 2013) have and will further shed light on this issue.

Synopsis

The results show that – despite strong country differences in the cash intensity – reports about the death of cash were premature. Cash is still used intensively for payments, even among the young or among consumers who are in possession of payment cards. In countries with a lower cash share, cash is predominantly used for small value transactions, in AT and DE with still a relatively high cash share cash is also used for higher transaction values. The paper of Bagnall et al. (2014) demonstrates that, apart from transaction sizes and consumer preferences for ease of use, the use of cash is strongly correlated with demographics, point-of-sale characteristics such as merchant card acceptance and venue as well as with cash holdings.

Our assessment on the prematurity of expectations on the demise of cash is solely based on its use as a transaction medium for legal transactions. We have not discussed its use in the shadow economy or as a store of value. The increase in the currency-in-circulation ratios of Figure 1 could partly reflect increased cash demand in response to lower confidence in banks (Knell and Stix, 2015; Stix, 2013). Goodhardt and Ashworth (2014) argue that the rather similar increase in the United Kingdom reflects a rapidly growing grey economy. In either case, extending our assessment beyond the mere transaction function of cash would reinforce our conclusion.

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Tamás Briglevics[1] and Scott Schuh[2] An Initial Look at how the electronic Payments Transformation is changing Consumer Payments[3]

Tamás Briglevics
Magyar Nemzeti Bank, Hungary

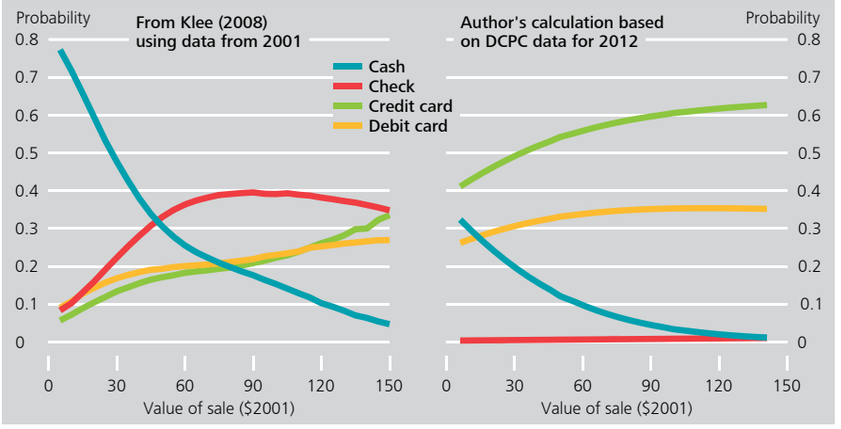
1 Introduction

The way U.S. consumers make payments has undergone a tremendous change over the last decade, most notably, checks have virtually disappeared from point-of-sale transactions. While some old technologies are on their way out, there is no shortage of new inventions, from prepaid cards to different kinds of electronic and mobile payments. To better understand why people switch from one technology to another,

1 E-mail: tbriglevics@gmail.com
2 E-mail: Scott.Schuh@bos.frb.org
3 The views and opinions expressed in this paper are those of the authors and do not necessarily represent the views of the Federal Reserve Bank of Boston, the Federal Reserve System or Magyar Nemzeti Bank. Tamás Briglevics would like to thank the organizers of the Bundesbank Cash Conference in Dresden for their hospitality and the participants for engaging discussions. The authors would also like to thank for numerous helpful comments at previous presentations.

the Federal Reserve Banks of Boston, Richmond and San Francisco designed and implemented the Diary of Consumer Payment Choice (DCPC) in 2012. Details about the diary can be found in Bennett, Schuh, and Schwartz (forthcoming) [4]

Payment instrument choice at grocery stores Figure 1



In this paper we highlight some of the most interesting initial results from the diary. First, we are able to document the transformation in consumer payments that took place over the past 10 years. Second, we demonstrate the usefulness of data sets that focus on consumers, by showing how individual level data on payment instrument characteristics might explain a large part of the variation in observed payments behavior.

4 While the DCPC is a novelty in the United States, Bagnall et al. (2014) describes the results from a number of countries that conducted similar payment diaries around the same time

2 Payments transformation 2001–2012

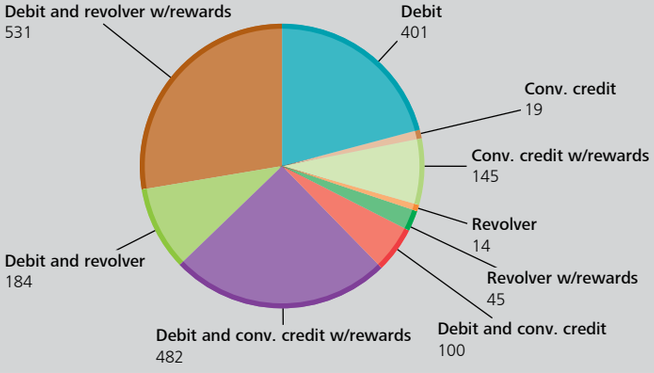
In this section we use the DCPC data to replicate the analysis in Klee (2008), who estimated the probability that customers use cash, credit, debit[5] or check at the checkout counter of grocery stores with data from 2001. Figure 1 compares the estimated payment choice probabilities for different transaction values reported in Klee (2008) (left panel) and obtained from the 2012 DCPC (right panel). To make the figures comparable, dollar values recorded in 2012 were converted back to 2001 dollars using the Consumer Price Index on the right panel of Figure 1. The most striking difference between the two panels is that checks have virtually disappeared from grocery stores over the past decade. Note that in the 2001 sample checks were the most popular instrument for transactions above $50, accounting for about 40 percent of all the transactions in that range, and they were used as much as credit and debit cards combined in the range of $50-$100. Another change that stands out from the figure is that the probability of choosing cash has roughly halved at all transaction values. Similar to 2001, cash is still used overwhelmingly for low-value transactions. Credit and debit cards have filled the void left by the decline of cash for low-value transactions and checks for larger transaction amounts. In particular, cards are now used for at least 6 out of 10 grocery transactions at every transaction value, and are essentially the only payment instrument for transactions exceeding $100 (in 2001 dollars). This simple comparison shows how quickly the payments landscape can change: instruments that once were a staple of the system can become extinct, at least in some sectors of the economy[6].

5 Actually, the data only allowed her to tell whether a transaction was routed through a credit card or a debit card network, hence signature debit transactions in her sample would be recorded as credit card payments. Details of the replication exercise can be found in Briglevics and Schuh (2014).

6 For a more detailed analysis on the use of checks see Schuh and Stavins (2010) and Schuh and Stavins (2013).

Combinations of debit and different types of credit cards in the DCPC Figure 2

Number of respondents



The simple comparison, however, does not tell us much about why the change happened? An important limitation of the above analysis is that it does not take into account what payment instruments people actually have in their wallets[7]. The following section shows that the perks and costs of different instruments are very strongly correlated with payment instrument choice. This is where the breadth of consumer data sets, i.e. rich individual specific information, outweighs the length of merchant data, i.e. billions of observations[8].

7 See Koulayev et al. (2012) for a model on how consumers choose their payment instrument bundle optimally.

8 See, for example, Wang and Wolman (2014) and Cohen and Rysman (2013) for recent studies using large merchant data sets..

3 Payment instrument portfolios

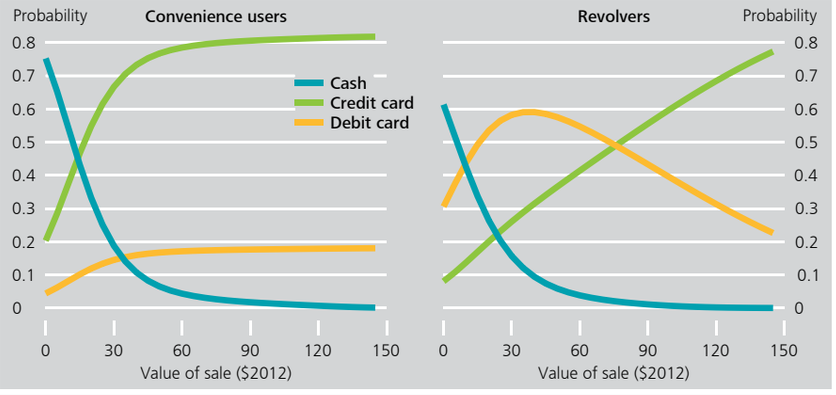
Combining the DCPC with responses from the Survey of Consumer Payment Choice enables us to see if a respondent has a debit or credit card and (i) whether these cards earn some kind of rewards (for example, cash back, frequent flyer miles) and (ii) if the respondent carries outstanding balances on a credit card[9,10].

Figure 2 shows the share of the possible debit and credit card combinations in the DCPC. Regression evidence found no significant effect of debit card rewards programs on payment instrument choice (see Briglevics and Schuh 2014, for more details), therefore the discussion below does not distinguish between different types of debit cards. Even so, the pie-chart indicates that consumer face very different trade-offs when deciding which payment instrument to use. The figure shows that about one sixth of the sample did not have a credit card (blue area). Continuing clockwise, there is another sixth of the sample did not have a credit card (blue area). Continuing clockwise, there is another sixth of the sample that does not have a debit card, but has credit card(s). The majority of these individuals are convenience users of rewards credit cards (green area), that is, they pay off their credit balances, hence incur no interest charges when using their credit card(s).

9 To be precise, we know if a consumer has a rewards card and we know if she has outstanding balances on at least one of her credit cards. For respondents with multiple credit cards, we cannot distinguish which card she uses..

10 Briglevics and Schuh (2013) found a significant effect of revolving debt on the interest elasticity of cash demand..

Payment instrument choice probabilities of convenience users* (left) and revolvers* (right) in 2012 Figure 3



* Subset of respondents who had a debit card and a rewards credit card.

The remaining two-thirds of the DCPC respondents have both a debit and a credit card, roughly half of whom are convenience users and most of them earn rewards (purple area). The other half, however, rolls over debt making the credit card an expensive option for payments[11] while again the majority of these respondents would earn rewards on credit card payments (brown area).

Turning to the main focus of our paper, the effects of payment instrument characteristics on payment instrument choice will be illustrated on two figures. Unlike in the previous section the sample here is not restricted to grocery store payments; we used all in-person purchases to estimate the multinomial logistic regressions underlying the predictions displayed on Figures 3 and 4. Also, dollar values denote

11 We do not know the interest incurred on credit balances. As pointed out in footnote 6, we also do not know if consumers have another credit card that can be used as a convenience card.

2012 dollars. Figure 3 shows the payment instrument choices of respondents who have debit card(s) and earn rewards on their credit card(s), but differ in whether they revolve credit card debt. Not surprisingly, the extent to which these groups use credit cards is very different: revolvers (right panel) use credit cards much less than convenience users (left panel). Even for convenience users, however, cash payments dominate at low transaction values, credit cards become the most likely choice at roughly $15. The share of debit cards stays under 20 percent at all transaction amounts for convenience users.

For revolvers, however, debit cards play a much more prominent role. Cash is still king at low values, but commands a lower share than for convenience users. It is overtaken by another payment method (in this case debit cards) at a lower transaction value (just below $10) than for convenience users. Debit cards remain the most likely choice up to about $75 when the steadily increasing share of credit cards catches up to them.

Payment instrument choice probabilities conditional of rewards (left) and non-rewards (right) credit card users in 2012 Figure 4

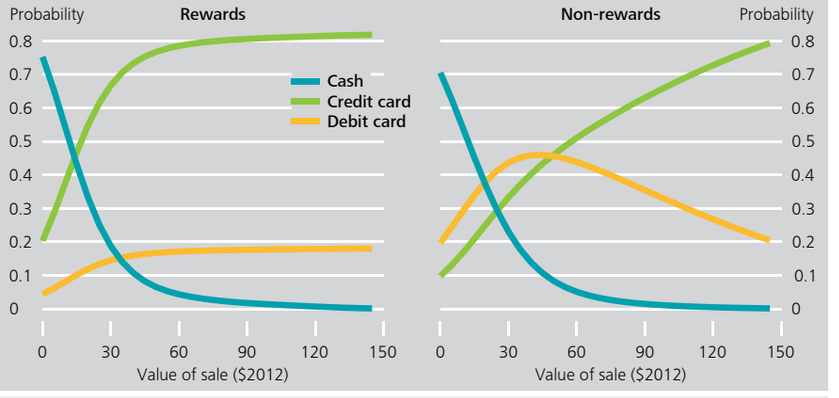


Figure 4 reveals that credit card rewards programs have similar effects. Those who earn rewards (left panel, identical to the left panel of Figure 3) use credit cards significantly more than holders of non-rewards cards at every transaction value. The main difference between Figures 3 and 4 is that when it comes to reward programs the substitution away from credit cards (for nonrewards users) affects cash use more, even at higher transaction values: cash remains the first choice for transaction sizes close to $20. Credit card usage of non-rewards card holders is more similar to revolvers than to convenience users who earn rewards, but the share of credit cards increases more quickly at lower transaction values than in the case of revolvers.

These differences in payment behavior for the three subsamples displayed on Figures 3 and 4, however, should not be interpreted as causal effects of credit card characteristics. For example, people who like to use credit cards might be more willing to join a rewards credit card program, reversing the (hypothesized) causal link. That is, based on these figures it cannot be definitively stated whether rewards programs increase credit card use or they just attract people with a strong preference for credit cards. Technically, the same argument could be made for revolving: maybe people who do not like to use credit cards self-select themselves into revolving. However, it seems much less likely that consumption-saving decisions would be affected by preferences towards payment methods. Therefore, we find it more likely that the difference between the two panels of Figure 3 is due to the high cost of using credit cards for revolvers.

4 Conclusion and future research

Analyzing payments from the consumers perspective offers new insights into why certain methods are selected. We have shown that individual-specific information (such as credit card features) is strongly correlated with payment behavior. While selection bias might undoubtedly explain some of this correlation, it seems unlikely that it can explain all of it. If our conjecture is right and consumers do in fact respond to monetary incentives when making payments one might wonder if non-monetary incentives also play a role. For example, the inconvenience of withdrawing cash might limit its use. A first attempt at an estimable model that tries to capture this is described in Briglevics and Schuh (2014).

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Shaun O'Brien[1]

Consumer Preferences and the Use of Cash: Evidence from the Diary of Consumer Payments Choice

presented by Barbara Bennett
Federal Reserve Bank of San Francisco, USA

Abstract

This paper provides new evidence on the determinants of cash usage for small value payments and particularly how consumers' stated payment instrument preference and the amount of the purchase affect their propensity to use cash. Participants who stated a cash preference have a predicted probability of a cash payment of 80 percent overall. However, if the amount of the transaction is less than $20, the probability increases to 91 percent. If the transaction is greater than $20, the probability decreases to 57 percent. Individuals who stated a payment card

1 Policy Analyst, Cash Product Office, Federal Reserve Bank, 101 Market St., San Francisco, CA 94105, shaun.o'brien@sf.frb.org. The views in this paper are solely the responsibility of the author and should not be interpreted as reflecting the views of the Federal Reserve Bank of San Francisco or the Board of Governors of the Federal Reserve System.

preference were estimated to have approximately a 30 percent probability of a cash transaction overall, but that probability increases to 49 percent when the transaction is less than $20 and drops to 8 percent when purchases are over $20. These estimates were conducted using the Federal Reserve October 2012 Diary of Consumer Payment Choice dataset, which includes all the recorded financial transactions of approximately 2,500 individuals who participated in the diary during their variously assigned three consecutive-day periods within the month of October 2012. In addition to recording all their financial transactions, they answered questions regarding payment instrument and cash handling preferences. These regressions suggest cash continues to play a large role as a payment instrument especially in lower value transactions for all demographic groups.

Introduction

The growth of electronic payments in the U.S. continues to be impressive, as it has been for the past 20 years. The triennial Federal Reserve Payment Study from 2012 shows that debit cards have increased from 8.3 billion transactions in 2000 to 47.0 billion transactions in 2012, more than a fivefold increase. Credits cards, while declining slightly during the financial crisis in 2009, have increased from 15.6 to 26.2 billion transactions over the same 12 year period.[2] However, the limited amount of information regarding cash usage at the transaction level makes it difficult to determine how this influx of electronic payments impacts the demand for cash as a payment instrument. Currency in circulation data from the Federal Reserve can give some insight into how the demand for cash has been affected by these electronic payments, but these data cannot distinguish between cash usage as a payment instrument and usage as a store of value.

2 The 2013 Federal Reserve Payments Study

To determine the effect of electronic payment adoption on the use of cash as a payment instrument, individual transactional level data could be used to see who is using cash, as well as how and where cash is being used. Previous studies have shown that higher ticketed goods and services are more associated with non-cash payment instruments, but the dollar value where a consumer is likely to switch from a cash payment to a non-cash instrument remains unknown. This paper uses transaction level data that will shed light on how cash and payment card usage can be quite different for different populations, the extent of substitution between cash and payment cards at different transaction amounts and the effect that an individual's payment preference has on the likelihood of a cash payment.

This paper utilizes two datasets. The first is the Survey of Consumer Payment Choice (SCPC) from Federal Reserve Bank of Boston and the other is a new dataset collected by the Boston, Richmond and San Francisco Federal Reserve Banks called the Diary of Consumer Payment Choice (DCPC). The SCPC is a survey conducted annually since 2008 where individuals are asked about their usage of different payment instruments over a period of time, such as a week, month, or a year. The October 2012 SCPC surveyed 3,176 individuals, while the DCPC followed 2,468 individuals.[3] Between both datasets, there were 2,348 individuals who participated in both the SCPC and the DCPC. The framework for the Diary was based on similar studies conducted by central banks in other countries[4], as well as pilot diaries conducted by the Federal Reserve in 2010 and 2011 [Foster (2013)]. Participants in the DCPC were assigned a specific three day period in October 2012. During their three day period, participants were asked to record all financial transactions including bill payments, automatic bill payments, purchases of goods and services, cash deposits

3 The population is nationally representative with respect to age, race/ethnicity and education after applying the population weights so the percentages would constitute a similar composition to that of the Current Population Survey conducted by the Bureau of Labor Statistics.
4 The diaries that were used as a framework, Australia, Austria, Canada, France, Germany and Netherlands, are the same countries used by Bagnall, Bounie, Huynh, Kosse, Schmidt, Schuh and Stix (2014)

and withdrawals and daily cash holdings. In addition to the transactional and demographic information, people were asked what payment method they prefer to use as well as the backup payment instrument they use when their preferred method is not available. This paper examines both demographic and socioeconomic factors that influence an individual's stated payment preference and, more importantly, how an individual's stated payment preference determines the level of substitution of cash for payment cards at different transaction amounts.

Previous work on payment instrument usage from national diaries shows that demographic characteristics, such as increased levels of education and household income and increased transaction amount are negatively correlated with the probability of cash usage, yet the probability of cash usage, on average, is quite different for each country. Kalckreuth, Schmidt and Stix (2009) use the "Payment Habits in Germany" dataset from the spring of 2008, which shows that over 80 percent of transactions take place in cash and their regression results find little difference in cash usage for different age groups after controlling for additional demographic factors. Interestingly, payment card adoption does influence cash usage but could not explain why cash usage remains so high relative to other developed countries. Bounie and Francois (2006) use a diary dataset from France that was conducted from March to May of 2005. As is the case with the U.S. market, checks are primarily used for bill payments and cash is the dominant small value payment instrument, with payment cards being used for larger non-bill purchases. What is also similar is the "specialization" of payment instruments within a spending category, where cash is heavily used for "food and beverage" and "newspapers, tobacco and lotteries" while cards are used for "transport" and "equipment and personal care." Arango, Hogg and Lee (2012) use the Bank of Canada's Method of Payment survey and find that while cash transactions account for over 50 percent of transaction volume, for transactions under $25, cash accounts for about 70 percent of transactions. However, the probability of a cash payment drops by 30 percent when cards are accepted, suggesting that acceptance of cards in more locations and for

smaller values may reduce cash usage. Boeschoten (1998) uses transactional data from Dutch households from 1990 to 1994 and finds that the size of the transaction is the most important factor determining which payment instrument is used; doubling the purchase amount reduces the probability of a cash payment by 20 to 30 percent. More recently Bagnall, Bounie, Huynh, Kosse, Schmidt, Schuh and Stix (2014) compare diary results from Australia, Austria, Canada, France, Germany, Netherlands and the United States. Their results show that across all countries the use of cash varies widely by countries, but is still the most used payment instrument despite level of debit cards ownership ranging between 76 and 93 percent. Consistent with other results is the probability of a cash payment decreases as the transactions value increases across all countries and demographic characteristics are strongly correlated with age, education and household income.

The remainder of this paper is laid out as follows: Section 2 describes aggregate results from the DCPC; Section 3 discusses the methodology; Section 4 discusses the regression results; and Section 5 is the conclusion.

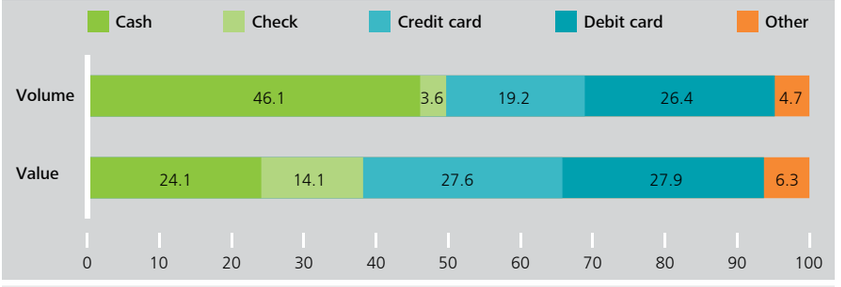
Diary of Consumer Payment Choice: an overview

The aggregate results from the DCPC show that in October 2012 each consumer, on average, made 58.7 transactions, of which 50.5 were non-bill transactions. Figure 1 shows that 46 percent of the non-bill transactions took place with cash, by far the largest percentage of any payment instrument. Even when debit and credit cards are combined (45.6 percent), the number of cash transactions is still greater than the number of card transactions. Yet, the difference for cash transactions in the volume and value percentages indicates that cash is used mostly for small value transactions (as shown in Table 1). In contrast, debit and credit cards make up 19.2 percent and 26.4 percent of the volume of transactions and 27.6 percent and 27.9 percent of the value of transactions, respectively. These compar-

ative differences between the volume and value percentages for cash and cards indicate that in the aggregate, cash and cards are used differently by consumers.

Non-bill purchases Figure 1

%



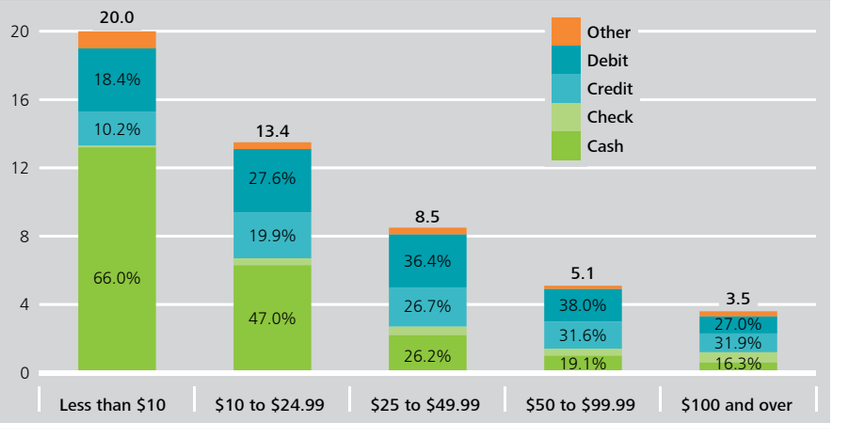
Average Purchase amount by Payment Instrument Table 1

Cash	Check	Credit Card	Debit Card	Other
$19.16	$143.16	$38.77	$52.62	$50.10

Figure 2 shows the number of non-bill transactions by payment instrument sorted by transaction amount. What is evident from the bar charts is that cash is the dominant small value payment instrument. The majority of the purchases (33.1 out of 50.5) made by consumers are for transactions where the value is less than $25. Within this range, cash accounts for 66 percent of transactions under $10 and 58 percent of the transactions under $25. In contrast, cash makes up less than 20 percent of the transactions when the purchase amount is over $50. The number of debit and credit card transactions does not vary much as purchase amount rises. However, the shares of both generally rise in terms of volume and value as the ticket size increases.

Payment use by transaction amount Figure 2

Number of transactions per month

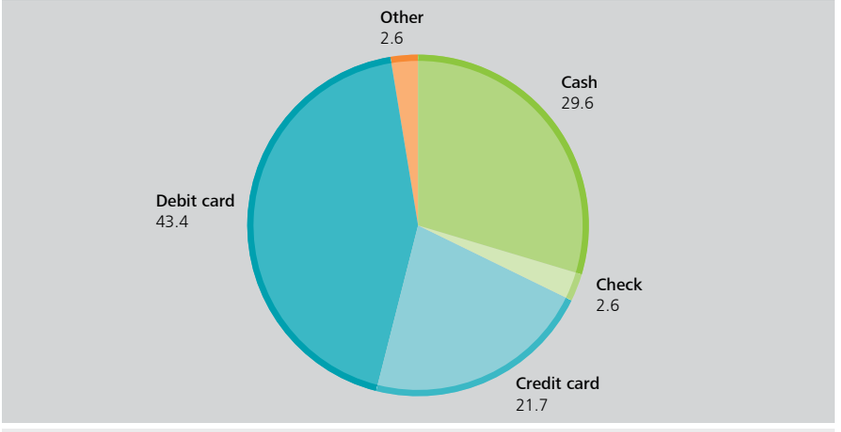


Previous work by Klee (2006), Zinman (2009) and Schuh and Stavins (2010, 2013) have shown that payment adoption and use are not the same across different populations. While Figures 1 and 2 provide interesting insight into aggregate payment instrument use, they do not provide discernment into whether different populations are using cash more than others. To help identify who is more likely to use one payment instrument over another, the DCPC asked each person to specify their preferred method of payment. Figure 3 shows the responses in percent of the population[5] where 43.4 percent of people prefer debit cards, 21.7 percent prefer their credit cards and 29.6 percent prefer cash. Looking at the table from a cash-card perspective, payment cards are preferred to cash at a ratio of more than 2-1.

5 Percentages are weighted

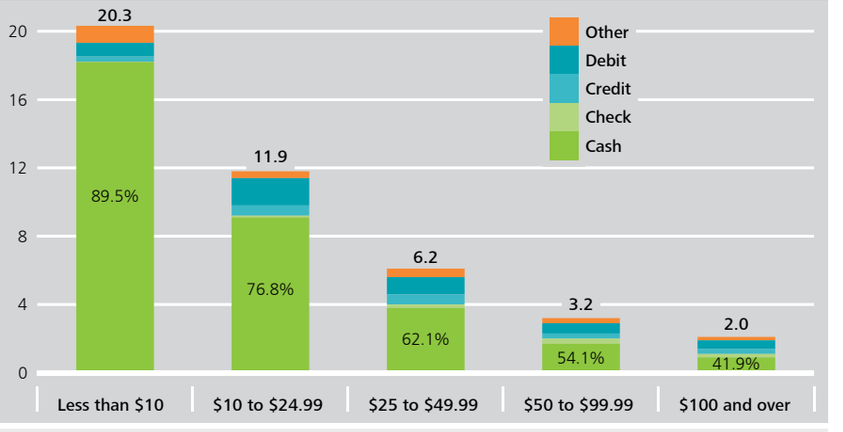
Primary payment preference Figure 3

%



Purchases per person for those with a cash preference Figure 4

Number of transactions per month



While cash is not the most preferred payment instrument, those who indicated that payment cards are their preferred payment instrument are still using cash for a significant number of transactions. Figures 4, 5 and 6 group the participants based on their payment preference and then graph their payment usage by purchase amount. Figure 4 shows payment usage patterns for those with a cash preference and, not surprisingly, cash is the payment instrument that is used most often. A majority of transactions under $100 and 42 percent of transactions over $100 take place in cash for this population. There is also little substitution between cash and cards for this population when compared to those who prefer to pay with cards. When cards are used by those who prefer to pay with cash, debit cards are used two thirds of the time, suggesting that the direct substitute for cash is likely debit cards, rather than payment cards in general.

Figure 5 shows the same information as Figure 4 but for participants with a credit preference rather than those with a cash preference. A majority of the purchases made by this group are with their preferred payment instrument, credit cards. The only exception where the majority of transactions, 53 percent, take place with cash is for purchases valued at less than $10. What is unknown is whether the cash purchases were made because the individual considered cash more convenient than cards for smaller value transactions or whether the person may have been forced into using cash if cards were not accepted for these low value purchases.[6] The data from the DCPC does not contain information that allows one to determine

6 Klee (2006b) uses grocery store data to show that the payment instrument choice is greatly dependent on transaction costs in the form of time. Her analysis shows the importance of time in the use of payment instruments. For small value transactions, cash may be quicker and easier to use than a payment card, while using cash for a larger transaction may in fact lead to a second transaction to acquire more cash if the stock of cash on hand is depleted.

if the payment instrument was made as a choice or if the preferred instrument was not accepted.[7]

Purchases per person for those with a credit preference Figure 5

Number of transactions per month

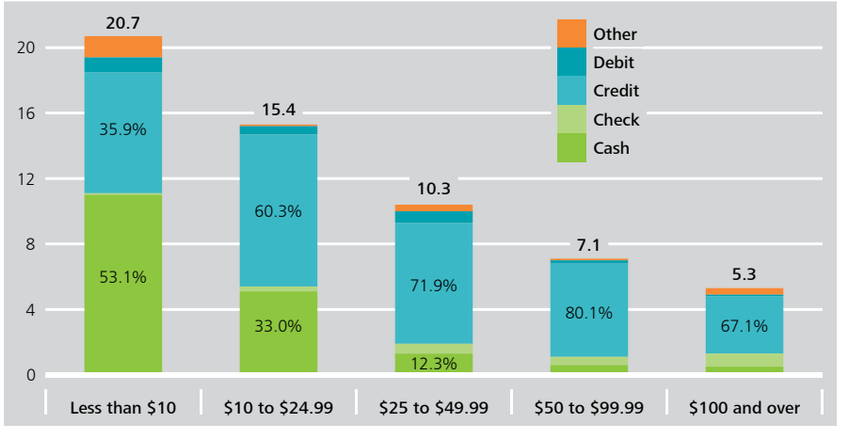
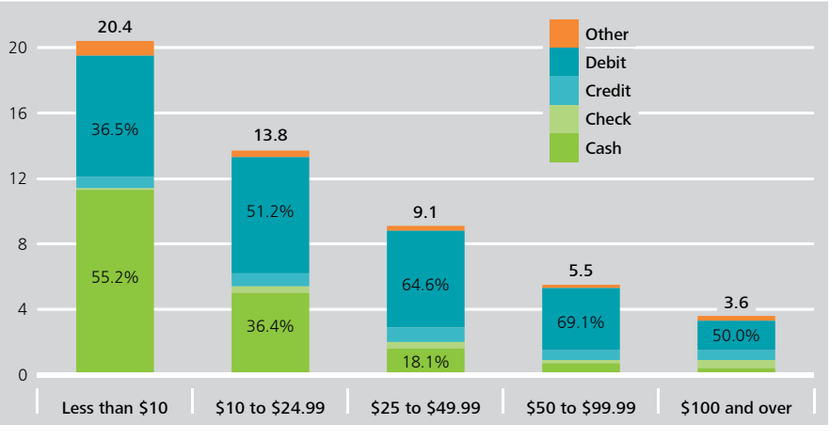


Figure 6 shows the payment choice for those with a debit card preference and this Figure is nearly identical to the Figure showing those with a credit card preference. A majority of the transactions are made using a debit card except for transactions less than $10 where 55 percent of the transactions take place with cash.

7 For most transactions, cash is the payment instrument that is always accepted, but for online transactions, a person who prefers to pay with cash is usually forced to pay with a non-cash instrument.

Purchases per person for those with a debit preference Figure 6

Number of transactions per month



Klee (2006a) analyzes U.S. payment usage behavior by using the Survey of Consumer Finance (SCF) from 1995, 1998 and 2001 to determine the factors that have influenced the increase in electronic payment instruments. Similar to the diary studies referenced above, she finds "financial characteristics" such as income, number of financial institutions, homeownership and education, as well as demographic characteristics, are correlated with electronic payment adoption and usage. Those characteristics that influenced adoption remain "relatively constant" in the SCF from 1995 to 2001. Yet adoption of electronic payments increased during that period indicating that "multihoming," or adoption of more than one payment instrument, was likely taking place.

While adoption of both credit and debit cards expanded over that time period, the data from the DCPC suggests that these two payment instruments may not be complements. People who prefer to use debit cards, on average, use credit cards

for only 6.7 percent of their transactions and people who prefer to use credit cards use debit cards only 4.2 percent of the time. While most consumers have access to both debit and credit cards, individuals who prefer to use cards tend to use only two types of payment instruments for most of their transactions: their preferred instrument and cash, as shown in the preference Figures above.

The data in Table 2, which shows the relationship between payment preference and payment card adoption, suggests that lack of access to a particular payment instrument does not determine preference. In most cases, preference does not preclude adoption of other options.

Card Adoption Percentages by Payment Preference Table 2

	Credit Card Adoption	Debit Card Adoption	Prepaid Adoption	Any Card Adoption
Cash Preference	47.9%	74.8%	16.3%	92.4%
Credit Preference	100%	73.7%	9.2%	100%
Debit Preference	71.4%	100%	7.8%	100%

Notes: Card adoption was calculated using both the Diary of Consumer Payment Choice 2012 and the Survey of Consumer Payment Choice 2012. Individuals from the DCPC who preferred a specific instrument were considered adopters of that instrument as well as if the person carried the instrument at any point throughout the three days of the diary s/he were defined as adopters. Those individuals who also participated in the SCPC and indicated that s/he had a debit, credit, or a general purpose prepaid card were also considered adopters.

Those with a cash preference have a credit card adoption rate of 47.9 percent, 74.8 percent rate for debit cards and 16.3 percent for prepaid cards; yet despite the availability of a card for more than 92 percent of this group, they still prefer to use cash. The adoption of a card is a necessary but not sufficient condition to explain an individual's preference for a payment card.

Table 3 below shows the demographic breakdown by payment preference. There are clearly large differences in payment preference by race, ethnicity, gender and education. However, this table cannot tell us which characteristics independently influence payment preference. To determine which of these characteristics influence preference for one payment instrument over another, this study uses the regressions outlined in the methodology section to assess the independent impact each variable had on preference. Given one's payment preference, this study then assesses the impact these demographic characteristics and transaction specific variables have on the likelihood that a consumer will use cash versus their preferred instrument.

Demographics by Payment Preference

Table 3

	Cash Preference	Credit Preference	Debit Preference	DCPC Population
Race				
Asian	1.4%	5.3%	1.2%	2.1%
Black	19.3%	4.4%	9.9%	11.9%
Hispanic	22.7%	6.7%	19.4%	17.6%
Other Race	13.4%	4.7%	9.5%	9.6%
White	65.8%	85.4%	79.2%	76.4%
Gender				
Male	53.8%	52.5%	42.0%	48.1%
Female	46.2%	47.5%	58.0%	51.9%
Education				
No High School Degree	16.0%	1.8%	4.2%	8.2%
High School Degree	63.2%	37.9%	56.3%	34.7%
Assoc. Degree	7.1%	7.0%	12.5%	19.4%
Bachelor's Degree	8.6%	27.5%	16.8%	25.8%
Graduate Degree	5.1%	25.9%	10.1%	11.9%
Marital Status				
Married	54.7%	75.8%	62.3%	62.4%
Separated	3.7%	0.5%	2.7%	2.6%
Single	28.4%	11.9%	19.8%	19.7%
Employment Status				
Working	46.0%	58.0%	65.1%	56.4%
Unemployed	15.7%	2.7%	5.3%	7.8%
Laid Off	2.1%	0.5%	1.0%	1.1%
Disabled	10.9%	2.4%	4.8%	6.5%

Note: Weighted Values

Methodology

Figure 3 above shows that 94.6 percent of individuals chose cash, credit, or debit as their preferred option; as such, this analysis focuses on those individuals who selected said payment instruments. Individuals who selected checks, prepaid, online banking bill payment, bank account number, text, or mobile payments as their primary payment preference are not included in the regressions below. Because an individual can choose any one of the three payment options as the preferred payment instrument, a multinomial logistic regression is used where preference is regressed on demographic variables.

For equations (1) – (3), χ_i is a vector of exogenous variables for each individual, i, which includes race, gender, education, household income, employment status and age. The variables j and k represent the possible preferences where cash = 0 (base outcome), credit = 1 and debit = 2 and α'_j is a vector of coefficients for the j-th preference.

$$Prob(Pref = j|x_i) = \frac{e^{\alpha'_j x_i}}{\sum_{k=0}^{2} e^{\alpha'_k x_i}}, \quad where\ j = 0,1,2 \tag{1}$$

The results are estimated relative to a base outcome, the cash preference in this case. Setting α_k=0 where k=0 for those who prefer to use cash as their primary payment instrument allows equation (1) to be rewritten as:

$$Prob(Pref = j|x_i) = \frac{1}{1 + \sum_{k=1}^{2} e^{\alpha'_k x_i}}, \quad where\ j = 0 \tag{2}$$

and

$$Prob(Pref = j|x_i) = \frac{e^{\alpha_j' x_i}}{1 + \sum_{k=1}^{2} e^{\alpha_k' x_i}}, \quad where\ j = 1,2 \tag{3}$$

While the first set of regressions estimates the effects of observables on preference, Figures 4, 5 and 6, above, show that once a primary preference has been selected by the individual, the payment choices are predominantly cash and the primary payment choice. To determine the probability of a cash payment for each of the preference populations, a dummy variable indicating a cash payment is regressed on a set of explanatory variables using a random effects logistic model.

$$Prob(Cash\ Payment = 1|x_i, Preference) = \frac{e^{\beta_j' x_i + \gamma_j' p_{it}}}{1 + e^{\beta_j' x_i + \gamma_j' p_{it}}} \tag{4}$$

In equation (4), χ_i is, again, a vector of exogenous variables for each individual i and p_{it} is a vector of variables associated with each purchase. The variables for each transaction include the merchant type[8], the value of the transaction, dummy variables in $5 increments from $0 to $25 and interaction terms between the amount dummy variables and the transaction amount. The dummy variables and interaction terms between $0.01 and $25.00 allow for a better fit of the model without a predefined functional form. The dummy variables allow for different intercepts and the interactions permit different slopes within the $5 dollar increments. Estimating separate regression for those who prefer to pay with cash, debit, or credit allows for different coefficient estimates for each population on the transaction variables,

8 The merchant categories in the DCPC were aligned with the categories North American Industry Classification System (NAICS).

p_{it} and the demographic variables, χ_i. Because these regressions are examining the probability of a cash payment, participants must also be able to make a non-cash payment. Therefore, only individuals who have access to prepaid, debit and credit cards are included in these regressions.

Results

Preference Regressions

The first set of regressions in Table 4 show the odds ratios[9] from the multinomial regressions of preference regressed on the observables and are compared against those with a cash preference as the base group for comparison purposes. The group not included in the regression is an employed, unmarried, white male under the age of 25 who graduated from high school, was born in the U.S., lives in the Pacific census region and makes less than $25,000 per year. The numbers in parentheses are the z-scores calculated from the standard errors.

9 Odds ratios are interpreted in such a manner that values less than one represents a lower likelihood of a person from a population choosing that payment preference when compared to those in the base group, which in this case is the population with a cash preference. Therefore, the odds ratio of 0.5 for variable "x" comparing debit preference to a cash preference is the inverse of an odds ratio of 2.0 for variable "x" comparing a cash preference to a debit preference. Both ratios are conveying the same information.

Odds Ratios with Cash Preference as the base group Table 4

	(1)	Debit Preference	(2)	Credit Preference
Race				
Asian	0.65	(0.87)	1.75	(1.23)
Black	0.56***	(2.72)	0.27***	(3.95)
Hispanic	0.98	(0.11)	0.35***	(3.67)
Other Race	0.76	(1.04)	0.99	(0.02)
Gender				
Female	1.94***	(4.83)	1.28	(1.46)
Marital Status				
Married	1.24	(0.89)	1.03	(0.10)
Separated	1.32	(0.75)	0.45*	(1.20)
Place of Birth				
Born outside the U.S.	0.90	(0.44)	1.68*	(1.65)
Age				
25 to 34	0.91	(0.35)	2.21*	(1.89)
35 to 44	0.81	(0.68)	1.48	(0.81)
45 to 54	0.57*	(1.91)	1.76	(1.27)
55 to 64	0.80	(0.73)	2.15	(1.64)
65 and over	0.73	(0.81)	4.38***	(2.74)
Education				
No High School Degree	0.39***	(3.08)	0.42	(1.55)
Assoc. Degree	1.58**	(2.37)	1.09	(0.33)
Bachelor's Degree	1.59***	(2.71)	3.04***	(5.47)
Graduate Degree	1.47*	(1.80)	3.05***	(4.59)

* p<=0.10, ** p<=0.05, *** p<=0.01

Odds Ratios with Cash Preference as the base group Table 4

	(1)	Debit Preference	(2)	Credit Preference
Household Income				
$25,000 to $49,999	2.66***	(5.43)	4.09***	(5.01)
$50,000 to $74,999	3.09***	(5.23)	7.38***	(6.58)
$75,000 to $99,999	3.86***	(4.67)	16.1***	(7.39)
$100,000 to $124,999	4.05***	(4.38)	15.9***	(7.10)
$125,000 to $199,999	3.57***	(3.42)	14.0***	(6.36)
$200,000 or more	1.71	(0.93)	31.5***	(6.14)
Employment Status				
Unemployed	0.42***	(3.60)	0.48*	(1.76)
Laid Off	0.43*	(1.65)	0.38	(1.15)
Disabled	0.64*	(1.65)	0.98	(0.04)
Regional Dummies	Yes		Yes	
Additional Employment Dummies	Yes		Yes	
Additional Marriage Dummies	Yes		Yes	
Pseudo R^2	0.191		0.191	

* p<=0.10, ** p<=0.05, *** p<=0.01

The race and ethnicity estimates from Table 3 shows that cash is the preferred payment method for minorities and that minorities are much less likely to state that either debit or credit cards are their preferred payment instrument. Asian individuals are much less likely to prefer debit cards, but are 75 percent more likely to prefer credit cards than cash. Black individuals show a statistically significant difference in preference between cash and cards where they are 79 percent (1/0.56) less likely to prefer debit cards and four times less likely to prefer credit cards. Similarly, Hispanic individuals are much less likely to prefer credit cards and about equally likely to prefer debit cards when compared to cash. Women are more likely to prefer cards over cash and are twice as likely to state they prefer debit cards.

