Tokenomics: When Tokens Beat Equity

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DEUTSCHE BUNDESBANK
EUROSYSTEM

Key Challenges for the Crypto Community

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Technology

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Legal/Regulation

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Legal/Regulation

Economic functions

Key Economic Questions for Blockchain Design

How much do we have to pay operators to maintain the chain?
⇒ mechanism design

How do platform payment means interact with outside world
⇒ open-economy macro

How should we design tokens as contracts?
⇒ corporate finance

What is the right governance structure for systems?
⇒ political economy

Meanwhile, crypto markets are staging a comeback ... this time in "Decentralized Finance"

Total value locked in DeFi applications

State of Debate on Tokens

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- Do tokens solve an economic problem?
- Is there economic merit to tokens?

Literature

Financing mechanism

- Catalini and Gans (2019)
- Chod and Lyandres (2020)
- Davydiuk, Gupta, and Rosen (2019)
- Lee and Parlour (2019)
- Garratt and van Oordt (2019)

Platforms

- Sockin and Xiong (2018)
- Li and Mann (2020)
- Bakos and Halaburda (2019)
- Cong, Li, and Wang (2018)
- Canidio (2020)
- Chod, Trichakis, Yang (2019)

Blockchain Tech Stack: Where would tokens matter?

Tech Stack Layer	Role of Token

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Infrastructure	*reward and internal currency*

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Service	*usage fee or incentive*
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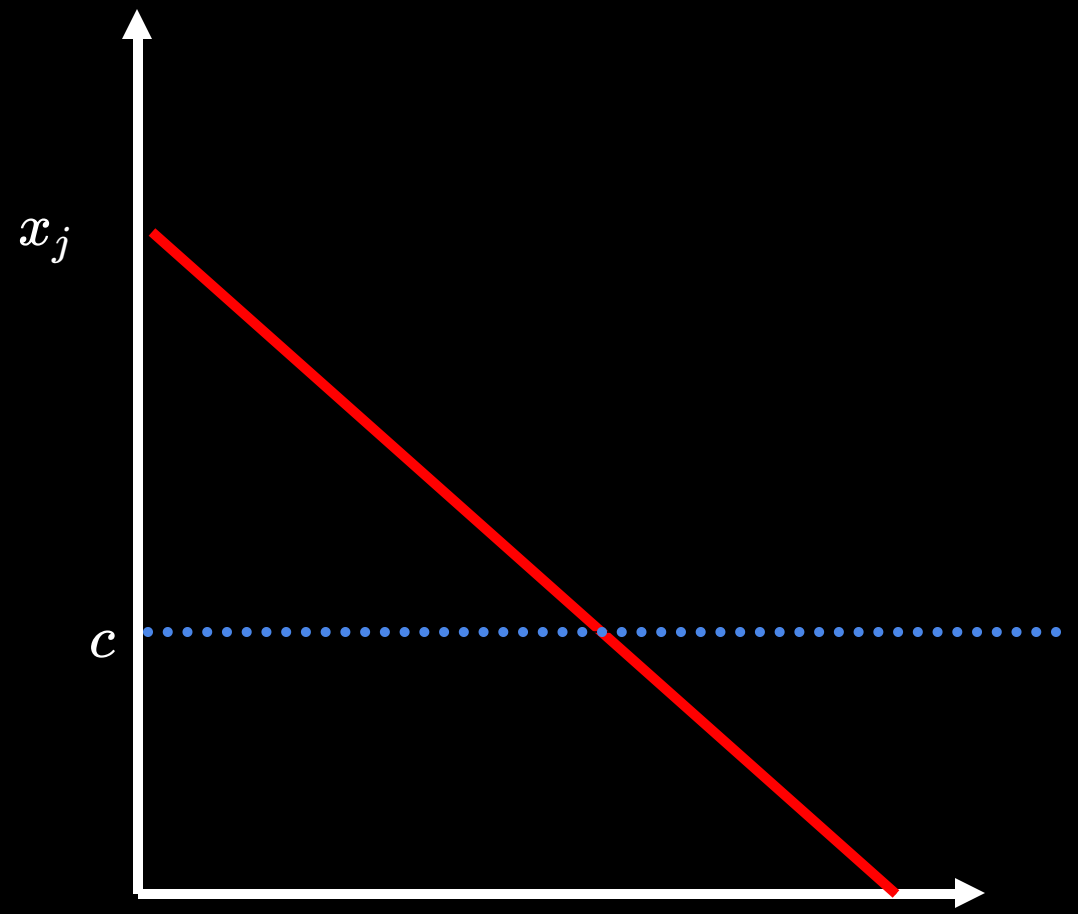
Tech Stack Layer	Role of Token
Application	*usage fee*
Service	*usage fee or incentive*
Infrastructure	*reward and internal currency*

A Simple Model of Token-Based Financing

- entrepreneur wants to produce a good or service
- Setup cost for production C_0
- Marginal cost of producing c
- Demand is uncertain: revealed after the setup cost has been paid but before production.
- Inverse demand $p(q) = x - q$

  x is uniform on $[0, \theta]$.



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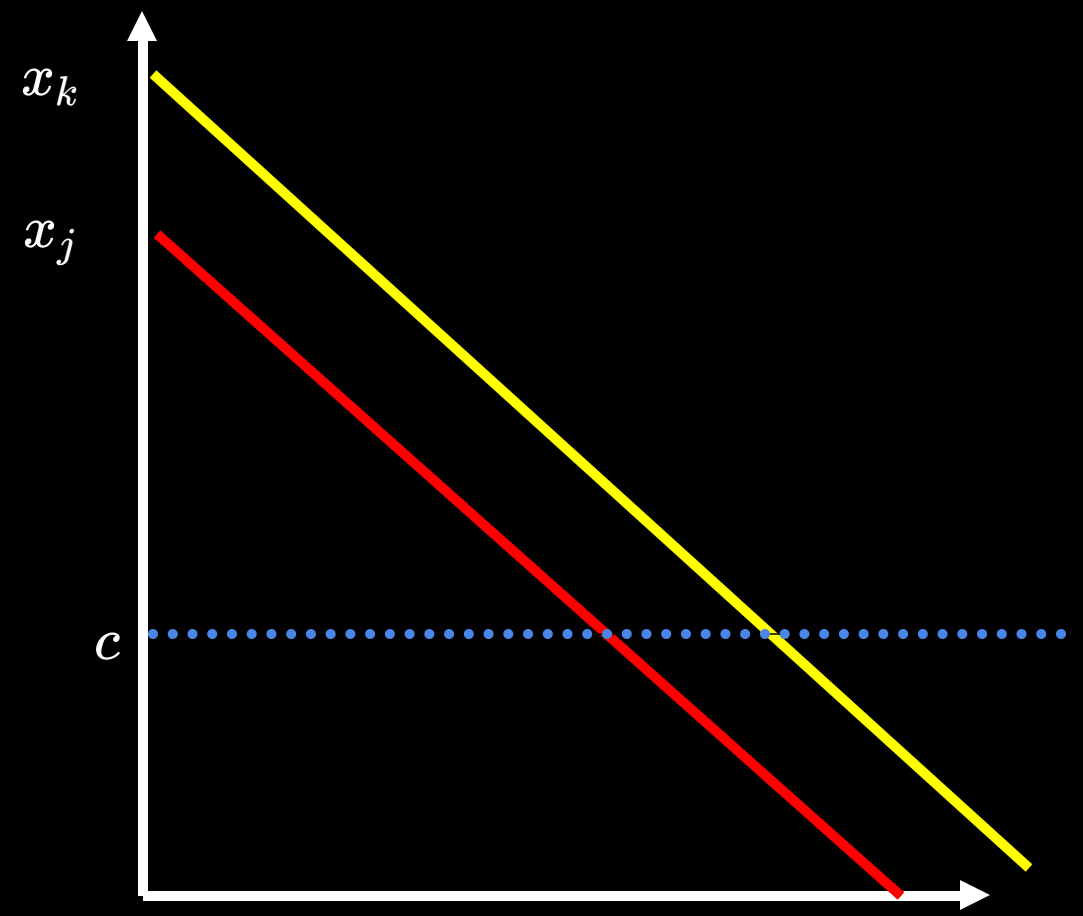

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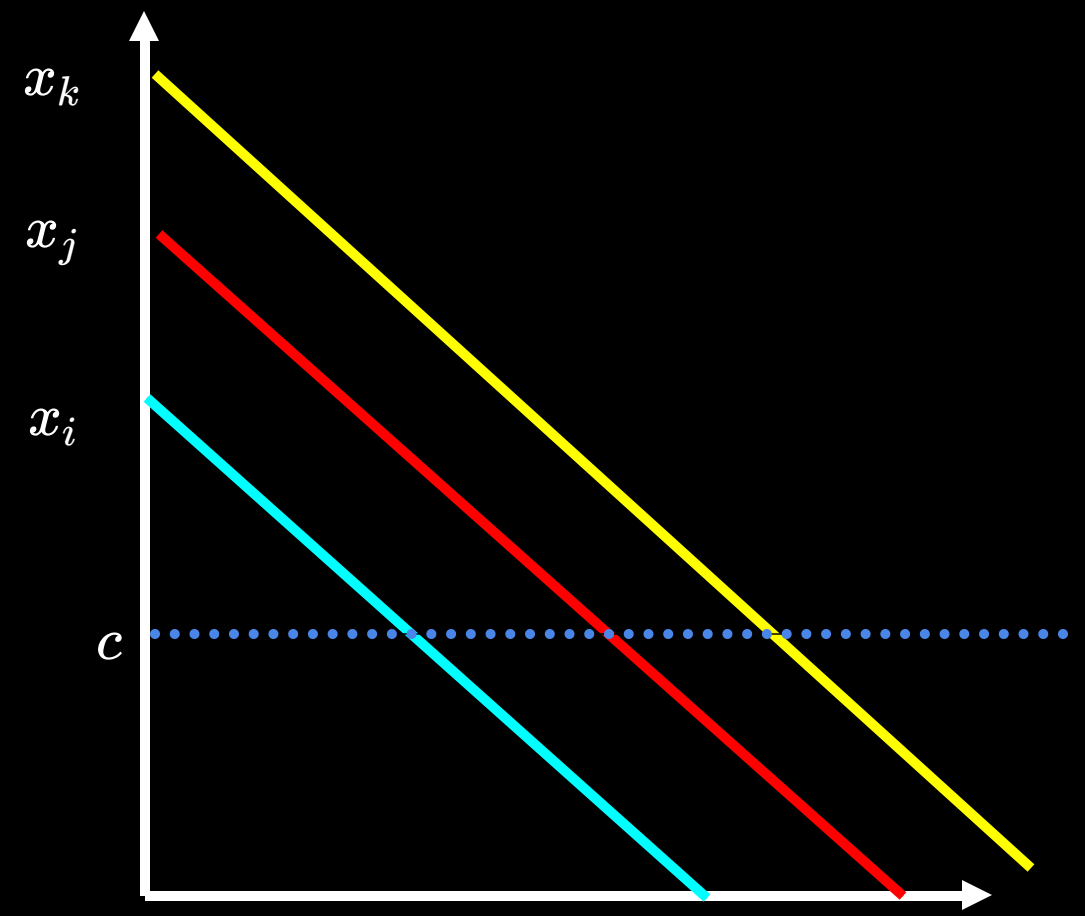

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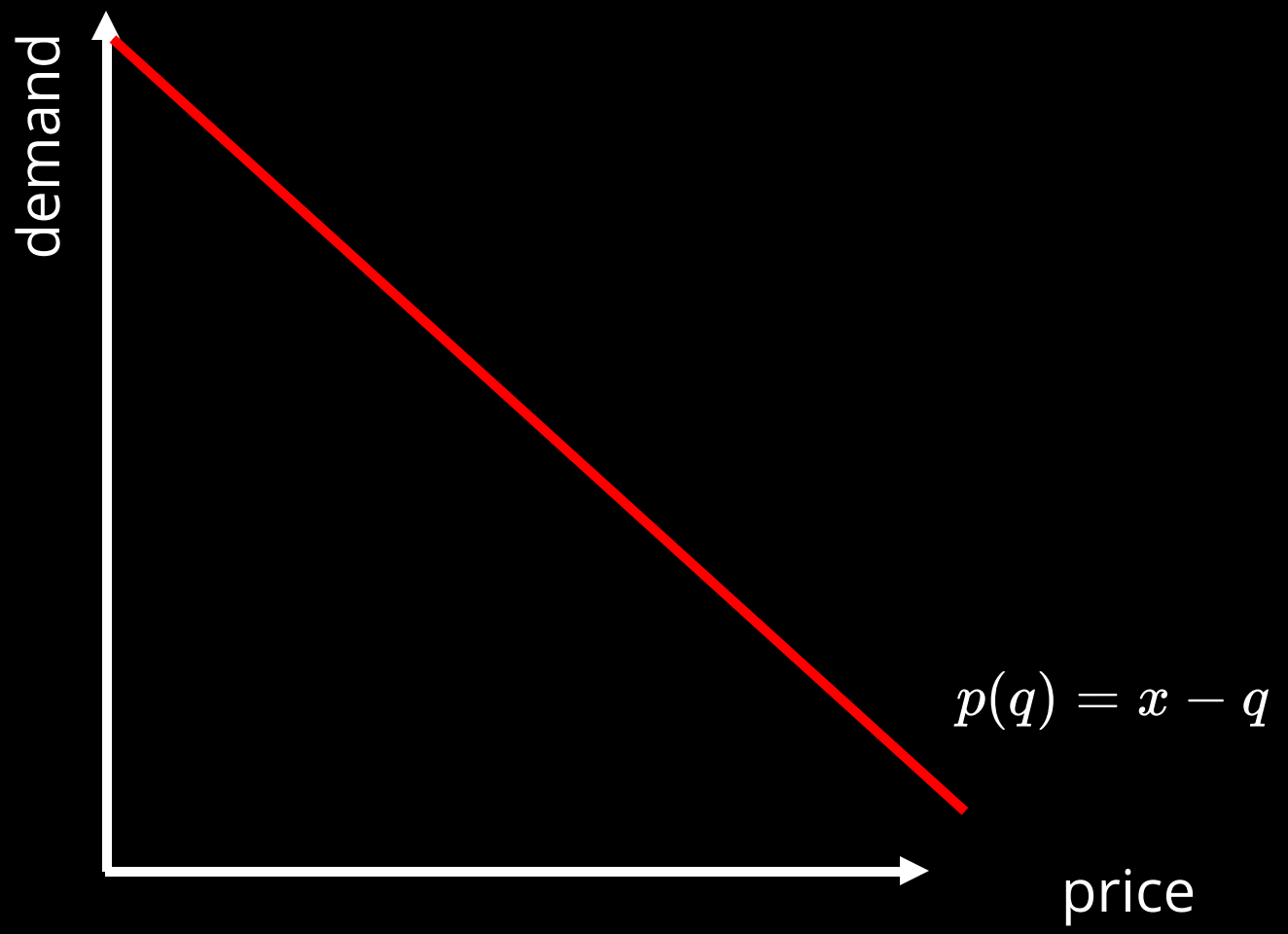

