From Cash to Buy-Now-Pay-Later

Impacts of platform-provided credit on market efficiency

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Motivation

- The dual role of e-commerce platforms
  - Brokerage: match buyers and sellers
  - Credit: delayed settlement, record-keeping, enforcing repayment, e.g., **buy-now-pay-later** on Amazon, Alipay, JD.com.

- Regulatory frameworks tend to treat two roles separately

EU: Revised European Consumer Credit Directive (Oct 23)
US: Proposal by Consumer Financial Protection Bureau (Nov 23)
UK: Treasury's Legislative Proposal (Feb 23)
China: Pilot Management Measures for Consumer Finance Companies (Nov 13)

amazon pay Shop with Amazon Pay > Amazon Pay for business > Sign in > Business Registration

BUY NOW AND PAY OVER TIME WITH PROMOTIONAL FINANCING

Shop beyond Amazon.com with your Amazon Store Card

Here's one more reason to love the Amazon Store Card. You can use your card to make purchases beyond Amazon.com using Amazon Pay. And you have the option to choose 0% APR financing with 6 equal monthly payments on qualifying Amazon Pay purchases*.

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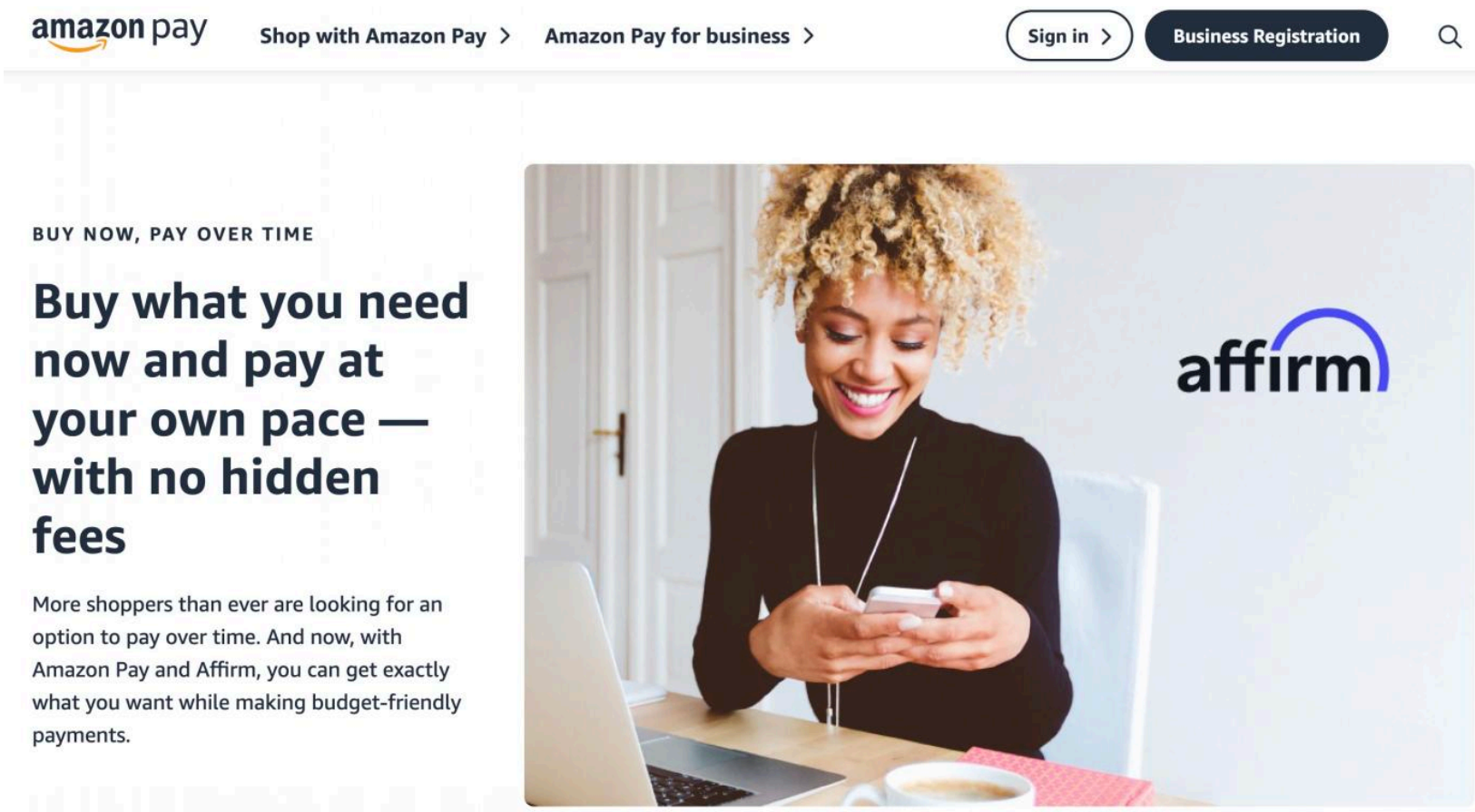
Amazon Pay purchases made using your Amazon Store Card and Prime Store Card are not eligible to earn reward points.


amazon pay
Shop with Amazon Pay
Amazon Pay for business
Sign in
Business Registration
BUY NOW, PAY OVER TIME
Buy what you need now and pay at your own pace — with no hidden fees
More shoppers than ever are looking for an option to pay over time. And now, with Amazon Pay and Affirm, you can get exactly what you want while making budget-friendly payments.
affirm

- The separated regulation can be problematic ...
  - participants: sellers may lack the incentive to adopt credit
  - platform: the platform can provide credit *for free*, but charge a high transaction fee to extract surplus
  - regulator: given that credit is highly subsidized, challenge to regulate directly

- Questions:
  1. Why do some sellers adopt credit while others do not?
  2. To whom would the platform find it profitable to provide credit?
  3. What are the possible distortions? How to regulate?

- We examine the equilibrium, distortions, and regulations of a monopolist dual-role (brokerage + credit) platform.

Result I: Microfoundation of payment

Means of payment

- Money: money holding costs, e.g., inflation (possibly passed on to the seller)
- Credit: cost paid by seller (lump sum in the baseline)

Matching efficiency and adoption of credit payment

- Some sellers have higher matching efficiency
  - e.g., better inventory, advertising capacities, etc.
- In directed search equi., these sellers can attract more buyers and charge higher prices $\Rightarrow$ bear higher inflation costs $\Rightarrow$ higher incentive to adopt credit

Result II: Platform-provided credit

A model of platform economy

- sellers of heterogeneous search efficiencies / free entry of buyers
- a monopolist platform: matching & credit
  - monetary payment sector
  - credit payment sector

Means of payment in equilibrium...