What does not statistically affect payment preference is an individual's age. Only three of the Age Variables were significant and the largest impact was individuals over 65 preferring credit to cash by more than a 4 to 1 ratio. Overall, older individuals tend to prefer credit cards, but the z-scores indicate that age does not significantly impact an individual's payment preference.

The likelihood that an individual will prefer a card payment over cash is largely dependent on one's household income and to a lesser extent, though not insignificant, one's level of education. The type of card one is likely to prefer is dependent on the level of education. Increased levels of education are correlated with a card preference, but higher levels of education are correlated with a credit card preference. Individuals with an associate's degree are about 60 percent more likely to prefer a debit card and, statistically, just as likely to prefer cash as one is a credit card. People with at least a bachelor's degree are also more likely to prefer debit cards over cash, but unlike those with an associate's degree, those people who have earned at least a four year degree are three times more likely to prefer credit cards over cash.

Household earnings between $25,000 and $199,999 increase the likelihood of preferring debit cards by two to four times when compared with those who earn less than $25,000. The effect of earnings on the likelihood that a person will want to pay with a credit card is even more dramatic. Household earnings between $25,000 and $74,999 will increase the likelihood of preferring a credit card by four to seven times. Those earning $75,000 or more are at least 14 times more likely to say they prefer to pay with a credit card than pay with cash. In general, the results show that the higher one's household income the greater the probability that a person will prefer to pay with a card and increased household income increases the odds that the payment preference will be credit cards rather than debit cards.

Cash Payment Regressions

The Tables below show how the probability of a cash payment is affected by demographic and transactions level variables. Table 5 shows the marginal probabilities of cash payments for each payment preference for the random effects logistic regressions. Each column shows selected variables from each of the three regressions. The regressions for those with a cash preference only include individuals who have acquired a debit, credit, or a prepaid card so that the lack of card adoption does not bias the estimates. The Amount Variables include the amount of the purchase, dummy variables in $5 dollar increments from $0.01 to $25.00, as well as interactions between the dollar amount and the $5 dollar dummy increments. These Amount Variables allow for a non-predetermined functional form with respect to how the transaction amount influences the probability of a cash payment. These additional transactional level data will give insight into where consumers use cash, as well as the probability of a cash payment for different transaction values.

Marginal Probabilities of a Cash Payment

Table 5

	(1) Cash Preference		(2) Debit Preference		(3) Credit Preference	
Amount Variables						
Amount	-0.003***	(2.61)	-0.0004**	(2.34)	-0.0001	(1.01)
Amount Dummy ($0.01-$5)	0.403***	(9.15)	0.644***	(21.12)	0.646***	(17.12)
Amount Dummy($5.01 – $10)	0.210**	(2.21)	0.415***	(6.64)	0.449***	(5.72)
Amount Dummy($10.01 – $15)	0.103	(0.65)	0.271*	(1.91)	0.299*	(1.75)
Amount Dummy ($15.01 – $20)	-0.096	(0.41)	-0.722***	(3.29)	-0.389	(1.61)
Amount Dummy ($20.01 – $25)	0.144	(0.43)	0.363	(1.10)	-0.137	(0.33)
Amount Interaction ($0.01 – $5)	0.027**	(2.14)	-0.044***	(5.04)	-0.052***	(4.86)
Amount Interaction ($5.01 – $10)	0.011	(0.92)	-0.011	(1.41)	-0.012	(1.25)
Amount Interaction ($10.01 – $15)	0.004	(0.30)	0.004	(0.32)	-0.001	(0.06)
Amount Interaction ($15.01 – $20)	0.012	(0.93)	0.051***	(4.34)	0.034**	(2.29)
Amount Interaction ($20.01 – $25)	-0.002	(0.12)	-0.010	(0.69)	0.013	(0.70)
Race						
Asian	0.107	(1.14)	-0.010	(0.11)	-0.049	(0.85)
Black	0.041	(1.23)	0.062*	(1.95)	-0.049	(0.75)
Hispanic	0.035	(1.03)	0.025	(0.87)	0.061	(1.15)
Other Race	0.024	(0.60)	0.011	(0.87)	-0.082	(1.27)
Gender						
Female	-0.014	(0.61)	0.033*	(1.65)	-0.023	(1.06)
Place of Birth						
Born Outside the U.S.	-0.018	(0.47)	0.026	(0.68)	0.026	(0.64)
Marital Status						
Married	-0.018	(0.59)	-0.025	(0.90)	-0.101***	(2.79)
Separated	-0.073	(1.23)	0.143**	(2.34)	-0.105	(0.66)

* p<=0.10, ** p<=0.05, *** p<=0.01

Marginal Probabilities of a Cash Payment

Table 5

	(1) Cash Preference		(2) Debit Preference		(3) Credit Preference	
Age						
25 to 34	0.078	(1.10)	0.045	(0.90)	-0.001	(0.02)
35 to 44	-0.150**	(2.09)	0.087*	(1.65)	0.086	(1.00)
45 to 54	-0.098	(1.37)	0.188***	(3.60)	0.181**	(2.15)
55 to 64	-0.122*	(1.67)	0.142***	(2.67)	0.200**	(2.33)
65 and over	-0.109*	(1.35)	0.208***	(3.25)	0.184**	(2.03)
Education						
No High School Degree	-0.060	(1.26)	0.042	(0.63)	0.115	(0.87)
Assoc. Degree	-0.115	(0.33)	0.030	(1.08)	-0.015	(0.32)
Bachelor's Degree	-0.007	(0.24)	-0.021	(0.91)	-0.034	(1.14)
Graduate Degree	0.009	(0.24)	-0.011	(0.39)	-0.025	(0.79)
Household Income						
$25,000 to $49,999	-0.069**	(2.29)	0.002	(0.07)	-0.083	(1.58)
$50,000 to $74,999	-0.082**	(2.30)	-0.028	(0.83)	-0.028	(0.54)
$75,000 to $99,999	-0.068	(1.39)	-0.048	(1.23)	-0.041	(0.75)
$100,000 to $124,999	-0.083	(1.51)	0.056	(1.26)	-0.081	(1.42)
$125,000 to $199,999	-0.065	(1.04)	-0.005	(0.11)	-0.055	(0.94)
$200,000 or more	-0.096	(1.11)	-0.031	(0.31)	-0.022	(-0.34)
Employment Status						
Unemployed	0.000	(0.00)	0.097**	(2.36)	0.108*	(1.75)
Laid Off	-0.113	(1.33)	0.104	(1.02)	–	
Disabled	0.040	(0.81)	0.069	(1.43)	0.086	(0.95)

* p<=0.10, ** p<=0.05, *** p<=0.01

Marginal Probabilities of a Cash Payment

Table 5

	(1) Cash Preference		(2) Debit Preference		(3) Credit Preference	
Merchant Category						
Auto and Vehicle Related	-0.077***	(3.68)	-0.032	(1.59)	-0.112***	(4.00)
General Merchandise	-0.093***	(4.42)	-0.047**	(2.36)	-0.097***	(4.00)
Entertainment and Transportation	-0.089***	(2.90)	0.044	(1.51)	0.056*	(1.82)
H using Related	-0.170***	(3.24)	-0.069	(1.30)	-0.171**	(2.51)
Medical, Education and Personal Service	-0.049	(1.20)	0.052*	(1.66)	0.038	(1.02)
Financial, Professional and Miscellaneous Services	-0.095*	(1.72)	0.024	(0.42)	-0.120*	(1.85)
Government and Nonprofit	-0.015	(0.26)	0.174***	(3.43)	0.108**	(2.01)
Gifts and Transfers to People	0.097**	(2.03)	0.341***	(10.09)	0.373***	(7.74)
Other	0.199*	(1.90)	0.039	(0.65)	0.152*	(1.86)
Regional Dummies	Yes		Yes		Yes	
Additional Employment Dummies	Yes		Yes		Yes	
Additional Marriage Dummies	Yes		Yes		Yes	

* p<=0.10, ** p<=0.05, *** p<=0.01

In general, all individuals are less likely to pay with cash as the purchase amount increases. The variable "Amount" shows the marginal probability of a cash purchase for the merchant category Food and Personal Care Supplies above $25. While the marginal probabilities for those with a card preference are lower, overall the probability of a cash payment for those with a cash preference is higher. When making purchases between $0.01 and $10.00, the dummy variables for each population are positive, indicating that despite preference there is still statistically significant cash usage in lower transaction amounts. Those with card preferences are between 40 and 65 percent more likely to pay with cash when the purchase amount is less than $5 dollars and 37 to 45 percent more likely when the purchase amount is between $5.01 and $10.00 dollars.

For this series of regressions, the main variables that influence the probability of a cash payment are amount, age and spending category. Unlike in the preference regression results, the observable characteristics do not show much influence after individuals have sorted themselves into their primary preferences. This shows that behavior is driven by preference which, in turn, is driven by demographic and socioeconomic factors, but once people have decided on their preferred payment method, regardless of most demographic variables, everyone within that group behaves in a similar fashion.

The one demographic variable that is important in the probability of cash usage is age. The full cohort of 25 to 34 year olds does not have a statistically higher probability of using cash than 18 to 24 year olds. Part of the similarity between 18 to 24 and 25 to 34 year olds may be one's stage of life since these results are consistent across payment preferences. For those who prefer to use cash, older individuals are less likely to use cash than those under the age of 35. This is not a surprising result as these individuals are more likely to be financially stable and able to make larger value purchases, which have a higher probability of card usage.[10]

Individuals 45 and older who prefer to use cards are at least 14 percent more likely to use cash for a transaction than 18 to 24 year olds and 6 to 10 percent more likely than 35 to 44 year olds. Assuming payment habits stay relatively constant, these results suggest that if the younger cohorts prefer to use a payment instrument other than cash, cash usage as a payment instrument will drop as individuals age. The assumption that a person's payment habits remain constant after reaching their 30s seems reasonable when one looks at the difference in coefficients between 35 to 44 year olds and compares them to 45 to 54 year olds. The older cohort for both card preferences is 10 percent more likely to use cash than their 35 to 44 year old counterparts.

10 All individuals in the second set of regressions have obtained at least one payment card, whether debit, credit, or prepaid.

Both groups are in their prime working age and it is reasonable to assume that the difference seen is a generational difference rather than a stage of life difference.

The merchant category also has a major influence on the probability of a cash payment. Those who prefer to pay with cash are less likely to use cash when purchasing goods and services that are not from the merchant category Food and Personal Care Supplies. The other merchant categories have negative coefficients ranging from -17 percent for Housing Related to -1.5 percent for Government and Nonprofit. The two exceptions are Gifts and Transfers to People and Other where people are 10 and 20 percent more likely to pay with cash, respectively.

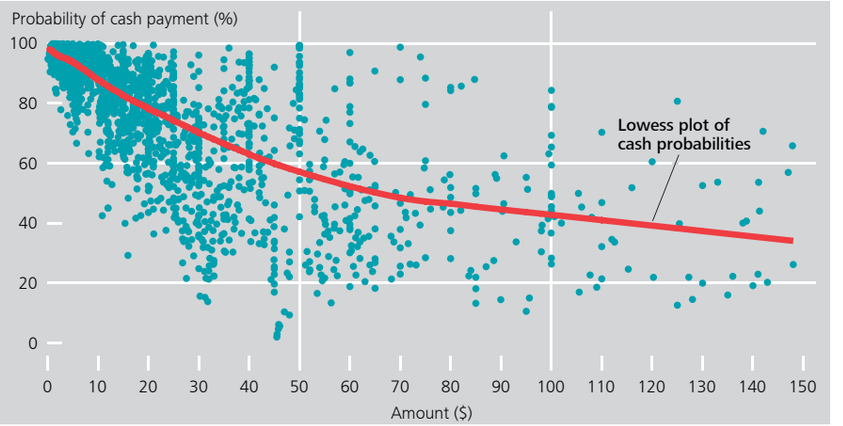
The estimated coefficients on the merchant categories for those who prefer to pay with cards are quite different than those who prefer to pay with cash. Individuals who prefer debit and credit are about 10 percent less likely to use cash for Auto and Vehicle Related and General Merchandise, which are the second and third most frequented merchant types after Food and Personal Care Supplies. The one area where people who prefer to use cards are significantly more likely to use cash than they are in Food and Personal Care Supplies purchases is for Gifts and Transfers to People. The reason for this increase in probability is the lack of alternatives within these categories. People will use cash when alternative payment instruments are limited. The only convenient way to transfer money from one person to another is either a check or cash. There are fast ways to transfer money from one person to another if both people happen to belong to the same bank, but even transferring money through PayPal without fees takes longer than it does to simply deposit a check.[11] Not surprisingly, merchant categories that accept payment cards see a decrease in the probability of cash usage by those who prefer to pay with cards. While payment options for transactions with the merchant category Gifts and Transfers to People may not impact the overall demand

11 Assuming one does not have money already in their PayPal account, since it takes 3-5 days to move money from a bank account to one's PayPal account without fees.

for cash, large-scale acceptance of cards for small value transactions with Food and Personal Care Supply merchants has the potential to decrease the overall demand for cash.

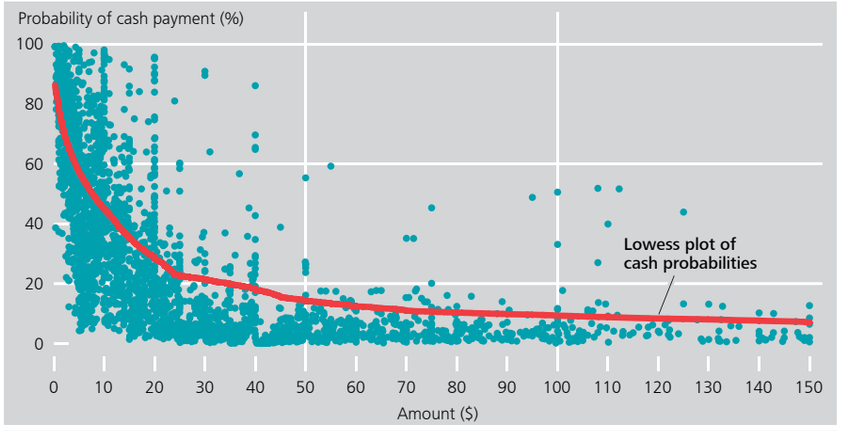
Predicted Probabilities

Probability of a cash payment – Cash preference Figure 7

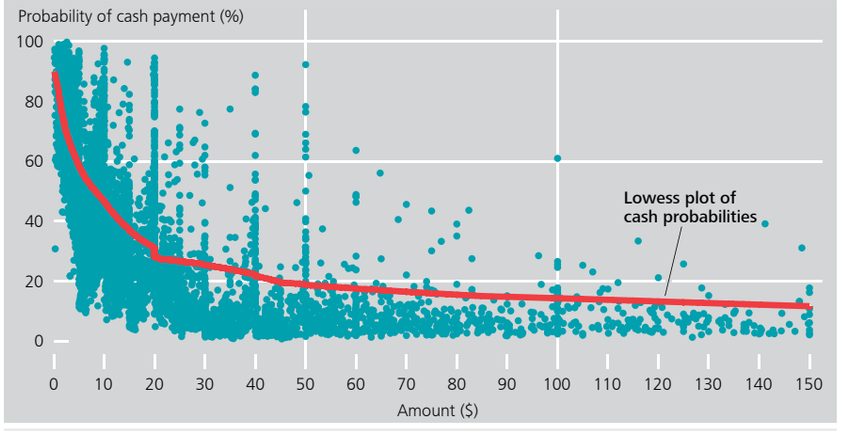


Figures 7 through 10 show the predicted probabilities by purchase amount from the regression results in Table 4 for each payment preference. Each dot within the Figure represents a predicted probability for a specific transaction. The displayed line is a locally weighted scatterplot smoothing (Lowess) line that averages ± 5 predicted values to produce the weighted probabilities by amount. The predicted probability for those who prefer cash is approximately linear with a slope of about -0.66 when the purchase amount is between $0.01 and $75 dollars. The slope of the line then changes and flattens out to about -.18 when the purchase amount is greater than $75. For individuals who prefer to pay with cash, the probability of a

Probability of a cash payment – Debit preference Figure 8



Probability of a cash payment – Credit preference Figure 9



cash payment for purchases $20 or less is about 91 percent and for purchases greater than $20 and less than $50 the probability is about 60 percent.

Figures 8 and 9 show the predicted probabilities of a cash payment for debit and credit cards, respectively. The two Lowess plots are very similar for the two card populations, which suggests that those who prefer debit and credits cards show a "card preference behavior" rather than a "debit preference behavior" or "credit preference behavior." Similar to those with a cash preference, people who prefer to use cards have a very high likelihood of using cash for smaller value transactions. The slope of the Lowess plots for purchases less than $20 dollars is quite steep and, over all, the functions are asymptotic. For purchases less than $20 the probability of using cash for people who prefer debit cards is 51 percent and 49 percent for individuals with a credit preference and for purchases greater than $20 and less than $50 the probability of a cash payment is 13 and 9 percent, respectively for individuals with a debit or credit preference. For purchase amounts greater than $70, the probability of a cash payment levels off at 8 percent for those who prefer debit and at 6 percent for those that prefer credit.

Predicted probabilities of cash payments by amount Figure 10

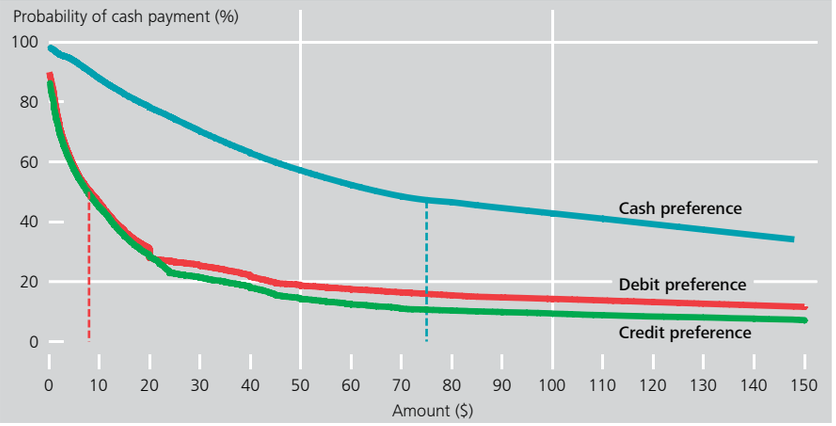


Figure 10 shows the Lowess plots of the predicted probabilities for the cash, debit and credit preference populations. The red dashed-dot line and the blue dashed lines show the point estimate where the probability of a cash payment is equal to 50 percent. For those with a card preference, that amount is just below $9 dollars and those with a cash preference that amount is about $75 dollars. Clearly, an individual's payment preference is the primary determinant of the payment instrument use for higher value transactions, but these results show that all individuals are likely to use cash for small value transactions. Whether these cash transactions are made with cash because of convenience or because merchants do not accept cards for small value transactions is not ascertainable from the data. Even so, the average transaction in the diary is $14 and, indicating even with the growth of electronic payments, the continued use of cash for small value transactions is likely even among those who prefer to use a non-cash payment instrument

Conclusion

This paper uses the Diary of Consumer Payment Choice and the Survey of Consumer Payment Choice from 2012 to estimate the influence of various demographic and socioeconomic characteristics on payment preference. Then, conditional on an individual's payment preference, this paper estimates the probability that the individual will use an alternative to their preferred instrument based on transaction details.

Once consumers sort themselves into their respective "payment preference populations," they tend use their preferred payment instrument most of the time, followed by cash. The results show that education and household income are the largest factors explaining consumer payment preference. The cash payment regressions show that most demographic variables have little influence on the probability of a cash payment once individuals have sorted into their "payment preferences populations." The variables that have the largest correlation with an increased probability of a cash payment are age, spending category and amount.

A majority of consumers prefer to make payments with either a debit or a credit card, while only 30 percent of the population prefers to pay using cash. However, because cash is the preferred payment method for small value transactions and the majority of transactions are low value transactions, cash is used 46 percent of the time for transactions. Despite the expansion of electronic payment instruments, cash is still the most used payment instrument and understanding how individuals use cash is vital for the Federal Reserve to estimate the future demand for cash in a dynamic payment landscape. Further research into small merchants' acceptance of cards, the development of mobile payment systems and how continued data breaches influence a consumer's use of cash is needed to more accurately estimate an individual's future demand for cash, as well as the role cash will play in a more diversified payment environment.

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Markus Altmann and Nikolaus Bartzsch
The volume of euro coins held for transaction purposes in Germany

Nikolaus Bartzsch
Deutsche Bundesbank, Germany

1 Introduction

Since the introduction of the euro banknotes and coins, there has been a marked upward trend in the demand for German-issued euro coins.[1] At the start of 2002 there were only €3.8 billion worth of coins in circulation (11.1 billion coins); however, by the end of 2012, this figure had risen steadily to €6.8 billion (29.6 billion coins).[2] In statistical terms, this worked out most recently at 368 coins with a value

1 In this context, the volume of (German-issued) euro coins is the imputed value of euro coins paid out by the Deutsche Bundesbank less those paid in (cumulative net issuance). Euro regular issue coins comprise all the coins in the denominations from 1 cent to €2, including €2 commemorative coins (such as the Federal States series). All of these coins are legal tender throughout the entire euro area. €10 coins and euro gold coins (€20, €100 and €200) count purely as collectors' coins and not as regular-issue coins.

2 During this period, the volume of coins issued by the euro area rose from €12.3 billion (38.1 billion coins) to €23.7 billion (102.0 billion coins).

of €85 euro for each person living in Germany. The growth in 1 and 2 cent coins is particularly pronounced. On average, each German citizen is in possession of 187 coins of these denominations. The coins in circulation are used for the following purposes: firstly, the (domestic) transaction balance for purchases; secondly, (domestic) hoarding; and thirdly, foreign demand. Coins may be hoarded permanently or temporarily. Based on the broad definition that is applied here, this not only comprises classical hoarding as a store of value and the regular setting aside of coins to be used as small change, eg for vending machines (temporary hoarding), they also include seepage losses in the form of collections, as well as coins that are lost or damaged (permanent hoarding). Up to now, there has not been any in-depth study conducted into dividing the euro coins that have been issued in Germany ("German" euro coin circulation or the circulation of "German" euro coins) into the different purposes of use. However, it is clear from the figures indicated that the rise in the number of German coins in circulation cannot be explained simply by an increase in the amount of cash held by individuals for transaction purposes. This is all the more the case given that the reduction in cash payments made by households does not exactly suggest dynamic growth in the balance of coins held for domestic transactions[3]. In this analysis, we will seek to estimate the level of these transaction cash balances and how they progress over time. The remainder of the total volume of coins in circulation is consequently accounted for by the domestic hoarding balances and German euro coins circulating outside the country (foreign demand).

The determination of the level of the transaction balance of euro coins in Germany is of interest for the following reasons. Firstly, it is of relevance to seigniorage. Responsibility for minting euro coins lies with the national governments of the euro-area countries. The total value of all the coins to be brought into circulation every year has

3 For information about the decline in the cash payment share, refer to Deutsche Bundesbank (2012, p 36).

to be approved by the ECB Governing Council. In Germany, coins are issued by the Deutsche Bundesbank in consultation with the European Central Bank. While the German Federal government is responsible for the minting of coins, it is the Deutsche Bundesbank that puts the coins into circulation by purchasing them from the Federal government at their face value. The difference between the face value and the minting costs is the money creation profit (seigniorage). Unlike in the case of banknotes, the seigniorage generated from the issuance of coins is collected directly by the Federal government.[4] Consequently, the issuance of coins contributes towards the funding of the state budget.[5] If the overall demand for coins is broken down into the categories "transaction balance", "hoarding" and "foreign demand", the sources of seigniorage can be determined from the coins in circulation. If the share accounted for by permanent hoarding and (net) foreign demand is high, this is favourable for the state budget. These "inactive" coin balances generally do not flow back to the central bank. The seigniorage associated with these coins is therefore permanently ascribed to the state budget.

As described in Deutsche Bundesbank (2013, p 40), the costs for the production of one and two cent coins (known as small denomination coins) are close to or even higher than their nominal value. A money creation loss occurs in this case. If there are any further rises in the cost of raw materials, it could become uneconomical to produce these coins, and they could become used for purposes other than those intended. In addition, not inconsiderable costs arise in the banking industry and in the retail trade sector for the counting, preparation (eg rolling) and transportation

4 The seigniorage resulting from the issuance of banknotes is distributed between the central banks of the individual member states according to their ECB capital share. The seigniorage is distributed among the governments following deduction of any expense items.
5 According to the Treaty establishing the EU, the stock of euro coins held by the central bank, which has already been credited to the government, may not exceed 10% of the national volume of euro coins in circulation.

of these coins.[6] If only a small share of the small denomination coins in circulation were used for transaction purposes, this would be an argument in favour of restricting their use, for example, by applying a rounding rule. So far, two of the euro-area member states have introduced a rounding rule, Finland and the Netherlands, in order to make payment transactions more efficient; see Deutsche Bundesbank (2013). The payment amount is rounded up or down to the nearest five cents at the checkout. The findings of a survey conducted by the Deutsche Bundesbank on payment behaviour indicate that the German public is currently not especially concerned about the introduction of a rounding rule (Deutsche Bundesbank, 2012). However, no clear trend can be derived from the responses. According to a study conducted by the European Commission, 39% of the respondents in Germany indicated in 2011 that they had particular difficulty using 1 cent coins. This figure was even as high as 55% in the case of 2 cent coins. Therefore, these surveys do not provide a uniform picture of the attitude of the general public towards small denomination coins. An important consideration in this regard is the question regarding the degree to which small denomination coins are used at all when making a payment. This question will be answered on the basis of the transaction balance shares estimated in this study.

The division of coins in circulation into their components is also a significant factor in terms of the costs of processing coins. These costs are incurred by domestic cash handlers, principally through the balance of coins held for (domestic) transactions or through the active circulation of coins. An increase in the number of German euro coins in circulation only leads to higher cash (processing) costs if it is attributable to a rise in the transaction balance.

6 At the end of 2011, small denomination coins accounted for a 50% share of the German euro coins in circulation in terms of pieces or volume.

Ultimately, the determination of the transaction balance is also significant for forecasting coin circulation. The Deutsche Bundesbank forecasts the change in circulation for each denomination every January and September as part of its coin requirement planning for the Federal Ministry of Finance, see Deutsche Bundesbank (2013). Time series models from the RegARIMA class are used for this.[7] Forecasts using structural models which map the individual motives of the demand for cash, such as transactions and hoarding, can essentially be used as an alternative. However, it is difficult to find suitable variables for this. The transaction motive can be more or less recorded using a proxy variable for consumption which is paid for using coins ("cash consumption"). It is much more difficult to find an opportunity cost variable for the hoarding motive. Structural models are all the more suitable for forecasting, the greater the dynamics of the coins in circulation are driven by the transaction balance.

Existing scientific studies on the purposes of cash have been primarily concerned with cash as a whole or with banknotes. Sumner (1990), for example, conducted a study into the transaction balances and hoarding balances of US dollars. He compared the seasonal fluctuations in the cash in circulation and retail sales figures in order to estimate the transaction balances. According to his study, the transaction balance accounted for 38% of the US currency in circulation in 1980. Bartzsch, Rösl and Seitz (2011a, 2011b) studied the breakdown of euro banknotes brought into circulation by the Deutsche Bundesbank ("German" euro banknotes) into transaction balance, foreign demand[8] and hoarding. The transaction balance of banknotes can only explain a small proportion (10% to 15%) of German euro banknotes in circulation. Foreign demand accounts for the greatest share at almost

7 RegARIMA or ARIMAX models are ARIMA models with an exogenous input. The input can be both deterministic (eg dummy variables) or stochastic and exogenous.
8 Foreign demand covers German euro banknotes in circulation, both within the (other) euro-area countries and outside the euro area.

70%. According to studies conducted by the Federal Reserve Board, between 60% and 70% of US currency is held abroad (United States Treasury Department 2006).[9]

Unlike cash (banknotes and coins), few studies have been conducted into the usage of coins. Glanville (1970) put forward estimates for the rates at which coins are lost in the United Kingdom. The coins included in these estimates had either been lost, damaged, permanently collected and were in circulation abroad. The wastage rates were determined using the "vintage method". Consequently, they correspond to the constant annual rate at which the active circulation of coins of a certain age has to shrink in order to maintain the proportion of those coins in a random sample. The derived wastage rates were between 0.7% and 3.7%, depending on the random sample, the denomination of the coin and the date on which the coins were first issued. Similarly, Goldin (1985) estimated the annual rate at which Israeli pound coins, issued between 1960 and 1979, were lost. To this end, he took a random sample of coins at the end of 1981. Their distribution in terms of their date of issue (imprinted on the coin) was compared with the corresponding distribution of the coins issued in the period indicated. The fewer older coins that were found in the sample, the greater the number of coins that had been lost of the denomination in question. On balance, the loss rates for the small denomination coins were rather high (40% in the case of the smallest denomination). In the case of large denominations, however, the annual loss rates were in single digit percentages. Applying the same method for the Netherlands and Germany respectively, Bos (1994) and the Deutsche Bundesbank (2003) also concluded that the loss rates for large coin denominations are much lower than those for small denomination coins. Deutsche Bundesbank (2003) also contains a model calculation, based on household surveys, into the hoarding of euro coins by individuals between the years 2002 and 2004. Furthermore, a seasonal method was applied to estimate the cash balance held in DM coins for domestic transactions for

9 However, the figures quoted in the literature fluctuate between 20% and 70% (Feige 2009).

the period from 1970 to 2001. This was estimated at DM 6.2 billion at the end of the 1990s, which corresponds to 53% of all the coins in circulation.

The studies on euro coins are primarily concerned with the mixing of national coins (coins with a national reverse side) in each of the member states. As the reverse sides of the euro coins are different in each country, surveys and random samples can be used to determine the proportion of domestic and foreign coins present in the domestic coins in circulation. In this regard, Seitz, Stoyan and Tödter (2012) estimated that, extrapolating the existing growth rate of coins in circulation in the likeliest variant, €1 coins with a German reverse will drop to a share of around 50% of all the €1 coins in circulation in Germany in the long term (from around 75% in 2008). However, no conclusions can be inferred from this about the circulation of "German" euro coins (in the sense of cumulated net issuance by the Deutsche Bundesbank).

This study is structured as follows. Section 2 contains a general description of direct and indirect approaches to estimating the cash balance held in euro coins for domestic transactions. In section 3 we will estimate the cash balance held in euro coins for domestic transactions both for each individual denomination, as well as for the overall (value of all denominations in) circulation. The shares of the circulation of each denomination (by value) are calculated in section 3.2, and the transaction balances are calculated in euro in section 3.3. The results are summarised in section 4.

2 Direct and indirect approaches to recording the cash balance held in euro coins for domestic transactions

In the case of direct approaches, attempts are made to a greater or lesser degree to identify the cash balance held in euro coins for domestic transactions directly. Among other things, surveys on the payment and cash-withdrawal behaviour of households, as well as cash balance notifications from credit institutions are used.

Indirect approaches, on the one hand, are those which make use of information from special, one-off events, such as the introduction of euro cash.[10] Another type of indirect approach, on the other hand, makes use of the fact that the cash balance held in euro coins for domestic transactions exhibits different characteristics to the other components of the German euro coins in circulation. As the Deutsche Bundesbank satisfies any demand for cash, these characteristics reflect the demand behaviour for cash. The problem can be formulated more precisely as shown below (Feige 1997, p 184). Estimates are to be determined for the shares β_1 and β_2 of two sub-populations C_1 and C_2, which together give rise to the total population C. X_1 and X_2 denote the observed and recorded characteristics belonging to C_1 and C_2 in the sub-populations. The average attribute X is then derived as the weighted average of the two characteristics, whereby the weights are the unknown shares β_1 and β_2.

$$X = \beta_1 X_1 + \beta_2 X_2 \tag{1}$$

As β_1=1-β_2, the shares can be estimated from the characteristics that are observed and measured:

$$\beta_1 = \frac{X - X_2}{X_1 - X_2}$$
$$\beta_2 = \frac{X_1 - X}{X_1 - X_2}. \tag{2}$$

10 An overview of the direct and indirect approaches is provided by Feige (1997, p 168 ff) in connection with the estimate of foreign demand for US currency.

A meaningful solution to this problem exists if the characteristics of the two parts X_1 and X_2 differ ($X_1 \neq X_2$), and the calculated shares are between zero and one. Applied to the question of determining the level of the cash balance held in German euro coins for domestic transactions, the characteristics of the German euro coins that are hoarded in Germany or that exist abroad (X^a) must differ sufficiently from those of the German euro coins that are used for domestic transactions (X^d) to enable the share to be identified in the monitoring of overall behaviour.[11] Possible examples of characteristics or of differentiating features are age,[12] quality, speed of circulation or the seasonal structure of the coins. The share of the German euro coins in circulation accounted for by the cash balance held for domestic transactions is then determined

$$\beta^d = \frac{X - X^a}{X^d - X^a} \tag{3}$$

and for the corresponding share attributable to domestic hoarding and foreign demand

$$1 - \beta^d = \frac{X^d - X}{X^d - X^a}. \tag{3'}$$

11 In this study, "German" (euro) coins or "German" (euro) coins in circulation always means the coins brought into circulation by the Deutsche Bundesbank. They are not only euro coins with a German reverse side. Coins paid out again may also be coins with a foreign reverse side (from one of the other euro-area countries) that had been paid in previously to the Deutsche Bundesbank. The Bundesbank issues coins on behalf of the Federal Ministry of Finance (BMF) in its capacity as a "fiscal agent". The BMF decides which coins are produced and in what quantities. The circulation of German euro coins (including the cash balances of the credit institutions), which is also referred to here as "German" euro coins in circulation, corresponds to the cumulated net issuance, ie the balance arising from the cumulated difference between the monthly outpayments from and inpayments to the Deutsche Bundesbank. See also footnote 1.
12 Coins have a lifespan of between 20 to 30 years.

In section 3 we determine β^d with the aid of the different seasonal structures of X^a and X^d.

3 Seasonal method

In the following, the transaction balance of euro coins in Germany as a whole and by denomination is estimated using an indirect approach, ie applying what is known as the seasonal method. Section 3.1 contains a description of the seasonal method, and the formulas for calculating the transaction balance are derived from this. It is used in section 3.2 to estimate the transaction balance (by denomination) as a share of the circulation (by denomination). The corresponding absolute values of the transaction balances (in € million) are set out in section 3.3.

3.1 Deriving the calculation formulas

The aim of the seasonal method is to filter out information about the transaction balance from the "seasonal structure of the coins in circulation" characteristic. This idea originally came from Sumner (1990), who applied this approach to determine domestic hoarding balances for US currency. However, since then, this approach has also been adopted for several currencies to investigate the domestic and foreign component (Porter and Judson, 1996, p 889 ff; Seitz, 1995, section 2.2; Fischer, Köhler and Seitz, 2004, section 5.1; Bartzsch et al, 2011b, subsection 2.2.2). The fundamental assumption of this approach is that the transaction balance has a more pronounced seasonal structure than coins in circulation as a whole. The latter ultimately also includes hoarding balances and foreign demand. Both have little to do with seasonal developments domestically (in Germany). Altmann and Bartzsch (2014, chapter 6) show that foreign demand for German euro coins principally consists of coins which foreign tourists take outside the euro area and which are hoarded there permanently owing to the difficulties involved in exchanging them. As described in Deutsche Bundesbank (2003, p 161), there is already a greater assumption about the invariance of the domestic coin hoard. One cannot

rule out the possibility that this hoard will increase at a greater rate than usual because of the rise in transactions at the end of the year. This applies, for example, if individual households regularly empty small change out of their wallets and hoard it temporarily. However, the resulting seasonal fluctuations in the balance of the domestic coin hoard may be considerably lower than in the inflow and outflow. Nevertheless, this would lead to a certain under-estimation of the coins held for transaction purposes. At any rate, we assume that the cash balances held for domestic transactions and the remaining components of the circulation of German euro coins (domestic hoarding and foreign demand) differ from one another in the seasonal figure, and that the overall circulation shows a dampened seasonal factor.

The underlying seasonal model assumes that the time series for the circulation of German euro coins comprises three parts: a trend component T_t, a seasonal term S_t and an irregular component.[13] They should be linked together on a multiplicative basis (multiplicative seasonal model). Attributing the irregular component to the trend for simplicity and allowing for the fact that some of the coins are found in domestic hoards or abroad (a), this results in (t represents the time index, d stands for the domestic transaction balance)

$$T_t S_t = T_t^d S_t^d + T_t^a S_t^a. \tag{4}$$

If β_t now encompasses the share of the total trend that is found in the domestic transaction balance T^d and, as a consequence, $(1-\beta_t)$ is the corresponding share of the domestic hoard and of foreign demand, it follows that

$$T_t S_t = \beta_t T_t S_t^d + (1-\beta_t) T_t S_t^a \text{ or} \tag{5}$$

13 A cyclical component is not shown separately. This does not alter the results.

$$S_t = \beta_t S_t^d + (1-\beta_t) S_t^a. \tag{5'}$$

(5') is an application example for the general equation (1) in section 2, whereby the seasonal factor takes on the role of the measured characteristic X. Assuming that there is a missing season in the domestic hoard and in the foreign demand share, ie $S^a = 1 \; \forall$ t, (5') can be further simplified to

$$S_t = \beta_t S_t^d + (1-\beta_t). \tag{6}$$

Given the values for the seasonal terms S and S^d, this gives rise to the share of the domestic transaction balance accounted for by German euro coins as an equation for the unknown value β_t

$$\beta_t = \frac{S_t - 1}{S_t^d - 1}. \tag{7}$$

The share of the domestic hoard and foreign demand is then, in turn, $(1-\beta_t)$. S_t corresponds to the seasonal figure for the cumulated net issuance of euro coins by the Deutsche Bundesbank and can be determined by applying the normal seasonal adjustment processes (for example, X12-ARIMA, Tramo-Seats). On the other hand, S^d, the season for the domestic transaction balance, is unknown and must be determined on an approximate basis.

However, equation (7) does not always deliver meaningful results. If, for example, there is no seasonal influence during any period, ie $S_t = S_t^d = 1$, β_t tends towards infinite or any value of β_t can be reconciled with the equation (7). Problems may arise, even if the seasonal figure for the (total, value-based) German coins in circulation is not weaker during all the periods than that of the domestic transaction balance.[14] Consequently, this method does not always deliver clear results.

Therefore, further modifications are needed to allow for these eventualities and to enable this method to be implemented. Fairly accurate estimation results can often be obtained only for a certain frequency within a year (see also Porter and Judson, 1995, p 19 f). We therefore take into account the fact that seasonal fluctuations are usually greatest around Christmas owing to domestic transactions. In the case of German coin issues (total circulation), the seasonal high is in December, while there is a seasonal low in January (in this case, this is accordingly a one-month frequency). In order to factor this into the equation, we replace the time index t with m,j, whereby m denotes the m^{th} month and j stands for the j^{th} year. If equation (6) for January is subtracted from the corresponding equation for the preceding December, the domestic transaction balance share β_j reads as

$$\beta_j = \frac{S_{dec,j} - S_{jan,j+1}}{S_{dec,j}^d - S_{jan,j+1}^d}. \tag{8}$$

In Figure 1, both seasonal factors ($S_{dec,j}$, $S_{jan,j}$) of Germany's total issuance are presented for our observation period (2004 to 2011). 2002 and 2003 were not factored in because the circulation of euro coins was still in a transitional phase during those years following the introduction of euro cash. While data up to the end of 2012 have been used, we were only able to determine transaction balance shares, β_j, up to and including 2011 (see equation (8)).

14 If the seasonal figure in the domestic transaction balance is more pronounced than that in the domestic hoards and in foreign demand, the following equation applies to values greater than 100: $S_t < S_t^d$, for values less than 100: $S_t > S_t^d$.

The next thing to do is to approximately determine the unknown seasonal amplitude of the domestic transaction balance in the denominator of equation (8). This involves taking the seasonal amplitude of a transaction variable tr (which is still to be defined more closely), $\Delta S(tr)$, ie the difference between the seasonal high and low of the transaction variable. However, it is not simply a case of replacing the denominator in equation (8) with the seasonal amplitude of the transaction variable. This still has to be multiplied by the transaction or income elasticity in demand for coins in order to convert the "transaction variable" unit into the "(value-based) coins in circulation" unit. We have selected a value of 0.5 for transaction elasticity. This value is derived from the cash management theory for currency which is used for the payment of regular transactions (Baumol 1952).