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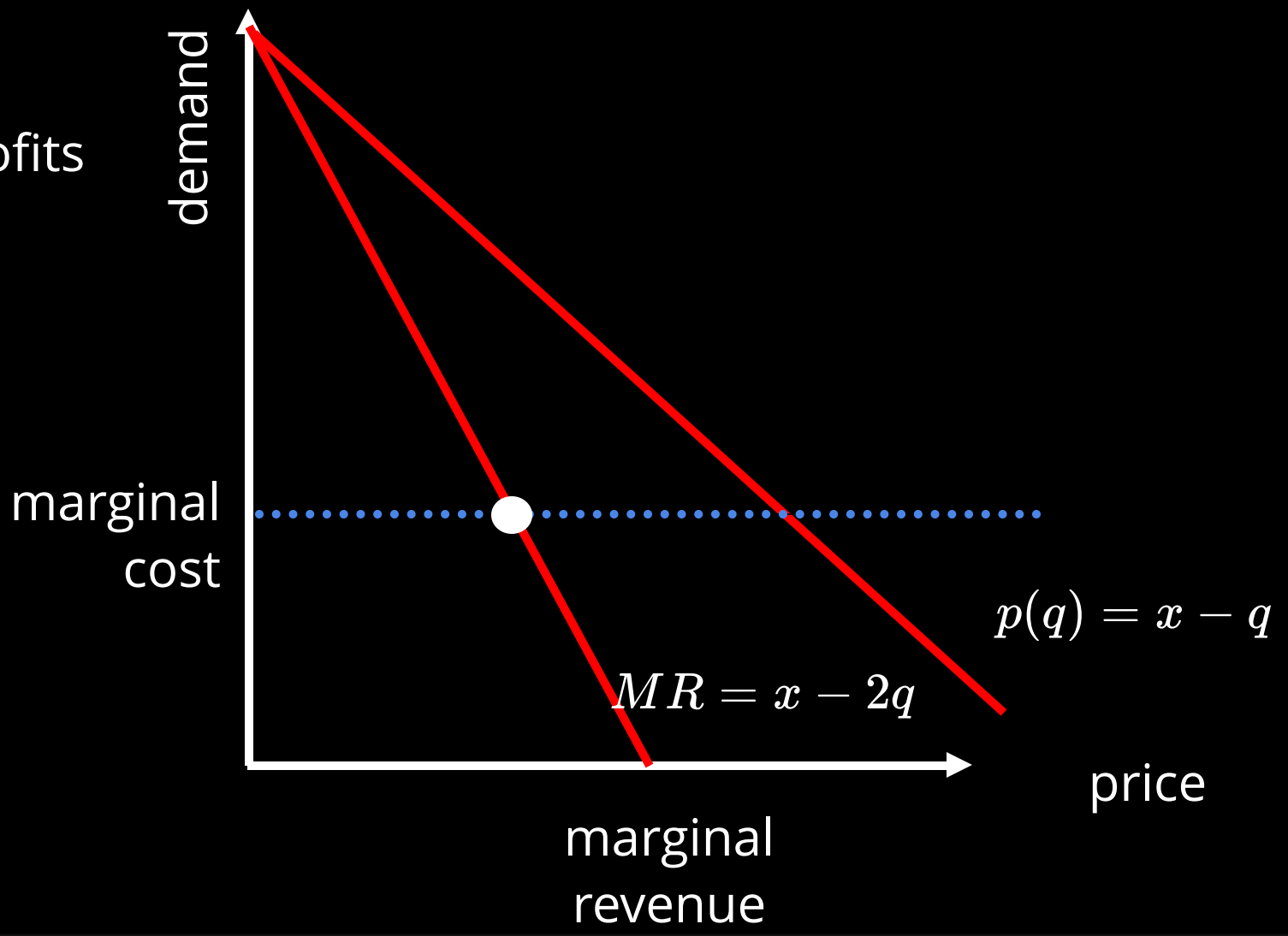

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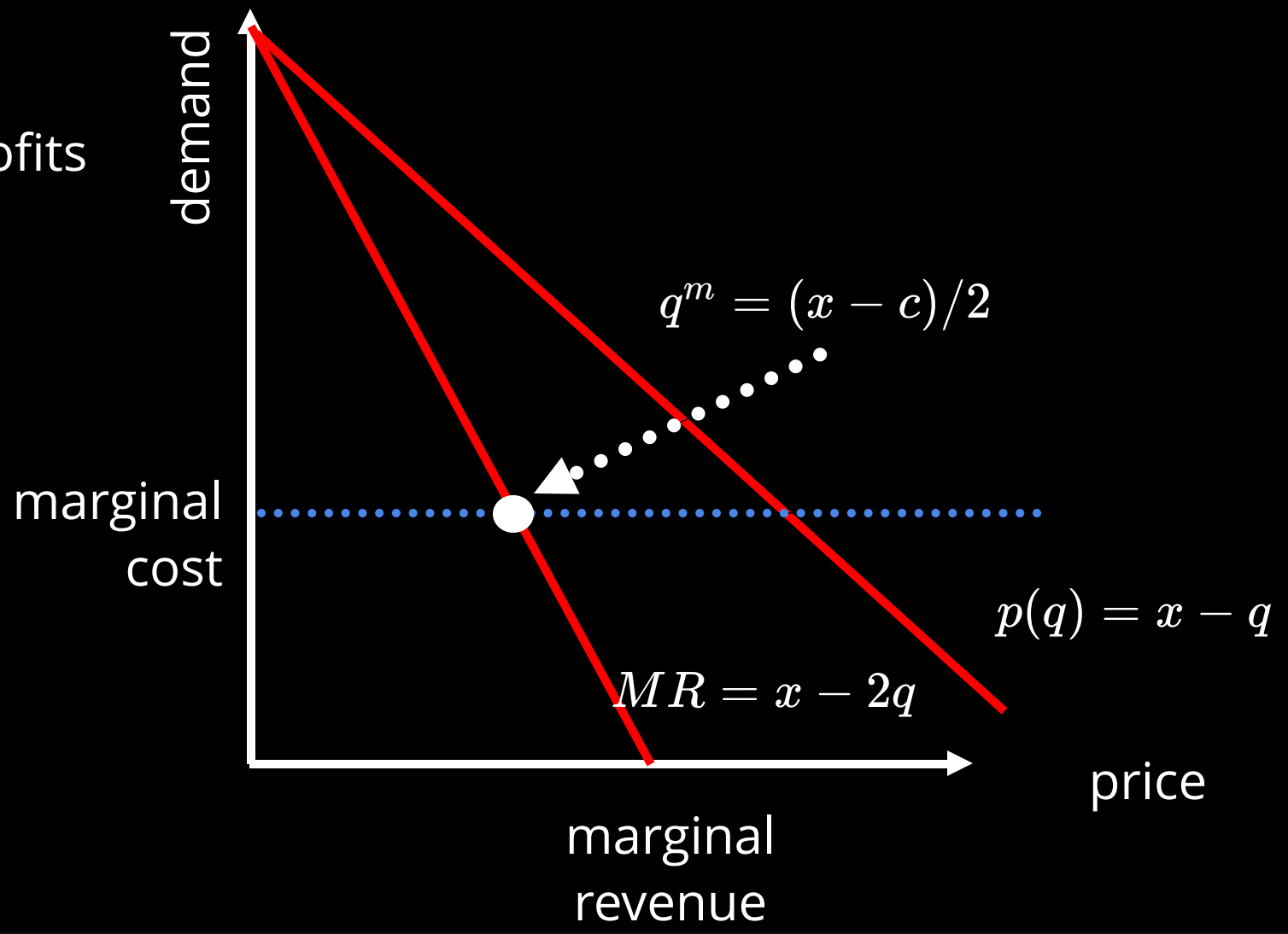

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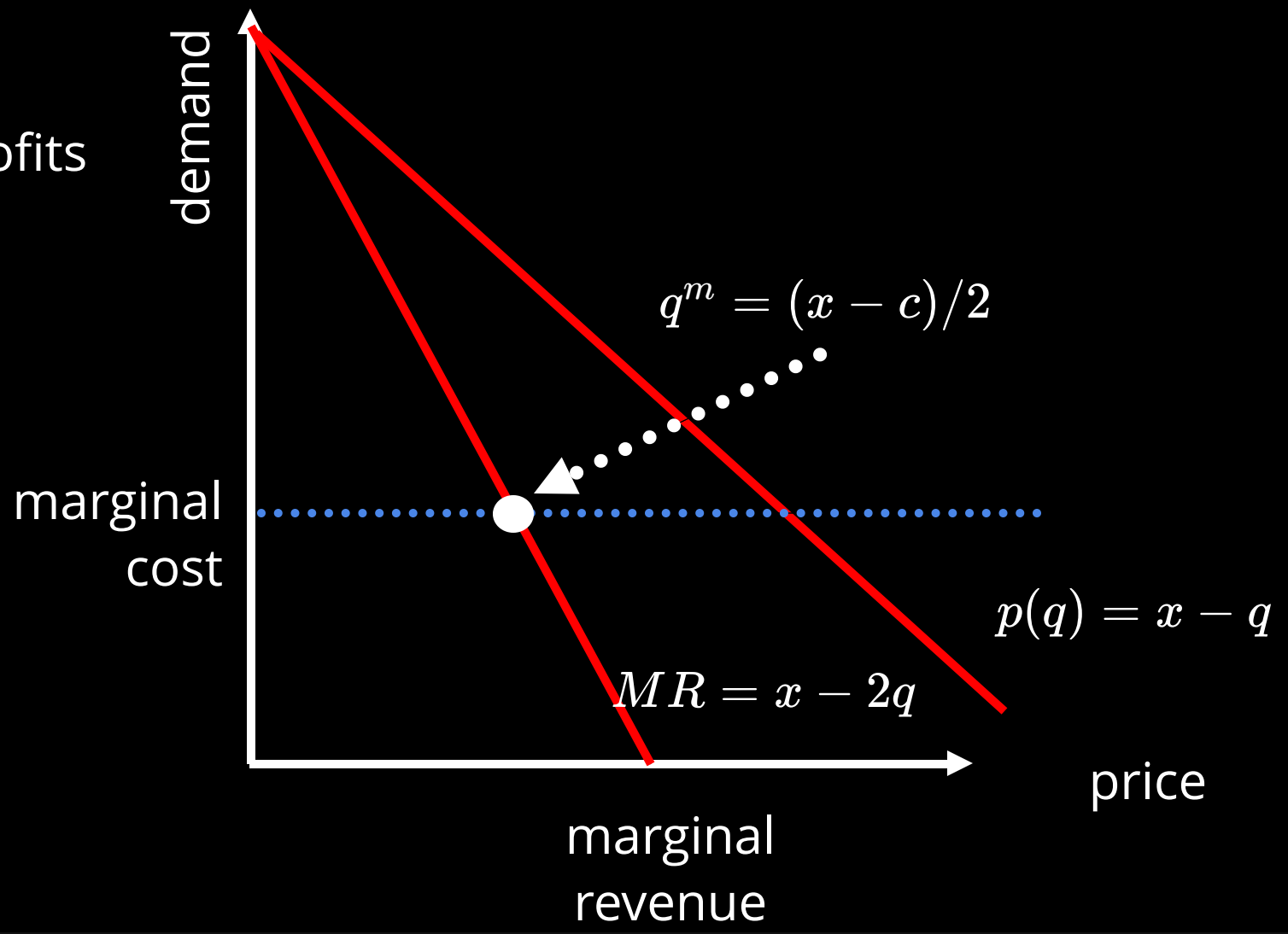