- depend on credit tech cost and money holding cost
- pure monetary (credit) payment for low (high) i;
- hybrid payment for medium i

Result III: Distortions and Regulations

Distrotions in credit provision

- if equil. has hybrid payment, credit provision is too low
  - platform does not get full surplus of providing credit
- if equil. has pure credit payment, credit provision can be too high
  - platform provides credit for free, and impose high transaction fee
  - even if credit is dominated by money in terms of surplus

Regulations

- To ensure efficient credit provision, regulators shall jointly regulate transaction and credit usage fees

Literature

Coexistence of credit and money

- Liu (2021), Dong and Huangfu (2021), Wang, Wright and Liu (2020), Andolfatto, Berentsen and Martin (2019), Lotz and Zhang (2016), Gu, Mattesini, Monnet and Wright (2013), Ferraris and Watanabe (2012), Nosal and Rocheteau (2011), Sanches and Williamson (2010), Telyukova and Wright (2008), Berentsen, Camera and Waller (2007)

Hybrid or dual-mode of platforms

- Tirole and Bisceglia (2023), Madsen and Vellodi (2023), Gautier, Hu and Watanabe (2023), Etro (2023), Shopova (2023), Hagiu, Teh and Wright (2022), Anderson and Bedre-Defolie (2022), Kang and Muir (2022), Padilla, Perkins and Piccolo (2022), Zennyo (2022)

This talk

- I. Micro-foundation of Payment
- II. Platform Economy
- III. Distortions
- IV. Regulations

I. The Microfoundation of Payment

Set-Ups

Markets

- A variant of Lagos and Wright (2005)
- Each period: DM then CM; agents discount between periods
- CM: Walrasian market / buyers work and prepare money / sellers produce the good for DM & set up means of payment
- DM: trade an *indivisible* good

Agents

- Buyers: unit demand (value u), free entry (entry cost k)
- Sellers: selling capacity 1 unit, measure one

Means of Payment in DM

- Sellers can adopt credit tech at cost ϕ
- w credit tech, the matched buyer can pay by credit*

  *pay in next CM and no credit limit
- w/o credit tech, buyers need to pay fiat money

Search Frictions in DM

- Directed search
  - prices and other infor. observable on platforms
- Matching prob, for sellers: $\xi\alpha(x)$, for buyers: $\xi\alpha(x)/x$
  - $\alpha' > 0, \alpha'' < 0$, $\alpha(0) = 0, \alpha(\infty) = 1$.
  - x: buyer-seller ratio (or queue length)
- Each seller has a matching efficiency $\xi \in [\underline{\xi}, \bar{\xi}]$
  - ξ follows a continuous dist. with cdf. $G(\xi)$ and pdf. $g(\xi)$

Timing

1. In CM, **sellers** draw ξ, decide to join DM or not. If join, he
   - produces one unit DM good at cost κ;
   - announces prices and accepted payment methods in DM.
2. Observing prices, means of payment and ξ's, **buyers** simultaneously decide which seller to visit, prepare money if needed.
3. Trade occurs in DM.

If a seller opts for credit payment ...

- The seller's problem:

$$\max_{x,p} \ \xi\alpha(x)p, \quad \text{s.t.} \ \ \frac{\xi\alpha(x)}{x}\,(u-p) = k,$$

$$\text{f.o.c}: \ \ \xi\alpha'(x_c)u = k.$$

  where k is the buyer's market value (entry cost).

- $x_c(\xi)$ increases in ξ, more efficient sellers attract more buyers
- The optimized profits:

$$\pi_c(\xi) = \xi\alpha(x_c)u - x_c k.$$

If a seller opts for monetary payment ...

- The seller's problem:

$$\max_{x} \xi\alpha(x)p, \quad \text{s.t.} \quad \frac{\xi\alpha(x)}{x}(u-p) - ip = k.$$

$$\text{f.o.c}: \quad x_m = x_m(\underset{-}{i}, \underset{+}{\xi}).$$

- The optimized profits:

$$\pi_m(\xi, i) = \xi\alpha(x_m)u - x_m k - ix_m p_m$$

- Money-holding costs are passed to the seller.

Adopting credit tech or not...

- A seller's maximized profit:

$$\text{under credit:} \quad \pi_c(\xi) = \xi\alpha(x_c)u - x_c k,$$
$$\text{under money:} \quad \pi_m(\xi, i) = \xi\alpha(x_m)u - x_m k - i x_m p_m.$$

- A seller opts for credit payment if

$$\begin{aligned}\phi < \Delta\pi(\xi, i) &\equiv \pi_c(\xi) - \pi_m(\xi, i) \\ &= \left\{[\xi\alpha(x_c) - \xi\alpha(x_m)]u - (x_c - x_m)k\right\} + x_m i p_m.\end{aligned}$$

- $\Delta\pi(\xi, i)$ increases in i and ξ

$$\frac{\partial\Delta\pi(\xi, i)}{\partial\xi} = \underbrace{(\alpha(x_c) - \alpha(x_m))(u - c)}_{\text{volume effect}} + \underbrace{x_m i[\partial p_m/\partial\xi]}_{\text{price effect}},$$

Equilibrium

- Equilibrium conditions

$$\text{Participate:} \quad \max\{\pi_c(\xi) - \phi, \pi_m(\xi, i)\} \geq \kappa,$$