Consequently, equation (8) becomes[15]

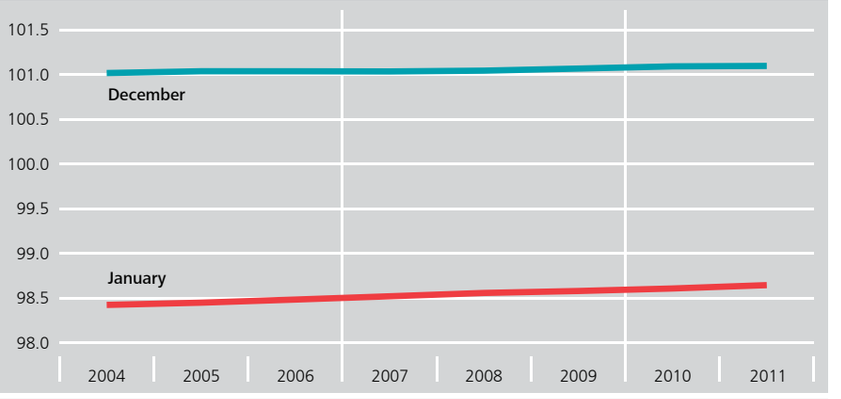
$$\beta_j = \frac{S_{dec,j} - S_{jan,j+1}}{S^d_{dec,j} - S^d_{jan,j+1}} \approx \frac{S_{dec,j} - S_{jan,j+1}}{0{,}5 \cdot \Delta S(tr)} \quad , \tag{8'}$$

whereby $\Delta S(tr)$ is the difference between the seasonal high and low of the transaction variable tr.

15 Only the part of the coins in circulation required for transaction purposes exhibits a seasonal pattern, which follows the seasonal deflections in transaction volume or, as the transaction variable is only an approximation, comes close to it. It is assumed, on the other hand, that there are no seasonal deflections in the other components of demand which are not required for payment purposes – hoardings (including losses) and foreign demand (see equation (6)). Therefore, the seasonal fluctuations in the entire volume of coins in circulation are dampened all the more so the higher the share of those components is in coins in circulation. See Deutsche Bundesbank (2003, p 157).

The volume of euro coins held for transaction purposes in Germany Figure 1

Seasonal factors $S_{dec,j}$ and $S_{jan,j}$ for the circulation of German euro coins (by value)



Source: Deutsche Bundesbank.

The selected transaction variable should illustrate the demand for coins for transaction purposes insofar as possible. The most suitable option appears to be a proxy variable which is most akin to consumption spending by households paid for using coins. As a rule, cash consumption as a subset of private consumption and retail sales figures can be considered as possible transaction variables tr. These variables are described in greater detail in section 3.2. In the case of cash consumption, we have to switch over to quarterly data (q) and adapt equation (8') accordingly. The seasonal amplitude of the quarterly (value-based) circulation of German euro coins (in the numerator) reflects the difference between the seasonal factor for coins in circulation in the second quarter of the year j and the seasonal factor for coins in circulation in the first quarter of the following year j+1. The seasonal amplitude of the cash consumption (in the denominator) is equal to the difference between the

seasonal factor for cash consumption in the fourth quarter and its seasonal factor in the first quarter of the following year. Consequently, equation (8') becomes [16]

$$\beta_j \approx \frac{S_{q2,j} - S_{q1,j+1}}{0{,}5 \cdot \Delta_{q4,j;q1,j+1} S(tr)}. \qquad (8'')$$

3.2 Domestic transaction balance shares in German euro coins in circulation

In the following, the share of the balance of coins in circulation held for domestic transactions, β_j, in accordance with equations (8'') or (8'), is determined both for the entire (value-based) circulation (total for all denominations) of German euro coins (ie those issued by the Deutsche Bundesbank) as well as for the (value-based) circulation of same, by denomination.[17] As previously mentioned, real cash consumption and real retail sales are possible transaction variables. As the quality of data available for private consumption is much better, we will present the results for this scenario first of all. At the end, we will take a brief look at the results arising when retail sales figures are used.

The cash consumption has to be determined from the components of real private consumption which are normally (also) paid for with coins. To this end, we first adopted the definition contained in Seitz and Setzer (2009) for cash consumption.

16 In accordance with equation (8'), one could expect that the seasonal high in the numerator for equation (8'') lies in the fourth quarter. However, it falls in the second quarter for the following reasons. In terms of monthly seasonal factors, those in December are the highest, immediately followed by the seasonal factors in June and May, which is attributable to public holidays and to the start of the holiday period. Furthermore, the seasonal factors in November are low.
17 As shown in Altmann and Bartzsch (2014, chapter 6), Germany is a net exporter of euro coins. This means that the entire domestic demand for coins is met by the Deutsche Bundesbank (in the net assessment, ie when assessing the cross-border net flows of euro coins). In addition, the Bundesbank also meets part of the demand for coins abroad. Therefore, the domestic balances of German euro coins (transaction balance and hoardings) correspond in the net assessment to the entire domestic balances of euro coins. The latter include euro coins which were brought into circulation by the Deutsche Bundesbank (German euro coins) and euro coins issued by other Eurosystem central banks (foreign euro coins).

According to that definition, cash consumption consists of the following private consumption components in Germany: 1) accommodation and hospitality services, 2) clothing and footwear, 3) leisure, entertainment and culture, 4) food and beverages, as well as 5) other purposes, such as body care and personal articles. This definition of real cash consumption is designated below as "real cash consumption within broad boundaries" because it is based on the transaction-related demand for banknotes and not primarily on the demand for coins. Therefore, we have defined "real cash consumption within narrow boundaries" as an alternative transaction variable, which should be more akin to consumption paid for with coins. "Cash consumption within narrow boundaries" consists of the following private consumption components: 1) "Food and alcoholic beverages" and 2) "Alcoholic beverages and tobacco products".[18]

The share of the total coins in circulation accounted for by the domestic transaction balance, β_j, is determined using equation (8'') for both the broad and narrow definitions of real cash consumption.[19] Both time series are shown in Figure 2. Based on the calculation formula, the transaction balance shares can only be calculated up to and including 2011, even though the database covers 2002 to 2012. The years 2002 and 2003 were not taken into consideration on account of the distortions to coin circulation following the introduction of euro cash. It is apparent that both series are close together at the start (2004) and end (2011) of the period. The maximum gap occurs in 2007 and amounts to five percentage points. Consequently, the results of

18 Other components that may possibly (also) be paid for with coins were not taken into consideration owing to an absence of available data. On the one hand, it entails components which are not published for the entire period under consideration here, ie 2004-2012, but rather only for 2002-2009: 1) newspapers and magazines, 2) stationery products and drawing materials, as well as 3) hairdressing services and other body care services. On the other hand, the following components were not taken into consideration because they are only available as annual series and not as quarterly series: 1) leisure and cultural services, as well as 2) catering services.
19 In the case of cash consumption within broad boundaries, the seasonal high only occurs in the fourth quarter from 2004 to 2008 inclusive. It occurs in the third quarter in the years after that. The shares of the transaction balance, β_j, that follow from equation (8'') are similar for those two seasonal highs.

the two transaction variables turn out similar, in any event. This is important because it is difficult to say which of them best reflects true coin consumption. Cash consumption within broad boundaries probably encompasses components which are only paid for to a limited extent with coins, if at all. On the other hand, cash consumption within narrow boundaries may not include all the components of private consumption that are paid for with coins. For this reason we calculate the (definitive) share of the transaction balance as an (unweighted) average of the two transaction balance shares arising from cash consumption within broad boundaries and that within narrow boundaries. In the following, we refer to this for the sake of simplicity as the transaction balance share, arising from the "average" real cash consumption (cc). The resulting share of the entire circulation of German euro coins accounted for by the transaction balance is also shown in Figure 2. The lowest level in the period under analysis was 2011, at almost 36%. The maximum occurred in 2006 and 2007 at almost 41%. The declining trend since 2008 could be attributable to the drop in the share of cash payments made in retail outlets. In addition, the share of coins in circulation accounted for by the transaction balance automatically reduces over time due to the accrual of coins that are lost or that are collected permanently. However, this argument principally applies to "older" coins in circulation.

The shares of all the cash in circulation accounted for by domestic transaction balances with the (average) cash consumption as a transaction variable in accordance with equation (8'') were alternatively also calculated with combined seasonal and calendar factors of (average) cash consumption instead of only with seasonal factors.[20] We rejected this variant due to inexplicable large deflections ("peaks") in the transaction balance shares.

20 There is no calendar dimension to the German euro coins in circulation, and thus, they do not have any combined seasonal and calendar factors either.

A further calculation variant is to use real retail sales figures as a transaction variable (tr) instead of real cash consumption. For the purposes of this monthly series, the shares of all the German euro coins in circulation (by value) accounted for by domestic transaction balances, $\beta_{j,}$ were calculated in accordance with equation (8'). There are also narrow and broad boundaries here once again.[21] The shares for the transaction balance lie within a range of between 15% and 19%. A low value such as this can only be expected with older issues of coins in circulation, but not with euro coins in circulation as they are still very young.[22]

Bartzsch et al (2011a, 2011b) have shown that euro banknotes issued in Germany account for a 10% – 15% share of the (domestic) transaction balance, while the foreign demand share is about 65%. As shown in Altmann and Bartzsch (2014, chapter 6) German euro coins (in the sense of net issuance) are in circulation to a much lesser degree abroad. By the same token, one would expect that German euro coins would account for a significantly greater share of the (domestic) transaction balance than German euro banknotes. For this reason and due to the inferior quality of the data on retail sales, we have favoured the estimates that are based on cash consumption.

Applying the seasonal method, the percentage shares accounted for by the domestic transaction balance can also be estimated for the individual coin denominations. The share of the domestic transaction balance (by denomination) refers here to the circulation of the denomination in question and not to the overall circulation

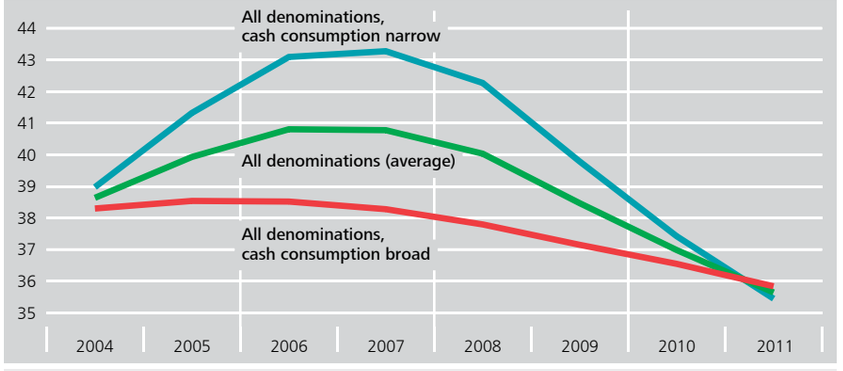
21 Real retail sales figures excluding trade in vehicles, as reported in the official retail sales statistics, were selected as real retail sales figures within broad boundaries. The retail sales figures within narrow boundaries consist of retail trade with various types of products, most notably food and luxury foodstuffs, beverages and tobacco products (all sales locations). The real retail sales figures within both boundaries experience a seasonal high in December and a seasonal low in February.
22 In Altmann and Bartzsch (2014, chapter 4) the share of the (older) DM coins in circulation accounted for by the transaction balance in 2000 was estimated at just under 15% with the introduction of euro cash.

(by value) (collective circulation of all denominations). In the case of small denominations (1 cent, 2 cents and 5 cents), the seasonal high occurs in the third quarter and not in the second quarter as happens with all coins in circulation[23]. Once again, the (average) real cash consumption (cc) is taken as a transaction variable. By adapting equation (8'') accordingly, the following formula is created for calculating the domestic transaction balance shares for small denomination coins

$$\beta_j \approx \frac{S_{q3,j} - S_{q1,j+1}}{0{,}5 \cdot \Delta_{q4,j;q1,j+1} S(cc)}. \qquad (9)$$

Percentage share of (all) the German euro coins in circulation (by value) accounted for by the domestic transaction balance

Figure 2



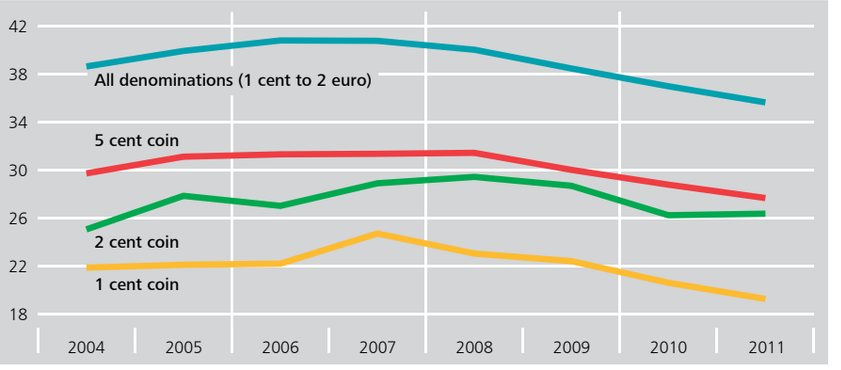
Source: Deutsche Bundesbank and authors' own calculations.

23 The seasonal high for all coin denominations apart from the €2 coin occurs in the third quarter. This could be attributable to the holiday period. The seasonal high for the €2 coin, however, is in the second quarter. Given the large weighting of €2 coins in the circulation of all German euro coins by value (about 50% at the end of 2011), the seasonal high for all the coins in circulation (by value) is also in the second quarter.

The resulting domestic transaction balance shares are shown in Figure 3. By way of comparison, the share of all the German euro coins in circulation accounted for by the domestic transaction balance from Figure 2 is also shown.

Percentage share of the German euro coins in circulation (by value) accounted for by the domestic transaction balance in the case of small denomination coins

Figure 3



Source: Deutsche Bundesbank and authors' own calculations.

The shares of domestic transaction balances of small denomination coins is between about 20% and 30%, well below the share of all the German euro coins in circulation (by value) accounted for by the domestic transaction balance. That can be explained by the fact that small denomination coins are presumably hoarded to a greater extent in order to lighten one's wallet or purse. At any rate, almost 30% of the respondents agreed with the following statement in Deutsche Bundesbank (2012, p 26): "I rarely pay with small change and generally put it aside."[24] Furthermore, people cannot pay with small change at vending machines. Moreover, lost coins are likely to play a relatively large role in the case of small denomination coins

24 For information about the motives for retaining coins, see also Deutsche Bundesbank (2003, p 141).

(Deutsche Bundesbank, 2003, p 142). They account for a correspondingly low share of the transaction balance. The latter rises as the size of the denomination increase. As with total circulation, small denominations have tended to account for decreasing shares of the domestic transaction balance in recent years.

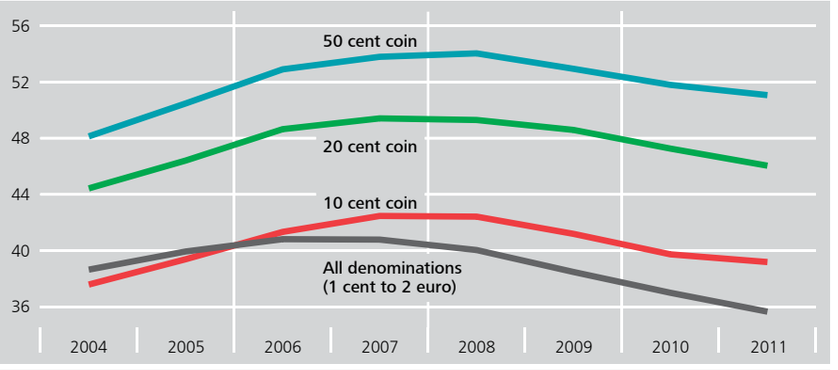
The transaction balance shares are particularly low among small denomination coins (1 cent and 2 cent coins). Therefore, these coins are used relatively infrequently to pay for goods and services. The majority of them are likely to be hoarded in order to lighten one's wallet or purse or are lost.[25] Given the current discussion on small denomination coins, this could be regarded as an argument in favour of introducing a rounding rule at the checkout (to the nearest five cents).

Domestic transaction balance shares by denomination, ie relative to the circulation (by value) of the respective denomination, β_j, are also determined for medium denominations (10 cent, 20 cent and 50 cent) from equation (9). The domestic transaction balance shares for medium denomination coins are above those for total circulation (see Figure 4). The shares of the domestic transaction balance for 20 cent and 50 cent denominations are particularly high. They were 46% and 51% respectively in 2011. The two denominations can be classed as typical transaction denominations. Unlike small denomination coins, people rarely hoard medium denomination coins in order to lighten their wallet or purse. Given their low face value, they are also not as good as a store of value as large denomination coins (€1 and €2 coins). Just like small denomination coins, the domestic transaction balance shares of medium denomination coins have fallen in recent years, and it rises as the denomination size increases.

25 This hypothesis for small denomination DM coins is confirmed in Deutsche Bundesbank (2013, p 38).

Percentage share of the German euro coins in circulation (by value) accounted for by the domestic transaction balance in the case of medium denomination coins

Figure 4



Source: Deutsche Bundesbank and authors' own calculations.

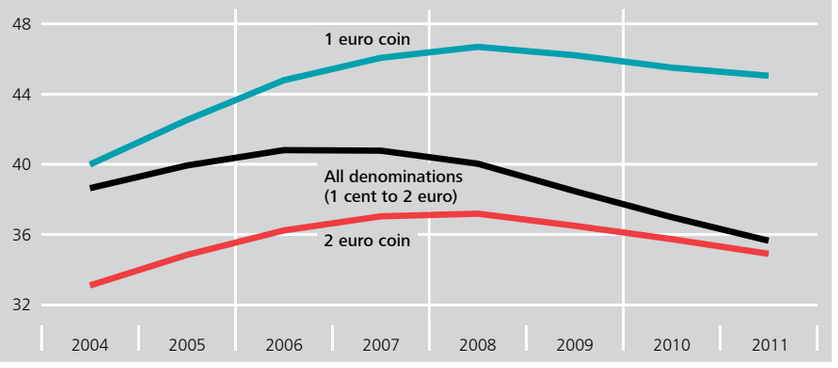
In the case of large denomination coins (€1 and €2), only the percentage domestic transaction balance share for the €1 coin is calculated according to equation (9).

The seasonal high for the circulation of the German €2 coin is not in the third quarter, but rather in the second quarter. Therefore, the following equation applies for the domestic transaction balance share in the circulation of the €2 coin, β_j, (see also equation (8'))

$$\beta_j \approx \frac{S_{q2,j} - S_{q1,j+1}}{0{,}5 \cdot \Delta_{q4,j;q1,j+1} S(cc)}. \quad (10)$$

Percentage share of the German euro coins in circulation (by value) accounted for by the domestic transaction balance in the case of large denomination coins

Figure 5



Source: Deutsche Bundesbank and authors' own calculations.

The corresponding transaction balance shares are shown in Figure 5. In the case of the €1 coin, this clearly exceeds the corresponding share of the total circulation (by value). However, this lies below the shares for 20 cent and 50 cent coins, which are "typical" transaction denominations. This could be due to the fact that €1 coins are more suitable as a store of value because of their comparatively high face value and are, thus, hoarded to a greater extent. This assumption is supported by the domestic transaction balance shares in the circulation of the €2 coin, which, over the entire period under consideration, are lower than the shares for the domestic transaction balance in the total (value of) coins in circulation. Because of its high face value, the €2 coin is particularly good for hoarding to be used as a store of value. However, it is also in demand as a collectible object in the form of commemorative €2 coins, including the Federal States series.

3.3 Balances of German euro coins held for domestic transaction purposes

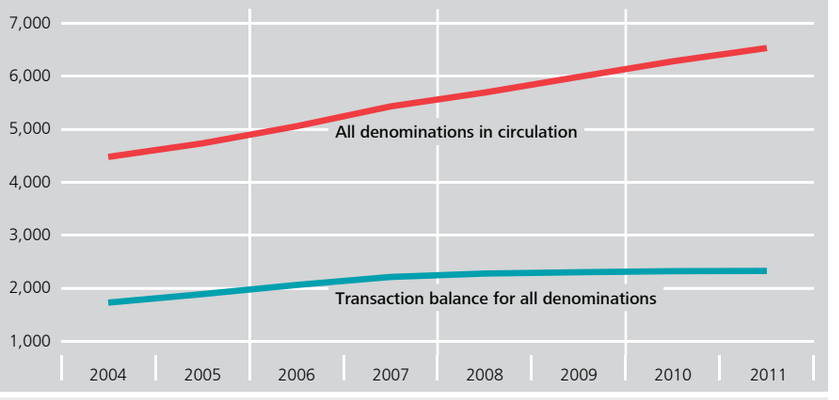
In section 3.2, the percentage shares for the domestic transaction balance of the German (value of) coins in circulation are determined by denomination and for the total circulation. The associated domestic transaction balances (in € million) are calculated by multiplying these shares by the denomination-specific or total circulation of German euro coins (by value).

The domestic transaction balance of German euro coins rose from more than €1.7 billion in 2004 to just over €2.3 billion in 2011. During the same period, the total value of German coins in circulation rose from almost €4.5 billion to just over €6.5 billion (Figure 6). Consequently, around 30% of this rise is attributable to the domestic transaction balance.

Domestic transaction balance and total value of German euro coins in circulation

Figure 6

million €



Source: Deutsche Bundesbank and authors' own calculations.

However, while the total volume of coins in circulation has grown markedly with a linear trend during the period under review, the time series for the domestic transaction balance has flattened out noticeably since 2008 and barely makes any contribution towards the growth of the total circulation. The share of the total value of German euro coins in circulation accounted for by the domestic transaction balance has therefore dropped since 2008 (Figure 2).

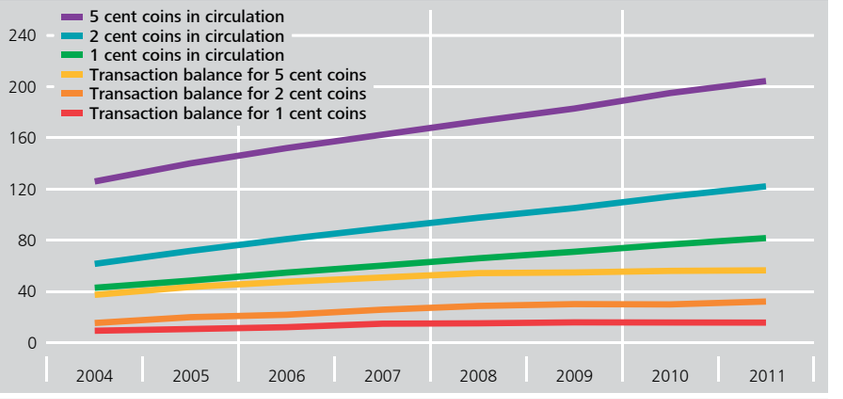
The transaction balances for small denominations are shown together with the respective circulations in Figure 7. The higher the denomination, the greater the (domestic) transaction balance. Reflecting the low value of the circulation of these denominations, the transaction balances are quite low at under €60 million. While the shares accounted for by the transaction balance in the circulation by denomination have been on the decline since 2008 (Figure 3), transaction balances have stagnated during this same period. Therefore, the downward trend in transaction balance shares is more than offset by the strong upward trend in circulation (by denomination).

The dynamic development in the circulation of small denomination coins is consequently not attributable to the domestic transaction motive because the corresponding transaction balances have remained more or less constant for a number of years. Domestic and foreign hoards are rather more likely to have played a part in this.[26] As described in section 1, structural models are therefore less suitable for estimating or forecasting the circulation of small German euro coins. To this end, one would have to identify a suitable opportunity cost variable for the hoarding motive, which is very difficult. By contrast, the transaction motive can be depicted via real cash consumption, as has been defined in section 3.2 as a transaction variable for calculating the transaction balance shares.

26 Refer to Altmann and Bartzsch (2014, chapter 6) on the role played by foreign demand.

Domestic transaction balance and German euro coins in circulation in the case of small denomination coins Figure 7

million €

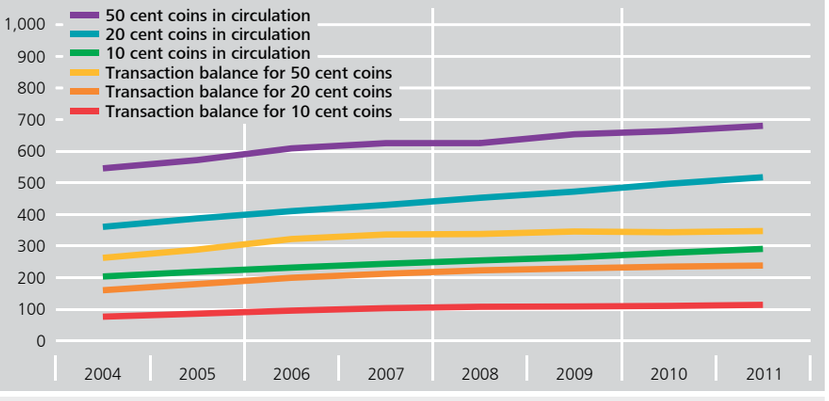


Source: Deutsche Bundesbank and authors' own calculations.

Figure 8 shows the domestic transaction balances and circulations of medium denomination coins. Transaction balances rise again as the size of the denomination increases and they have been stagnating since 2008. Since then, they have stood at between €100 million and €350 million, which is significantly higher than in the case of small denomination coins. As with the latter, the declining transaction balance shares in medium denomination coins (see Figure 4) have been more than compensated for by the rise in circulation (by denomination). Once again with medium denomination coins, the growth in circulation is not attributable to the domestic transaction motive, but rather to hoarding at home and abroad. Therefore, time series models are likely to be more suitable than structural models for estimating and forecasting the circulation of medium denomination German euro coins.

Domestic transaction balance and German euro coins in circulation in the case of medium denomination coins Figure 8

million €



Source: Deutsche Bundesbank and authors' own calculations.

The domestic transaction balances and circulation of the two large coin denominations are shown in Figure 9. The most recent transaction balances of just over €600 million for the €1 coin and just over €1.1 billion for the €2 coin are well above those of small and medium denominations, as one would expect. As with the latter, the declining transaction balance shares in large denominations (see Figure 5) are more than offset by the growth in circulation (by denomination). While the transaction balance for €1 coins, as well as for small and medium denominations, has been stagnating since 2008, the transaction balance for €2 coins has been rising markedly since 2004. This is due to the strong growth in the circulation of €2 coins. The share of the circulation (by value) for this denomination in the circulation of all coin denominations had risen from just over 44% at the end of 2004 to just under 50% by the end of 2011. The circulation of German euro coins (by value) is clearly dominated by the two large denominations. During the period under observation, they consistently accounted for a share of about 70% of the entire (value of the) coins

in circulation.[27] During the same period, the two large denominations' share in the transaction balance of all German euro coins rose from 65% to 76%.

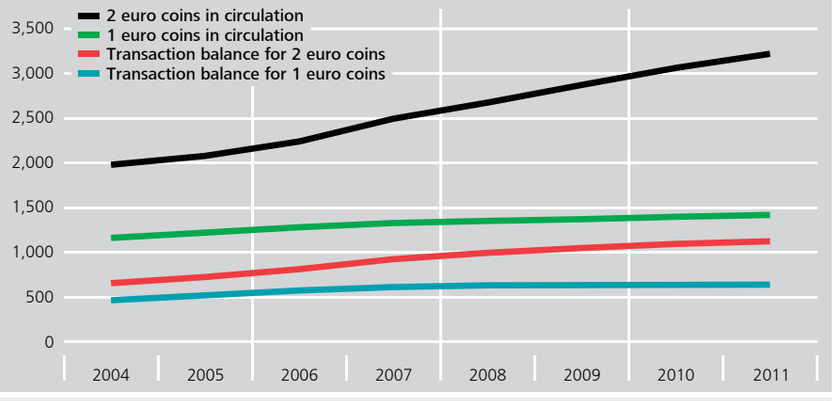
As with small and medium denominations, the transaction balance for €1 coins also makes no contribution towards the growth in the circulation of that denomination. This is different in the case of the €2 coin. Here, the rise in the transaction balance from 2004 to 2011 amounts to almost 38% of the corresponding rise in the circulation of that denomination, in any event. Therefore, structural models for estimating or forecasting the circulation of coins are still likely to be the most suitable for the €2 coin.

Following the reasoning set out in section 1, cash handling companies primarily incur costs for the processing of coins through the transaction balance, ie through coins which are "actively" in circulation.

27 Within the euro area, the share of the total circulation of coins (by value) accounted for by the two large denominations consistently stood at around 69%.

Domestic transaction balance and German euro coins in circulation in the case of large denomination coins Figure 9

million €



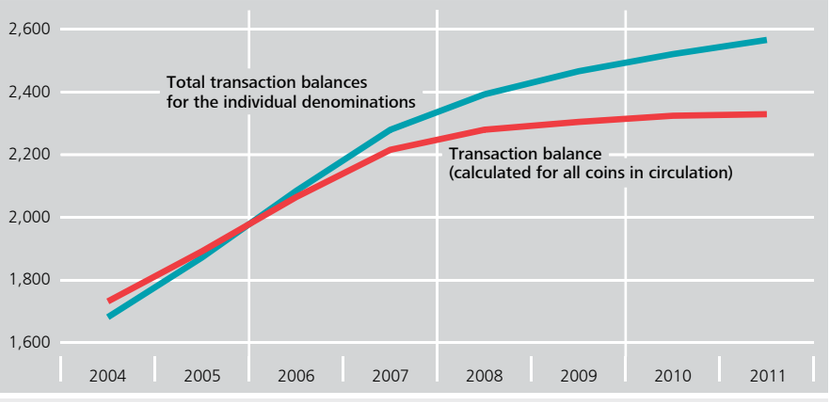
Source: Deutsche Bundesbank and authors' own calculations.

Therefore, the rise in coins in circulation (by volume) in recent years, has, all other things being equal, not been accompanied by a corresponding rise in cash-handling costs for coins. The €2 coin is the only denomination in which the transaction balance has risen in recent years. However, it accounts for a very low share of the German euro coins in circulation by volume (6% in 2011).

Finally, the (total) domestic transaction balance for German euro coins, calculated via the total (value of) coins in circulation, from Figure 6 is compared with the sum of the domestic transaction balances by denomination (see Figure 7, Figure 8 and Figure 9). Both time series should be at levels and at a chronology which are as close as possible to one another, so as to ensure that the estimates which are derived using the seasonal method are inherently conclusive.[28] As Figure 10 shows, this is also the case.

Domestic transaction balance of German euro coins: Total circulation versus denominations Figure 10

million €



Source: Authors' own calculations.

Since 2008, both series have diverged and by 2011 there was already a difference between them of about €240 million. However, in relation to the entire value of German euro coins in circulation, this difference only amounts to 3.6 percentage

28 Differences may arise, among other things, through problems in seasonal adjustments to the individual denominations. The seasonal adjustment to the entire circulation of coins (total for all the denominations) is easier.

points. The (total) domestic transaction balance for German euro coins, calculated via the total domestic transaction balances by denomination, (just under €2.6 billion) accounted for more than a 39% share of the German euro coins in circulation in 2011. The share of the domestic transaction balance, determined via the total (value of) German coins in circulation (just over €2.3 billion) amounted to just under 36% in the same year (see Figure 2).

As shown in Altmann and Bartzsch (2014, chapter 4) these estimates for the balance of German euro coins held for domestic transaction purposes according to the seasonal method are clearly confirmed by information from the introduction of euro cash.

Using surveys and statistics (direct methods), Altmann and Bartzsch (2014, chapter 5) also estimated transaction balances by sector. Due to the inadequate data situation, the cash balance held for domestic transaction purposes could not be fully recorded with this approach. The total cash balances held for domestic transactions by sector were estimated at between €0.7 billion and €1.0 billion in 2011. The single largest value was the coin balances in the wallets and purses of households at around €0.4 billion. This was followed by credit institutions, commercial enterprises and vending machine operators. The total for the (domestic) transaction balances (by sector) is thus well below the 2011 cash balance held for domestic transactions estimated using the seasonal method at around €2.3 billion. There is a frequent observation that the estimates of cash components made using direct approaches are lower than those determined using indirect approaches. This is true, for example, of the foreign demand for US currency (Feige, 2009, section 2) or of the hoarding of euro banknotes in Germany (Bartzsch et al, 2011a, section 3.3 in conjunction with Bartzsch et al, 2011b, section 2.2.2).

4 Summary, conclusions

According to our estimates conducted using an indirect method (seasonal approach), the transaction balance of euro coins in Germany rose from just over €1.7 billion in 2004 to around €2.3 billion in 2011. During the same period, the circulation of euro coins issued by the Deutsche Bundesbank ("German" euro coins in circulation) rose from just under €4.5 billion to just over €6.5 billion. Consequently, 30% of this rise is attributable to the cash balance held for domestic transaction purposes. However, while the total volume of German euro coins in circulation has grown steadily and markedly during the period under review, the time series for domestic balances has flattened out noticeably since 2008 and barely makes any contribution towards the growth of the volume of German euro coins in circulation. The share of the (overall) volume of German euro coins (by value) accounted for by the cash balance held for domestic transactions has therefore dropped since 2008 and stood at just under 36% in 2011. The declining trend in recent years could be due to the diminishing proportion of cash payments in retail trade. In addition, the share of coins in circulation accounted for by the transaction balance drops automatically due to the accrual of lost and collected coins over time.

The cash balance held in small denominations (1 cent to 5 cents) for domestic transaction purposes was very low with less than €60 million in 2011 in each case. This is in line with the low circulation of these denominations by value. The largest cash balances held for domestic transactions were accounted for by the €1 coin (€600 million of late) and the €2 coin (at just over €1.1 billion). The €2 coin is the only denomination in which the cash balance held for domestic transaction purposes is still rising significantly, unlike the other denominations which have been stagnating since 2008. The circulation of German euro coins (by value) is clearly dominated by the two large denominations. During the period under assessment, they consistently accounted for a share of about 70% of the entire coins in circulation.

During the same period, their share of the transaction balance (by value) of all German euro coins rose from 65% in 2004 to 76% in 2011.

The shares of the cash balance held for domestic transactions of the German euro coins in circulation (by denomination and by value) was 20% to 30% for small denomination coins in 2011, which is well below the transaction balance share for the total circulation (by value) (36%). This may be explained by the fact that small coins are hoarded to a greater extent in order to lighten wallets and purses, or are lost. Furthermore, they cannot be used for making payments at vending machines. The shares of the cash balance held for domestic transaction purposes for 20 cent or 50 cent coins are above average (46% and 51% respectively in 2011). These two denominations can be classed as typical transaction denominations. Unlike small denomination coins, people rarely hoard them in order to lighten their wallet or purse. Given their low face value, they are also not as suitable as large denominations to be used as a store of value.

The estimates mentioned suggest that the following conclusions may apply. Firstly, the low transaction balance share for small denomination coins (1 cent and 2 cent coins) can be used as an argument for applying a rounding rule at the checkout (to the nearest 5 cents). Small denomination coins are used relatively infrequently to pay for goods and services. The majority are likely to be hoarded in order to lighten one's wallet, or are permanently lost. In addition, as the prices of raw materials rise, there is a risk that production costs will exceed the face value of small denomination coins. Furthermore, given their large quantities in the banking industry and in the retail trade, considerable costs are incurred as a result of the counting, processing and transport of small denomination coins.[29]

29 At the end of 2012, 1 cent and 2 cent coins accounted for 50% of the total volume of German euro coins in circulation.

Secondly, with the exception of the €2 denomination, the rise in coins in circulation by denomination in recent years, has, all other things being equal, not increased in line with a corresponding rise in cash-handling costs. The latter are primarily incurred by cash handling companies through the transaction balance (coins which are in active circulation). With the exception of the largest denomination, this has been more or less constant for all denominations since 2008.

Thirdly, our results are of interest for the estimation of demand for coins or for forecasting the coins in circulation. The demand for coins essentially depends on a transaction variable (for the transaction motive) and on an opportunity cost variable (for the hoarding motive to be used as a store of value). The cash consumption defined in section 3.2 can be used as one such transaction variable in structural models. It is more difficult to find a suitable proxy variable for opportunity costs. Structural models for demand for German €2 coins are the most suitable. This is the only denomination in which the transaction balance makes a significant contribution towards the growth of the (entire) circulation. Hoarding balances play a greater role in other denominations. Time series models appear to be more suitable here.

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Jonathan Warner[1]
The future of Community Currencies: physical cash or solely electronic?

Jonathan Warner
Professor of Economics, Quest University, Canada

Abstract

Accompanying the decline in the use of cash over the past 20 years has been a revival of interest in, and development of, near-moneys – alternative, complementary and community currencies. Much of the growth has been in non-physical (i.e. non-cash or – voucher based) forms, but there are market segments where physicality is essential, making them resilient to any trend away from cash. Alternative currencies, that seek to compete with (and perhaps ultimately even replace) national currencies, are likely to become digitized. Bitcoin, despite its shaky start, seems to be gaining traction; and there is no suggestion that it needs to be anything other than digital. Complementary currencies, that seek to fill gaps that are badly served by conven-

1 Professor of Economics, Quest University Canada, 3200 University Boulevard, Squamish, BC V8B 0N8 Canada, e-mail: jonathan.warner@questu.ca.

tional currencies, such as Business to Business currencies, and business currencies such as Air miles, are only rarely physical, and, where they are, are more likely to be business-specific gift certificates, rather than a circulating medium of exchange.

On the other hand, certain forms of community currencies – local currencies designed to promote transactions within a particular area are more likely to be physical, in other words, cash. Although time-based systems, such as Community Exchange Systems, have adopted a completely non-tangible approach, currency-based community currencies (where the unit of account is set equal to the national currency) have almost invariably adopted a physical medium. For example, the Transition Towns currencies in Britain, Canada and US are all cash-based. This is because there are significant subsidiary benefits that rely on the physicality of the currency. Visibility, and saliency of an image appearing on a physical note, will build awareness, and encourage usage. In addition, the currency itself can play a part in marketing the community. Often, the group at whom the currency is aimed appreciates the physicality of the currency (and allows for the recreation of lost dominations of notes, such as the $1 in Canada, or the £1 in Britain, where coins have replaced notes in the national currency).

This paper documents the trends in physical community currencies over the past decade, and explores the reason for what appears to be a retrograde step – the use of cash. Lessons are drawn from the experience of physical community currencies to suggest that, beyond micro-transactions, there are other niche uses for which cash is likely to be attractive.

Introduction

The decline in cash as a medium of exchange has been a significant development in the evolution of money. Banking services, standing orders, direct debits, cheques, electronic transfers, debit and credit cards have all allowed people to purchase goods and services without the need for cash. As these payment methods have become ever more prevalent, cash has played an increasingly small role in facilitating transactions.

In recent years, the arrival of new payment methods and currencies such as Bitcoin and its competitors has matched the move to solely non-physical currencies of the types originally pioneered by business reward currencies. Earlier generations had trading stamps given out with purchases, and redeemable for goods and services. The largest trading stamp scheme in Britain was Green Shield stamps (given out primarily at petrol stations for purchases of fuel) which started in 1958, and survived until 1991. In the last 20 years one of the most successful types of reward currency, Air Miles, has been solely in electronic form. Even the iconic Canadian Tire currency, seen by Moody's as a "sub-fiat" currency (Babad, 2014) began moving from a physical medium to an electronic one in 2000; as electronic rewards (linked to a credit card) can be earned at twice the rate of the physical currency, the volume of the paper money printed is surely likely to decline. Indeed, rumours have been around since at least 2011 that its demise is imminent.[2]

2 The options for Canadian Tire – move with the times, and have an electronic loyalty programme (especially to match competition from Target as it enters the Canadian market) or keep the iconic paper form is nicely summed up in Strauss (2012).

Figure 1

Canadian Tire's iconic money; 5c note. Like all notes until recently, it features

A revival of interest in local community currencies (or scrip) in recent years, though, has seen an opposing trend – the development of physical currencies that emphasize the benefits of tangibility to encourage the localization of business and consumer spending. Just as business currencies are usable only at the business that issued them, so a local currency can be used only within a particular area (and often only at locally-based businesses). There are various motivations for developing local currencies – a demonstration of local identity, a way of keeping spending local, a way of avoiding big banks and the trappings of a late-capitalist economy: in part, the recent trend can be seen as a reaction to the 2008 (and ongoing) financial crisis and to a search for an alternative economic system. As such, it is largely associated with the political left.

An alternative currency is anything that can serve as a substitute for the national medium of exchange. It may aim to supplant a national currency (as the digital Bitcoin or the physical silver Liberty Dollar might have aspirations to do), or it may be more limited in scope, aiming only to facilitate some particular types of transaction. Numerous types of alternative currencies exist, so a note on terminology might be helpful. Although Jerome Blanc (2011) and Jens Martignoni (2012) have suggested different classification systems for types of community currencies, the following simplified structure will suffice for our purposes.

Classification of alternative currencies Table 1

	Local	Universal
Electronic	LETS, CES	Air Miles, Bit Coin
Physical	Transition towns	Liberty dollar/Trade dollars

It is not impossible to imagine the development of a new universal cash currency if government-issued cash were to disappear. Trade currencies, such as the Maria Theresa Thaler (still being minted, and still dated 1780 – Gervais, 1982; Tschoegl 2001); Bernard von NotHaus's ill-fated Liberty Dollar would have been able to play similar role (at least if it could have avoided running foul of US law – see Feuer 2012). But for credibility, any such currency would likely have to be backed by a trusted source: having a set amount of precious metal in the currency would, once again, be the easiest way to achieve this on a transnational scale. Liberty Dollar warehouse receipts had the ability to avoid this; but, as holders discovered when the US government raided the warehouse, they are subject to political (or legal) risk.