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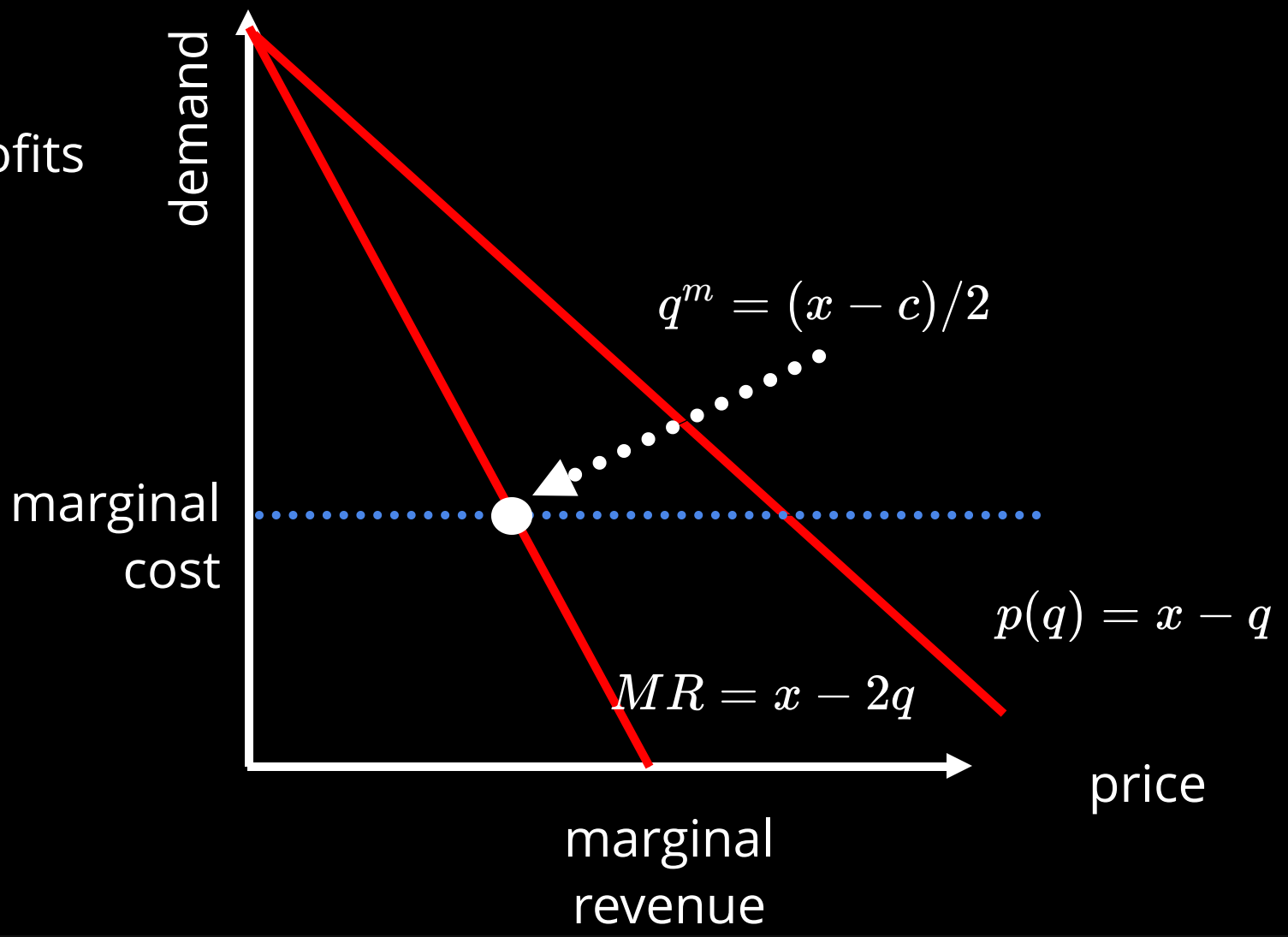

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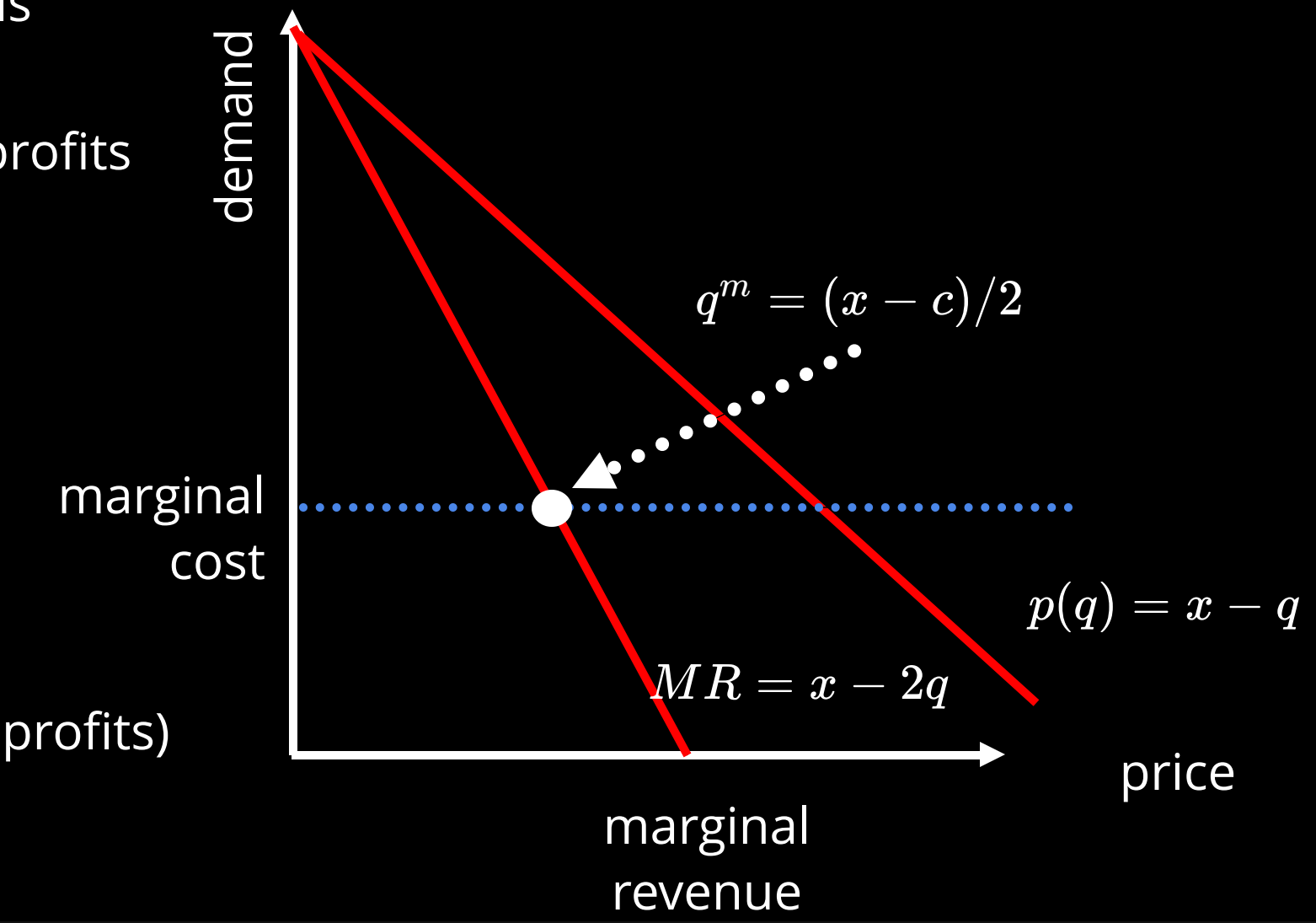

- Equity financing
  - ⇒ max $(1 - \alpha)$(monopoly profits)

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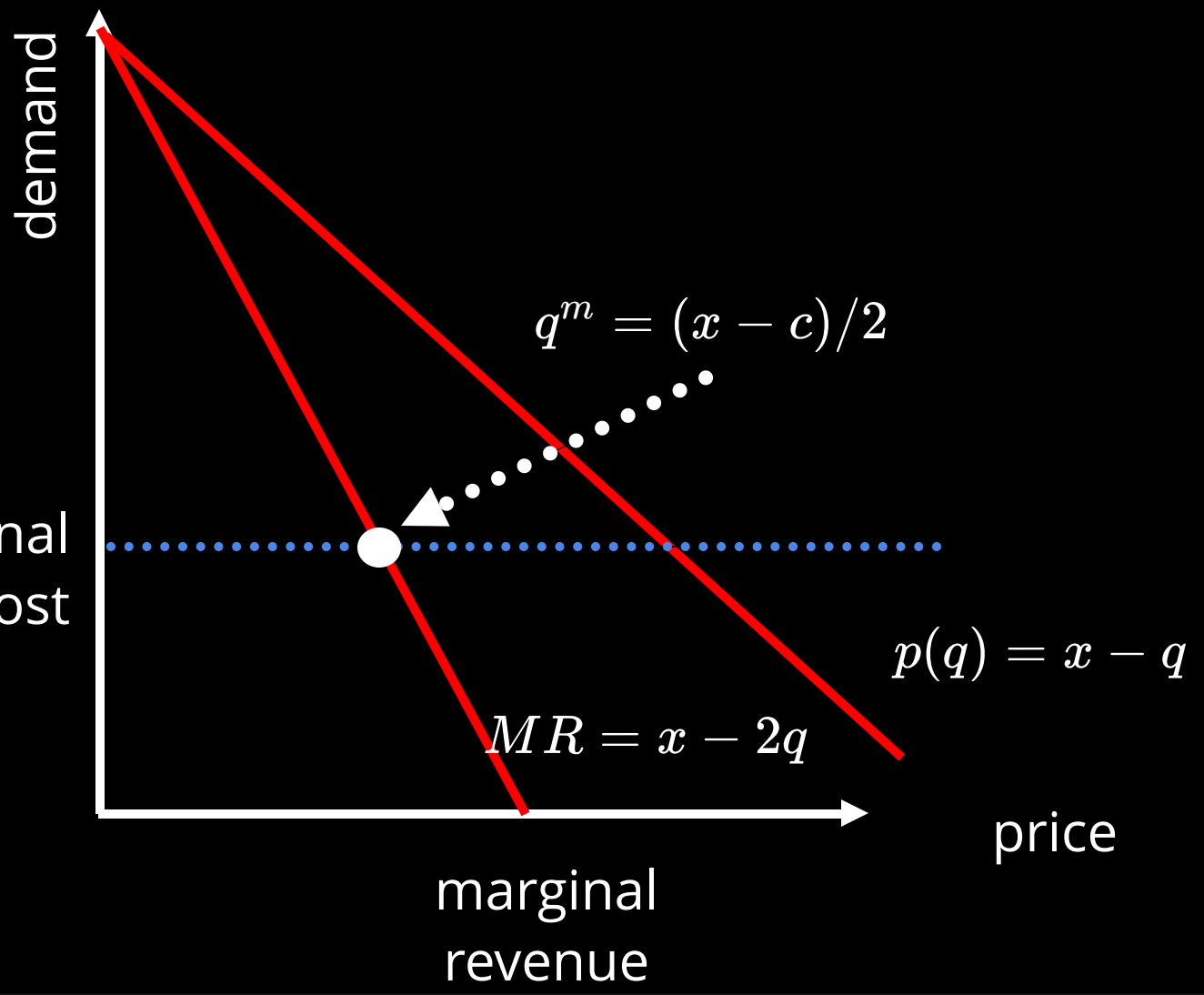

- Equity financing
  - ⇒ max $(1 - \alpha)$(monopoly profits)
  - => no distortion

Token Financing

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general idea: sell future output

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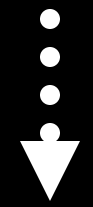
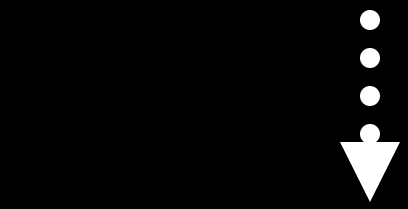


two approaches for token sales

Token Financing

general idea: sell future output



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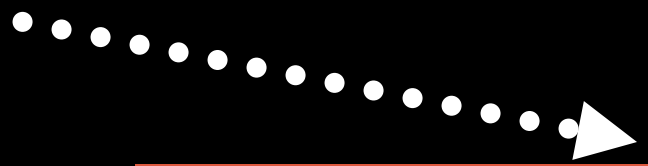

sell units of future output

- we call this *output presale*
- formally: sell t tokens
- produce q units and keep revenue from $q - t$ tokens

Token Financing

general idea: sell future output

two approaches for token sales

sell a fraction of future revenue

- we call it *revenue sharing*
- formally: sell α_t of T tokens
- produce q units a require T/q tokens per unit

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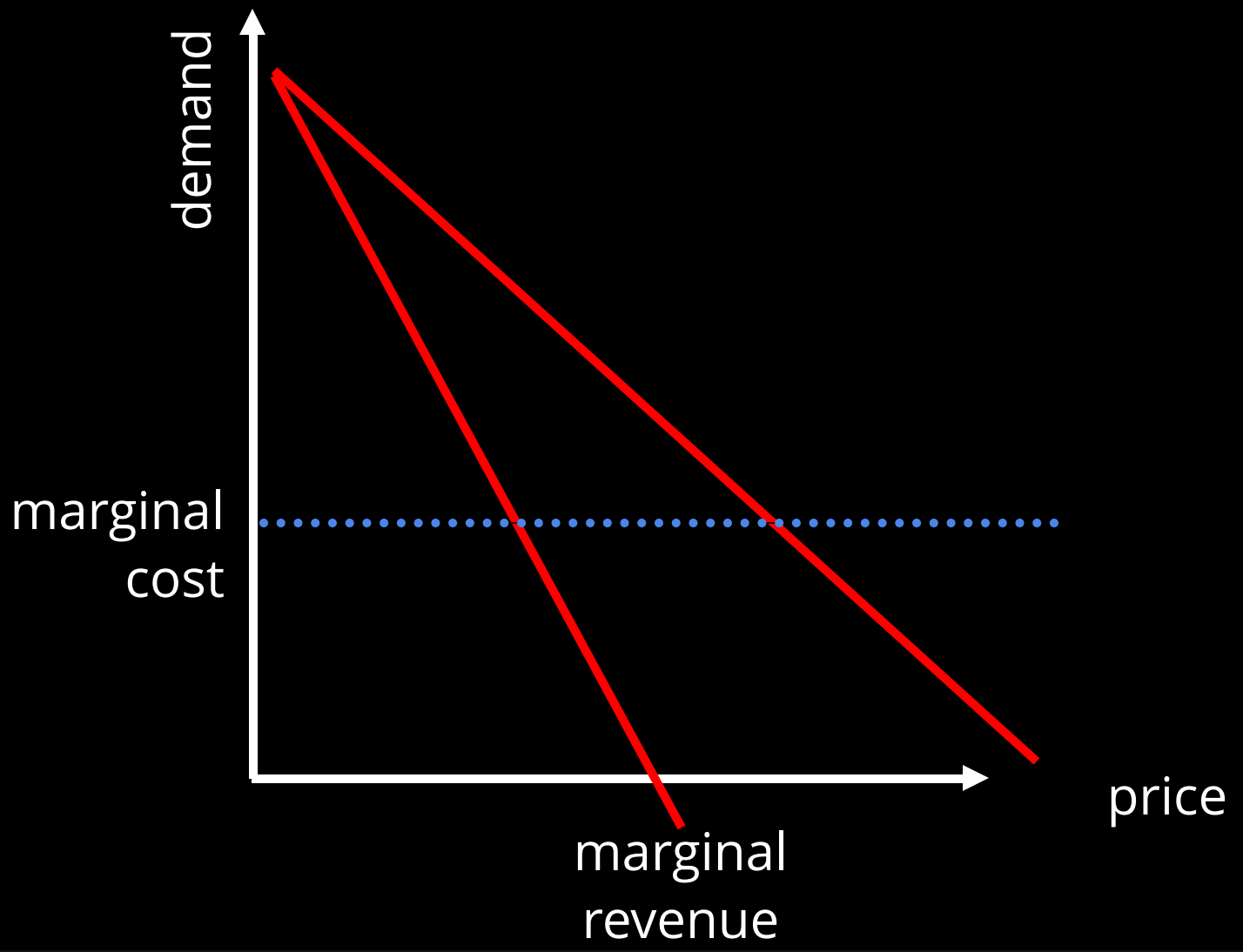
Output Presale