$$\text{Adopt credit:} \quad \phi \leq \Delta\pi(\xi, i).$$

- Notations

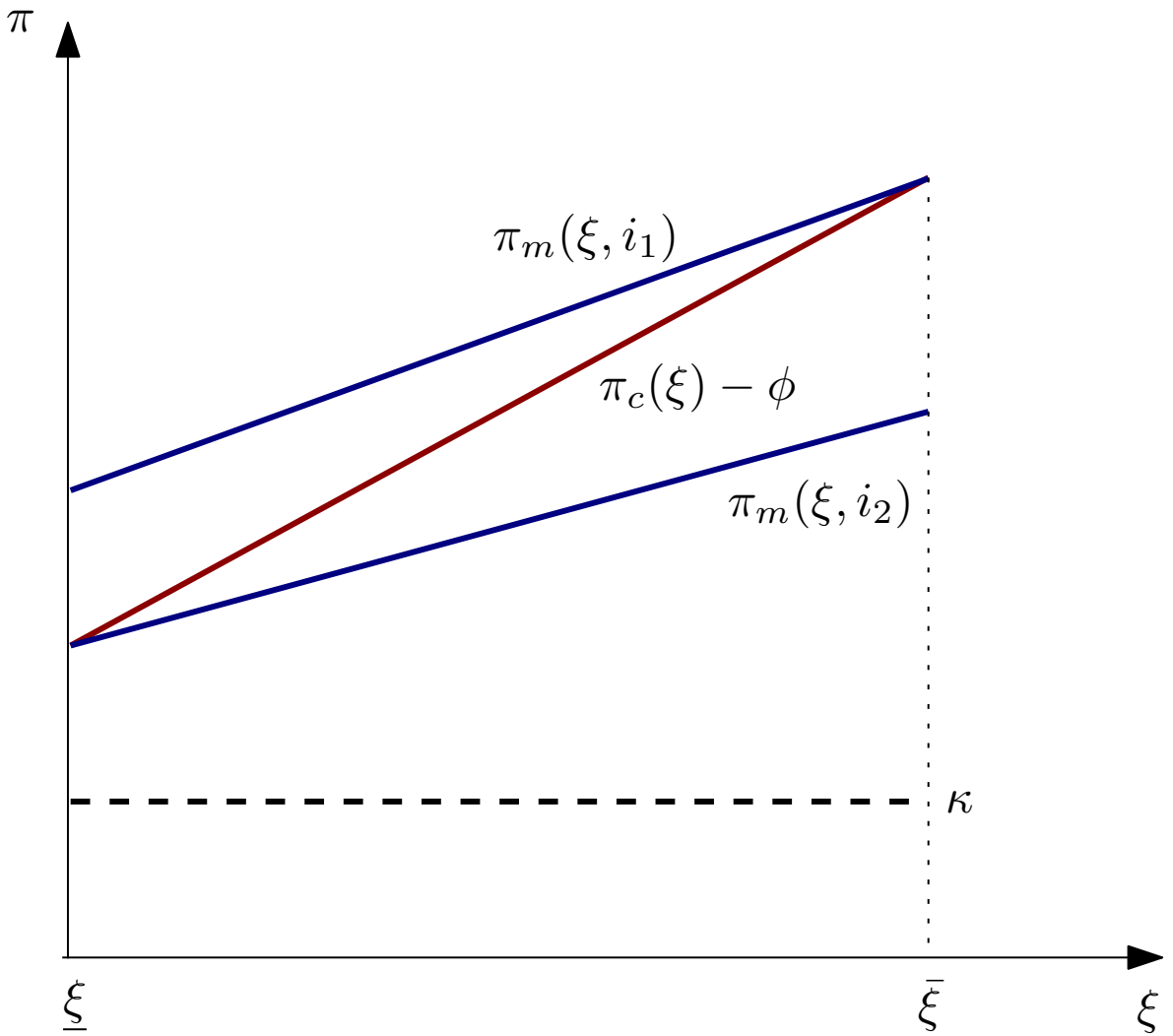
ξ_l : the lowest ξ of participating sellers,

$\hat{\xi}$: the threshold to adopt credit.

- Assumption:

production cost is low, i.e., $\kappa < \pi_c(\underline{\xi}) - \phi$

Props. $\xi_l = \underline{\xi}$. $\hat{\xi}$ satisfies $\Delta\pi(\hat{\xi}, i) = \phi$ if $i \in (i_1, i_2)$; $\hat{\xi} = \bar{\xi}$ $(\underline{\xi})$ if $i \leq i_1$ $(i \geq i_2)$.



II. The Platform Economy

The Two Roles of the Platform

- Brokerage
  - sellers can contact buyers only via the platform (directed search)
  - proportional transaction fee $t \in [0, 1]$
- Means of Payment
  - sellers can always accept cash
  - sellers can accept credit by paying lump sum fee $f \geq 0$ to the platform
  - cost of credit tech for the platform: $\phi > 0$

Timing

0. **In CM, the platform publicly announces** $(t, f) \in [0, 1] \times \mathbb{R}_+$**.**
1. Sellers draw ξ, decide to join DM or not. If join, he
   - produces one unit DM good at cost κ;
   - announces prices and accepted payment methods in DM.
2. Observing prices, means of payment, and ξ's, buyers simultaneously decide which seller to visit, and prepare money if needed.
3. Trade occurs in DM.

Equilibrium

Sellers' best responses

- join platform iff $\max\{(1-t)\pi_m(\xi,i),(1-t)\pi_c(\xi)-f\} \geq \kappa$
- opt for credit iff $(1-t)\Delta\pi(\xi,i) \geq f$

Divide platform's strategy space

- **Credit Entry**: ξ_l-seller opt for credit payment
- **Money Entry**: ξ_l-seller opt for monetary payment
- Under **money entry**, a hybrid payment system is possible

Credit Entry

- The platform's problem:

$$\Pi_c = \max_{(t,\phi)\in\mathbb{T}} \int_{\xi_l}^{\bar{\xi}} (t\pi_c(\xi) + f - \phi)\, dG(\xi),$$

$$s.t.\ \ (1-t)\pi_c(\xi_l) - f = \kappa,$$

$$(1-t)\pi_m(\xi_l, i) < \kappa.$$

lemma Profit maximization indicates $f = 0,\ t = 1 - \frac{\kappa}{\pi_c(\xi_l)}$.

- A monopoly quantity distortion:

$$\Pi_c = \max_{\xi_l\in[\underline{\xi},\bar{\xi}]} \int_{\xi_l}^{\bar{\xi}} \left(\left(1 - \frac{\kappa}{\pi_c(\xi_l)}\right)\pi_c(\xi) - \phi\right) dG(\xi).$$

Money Entry

- The platform's problem:

$$\Pi_m(i) = \max_{(t,\phi)\in\mathbb{T}} \left\{ \int_{\xi_l}^{\hat{\xi}} t\pi_m(\xi, i) dG(\xi) + \int_{\hat{\xi}}^{\bar{\xi}} (t\pi_c(\xi) + f - \phi)\, dG(\xi) \right\}$$

