# Firms, Failures, and Fluctuations

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Discussion by

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# The Players

- A representative household maximizes utility from consumption and provides inelastically $L$ units of labor to the production side of the economy.
- A set of firms that operate with constant returns to scale technologies. and are grouped in $n+1$ industries, labelled by a number $0, 1, ..., n$.
  - Firms in industry 0 transform the intermediate inputs produced by firms in industries $\mathcal{I} \in \{1, ..., n\}$ into industry level bundles of final products. These are finally aggregated in a unique final consumption good.
  - Each industry $\mathcal{I} \in \{1, ..., n\}$ is composed by a representative producer $i^{\circ}$ of a generic variant and a collection of firms $i \in I$ that may produce specialized variants of an intermediate good.
  - Producers of customized variants have to pay a fixed cost (expressed in units of labor) to be able to operate. Firms in each industry use labor and inputs from other sectors to produce:

$$y_i = F_{\mathcal{I}}\left(l_i, \left\{A_{\mathcal{I}\mathcal{J}} x_{ij} + B_{\mathcal{I}\mathcal{J}} x_{ij}^{\circ}\right\}_{(j,i)\in \mathbf{G}}, \left\{B_{\mathcal{I}\mathcal{J}} x_{ij}^{\circ}\right\}_{(j,i)\notin \mathbf{G}}\right)$$

  - $A_{\mathcal{I}\mathcal{J}}$ and $B_{\mathcal{I}\mathcal{J}}$ are the input-augmenting productivities of the customized and generic inputs, $A_{\mathcal{I}\mathcal{J}} \geq B_{\mathcal{I}\mathcal{J}}$.

# Timeline and terms of trade

- At time $t = 0$ Specialized firms decide whether to pay the fixed cost.
- At time $t = 1$, all active firms — generic producers, final good producers, and customized producers that pay the fixed costs — enter into pairwise contracts that specify the prices for future trades.
- At time $t = 2$ trades, production and consumption take place.

Terms of trade:

- Period $t = 1$ consists of infinitely many sub-periods. In any given sub-period, the supplier firm $j$ is selected with an exogenously-specified probability to make an offer $p_{ij}$ to the customer $i$. The customer makes an offer to the supplier with probability of $1 - \delta_{ij}$.
- $\delta_{ij}$ that captures the relative bargaining power. If one party accepts the other party's offer, the agreement $p_{ij}$ is implemented. Each party also has the outside option of walking away with no agreement and no trade.
- The two parties discount future sub-periods at a common rate $\eta \leq 1$.

# The equilibrium concept

A **full equilibrium** consists of a network of active firms $\mathbf{G}^*$ and collections of prices and quantities such that:

i. The quantities correspond to a **production equilibrium** in the corresponding subgames at t = 2. Given a feasible network of active firms $\mathbf{G}^*$ and the vector of prices, a **production equilibrium** is a collection of intermediate input, labor, outputs, and consumption such that: (i) all firms minimize production costs while meeting their output obligations to their customers;(ii) the representative household maximizes her utility; (iii) all markets clear.

ii. The prices correspond to a **pricing equilibrium** in the corresponding subgames at t = 1. Given a feasible network of active firms $\mathbf{G}^*$, a **pricing equilibrium** is a collection of prices and quantities such that: (i) the quantities in any ensuing subgame correspond to a production equilibrium; (ii) no generic producer $i^\circ$ can earn higher profits by offering a different price; (iii) given prices, for any $(j, i)$ the agreement price is the SPNE of the pairwise bargaining game between $i$ and $j$.

iii. No customized firm has an incentive to change its decision to operate at t = 0.

# Main Results

Assume Leontief Production Functions:

- Th.3 Any equilibrium network $\mathbf{G}^*$ consists of **a union of trees, each of which consisting of finitely many firms and a root vertex in the final-good producing industry 0**. The economy exibits upstream propagation of failures: a negative shock that leads to $i$ 's failure also results in the failure of all of $i$ 's direct and indirect customized suppliers.
- Th.4 (a) For any equilibrium network of active firms $\mathbf{G}^*$ there is a unique pricing equilibrium; (b) a full equilibrium exists; (c) the set of full equilibria has a greatest element with respect to the set inclusion order;
- Aggregate demand externalities imply that the inclusion of an active customized firm may result in lower profits for some or all other customized firms in the economy. Firm-level profits are not necessarily increasing (with respect to the set inclusion order) in the set of active firms.
- Comparative statics w.r.t. all the relevant parameters etc.

# From Micro to Macro

- The paper builds on the fast growing field, initiated by the authors' themeselves, on the role of production networks in shaping productivity aggregation properties. See the nice review paper Carvalho and Tabaz-Salehi (2018) for an updated reference list.
- Along this line of research, the paper improves over most recent contributions endogenizing the upstream cascading effects induced by failure. The economic rationale motivating this contribution: quantifying the creative-destruction role of failure shocks on growth with control on prices, markups.
- Technical results pose already relevant challenges. Minor technical comment: mathematics of constant returns to scale involves cross-ratios and projective geometry!
- I will focus my discussion on a key modeling choice, the one-to-one relationship:

$$\textit{final product} \leftrightarrow \textit{production tree}$$

- An interesting tradeoff between simplicity and realism!

# Production trees and Growth potential

One possible alternative application: measures of economic complexity. A way to quantify the level of economic development of a country or an economic area:

Complexity of a product $\rightarrow$ complexity of the production tree.

- Growth potential is measured by the capacity to implement complex production trees.
- Production flexibility: capacity to adjust quickly production trees in response to technology shocks.

Potential growth and production flexibility are deteremined by $\delta_{ij}$, $p_{ij}$, $A_{\mathcal{I}\mathcal{J}}$ vs $B_{\mathcal{I}\mathcal{J}}$

A relevant limitation due to the tree topology constraint: exclusivity of the relationship of specialized producers in **G** with customers:

- This constraint destroys 'districts' (downstream networks), i.e. no advantage in clustering of producers that share specialized suppliers.
- The tree model implies inefficient use of non-rivalry resources as e.g. no sharing of data hubs.

# Production Trees and Financial shocks in Production

Model is relevant to address SME optimal financing decisions: Is there a financial value of being part of the network of active firms $\mathbf{G}^*$? How is this value distributed along the production tree?

- SME (e.g. France, Italy, Spain) in southern Europe have limited access to capital markets. Main financing sources rely on trade credit and bank loans. Hence productive and financial decisions for these firms are two-way interlocked.
- Italian Civil law formalizes the notion of production tree under the name of Contratto di Rete: a binding production agreeement not affecting control rights and preserving firm financial independence. The contract generates a lot of practical problem for (Italian) specialized lenders:

# Production Trees and Financial shocks in Production

- 'Prudent' credit policy: loan price and quantity established on the basis of individual firm financial rating. It is inefficient because a breakdown of the production tree implies insolvency of the borrower.
- 'Productive continuity' credit policy: firm belonging to an active network is rated better: a tolerant lending policy is necessary in order to avoid discontinuing operations of the full network. This policy raises risk of capital misallocation (zombie lending) and reduction of productive flexibility.

The model may be helpful to address questions like: Is there an optimal tradeoff? How to compute it? Firm failures may generate systemic risk in production trees!

IN CONCLUSION: INTERESTING MODEL,
POTENTIALLY RELEVANT FOR MANY DIFFERENT APPLICATIONS!