Output Presale

- entrepreneur issues t tokens

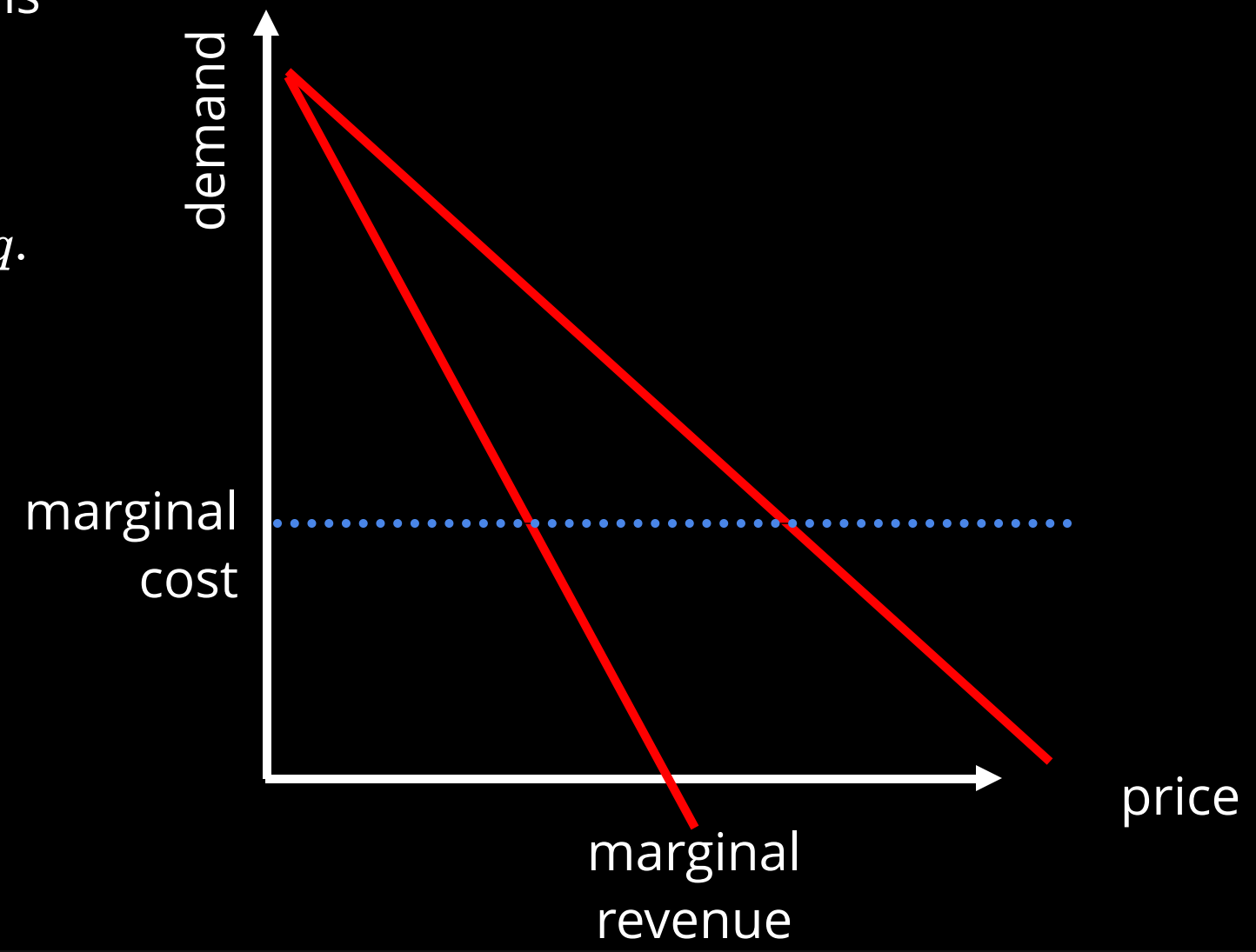
  for $x \leq t$: earns zero

  for $x > t$: solves

  $$\max_q \; q(x - q - t) - cq.$$

- effectively solves

  $\max_q$ s.t. $MR(q) + t = c$



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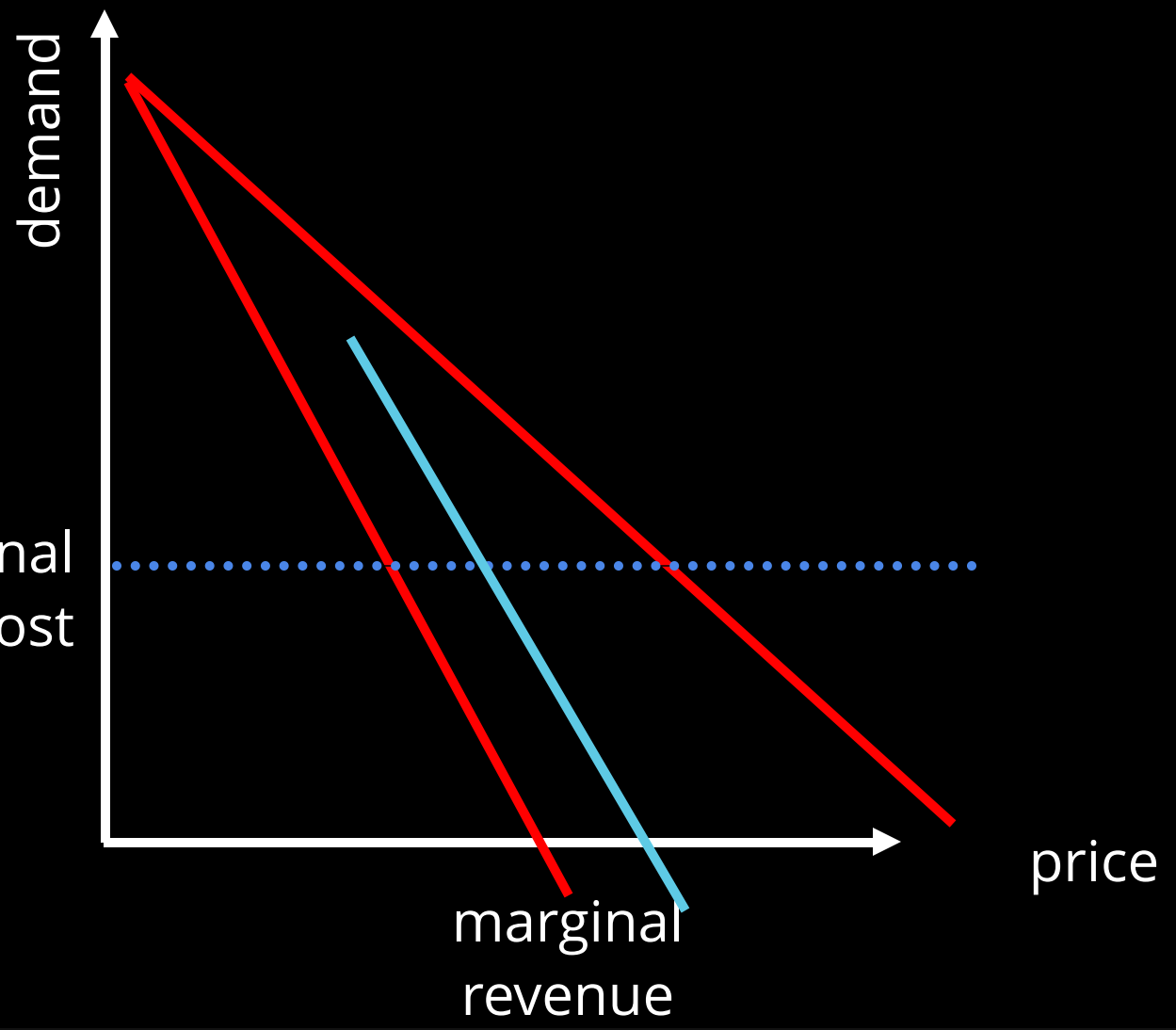

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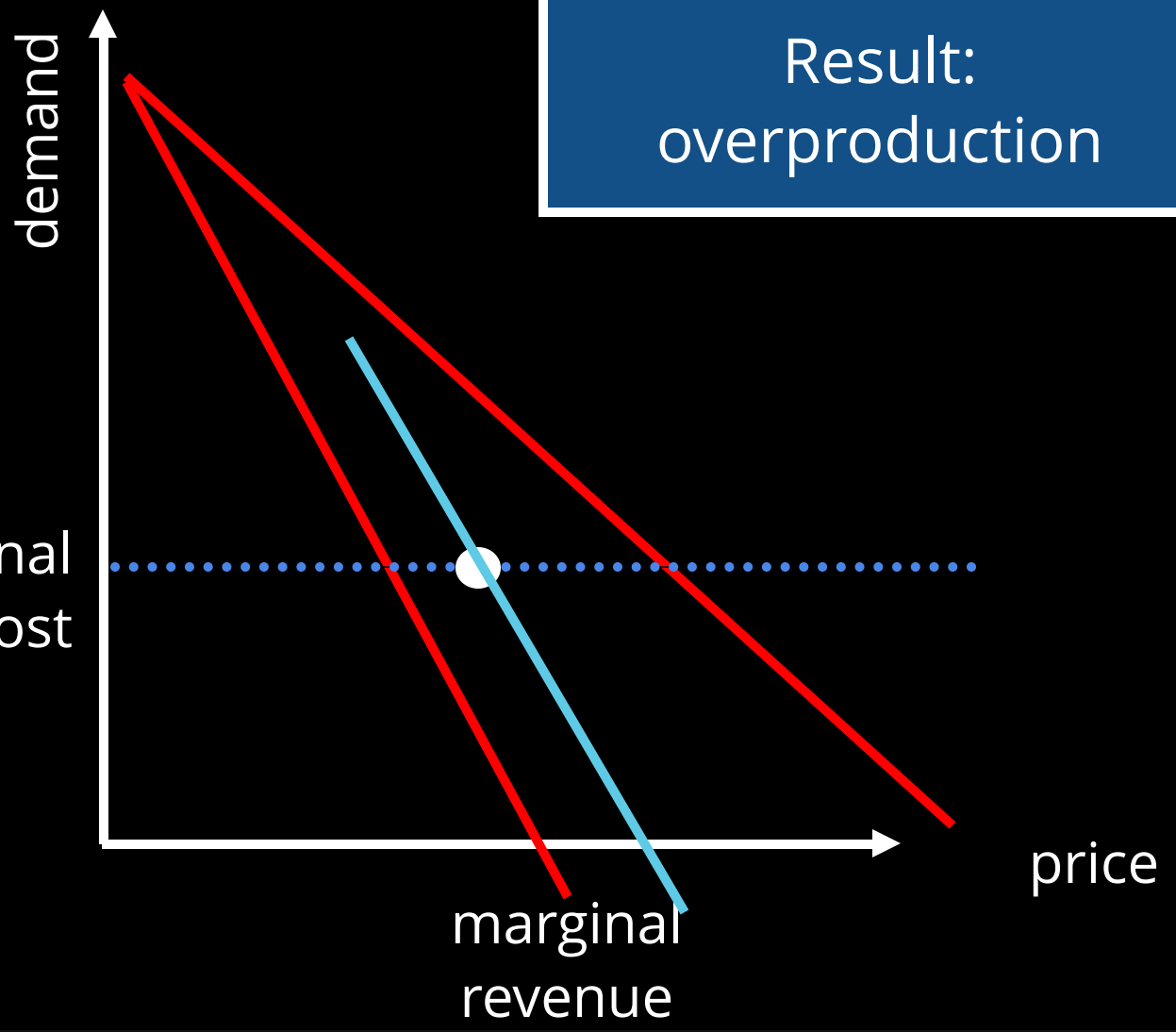