$$s.t. \quad (1-t)\pi_m(\xi_l, i) = \kappa,$$

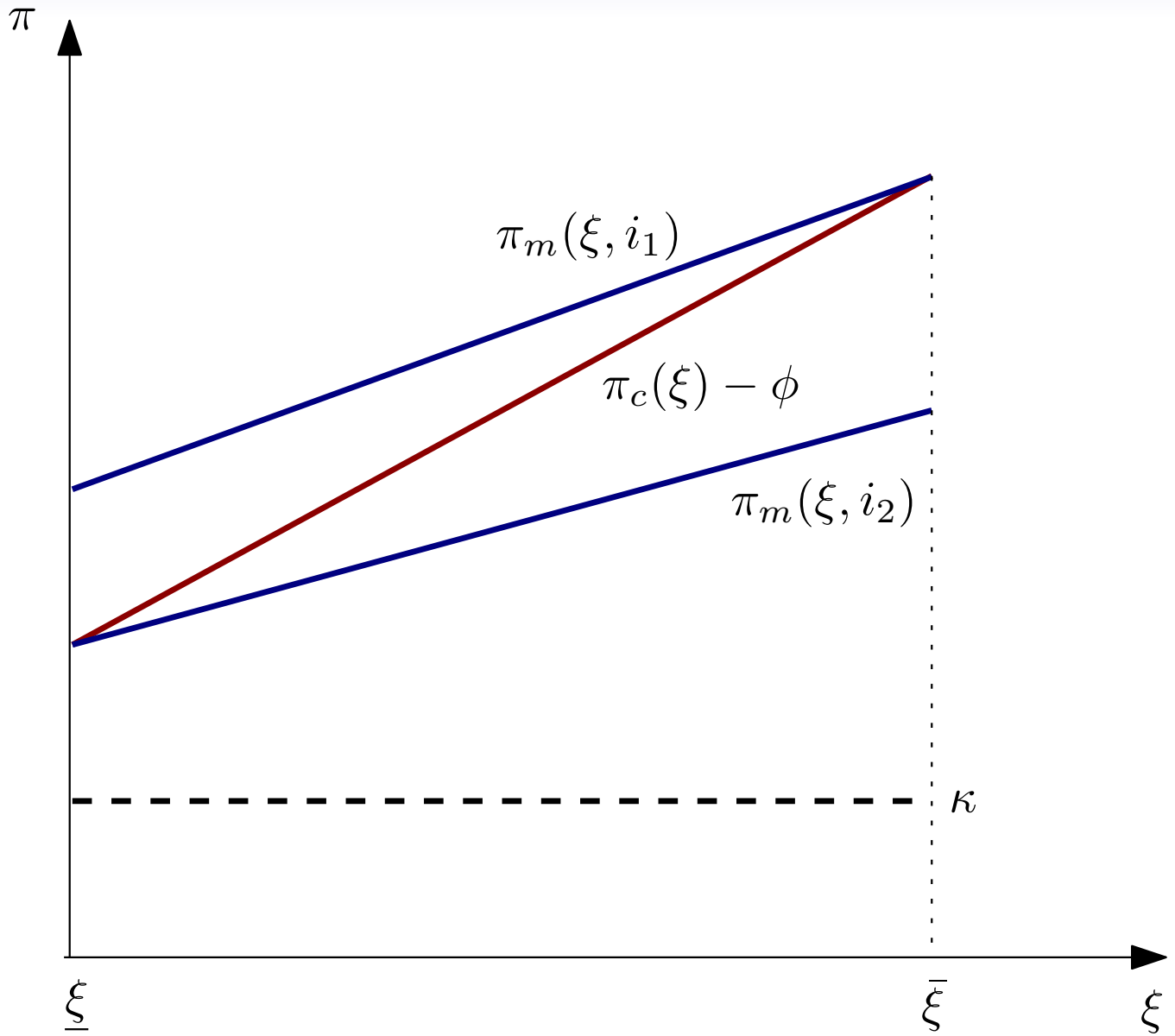
$$(1-t)\pi_c(\hat{\xi}) - f = (1-t)\pi_m(\hat{\xi}, i).$$

lemma Under money-entry, platform profits are maximized by $\hat{\xi} = \bar{\xi}$ iff $i \leq i_1$.

- $\hat{\xi} = \bar{\xi}$: pure monetary payment
- $i \leq i_1$: monetary payment gives higher surplus than credit payment for all ξ

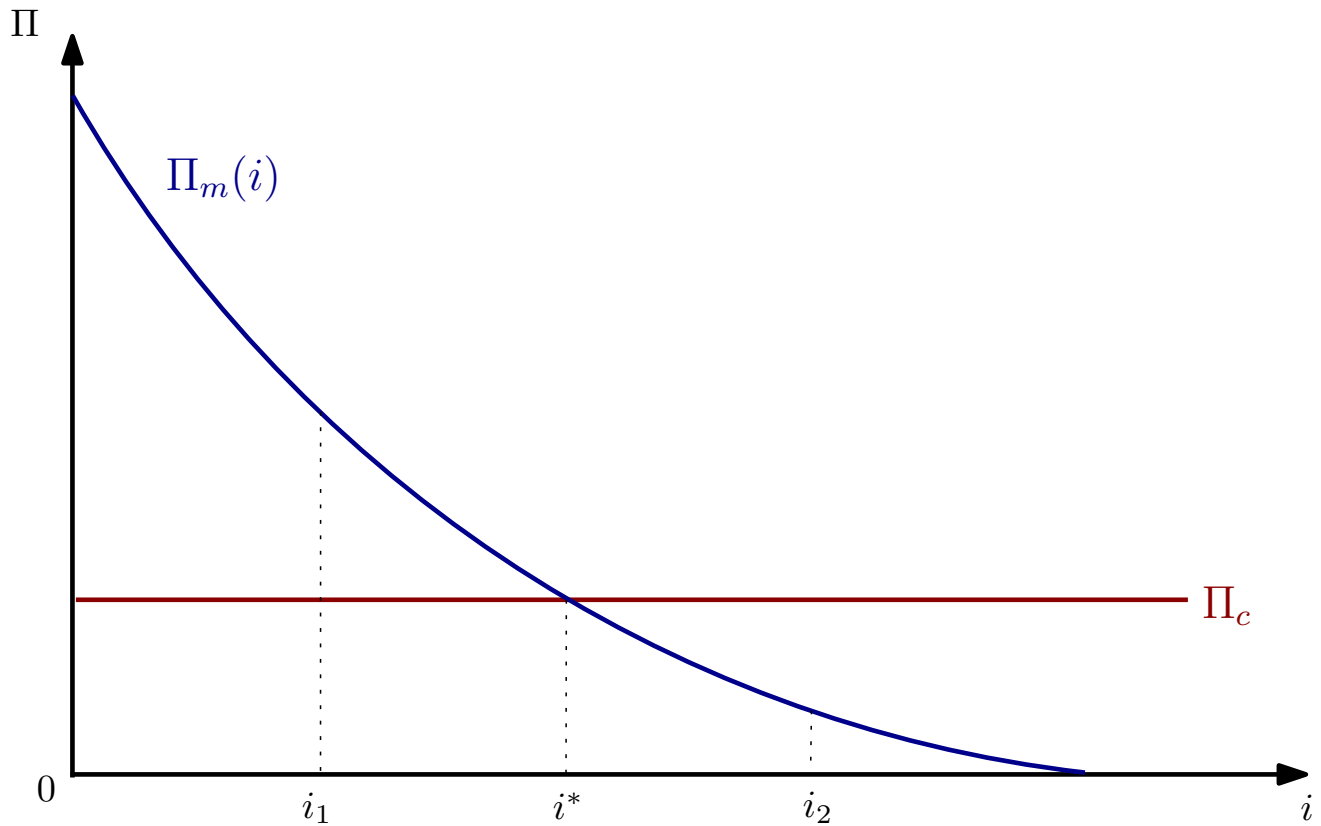
lemma $\Pi_m(i)$ decreases in i with

$$\lim_{i\to 0} \Pi_m(i) > \Pi_c, \text{ and } \Pi_m(i) < \Pi_c \text{ for } i > i_2.$$