A complementary currency, by contrast, has no aspirations to replace a national currency, but operates alongside the legal medium of exchange. A local, or community, currency is a complementary currency designed to operate only within one area; this paper is concerned largely with such currencies. While they are of marginal significance in terms of the percentage of (local) transactions that they account for, their proponents claim that significant benefits come from them. These benefits include spillover effects on other local projects, the generation of publicity for the area, and education, both in explaining how money works, and how economic localization might benefit the area.

It is worth noting that private cash currencies, of whatever kind, are not generally a close substitute for legal tender, as generally taxes must be paid in government-approved currency. There are exceptions to this: one form of emergency currency issued by cash-strapped municipalities in the US in the depths of the Great Depression was the tax anticipation note, which was guaranteed acceptance by the local government in payment of taxes. In the interim, this meant that the notes came to circulate freely and at par with US notes (Gatch, 2012). In an interesting move, Bristol City Council has recently decided to accept Bristol Pounds for both Business rates and Council Tax.

Most of the modern local community currencies are designed to trade at par with the national currency (although they may be purchasable at a discount initially), but may take a local name (such as bucks, bits, pieces, Whistles). A minority have taken time as the unit of value, perhaps because of an egalitarian idea that each person's work time is of equal value, an idea pioneered by Robert Owen's National Equitable Labour Exchange from 1832. Ithaca, New York has perhaps the best-known modern hour-based system. But here each hour has a set monetary value in dollars, and so "hour" is more a name of a monetary denomination than a substitute basis of value.

Mention should also be made of a trend towards "currencies" for particular specialized uses. These may be just a form of record-keeping (which, some argue, preceded the appearance of physical monies) – allocating household chores, perhaps, in a way that lets prices adjust according to the relative attractiveness of the chore. (How many times do I have to clean the bathroom to make up for you making the bed each day?) And it's perhaps cooler to talk of a currency here rather than a rotating list of chores, which doesn't harness the benefits of specialization and the division of labour. Other ideas are the Belgian e-portemonnee, an electronic discount voucher system run by an inter-municipal waste disposal company, which lets local people gain discounts at municipal facilities in exchange for reducing their waste and other environmental actions (Balch, 2014). Fairfield, Iowa, experimented with "Hero Rewards" or "merits" – local people earned vouchers for working with local charities, which could be used for discounts at local merchants (Ragogna, 2011). Denison University (in Granville, Ohio) requires students to earn Denison Volunteer Dollars (by working at approved local charities) to earn money for a "tax" payable to take certain economics courses.[3]

For any alternative currency to have a chance of success, it has to pass what might be called the usefulness test. Friedrich Hayek (1976, 1978) argued that competing currencies would allow people to use ones that were most helpful for them, and this would tend to prevent inflationary over-production by issuers, as rational users would prefer a currency that is a good store of value rather than one which wasn't. Any alternative must give the user reasons for using it: as Michael Linton says, the promoters must be able to answer the question from businesses, consumers and governments, "What's in it for me?" If a currency is accepted in only a few places, perhaps solely at high-end establishments, or for goods and services that are inessential and rarely used, it will fail. A currency accepted only by the yoga teacher and the candle-stick maker (but not the butcher or baker) is unlikely to flourish. A

3 See http://denison.edu/academics/economics/denison-volunteer-dollar-program for details.

small group of people may get involved for ideological reasons; other people and businesses will need to be persuaded that the community currency gives them benefits that they cannot easily obtain by using government money. Indeed, many are the plans, but few are the successes. Wikipedia currently lists about 130 community currencies in the US and Canada, but at best only 85 of these are active. Although Martignoni (2012) reckoned that there were more than 5000 community currencies around the world, many schemes are tiny, and some are moribund. Creating and maintaining a functioning community currency is a tough challenge!

In what follows, frequent reference is made to the U.S. emergency scrip issues of the Great Depression; there are many parallels between the history of those issues and those of today. The Depression also saw the birth of the WIR network, Switzerland's parallel currency. Emergency Notgeld issues in Central Europe at the end of the First World War were produced (in overabundance) for similar reasons. I major on the UK Transition Towns currencies, a recent trend that has considerable support, with evidence from contemporary US and Canadian community currencies, and also the German Regiogeld phenomenon.

Non-physical currencies: LETS, CES currencies and Time Banks

There is no necessary reason why a community currency must be tangible, with physical coins or tokens, notes or vouchers. In fact, the first type of modern community currency, Michael Linton's pioneering Local Economy Trading System (LETS) idea of the 1980's, merely recorded transactions and members' balances, and operated without any physical manifestation. The advent of the internet has allowed for the development of similar ideas, where participants themselves do the record-keeping, subject only to an auditing oversight from the administrator. This means that modern LETS-style schemes should be more attractive and more liquid than the pioneering 1980's versions. Having a currency that is solely electronic

saves the costs of printing or minting and, possibly, legal difficulties (an electronic currency can't be a counterfeit of government fiat money). Given the decline in the significance of cash, and the lower start-up costs of non-physical currencies, one might expect a growth of these types of currency.

Work on (non-physical) Time Banks over the past decade has demonstrated their usefulness (Seyfang and Smith, 2002; Seyfang, 2004: Collom et al., 2012). Research undertaken by Miranda van Kuik (2009) for the municipality of Landgraaf concluded that to achieve improvements in poverty alleviation, care provision, social integration and the reintegration of long-term unemployed into the workforce a Time Bank-like model, with no physical medium, would be most likely to help.

Time Banks now exist in numerous countries, and, with the exception of Ithaca, almost all are non-physical currencies. The US-based website timebanks.org lists 450 Time Banks in the US and other countries; but of these, half are still "starting up" and fewer than 150 have seen time banked or traded in the past year. As with other community currencies, there is no shortage of ideas, but not many come to fruition.

Physical Currencies and the Transition Towns movement

Before the advent of LETS and computerized record-keeping, virtually all community currencies were physical. These ranged from the clearing house scrip issued in the financial panics in the United States from the late nineteenth century until the Great Depression to the various circulating cheques and notes issued by businesses and municipalities, and novelties such as wooden currency and commemorative coins, whose role was more of a one-off attempt to raise funds for a project rather than produce local economic revival. Examples from the US are the wooden currencies of Tenino, Washington (O'Cathey, 1971) and Fenton, Michigan (Hudson, 1966 p.3). Heppner, Oregon, experimented with notes made of sheepskin, and other animals' pelts, and even oyster shells, were used in other towns.

Figure 2

Slicewood emergency scrip, Tenino, Washington, USA (issue of March 1932)

In the 1980's Manitoulin Island (a Canadian island in Lake Huron) gained publicity by issuing $3 notes which were meant more as a tourist souvenir than as an alternative currency: the target market was visitors, not locals. In British Columbia, Canada, the venerable Salt Spring Island dollar, launched in 2001, has been joined by community currencies in towns and cities across the country, ranging from the large (Calgary and Vancouver) to the small. The Chemainus Dollar, launched in

2010 in a town of 4,000, aims to entice visitors to the town by featuring representations of its famous murals.

Figure 3

Salt Spring Island (British Columbia, Canada) $2 note

Manitoulin Island, $3 note of 1988

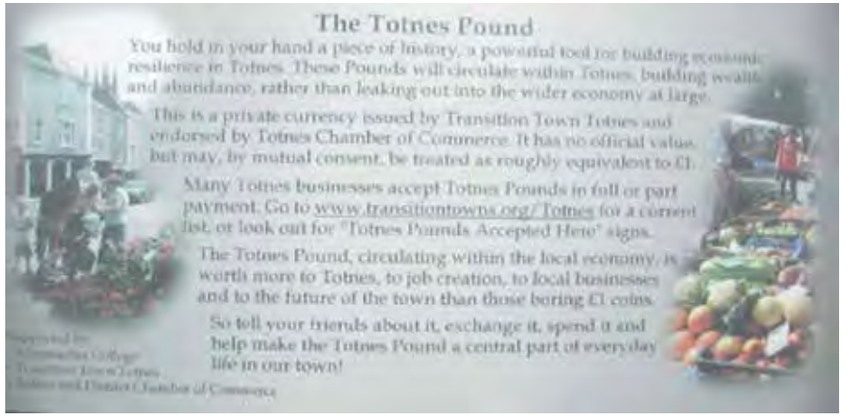
In Britain, the Transitions Towns movement dates from 2006, when Rob Hopkins launched it in Totnes. The motivation was concern about climate change, and the perceived need to develop local solutions to this and allied problems. One way to reduce carbon emissions would be to reduce the amount of distance goods had to travel to reach their ultimate consumers; local (farmers') markets selling locally-grown produce were a significant part of this strategy. Supporting a thriving local economy was seen as important to reduce travel and its associated emissions; and a way of achieving this would be to discourage the leakage of spending away from the community. If residents would shop locally, local employment would be expanded,

opening the opportunity for more businesses, in a virtuous circle that would generate local prosperity and reduce both ecological and carbon footprints of the community. A local community currency would be a way to help with the achievement of these goals in general, only locally-based businesses participate – national chain stores and supermarkets generally do not want to accept the currency. This was true of earlier schemes: most of the local Depression-era scrip plans recruited only local participants. Stores headquartered out of town, and businesses such as railway companies generally refused to participate.[4] There are now well over 1000 Transition Town initiatives worldwide, but only a small subset have produced their own local currency.

Figure 4

Totnes Pound (2nd issue) –front. The vignette on the left shows the Eastgate

4 Winnfield H Caslow, of Chicago, launched his own stamp scrip currency in 1933 as part of a campaign to encourage spending at local stores; the Iowa County Scrip scheme of the same year was challenged by people such as the newspaper editor, Merle Stone (1933), partially because it in effect allowed the railways to avoid contributing to the project by not being compelled to accept the scrip.



Totnes Pound (back), explaining the reason for the currency.

Specifically, a local currency aims to promote local trade and build community in a number of ways:

– **Strengthening the local economy:** Multiplier effects on the local economy are up to three times the size for spending in local businesses compared to spending at supermarkets or other businesses based out of town (Ward and Lewis 2002). One doesn't need a local currency to encourage people to shop local, but evidence suggests it helps. There are, of course, some downsides – keeping value in the community removes value from where it would have otherwise gone, and so has the potential to impoverish other areas. In addition, basic economic theory demonstrates that substitution of local trade for non-local (external) trade will reduce overall economic gains. Otherwise, as Tim Harford pithily puts it, prevention of external trade would be a good thing: "economic sanctions would be a blessing" (Harford, 2008).

– **Raising awareness of the possibility of local trade:** A local currency has an educative function: in bringing the idea of buying locally into the public awareness, residents will be able to make a more informed choice when they go shopping.
– **Building community spirit (enhancing social capital):** A local currency can serve to bring the community together. It is something with which residents can identify, and feel proud of. Also, communities that use local currencies can make its use a focal point for local events.

– **Reducing the area's carbon footprint:** This is the major motivation for Transition Towns participants, and often the reason for trying to encourage local economic activity by means of a community currency.

– **Creating a strong community profile:** Early adopters found that having a local currency puts the community 'on the map' and helps to attract visitors and press to the town. It also raises the town's profile should it seek to raise funds for community initiatives. (It might also attract visitors: these might come to learn about the local currency – something which guaranteed the success of Hawarden's 1932 Stamp Scrip scheme – or to learn more about the Transitions Towns movement and its other initiatives.)

(Source: Adapted for Lewes Pound 2009, p.3)

The first Transition Town, Totnes, in Devon, launched its local currency in March 2007. Lewes, in East Sussex, which serendipitously launched its currency at the time of the Lehman Bros. collapse in September 2008, is probably better known (as a result of a BBC report linking the two events). Other towns, such as Stroud followed suit; while Brixton in London and Bristol pioneered currencies in larger areas. Many other local currencies are in the planning stages.

Table 2

Location	Population	Launch	Denominations	No. Issued	Firms
Bristol	430,000	Sept 2012	£ 1, 5, 10, 20	£ 250,000 (2014)	650
Brixton	65,000	Sept 2009	£ 1, 5, 10, 20	£ 100,000 (2013)	270
Hawick	14,000	March 2010*	£ 1	£ 5,000	40
Lewes	16,000	Sept 2008	£ 1; £ 1,5,10,21	£ 33,000 (2008)	80
Stroud	13,000	Sept 2009	£ 1,2,5,10	£ 10,000 (2009)	63
Totnes	23,000	March 2007	£ 1; £ 1,5,10,21	£ 6,500 (2008)	125

* Hawick's was a demonstration project, that ran for four months, ending on 30 June, 2010. The reception by the town was lukewarm, and no further issue followed.

It should be clear from the above that there are considerable perceived advantages to having a physical medium of exchange. The Lewes Pound chose a physical medium as the notes are a "visible representation of the currency to enhance visibility and community buy-in" (Lewes Pound, 2009 p. 4). The notes themselves can be used to promote the issuer, the town and the benefits of the currency, which is harder to do with a virtual medium. Many of the more recent community currencies have attempted to blend the curio aspect (having well-designed notes, featuring locally-significant landmarks, buildings, or people to attract collectors) with a way of generating local pride and a desire to demonstrate one's commitment to buy local. Lewes, for example, rather subversively used a Figure of the revolutionary Tom Paine in the space where the Queen's head appears on English notes.[5] He at least did live for a time (1768-74) in Lewes, but one can make a local hero out of a non-resident; Chemainus' Vancouver Island, Canada) use of the artist Emily Carr is a stretch, as she never lived in the town.

5 Scottish banks which still have the right to issue their own notes, can use the design to promote Scotland or the Union with England and Wales. Penrose and Cumming (2011) detect politically-significant differences between the Figures on the Unionist Royal bank of Scotland notes, and those used by Clydesdale Bank.

Figure 5

Chemainus, $1 2010 featuring Emily Carr

Lewes, £1 first issue, featuring Tom Paine

To ensure acceptance and build confidence, most modern community currencies are fully backed by the national currency to guarantee redemption of any notes on demand. This is particularly helpful for businesses who worry they might otherwise be stuck with a large number of the notes. A limited validity (one year in Lewes), supposedly to encourage circulation is another feature that some community currencies have adopted. It also allows for an exit strategy if things don't work out.

While it is easy to set up a virtual currency (free software is available), a physical currency is more complex. The costs associated with printing and distributing the notes are not trivial: the paper used has to be of good quality, and steps need to be taken to prevent forgery. The costs of administering the currency, and enabling its sale and redemption are higher than for a virtual currency. These costs present

a considerable obstacle for those seeking to launch a physical local currency. All the Transitions Towns currencies have received grants in order to launch and maintain the schemes; none, as yet, is fully self-supporting. The other sources of revenue are a type of seigniorage (if the currency is fully backed by national currency, the amount gained from sales can earn interest in an account until notes need to be redeemed; the same is true of Scottish and other non-English banknotes in the UK), revenue from sales of notes to collectors (or those lost or destroyed), plus, in some cases, a membership fee for businesses taking part in the scheme, or a payment necessary for redeeming the notes. With interest rates at very low levels, seigniorage revenue is minimal; sales to collectors (unredeemed notes) might, in effect, be the biggest contributor to revenue for many schemes. Of Lewes' first issue, over 35% of the notes did not return; this was roughly enough to cover the printing costs.

The pilot Totnes Pound that Transition Town Totnes (TTT) issued, which was valid for three months (until June 2007) was an example of the virtue of physicality. People were able to hold in their hands a tangible, beautiful and spendable banknote. A total of 300 first-issue Totnes Pounds were given away at a public talk on financial systems, and several local businesses and shops agreed to take them in payment for goods and services. The idea developed, and further issues followed. The fourth iteration of the Totnes Pound launched in May 2014.

Rob Hopkins (2008) explains his excitement at the initial launch, in March 2007:

> It's a cool March evening in the small town of Totnes in Devon. Around 160 people are filling the seats of St John's Church for an evening event called 'Local Money, Local Skills, Local Power'. The … evening itself is something of an achievement: 160 people turning out to an event about economics, usually a subject guaranteed to stick people to their sofas tighter than superglue.

> Each person, on arrival, is given a Totnes Pound, one of 300 notes produced by Transition Town Totnes as a pilot to see how a printed currency might be received in the town. One side is a facsimile of an 1810 Totnes banknote. … I invite the audience to each wave their Pounds in the air – it is quite a sight. 160 people, Pound in hand, beginning the powerful journey of telling new stories about money, and also about the future, its possibilities and their interdependence as a community.
>
> As I stood at the front of that hall, … I felt very moved. Here was a room full of people who were positively elated, yet were also looking the twin challenges of peak oil and climate change square in the face.
>
> What might environmental campaigning look like if it strove to generate this sense of elation, rather than the guilt, anger and horror that most campaigning invokes? What might it look like if it strove to inspire, enthuse, and focus on possibilities rather than probabilities?

This initial issue was chiefly significant for its educational value, a kind of consciousness-raising exercise to suggest that something could be done about global warming. The amount in circulation is a tiny fraction of the local economy (about 0.01%) but it was very good at raising awareness of the need to buy local. And, of course, several other local currencies started, inspired by the Totnes £ (Hopkins, 2008).

Generally, with a community currency, as with the Depression-era issues, things tend to go well at first. Sometimes even too well, if too many souvenir-hunters, like the purchasers of early wooden currencies, remove notes from circulation (BBC 2008 – report on Lewes). The promoter of the Chemainus dollar, Karl Schultz, says that the prime purchase of the CH$ has come from those wanting smaller denominations for souvenirs or "novelty use." But this produces a paradox: pretty notes encourage collectors and help pay for the costs – but if all the notes disappear into collections, this defeats the purpose of the currency: it isn't being used to generate local economic value. To try to provide an attractive alternative for collectors, many of the Regiogeld systems in Germany mint special coins for collectors (Thiel, 2011 p. 18). Lewes, Bristol and Brixton all sell collectors' packs of their notes at a premium over face value as a way to capitalize on this market without undermining the purpose of the currency.

Later, though, after the novelty has worn off, the rate of circulation tends to slow, and the currency moves slowly, if at all. There are probably fewer collectors on the look-out for the notes. This, too, happened with the stamp scrip issues in the Great Depression (Warner, 2012) – given that you can do more things with real money than with a local currency, it is not a good substitute for normal money. Maintaining enthusiasm is hard: the Toronto Dollar, for example, was forced to suspend operations when not enough volunteers could be found to keep it running.

Demurrage (Gesellian money) The Chiemgauer, Regiogeld

Community currencies, their proponents say, are made to be used. They need to circulate, and, preferably circulate rapidly, in order to produce the local economic benefits claimed. One way to encourage quick circulation is to have the value of the money decline over time.

Silvio Gesell (1916, 1929) argued that money ought to decline in value over time – to correct what he saw as an inequality between sellers of goods and holders of money: sellers can sometimes be forced into selling their goods cheaply, as the quality deteriorated (think fresh produce left at the end of the day in a market); whereas holders of money face no such imperative. Therefore, he argued, money should decline in value over time, by means of a tax or price (demurrage) paid for holding on to the money. Logistically, the easiest way to do this was to require that the value of the note be maintained by affixing a special stamp on the back. In the

1930's there were numerous currencies of this kind. In Germany, Schwanenkirchen's Wara was widely copied. It had a 1% per month demurrage fee. The Wörgl, in Austria, had an 8% p.a. demurrage fee (see Lietaer, 2010). In the United States and Canada stamp scrip, promoted by Irving Fisher (1932, 1933) was put into circulation – the stamp used here implied a much greater negative interest rate than the 5.2% per annum that Gesell had envisioned; it was often 1 or 2% per week.[6] Few of these currencies were successful and most disappeared once Roosevelt started printing money in March 1933. Data collected by Hugo Godschalk (2012), though, suggests a higher velocity of circulation for stamp scrip than for conventional currency during the scrip's heyday in early 1933.[7]

Figure 6

Wara (1931) Demurrage is 1c per month (12% per annum)

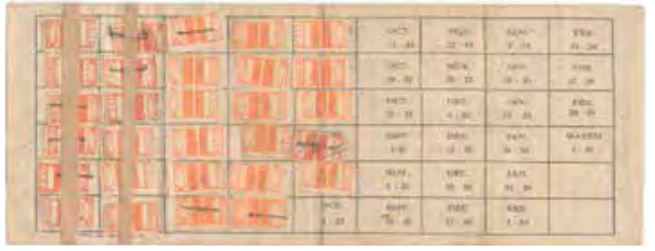
6 Unfortunately, an inferior version – transactions stamp scrip, pioneered by Joe Elliott in Anaheim, California (Warner, 2008), and more famously by Charles Zylstra in Iowa (Clifton, 1932, Buchan, 1977, Elvins 2005) gained greater salience in the US.

7 Even though most of Godschalk's examples are of the inferior transactions scrip type, the hybrid Mason City scrip (see also Godschalk 2001; Warner 2012) , which required stamping each week, or with each transaction, whichever came sooner, worked tolerably well.

Hawarden, Iowa, USA (1932) Transactions stamp scrip – one 3c stamp (3%) required for every transaction

Hawarden stamp scrip redemption stamp: 36 needed to be affixed to the back of the note before it could be redeemed.

Mason City, Iowa $1 Time-based stamp scrip (1933), front.



Red Oak (Iowa) Time-based scrip (1933). As with Mason City, a 2c stamp was required each week; with 52 needed for redemption (104% demurrage per annum)

Despite Fisher's support, Gesell's idea of a national declining currency never caught on. Instead, John Maynard Keynes (1936) built on Gesell's ideas (which he praised in Chapter 23 of his General Theory) to suggest that what mattered was not a declining nominal value of a particular note, but a decline in its real value, which could more easily be accomplished by inflationary policies. However, Gesell's idea of a declining currency has been used for certain regional and local currencies in Germany. The Regiogeld initiatives, pioneered by the Bremer Roland (2001), spread steadily: by 2006 there were 13 such initiatives (Schroeder, 2006) and, depending on how you count, up to 73 by 2011 (Thiel, 2011). Probably the best-known, largest, and most successful example is the Bavarian Chiemgauer (see Thiel, 2012), which requires stamps of 2% of the value of the note to be affixed to it every three months. Other Regiogeld have different rates of demurrage; Stroud (England, which models the Chiemgauer, see Scott Cato and Suarez, 2012) has a 3% stamp due every six months.

Figure 7

Chiemgauer, 2010 issue; one 2c stamp (2%) needed every three months (8% p.a. demurrage)

Stroud, 2009 issue; £1 note. 3p stamp required every six months (6% demurrage per annum)

In an age of negative nominal interest rates, cash becomes a better substitute for bank deposits than in more normal times; Gesellian money is a way of decreasing the attractiveness of this substitution. But it is unlikely that "extraordinary monetary policies" will include a move to a declining physical Euro. So far, the European Central Bank has limited negative interest rates to deposits held with it by commercial banks, to try to encourage them to lend, rather than park excess deposits with the ECB.

Significance: Do Community Currencies Matter?

Central Banks have sometimes worried that community currencies might undermine the national currency, and disrupt the smooth operation of monetary policy. Some states have laws on counterfeiting which cover alternative currencies. For example, the Liberty Dollar fell foul of US regulations that limit the minting of coinage to the Treasury, as directed by Congress; and in Kenya, Peace Corps volunteer Will Ruddick spent an uncomfortable few nights in jail when the Kenyan authorities decided that his Bangla-pesa was unlawful. Authorities elsewhere take a more relaxed view: paper community currencies have not had any problems in the US or the EU; in Canada they are formally classed as gift cards (which means they must be redeemable in perpetuity); in Britain, they are akin to vouchers, which rely on the good faith (and solvency) of the issuer for their redemption (Naqvi and Southgate, 2013 p.5).

Naqvi and Southgate, for the Bank of England, concluded, with classic British understatement, that "local currencies are unlikely to pose a risk to the Bank's monetary and financial stability objectives" (Naqvi and Southgate, 2013 p.1).

In practice, the size of UK schemes relative to aggregate spending in the economy is currently too small to have a significant impact on the price level or the desired path for monetary policy. Moreover, even if the schemes were large enough to affect spending at the macroeconomic level, this would not impede the Bank's Monetary Policy Committee's (MPC's) ability to set monetary policy to meet its inflation target unless these impacts were unanticipated over the MPC's forecast horizon (Naqvi and Southgate, 2013 p. 7).

Central banks, it seems, need not worry about being blown off course by community currencies; unless there is a sudden unexpected massive substitution of community currencies for national currency. It would take something like Dario Negueruela's perfect storm of concurrent crises in banking, confidence in governments, and in the values that underlie our current economic, political and social structures for something like this to happen (Negeurula, 2014).

Would-be users of community currencies are warned, though, that the notes are not legal tender, and are not backed by the Bank of England. So, if someone were to make off with the sterling that backs the Transition Towns monies, people would be left holding valueless pieces of paper.[8] So far, though, no Transition Town has reneged on its commitment to redeem its currency on demand.

Although awareness of the existence of a local currency might be high, the proportion of people using is often tiny. In Totnes, although most (88%) of respondents to a survey were aware of the Totnes Pound, around three-quarters of those had never used it. Only 0.01% of the local economy is represented by Totnes Pound transactions (Banks et al, 2010). According to Schroeder (2006) the Chiemgauer is the only Regiogeld system to achieve any economic significance. Community currencies are not about to take over the world monetary system.

But the economic significance of community currencies might go beyond the number in circulation, as the currency circulates around the local area, representing economic value each time it is used. However, calculating the multiplier effects on the local economy of a community currency is fraught with difficulty. While, undoubtedly, local spending that is recycled from local businesses to local employees and suppliers (and then back into local purchases) must have a greater local stimulus effect than spending that leaks out to other places, measuring the size of this effect (the local multiplier) is not easy. In addition, the use of a local currency won't

8 This distinguishes community currencies from those issued by banks in Scotland and Northern Ireland. Following the bailout of the Royal Bank of Scotland in 2008-09, legislation was passed that now requires Scottish and Northern Irish note-issuing banks not only to back every pound with a pound deposit at the Bank of England, but also to ring-fence those accounts (Naqvi and Southgate, 2013 p.4).

necessarily stimulate more local spending: people might just substitute spending local currency for national currency at the same (local) businesses as before. So, even if the New Economic Foundation is correct to propose a multiplier three times bigger for local rather than leaking spending, it is by no means clear that introducing a local currency would produce significant gains in local economic activity. What matters is the proportion of local spending, not the means by which it is spent. Similarly, the desire to have the currency circulate faster looks as if it would increase activity; if people merely substitute using community currency cash for using digital money, the velocity of circulation of the local currency is likely to be higher than for national currency, although it is not clear that a substitution of this kind would be a net benefit for the local economy. In addition, as it makes sense to keep your stock of an inferior asset (the community currency) at low levels, velocity of it is likely to be higher than for government-issued cash.

But as the amount of community currency in circulation is tiny compared with the volume of national currency any effects are likely to be very small. For example, the value of British banknotes in circulation is around £54 billion; in a year Bristol issued about £250,000 in Bristol pounds. Taking Bristol's population to be 430,000, this equates to just under £0.60 per person per year (whereas the stock of Bank of England notes in circulation is a little under £800 per capita).[9,10] One would expect that the velocity of circulation would be less than for the depreciating Chiemgauer (where velocity is 13.5) Even if velocity were as high as the figures reported in Godschalk (2012), where the weekly stamping necessary for the Mason City scrip implies a minimum velocity of 52 for rational actors, this would still mean only £30 per capita of spending accounted for by the community currency. Gross Value Added in Bristol in 2012 was £11.7 billion, or £27,300 per capita. Transactions in Bristol Pounds would account for 0.1% of this. Even if the velocity calculation were wrong by an order of magnitude, and all Bristol Pound spending was new local spending, the boost to the local economy would still be less than £300 per capita per year. Only the venerable Swiss WIR (16% of spending in Switzerland) and the Chiemgauer €1920 per member, or just under 5% of the average per capita Bavarian GDP, reach any level of significance; and, as a percentage of GDP, total Chiemgauer spending in Bavaria is less than 0.002%.[11]

9 Of course this figure is probably an overestimate: not all currency in circulation, especially larger-denomination notes, actually circulates, and some may still be used overseas. Adding in Scottish and Northern Irish bank notes increases the total stock of banknotes in circulation by about 10%.

10 In 1933, the bottom of the Great Depression, Willis and Chapman (1934 p. 15) estimate that there was about $1 billion in various kinds of scrip in circulation (see also Friedman and Schwartz, 1963, pp. 322-25). The value of notes and coins in circulation was about $5.7 billion, so scrip represented perhaps 15% of the cash-money supply. The $1 billion of scrip would represent around $8 per capita, or just over $100 per capita in today's money. But the comparison is misleading: much of the scrip, in terms of value, was represented by emergency clearing house certificates that were used mainly for interbank settlements.

Figure 8

11 Over the period 2005-13, the Chiemgauer organization donated €335,000 to charity. While this is certainly significant to the recipients, it is trivial when compared to the over one billion Euros Bavarians give to non-profits each year.

Two examples of Bristol pounds (UK)

Demurrage should reduce any benefits: Rösl (2006) estimates the welfare costs of a universal Chiemgauer replacing the Euro to be in the region of €130 per capita per year. The declining value of the currency would increase velocity, but the benefits of this are exceeded by the (utility) losses from the demurrage, which, in effect, has the same result as a higher rate of inflation.

Community currency schemes may have non-economic benefits in terms of empowerment, building social capital and generating a strong community profile (as their promoters argue); as far as macroeconomics is concerned, they are insignificant.

The Future of cash community currencies

To judge from news reports of new initiatives (at the time of writing, a "Colne Quid" has been slated for launch in East Lancashire in early August and a feasibility study for a Cardiff local currency has just been launched)[12] the future for physical community currencies looks bright. But most proposed currencies die on the drawing board, as the impediments to their introduction become apparent, and/or seed financing is not forthcoming.[13] Those that do make it into circulation tend to follow the pattern of the 1930's scrip schemes: initial enthusiasm followed either by collapse, or, more commonly, a gradual withering away. Every so often, though, one breaks through and receives ongoing media attention. This makes the future of community currencies hard to predict. The unlikely success stories of the Chiemgauer and Lewes Pound are testament to the fact that local pride, having a currency to call our own,[14] can trump more rational cost benefit analyses.

Although there is a trend away from cash even within community currencies, physicality remains important, as explained above. Until it's possible to wave virtual notes, or put Figures on them, the "postcard" function of physical community currencies will continue to exist, and attract collectors.

Experiments with community currencies will doubtless continue, and local pride may be harnessed to create local souvenir-you-can-spend money in areas that want to attract visitors. They may be useful for education as well – a form of "play money" that has pretensions to usefulness. Some currencies encourage the maintenance of a physical form because local businesses are prepared to offer discounts for people using the local currency. This might make good business sense if it can be used as a form of price discrimination between locals and out-of-towners (and may be cheaper than issuing business-specific discount coupons); but as the local currencies are not hard to obtain, the discrimination might not work. It is, however, unlikely that there will be further development of big cash-based community currencies unless they also offer both an electronic option of some kind, and strong

12 East Lancashire town set to pioneer new currency, Lancashire Telegraph July 9, 2014; 'Cardiff pound' feasibility study launched, BBC news July 29, 2014 http://www.bbc.co.uk/news/uk-wales-south-east-wales-28539490 . But the Colne project has been delayed, and now hopes to launch in time for Christmas 2014, and little progress seems to have been made on the Cardiff Pound.

13 The long list of the stillborn includes the Squamish and Dunbar dollars in BC, and the Milton Keynes pound in England.

14 These words formed the title of a newspaper report (Robertson, 2010) on the proposed Squamish dollar, which, although conceived in 2010, has yet to be born.

support from local government (i.e. grants to get them started and to keep them going, and/or the ability to use them to pay taxes).

In any case, if community currencies were so great, wouldn't we expect there to be more of them, and that they would be self-sustaining? In Britain, where there is considerable support for the idea, only the five transitions towns mentioned above have persevered with their currencies; despite plans for local currencies in Milton Keynes, Edinburgh, and other cities, none has yet left the drawing board.[15] The problem is that it takes a lot of time and effort to launch a currency, and also its ongoing operating costs. Covering these is difficult. LETS and CES currencies tend to compensate their administrators by levying a fee on transactions within the system.[16]

15 The "Colne Quid might be close, though: see Shoppers given first glance at new 'Colne Quid' Pendle Today 19 October, 2014 – see http://www.pendletoday.co.uk/news/shoppers-given-first-glance-at-new-colne-quid-1-6898707.
16 See CES Concepts https://www.community-exchange.org/docs/CES_concepts.html#5; the standard rate is 4% of a transaction's value, 2% from both the buyer and seller.

If the LETS or CES is small, and trades solely in "hobby" services, the transaction levy is often smaller than the tax that would be payable if the national currency is used. But any transaction levy is salient – for countries where prices are quoted sales-tax (or VAT) inclusive, the fee may add extra friction and reduce transactions; in addition, amateur hobby services may be inferior substitutes for professional services.

For Transition Towns and Regiogeld currencies, tax must be included in prices charged (and income tax on the surplus of revenue over costs) – community currencies are not a legal tax avoidance mechanism. Therefore, unless the currency reaches a sufficient volume of transactions so that the administrative costs can be covered by earnings through seigniorage, or the costs are swallowed (either by a membership fee on businesses or an encashment fee when local currency is changed into national currency, or by a bank or credit union acting as clearer for the system) it is hard to get a physical currency to be self-sustaining. Overcoming low levels of usage and high costs remains a challenge for all the Transitions Towns currencies.

Much of the cost comes from handling the physical currency. Retailers and banks need bigger tills, and the national and community currencies will need to be counted separately at the end of each day.[17] Given that non-cash transactions are continuing to grow in importance, it is not surprising that users of community currencies want the same convenience. Four of the five Transition Town currencies either have electronic versions of the currency (Bristol, Brixton's pay-by-text) or are talking about introducing it soon (Totnes, Lewes). Competing with rewards-giving credit cards is particularly challenging for a physical medium. (Lewes experimented with a Lewes pound cash-back scheme for local purchase paid for by any means in

17 In 2011, the Squamish Credit Union estimated the costs to them of clearing Squamish Dollars would be around $700 per month.

2011). In Germany, 70% of Chiemgauer transactions are made electronically (Thiel, 2012), suggesting that the physical currency may not long survive. In effect, electronic versions of community currencies are reloadable visa or gift cards. An attractive Figure and logo may attract users, but there will be less scope for different designs than with a physical currency that has a number of differently-denominated notes. This would probably deter collectors, but would do little to increase local spending.

Conclusions

Tangible community currencies work better where the economy is cash-based: physical community currencies not surprisingly seem do better in places where people are unbanked and electronic money is not an option. The Banca Palma model (which predates most of the modern European and American currencies) has flourished in the favelas of Brazil's big cities. As it is bank-based, it also has a non-tangible form, which may, in time, cause the physical form to fade away.

For the unbanked poor, however, cash is still king. The local currency in Santisuk Thailand is used, it is claimed, for 10% of transactions (Hookway, 2009; Walker, 2009). A recent cash community currency success is the Bangla-Pesa, developed for the Bangladesh slum in Mombasa, Kenya. This obtained significant publicity when Mr Ruddick was arrested for fraud and destabilizing the Kenyan Shilling. An about-face by the Government saw a minister attend the re-launch. For the Bangla-Pesa Michael Linton's "what's in it for me?" question is easily answered: businesses that sign up (mainly women entrepreneurs with microbusinesses) receive a credit of 200 Pesa. Circulation reached 10,000 Pesas (about $210) a day in mid-2014 (Mghenyi, 2014). Small beer, perhaps, but still useful to people living on less than $2 a day, especially as the project reports that member businesses have seen

sales rise by 22% since the Bangla-Pesa was introduced; this seems to be new business, as sales in Kenyan shillings have remained the same.[18]

Figure 9

Bangla-Pesa (Mombasa, Kenya) five shillings note

Banco Palmas (Fortaleza, Ceara, Brazil) 10 palms note

18 Interestingly, Kenya is home to the M-Pesa payment system, which has led the way for money transfers and mobile banking in Africa. This, in time, could underline the Bangla-Pesa. Also, Mr Ruddick's attempts to raise seed financing for similar projects elsewhere in Kenya seem to have failed.

Where there is no alternative to cash, and official currency is scarce, community currencies have the best chance of success. This is also borne out by a study of the various Great Depression scrip issues: once more government money started to reach people, the attractiveness of clunky substitutes like stamp scrip quickly waned. Similarly, as electronic money becomes more attractive and cash declines in significance, so will tangible community currencies. But just as many mints will continue to issue special commemorative coins, so community currency promoters will continue to issue notes and coins for collectors. And, given the perceived ability of community currencies to build social cohesion and instil local pride, as long as merchants are willing to accept cash, community currencies will continue.

There is one other possible spur for physical community currencies. Suppose (official) cash were to disappear through government order: would there be a rush to produce physical community currencies (or wider-ranging universal alternatives)? Initially, there would likely be considerable resentment about the disappearance of cash, and perhaps an attempt to find an alternative. Attempts to change the coinage and currency, except after a bout of hyperinflation, are never popular. For example, in 1983, the UK's Royal Mint decided to phase out the £1 Bank of England note, issuing a coin and ceasing to produce the note a year later. There was a flurry of interest in finding a substitute, and Scottish £1 notes appeared in significant numbers south of the border, but their life was short. People grumbled, but used the coins, and the Scottish notes disappeared again.[19] Similarly, Canada successfully introduced the "loonie", the one-dollar coin in 1987, despite dire warnings that it would not be accepted.[20] It is perhaps notable, though, that all the Transition Towns currencies have a £1 denomination, just as Canadian community currencies have a $1 denomination.

19 Alan Franks (1985) chronicles the demise of the pound note; one-third of the pound notes in a London bar's till were Scottish. In addition, a small Cornish company, Polyplus Laminates, offered to laminate the €1 notes so that they would last indefinitely (Times Diary, April 21. 1983); Even Mrs Thatcher, not noted for policy swings, said the note might be retained if the coin was very unpopular (Dec 23, 1983); Stephen Petty wondered if it were all a plot to get Britons to spend more (Stephen Petty. "First Person." Times [London, England] 25 Feb. 1985: 13). But by 1986 the coin was accepted, pound notes had disappeared and the world did not come to an end.

On the other hand, there are other issues that make physical notes problematic. Producers of notes fight an ongoing war with counterfeiters. As community currencies have not generally needed to be as secure as national currencies, would counterfeiting them be attractive? Although imitation is the sincerest form of flattery, attempts to forge scrip and community currencies have been few, but counterfeiting would be a measure of their desirability. Someone in 1933 Detroit did counterfeit the City's June issue of scrip, but the quality was poor, and the counterfeits easily spotted (Mitchell and Shafer, 1984 p. 117). More recently, there have been two attempts to counterfeit Canadian Tire money – one in Germany and one in Armenia. Both perpetrators were easily caught – travelling to Canada with $11 and $45 million respectively in Canadian Tire Money was more than a mite suspicious. The take-home message is this – if you're a professional forger, go for national notes; if you're an amateur, counterfeiting even a community currency is unlikely to be successful.

One other form of flattery is to have your currency used beyond its intended area. This has happened for some widespread business currencies – airlines sell air miles to credit card companies for use as rewards for their customers, and the Air Miles themselves can be spent on a variety of goods and services beyond air tickets. A few businesses, such as a liquor store in Edmonton have accepted Canadian Tire money. (Montgomery, 2006). MacLeans magazine also reported that Toronto musician Corin Raymond was able to crowd-fund a music album ("Paper Nickels") with Canadian tire money; while tourists in Jamaica found they could buy trinkets

20 See: Canadian govt. may be courting disaster with dollar coin, Ottawa Citizen 19 August 1985 p. A 12

from a handicraft vendor with it (he had family in Canada).[21] On the other hand, it seems that Brixton drug dealers are more likely to accept Bitcoin than Brixton pounds (Cathead, 2013).

These anecdotes, combined with the analysis and stories of the previous sections, all suggest that community currencies are not good substitutes for regular cash. If regular cash were to disappear, any boost to them would likely be small. Conversely, as cash becomes less significant, community currencies themselves are likely to be squeezed out, unless they produce an electronic version.

However, it is worth returning to Michael Linton's question. Why would anyone use a physical community currency? For merchants, there are benefits if, like the Bangla-Pesa, the currency generates additional business. If people want to use it, and differentially choose businesses that accept the physical notes, then merchants have an incentive to accept them, and cash community currencies will continue, if not flourish. For consumers, the arguments put forward by the Transitions Towns movement and the Regiogeld proponents have some traction. Certain people like using a local currency. If this group overlaps with people who like using cash, then community currencies will survive, albeit as marginal and economically insignificant forms of money.

21 See the report at http://www.macleans.ca/society/life/7-surprising-things-bought-with-canadian-tire-money/

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Boryana Madzharova[1]
The impact of cash and card transactions on VAT collection efficiency[2]

Boryana Madzharova
University of Erlangen-Nuremberg, Germany

Abstract

Using EU country-level data, this paper investigates the connection between transactions' payment method and tax compliance in the context of the Value-added tax. Intuitively, the visibility of card payments by third-party institutions can serve as a deterrent to sales under- reporting and other evasion strategies. Countries like the U.S. and Turkey have already implemented policies directly utilising electronic payments as a tax control instrument. Estimates based on the European data do not find a statistically significant effect of cards on VAT performance, but do show that cash usage has a negative impact, a result that remains robust to a wide range of controls and specifications. It is further demonstrated that the relationship between

1 Post-doctoral fellow, University of Erlangen-Nuremberg, Chair of Public Finance, Prof. Dr. Thiess Buettner, Lange Gasse 20, Nuremberg 90403, e-mail: Boryana.Madzharova@fau.de
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cards, cash and the VAT revenue ratio is best modeled via a second-order Taylor approximation. The role of standard and reduced VAT rates, turnover thresholds and exposure to trade is also explored.