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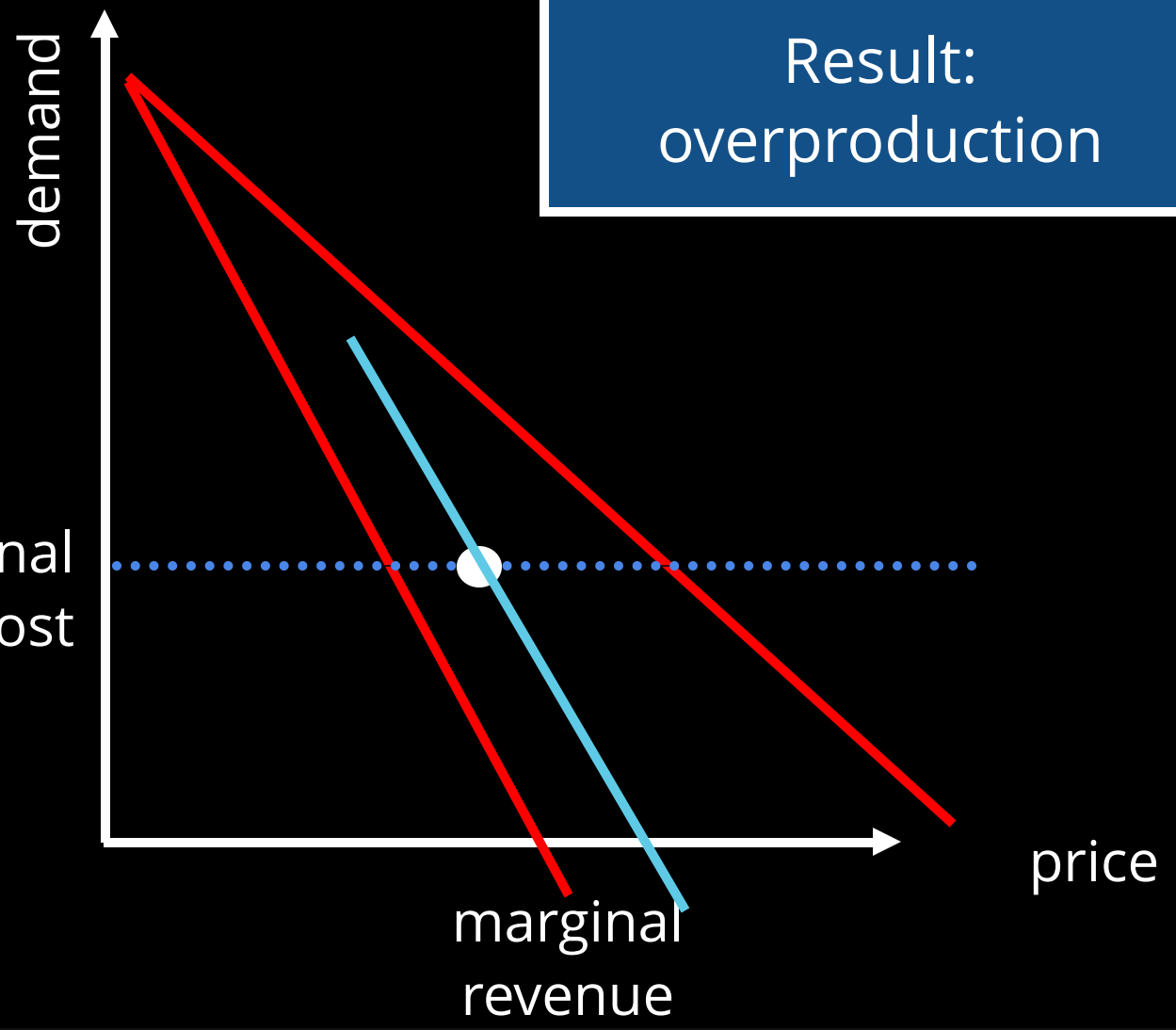
Entrepreneur does not internalize the effect of an extra output unit on the token value for the tokenholders!



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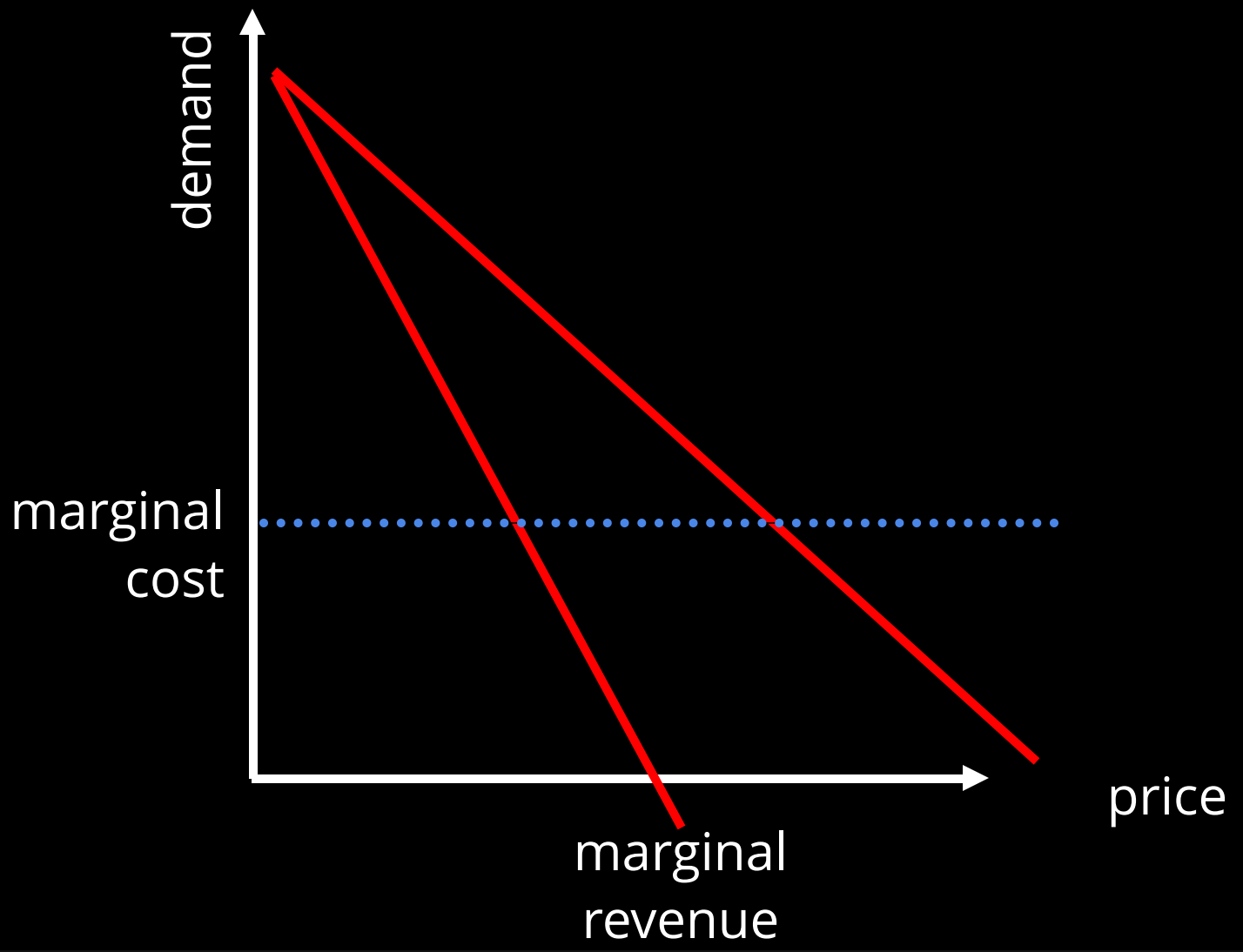

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- $\Rightarrow$ "tilts" marginal revenue for entrepreneuer left because get only fraction of *revenue*
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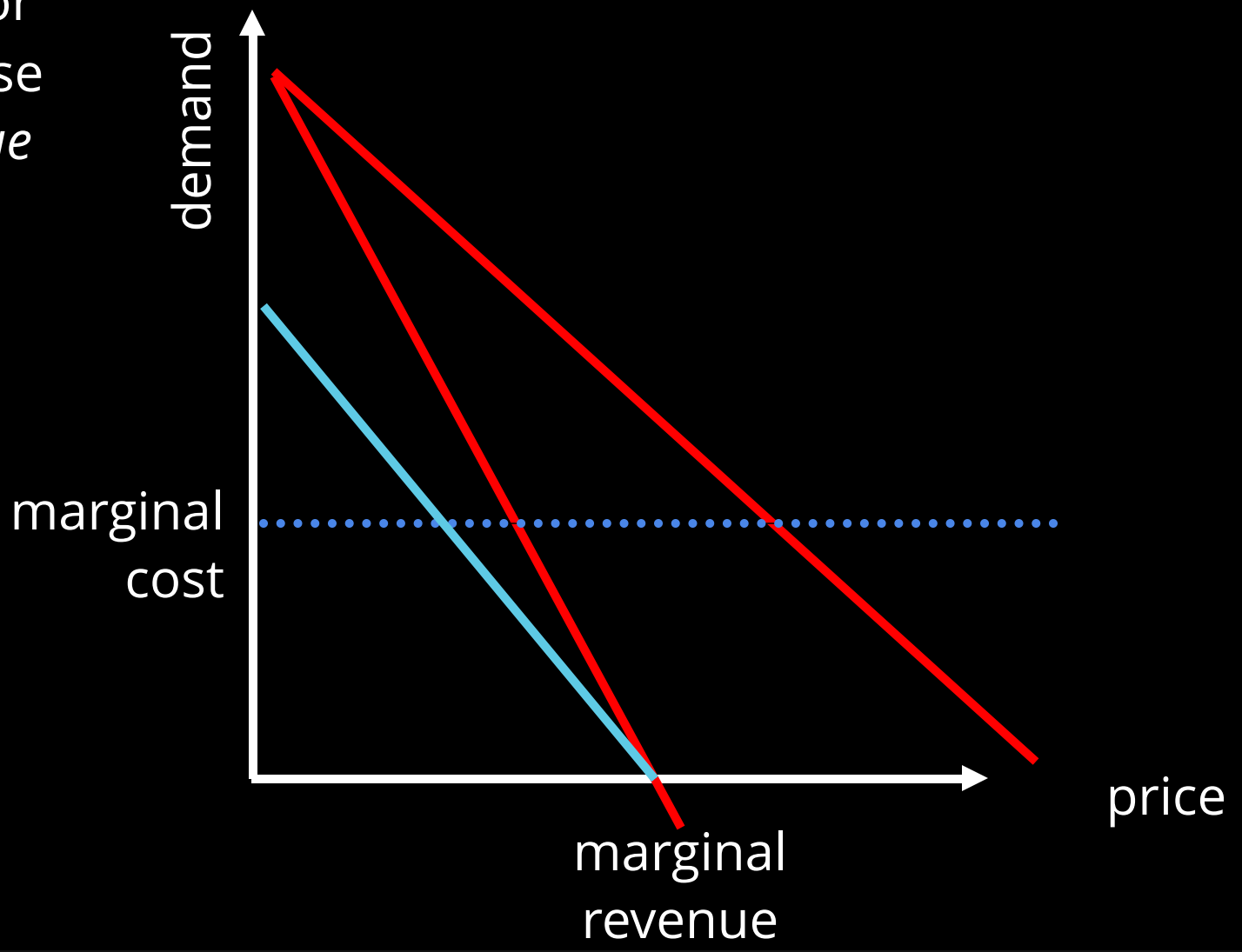

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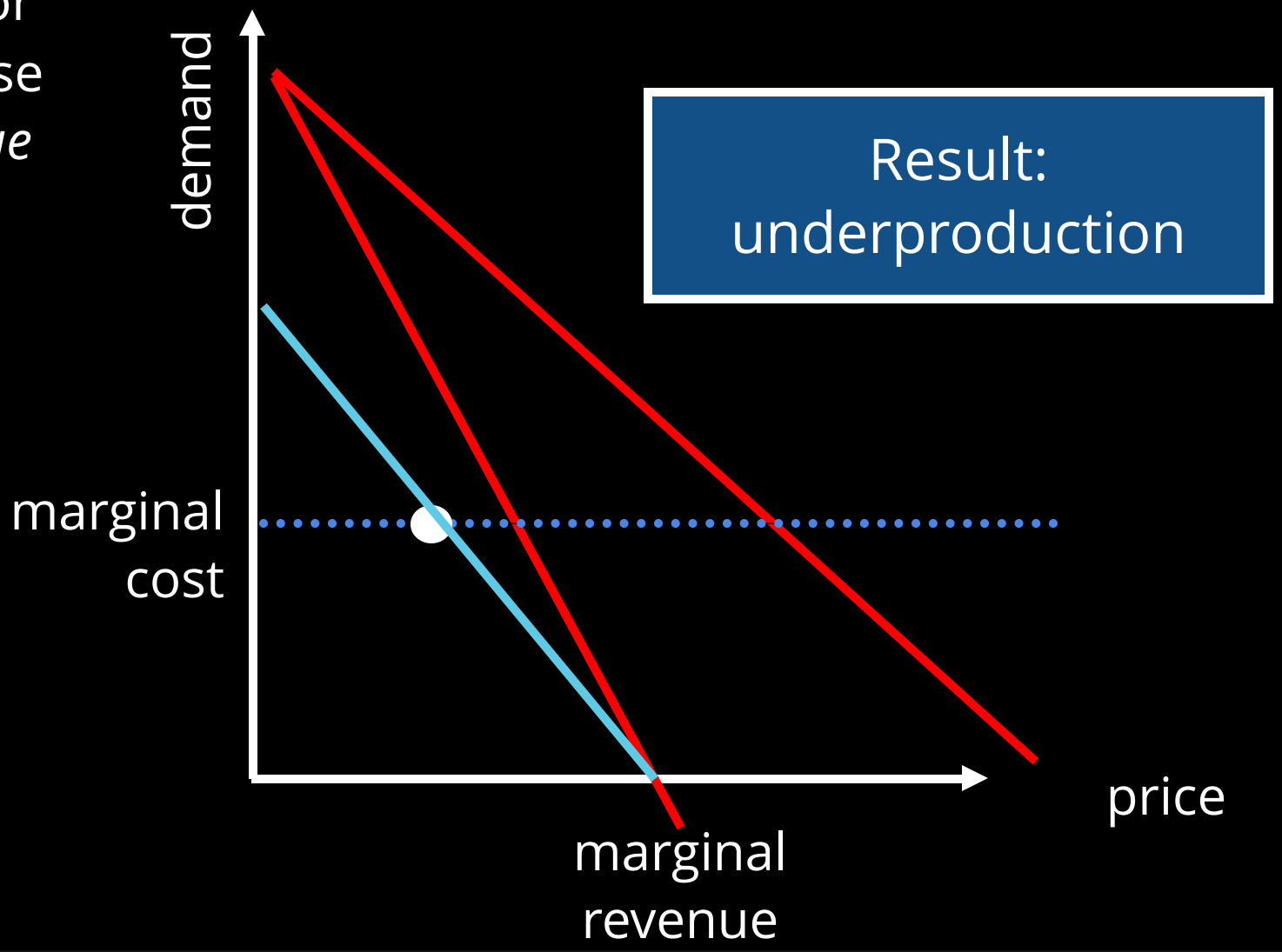

Result: underproduction

NB: Similar to underinvestment in Chod and Lyandres (2020)