π
$\pi_m(\xi, i_1)$
$\pi_c(\xi) - \phi$
$\pi_m(\xi, i_2)$
κ
$\underline{\xi}$
$\bar{\xi}$
ξ

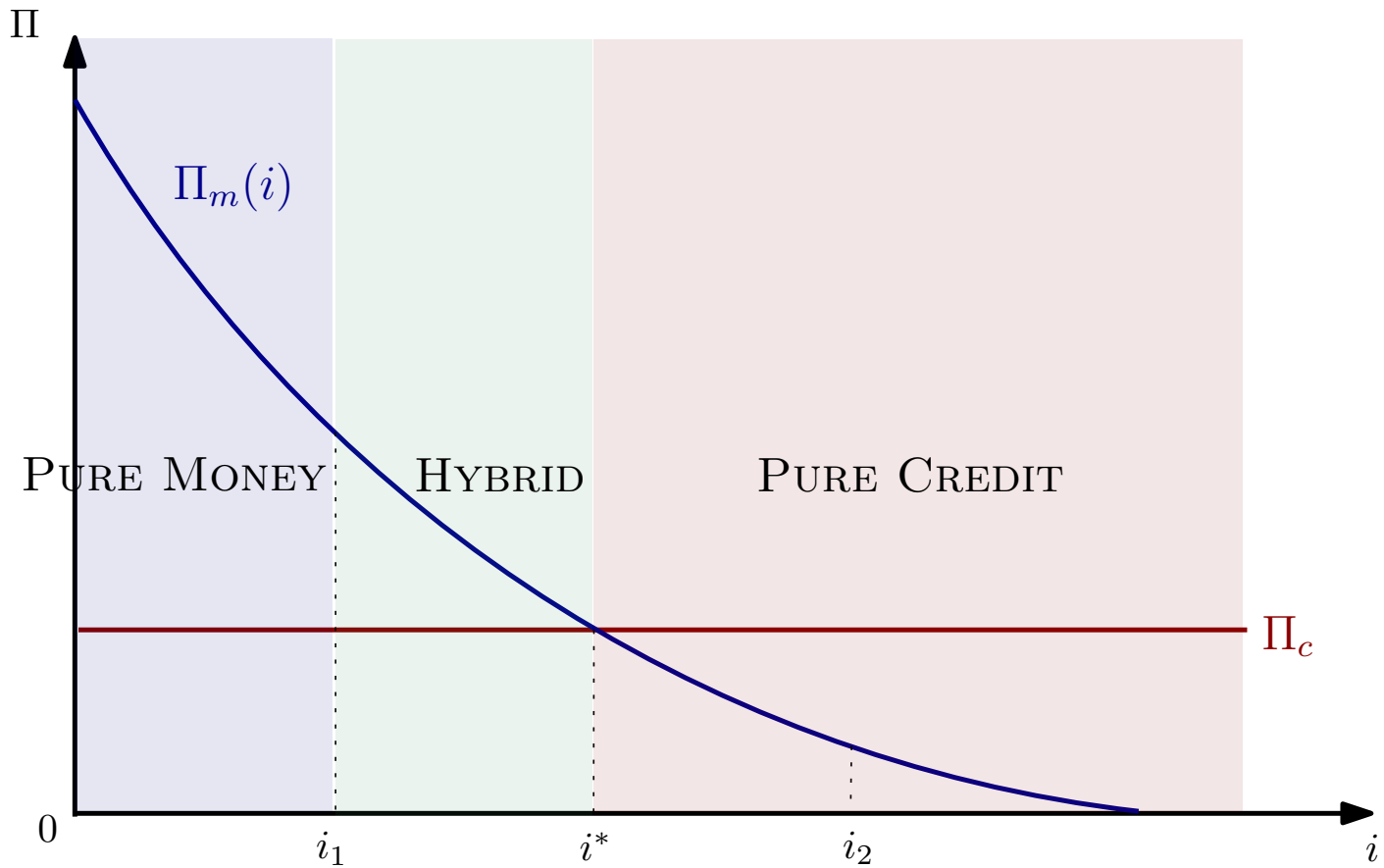
Platform profit-maximization

Propos. $\exists! i^* \in (0, i_2]$, $\Pi_m(i^*) = \Pi_c$.