1 Introduction

Due to technological progress and the introduction of new methods of payment, tax administrations face new possibilities of improving tax enforcement, while firms devise creative opportunities for tax evasion. Nowhere is this trend more pronounced than in the case of the value-added tax (VAT). Ainsworth (2011) points out that the supply of goods and services, the movement of the supply and funding in the context of carousel VAT fraud are already entirely digitised. Given the enormous estimated losses of VAT revenue, radical proposals for fraud prevention are not infrequent. Examples range from VAT withholding, which would split the VAT amount from the taxable amount in real time, thus eliminating both firms' access to VAT and voluntary compliance, to data mirroring of companies' hard disks for tax control purposes as advanced in a bill by the Danish Ministry of Taxation (PriceWaterhouseCoopers, 2010; Skatteministeriet J. 2010-711-0044, 2010).

A common factor among these proposals and recent developments in tax enforcement policies in general, is the move to discourage business/customer cash transactions in favour of electronic payments that are more easily monitored, and hence constitute a strong incentive for compliance. The deterrent effect of card transactions on tax evasion, however, is yet to be established in the economic literature. Recently, Hasan et al. (2012) provided some preliminary evidence that retail electronic transactions, and especially retail card payments are positively correlated with GDP per capita growth, consumption, and trade. Whether a similar effect exists between electronic payments and tax compliance remains a largely unexplored question.

The empirical literature on VAT thus far has primarily studied the effect of standard and reduced rates (Bogetić and Hassan (1993), Agha and Haughton (1996), Engel et al. (2001)), and the quality of tax administrations (de Mello (2008)) on VAT's performance, predominantly using a large cross-section of countries. A more recent panel data analysis performed by Aizenman and Jinjarak (2008) focuses on levels of urbanisation, trade openness and some political variables as determinants of VAT's collection efficiency.

While controlling for most of the variables used in the above studies, this paper further investigates if there is any association between method of payment and VAT's revenue outcomes. Using country-level panel data for 26 EU countries in the period 2000-2010, I find that the relationship between both cash and cards and the chosen VAT performance ratio is non-linear, even after controlling for the number of ATMs and point of sale terminals (POS) per million of inhabitants, the VAT rate, and other explanatory variables. In particular, this relationship is convex in the case of cash, measured as the share of ATM cash withdrawals in GDP, vis-à-vis VAT revenue as a proportion of net consumption, and concave for card transactions (share of total card transactions in GDP).

The empirical analysis does not demonstrate a statistically significant relationship between VAT revenue and card usage, but shows the consistently negative impact of cash, whose effect can turn positive in countries with high preference for cash transactions. While it is possible that there is simply no connection between cards and VAT performance, this lack of correlation can also be attributed to the fact that electronic payments are not an explicit tax control instrument in the EU, as is the case in the U.S. and Turkey, for example. Despite the insignificant results for cards, POS terminals are shown to affect the VAT-to-consumption ratio positively in almost all regressions.

These findings are robust for both low- and high-income member states, and hold for alternative dependent variables. They are also unaffected by the inclusion of additional control variables. Although a different specification strategy, in which the VAT rate is considered endogenous and is hence, instrumented for, yields higher coefficients in absolute value, the results remain qualitatively the same. Nevertheless, since the study is limited to 26 EU members, its findings are likely specific.

The paper is organised as follows. The next section discusses the specific role electronic payments play in tax policies targeting compliance. Section 3 describes the data, the estimation strategy, and examines the results. Concluding comments are presented in Section 4.

2 Role of Electronic Payments in Tax Policy and Enforcement

The retail sales of a firm can generally be split into two categories based on the method of payment chosen by the consumer: electronic payments via credit/debit cards or mobile devices (m-payments), and cash payments. The former have an almost 100% probability of detection if an audit is instigated, since a record of the transaction exists and can be cross-checked through third-party reporting, while the latter are easily manipulated and evaded. In fact, for resourceful retailers the probability that the tax authorities would uncover cash sales evasion has decreased substantially with the invention of Zappers – add-on programs in electronic cash registers (ECR) or point of sales systems, which skim sales and simultaneously re-number and re-calculate the records of the remaining invoices, thus creating consistent financial statements (Ainsworth, 2010). Even if a retailer is unaware of the evasion opportunities arising from Zappers, Ainsworth, (2012) notes that an operation conducted by the US Department of Taxation and Finances, in which false restaurants were opened with the goal of soliciting tenders for ECR, showed that 70% to 80% of the sales representatives actively marketed sales deletion software.

With regard to electronic payments, the firm's knowledge that transactions are recorded by banks, credit card companies, mobile operators or others can serve as a major deterrent to evasion and as a tool to diminish the tax gap.[3] This was the objective of adding Section 6050W to Title 26 of the US Code in 2008 (in force from January 2011), which requires banks, third-party settlement organisations, and other organisations with contractual obligations in the settlement of payment cards to send annual reports to the IRS containing information on payments made to merchants via debit/credit cards or certain electronic means. The IRS can use this data to match merchants' sales with the ones reported on their tax returns (Treasury Inspector General for Tax Administration, 2011).

A similar policy is in place in Turkey. According to Dogan (2011), since 2008, Turkish businesses can check their monthly credit card sales online when preparing their VAT returns. If there is a discrepancy between the company's records and the online statement, the firm can ignore the discrepancy provided it can furnish an explanation; otherwise it will be subject to an audit. Before the implementation of the system, 140,000 taxpayers did not report any credit card sales in their VAT returns and 60,000 had deviations in more than 20% of their transactions. One year later fewer than 20,000 had a discrepancy rate of over 20% (Dogan, 2011). It is unclear, however, how issues of data protection and privacy, as well as compliance costs incurred by merchants are to be addressed by the US and Turkish policies.

Effective taxation hinges crucially on the availability and processing of information. The rise in cashless retail sales means that complete information exists for the fraction of firms' retail transactions executed electronically. Thus, while businesses act

3 In a randomised enforcement experiment studying evasion responses of individuals, Kleven at al. (2011) show that in Denmark evasion is modest for personal income subject to third-party reporting, and considerable for self-reported income. The advantages of third-party collection – withholding employees' PIT and collecting it from employers – versus self-declaration are, for example, explored in Dusek (2003)

as collectors of VAT for the tax authorities, at the retail stage of VAT collection, customers increasingly become the enforcers. Clearly, the substantial wedge between the probabilities of detection of suppressed cash and electronic transactions can induce firms to hide more of their cash receipts to compensate for their inability to cheat elsewhere. In a laboratory experiment conducted by Johnson et al. (2009), for example, tax revenues declined by 15% when participants were told that part of their income would be perfectly monitored by the tax administration but that they had the opportunity to transfer income from the monitored to the unmonitored source at a cost. Even if transfers were not allowed, reporting rates remained similar to the baseline case without perfect monitoring, suggesting that taxpayers would find a way to adjust to tax policy changes in order to maintain their preferred level of tax compliance (Johnson et al., 2009).

In general, a firm cannot switch easily between monitored and unmonitored sales as it faces exogenously given demand for the methods of payment, which is determined by consumers' preferences for anonymity and convenience, the amount of transaction fees, and other factors. Nevertheless, if the firm is a monopolist it can use cash discounts as a means of price discrimination, a possibility explored by Gordon (1990). Alternatively, provided that the customer initiates bargaining for a price reduction, as modeled by Fedeli (2003), then the chosen method of payment will depend on the customer's intention to evade VAT.

To prevent collusion between retailers and customers, tax administrations resort to various policies. In Italy, for example, upon leaving a restaurant, hotel, or a bar, a consumer may be required by the police to produce a fiscal receipt showing the VAT paid. Failure to do so, results in a fine (Tait, 1988). Gordon (1990), however, demonstrates that shifting part of the liability for unpaid taxes onto consumers can increase tax evasion, since the firm has to cut its cash price to maintain cash sales demand constant.

A superior strategy is to align the incentives of the final consumer and the tax authorities, especially in areas that are notoriously hard to tax – the businesses of plumbers, builders, electricians, etc. Instead of establishing a reduced VAT rate for renovation and restoration of private dwellings, Denmark allows 15,000 DKK (≈ €2000) per person per year, which is spent on renovation, to be deducted from the personal income tax (PIT). In order to qualify for the deduction, a household must have paid for the services via a card or a bank (cash or check payments are not eligible) and present a detailed documentation about the supplier and the services performed.[4]

Although the scope of this policy is relatively limited, in a nutshell it contains several essential elements, which can be useful for broader tax purposes: 1) It demonstrates that the effect of reduced VAT rates can be successfully achieved through the interaction of tax bases, in this case through deductions in the PIT, while avoiding further complexity in VAT; 2) Despite the loss of tax revenue as a result of the deductions, the tax administration can obtain a very clear picture on the amount of VAT and income evasion in this predominantly cash-based sector. It can do so by comparing revenue before and after the introduction of the policy, taking into account the possibility that the tax policy itself could have increased the demand for home renovations; 3) Last, and possibly most importantly, the policy, even if of temporary nature, roots out the use of cash in an industry, where cash payments are practically entrenched. It is worth pointing out that while such measures can be effective in countries with high PIT rates relative to VAT, which makes deductions worthwhile for the consumer, most Central and Eastern European (CEE) countries, for instance, have flat PIT schemes below the standard VAT rate, so that VAT evasion remains the more profitable option.

4 Details on the conditions, requirements, and services covered are available on the website of the Danish Tax Authorities (in Danish): http://www.skat.dk/SKAT.aspx?oId=1947018&vId=0#os

Overall, the final consumer's choice of a payment instrument can be a powerful enforcement measure if card payments on retail level become the norm, as they already are in several EU countries. While a large part of the public will continue to adopt convenient, secure, and innovative cashless payment methods as they become more and more widespread, tax policy clearly has the means to considerably reinforce this trend through monetary or other incentives.

3 Data

To check if the method of payment matters for tax compliance, I use a small unbalanced panel dataset for 26 EU countries, namely Austria, Belgium, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and the UK for the period 2000-2010.

The main dependent variable is the VAT Revenue Ratio (VRR), which is a measure of the performance of countries' VAT regimes. The V RR is the ratio of actual collected VAT revenue to net consumption, divided by the standard VAT rate (SVAT). Net consumption is item P3 in the National Accounts minus VAT revenue. In the literature, VAT performance ratios differ given the economic base they assume for VAT. The Efficiency ratio, used for example by Engel et al. (2001) and Bogetić and Hassan (1993), scales the consumption-type VAT revenue by GDP, which would have been the tax base if VAT were a gross-product based tax, under which firms cannot deduct expenditure on capital goods from sales when computing their value-added (Department of the Treasury, 1984).

If the goal is to estimate the extent to which exemptions, reduced and zero rates, and avoidance/evasion activities erode VAT revenue collection, a more appropriate indicator would be the C-efficiency ratio, $\frac{VAT\ \text{Re}venue}{Final\ consumption * SVAT}$, whose denominator captures the potential tax base given a single VAT rate, no exemptions and full

compliance. This was the chosen performance variable in Ebrill et al. (2001), Aizenman and Jinjarak (2008), and de Mello (2008). The C-efficiency ratio, however, understates VAT's collection capacity since the National Accounts compute consumption inclusive of VAT, at market prices. Therefore, VAT revenue should be subtracted from final consumption in the ratio's denominator, resulting in an improved measure, VRR. Chapter 4 of the 2010 edition of OECD (Various Years) discusses the VRR in detail and proposes steps towards its further refinement.

The VRR is a combination of two efficiency ratios, the Policy efficiency ratio, which demonstrates the degree to which current VAT legislation deviates from a uniform tax on consumption, and the Compliance efficiency ratio – measuring compliance (OECD, Various Years). For the purposes of my estimation, ideally I would use the Compliance Ratio. It, however, entails the calculation of the theoretical tax revenue from actual tax law, or VAT revenue under full compliance, which is a daunting task, inevitably prone to error, and thus far attempted only by Reckon LLP and by some individual countries' tax administrations.

To better understand fluctuations in VRR, one needs to take a closer look at the specific legislative changes affecting the actual tax base in a given country. In terms of rates coverage and exemptions over the 2000-2009 period, very few changes with a likely minimal impact on revenue occurred in the tax bases of Austria, Belgium, Germany, Denmark, Netherlands, Finland, Italy, Luxembourg, Ireland, Sweden, and the UK, while in Spain there were no changes at all as shown in the Appendix. Out of these countries, Germany, Netherlands, Finland, Ireland and the UK increased the standard VAT rate modestly.

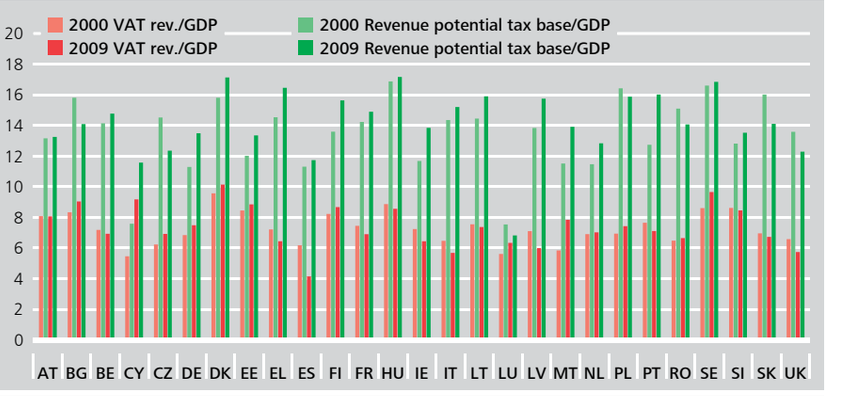
The CEE countries were the major VAT reformers, mostly due to their accession in the EU. The Czech Republic, and especially Hungary, expanded and changed VAT's coverage considerably in order to comply with the list of goods and services, which can be subject to reduced rates as listed in Annex H to the Sixth VAT Directive.

Nevertheless, the new member states negotiated various derogations, most of which expired in 2010. Given its aggressive base expansion, and despite having a 5 percentage points (pp) lower standard rate in 2006-2008 compared to previous years, Hungary raised SVAT back to 25% in 2009. Narrowing of the VAT tax base is observed in France, Portugal, and especially Greece. SVAT in Greece and Portugal grew by 1 pp and 3 pp from 2000 to 2009 and then by further 4 pp and 1 pp in 2010, respectively. Registration thresholds are generally higher in 2009-2010 in Western Europe, and especially in Ireland and the UK, whereas in CEE they decrease, albeit from a very high level.

In Figure 1, the dynamics of actual VAT revenue (VRR's numerator) as a % of GDP in 2000 and 2009 is compared to revenue from the potential tax base under a single VAT rate, no exemptions and full compliance (VRR's denominator), again as a % of GDP. Five countries stand out due to large falls in $\frac{VAT\,\mathrm{Revenue}}{GDP}$ % and simultaneous increases in the potential tax base receipts driven by jumps in SVAT and/or stronger final consumption – Spain, Ireland, Latvia, Greece, and Portugal. While the reduced revenue in Greece, Portugal and Ireland may be due to the possibility that the base narrowing effect of VAT reforms outweighed the increase in rates, the 2.03 pp drop in collected VAT to GDP in Spain in 2009 is hard to explain, given that there were virtually no alterations in VAT's legislation since 2000 and no major fluctuations in consumption. Revenues stabilised at 5.5% of GDP in 2010, after Spain raised SVAT by 2 pp. One possible factor behind the revenue decline may be the 15% decrease in the number of VAT registered traders and the overall effect of the financial crisis. In Hungary, however, in spite of a significant base expansion accompanied by higher SVAT and reduced rates, revenue fell by 0.30 pp suggesting that compliance issues may be at play.

Comparison of actual VAT revenue with revenue from a potential tax base Figure 1

As a % of GDP: 2000 vs 2009



Standard VAT rate.
Note: Revenues from a potential tax base equal (Final consumption - VAT rev.)

To distinguish between methods of payment, the main explanatory variables used are the value of card transactions by all cards issued in the reporting country and the value of ATM cash withdrawals (again pertaining to cards issued in the reporting country) both sourced from the ECB's Data Warehouse. ATM cash withdrawals are an imperfect measure of cash transactions, but they are by no means an insignificant one. ATM cash ranges from 30% of GDP in Estonia in 2001 and similar high values in other Baltic countries to less than 2% in Denmark. In fact, ATM cash withdrawals nearly perfectly coincide with Denmark's currency in circulation, once I exclude the value of the largest banknote – 1000 DKK, which is rarely used for retail payments.

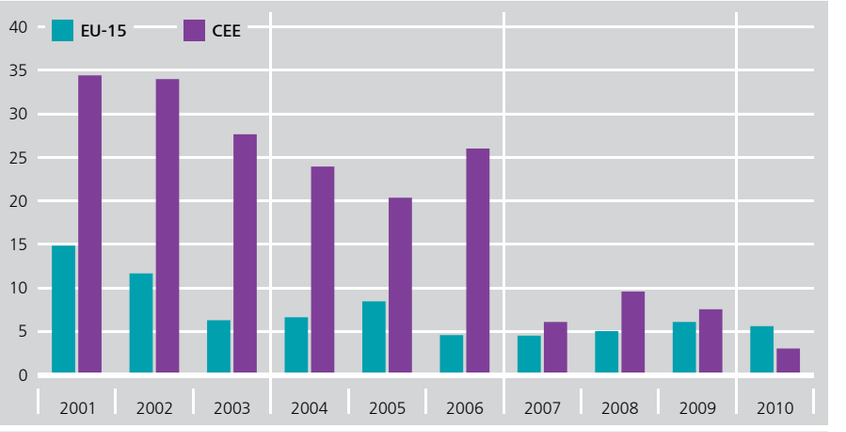
Figures 2 and 3 show the growth rates of $\frac{Cash}{GDP}$ and $\frac{Cards}{GDP}$ separately for CEE and the so-called 'Old' member states (EU-15) covering Austria, Belgium, Germany, Denmark, Luxem- bourg, Finland, the UK, France, Italy, Sweden, Malta, the Netherlands,

Ireland, Portugal, and Spain. After 2004, a convergence in the growth rates of cash and cards occurred for the two regions of Europe, with card transactions growing by more than 30% per annum in CEE before 2005 and less than 10% after 2006. Cash growth was negligible and negative for the EU-15, and turned negative in CEE only in 2010. Cash withdrawals, however, remain a very stable share of GDP in most EU economies as is clear from Table 1. Additionally, the mean value of the number of ATMs ($\frac{ATM}{POP\,M}$) has increased steadily, while point of sale terminals ($\frac{POS}{POP\,M}$) per million inhabitants have more than doubled from 2000 to 2010. The majority of the POS terminals are EFTPOS (electronic fund transfer at point of sale) terminals for debit and credit cards.

In principle, it would have been optimal to additionally include over-the-counter (OTC) cash withdrawals in the measure of cash, but this variable is available for a very limited set of countries (the Czech Republic, Greece, Germany, Spain, Finland, UK, Hungary, Italy, Latvia, Netherlands, Romania and Slovakia) and only for some years between 2000 and 2010. OTC transactions and ATMs are the two major sources of cash to the public, and hence the main indicators of retail payments done in cash. OTC withdrawals in Greece are several times higher than GDP, suggesting that they include additional payments, which are not mentioned in the description of the variable. For this reason, Greek data is not considered in Figure 4. Such high values apply to the CEE region in general, with OTC withdrawals being 52% of GDP on average compared to only 12% in the EU-15 countries, for which information is available. Even though the data should be viewed with caution, it is useful to see how OTC withdrawals change, especially in light of the fact that both ATM cash withdrawals and card payments grow as a percent of GDP, at least in CEE.

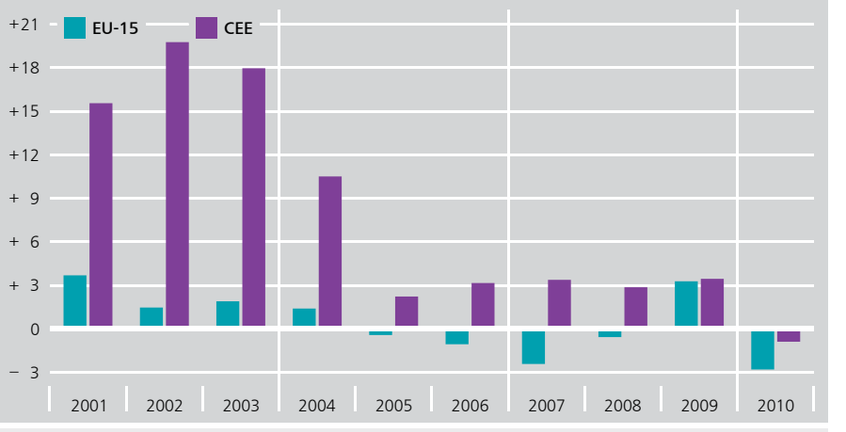
Growth rate of value of card payments Figure 2

As a % of GDP



Growth rate of value of ATM cash withdrawals Figure 3

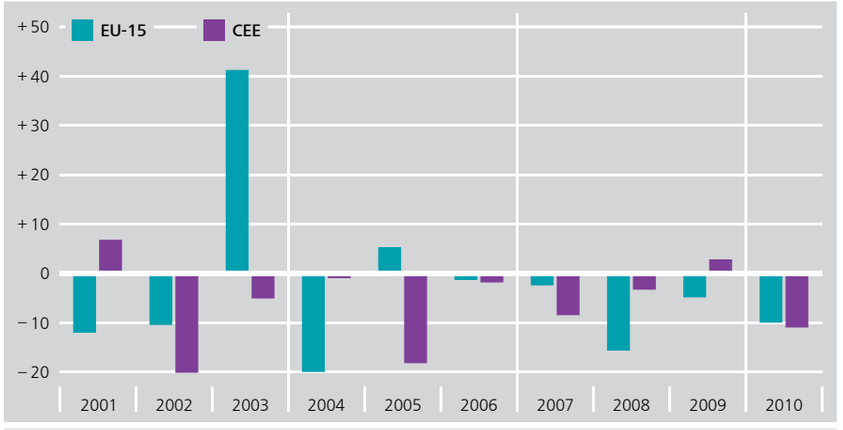
As a % of GDP



Growth rate of value of OTC cash withdrawals

Figure 4

As a % of GDP



Source: ECB. Data for OTC withdrawals covers only the Czech Republic, Germany, Spain, Finland, the UK, Hungary, Italy, Latvia, Netherlands, Romania and Slovakia.

DESCRIPTIVE STATISTICS

Table 1

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	N
VRRM	10.6 (1.94)	10.4 (1.87)	10.4 (1.86)	10.5 (1.86)	10.7 (1.99)	11.3 (1.99)	11.4 (2.08)	11.6 (2.02)	11.1 (2.18)	10.4 (2.4)	10.8 (2.06)	286
CeffM	9.58 (1.57)	9.41 (1.51)	9.42 (1.51)	9.47 (1.51)	9.7 (1.61)	10.1 (1.6)	10.3 (1.66)	10.4 (1.61)	10.0 (1.76)	9.38 (1.97)	9.78 (1.67)	286
EffR	7.34 (1.00)	7.24 (0.95)	7.26 (0.95)	7.32 (1.00)	7.44 (1.07)	7.74 (1.10)	7.78 (1.19)	7.74 (1.17)	7.59 (1.24)	7.32 (1.34)	7.56 (1.12)	286
$\frac{Cards}{GDP}$	6.8 (5.91)	6.66 (6.10)	7.49 (5.54)	8.10 (5.58)	8.79 (5.76)	9.73 (5.73)	10.36 (5.91)	10.93 (5.97)	11.60 (6.18)	12.29 (6.22)	12.96 (6.11)	281
$\frac{Cash}{GDP}$	9.58 (5.71)	10.02 (5.98)	10.74 (5.44)	11.55 (5.51)	12.12 (5.72)	12.27 (5.75)	12.82 (5.99)	12.94 (6.09)	13.21 (6.29)	13.66 (6.31)	13.42 (6.19)	273
CIT	31.83 (6.8)	30.94 (6.07)	29.39 (6.79)	28.45 (6.85)	27.5 (7.64)	26.16 (7.93)	25.85 (7.49)	25.56 (7.95)	24.46 (7.15)	24.43 (6.94)	24.08 (7.07)	286

Note: All means are expressed in % ,except $\frac{GDP}{POP}$, which is in €, Range in percentage points, while $\frac{ATM}{POP\,M}$ and $\frac{POS}{POP\,M}$ are pure numbers

DESCRIPTIVE STATISTICS

Table 1

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	N
GovExp	43.85 (6.2)	43.88 (6.06)	44.36 (6.31)	44.54 (6.95)	43.99 (6.71)	43.8 (6.63)	43.38 (6.33)	43.03 (5.73)	44.55 (5.24)	48.74 (5.19)	48.45 (6.70)	286
Deficit	-.942 (4.09)	-1.6 (3.30)	-2.4 (2.96)	-2.5 (2.88)	-1.96 (2.71)	-1.49 (3.02)	-.926 (3.27)	-.4 (2.84)	-2.21 (3.32)	-6.56 (3.90)	-6.53 (5.89)	286
$\frac{ATM}{POP\,M}$	483 (296)	503 (308)	532 (311)	568 (317)	601 (328)	625 (330)	657 (335)	711 (345)	738 (342)	750 (338)	736 (333)	285
$\frac{POS}{POP\,M}$	8,907 (5,549)	10,229 (6,959)	11,030 (7,663)	11,451 (7,393)	12,196 (7,848)	12,697 (7,569)	13,731 (7,880)	15,187 (8,104)	16,474 (8,766)	17,181 (9,006)	17,661 (9,351)	280
Open	109 (54.6)	108 (52.5)	104 (49.1)	102 (46.7)	107 (50.6)	109 (51.7)	117 (55.9)	119 (57.4)	120 (56.3)	105 (52.2)	116 (56.3)	286
Urban	70.59 (12.45)	70.7 (12.44)	70.8 (12.44)	70.9 (12.45)	71.05 (12.45)	71.17 (12.46)	71.33 (12.46)	71.49 (2.46)	71.64 (12.47)	71.8 (12.47)	71.9 (12.48)	286
Unempl	8.84 (4.66)	8.77 (5.13)	8.76 (4.68)	8.69 (3.94)	8.79 (3.69)	8.30 (3.18)	7.42 (2.49)	6.49 (1.97)	6.39 (1.88)	9.07 (3.68)	10.48 (4.41)	285
Corrupt	6.23 (2.18)	6.23 (2.09)	6.25 (2.15)	6.32 (2.16)	6.4 (2.09)	6.46 (2.04)	6.52 (1.93)	6.56 (1.79)	6.47 (1.74)	6.34 (1.83)	6.3 (1.91)	282
Thresh GDP	417 (669)	334 (517)	343 (585)	238 (394)	241 (355)	236 (355)	247 (345)	190 (235)	186 (224)	213 (216)	201 (230)	249
SV AT	19.57 (2.92)	19.61 (2.89)	19.73 (2.87)	19.65 (2.78)	19.61 (2.60)	19.73 (2.59)	19.54 (2.36)	19.65 (2.25)	19.61 (2.24)	19.96 (2.56)	20.65 (2.44)	286
Range	10.53 (5.32)	10.47 (5.31)	10.95 (5.79)	10.66 (4.93)	10.82 (4.53)	10.9 (4.54)	10.70 (4.47)	11.86 (3.23)	11.66 (3.21)	11.45 (3.14)	12.16 (3.28)	286
$\frac{GDP}{POP}$	18,880 (13,621)	19,215 (13,745)	19,569 (13,967)	19,830 (13,965)	20,396 (14,271)	20,919 (14,612)	21,661 (14,948)	22,403 (15,429)	22,350 (15,142)	21,083 (14,194)	21,357 (14,376)	286

Note: All means are expressed in % ,except $\frac{GDP}{POP}$, which is in €, Range in percentage points, while $\frac{ATM}{POP\,M}$ and $\frac{POS}{POP\,M}$ are pure numbers

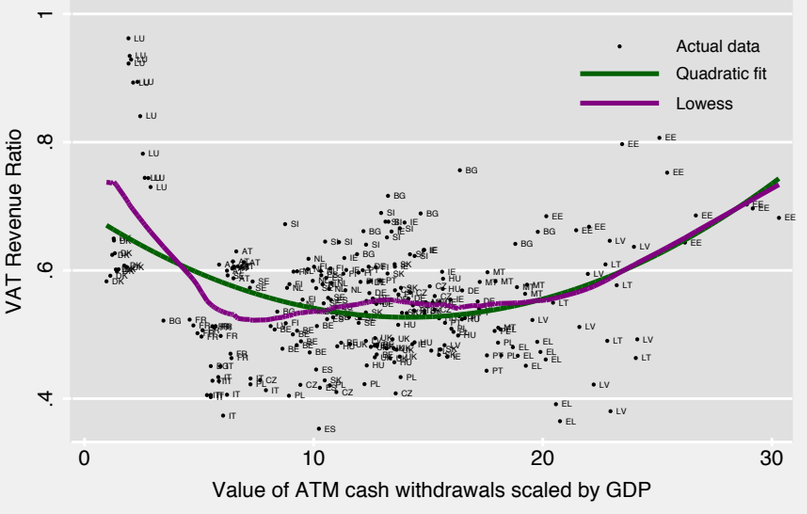
DESCRIPTION OF VARIABLES AND SOURCES

Table 2

VRR	VAT Revenue Ratio =VAT Revenue $\frac{VAT\ Revenue}{\{Final\ consumption - VAT\ Revenue\} * SV\ AT}$, where VAT Revenue is the actual VAT revenue, and Final consumption is item P3 of the national accounts consisting of 1) private final consumption expenditure of households and non-profit organisations serving households and 2) individual and collective consumption expenditure of general government. $\frac{VAT\ Revenue}{\{Final\ consumption - VAT\ Revenue\} * SV\ AT}$ is used in estimation, since SVAT is used as a control variable. Source: OECD, Eurostat.
Ceff	C-effciency = $\frac{VAT\ Revenue}{Final\ consumption * SVAT}$. CeffM = $\frac{VAT\ Revenue}{Final\ consumption}$ is used in estimation, since SV AT is used as a control variable. Source: OECD, Eurostat.
Eff R	Efficiency Ratio = $\frac{VAT\ Revenue}{GDP}$
$\frac{Cards}{GDP}$	Value of transactions for all cards issued in the reporting country, except e-money function scaled by the Gross Domestic Product. Source: Payments and Settlement Systems Statistics, ECB Data Warehouse.
$\frac{Cash}{GDP}$	Value of cash withdrawals for all cards issued in the reporting country via customer terminals scaled by the Gross Domestic Product. Source: Payments and Settlement System Statistics, ECB Data Warehouse; Eurostat.
CIT	Statutory corporate tax rate. Source: Eurostat.
GovExp	Total general government expenditure as a % of GDP. Source: Eurostat.
Deficit	General government deficit (-) surplus (+) as a % of GDP. Source: Eurostat
$\frac{ATM}{POP\ M}$	Number of ATMs per million inhabitants. Source: Payments and Settlement Systems Statistics, ECB Data Warehouse
$\frac{POS}{POP\ M}$	Number of Point of Sale Terminals per million inhabitants. Source: Payments and Settlement Systems Statistics, ECB Data Warehouse.
Open	Imports + Exports as a percent of GDP. Source: World Development Indicators, World Bank
Urban	Urban population as a percent of total population. Source: World Development Indicators, World Bank.
Unempl	Rate of unemployment. Source: Eurostat.
Corrupt	Corruption Perceptions Index ranging from 0 (highly corrupt) to 10 (very clean). Source: Transparency International.
Thresh GDP	A minimum turnover threshold, below which small traders are exempt from registering for VAT. % of $\frac{GDP}{POP}$. Source: European Commission, Taxation and Customs Union, OECD (Various Years), Ernst & Young Worldwide VAT, GST and Sales Tax Guides for 2003 and 2010, Various tax administration websites.
SVAT	Standard VAT rate. A single standard VAT rate is used even in countries with several standard rates applied in specific regions, as is the case in Austria, Greece, France, Portugal and Spain. For example, standard rates are different on m ainland Greece and Lesbos, Chios, Samos, and the other Greek islands. The same holds for mainland Portugal and the Azores and Madeira. Source: OECD (Various Years), Eurostat.
Range	The difference between the standard VAT rate, SVAT and the reduced rate. In countries with more than one reduced rate, the average is taken. If there is no reduced rate, Range is set to zero. Source: Eurostat.
Prefill	A dummy variable equal to 1 if a country uses fully/ partially pre-populated personal income tax returns. Source: OECD (2008).
$\frac{GDP}{POP}$	Real gross domestic product per capita in Euro. Source: Eurostat.

Marginal relationship: VRR vs. ATM cash withdrawals

Figure 5



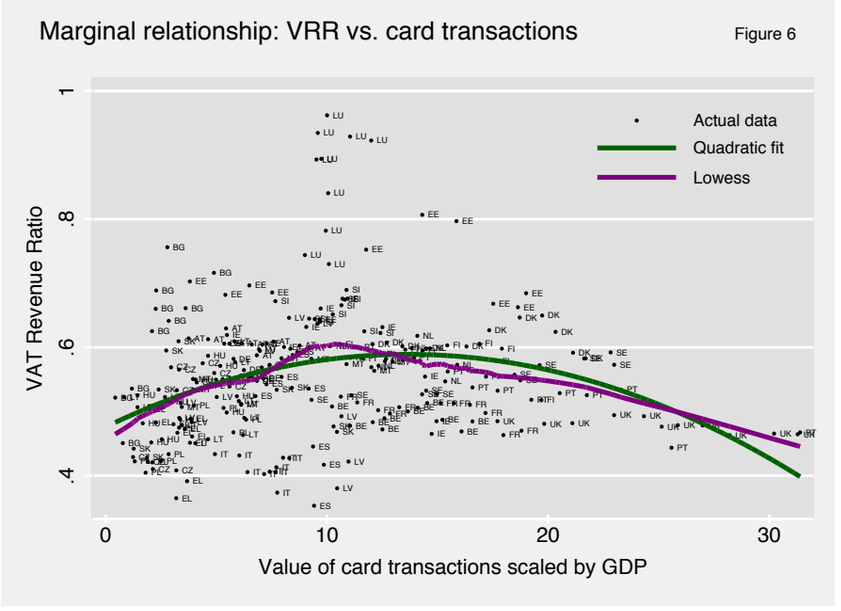


Figure 4, which depicts the growth rate of OTC cash withdrawals as a % of GDP, demonstrates that the biggest decline in the use of cash stems from vastly diminishing over-the-counter withdrawals, with Finland and Netherlands having the largest negative rates. Apart from a single substantial positive spike in 2003 driven by Hungarian and Latvian data, the growth rates are negative for both the EU-15 and CEE. If looking only at ATM cash withdrawals in CEE, one can misleadingly conclude that cash usage is growing, while in fact OTC cash is substituted with ATM withdrawals, with overall cash usage likely not trending upward, and strongly declining in the EU-15. Takala and Viren (2012) who construct a measure of cash usage in the Euro area based on both ATM and imputed OTC cash, note that bank branches' withdrawals usually involve higher denomination banknotes and large

single amounts, which can be used not only as payments, but also as a store-of-value.[5]

Simple scatter plots of VRR versus $\frac{Cash}{GDP}$ and $\frac{Cards}{GDP}$ depicted in Figures 5 and 6 respectively, suggest that the marginal relationships between the dependent and the main explanatory variables of interest may not be linear. In fact, a quadratic prediction plot fits the non-parametric lowess smoothing well. Nevertheless, other predictors are ignored in these plots, and since typically control variables are correlated, there can be a substantial difference between the marginal and partial effects, which I will explore below.

3.1 Empirical specification and results

To find out if the method of payment has any effect on VAT's collection performance, I start out with the following basic specification:

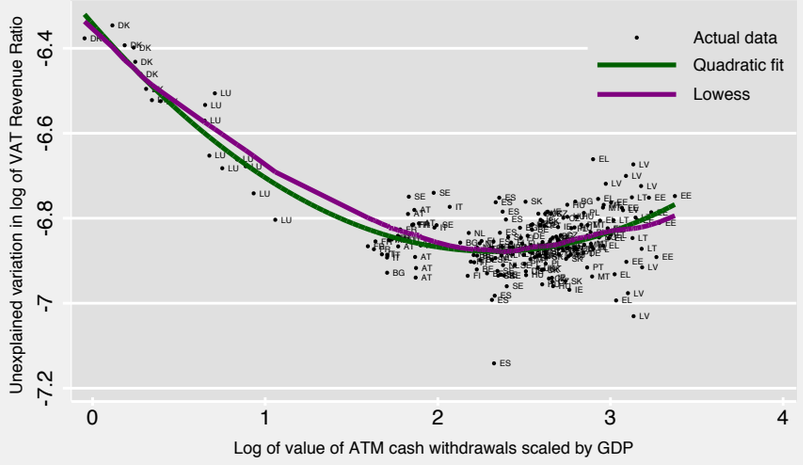
$$VrrM_{it} = \alpha_j + \gamma_t + \alpha_1 In\frac{Cards_{it}}{GDP_{it}} + \alpha_2 In\frac{Cash_{it}}{GDP_{it}} + \beta_1 In\frac{GDP_{it}}{POP_{it}} + \beta_2 InSVAT + \beta_3 In\frac{ATM_{it}}{POP\,M_{it}} + \beta_4 In\frac{POS_{it}}{POP\,M_{it}} + \beta_5 Range + \varepsilon_{it},$$

where lnVRRM$_{it}$ = $\frac{VAT\ Revenue_{it}}{Final\ consumption_{it} - VAT\ Revenue_{it}}$ in country i at time t. As pointed out by Ebrill et al. (2001), since SVAT is explicitly controlled for on the right-hand side of theregression, the specificationeffectively models VRR. ln $\frac{GDP}{POP}$ the log of GDP per capita, and Range is the difference between the standard VAT rate, SVAT, and the reduced rate(s), if any. For countries without a reduced rate, Range is set to zero. For this reason, it is not log transformed. 1 pp increase in Range will lead to a β_4* 100% change in VRRM. α_i are country fixed effects with no assumption being made about cov(α_i, χ_{it}) for now, while γ_t are year dummies. If the expectation that an audit

5 Takala and Viren (2012) impute OTC withdrawals by using the value of new and fit banknotes withdrawn by third parties at NCB counters (a), and assuming the value of two recycling rates: cash-in-transit (b) and credit institutions' (c) recycling rates in the following formula: a(1 + b)(1 + c). a is sourced from the Currency Information System 2, covering only the Euro countries, with only Euro area aggregates being officially available to the public.

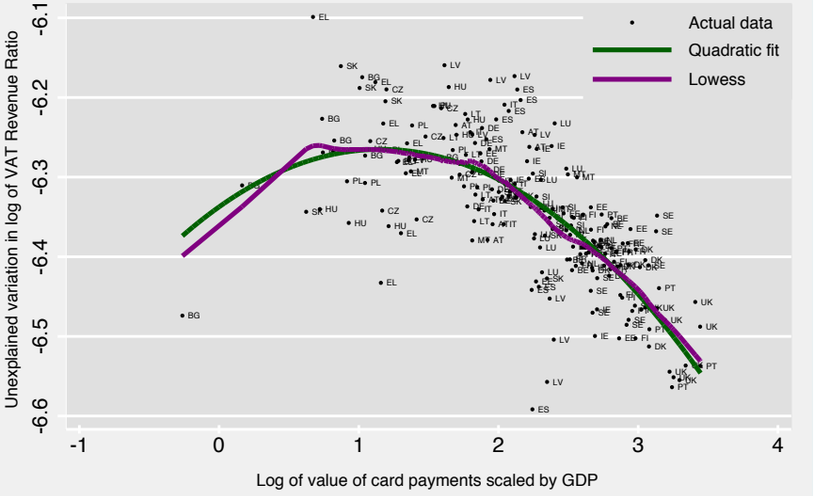
would uncover any undeclared electronic sales drives firms to report these sales in full, then the effect of card transactions on VRRM should be positive ($\alpha_1 > 0$). Conversely, if cash transactions are associated with greater evasion opportunities, then $\alpha_2 < 0$.

lnVRRM vs. ln(cash/GDP) Figure 7



Note: The Y-axis variable is logVRRM net of the estimated effect of ln(cards/GDP), ln(GDP/POP), ln(ATM/POP M), ln(POS/POP M), lnSV AT, and Range, but excluding ln(cash/GDP) and ln(cash/GDP)². The regression was estimated with clustered standard errors, year and country dummies.

lnVRRM vs. ln(cards/GDP) Figure 8



See note under Figure 7. This time ln(cash/GDP) is included, and ln(cards/GDP), ln(cards/GDP)² excluded.

Estimates based on the baseline specification are presented in Table 3. When the relationship between VRRM , cash, and cards is assumed to be linear, as is the case in Column (1), neither the coefficient on ln $\frac{Cards}{GDP}$, nor that on ln $\frac{Cash}{GDP}$ are statistically significant, implying virtually no impact of the method of payment on VAT's collection efficiency.