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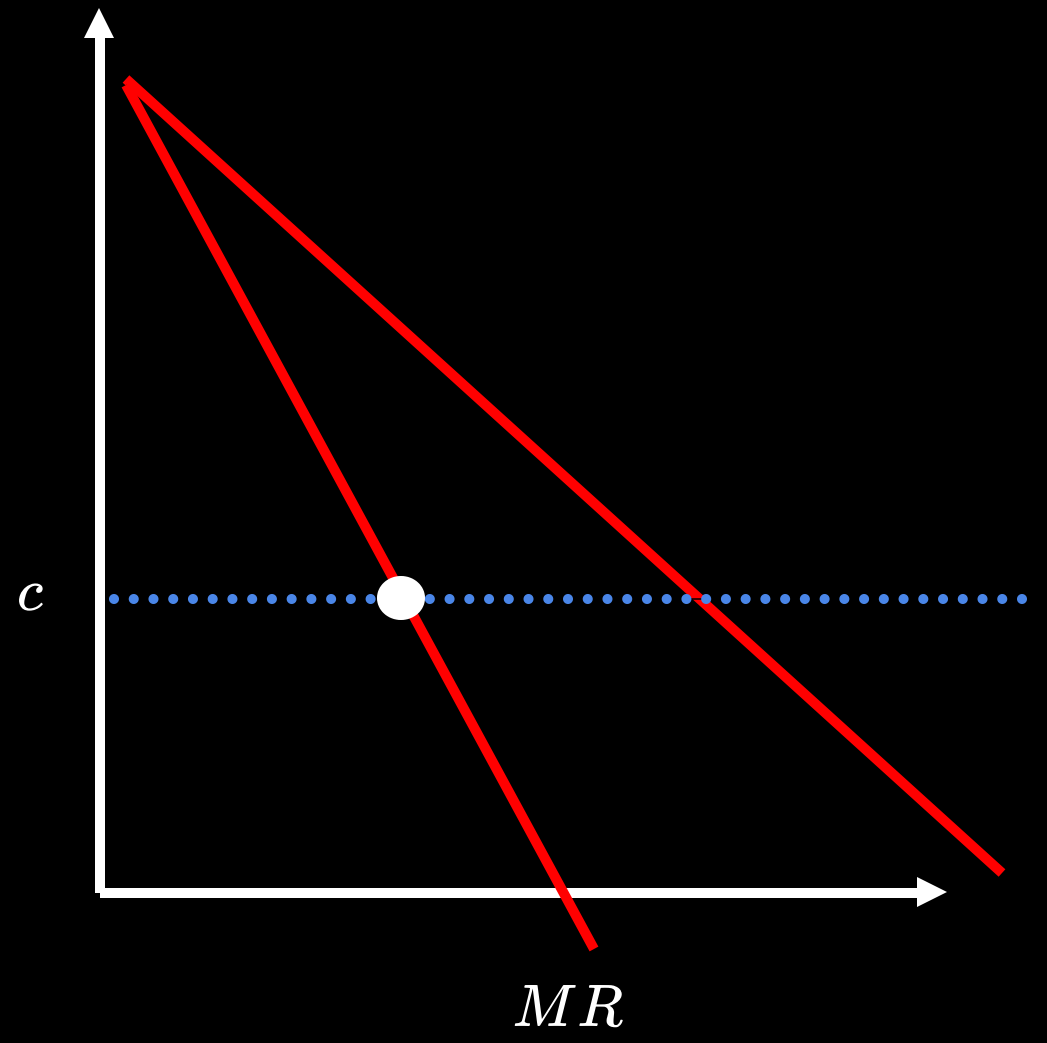

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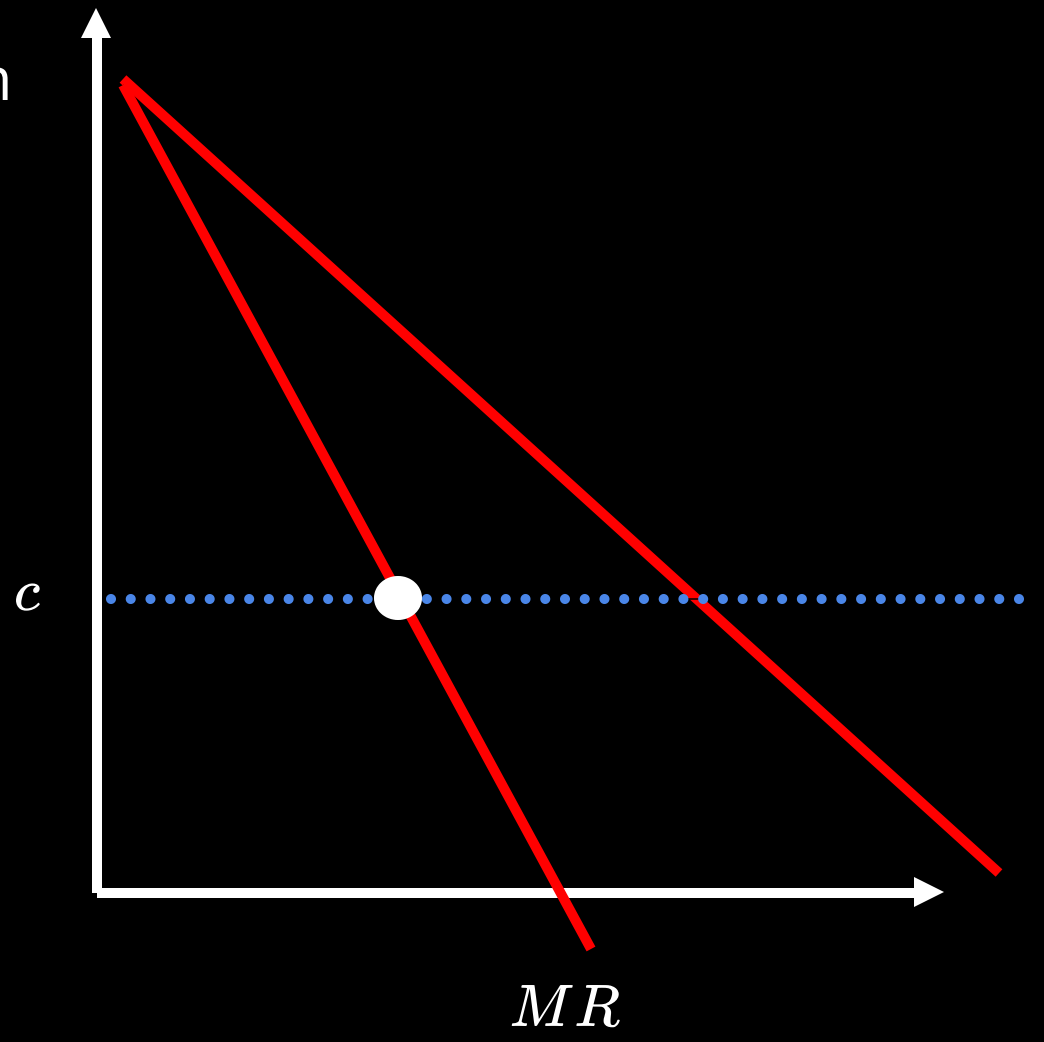

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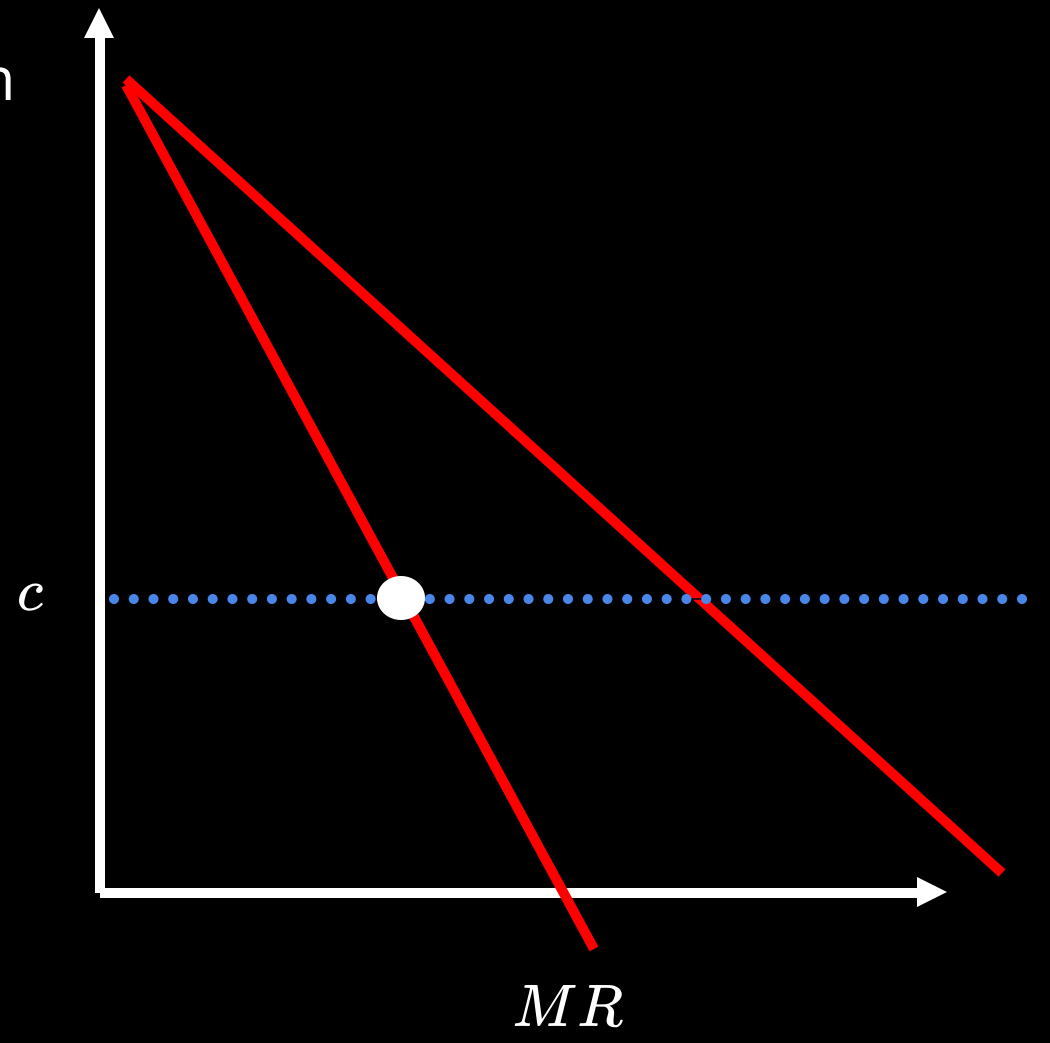

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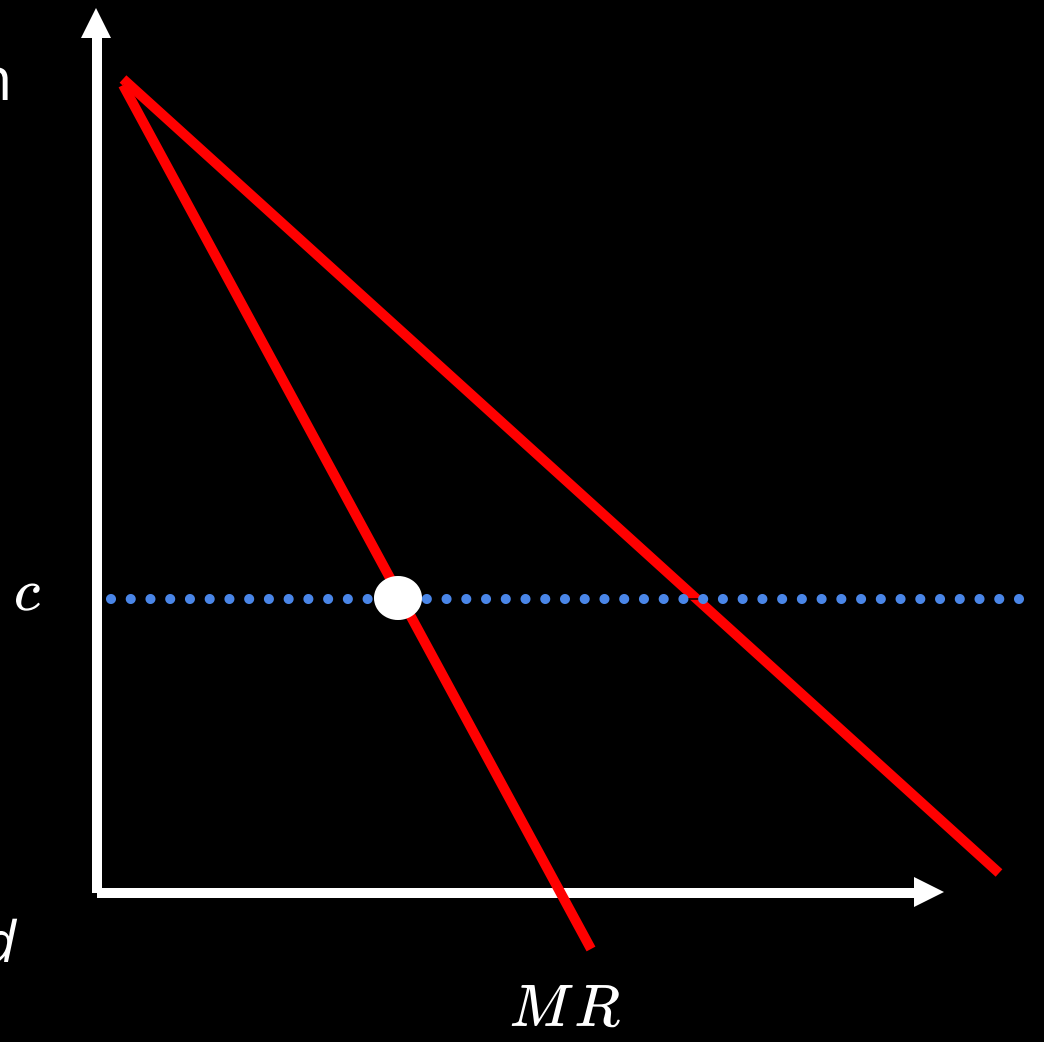
  address externality: TAX!
  here: tax future token income
  incremental token income gets shared