Platform mode

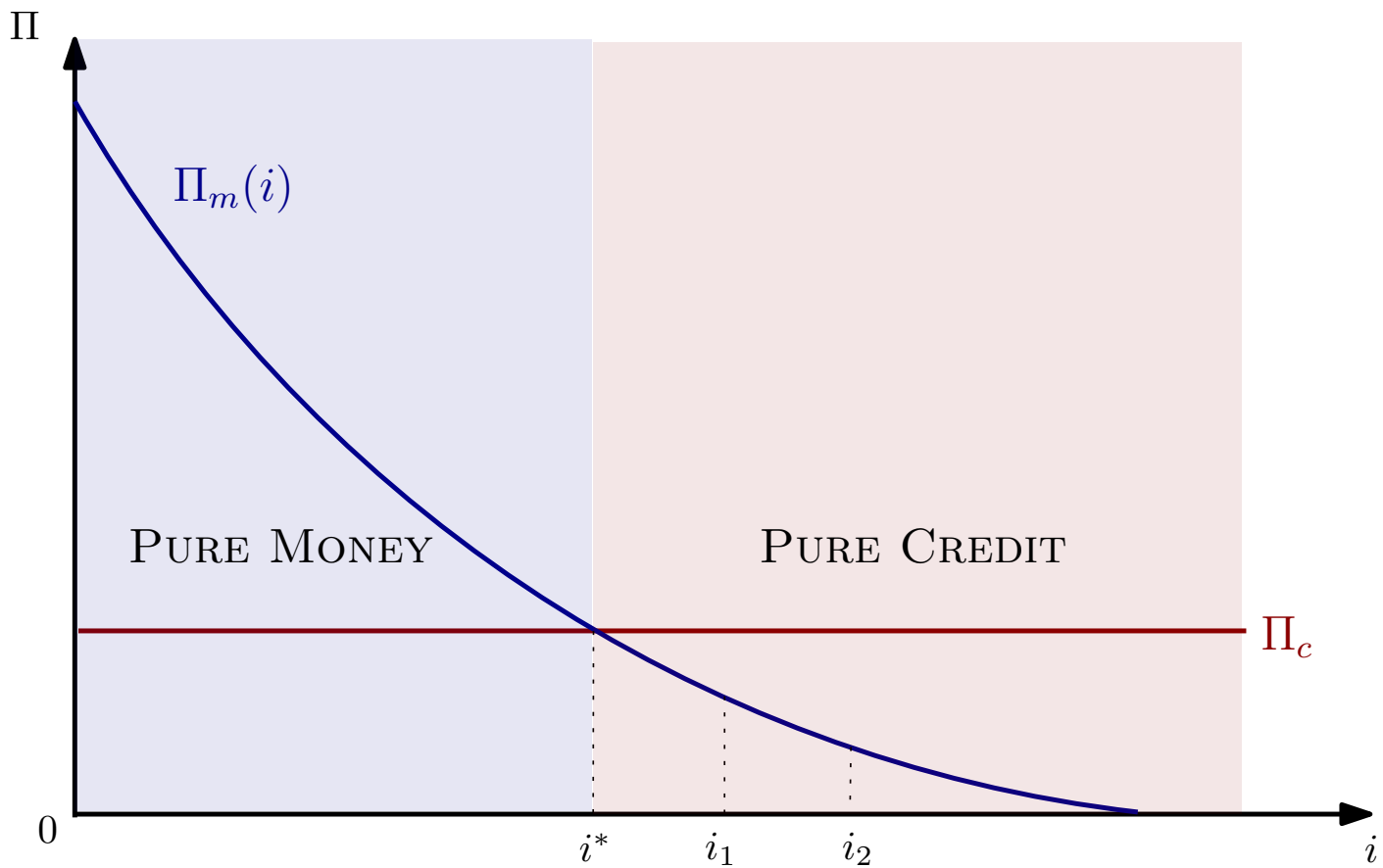
Propos. $\exists! i^* \in (0, i_2]$, $\Pi_m(i^*) = \Pi_c$.



Credit-entry: profitable but suboptimal

Cor. $\exists \bar{\phi} > 0$. If $\phi < \bar{\phi}$, then $i^* < i_1$.

Remark: Despite $\pi_m(\xi, i) > \pi_c(\xi) - \phi$ for all ξ, platform still chooses credit-entry.



Credit-entry: profitable but suboptimal

- Even if $\pi_m(\xi, i) > \pi_c(\xi) - \phi$ for all ξ, platform may choose credit-entry.
- The most profitable money entry strategy gives

$$\Pi_m = \int_{\xi_l}^{\bar{\xi}} t_m \pi_m(\xi, i) dG(\xi) \text{ with } (1 - t_m)\pi_m(\xi_l, i) = \kappa.$$

- Switching to credit entry yields

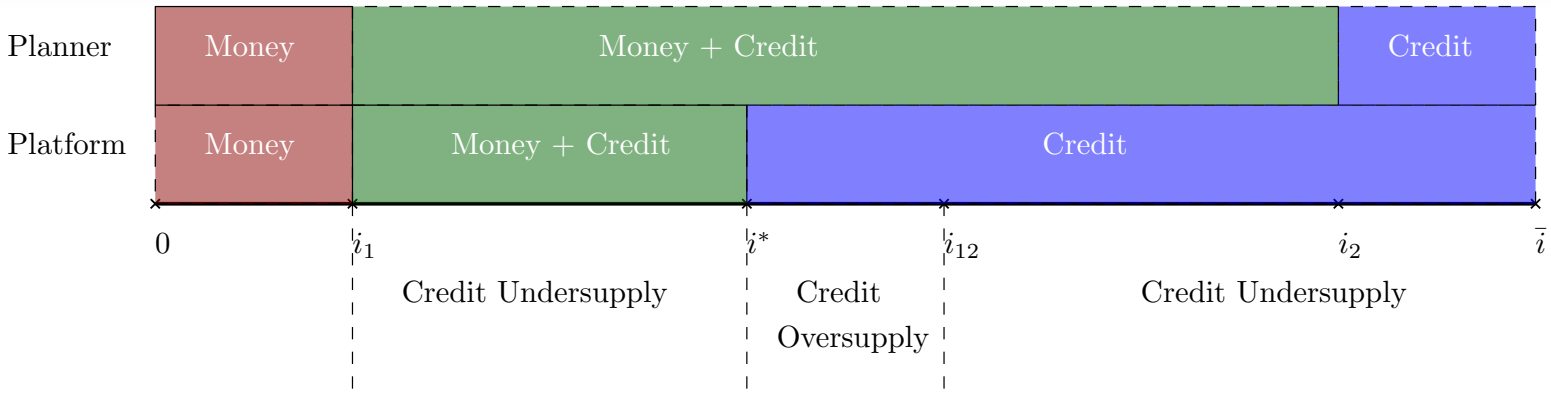
$$\Pi_c = \int_{\xi_l}^{\bar{\xi}} (t_c \pi_c(\xi) - \phi) dG(\xi) \text{ with } (1 - t_c)\pi_c(\xi_l) = \kappa.$$

III. Distortions

Distortions on two margins

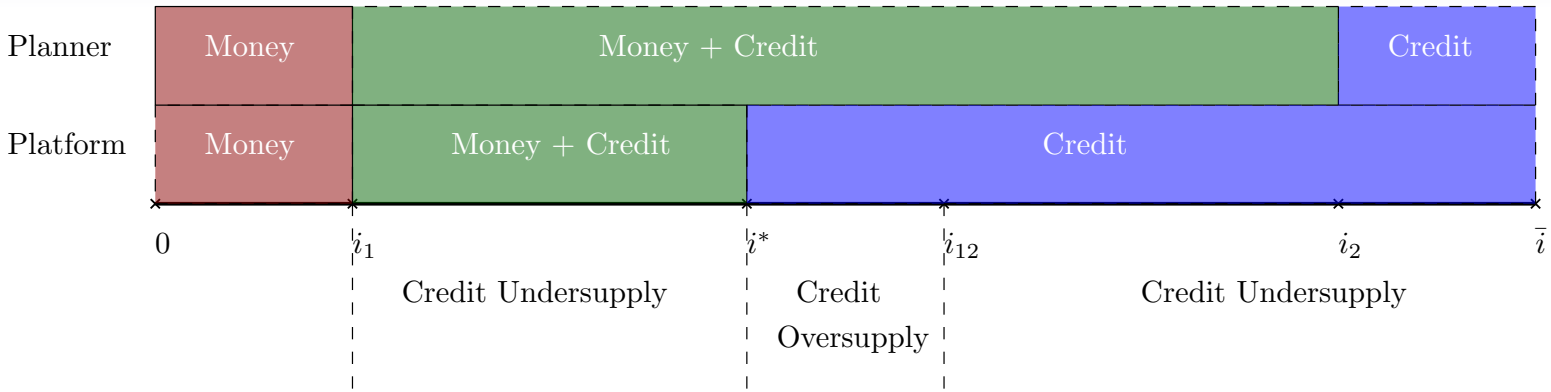
1. Entry margin: efficiency requires $\xi_l = \underline{\xi}$.
2. Credit adoption margin: efficiency requires $\phi = \Delta\pi(\hat{\xi}, i)$.