Given the non-linearity suggested by the simple scatterplots in Figures 5 and 6, I check if the relationship between VRRM and $\frac{Cash}{GDP}$ / $\frac{Cards}{GDP}$ is linear once the variables are log-transformed, and additional covariates are added to to the estimation. To do so, eq. (1) is estimated with all shown controls, except ln $\frac{Cash}{GDP}$. The difference between the actual and predicted values of lnVRRM , which constitutes the unexplained variation in the dependent variable, is then plotted against ln $\frac{Cash}{GDP}$ in Figure 7. The same procedure is followed to obtain the plot in Figure 8, but this time ln $\frac{Cards}{GDP}$ is excluded from

the regression. The figures present a second-order polynomial fit as well as a non-parametric locally weighted scatter plot smoothing (lowess) with a bandwidth set to .4.

Both graphs indicate distinct non-linearity between the main explanatory variables and lnVRRM , with the quadratic approximation almost matching the non-parametric plot for cash, and fairly closely following the lowess smooth for cards. VAT's collection efficiency decreases with increases in cash use, but for high values of cash withdrawals, the curve bends upwards, showing a convex relationship. Cards, conversely, exhibit a concave relation with lnVRRM , improving collection up to a point, after which their effect turns negative.

When the quadratic terms are added in Column (2) of Table 3, their coefficients are both significant at 5%. I assume that cov(α_i, χ_{it}) ≠ 0, so that the presented estimates are obtained through a fixed effects regression, which centres the variables around their means within each cross-section. ln $\frac{Cards}{GDP}$ remains insignificant, but cash has a strong negative effect on VAT's collection. 1% rise in GDP per capita is associated with .35% higher VRRM. Even though at conventional statistical levels the eff of cards on the dependent variable is nil, the number of point of sale terminals do have a positive impact on VAT's performance, a result, which remains consistent across various specifications. Jumps in the VAT rate lead to a less than proportionate increase in the VAT revenue to consumption ratio. According to Ebrill et al. (2001), who obtain similar estimates for a cross-section of approximately 90 countries, the less than 1 elasticity can be explained with narrower tax bases, although reduced compliance is likely to be a contributing factor as well. Neither the number of ATMs per million of inhabitants, nor Range are precisely estimated.

Note that in Column (2) the non-linear relationship is not identified by pure within variation. In fact, as argued by McIntosh and Schlenker (2006), if y is a globally quadratic function of χ, deviations from group means cannot be used to identify the data generating process, since the marginal effect must depend on the uncentred

values of χ. Identification, therefore, stems from elements of between variation, as χ is first squared, and then demeaned. In this way, the group means are re-introduced into the regression (McIntosh and Schlenker, 2006).[6,7]

The C-efficiency ratio and VAT revenue to GDP, or the Efficiency Ratio, replace VRRM as dependent variables in Columns (3) and (4), respectively. There is virtually no change in the estimated coefficients and their significance when lnCeffM is used instead of lnVRRM. The Efficiency ratio regression, however, yields substantially lower estimates. Nevertheless, both the main and quadratic terms of cash remain significant at 10%, whereas GDP per capita is found to have no influence on the ratio.

Even though the impact of major macroeconomic shocks should be captured by the year dummies, which are present in all regressions, Column (5) removes 2008-2010 data from the estimation in order to check the extent to which the financial crisis affects the results. Apart from the finding that before the onset of the crisis a 1% increase in the VAT rate is associated with a stronger positive response of the VAT revenue to net consumption ratio, excluding the last three years of the data does not alter the estimates qualitatively or quantitatively.

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6 In the fixed effects regression, χ_{it}^2 is transformed into $\chi_{it}^2-\overline{\chi_i^2}$, which can be rewritten as $(\chi_{it}-\overline{\chi_i})^2+2(\chi_{it}-\overline{\chi_i})\overline{\chi_i}+(\overline{\chi_i})^2-\overline{\chi_i^2}$

7 I additionally performed Random-effects (RE) GLS estimation, which uses both the cross-sectional and time-series variation in the data, and imposes the restriction that cov(α_i, χ_{it}) = 0. Compared to Column (2), there are two main differences: the coefficient on ln $\frac{Cards}{GDP}$ doubles and becomes statistically significant at 10% (.041 with s.e. .023), while the effect of GDP per capita is close to zero. A simple Hausman test for fixed effects would be inappropriate in this context, since it can only be performed with unclustered standard errors and assumes that α_i and ε_{it} are i.i.d., which is unlikely to hold. Indeed, standard errors are substantially underestimated when observations are not clustered by country as a consequence of considering each observation to be an independent piece of new information (Cameron and Trivedi, 2009). I use, instead Schaffer and Stillman (2010) xtoverid test, which treats RE's orthogonality condition E($\chi_{it} * \alpha_i$) = 0 as an overidentifying restriction and allows for clustered errors. The very large Sargan-Hansen statistic of 257.6 with p-value of zero strongly rejects the null hypothesis that RE is consistent. Thus, all subsequent regressions employ the within estimator.

Determinants of VAT collection efficiency Table 3

DVP	(1) lnVRRM	(2) lnVRRM	(3) lnCeffM	(4) lnEffR	(5) 2000-2007 lnVRRM	(6) EU-15 lnVRRM	(7) CEE lnVRRM	(8) Cross-section lnVRRM
ln $\left(\frac{Cards}{GDP}\right)$	-.016 (.035)	.021 (.026)	.020 (.023)	.029 (.024)	.028 (.022)	.069 (.160)	.004 (.025)	.244* (.122)
ln $\left(\frac{Cards}{GDP}\right)^2$		-.024** (.011)	-.022** (.010)	-.008 (.006)	-.014 (.010)	-.029 (.031)	-.016 (.012)	-.045 (.033)
ln $\left(\frac{Cash}{GDP}\right)$	-.029 (.062)	-.326** (.122)	-.293** (.109)	-.129* (.067)	-.266** (.115)	-.367* (.181)	-.228* (.111)	-.235 (.313)
ln $\left(\frac{Cash}{GDP}\right)^2$		.062** (.025)	.066*** (.025)	.028* (.016)	.067*** (.022)	.070 (.044)	.065*** (.020)	.059 (.082)
ln $\left(\frac{GDP}{POP}\right)$	.308** (.120)	.350** (.130)	.315** (.117)	.067 (.095)	.348*** (.116)	1.12*** (.236)	.336** (.149)	.072 (.082)
ln $\left(\frac{ATM}{POP\,M}\right)$	.071 (.057)	.036 (.055)	.031 (.050)	.003 (.053)	.022 (.038)	.057 (.067)	-.027 (.111)	-.054 (.068)
ln $\left(\frac{POS}{POP\,M}\right)$	.045 (.034)	.066** (.032)	.060** (.029)	.044 (.028)	.057* (.029)	.012 (.040)	.109* (.057)	-.090 (.062)
lnSVAT	.460** (.181)	.517*** (.185)	.471*** (.168)	.425** (.162)	.653*** (.117)	.618*** (.159)	.443* (.202)	.654** (.295)
Range	-.003 (.004)	-.005 (.003)	-.005 (.003)	-.003 (.003)	-.004 (.003)	.006 (.004)	-.010*** (.003)	-.010 (.011)
Observations	267	267	267	267	189	159	108	26
Countries	26	26	26	26	26	15	11	

Note: The sample in each regression pertains to 2000-2010, except in Column (6), in which 2008-2010 are excluded. The dependent variables are the logs of VRRM = $\frac{VAT\ Revenue}{Final\ Consumption - VAT\ Revenue}$; CeffM= $\frac{VAT\ Revenue}{Final\ Consumption}$ or EffR= $\frac{VAT\ Revenue}{GDP}$. All specifications include country and year fixed effects; in Column (3) results are based on GLS estimation with random effects. Standard errors are always clustered at the country level. Asterisks denote significance at the 1% (***), 5% (**), and 10% (*) level.

The next two columns of Table 3 split the sample geographically into two groups: 1) the CEE region, herein the Baltic states, and 2) the EU-15. Besides geographical, the split is also along income lines, with CEE having an average of €8,140 GDP per capita, and the EU-15 – €29,898. Similarly to previous estimations, cards enter with a positive sign for the linear and negative sign for the quadratic term, both imprecisely estimated for the two subsets of countries. The coefficient of ln $\frac{Cash}{GDP}$ is negative and significant at 10%, but only the quadratic term for CEE is statistically significant, suggesting that the positive effect of cash on VAT's performance is prevalent in countries, where cash continues to be a preferred method of payment. On average, ATM cash withdrawals are 6 pp higher and card payments 7 pp lower in CEE than in the EU-15. Another interesting outcome of the sample split is that Range is negative and highly significant for CEE: 1 pp widening of the range between SVAT and the lowest reduced rate would lead to a 1% fall in VRRM .

The arguments against reduced VAT rates are many and succinctly summarised by Tait (1988). Perhaps the most compelling justification against rate differentiation is the inevitable increase in traders' compliance costs. There are also considerable administrative costs associated with the management of a complex VAT system, which functions with multiple rates, exemptions, and zero rating. It is further doubtful whether reduced rates achieve what they are aimed at, namely mitigating the impact of VAT's regressivity on low income households. In a cross-sectional analysis, Bogetić and Hassan (1993) estimate a negative relationship between Range and the Efficiency Ratio. Likewise, Agha and Haughton (1996) demonstrate that the higher the number of VAT rates, the lower the VAT compliance. Even though Range is found to be statistically significant only for the CEE countries, once exposure to foreign trade is taken into account, the variable becomes significant for the whole sample, as shown in Table 4.

Finally, Column (8) presents results from a cross-sectional regression, where the data has been collapsed to country means. With only 26 data points, standard errors

increase substantially with most of the coefficients becoming statistically insignificant. In particular, a measure of cash calculated as an average over the 2000-2010 period is generally not significant in explaining VAT's performance, even though the estimates are virtually unchanged from the fixed effects coefficients. Interestingly, however, the linear term of cards turns barely significant at 10%, a result, which is in line with the outcome of the Random Effects regression (see footnote 6), that utilises both the time-series and cross-sectional variation in the data.

Next, Table 4 checks if the coefficients on cash and cards and their significance are sensitive to the incorporation of additional explanatory variables. The first departure from the benchmark specification is the inclusion of openness (Open), measured as exports and imports divided by GDP. Invariably, studies modeling VAT revenue as a function of trade openness find a positive association (Ebrill et al., 2001; Aizenman and Jinjarak, 2008). The intuition is that, all in all, more trade enhances VAT collection on imports, despite the existence of various fraudulent mechanisms exploiting the zero rating of exports at the border. In Table 4 Open enters with a positive sign and is always significant at 5%. The estimated elasticity of VRRM to the level of trade is .24 in most regressions. Both the linear and quadratic terms of cash remain statistically significant and similar in magnitude to the estimates in Table 3. The quadratic term of cards is barely significant at 10%. As mentioned above, due to smaller estimated standard error, there is some indication that Range is negatively correlated with VRRM.

Column (2) adds the rate of unemployment as an explanatory variable that not only denotes the general state of the economy, but also directly affects private consumption. Not surprisingly, the coefficient of lnUnempl shows that VAT's performance deteriorates as the number of unemployed rises. As long as unemployment is explicitly controlled for, GDP per capita turns insignificant. Perceptions of corruption, which can influence the willingness to pay tax, also enter with a negative sign in Column (3), albeit imprecisely estimated. Previous research has shown a positive

connection between the level of urbanisation and VAT revenue, but Column (3) does not corroborate this finding (Aizenman and Jinjarak, 2008; de Mello, 2008).

By exempting the smallest traders from VAT registration, the VAT turnover threshold could potentially reduce revenue, even though, given the high number of small traders, savings in administrative costs could outweigh foregone revenue. Including the threshold as a percent of GDP per capita in Column (4) shows, at a 5% level of significance, that if TreshGDP grows by 1 pp, VRRM falls by 0.9%. Neither of the additional explanatory variables in Columns (2)-(4) alters the effect of cash on VRRM. Cards also remain insignificant.

One possible explanation for cards' lack of influence on VRRM is that, unlike Turkey, and more recently the US, where a clear signal is sent to firms that electronic sales are monitored, in Europe card transactions may not serve as a sufficiency powerful deterrent to evasion. In particular, it is unclear to what degree EU tax administrations match firms' card transactions to reported sales as a preventive mechanism before suspicions of non-compliance arise (before the fact) as opposed to a pursuant mechanism, once suspicion is already established and an audit is instigated as a consequence (after the fact).

Even if a specific tax policy utilising firms' card transactions for enforcement purposes is not in place, I test whether in general tax administrations that make extensive use of third-party reporting are more effective in VAT revenue collection. To do so, I introduce a dummy variable Prefill, which equals one for countries that use pre-populated personal income tax returns; this dummy is also interacted with $\frac{Cards}{GDP}$. A high level of pre-filled returns indicates that most salaries are paid electronically, which is also conducive to a greater use of cashless transactions, provided that an adequate payment infrastructure exists. In Column (5), the coefficient of Prefill is identified from countries (Estonia, France, Netherlands, Portugal, Belgium, and Slovenia) that switched fully or partially between taxpayer submitted returns to pre-populated re-

turns in the period 2000-2010. Use of third-party reporting for personal income taxation was pioneered by Denmark in 1988, followed by Sweden and Finland in 1995 (OECD, 2008). In view of the results in Column (5), however, I cannot find evidence that third-party reporting for individuals, or card transactions given third-party reporting have any eff on VAT revenue proportionate to consumption.

Last but not least, Column (6) explores the possibility of the endogeneity of the VAT rate. On the one hand, higher SVAT can translate into higher collected revenues. On the other hand, if revenue realisations do not meet a government target, SVAT can be adjusted accordingly.[8]

8 To detect the presence of reverse causality – revenue driving the rate rather than vice versa, one can replace the dependent variable with the VAT rate, keeping VAT revenue on the right-hand side. In such a regression, it turns out that VRRM does have a statistically significant effect on SVAT , which poses the question of whether the results for cash and cards will change if SVAT is instrumented for.

Determinants of the VAT sollection efficiency: robustness checks Table 4

	(1)	(2)	(3)	(4)	(5)	(6) IV
$\ln\left(\frac{Cards}{GDP}\right)$	.012 (.026)	.019 (.026)	.007 (.023)	.017 (.019)	.022 (.027)	.046 (.051)
$\ln\left(\frac{Cards}{GDP}\right)^2$	-.020* (.011)	-.020 (.012)	-.020* (.010)	-.014 (.009)	-.023 (.013)	-.040** (.015)
$\ln\left(\frac{Cash}{GDP}\right)$	-.275** (.117)	-.293* (.144)	-.282** (.130)	-.291** (.109)	-.330** (.149)	-.446** (.222)
$\ln\left(\frac{Cash}{GDP}\right)^2$	.051** (.022)	.054* (.026)	.047* (.023)	.041** (.019)	.062** (.026)	.097** (.048)
$\ln\left(\frac{GDP}{POP}\right)$	.362*** (.116)	.130 (.152)	.179 (.174)	.050 (.176)	.151 (.147)	.635*** (.234)
$\ln\left(\frac{ATM}{POP\,M}\right)$	.045 (.049)	.051 (.050)	.074 (.043)	.119*** (.033)	.062 (.054)	-.017 (.093)
$\ln\left(\frac{POS}{POP\,M}\right)$	.070** (.029)	.077** (.029)	.076** (.032)	.065** (.029)	.072** (.029)	.077* (.044)
lnSVAT	.594*** (.167)	.619*** (.138)	.526*** (.131)	.540*** (.102)	.621*** (.137)	2.63*** (.513)
Range	-.006* (.003)	-.006* (.003)	-.006* (.003)	-.009** (.003)	-.006* (.003)	-.024*** (.006)
lnOpen	.242** (.097)	.237** (.096)	.242** (.098)	.226** (.100)	.244** (.097)	.336* (.174)
lnUnempl		-.094** (.042)	-.082* (.042)	-.095** (.040)	-.092** (.040)	-.121* (.066)
lnCorrupt			.025 (.092)	-.061 (.099)		
lnUrban			.217 (.681)	-.923 (.633)		
ThreshGDP				-.009** (.004)		
Prefill					-.103 (.132)	
$\ln\left(\frac{Card}{GDP}\right)$*Prefill					.046 (.050)	
F-stat. of excl. instruments						6.10
P-Value						.0031
Hansen-J						1.417
P-Value						.4923
Observations	267	266	264	233	266	265

Note: The sample in each regression pertains to 2000-2010. The dependent variable is the log of VRRM = $\frac{VAT\ Revenue}{(Final\ consumption - VAT\ Revenue}$. All specifications include country and year fixed effects. In Column (6) lnSVAT is instrumented with Deficit, lnCIT and lnGovExp; estimation is performed with xtivreg2 (Schaffer, 2010). In all specifications, standard errors are clustered at the country level. Asterisks denote significance at the 1% (***), 5% (**), and 10% (*) levels.

Among various sets of instruments, the following three variables met the relevance and validity criteria best: the natural logs of corporate income tax rate and government expenditure, and, due to numerous negative values, the non-transformed government deficit. At least before the financial crisis, hikes in the VAT rate were generally compensated with cuts in the CIT rate and/or PIT deductions. Since raising SVAT is a quick way to generate more revenue, I expect that fluctuations in government's deficit and expenditure would closely correspond to the dynamics of the VAT rate. The results of a fixed-effects instrumental variable regression with clustered errors are reported in Column (6). The first-stage F-statistic testing for the joint significance of the excluded instruments is 6.10 with a P-value of 0.0031, indicating that the instruments are relevant. Further, given a Hansen-J statistic of 1.417 (χ^2(2) P-value=0.4923), I cannot reject the null hypothesis that the full set of orthogonality conditions are valid.

Overall, instrumenting for the VAT rate produces higher coefficients in absolute value, especially when it comes to SVAT , which increases four times. Both GDP per capita and the unemployment rate are significant in Column (6) as opposed to previous regressions, in which only unemployment mattered. The linear and quadratic terms of cash almost double and remain significant at 5%. A similar increase is observed for cards, but the linear effect does not change its statistical significance.[9]

9 Another robustness check was performed with a different measure for cash, namely net currency in circulation, taken from ECB's data warehouse and defined as the number of banknotes/coins in circulation, where for banknotes, circulation equals created notes minus destroyed notes less stock of the National Central Bank (NCB). This measure is readily available for the EU members, which are not part of the monetary union, and is not reported by the ECB for the Euro area countries. Currency in circulation for the Euro zone states was obtained from the individual countries' NCB websites, and in the case of Germany, Spain and Portugal, it was estimated. The derivation is performed by assuming that the notes put in circulation are proportional to the countries' subscription key to the ECB's share capital minus the 8% ECB's share of total euro banknotes issued. An analogous analysis to the one performed in Figures 7 and 8 showed that a quadratic term for net currency in circulation is not justified and that the relationship between lnVRRM and currency in circulation is negative. Replacing ATM cash withdrawals with net currency in circulation in eq. (1) yields a negative estimated coefficient of -.045, which however is not statistically significant (standard error is .034).

4 Conclusion

The exceptional amount of firm-related information tax administrations nowadays could or already have access to leads to the gradual implementation of policies whose aim is to prevent rather than pursue tax evasion. If these policies require traders to transition from cash to electronic payment systems, compliance costs are unavoidable. It is therefore important to study such practices and their expected effect on enforcement.

In itself card payments' traceability could improve compliance by increasing the perceived probability of detection, even if no explicit policy using electronic transactions data as a preventive mechanism is in force. It is this particular aspect of cards that this paper focused on. Given the data, the visibility of electronic payments does not appear to influence VAT's collection efficacy in a significant manner. It is possible that a more proactive tax policy following the example of the US and Turkey can induce a considerable impact on compliance. Alternatively, it is equally possible that the outcome could be limited if those firms that are bent on evading, are inventive enough to find the means to do so. The picture is more clear-cut with respect to cash, whose negative eff on VAT's performance is unambiguous, at least in the countries where card payments are well-established.

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Appendix

Changes affecting the tax base

	2000	2009
AT	No zero rate; Lower rate 10%. Standard rate 20%. General registration threshold (GRT) €22,000. Aggregate administrative costs for tax functions as % of GDP (AAC): 0.22%. Number of VAT registered traders, millions (NVT): 0.69.	Lower rate [added]: water supply; refuse (waste) collection; sewage; dwelling; passenger transport; hotel accommodation; restaurant services (except drinks); medicine. GRT: €30,000. AAC: 0.19%. NVT: 0.82. No change in rates and exemptions
BE	Zero rate; Lower rates 6%, 12%. Standard rate 21%. GRT: €5,580. AAC: -. NVT: -.	Lower rate [added]: some labour intensive services (small repair services) [2003]; construction work leading to the construction of new private housing and the sale of new private housing (subject to conditions, limitations and of temporary character) [2009 to 2010]. GRT: €5,580. AAC: 0.35%. NVT: 0.7. No change in rates and exemptions.
CZ	No zero rate; Lower rate 5%. Standard rate 22%. GRT: €85,567. AAC: -. NVT: -.	Zero rate on international passenger transport; Lower rate 9%. Standard rate 19%. Scope of lower rate reduced from covering most services in 2000 to: supply of water; disposal or waste water; accommodation; construction of private dwellings and social houses; healthcare and domestic care services; cleaning in households; funeral; sport activities. Exemptions [removed]: supplies of enterprises. GRT: €39,904. AAC: 0.20%. NVT: 0.53.
DE	No zero rate; Lower rate 7%. Standard rate 16%. GRT: €16,620. AAC: -. NVT: 4.87.	Standard rate 19%. Lower rate [added]: plants; flowers; devices for the disabled; museums; zoos; circuses; authors' rights [2003]. GRT: €17,500. AAC: 0.29%. NVT: 5.70.
DK	Zero rate; No lower rate. Standard rate 25%. GRT: €2,680. AAC: -. NVT: 0.39	First time sale of artistic work valued over DKK300,000 taxed at 5%. Exemptions [added]: sale of products of artistic work valued under DKK300,000; [removed]: supply of all land and buildings. GRT: €6,711. AAC: 0.3%. NVT: 0.43.

Sources: OECD (Various Years), OECD (2004, 2009), Eurostat. Used abbreviations: AAC Aggregate administrative costs for tax functions as % of GDP; GRT General registration threshold; NVT Number of VAT registered traders (millions). In the 2000 column, the value of NVT is for 2003, as this data is not available for previous years. 2000 is the benchmark year. For coverage of lower rates and exemptions in 2000, refer to the 2001 edition of OECD (Various Years). The 2009 column lists only the low rate goods and services/ exemptions, which have been added/removed as compared to 2000.

Changes affecting the tax base

	2000	2009
EL	No zero rate; Lower rate 8%. Standard rate 18%. GRT: €6,070. NVT: 1.45.	Lower rate 9%. Standard rate 19%. Exemptions [added]: legal and artists' services; authors' rights; public radio and TV; supply of water by public bodies [2003]; supply of new buildings [2005]; welfare and social security works; supply of goods used exclusively in an exempt activity, services included in the taxable value of imported goods; postage and other similar stamps [2009]. [removed] supply of new buildings [2007]. Lower rate [added]: books [2003]; cultural and sporting events; collection and treatment of waste; some labour intensive services [2005]; gas; live animals; seeds; fertilisers; pharmaceutical products; charitable work; plants and flowers [2009]. GRT: €10,000. NVT: 1.10.
ES	No zero rate; Lower rate 7%. Standard rate 16%. GRT: None. AAC: -. NVT: 3.3.	No change in rates, exemptions, and lower rate coverage. GRT: None. AAC: 0.13%. NVT: 2.8.
FI	Zero rate; Lower rates 8%, 17%. Standard rate 22%. GRT: €8,500. AAC: 0.21%. NVT: 0.5.	Zero rate [removed]: international transport [2003]. Lower rate [added]: works of art supplied by their creators or imported [2003]. Exemptions [removed]: products of visual art sold by the artist [2003]. No change in rates. GRT: €8,500. AAC: 0.22%. NVT: 0.58.
FR	No zero rate; Lower rates 5.5% Standard rate 19.6%. GRT: €76,300. AAC: 0.39%. NVT: -.	Lower rate [added]: most foods and drinks [2007]; gas; electricity; pharmaceutical products; farm products, gardens, plants and flowers; refuse collection; sewage [2009]; [removed]: museums. Exemptions [added]: construction, work on monuments; cemeteries and graves of war victims; commodity futures transactions, services rendered by resource consortia to their members that are VAT exempt [2003]. No change in rates. GRT: €80,000. AAC: 0.23%. NVT: 4.20.

Sources: OECD (Various Years), OECD (2004, 2009), Eurostat. Used abbreviations: AAC Aggregate administrative costs for tax functions as % of GDP; GRT General registration threshold; NVT Number of VAT registered traders (millions). In the 2000 column, the value of NVT is for 2003, as this data is not available for previous years. 2000 is the benchmark year. For coverage of lower rates and exemptions in 2000, refer to the 2001 edition of OECD (Various Years). The 2009 column lists only the low rate goods and services/ exemptions, which have been added/removed as compared to 2000.

Changes affecting the tax base

	2000	2009
HU	Zero rate; Lower rate 12%. Standard rate 25%. GRT: $7,544. AAC: 0.57%. NVT: 0.55.	No zero rate; Lower rates 5%, 18%. Lower rate [removed]: food, electricity, live animals, water, pharmaceutical products, transportation, veterinary, movie, art, library and bath services, etc. [added] musical notes. Exemptions [removed]: mass sports events; services rendered by intermediaries; lending of buildings for education, sport, or cultural purposes; transfer of creditors and ownership rights, compulsory social security insurance, public administration. GRT:€17,921. AAC: 0.39%. NVT: 0.52.
IE	Zero rate; Lower rate 12.5%. Standard rate 21%. GRT: €51,000/$26,050. AAC: 0.26%. NVT: 0.22.	Lower rate 13.5%. Zero rate [added]: certain aircraft and sea-going vessels [2005]; Lower rate [added]: gas; recreational and sports services; certain nursery and garden centre stock [2009]. Exemptions: [added] child care [2003] and [removed] [2005]. GRT: €75,000. AAC: 0.28%. NVT: 0.28.
IT	Zero rate (scrap iron); Lower rate 10%. Standard rate 20%. GRT: €2,400. AAC: - . NVT: -.	No zero rate; Lower rate [added]: accommodation let by building enterprises [2003]; Exemptions [added] taxi; [removed] municipal passenger transport [2009]. GRT: €30,000. AAC: 0.20%. NVT: 5.26.
LU	No zero rate; Lower rates 5%, 12%. Standard rate 15%. GRT: €10,000. AAC: -. NVT: 0.076.	Lower rate [added]: accommodation; cultural, sporting events; certain labour intensive services; childrens' clothing; electricity; construction of dwellings; gas, passenger transport, pharmaceutical products etc. Rates and exemptions unchanged. GRT: €10,000. AAC:0.24%. NVT: 0.06.
NL	No zero rate; Lower rates 6%. Standard rate 17.5%. GRT: e1,345. AAC: 0.69%. NVT: 1.	Standard rate 19%. Lower rate [added]: cut flowers and plants; hotel and holiday accommodation; lending of books [2005]; cleaning of dwellings and hairdressing [2009]; [removed] lending of books [2009]. Exemptions unchanged. GRT: e1,345. AAC: 0.36%. NVT: 1.45.

Sources: OECD (Various Years), OECD (2004, 2009), Eurostat. Used abbreviations: AAC Aggregate administrative costs for tax functions as % of GDP; GRT General registration threshold; NVT Number of VAT registered traders (millions). In the 2000 column, the value of NVT is for 2003, as this data is not available for previous years. 2000 is the benchmark year. For coverage of lower rates and exemptions in 2000, refer to the 2001 edition of OECD (Various Years). The 2009 column lists only the low rate goods and services/ exemptions, which have been added/removed as compared to 2000.

Changes affecting the tax base

	2000	2009
PL	Zero rate; Lower rate 7%. Standard rate 22%. Exemptions: agriculture, taxi, R&D, cremation and cemetery, and attorney services; funeral. GRT: €20,833. AAC: 0.18%. NVT: 1.3.	Zero rate [removed]: new dwelling immovable property; agricultural means of production. Lower rate [added]: basic agricultural means of production; restaurant, cemetery, certain construction, and reception of broadcasting services; certain foodstuffs and beverages; passenger transport, etc. All goods/ services subject to lower rate in 2000 removed. Exemptions: students' accommodation; public radio and TV. GRT: €24.390. AAC: 0.36%. NVT: 2.14.
PT	Zero rate; Lower rates 5%, 12%. Standard rate 17%. GRT: €10,000. AAC: 0.36%. NVT: -.	Standard rate 20%. Lower rate [added]: devices for the disabled, medical services, natural gas, hotels, social housing; some goods used in agriculture; restaurant services; tools, machines or other equipment used for collecting and using alternative energy sources, etc. GRT: €12,000. AAC: 0.23%. NVT: 1.50.
SE	Zero rate; Lower rates 6%, 12%. Standard rate 25%. GRT: None. AAC: 0.27%. NVT: 0.84.	Standard rate 15%. Lower rate [added]: books; newspapers; magazines; zoos [2003]. Exemptions [added]: creative artists; investment gold [2007]; [removed]: certain memberships, publications [2003], authors' rights [2005], investment gold [2009]. Rates unchanged. GRT: None. AAC: 0.18%. NVT: 1.
UK	Zero rate; Lower rate 5%. Standard rate 17.5%. GRT: €82,258. AAC: 0.33%. NVT: 1.73.	Standard rate 15%. Lower rate [added]: certain grant-funded installations of heating equipment; children car seats; certain pharmaceutical products. Exemptions [added]: works of art. GRT: €80,000. AAC: 0.28%. NVT: 1.9.

Sources: OECD (Various Years), OECD (2004, 2009), Eurostat. Used abbreviations: AAC Aggregate administrative costs for tax functions as % of GDP; GRT General registration threshold; NVT Number of VAT registered traders (millions). In the 2000 column, the value of NVT is for 2003, as this data is not available for previous years. 2000 is the benchmark year. For coverage of lower rates and exemptions in 2000, refer to the 2001 edition of OECD (Various Years). The 2009 column lists only the low rate goods and services/ exemptions, which have been added/removed as compared to 2000.

Edoardo Beretta[1]
The Irreplaceability of cash and recent limitations on its use: Why Europe is off the track[2]

Edoardo Beretta
Research and Teaching Post-Doc Assistant,
Università della Svizzera italiana, Switzerland

Abstract

The paper questions whether cash payments, in any post-industrial economy, are merely a barbarous relic of the past and whether they should be replaced by dematerialized payment methods. Our analysis aims to demonstrate that, being faster and more 'expendable' than bank transfers, cheques and other forms of credit, liquid money represents a natural drive towards economic flexibility and growth. From a behavioural perspective, cash resources entail reassuring as well as emotive components, which have ancestral origins and cannot be simply rooted out by law.

1 Edoardo Beretta, PhD, c/o Università della Svizzera italiana (USI), Faculty of Economics, Via Giuseppe Buffi 13, 6904 Lugano (CH), edoardo.beretta@usi.ch.
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Another major critical issue in today's academic and political debate is the alleged contribution of cash transactions to avoiding capital traceability. In the same way as not every hard-copy letter can necessarily be tracked, there is no specific economic need for limiting cash payments. Nevertheless, in several European countries (Belgium, Italy, Portugal, Slovakia, and Spain) a clear trend has emerged towards setting a limit to the use of cash, based on the wrong assumption that it can curb capital flight and tax fraud. Instead, not only are these upper cash ceilings – mostly introduced in crisis year 2012 – unlikely to have a negative impact on consumption (depending also on economic and local factors), but they may also cause panic waves in times of economic trouble. These phenomena are all the more plausible given the imperfect substitutability of cash by other payment instruments. Bad communication by economic bodies combined with the increasing taxation of intangible financial assets (see: the Tobin Tax) and the risk, albeit occasional, of haircuts on bank accounts (see: Cyprus banking crisis) do not represent a coherent marketing strategy in support of dematerialized payment instruments. Upper limits on the use of cash, therefore, threaten economic agility and are also likely to have recessionary repercussions. However, as the Swedish case shows, accepted means of payment may be restricted by agreement, since no physical or juridical person should be obliged to accept cash unlimitedly, provided this condition is clearly stated before closing the deal.

1 Introduction

Are cash payments perhaps a barbarous relic in post-industrial economies? They certainly are. Should cash therefore be progressively replaced by cashless payment methods? Despite widespread criticisms, it definitely should not. This is precisely what this paper aims to prove, by answering:

1. why paper money and cash payment instruments are necessary to maintain a primary source of economic growth;

2. why dematerialized payment methods are used particularly by banking institutions, while economic subjects prefer to adopt rather diversified payment instruments;

3. why the abolition of cash transactions is not the proper solution to reduce capital flight and tax fraud.

More precisely, the paper has been conceived as an economic memorandum, to prompt a thorough investigation of this monetary issue from an academic and political perspective. To this end, the approach we have adopted is mostly analytical, even though statistical data have also been used to empirically corroborate the theoretical findings. The fact that cash is irreplaceable has to be proved mainly on an inductive basis by indicating the deep-seated reasons that make it so. Money and, especially, material payment instrument namely entail an emotive component, which must be taken into account while weighing pros (e.g. benefits) and cons (e.g. costs) of using tangible payment methods.

To put it differently, nowadays cash and dematerialized payment instruments are imperfect mutual substitutes, although particularly innovation-friendly societies like Sweden may have opted for nearly completely banning cash payments in practice ("Cash is used relatively infrequently in Sweden, compared with other countries, while cards are used to a great extent" (Sveriges Riksbank 2013, 7)). Money is therefore not only a means of payment as well as a unit of account, but also a "symbol" or "sign" (Smelt 1980, 204) meaning "national identity" (Maurer 2006, 27). Generally, symbols and signs are representations of material forms and would lose most of their iconic meaning if they were a mere abstraction. If psychological explanations were the only obstacle to restricting or even abolishing cash payments, we could decide to ignore them. On the contrary, the paper sets out to demonstrate why cash remains an irreplaceable payment method, which, if limited or eliminated by law, could have detrimental consequences on the wellbeing of the economy.

2 Advantages from cash (that barbarous, but necessary relic)

Paradoxically, paper money and coins – the main instruments for making cash payments – seem to have turned into an archaism in the 20th century, while remaining at the same time indispensable.

Not surprisingly, money is increasingly regarded by the banking system as a dematerialized payment instrument, which enables financial institutions to make and receive payments nearly instantly. And there would be nothing wrong with this, if money were still conceived as a quantum of physical goods, as was the case centuries ago. More precisely, the vehicular and dematerialized essence of modern money is particularly true of, and accepted by, financial systems, as the following quotation from the Bank for International Settlements shows: "settlement of a securities trade involves the transfer of the securities from the seller to the buyer and the transfer of funds from the buyer to the seller. Historically, securities transfers involved the physical movement of certificates. However, in recent years securities transfers have increasingly occurred by book-entry" (Bank for International Settlements 1992, 11). However, individual subjects, who are not frequently involved with banking and financial procedures, prefer to use material money instruments. The Deutsche Bundesbank has highlighted that cash payments are still predominant and still represent 53% of all transactions, although between 2008 and 2011 e-money has registered an increase of 6% (Deutsche Bundesbank 2012b, 9). How do we explain this? There are emotive components to the particular statistical evidence, and they play a significant role, especially with concepts like "money", "savings" and "wealth". More precisely, non-financial private subjects like residents, retirees, savers and small investors are aware that modern money is frequently dematerialized and savings are often held as stock/bond shares; yet they are prone to hold (at least) a portion of their savings in the form of physical assets. This mindset, or modus cogitandi, has ancestral roots going back, on the one hand, to precious metals (gold and silver), which were used until the breakup of

gold standard regimes in the 1930s as payment instruments and store of wealth; and on the other hand to subliminal epitomes of money and wealth. A memorable fictional example of these complex psychological or emotional components may be seen in the comic-book character Uncle Scrooge, Walter Elias "Walt" Disney's ingenious creation. These apparently "soft" elements showing why money is often still conceived as a tangible asset are nonetheless crucial in predicting and understanding the impact of any economic reform. In the same way as fixed exchange-rate regimes like the currency-board system, dollarization, and monetary unification have an emotive impact on people's minds, which often present a sceptical attitude towards abolishing the national currency (cf. Dollarization and monetary unification) or deprive it from a significant part of its monetary sovereignty (cf. currency-board system), non-financial private residents will probably feel safer in thinking of money and economic wealth as a portfolio of coins, paper money, cheques, share/bond stocks, certificates of deposits, etc.

Besides rather emotive components supporting money in its material form, cash money represents a natural impulse towards economic flexibility and growth, because it is often much faster and easier to use than bank transfers, checks and other credit forms. There is no denying that vehicular money, generally used by banks and financial institutions to make payments, benefits from an even higher money velocity, which is ensured by the fact that bank money is almost instantly transferable from payer to payee. This procedure is facilitated by modern clearing and settlement systems, which have partially deprived payment instruments of their physicality. Nevertheless, if we think of economic wealth (and growth) we should always keep in mind that Gross Domestic Product (GDP) is the aggregation of consumption (C), investments (I), Government spending (G), and net exports (X – M):

$$Y = C + I + G + (X - M).$$

On the one hand, investments (I), government spending (G) and net exports (X – M) are mostly settled by means of several payment instruments, not necessarily represented by cash money. On the other hand, consumption (C), which is often not only the largest GDP component, but indeed the most psychological and pervasive one, is strongly influenced by the amount of disposable cash payments. It stands to reason that private residents will probably not buy goods and services unless they feel sufficiently (economically) safe. This perception of "economic safety" is particularly subjective and influenced by irrational as well as more rational components like disposable income. For instance, the change in the propensity to consume of German people after the reabsorption of high unemployment rates (2003 – 2005) in the wake of the Agenda 2010 (2006 – 2013) has been motivated by a more pronounced perception of economic safety, which is also corroborated by statistical evidence like the GfK-Konsumklima-Index (Gesellschaft für Konsum-, Markt- und Absatzforschung e. V., 2014). But what is the link between "economic safety", consumption expenditure and cash payments? If we admit that:

– "economic safety" is directly interconnected with net disposable income;
– consumption rates are interlinked with economic and social factors, often striking a precarious balance;
– cash payment instruments are characterized by ancestral emotive components, which remind people of by-gone times when money and wealth were entirely material or even gold-bound;

then there is a clear relation between increasing "economic safety", soaring consumer spending and cash payments, the most common settlement method in several post-industrial countries like Germany:

$\Delta \uparrow$ "economic safety" $\Rightarrow \Delta \uparrow$ consumption $\Rightarrow \Delta \uparrow$ payment volumes (in cash too).

Scientific research has sometimes evinced that the use of dematerialized payment methods leads to a higher degree of propensity to consume because, in people's minds, transfers of non-physical amounts of money are seen less as actual spending. That notwithstanding, readers should bear in mind that paper money and coins are (generally speaking) accepted worldwide, while the same cannot always be said of e-money and, more specifically, ATM cards or credit cards, as recent publications have highlighted (Drehmann, Goddhart, Krueger, Boldrin and Rose 2002, 216). Furthermore, cash payments are not subject to transaction fees the way e-money transactions often are (Migliaccio and Sirletti 2011). One additional drawback is worth mentioning: payments carried out electronically are often capped if they exceed a given contractual limit.

Furthermore, the concept of "payment finality", which has been defined by the Bank for International Settlements (BIS) itself and has been dealt with in several publications ("[F]inality of payment" has acquired diverse meanings. In one sense, it has come to denote the irreversibility of the payment process, particularly in connection with insolvency. Otherwise, it has also been taken to signify the loss of the right to recover a mistaken payment. Finally, it has been used to mark the accountability to the payee/beneficiary by a bank instructed to pay to that payee/beneficiary" (Geva 2008, 633-634)), embodies two (slightly) different connotations depending on the non-physicality of payment instruments. In fact, private residents are fairly confident of having fully settled the outstanding amounts only when they have disbursed those amounts in cash. Obviously, this is equally true of cashless payment instruments, although these transaction methods are perceived as less reliable in terms of "payment finality" inasmuch as the payer's credit card details are revealed to the payee or has had negative experiences in terms of data theft. Indeed, if "economic safety" is a significant factor behind growing consumption rates, unsafe (or perceived as such) payment methods do in turn not stimulate consumption expenditure. Another observation with specific regard to the concept of "payment finality" has been highlighted in the following way: "only currency, which is legal tender, provides for an immediate final settlement of the transaction in which it is used. The other are linked to the payers' bank accounts or credit lines

extended by the card issuers. […] In the case of account-linked instruments the costs are generated by the credit verification, bookkeeping, and communication with the central operators of the system. Because of the cost structure, currency is still the dominating means of payment in small transactions, whereas the account-based instruments are used mainly for medium-sized and large transactions" (Shy and Tarkka 2002, 299). Interestingly enough, the dichotomy between "small payments" and "medium-large payments", where the former usually pertain to individual non-financial subjects while the latter to financial (or, at least, more financialized) agents, can still be felt and is likely to characterize the near future too.