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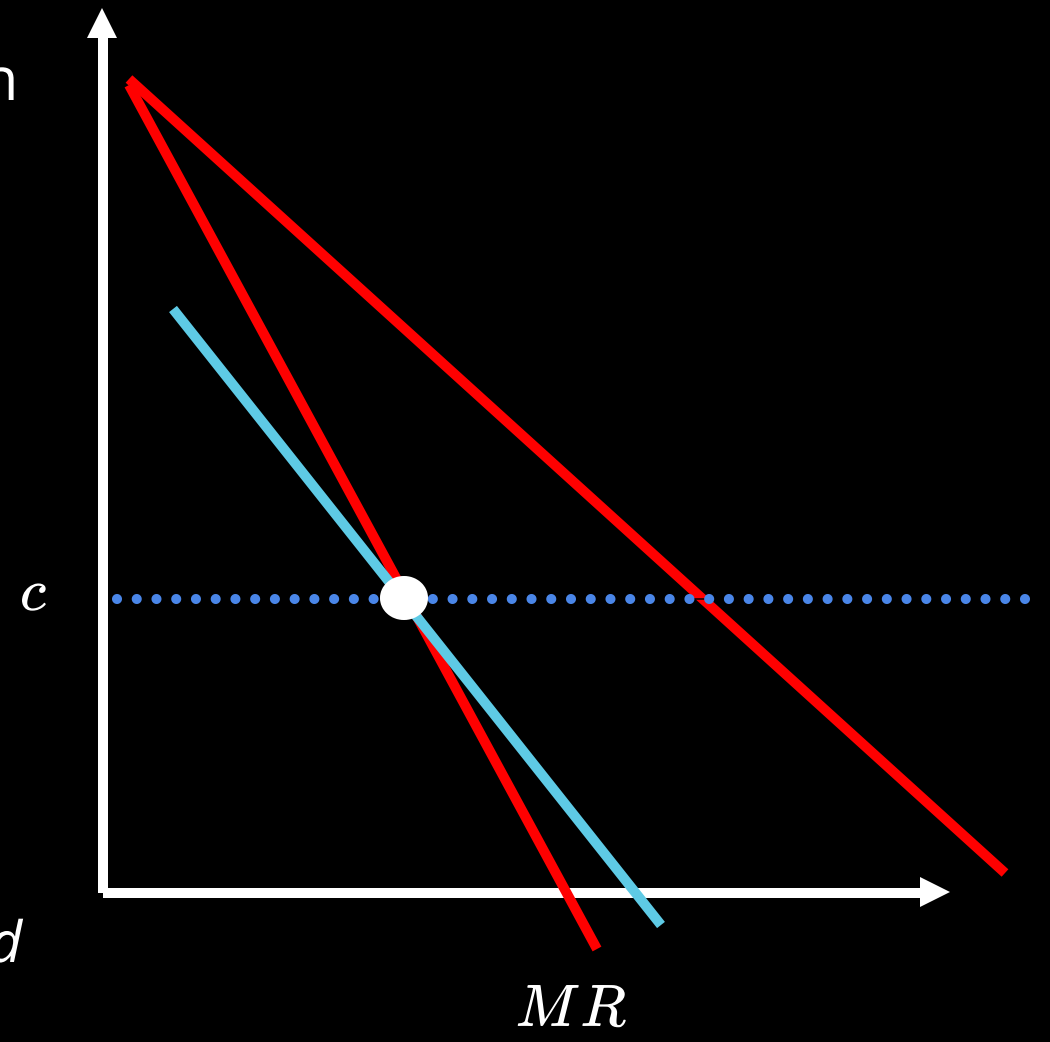

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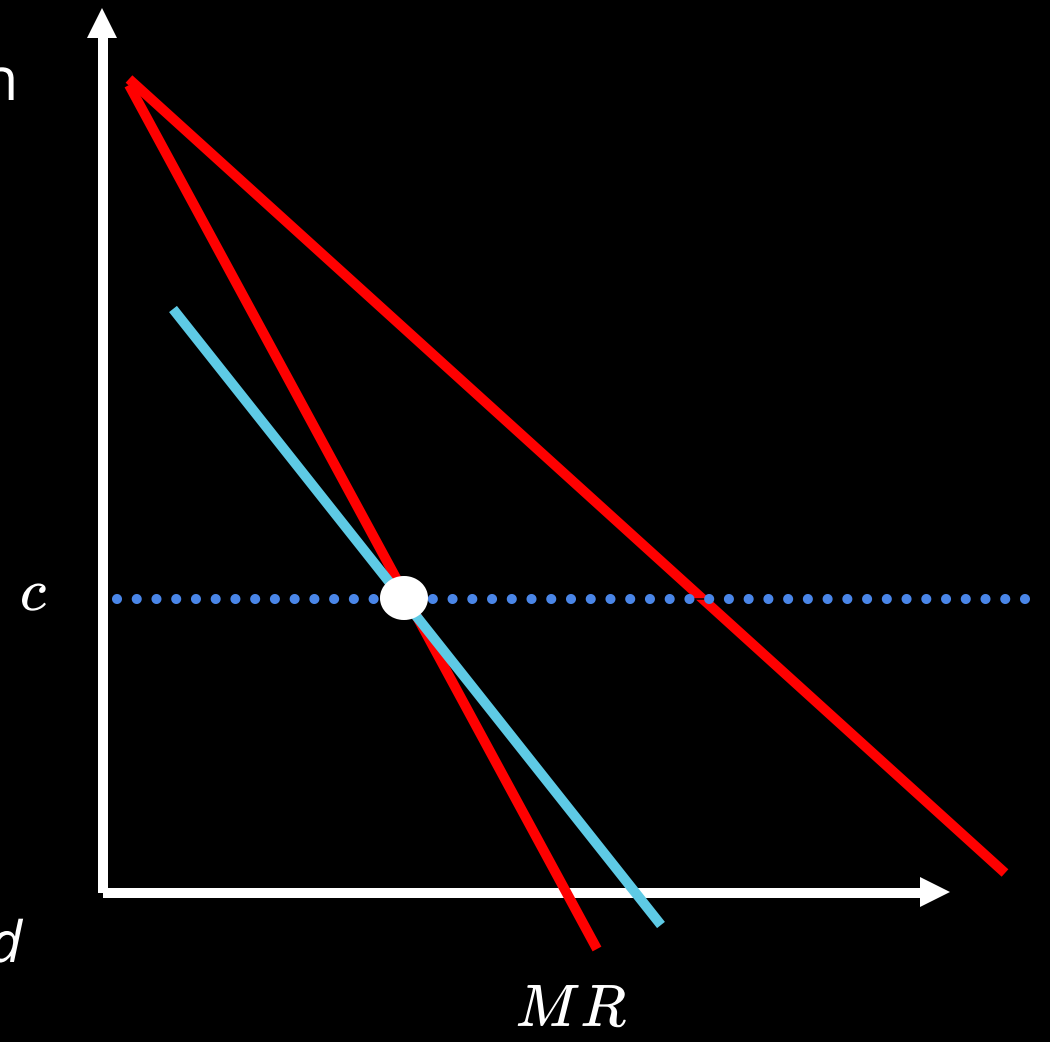

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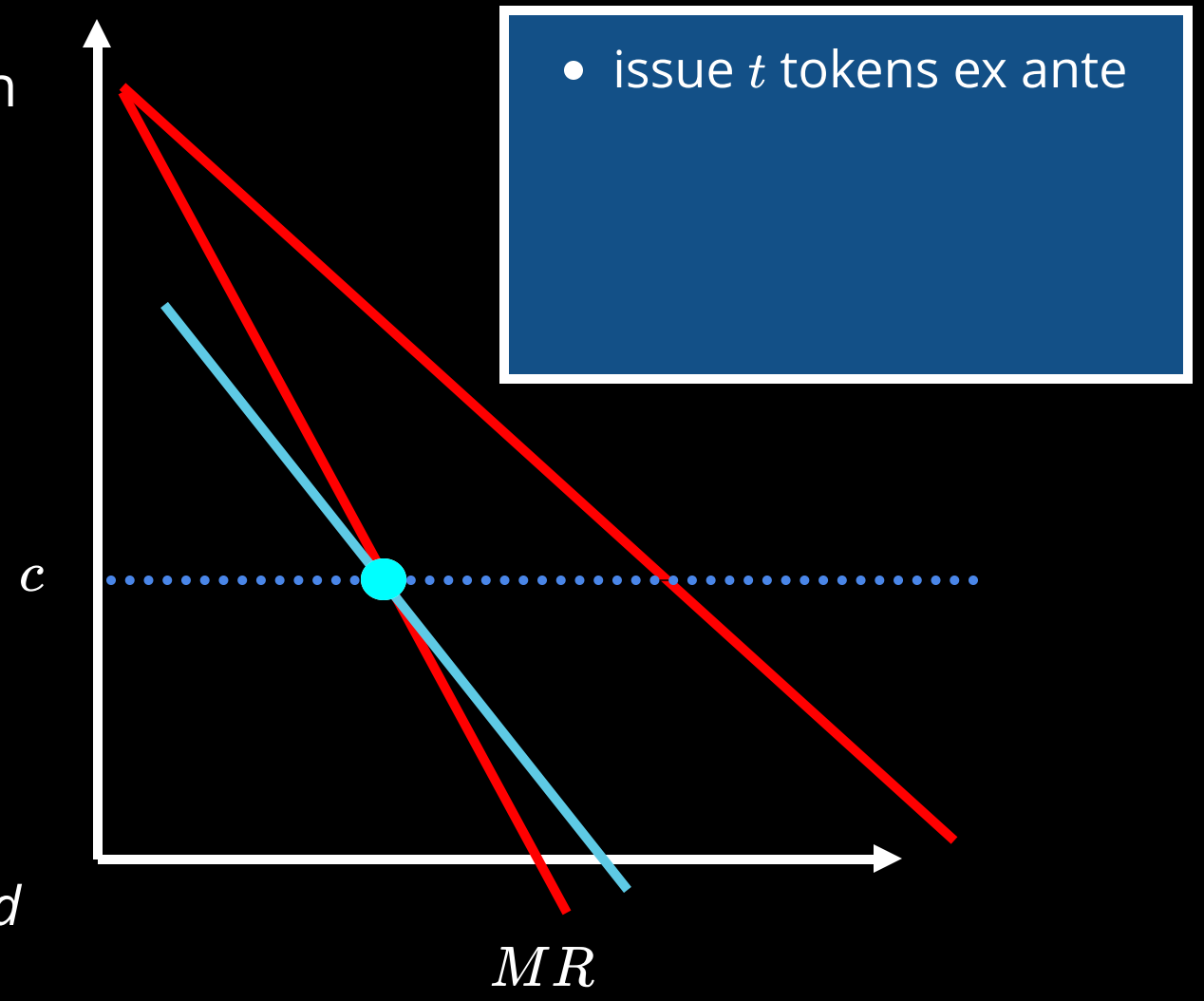

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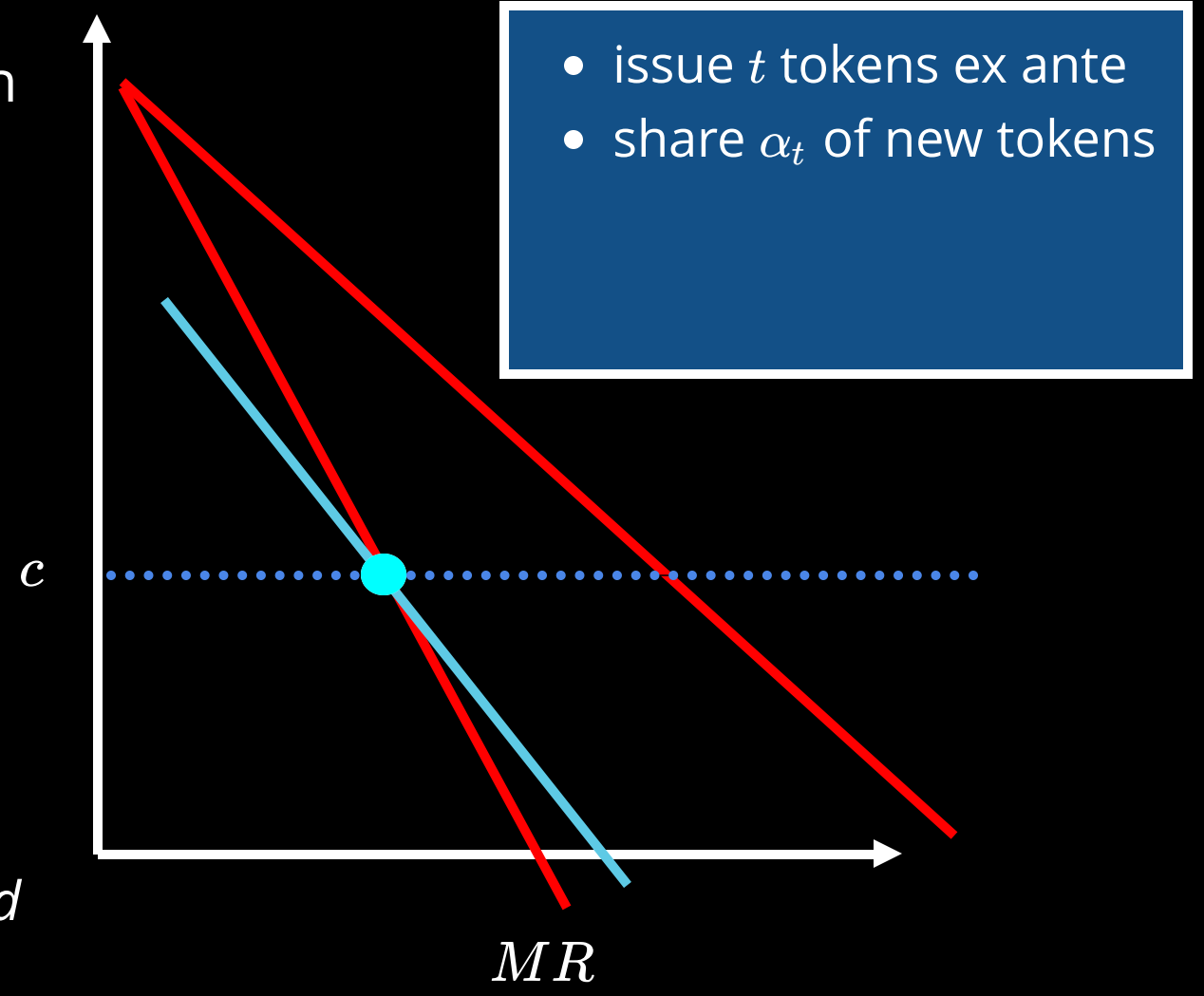