- Under Pure Money, only the entry margin.
- Under Hybrid Payment, two margins are separate.
- Under Pure Credit, entry margin = adoption margin.



Pure Monetary Payment

- standard monopoly quantity distortion
- insufficient entry of sellers



Hybrid Payment (Money + Credit)

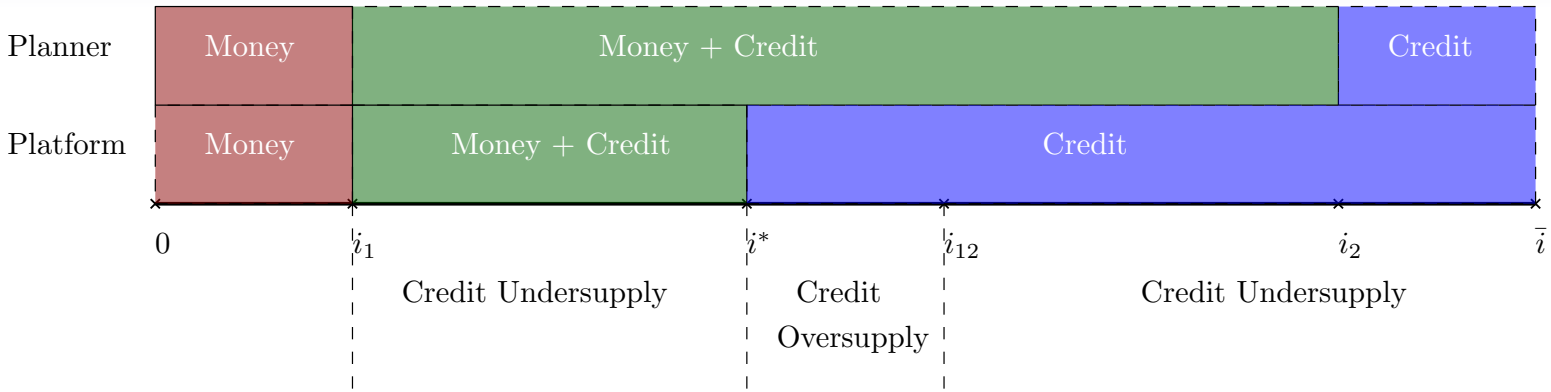
Propos. Credit provision is always too low compared to the efficient level.

proof. Fix ξ_l, platform's profits:

$$\int_{\xi_l}^{\hat{\xi}} t\pi_m(\xi, i)dG(\xi) + \int_{\hat{\xi}}^{\bar{\xi}} \Big(t\Delta\pi(\xi, i) + f - \phi\Big)dG(\xi).$$

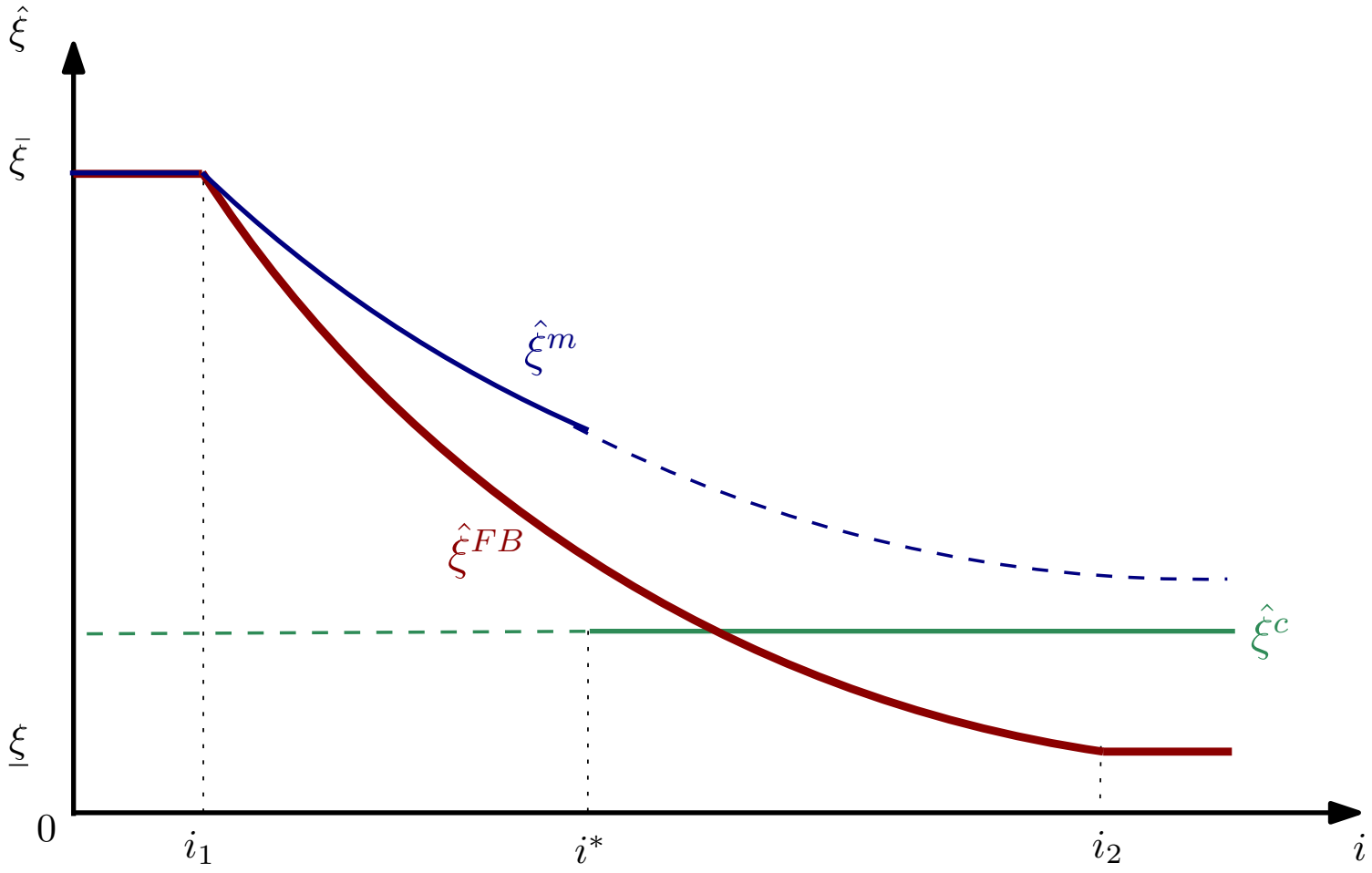
F.O.C yields

$$\Delta\pi(\hat{\xi}^m, i) - \phi = (1-t)\frac{1 - G(\hat{\xi}^m)}{g(\hat{\xi}^m)}\frac{\partial\Delta\pi(\hat{\xi}^m, i)}{\partial\hat{\xi}^m} > 0.$$