Nevertheless, as we have already seen, sometimes economists ignore or fail to give due consideration to psychological factors, which are at least as important. In the light of the previous reflections, it is possible to assert – even at the risk of exaggerating – that the abolition (or even limitation) of cash payment methods would have the same destabilizing effect as the demonetization of precious metals, which at the time of the gold standard (approximately 1870 – 1914 and 1925 – 1935: the classical and interwar gold standards, respectively) or the gold-exchange standard were often perceived as the key collateral to cover (paper) money issues. Nowadays, in the absence of gold-bound economic systems, cash plays the same role as precious metals did with respect to paper instruments: tangible payment methods are therefore, whether we like it or not, considered to be safer, at least by consumers. This finding is particularly true during economic crises, as recent empirical evidence demonstrates. In the same way as "between 1958 and 1962 the average U.S. gold loss increased sixfold to nearly $1.4 billion per year [and t]he U.S. gold stock declined by $6.8 billion or 30% as foreign countries converted dollar reserves into gold" (Bordo, Humpage and Schwartz 2006, 7) amid fears of economic instability caused by soaring US current account deficits, bank runs, arguably a thing of the past in post-industrial banking systems until Northern Rock collapsed in 2007, are the best proof of the fact that tangible payment methods, i.e. cash, are implicitly perceived as more reliable than intangible ones. In the case of the above mentioned bank savers asked in fact to withdraw their deposits and not to transfer them to another bank account: a far from negligible event indeed. Interestingly, this circumstance does not go unnoticed in times of economic turmoil, while it is rather buried in oblivion in times of widespread "economic security".

There is another commonplace worth mentioning in the present context. The economic community easily falls prey to a prejudice, which consists in associating:

1. cash payment methods with "obsolescence";

2. non-cash payment methods with "modernity".

In the light of this, Table 1 contains statistical data on the value of banknotes/coins as a percentage of GDP for selected non-EMU countries or country groups as compared to the Eurozone itself.

Banknotes and coins in circulation: value as a percentage of GDP Table 1

	2008	2012	Change (%)
Euro Area	8.50	9.78	+1.28
Hong Kong SAR	10.88	14.79	+3.91
India	12.27	11.78	-0.49
Japan	17.17	19.26	+2.09
Russia	10.61	12.26	+1.65
Singapore	7.74	8.42	+0.68
Switzerland	9.13	10.93	+1.8
United States	6.05	7.20	+1.15

Source: Bank for International Settlements (2013, 439)

For instance, Singapore, Switzerland and the United States of America are respectively the fourth, fifth and seventh most relevant countries in terms of GDP per capita (World Bank 2014), which is considered not only the principal measure of economic wealth, but also a good approximation for (high/low) living standards and, conceivably, economic modernity and development, too. If notes and coins had already become a thing of the past or, more specifically, were perceived by their users as 'barbarous relics', how could the amounts of cash instruments still circulating in those (modern post-industrial) countries be explained? They cannot be. In other words, there seems to be no a-priori 'one size fits all' answer to the question of which payment instrument(s) to use in which country.

Now, if economists and politicians fail to fully recognize the economic and psychological role of cash payments, paper money and coins will become a truly anachronistic payment method, and lose any remaining raison d'être. In the light of this, the trend towards cash payments limitations – especially in the European Union (EU) – is not only economically hard to explain, but also potentially detrimental to economic growth. As we have already seen, consumption expenditure (C) is often the largest component of the GDP relation: if the most common payment method in several EU countries, namely cash, becomes limited in use by law, then this measure is more than likely to have a negative impact on economic growth. Tertium non datur. Having thus analysed theoretically some key benefits of making cash payments, let us now investigate the main reasons behind this new trend to reduce cash transactions, and demonstrate why it is profoundly misguided.

3 The drawbacks of cash (that barbarous, but necessary relic)

A major target of criticism in today's academic and political debate is the alleged contribution of cash transactions to avoiding capital traceability. It goes without saying that cash payments are less controllable by public authorities than digital (e.g. electronic) transaction methods. But does this fact necessarily mean that preference for cash is to be denounced, denigrated, or suspected of facilitating illegal activities? Not so. In the same way as not every mail typology is easy to track down or retrieve, there is no specific economic need for limiting cash payments in order to allegedly ensure more traceability of (inter)national capital flows.

Nevertheless, if we think of cash payments as the German Finance Minister, Wolfgang Schäuble does, namely as "intransparent payment methods" (Ramthun 2012), we should ask ourselves why the majority of German citizens still use cash. Is it because German people prefer an "intransparent payment method" compared to a more traceable one? And if that were the case, why? If we adopted this outlook, we would forsake any accurate approach, to embrace a rather broad-brush one. Nevertheless, in several European countries (e.g. Belgium, Italy, Portugal, Slovakia and Spain) there seems to be a clear trend towards setting limits to the use of cash, based on the wrong assumption that it is, or might be, the only way to curb capital flight and tax fraud. As reported by the European Consumer Centre France (2014), several member countries of the European Union have introduced legal limitations to cash payments or set implicit restrictions on them deriving from daily practice (Table 2).

Cash payment restrictions in the European Union: an overview Table 2

Belgium	€3,000	1 January 2014
Bulgaria	BGN 10,000 (≈€5,112)	1 July 2011
Czech Republic	CZK 350,000 (≈€12,763)	1 January 2013
Denmark	DKK 10,000 (≈€1,340)	1 July 2012
France	€3,000 (residents and non-resident traders) €15,000 (non-resident consumers)	1 January 2002
Greece	€1,500	1 January 2011
Hungary	HUF 1.5 million (≈€5,000) (legal persons)	1 January 2013
Italy	€999.99	6 December 2012
Portugal	€1,000	14 May 2012
Slovakia	€5,000 €15,000 (natural persons being not entrepreneurs)	1 January 2013
Spain	€2,500 (residents) €15,000 (non-residents)	19 November 2012

Source: European Consumer Centre France (2014); Véber and Brosch (2013)

At first sight, there may seem to be no significant empirical evidence that member countries, which have decreed legal or practical limitations to cash payments, have been particularly subject to recent crisis episodes. In order to formulate a more precise analysis it may be useful to highlight those countries in Table 2 whose GDP growth rates were down in 2013. In fact, 2013 is particularly emblematic, characterized as it was by a discordant economic evolution at the European level: some countries registered economic growth results, while other (weaker) ones did not benefit from those economic improvements. By doing so it appears that several countries still affected in 2013 by the economic and financial crisis have legally set a limit to cash payments. It would be preposterous and unscientific, we feel, to claim that precisely those cash limits are to blame for negative growth rates in

those countries in 2013. Nonetheless, it remains a fact that the countries analysed, for which reliable data are available (European Consumer Centre France (2014)), have been affected by two different approaches (cash limitations versus unlimited cash usage) and negative/positive growth rates.

Curiously enough, the EU Directive 2005/60/EC is far less restrictive in terms of cash limitations, as confirmed by the upper limit set, namely 15,000 Euro (European Union 2005, 16). In fact, the European Central Bank (ECB) has often pleaded for adequately "weighting the measures proposed […] against the public benefits expected to be derived from them in order to ensure that the effects of those measures do not go beyond what is necessary for achieving the objective of combatting tax fraud and criminal activity" (European Central Bank 2013, 3). The same formulation has been incorporated in other official statements (European Central Bank 2012, 3) and, although it may sound like a standardized formula, the message is particularly clear: the fight against tax fraud and criminal activity is legitimate and an absolute necessity, provided it safeguards the main principles of liberalism, it does not endanger legal economic transactions, and does not criminalise cash holdings per se (Maxeiner and Miersch 2014), which are still the legal tender and have been used unrestrictedly as of very recently.

There is no doubt – if we are to judge the statistical weight of cash payments – that some tax frauds are perpetrated by making cash payments, although the flip side of using more e-money is cybercrime (Rising 2012). In this specific regard, it may not be coincidental that German people have a preference for ATM cards (e.g. EC-Karte) as compared to credit cards – 28% of total expenses are namely settled by making use of EC-cards while only 7% by using credit cards (Deutsche Bundesbank 2012a) –, because ATM cards have a pin code and are therefore seen as more secure. Nonetheless, this observation does not justify the resolution, apparently envisaged by the European Union, to limit or even abolish cash payments, on account of allegedly being used as an instrument to conduct illicit activities. Even admitting

they are, they certainly are not the only one and, more importantly, not the root of all tax evasion or similar fraudulent activity. It would be simply illogical to claim that – since public authorities are powerless to prevent illicit transactions – the most common payment method in post-industrial countries must be restricted. Perhaps, if this decision had no detrimental repercussion on economic activities and growth, we could decide to adopt cash payments restrictions. But, as we have already seen, cash instruments are possibly a barbarous relic, but they are still necessary to stimulate consumption spending and, more generally, to allow people to decide which payment method they prefer. This last point, i.e. the freedom to choose – to borrow a felicitous phrase from Milton Friedman's legendary book title (Friedman and Friedman, 1979), is a true condition sine qua non in liberal societies, which cannot in any case be restricted without first holding a referendum allowing citizens to exercise their rights to vote on it.

Another negative consequence, which has not been mentioned before and is directly related to the aforementioned freedom to choose, is inequality in cash payments limitations. Clear evidence of the fact that Governments should sometimes avoid intervening in economic operations is provided by the French case, characterized by two different cash acceptance thresholds, namely €3,000 for fiscal residents in France and €15,000 for non-residents acting as consumers: the same disparity is true of Slovakia (cf. Table 1). In fact, there is no plausible economic reason to justify this decision, which explicitly discriminates French residents who are, after all, the main fiscal contributors to the French State budget. Why should they be subject to a more restrictive upper limit to the acceptance of cash payments compared to non-fiscal residents, while the latter, not being fiscally indictable in France, might be encouraged to engage in unlawful transactions? In truth, we would be hard put to come up with a credible explanation for such a policy. Maybe, public authorities have preferred to enable people travelling abroad to continue making payments in cash, because empirical evidence proves that the majority of travellers in several countries like Germany (Deutsche Bundesbank

2012b, 10) still prefer cash instruments. In any case, such measures are potentially recessionary and unquestionably unjustifiable from an economic viewpoint as well as in terms of freedom of choice.

Furthermore, there is no clear correlation either between cash limitations and more financial legality, as the German case (characterized by no cash thresholds and less tax evasion than in the Italian case despite restrictive cash acceptance prescriptions) clearly demonstrates. The point at issue is that cash payments are often judged with suspicion by public authorities and the media. In any democratic society, which the European Union has represented since its very foundation, there should be no a-priori suspicion towards licit preferences and, more specifically, transactions settled in cash. Italy is a prime example, where 90% of all transactions are settled in cash (Ardizzi and Iachini 2013, 5): older people but also traditional individuals have a clear preference for cash instruments, which should be accepted for what they are, namely a preference. The attempt by national Governments to impose decisions without the general approval of the population tends to end up fomenting social conflicts and generating distrust of public authorities, which is in no way affordable in the middle-to-long term. Even admitting that cash restrictions may reduce illegal transaction volumes, we do not believe that this 'one size fits all' approach is worth pursuing as a means to deter honest citizens and travellers from freely choosing their payment method and, more dramatically, from purchasing what they want at the price they are ready to pay or can afford (dampening therefore generalized economic growth)? We don't really believe so.

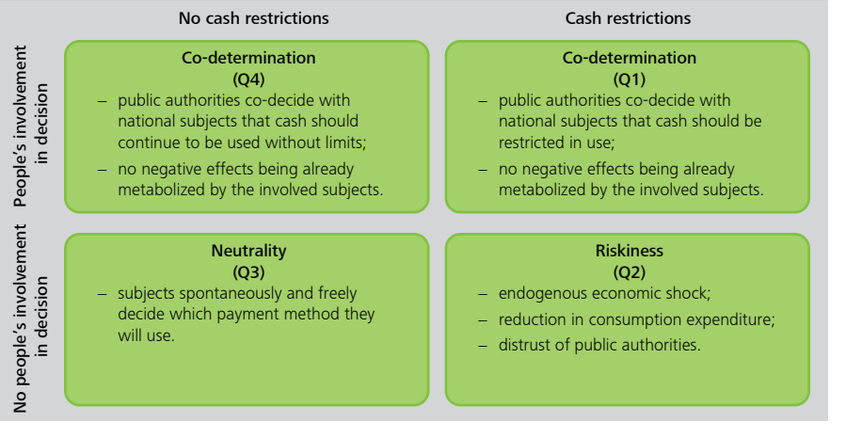
Therefore, public authorities should carefully weigh up whether:

1. to introduce cash limitations (Quarters 1 + 2);
2. to have no cash restrictions (Quarters 3 + 4);
3. to get people involved in the decision process (Quarters 1 + 4);
4. not to get people involved in the decision process (Quarters 2 + 3).

As shown in Figure 1:

1. (no) cash restrictions combined with people's active involvement in decisions (1st quarter + 4th quarter) are characterized by democratic co-determination, which will not in any case lead to (negative) effects, already metabolized by the subjects involved (who have also participated in the decision process);
2. cash restrictions without people having been actively involved in the decision-making process (2nd quarter) are particularly risky and likely to have negative repercussions on consumption expenditure and (dis)trust levels in public authorities. Furthermore, endogenous economic shocks are also expected to occur, because national individuals might disagree with the resolutions taken and take individual measures to reduce the impact on their lives;
3. no cash restrictions without people having been actively involved in the decision process (3rd quarter) are neutral in terms of economic effects, because national citizens spontaneously and freely decide which payment method they will use.

The matrix of (no) cash restrictions and (no) people's involvement in decision Figure 1



Source: own representation

Based on these observations, we claim that cash restrictions are not necessarily detrimental or likely to have a negative impact on the wellbeing of the economy. In fact, any potentially negative outcome of cash limitations is caused by failure to fit, or adjust, economic measures (e.g. the decision to restrict cash use) to the traditional behaviour and needs of the individual users (e.g. a marked preference for tangible payment instruments). In other words, there is no a-priori "right" or "wrong" judgement, only contextually well or badly designed economic measures. The same conclusion, namely that there is no such thing as a magic bullet or 'one-size-fits-all' solution, equally applies to the ongoing debate on the abolition of big bills (e.g. 200 and 500 Euro banknotes), which can be:

1. undoubtedly useful in some countries where private individuals tend to settle (even) high-value transactions in cash;

2. completely useless in other countries, where there is a high propensity to use cashless payment methods to settle high- as well as low-value transactions.

Prominent economists have pleaded for abolishing high-denomination banknotes (Rogoff 2014). That notwithstanding, "[u]sing the high denominations (€200, €500), people can hold large sums in cash. They serve mainly as a store of value, but are also used to purchase expensive items. […] The €500 notes, with an overall circulation value of €290 billion, accounted for 30% of the total banknote circulation value" (European Central Bank 2014). More precisely, "high-denomination euro banknotes fulfil an important role as a store of value and are a last resort for storing assets […]. The issuance of euro banknotes follows the demand of the economic agents […]. Therefore, the ECB does not plan to change the denominational structure of the euro banknotes" (Draghi 2012). For instance, in peripheral EMU countries, where cash still rules and people seem not to be ready to limit its use further, abolishing large Euro banknotes could therefore:

1. further reduce consumption expenditures as a consequence of this sudden, external shock;
2. contribute to increase processing costs of banknotes, since economic agents would need – at least ceteris paribus, namely assuming an identically high propensity to use cash as before the abolition of 'big' Euro banknotes – an increasing number of banknote pieces to settle the same transaction and/or hold the same amount as a store of value.

In the latter case, each banknote – regardless of its size, big or small – is loaded with production and processing costs. Although cash payment methods do entail numerical costs, these can be outweighed by their immaterial (not to say difficult to measure) advantages. Undeniably, cash can act as a potent stimulus to consumption spending. The same intellectual approach, incidentally, is also true of pension systems.

An initial repercussion of the recent cash limitations in the Italian case, which is characterized by particularly high levels of cash payments ("The use of cash is still predominant: it has been estimated that in 2010 cash accounted for about 90% of all micropayments" (Bank for International Settlements 2012, 247)), has been highlighted by critical media. As empirical evidence demonstrates, consumption expenditure by Italian people has shrunk by 2.6% in 2013 (Organisation for Economic Co-operation and Development (2014)). Of course, this trend is mainly due to high unemployment rates, up from 8.2% in January 2004 to 13% in February 2014 (Istituto nazionale di statistica (2014)), political instability owing to four different Governments in less than three years[3] and, more generally, the economic and financial crisis, which still endures in some part of the European Union. Furthermore, we are firmly convinced that cash limitation of up to €999.99 has added another source of economic distrust leading to an even more pronounced, drastic cut in consumer spending (Trovato 2014). It would be hazardous to assert that the correlation between these circumstances can easily be shown, because every economist and every management and marketing expert knows that consumption is a very sophisticated economic variable.

In fact, consumption expenditure is a consequence of several factors, which do not depend only on one's economic situation, but also on psychological and instinctive inputs, as marketing and behavioural researchers well know (Puto 1987). Upper cash limits are therefore likely to have put a stop to consumer spending, even when people may have had sufficient resources. Does this hypothesis imply that consumption expenditure have been also reduced to avoid capital traceability above the threshold of €999.99? And if so, does it mean that those people are likely to have been (now or in the past) involved in illegal activities, to the point of curtailing consumption expenditure to eschew more transparent payment methods? Not neces-

3 Silvio Berlusconi (2008-2011), Mario Monti (2011-2013), Enrico Letta (2013-2014) and Matteo Renzi (2014 -) (Governo italiano - Presidenza del Consiglio dei Ministri, 2014).

sarily. Cash payments are in fact also a way to ensure more privacy. As we have already said, the consumption and purchase process is something very peculiar indeed, and is not merely the mathematical result of having sufficient disposable income. To be more precise, even a single variable in the entire buying process can be responsible for resolving not to purchase after all. Therefore, there are enough theoretical-analytical elements to claim that even upper cash limits may (have) prevent(ed) people with sufficient economic resources from making purchase decisions.

Concluding remarks

One main contention of this paper was to show why European countries that have recently adopted cash restrictions are off the track. As we have already seen, cash still plays a symbolic role in post-industrial societies, a role that becomes particularly visible in a situation of economic turmoil, characterized by generalized distrust in the banking and financial system (Moss 2013). Interestingly enough, "54% of all payments in the UK [are] made by cash [whose] use increased in the UK last year […]. This breaks the longer term trend of falling cash volumes year-on-year seen over most of the last decade. More people are turning to cash exclusively, possibly to help them monitor the amount they are spending on a day-to-day basis" (Payments Council, 2013). We clearly cannot predict whether this trend is set to continue, or even spill over to the majority of European countries.

At any rate, upper cash thresholds – mostly introduced in crisis year 2012 – are not merely likely to have a negative impact on consumption depending also on conjuncture and local factors, but they may also cause panic waves during economic turmoil. From a behavioural perspective, cash resources entail reassuring as well as emotive components, which have ancestral origins and cannot be simply rooted out by law. These phenomena are all the more plausible in the light of the imperfect substitutability of cash resources by other payment instruments. In fact, bad communication by economic bodies combined with the increasing taxation of intangible

financial assets (cf. the 'Tobin tax') and the (though occasional) risk to be subject to haircuts on bank accounts (cf. Cyprus banking crisis) do not represent a coherent marketing strategy in support of e-money and dematerialized payment instruments. Upper limits on the usage of cash can therefore become a great menace to economic agility and are also likely to have recessive repercussions. However, as the Swedish case tells us, accepted means of payment may be restricted on a contractual basis, since no physical or juridical person should be obliged to unlimitedly accept cash, if this condition is clearly stated before closing the deal. What remains nonetheless true is that:

1. trend reversals in terms of cash usage;
2. high volumes of daily transactions still settled in cash;

provide clear evidence for us to infer that several, or even most, people are not prepared to abandon cash payment methods. If Governments were to try to modify people's mentality by imposing cash restrictions by law, citizens would be inevitably forced to accept them, but fraudulent people will 'structure' transactions, namely "break[…] down large quantities of cash into amounts which will fall under the […] cash transaction reporting threshold" (Australian Transaction Reports and Analysis Centre 2008, 9) while common citizens will be de facto discouraged (at least under specific economic conditions) from purchasing.

No top-down cash limitation will therefore achieve fruitful economic results. On this basis, it appears that the only solution to avoid these damaging consequences is to wait and see whether cash payments will be abandoned voluntarily, i.e. by decision of the payers themselves. Yet, one could argue that this sort of outcome might entail the same (emotive as well as economic) risks as in the case of cash limits fixed ex lege. The profound difference would be that, by relinquishing cash payment methods voluntarily, people would have already metabolized the implications of this decision, which is evidently not true for any top-down resolution.

Finally, let us look a little closer at a particular observation, namely the fact that the American approach to cash payments (where "small-value transactions" (Bank for International Settlements 2003, 438) are particularly often settled in cash) cannot be necessarily adapted to the European case. In fact, the US is notoriously characterized by higher labour flexibility as well as mobility, which indirectly implies less need for cash payment methods and a more pronounced preference for dematerialized payment methods (greater ease and convenience). In turn, the American society is more dynamic than the European one, because of its more recent historical roots and higher propensity for innovation. Thus, member countries of the European Union should find the most appropriate mix, or balance, between dematerialized payment instruments, which is becoming undeniably more relevant, and more traditional payment methods, which should not eliminated or restricted by law. Claiming that use of cash should be legally regulated to prevent tax frauds and illicit activities is no more plausible than asserting that people's phone calls should be indiscriminately intercepted to combat terrorism… . By the way, are we sure it isn't happening already?

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Sibel Aydogan[1] and Leo van Hove[2] Nudging Consumers Towards Card Payments: A Field Experiment

Sibel Aydogan
University of Brussel, Belgium

Abstract

We investigate the impact of soft interventions – so-called nudges – on the way consumers pay at the point of sale. In particular, we set up an experiment in a university canteen frequented by both students and university personnel. In an attempt to steer consumers towards card payments, we administered two temporary interventions. In a first stage, posters with pro-card slogans appealing on customers' sense of loyalty and connection with their alma mater were mounted on the cash registers. In a second stage cashiers were instructed to also explicitly point out that payment by card would be appreciated. Time series analysis shows no impact of the oral prompts, but we have indications that they may not have been implemented

1 Corresponding author: Sibel Aydogan, e-mail: sibel.aydogan@vub.ac.be, vox: +32-2-6292123, fax: +32-2-6292060, postal address: Vrije Universiteit Brussel, Department of Applied Economics (APEC), Pleinlaan 2, 1050 Brussels, Belgium.
2 Leo van Hove, e-mail: leo.van.hove@vub.ac.be

as instructed. The impact of the posters differs for students and employees. For students, we could not detect any effect. For employees, the posters would appear to have increased card usage (by 3 per cent), but only towards the end of the experiment. Also, while employees' card usage is still higher in the first week after the removal of the posters, this effect disappears in the second week. The effect of the posters is thus not lasting. However, the fact that the posters did to some extent nudge employees but not students suggests that nudges are more effective when consumers feel more connected to the merchant.

1 Introduction

In recent years, interest in behavioral economics has been growing. Studying the influence of feelings, motives and attitudes on economic decisions is an increasingly popular topic among behavioral economists and economic psychologists (Kirchler and Hoelzl, 2011). Angner and Loewenstein (2012, p. 642) define behavioral economics as "the attempt to increase the explanatory and predictive power of economic theory by providing it with more psychologically plausible foundations". One field of economics that would stand to benefit from such foundations is payments economics, the study of payment systems, and in particular those studies that look into the determinants of the adoption and usage of payment instruments. A better understanding of these determinants would help social planners, payment system providers as well as merchants in their attempts to steer consumers in the direction of more efficient payment instruments.

A potentially promising tool for such steering are so-called nudges, as popularized by Thaler and Sunstein (2008). Nudges, also called soft interventions, do not radically change the pecuniary incentives or the choice architecture – the context in which people make decisions – but rather harness unobtrusive influences on their choice behavior. As documented by Thaler and Sunstein, 'choice architects' are present in many decisions in our life: decisions about medical treatments, health

care plans, education programs and even the meals we order in a restaurant. Rearranging the dessert bar in a school canteen by putting the healthy desserts at eye level is an example of trying to nudge people towards a healthier diet. By contrast, hard interventions alter people's pecuniary incentives or even simply block certain choices. In a payments context, examples of hard interventions are the surcharges that merchants sometimes apply when customers want to pay small amounts by card (Jonker, 2011) or card-only lanes in supermarkets.

In this paper we analyze payment behavior in a university canteen frequented by both students and personnel. In the canteen we set up an experiment to test two soft interventions. With our nudges we wanted to influence customers' payment choice at the checkout and, in particular, steer them away from cash, towards payment cards. In a first step we used small posters containing a pro-card slogan that was meant to harness social norms in general and appeal to customers' connection with the university in particular. Specifically, the message stated that for security reasons the university preferred card payments. The posters were placed in a visible spot at all cash registers. In a second step, cashiers were asked to also explicitly point out to customers that payment by card would be appreciated.

We evaluated the impact of our nudges by means of a post-experiment survey but also, and primarily, by means of time series analysis. Specifically, we first estimated ARIMA models based on pre-experiment data and then used intervention analysis to test for any effect of the nudges, during as well as after the experiment. Overall, we find that, for university personnel the experiment had a small accelerating effect on the structural decline in cash payments that was already present, but that this effect did not last. For students, however, the nudges do not seem to have had any effect at all.

The structure of the remainder of this paper is as follows. In the next section we present a literature review on payment behavior in general and interventions in

particular. In section 3 we explain the experiment setup. In section 4 we present the data and our evaluation methods. Section 5 presents and discusses the results. Section 6 concludes.

2 Literature Review

Which factors play a role in consumers' choice of payment method? Can we influence this payment behavior? And, if so, how can we steer consumers towards cost-efficient instruments? Researchers in various countries have already investigated (some of) these questions, and have done so in several ways. We distinguish two main groups of contributions, but the reader should be aware that some fall in both categories[3]. The first group of papers either analyzes the use of one specific payment instrument or studies the influence of certain characteristics on consumers' payment choice. These characteristics are typically of two types: characteristics of the transaction itself and consumers' socio-demographic identities. The second group of contributions attempts to analyze the effects of price and cost mechanisms on the adoption or use of payment instruments, typically in combination with socio-demographic characteristics.

To start with the first group, the use of cash as a means of payment has of old been the subject of many a study. The rise of payment cards and their impact on cash usage has kept studies on payment patterns popular. Recent examples, mainly based on household survey data, are Bagnall and Flood (2011) for Australia, Jacobsen and Nielsen (2011) for Denmark, Segendorf and Jansson (2012a) for Sweden, Jonker, Kosse and Hernández (2012) for the Netherlands, Briglevics and Schuh (2014) for the US, and Arango et al. (2012, 2014a) for Canada[4]. The main conclusion of these studies is that when the transaction value is low, cash is used more often. As a result, in most countries mentioned earlier – with the exception of Denmark and Sweden – cash still dominates when it comes to the number of transactions. In terms of value, debit card payments account for the largest share. Also, in all countries the average amount paid by debit card exceeds the average ticket of cash transactions, again illustrating consumers' preference to pay low-value amounts in cash (Jacobsen and Nielsen, 2011; Jonker et al., 2012). This is not to say that there are no differences between countries. For example, for transactions below 5 euro the share of cash payments is much lower in the Netherlands than in Canada, France, and Germany, suggesting more card-oriented payment behavior in the Netherlands, even for low-value transactions (Arango et al., 2014b).

Still in the first group of contributions, other empirical studies show that socio-demographic attributes also affect consumer payment behavior. In most studies, age has a significant impact on the choice between cash and card payments. Using Swedish data for 2006, Bergman, Guibourg and Segendorf (2007) find that card usage increases with age. However, evidence for other countries indicates that this effect is not necessarily linear. Bagnall and Flood (2011) ascertain that in Australia not only older but also younger people use cash more often than people between 30 and 50 years old. In the same line, Dutch data show that younger consumers between the age of 15 and 24 are the heaviest cash users, even more so than those over 65 (Jonker, 2007). For Canada, Arango et al. (2012) find no significant difference in cash usage between individuals in the 35-55 age group and those younger than 35, while the oldest individuals tend to use cash more often. Besides age, other demographic factors that almost consistently prove to significantly correlate with payment choice are income, marital status, education, gender, and degree of urbanization (Arango et al., 2012; Bergman et al., 2007; Jonker et al., 2012; Jonker, 2007; Klee, 2008).

3 For alternative classifications, see Bounie and François (2006) or Bolt, Jonker and van Renselaar (2008).
4 For an overview and an international comparison of the findings of these country-specific studies, see Jonker et al. (2012), Arango et al. (2014b), and Bagnall et al. (2014).

Continuing our overview of the first group of contributions, other transaction characteristics than size matter too. Hayashi and Klee (2003) find, in a study for the US, that cashier presence and self service are significant factors in consumers' payment choice. Bounie and François (2006) study, with French data, the effect of type of good, spending place, type of contact, day of the week, and constraints at the supply side (acceptance by merchants). With the exception of day of the week, all characteristics have a significant influence on payment choice.

Apart from socio-demographic factors and transaction characteristics, consumers' perceptions or attitudes also help to understand their payment behavior. Some authors even argue that the perceived characteristics of payment instruments more often have significant effects on payment behavior than socio-demographics and that the effects are also larger (Arango et al., 2014a; Arango and Taylor, 2009; Schuh and Stavins, 2010). This is because not all consumers perceive and value a given characteristic of a payment instrument similarly, and perceptions can be very subjective, emotional even. Jonker (2007) studies, for the Netherlands, the effect of perceived safety, perceived speed, perceived cost, and perceived ease of use. In a study on Canada, Arango and Taylor (2009) focus on convenience and risk, but also acknowledge other factors such as acceptance, speed, security, access to funds, fees and rewards, record keeping, and budgeting control. Schuh and Stavins (2010) use US data and investigate seven payment characteristics: cost, convenience, safety, privacy, accuracy, timing, and record keeping. Kosse (2013) studies the impact of perceived safety on cash and debit card usage in the Netherlands. Finally, Teoh et al. (2013) concentrate on the effect of self-efficacy[5], trust, security, benefits and ease of use on Malaysian consumers' perception towards electronic payment means.

5 Self-efficacy is an individual difference variable that represents one's belief about her or his ability to perform a specific task or job using a computer (Teoh et al., 2013).

The second group of contributions in the field of consumer payment behavior seek to analyze the effect of price and cost mechanisms on the adoption or use of payment instruments. One way to measure the efficiency of a payment system is in terms of social costs[6]. Schmiedel et al. (2012, p. 6) define social costs as "the costs to society, reflecting the use of resources in the production of payment services; that is, the total cost of production excluding payments made to other participants in the payment chain". The ratio between the social cost of a given payment instrument and GDP differs between countries and sectors, see Brits and Winder (2005); NBB (2005), Bergman et al. (2007); Bolt, Jonker and van Renselaar (2008); Jacobsen and Pedersen (2012); Segendorf and Jansson (2012b), and Schmiedel et al. (2012). Obviously, in practice, merchants' and consumers' choice for a payment means is determined not by (aggregate) social costs but by the private costs of alternative payment instruments (Bergman et al., 2007).

Besides the effect of costs, the literature has also examined the impact of pricing. The paper by Bolt, Humphrey and Uittenbogaard (2008) is an important contribution. It compares, in a two-country model, pricing and non-price effects on the usage of electronic means of payment over the period 1990-2004. The paper focuses on Norway and the Netherlands because consumers face direct, per-transaction fees in Norway, but not in the Netherlands. Bolt et al. (2008) find that transaction-based pricing clearly accelerated the shift towards electronic payment instruments in Norway: the relative rise of debit card use from price and non-price effects is estimated at 10.4 percentage points, with one fifth of this rise caused by pricing. Borzekowski, Kiser and Ahmed (2008), for their part, study the effect of fees charged for PIN-based debit card transactions in the US. Predictably, the fees steered consumers towards signature debit cards or even dissuaded them from using debit cards at all. Bolt, Jonker and van Renselaar (2010) conduct a similar

6 For further reading on costs of payment methods, see Garcia-Swartz, Hahn and Layne-Farrar (2006a, 2006b) and Shampine (2007, 2012).

study with Dutch data, and conclude that retailers who surcharge can expect a significantly lower share of debit card payments than those who do not. They also estimate that removing debit card surcharges would increase the use of debit card payments and reduce the use of cash. Briglevics and Shy (2012) study not so much card surcharges but rather price discounts for paying by debit card instead of credit card, and for paying in cash instead of by debit card. They find that price discounts steer consumers' payment choice towards the merchant's preferred – least costly – payment means, which increases profits. However, Briglevics and Shy cannot ascertain whether higher profits outweigh the (hidden) cost of administering the price discounts. Finally, papers that deal specifically with loyalty rewards confirm that participation in loyalty programs increases credit card use at the expense of other payment instruments (Ching and Hayashi, 2010; Simon, Smith and West, 2010).

Somewhere in between these two main groups of studies, we place the papers by Leenheer, Elsen and Pieters (2012) and van der Horst and Matthijsen (2013) – the two papers that are most relevant for our own research. Leenheer et al. address the questions which factors influence consumers' payment choice and which interventions could alter it. They use a large panel[7], representative for Dutch society, to conduct both a survey and experiments, next to controlled lab experiments with students. Overall, Leenheer et al. conclude that payment behavior is influenced by three factors: perception and attitudes, wallet content, and habits. In their research set-up, several hard and soft interventions prove effective, but the impact varies depending on the user segment. For instance, prompts (small messages at the checkout with variants of the slogan "pleases use cards") are effective for users who chose their payment instrument based on the sector and the value of the transaction, but not for persistent cash users. Unfortunately, Leenheer et al. do not present figures as to the magnitude of these effects. Van der Horst and Matthijsen

7 Longitudinal Internet Studies for the Social sciences (LISS).

(2013), in their paper, conjecture that payment choice is fundamentally based on habits and therefore cannot easily be manipulated. Besides a small-scale neuro-scientific study, van der Horst and Matthijsen conducted a virtual-reality study with a representative Dutch panel[8], where participants had to play a game in which they were asked to shop in a virtual supermarket and to visit a virtual restaurant for a meal. Respondents were told that the study was about their choice between healthy and less healthy options. The aim was to test for the effect of surcharges and pro-card signs. Van der Horst and Matthijssen find that actively promoting card usage by means of signs decreases the likelihood that respondents pay in cash in restaurants (by 33%), but not in supermarkets. Conversely, surcharges on card payments increase the probability to pay in cash in both restaurants and supermarkets (by 45% and 43%, respectively). Crucially, however, none of these effects is significant.

Transaction-based pricing, price discounts, and loyalty rewards are all hard interventions; that is, interventions with the goal of directly affecting consumers' payment decisions. Unlike hard interventions, soft interventions – nudges – rule out any price or cost influence. The original definition of nudging in fact excludes the use of choice constraints or alterations to agents' economic incentives (Marteau et al., 2011). Nudges 'simply' try to affect the choice architecture, the context in which decisions are made, without limiting the choices or directly inducing changes.

Thaler and Sunstein (2008) provide examples of several nudging mechanisms, such as group conformity, the spotlight effect, and social influence. We only elaborate on social influence because it was the inspiration for our interventions in the university canteen discussed in section 3. Thaler and Sunstein identify three categories of social influence. The first category of nudging by social influence is through providing information. Knowing what other people do, decide, or think has an

8 The panel was recruited by CentERdata, a Dutch research institute with expertise in data collection.

impact on our own decisions. The second category is peer pressure. Nudges that harness information or peer pressure have already been used in environmental, societal and health matters. Examples are smart energy meters, consumption data sharing at community level, posters with sales figures of condom packages in Zambia, and manipulations of shelf layout and adjustments of the default fries portion in canteens (Allcott and Mullainathan, 2010; Allcott, 2011; Ashraf, 2013; Giesen et al., 2013; Marlow and Abdukadirov, 2012; Momsen and Stoerk, 2014; Rice, 2013; Torriti, 2012; van Kleef, Otten and van Trijp, 2012). A third way of nudging people's behavior is via priming. Priming involves triggering a signal in the brain that gives impulses towards a certain outcome without the subject consciously experiencing the nudge. For example, participants in a survey on their consumption of a specific food product tend to shift their consumption upwards (Kahneman, 2011; Thaler and Sunstein, 2008).

From a nudging perspective, several techniques for behavioral change can be applied. Seymour and Vlaev (2012) distinguish six types: incentives, mapping choices, defaults, feedback, error expectation, and structuring complex choices. Van Oorschot et al. (2013) add anchors, framing, required choosing, and reminders to the list. Leenheer et al. (2012) classify their interventions based on the timing (antecedent or consequent interventions) and degree of impact (structural or information interventions).

To sum up, payment patterns, and in particular the shift from cash to card payments, have been the subject of many a study. Yet, empirical papers that study the effect of nudges on payment patterns are rare. The contributions of Leenheer et al. (2012) and van der Horst and Matthijsen (2013) come close to what we do, but are based on survey and experimental data, not real-life data. We intend to fill this gap in the literature by conducting a field experiment.

3 Experimental Design

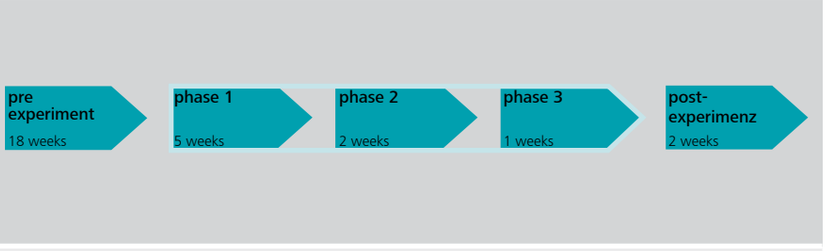
The experiment took place between March and May 2013 in the canteen on the main campus of the Vrije Universiteit Brussel (VUB). On an average day, the canteen has some 1,700 customers. While there are some external visitors among the clientele, the canteen is mainly frequented by students and university staff. The purpose of the experiment was to steer customers towards card payments – the management of the canteen being of the opinion that this would lower their back office costs.

The canteen is designed as a 'free flow' restaurant. A customer takes a tray, selects a menu from different counters and then goes to the checkout. A complete menu consists of soup, a main dish, a dessert and a side order of either rice, fries, or (mashed) potatoes. The restaurant has several main dishes: pasta, wok, vegetarian, grill, two menus of the day, and a light menu. The menus vary depending on the season, but each type of menu has a fixed 'bar'. There are six counters, which are placed in parallel two by two. One couple is immediately adjacent to the dessert bar; the four other counters are across. Counter 6 is only open at peak times and accounts for less than 1% of total turnover. We therefore excluded it from the experiment.

The design of the canteen limited the possible interventions and their implementation. Customers will typically not go to the same counter every day and can choose any of the five checkouts, so working with control groups (for example, vegetarians or users of specific checkouts) was impossible. We therefore decided to opt for a different approach and implement the interventions in such a way that they were clearly visible to all patrons. We thus looked for spots where all customers have to pass, and since the objective of the experiment was to influence the choice of payment means, the checkouts seemed an obvious place to do the interventions.

The restaurant accepts cash, meal vouchers, the Proton e-purse, and the Belgian debit card, which is called Bancontact/Mister Cash[9]. The restaurant does not accept Maestro or credit cards. Debit cards have only been accepted since June 2012. At the time of our analysis – and in particular in the pre-experiment period – they were thus still a relatively recent payment instrument at the canteen and, as we will show in section 4, their relative importance gradually increased over time.

Timeline of experiment Figure 1



We gradually built up the experiment, in five stages spread over 28 weeks (Figure 1). During the pre-experiment period we observed the patterns in payment behavior without any interventions. The pre-experiment period lasted for 18 weeks. The experiment itself consisted of three phases spread over 8 weeks. After the experiment, we continued to observe the payment patterns for another two weeks (post-experiment). This is a relatively short period but the end of the academic year was approaching, and once classes are over, the number of students on campus drops dramatically, thus altering the composition of the clientele of the canteen.

9 The canteen also accepts payments by PingPing. PingPing is a mobile payment instrument for payments up to 25 EUR. More information about PingPing is available on their website http://www.pingping.be/wp/. The use of PingPing in the canteen is nearly zero and not even considered in the dataset. It is therefore not included in any of our calculations.

For the actual experiment we tried out two interventions, following the example of Leenheer et al. (2012). In phase 1, we attached small posters with a pro-card slogan in both Dutch and English on the cash registers of all five checkouts. In phase 2, we added an intervention: cashiers of checkouts 1 and 2 were asked to also explicitly point out to customers that card payments would be appreciated. In phase 3, cashiers did not intervene any longer but the posters remained in place.

In order to select the message on the posters, we set up a pre-experiment survey. Specifically, we wanted to select a clear, informative message that was perceived as steering but that also appealed to customers' connection to the university. In order not to run the risk of influencing the results of the experiment itself, we did not conduct the survey on the campus of the experiment. Rather we distributed questionnaires among students and employees at the University of Antwerp (90 respondents) and at another campus of the Vrije Universiteit Brussel (48 respondents). The respondents were presented with five potential nudge messages, all containing at least one category of social influence as described by Thaler and Sunstein (2008) (Figure 2). The idea was to reinforce the informative component of the message by peer pressure. Specifically, the messages highlighted advantages of card payments: speed, safety, costs, and convenience. In addition, most slogans attempted to evoke a sense of loyalty or connection of the reader towards his or her university.

Five messages evaluated in the pre-experiment survey[10] Figure 2

A	Paying by card is faster. The canteen of the university prefers card payment. You too?
B	Less cash = safer for the university. Payment by card preferred.
C	Cash is expensive. Pay by card and help us save money at the university.
D	The people behind you don't like waiting. Card payments are faster.
E	Looking for coins? Follow the trend. Pull out your card!

Respondents were asked, among other things, if the messages were clear, understandable, and 'steering', and whether they had seen similar messages in real life. At the end of the survey, respondents had to express their preference by ranking the messages. They were also asked to rank the messages according to the level of connection they felt after having read them[11].