- issue t tokens ex ante
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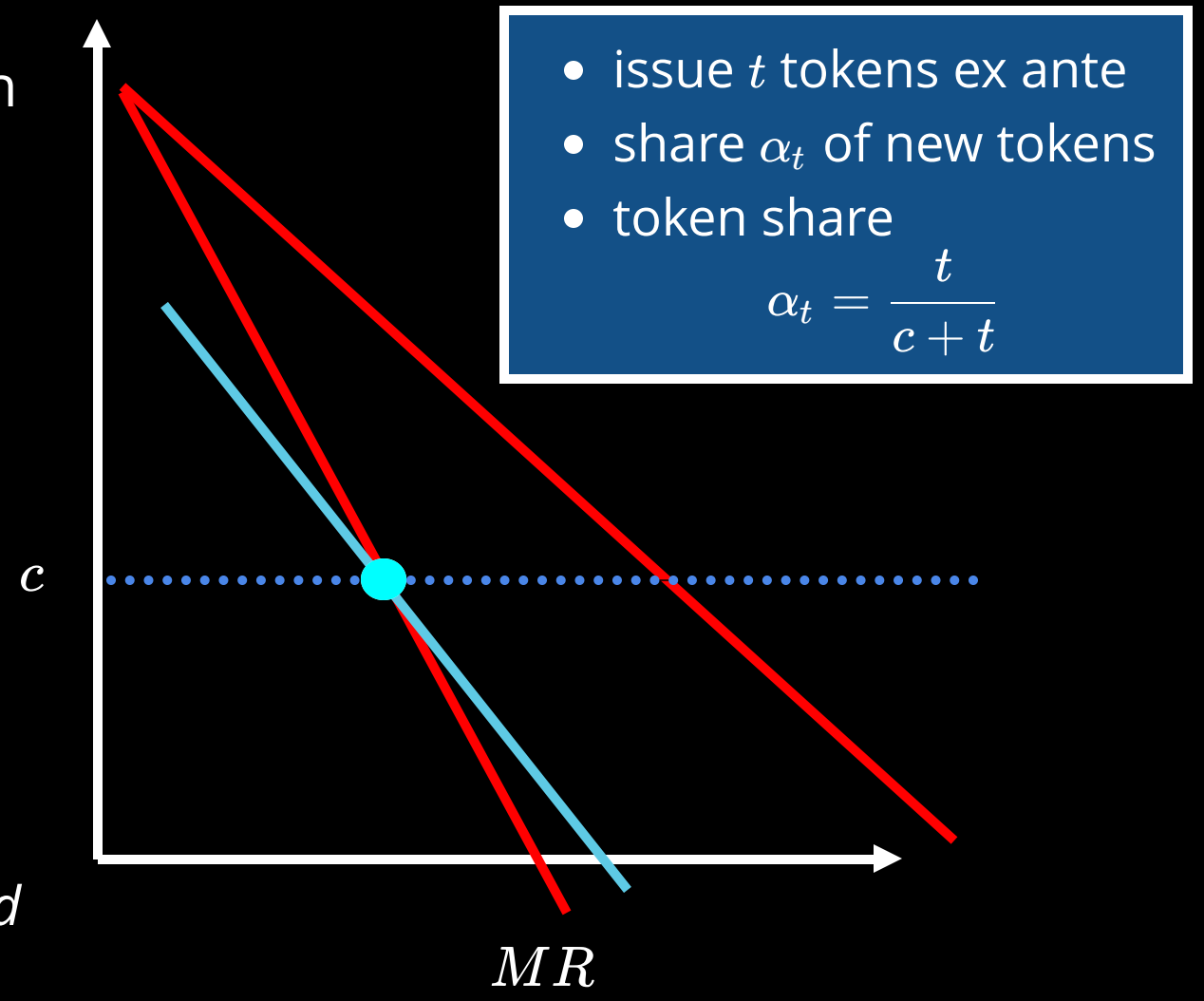

- issue t tokens ex ante
- share α_t of new tokens
- token share

$$\alpha_t = \frac{t}{c+t}$$

Formal Result: Optimal Token Contract

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Presell t
tokens.

Formal Result: Optimal Token Contract

If quantity produced $q > t$, then share α_t of revenue from incremental $q - t$ tokens with tokenholders

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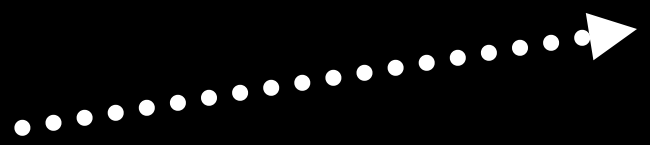

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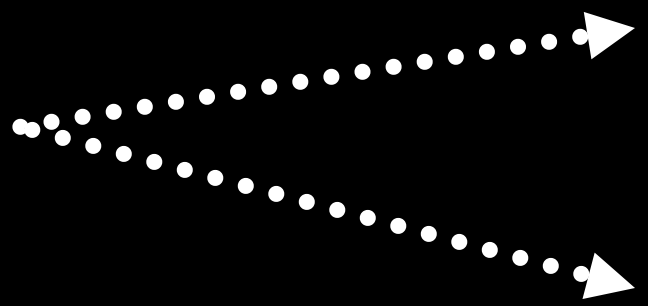

If $q < t \Rightarrow$ redeem at rate t/q and tokenholders receive refund of $c(t - q)$.

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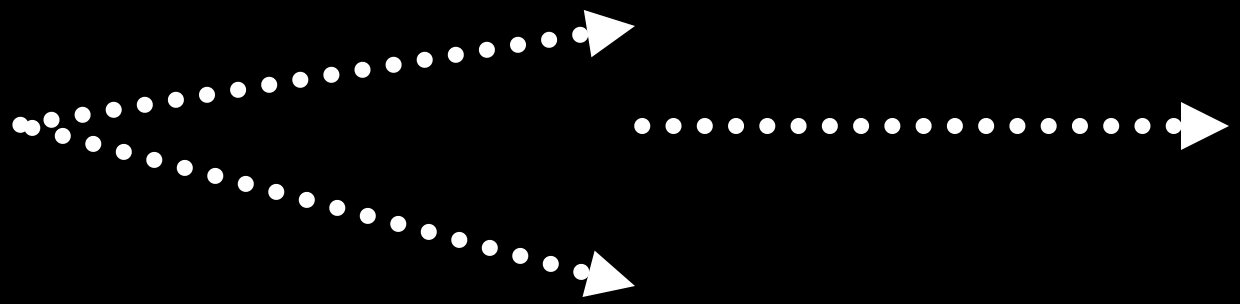

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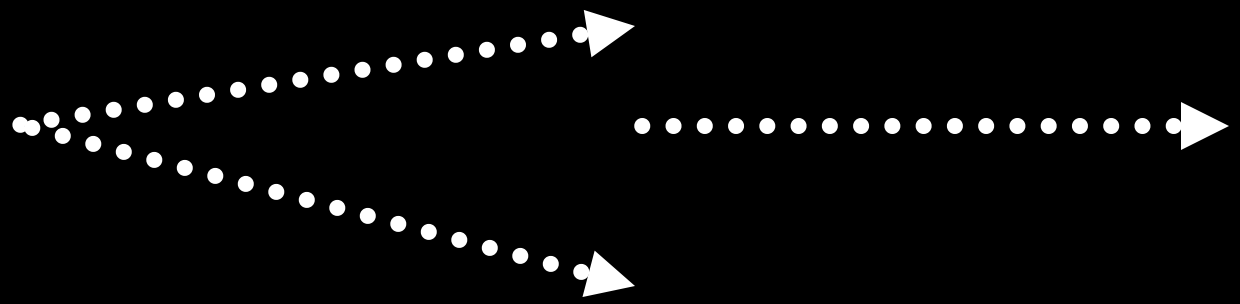

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As with equity, the entrepreneur receives the full NPV.

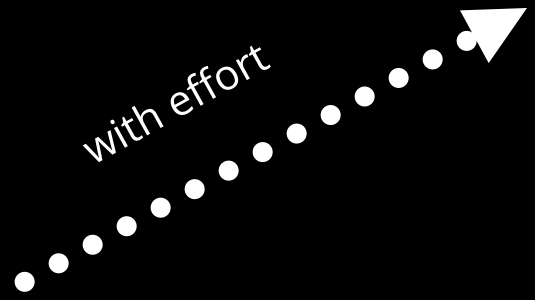
Token Issuance with Moral Hazard

Idea:

entrepreneur can influence
expected demand

Token Issuance with Moral Hazard

- costs her C_e
- $\theta \sim U(0, \theta_h)$



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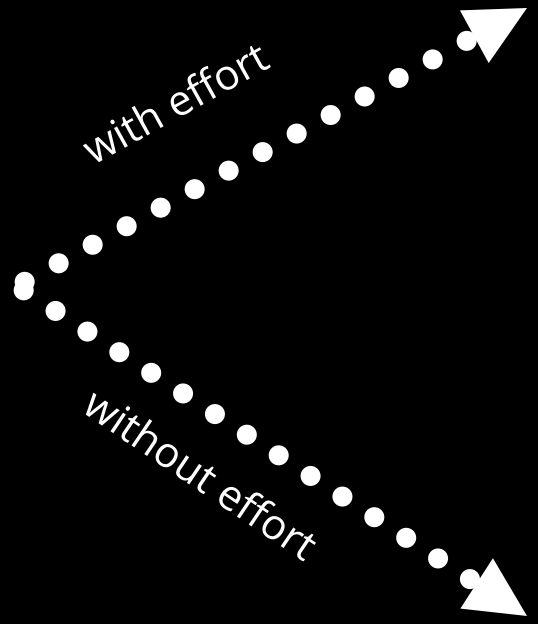

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- $\theta_l < \theta_h$

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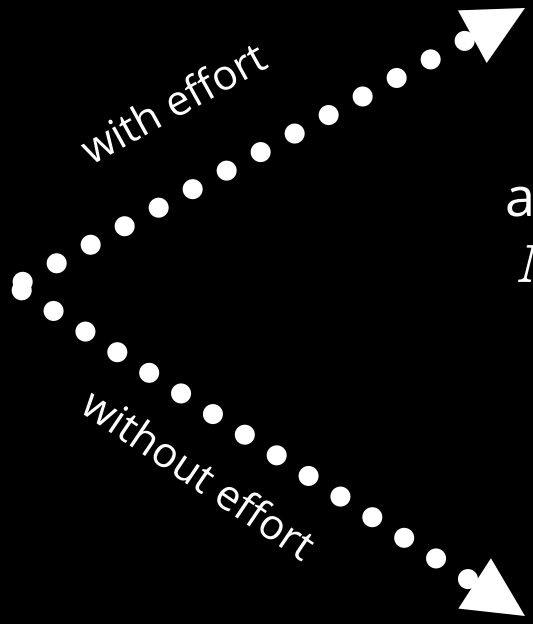

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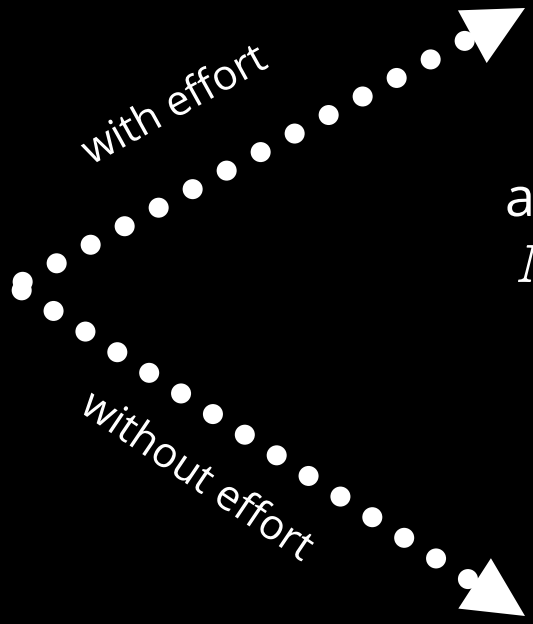

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- common topic in corporate finance
- very relevant in "decentralized" world where developers are scattered around the globe
- also applicable to, e.g. established firms that do something new

Token Issuance with Moral Hazard

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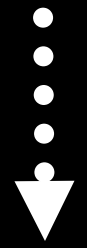

1. Solve for the optimal funding ***conditional*** on the entrepreneur taking the effort

2. Derive conditions such that the entrepreneur undertakes effort

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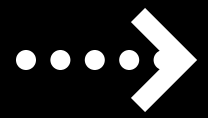

Key insight: a token contract incentivizes effort better than equity (similarly to canonical debt vs. equity insights)

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Key insight: a token contract incentivizes effort better than equity (similarly to canonical debt vs. equity insights)

- all projects that can be financed by equity can be financed by the optimal token contract but
- some projects that can be financed by optimal tokens contracts cannot be financed by equity.

Summary

- Simple model of revenue-based ICO vs equity financing from the standard corporate finance + IO toolbox
- Theorem 1: *Without frictions, an optimal token contract finances the same projects as equity*
- Theorem 2: *With entrepreneurial moral hazard,*
  - *any equity-financeable project can be financed by an optimal token*
  - *some token-financeable projects cannot be financed by equity*

Summary

- Simple model of revenue-based ICO vs equity financing from the standard corporate finance + IO toolbox
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  - *any equity-financeable project can be financed by an optimal token*
  - *some token-financeable projects cannot be financed by equity*

$\Rightarrow$ There is economic and conceptual merit to token financing

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