Pure Credit Payment

- ξ_l^c determines both entry and credit provision margins.
- The platform has different trade-offs from the planner.
  - Planner: let the seller use credit or money.
  - Platform: let the seller in (and use credit) or not $\Rightarrow$ ξ_l^c is independent of i.
- Oversupply and undersupply of credit coexist.


$\hat{\xi}$
$\bar{\xi}$
$\hat{\xi}^m$
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$\hat{\xi}^c$
$\underline{\xi}$
0
i_1
i^*
i_2
i

IV. Regulations

Restricting f and t separately

Regulating f (credit usage fee)

- Cap f may not solve credit inefficiency.
- Under hybrid payment, $f/(1-t) > \phi$, thus in often holds that $f < \phi$.
- Under pure credit payment, $f = 0$.

Regulating t (transaction fee)

- Platform then increase f to cover the loss
- It is ambiguous if credit provision becomes higher or lower.

- Using credit-entry strategies, the platform maximizes

$$\int_{\xi_l}^{\bar{\xi}} \left(t\pi^c(\xi) + f - \phi \right) dG(\xi),$$

$$\text{s.t.} \quad (1-t)\pi^c(\xi_l) - f = \kappa.$$

- w/o restriction on t:

$$\max_{\xi_l \in [\underline{\xi}, \bar{\xi}]} \int_{\xi_l}^{\bar{\xi}} \left(\underbrace{\left(1 - \frac{\kappa}{\pi_c(\xi_l)} \right)}_{t(\xi_l)} \pi_c(\xi) - \phi \right) dG(\xi).$$

- imposing $t \leq \bar{t}$:

$$\max_{\xi_l \in [\underline{\xi}, \xi_l^{ub}]} \int_{\xi_l}^{\bar{\xi}} \left(\bar{t}\pi_c(\xi) + \underbrace{(1-\bar{t})\pi_c(\xi_l) - \kappa}_{f(\xi_l)} - \phi \right) dG(\xi).$$

propos. $\xi_l^{rc} > \xi_l^c$ iff $\bar{t} < \bar{t}_1(\xi_l^c)$, viz. strong regulation reduces credit.

Jointly regulate (t, f)

The social planner's problem

$$\max_{(t,\phi)\in\mathbb{T}} \left\{ \int_{\xi_l}^{\hat{\xi}} \pi_m(\xi, i) dG + \int_{\hat{\xi}}^{\bar{\xi}} (\pi_c(\xi, i) - \phi)\, dG - (1 - G(\xi_l))\, \kappa \right\},$$

$$\text{s.t.} \quad (1-t)\pi_m(\xi_l) \geq \kappa, \quad \Delta\pi(\hat{\xi}, i) = \frac{f}{1-t}, \quad \Pi(t, f) \geq 0.$$

- Suppose $i \in (i_1, i_2)$, to implement first-best, (t, f) shall satisfy

  (1) upper bound for t: $t \leq 1 - \dfrac{\kappa}{\pi_m(\underline{\xi}, i)}$,

  (2) link f to t and ϕ: $f = (1-t)\phi$.

- When $i \leq i_1$ or $i \geq i_2$, more flexibility on f but rules above still apply

Jointly regulate (t, f) (cont.)

- Suppose $i \leq i_1$, to implement the first-best, (t, f) shall satisfy

$$\left\{ (t,f) \in \mathbb{T} \;\middle|\; t \leq 1 - \frac{\kappa}{\pi_m(\underline{\xi}, i)}, \quad \frac{f}{1-t} \geq \Delta\pi(\bar{\xi}, i) \right\}$$

- Suppose $i \geq i_2$, to implement the first-best, (t, f) shall satisfy

$$\left\{ (t,f) \in \mathbb{T} \;\middle|\; t + \frac{f}{\pi_c(\underline{\xi})} \leq 1 - \frac{\kappa}{\pi_c(\underline{\xi})}, \quad \frac{f}{1-t} \leq \Delta\pi(\bar{\xi}, i), \right.$$
$$\left. t \int_{\underline{\xi}}^{\bar{\xi}} \pi_c(\xi) dG - \phi + f \geq 0 \right\}$$

Discussions

Proportional credit usage fee

- Suppose the credit usage cost is $\phi\pi_c(\xi)$, then the marginal seller has $\hat{\xi}$ satisfying

$$\Delta\pi(\hat{\xi}, i) = \phi\pi_c(\hat{\xi}), \text{ or } \frac{\Delta\pi(\hat{\xi}, i)}{\pi_c(\hat{\xi})} = \phi.$$

- Assumption:

$$\frac{\Delta\pi(\xi, i)}{\pi_c(\xi)} \text{ is strictly increasing in } \xi.$$

- Suppose a planner chooses (t, f), then the marginal seller has

$$(1-t)\Delta\pi(\hat{\xi}, i) = f\pi_c(\hat{\xi}).$$

- Optimality requires

$$\frac{f}{1-t} = \phi.$$

Equilibrium and Distortions

Our results continue to hold.

Propos. $\exists! i^* \in (0, i_2]$, $\Pi_m(i^*) = \Pi_c$.

Cor. $\exists \bar{\phi} > 0$. If $\phi < \bar{\phi}$, then $i^* < i_1$.

Propos. Under hybrid payment, credit provision is always too low compared to the efficient level.

Propos. Under pure credit payment, credit provision can be too high or too low compared to the efficient level.

Takeaways

- Matching efficiency and means of payment.

  Under directed search search, sellers of higher matching efficiencies have higher incentives to adopt credit.

- A monopolist platform may provide too much or too little credit, compared to the planner's solution.

- To ensure efficient credit provision, the two roles should be jointly regulated

$$f = (1 - t)\phi.$$

To Do: Competing platforms (e.g., in the bottleneck framework)

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