In both universities message B had the highest score in both rankings (thus obliterating the need to weight the rankings)[12]. In addition, 81 percent of the respondents perceived the message as steering or very steering, and the scores for clarity and comprehension were above 90 percent. Message B was therefore selected for the experiment. As an aside, only one fifth of the respondents had ever seen similar

10 Messages are translated from Dutch. The selection was based on Dutch-language slogans only.
11 All respondents had to answer the same questions but in order to avoid answering biases we shuffled the order of the options and used five different versions of the survey. We conducted a Kruskal-Wallis one-way ANOVA test to test for group dependency by survey version and university. The results showed that the version of the survey did not significantly the results.
12 For the complete sample, Kendall's tau-b rank correlation coefficient between general preference and level of connection amounted to 0.44.

messages in real life. The use of posters at the cash register is not very established in Belgium, certainly not compared to the Netherlands, where a foundation set up by banks and retailers actively campaigns for debit card payments, with a variety of slogans[13].

To conclude the description of the set-up of our experiment, let us explain how our interventions fit into the typologies of nudges listed in the literature review. The use of posters relies on the mapping technique as described by Seymour and Vlaev (2012). The slogan that we selected emphasizes a specific characteristic of card payments, namely their safety for merchants and for society in general. By providing this information, the posters try to map customers' choice towards the preferred payment means of the canteen management: cards. The second intervention – the oral prompts – could be pigeonholed in van Oorschot et al.'s (2013) category of reminders: the cashiers restate the preference for card payments already signaled by the posters. Crucially, both interventions also try to harness social norms. The first part of the slogan ("Less cash = safer for the VUB.") states that cards are safer. It embodies a descriptive norm – how things are, rather than how things ought to be. The second part of the slogan ("Payment by card preferred.") and the oral prompts both explicitly encourage customers to pay by card. Here the focus is on how customers should pay, which is normative (Cialdini, Reno and Kallgren, 1990; Dolan et al., 2012).

4 Data and Methodology

In order to assess the impact of our interventions, we performed a time series analysis on the turnover data of the canteen. In addition, we also conducted an online survey after the experiment, in June 2013 (n = 438). Among other things,

13 For information on the Stichting Bevorderen Efficiënt Betalen (SBEB), see http://www.efficientbetalen.nl/. Translated literally: Foundation for the Promotion of Efficiency in Payments.

we asked whether the respondents had noticed the slogans and if they had been asked to pay by card at checkout 1 or 2. Respondents who answered affirmatively were also asked about the impact, if any, on their payment behavior.

For the time series analysis we obviously needed pre-experiment and later data. Let us stress that our unit of analysis is not individual transactions: the data are the daily turnover of the canteen per accepted payment instrument (and per checkout), with each day representing one observation. Overall, we have 133 observations: 87 in the pre-experiment period, 37 during the experiment, and 9 after the experiment. Unfortunately, we do not know the volume of transactions per instrument, let alone the size of individual transactions. As a result, we cannot determine whether transaction size matters in the choice of payment instrument, as the extant literature suggests (see the literature review in section 2).

On the positive side, for each customer, the cashiers do record whether she is a student, a university employee or an external visitor.[14] This is because the prices charged at the canteen are based on two criteria: the type of menu and the customer's relation to the university. Cold dishes are always the cheapest and grill dishes the most expensive. For students and external visitors each type of menu has a fixed price, with visitors paying more than students. For university employees, prices for a given menu increase with rank. During the pre-experiment period an employee of the highest rank paid 4.60 euro for a cold dish, compared to 2.65 euro for an employee of the lowest rank. The university canteen is thus an environment with almost exclusively low-value payments[15]. On March 1st, all prices increased slightly as a result of the annual price adjustment[16], but since we work with

14 This information was not available for the first 8 weeks of the pre-experiment period. Because we needed the distinction between employees and students in our analysis, the pre-experiment dataset thus shrank to 25 observations.
15 This makes it less of a problem that we cannot analyze the impact of transaction size; cf. supra.
16 The price rise was on average 2.02%.

percentage shares per payment instrument this does not cause problems for our analysis.

Importantly, the canteen applies a surcharge of 10 euro cents for debit card payments that are smaller than the lowest price of a full menu for the relevant customer segment. Specifically, this means that employees who spend less than 2.65 euro, students who spend less than 4.60 euro, and visitors who spend less than 8.30 euro are affected. For payments in cash, by e-purse or by meal vouchers there is never a surcharge. As it is unlikely that soft interventions overrule hard interventions, for our experiment the implication is that where very small payments are concerned we should not expect to be able to nudge patrons of the canteen in the direction of debit cards, given that the pecuniary incentives go in the other direction. There is the alternative of the Proton e-purse, but although everyone who has a Belgian Bancontact/Mister Cash card by definition also has an e-purse – the two applications reside on the same card – the vast bulk of the cardholders never use the e-purse application. Our post-experiment survey confirms this: while 96% of the respondents have a debit card, only 45% report to have the e-purse application too. Figures for the number of active e-purse users are undoubtedly dramatically lower (Van Hove, 2004).

Weekly average share per payment instrument during pre-experiment period Figure 3

Share of turnover in %

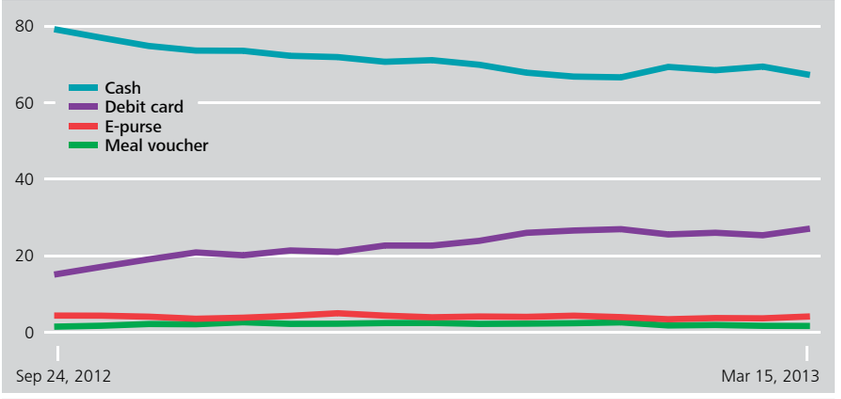


Figure 3 shows, for the pre-experiment period, the weekly average percentage shares in turnover of all (important) payment instruments. On average, cash represented 71%, followed by debit cards with 23%, e-purse with 4%, and meal vouchers with 2%. Crucially, Figure 3 shows a gradual increase in debit card use, at the expense of cash. Unlike for the e-purse and meal vouchers, the use of debit cards had thus not yet reached a stable level – which is not surprising as they had only been introduced in June 2012, three months before the start of our pre-experiment period. The decreasing trend of cash is clearly something that we will need to take into account.

For our analysis, we regrouped the four individual payment instruments shown in Figure 3 in 'paper' (that is, cash and meal vouchers) versus 'cards' (debit card and e-purse). There are three reasons behind this approach. First, the poster we prepared did not specify which type of card – debit or e-purse – the canteen preferred.

Second, as mentioned earlier, meal vouchers and the e-purse only account for a very small (and stable) share of turnover. Third, regrouping the payment instruments enabled us to focus on the relative importance of inefficient (paper) versus efficient payment instruments (cards).

As announced, we mainly gauge the impact of our interventions by means of time series analysis. Since the dataset only captures the choice of payment means, it is a univariate time series that can be modeled by an autoregressive moving-average (ARMA) model. A general ARMA (p, q) is modeled as:

$$\rho_p(L)y_t = \theta_q(L)\varepsilon_t$$

where

$$\rho_p(L) = 1 - \rho_1 L - \rho_2 L^2 - \ldots - \rho_p L^p$$

$$\theta_q(L) = 1 + \theta_1 L + \theta_2 L^2 + \ldots + \theta_q L^q$$

and with lag operator $L^j y_t = y_{t-j}$

The parameters p and q give the order of the AR and MA components, ρ and θ; ϵ_t is a white-noise disturbance term (Enders, 2010; StataCorp, 2011).

Let the d^{th} difference of y_t be denoted by $\Delta^d y_t$, where Δ denotes the difference operator $\Delta = 1\text{-}L$. Substituting y_t by $\Delta^d y_t$ yields the general autoregressive integrated moving-average ARIMA model:

$$\rho_p(L)\Delta^d y_t = \theta_q(L)\varepsilon_t$$

with orders (p,d,q).

Many time series exhibit a periodic seasonal component, implying the need for a seasonal ARIMA model, abbreviated as SARIMA. As default, multiplicative SARIMA models are applied where nonseasonal and seasonal factors work multiplicatively on the time series. A general multiplicative SARIMA model with parameters (p, d, q) $(P, D, Q)_s$ is modeled as:

$$\rho_p(L)\rho_{s,P}(L^s)\Delta^d\Delta_s^D y_t = \theta_q(L)\theta_{s,Q}(L^s)\varepsilon_t$$

where

$$\rho_{s,P}(L^s) = 1 - \rho_{s,1}L^s - \rho_{s,2}L^{2s} - \ldots - \rho_{s,P}L^{Ps}$$

$$\theta_{s,Q}(L^s) = 1 + \theta_{s,1}L^s + \theta_{s,2}L^{2s} + \ldots + \theta_{s,Q}L^{Qs}$$

s is the seasonal period, Δ_s denotes the lag-s seasonal difference operator $\Delta_s y_t = y_t - y_{t-s}$, Δ^d means that the difference operator is applied d times, and similarly for Δ_s^D . P and Q represent the order of the multiplicative autoregressive and multiplicative moving-average component, respectively (StataCorp, 2011).

To select the ARIMA model, we follow the Box-Jenkins methodology as described by Becketti (2013); Box, Jenkins and Reinsel (1994, 2008); Enders (2004, 2010); Gujarati (2003); Mélard (2007) and Suhartono (2011). The Box-Jenkins methodology consists of three iterative steps: model identification, model estimation, and diagnostic checking. After the model selection, we tested the effects of the interventions by means of dummy variables (see Results).

We focus on the pattern of paper payments (y_t)

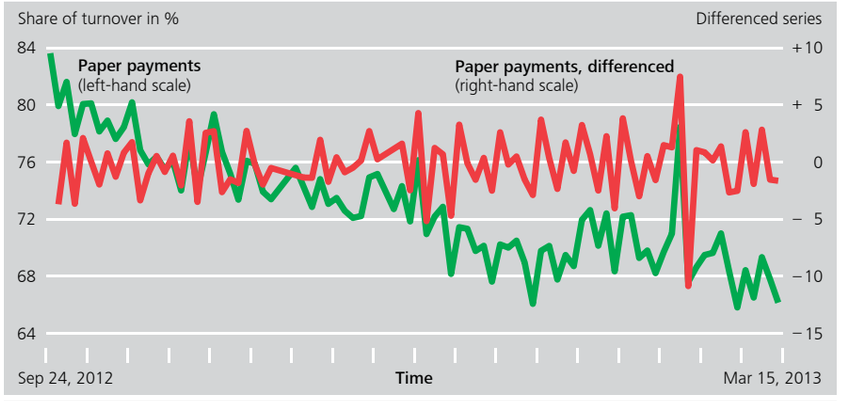
y_t:share of paper payments,

but we could just as easily have done the analysis for card payments. We have data for work days only. Weekends, public holidays and other closing days of the university canteen cause gaps in the time series. In order to have a continuous series, we created a calendar with only weekdays and built the time series based on that calendar[17]. We used ARIMA time series modeling in Stata to analyze the data.

We start the identification of the model by plotting the data that we have for the pre-experiment period. Figure 4 represents the share of paper payments on a daily basis, with the dashed vertical lines indicating the first day of every week. As was already evident in Figure 3, the share of paper payments decreased over time (and the share of card payments increased), suggesting a nonstationary series. Moreover, in the course of a week the share goes up and down, indicating an effect of the day of the week[18]. Phillips-Perron and Dickey Fuller (ADF) unit root tests show that the series contains a unit root and is thus nonstationary when each day of the week is considered separately. Taking the first difference of the data can be a remedy for nonstationarity (Figure 4).

17 Remaining gaps were caused by seven public holidays, but this did not cause problems in Stata.
18 February 27th is a clear outlier, with a spike in cash payments. The explanation lies with a malfunctioning card terminal at cash desk 1.

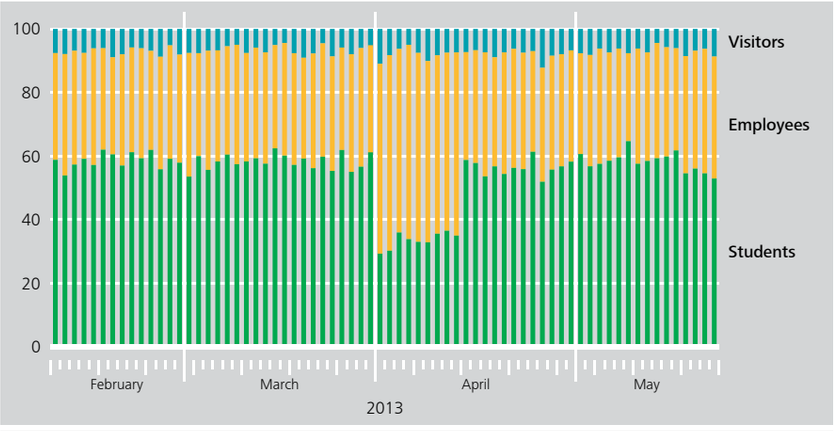
Share of paper payment on a daily basis during the pre-experiment period Figure 4



As mentioned in section 3, the clientele of the canteen consists of students, employees, and external visitors. We exclude visitors from our analysis because they represent only a small proportion of turnover (see Figure 5). They were also not part of the target group of our interventions, as we did not expect visitors to feel connected with the university. We did expect such a sense of loyalty among students and employees (Kim, Chang and Jae Ko, 2010; Meyer, Becker and van Dick, 2006). We even assumed that employees would feel more connected to the university than students, as many of the former have been at the university for quite some time. The results of the post-experiment survey support this assumption[19]. We therefore analyze the payment behavior of employees and students separately, and expect to see a bigger impact of our interventions among employees[20].

19 The association between status and level of commitment was tested by means of a Chi-square test.
20 As mentioned earlier (in footnote 14), the data per user segment is not available for the first 8 weeks. As a result, we have only 5 weeks of pre-experiment data for our analysis.

Share of segments in daily total turnover over time Figure 5

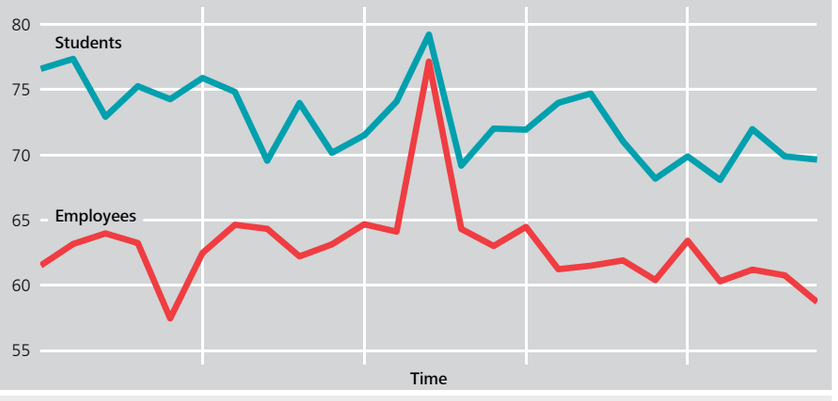


In Figure 6 we plot the share of paper payments in the pre-experiment period separately for students and employees. As can be seen, employees are substantially more card-oriented than students: the share of paper payments is on average 63 percent for employees compared to 73 percent for students.

Just like for the overall series in Figure 4, the series in Figure 6 again show a decreasing trend that suggests nonstationairty. For the selection of the parameters of the (separate) ARIMA models, we apply the autocorrelation function (ACF) and partial autocorrelation function (PACF). Figures 7 and 8 show the ACF and PACF of the share of paper payments for students and employees, respectively. The ACFs reveal the nonstationarity of both series since the functions only decay gradually. The PACFs of the data have an oscillating course, with significant spikes at lag 1 and 2 for students and at lag 1 and 5 for employees. In Figures 9 and 10 we take the first difference in order to eliminate the nonstationarity of the series.

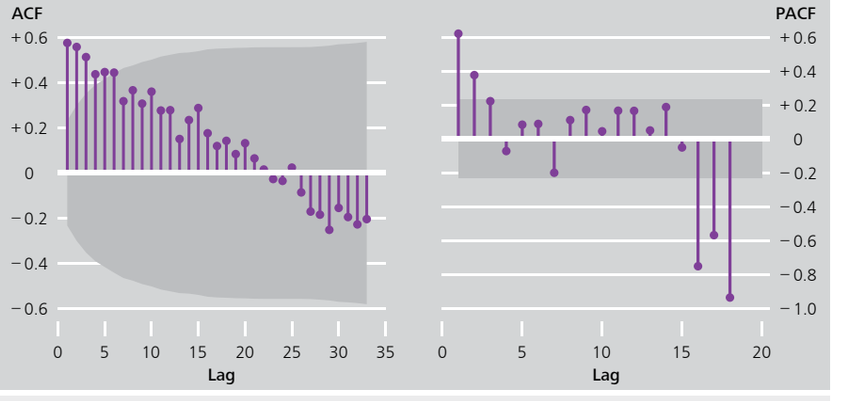
Share of paper payments in turnover before the interventions: students and employees (5 weeks) Figure 6

Share of turnover in %

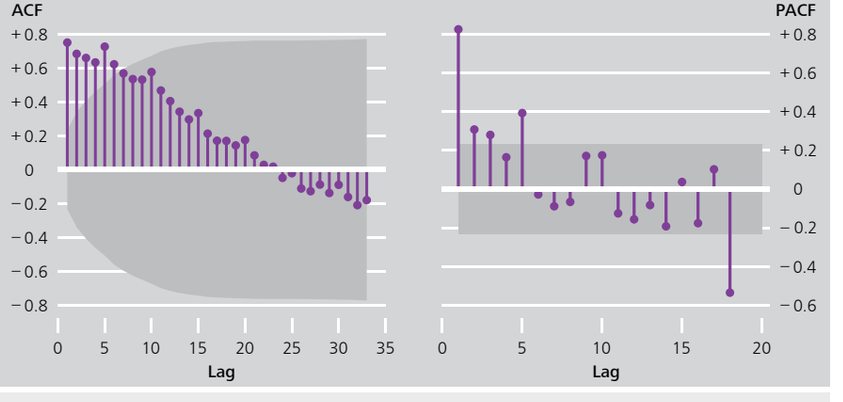


For students (Figure 9) taking the first difference makes the series stationary, so we continue with the differenced series. The clear spike at lag 1 in the PAC function suggests an autoregressive model of order 1. For employees (Figure 10) the first difference of the series does not lead to stationarity. The spikes at lags 5, 10, 15 … suggest seasonality with s = 5. We therefore take the seasonal difference of the series before we proceed. For the selection of the AR and MA components we follow the approach suggested by Mélard (2007). We explore the AC and PAC function of the series, fit simple models, and investigate the residuals. When the ACF and PACF show statistically significant (partial) autocorrelation in the residuals we may add AR or MA components to the fitted model. We test the residuals for serial correlation with the Portmanteau test for white noise (α=5%).

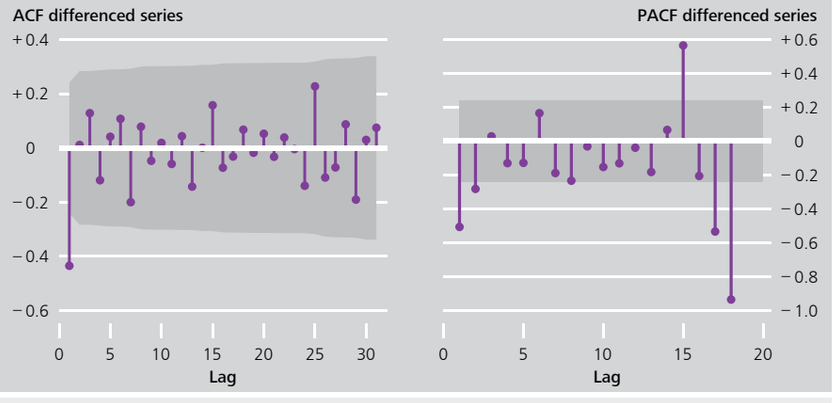
Students: Autocorrelation and partial autocorrelation function of the share of paper payments Figure 7



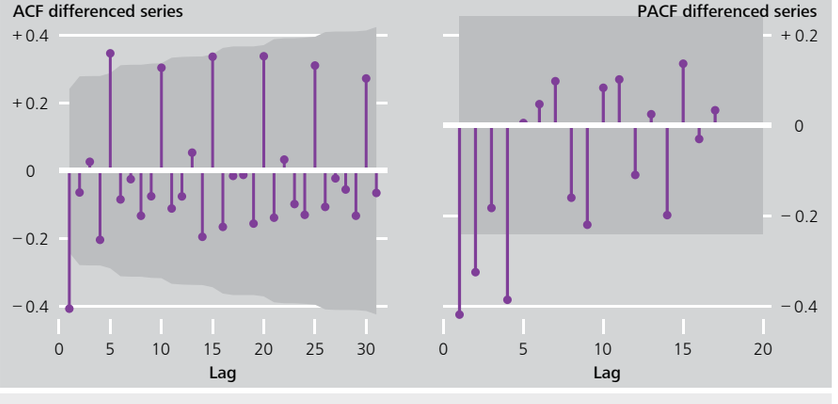
Employees: Autocorrelation and partial autocorrelation function of the share of paper payments Figure 8



Students: Autocorrelation and partial autocorrelation function of the differenced series Figure 9



Employees: Autocorrelation and partial autocorrelation function of the differenced series Figure 10



For students the appropriate model is an autoregressive model of order 1, after taking the first difference of the series. For employees the selected model is a multiplicative autoregressive model of order 1, after taking the seasonal difference with s = 5.

The second step of the Box-Jenkins methodology is the estimation of the model coefficients[21]. The estimation in Stata gives:

For students: $(1-\rho_1 L)\Delta y_t = \varepsilon_t$

$$(1+0.45L)\Delta y_t = \varepsilon_t$$

Standard error	0.19
t	-2.41

For employees: $(1-\rho_1 L)(1-\rho_{5,1}L^5)\Delta\Delta_5 y_t = \varepsilon_t$

$$(1+0.47L)(1+0.46L^5)\Delta\Delta_5 y_t = \varepsilon_t$$

Standard error	0.22	0.17
t	-2.17	-2.73

with y_t: share of paper payments

The final step of the Box-Jenkins methodology are diagnostic checks of the estimated models. We start with the significance of the model coefficients. All coefficients of the models are significant on the 5% level. We continue to check the

21 We opt for models without constants, as the coefficients of the constants are not significant.

adequacy of the models by performing tests of the residuals of the models. As already calculated, the Q statistics in the Portmanteau test show no evidence that the residuals of models differ from white noise. We also examine the cumulative periodogram of the residuals to highlight nonrandom periodicity in the data. The residuals of the models do not exhibit any signs of nonrandom periodicity.

5 Results

In this section we evaluate the impact of our experiment. Did the posters have any effect at all in steering customers towards cards? Did the prompts by the cashiers have an additional effect? And, crucially, are the effects lasting?

In section 5.1 we first present the results of the time series analysis. Next, in section 5.2, we use the post-experiment survey to double check selected results.

5.1 Time series analysis

For a first impression, in Figure 11 we plot students' and employees' use of paper payment instruments a second time. Unlike in Figure 6, we now do this for the entire period. The dashed vertical lines mark the start of, respectively, our observations, phase 1, phase 2, phase 3, and the post-experiment period.

Share of paper payments in turnover: students and employees Figure 11

Share of turnover in %

As can be seen, the decreasing trend in cash usage continued after our first intervention, for students and employees alike. For students we also notice a sharp – but temporary – decline of the share of paper payments between the 2nd and 12th of April, as marked by the solid vertical lines. This period corresponds with the spring break. During the spring break classes are interrupted but most of the university staff is present. Apparently the students who are still on or near campus during the spring break – foreign students who did not return home, doctoral students who continued working, … – exhibit a different payment behavior compared to the overall student population. Since we have no information on who these students are, we can only speculate as to why this is the case.

Table 1 gives an overview of the effect of the interventions, which we introduced as dummy variables. Specifically, the dummy variables take a value of 1 for the

period of the intervention and are zero otherwise. The values in Table 1 represent the coefficients of the dummy variables with y_t : the share of paper payments.

For students the model is: $(1-\rho_1 L)(\Delta y_t - aD_t^i) = \varepsilon_t$

For employees the model is $(1-\rho_1 L)(1-\rho_{5,1} L^5)(\Delta\Delta_5 y_t - aD_t^i) = \varepsilon_t$

As the purpose of our experiment was to encourage card use, and thus discourage cash use, the expected sign of the coefficients is negative.

Effect of interventions on share of paper payments Table 1

Dummy	students	employees
whole period	-0.22	-0.09
separate effect		
phase 1: posters	-0.53	-0.08
phase 2: posters & oral prompts	0.12	0.04
phase 3: posters	2.06	-1.45*
simultaneous effect		
phase 1: posters	-0.53	-0.10
phase 2: posters & oral prompts	0.14	0.22
phase 3: posters	2.06	-1.56*
post-experiment	-0.29	-0.51
first week	1.03	-1.83***
second week	-2.73	0.93

*** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level

First we tested for the overall effect of the experiment. The dummy variable, which takes value 1 for the whole period (that is, for phases 1, 2, and 3), has the correct sign but is not significant. This is true for both students and employees. Then we tested for separate effects, phase per phase. For students we do not find any effect, while for employees an effect is found in phase 3 – the last week of the experiment[22]. Finally, we also tested for a simultaneous effect; that is, all three dummy variables of the three phases of the experiment are tested at the same time. The results are very similar: no significant effect for students in any of the phases and a significant effect for employees in phase 3, but not in phases 1 and 2[23].

Finally, there is the question whether the interventions had a lasting impact. As shown in Table 1, when we consider the whole two weeks of the post-experiment period, we cannot find a significant effect, not for students and not for employees. If we treat the two weeks separately, we again detect no effect for students. By contrast, for employees there is a significant effect during the first week (of 1.8 percentage points), but this effect becomes insignificant by the second week. In short, the interventions had no lasting effect at all for students and only a temporary post-experiment effect for employees.

5.2 Post-experiment survey

In a final step we now have a look at the results of the post-experiment survey so as to improve our understanding of the findings of section 5.1 and in particular the

22 Because the oral prompts were only implemented at counters 1 and 2, their effect is, by definiton, diluted when working with data for all 5 counters. We therefore repeated the tests reported in Table 1 with data for counters 1 and 2 alone. This did not materially alter the results. In addition, we also compared individual cash desks by means of Mann-Whitney tests. However, cash usage at counters 1 and 2 proved to be no different from that at other counters.
23 As an aside, we also checked for an effect of the day of the week (tested over the whole period of the experiment). On Mondays students tend to pay more often in cash, while on Fridays cards become more popular. For employees there is no such effect.

differentiated effect for employees and students. For one, the survey reveals, quite surprisingly, that there is a statistically significant relation between the status of the respondent – student or employee – and simply noticing the posters at all[24] (α=1%). Only 34% of the students reported to have noticed the slogan at the checkouts, compared to 62% of the employees. Second, of the students who had noticed the posters, 21% indicated to pay "more often" by card after having seen the poster, while 40% kept on paying in cash (and 39% already paid by card). Among the employees who had noticed the posters, newly converted card payers represented 25%, diehard cash-payers 32%, and 43% already paid by card. Expressed as a percentage of the total number of respondents, these figures imply that, according to the survey, (only) 7 percent of the students and 15.5 percent of the employees would have started paying more often by card after seeing our slogan. It is thus understandable that we find in 5.1 that our interventions were (somewhat) more effective for employees than for students.

At the same time, the survey results also raise considerable doubts about the implementation of our second intervention, the oral prompts by the cashiers at cash desks 1 and 2. It is very likely that not all cashiers followed our instructions conscientiously. Indeed, only 7% of the respondents indicated that they had received an oral request to pay by card. If we assume that the cashiers only prompted those customers who wanted to pay cash, some 33% of the respondents should have received an oral request[25].

24 Since both variables are on a nominal scale, we used the Chi square test.
25 This figure is computed as follows. We assume, first, that the survey is representative for the customers of the canteen and, second, that cashiers, understandably, saw no reason to prompt customers who already had their card ready. In other words, we need to know the percentage of non-card payers at cash desks 1 and 2. If we multiply the share of cash payments at cash desks 1 and 2 with the share that these desks represent of the total turnover, we obtain 66.31 * 57.70 = 38.26%. In addition, it is not realistic to expect cashiers to promote card payments to customers who spend less than the price of a full menu price as such card payments would be subject to a surcharge (see Section 4). Based on data that we have on the number of menus sold, we estimate that roughly 5% of the turnover consists of such low-value transactions, thus lowering the expected target group for the prompt to 38.26 - 5 = 33.26 per cent of the customers.

6 Conclusion

This paper examines the effect of soft interventions on consumers' choice of payment instrument at the point of sale. In particular, we conducted an experiment in a university canteen by, firstly, displaying pro-card slogans at the counters and, secondly, instructing cashiers to explicitly request patrons to pay by card.

Unfortunately, where the oral prompts in phase 2 are concerned, (some of) the cashiers probably did not follow up our instructions correctly. Hence, we refrain from presenting definite conclusions about the effectiveness – or lack thereof – of the prompts. But it is safe to state that the bulk of the impact probably comes from the posters, especially so because the oral prompts were only implemented at 2 of the 5 counters. For the posters we find a different impact on the two largest segments of the clientele of the canteen: students and university personnel. For students, neither of the interventions had any discernible effect. Employees, for their part, apparently did increase their use of cards, but only slightly so (by 1.6 percentage points, or 3 per cent) and only towards the end of the experiment. The timing of the effect is counterintuitive, but our post-experiment survey results do suggest that it is not due to coincidence, in that a higher proportion of employees indicate that they had noticed the posters and had started to pay by card more often. Finally, our interventions did not have a sustained effect. For employees the impact is still significant in the first week after the experiment but then the share of card usage returns towards its pre-experiment trend.

Although, overall, the results of our experiment are thus somewhat disappointing, with the wisdom of hindsight they are not so surprising. As set out in Section 2, van der Horst and Matthijsen (2013) fail to find a significant effect of pro-card posters in their virtual-reality experiment. Leenheer et al. (2012), for their part, find that posters are not effective for persistent cash users. Moreover, our university canteen is an environment with almost exclusively low-value payments. As documented in

the literature review, for low-value amounts many consumers still prefer cash. In other words, compared to the Dutch experiments – which do not focus on low-value payments – our testing ground is a particularly tough one. An added complication was the existence of surcharges for very small payments. To end on a positive note, the different impact of our slogan on students and employees is interesting in itself as it seems to indicate that, in line with our hypothesis, nudging consumers towards card payments is (slightly) more effective when consumers feel more connected to the organization or institution where the payment takes place[26]. In our view, this merits further research.

Acknowledgements

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26 There are competing explanations: for one, students are younger and, as the literature review documents, younger people have a stronger preference for cash; second, students might receive their pocket money in cash or might be paid in cash for student jobs; and finally, the surcharges are less of a problem for employees than for students because for employees they kick in at a higher threshold than for students. However, with the data that we have we cannot discriminate between these explanations. Further research would be needed.

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Epilogue

Ralph Rotzler
Deutsche Bundesbank,
Germany

I am extremely pleased that we were able to attract so many high-calibre speakers and participants for the Deutsche Bundesbank's second Cash Conference. The conference programme was wide-ranging and covered a broad spectrum of topics relating to cash, from the costs and benefits of cash and cashless payment instruments through to the role of cash in financial crises and to studies on payment behaviour, to name just a few of the areas discussed. The papers presented here have made clear that cash is a field of research that overlaps with many other fields, such as cashless payments, monetary theory and policy, and experimental behavioural research.

The enthusiastic presentations of the issues at a high academic level coupled with the lively discussions have shown that cash plays a big role for a relatively small academic community. I would like to thank everyone who helped making this Cash Conference a success and I hope that more in-depth research on cash-related topics will be conducted in the coming years. As I see it, research into issues relating to cash

again took a significant step forward during this conference, but the questions that remain to be explored are multiplying rather than decreasing. This is particularly evident in view of the fact that certain circles question the very existence of cash.

As the Deutsche Bundesbank, we aim to promote research into topics relating to cash and the exchange of information and views among researchers in the future as well. That is why we are planning to hold the third Cash Conference in 2017. The success of our first two conferences has motivated us to turn them into a series of events, and we hope that many more conferences will follow the third one. I look forward to seeing the findings of the latest research being presented in 2017 and to exchanging personal views and experiences with you all.

Yours Ralph Rotzler

Photographs
Welcome reception 15 September 2014
Swissôtel Dresden am Schloss

Photographs
Official Dinner 16 September 2014
Schloss Eckberg Dresden

Photographs
Dinner 17 September 2014
Festungsmauern Dresden

Conference Programme 2014
15 – 18 September 2014

Monday, 15 September

18:00 – 19:30 Welcome reception

Tuesday, 16 September

09:00 – 09:15 Welcome
Helmut Rittgen (Deutsche Bundesbank, Germany)

Session I: Costs and Benefits of Cash and Cashless Payments
Chair: Dario Negueruela (Banco de España, Spain)

09:15 – 10:00 **Costs and Benefits of Cash and Cashless Payment Instruments in Germany – Overview and Initial Estimates**
Prof Dr Franz Seitz
(Ostbayerische Technische Hochschule Weiden, Germany),
Prof Dr Malte Krüger (Hochschule Aschaffenburg, Germany)

10:00 – 10:45 **Modelling Banknote Printing Costs: of Cohorts, Generations, and Note-Years**
Prof Leo van Hove (Vrije Universiteit Brussel, Belgium)

10:45 – 11:15 Coffee break

11:15 – 12:00 **Merchant Indifference Test Application – The Case for Revising the Interchange Fee Level in Poland**
Dr Jakub Górka (University of Warsaw, Poland)

12:00 – 13:30 Lunch

Session II: Role of Cash in Financial Crises and in Monetary Instability
Chair: Helmut Rittgen (Deutsche Bundesbank, Germany)

13:30 – 14:15 **The Role of Cash for Monetary Policy and in Financial Crisis**
Dario Negueruela (Banco de España, Spain)

14:15 – 15:00 **Currency Demand during the Global Financial Crisis: Evidence from Australia**
Tom Cusbert (Reserve Bank of Australia, Australia)

15:00 – 15:30 Coffee break

15:30 – 16:15 **Sectoral Holdings of Notes and Coins in the UK: The Effect of the Crisis commencing in 2007**
Dr David Barlow (Newcastle University Business School, Great Britain)

16:15 – 17:00 **Rethinking Money Theory in Light of Fragile States: What Changing Patterns of Cash Use infer for a Globalizing World**
Antonia C Settle (University of Sydney, Australia)

18:00 – 19:00 Transfer from Swissôtel Dresden to Schloss Eckberg

19:00 – 22:00 Dinner
Speaker Carl-Ludwig Thiele
(Board member of the Deutsche Bundesbank, Germany)

22:00 Return transfer to Swissôtel Dresden and Hotel Westin Bellevue

Wednesday, 17 September

Session III: Survey-Based Studies on Payment Behaviour
Chair: Prof Dr Franz Seitz
(Ostbayerische Technische Hochschule Weiden, Germany)

09:00 – 09:45 **The Irrationality of Payment Behaviour**
Frank van der Horst (De Nederlandsche Bank, Netherlands)

09:45 – 10:30 **Cash versus Debit Card: The Role of Budget Control**
Lola Hernández (De Nederlandsche Bank, Netherlands)

10:30 – 11:00 Coffee break

11:00 – 11:45 **Consumer Cash Usage: A Cross-Country Comparison with Payment Diary Survey Data**
Dr Kim P Huynh (Bank of Canada, Canada)

11:45 – 12:30 **This is what's in your Wallet ... And how you use it**
Tamas Briglevics (Magyar Nemzeti Bank, Hungary)

12:30 – 14:00 Lunch

14:00 – 14:45 **Consumer Preferences and the Use of Cash: Evidence from the Diary of Consumer Payments Choice**
Barbara Bennett (Federal Reserve Bank of San Francisco, USA)

14:45 – 15:30 **Whenever and Wherever: The Role of Card Acceptance in the Transaction Demand for Money**
Dr Helmut Stix (Oesterreichische Nationalbank, Austria)

15:30 – 16:00 Coffee break

Session IV: Topical issues
Chair: Ralph Rotzler (Deutsche Bundesbank, Germany)

16:00 – 16:45 **International Demand for U.S. Banknotes: Local and Global Determinants**
Dr Ruth Judson (Federal Reserve Board Washington DC, USA)

16:45 – 17:30 **Transaction Balance of Euro Coins in Germany**
Nikolaus Bartzsch (Deutsche Bundesbank, Germany)

18:00 – 19:15 Guided City Tour

19:30 – 22:00 Dinner

Thursday, 18 September

Session IV: Topical issues – continued
Chair: Ralph Rotzler (Deutsche Bundesbank, Germany)

09:00 – 09:45 **The Future of Community Currencies: Physical Cash or solely Electronic?**
Dr Jonathan Warner (Quest University, Canada)

09:45 – 10:30 **The Impact of Cash and Card Transactions on VAT Collection Efficiency**
Dr Boryana Madzharova (University of Erlangen-Nuremberg, Germany)

10:30 – 11:00 Coffee break

11:00 – 11:45 **Cash's (Un)Substitutability and recent Limitations on its Usage: Why Europe is off the Track**
Dr Edoardo Beretta (Università della Svizzera italiana, Switzerland)

11:45 – 12:30 **Steering Consumers from Cash to Payment Cards: Soft Interventions in a Field Experiment**
Sibel Aydogan (Vrije Universiteit Brussel, Belgium)

12:30 – 13:00 **Concluding remarks**
Ralph Rotzler (Deutsche Bundesbank, Germany)

13:00 – 14:00 Lunch

List of Participants
International Cash Conference 2014

Javier Alonso
Banco de España

Sibel Aydogan
Vrije Universiteit Brussel

David Barlow
Newcastle University Business School

Nikolaus Bartzsch
Deutsche Bundesbank

Franz Josef Benedikt
Deutsche Bundesbank

Barbara Bennett
Federal Reserve Bank of San Francisco

Edoardo Beretta
Università della Svizzera italiana
Wirtschaftswissenschaftliche Fakultät

Manuel Berger
Deutsche Bundesbank

Wilko Bolt
De Nederlandsche Bank

Tamas Briglevics
Magyar Nemzeti Bank

Marci Chavez
Currency Research

Ralf Conrad
Orfix International GmbH

Tom Cusbert
Reserve Bank of Australia

Tobias Dümmler
Deutsche Bundesbank

Geoffrey Dunbar
Bank of Canada

Henk Esselink
European Central Bank

Stephen Evans
Bank of England

Eugenie E Foster
International Association of Currency Affairs

Erwin Gladisch
Deutsche Bundesbank

Jakub Górka
University of Warsaw
Faculty of Management

Joachim Groppler
Orfix International GmbH

Harald Haare
Norges Bank

Shiry Hadash
Bank of Israel

Friedrich Hammerschmidt
Oesterreichische Nationalbank

Stefan Hardt
Deutsche Bundesbank

Monika Hartmann
European Central Bank

Lola Hernández
De Nederlandsche Bank

Christian Hernaut
Giesecke & Devrient

Kim P Huynh
Bank of Canada

Ondřej Jetmar
Czech National Bank

Nicole Jonker
De Nederlandsche Bank

Ruth Judson
Federal Reserve Board

Ricarda Kißler
Deutsche Bundesbank

Malte Krüger
University of Applied Sciences
Aschaffenburg

Susann Kühn
Deutsche Bundesbank

Des Lane
Central Bank of Ireland

Guillaume Lepecq
AGIS Consulting

Boryana Madzharova
University of Erlangen-Nuremberg

Irina Motovilova
Secura Monde International (SMI) Ltd

Achim Munck
AM Cash Competence GmbH

Dario Negueruela
Banco de España

Julien Novotny
Deutsche Bundesbank

Andrea Paleczek
Oesterreichische Nationalbank

Enda Palazzeschi
Banque de France

Giselher Pankratz
Bundesbank University of Applied Sciences, Hachenburg

Robert Pöhl
Deutsche Bundesbank

Helmut Rittgen
Deutsche Bundesbank

Ralph Rotzler
Deutsche Bundesbank

Gonzalo Santamaria
Currency Research Inc

Björn Segendorf
Sveriges Riksbank

Franz Seitz
Weiden Technical University of Applied Sciences

Antonia C Settle
University of Sydney

Ulrich Spiegel
Papierfabrik Louisenthal GmbH

Helmut Stix
Oesterreichische Nationalbank

Mita Harjivan Suthar
Ahmedabad University, H.L. Insitute of Commerce

Carl-Ludwig Thiele
Deutsche Bundesbank

Claus Tigges
Deutsche Bundesbank

Elisabeth Tillner
Deutsche Bundesbank

Christian Tropp
Giesecke & Devrient

Frank van der Horst
De Nederlandsche Bank

Leo van Hove
Vrije Universiteit Brussel

Leif Veggum
Norges Bank

Jonathan Warner
Quest University Canada

Marius Welsch
Deutsche Bundesbank

Heike Wörlen
Deutsche Bundesbank


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www.bundesbank.de

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