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
    - For instance, **buy-now-pay-later** on Amazon, Alipay, JD.com.
- Regulatory frameworks treat brokerage and credit provision 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)

  ...

  - These frameworks overlook that some of the major credit providers are also platforms.

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

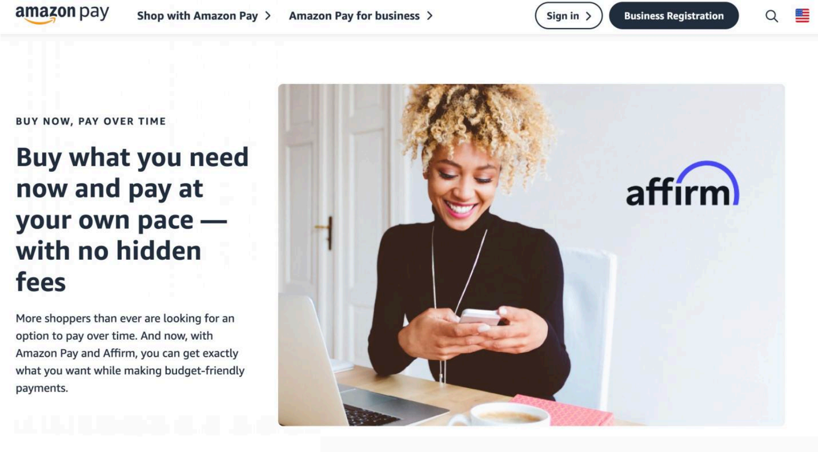
BUY NOW AND PAY OVER TIME WITH PROMOTIONAL FINANCING

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*.

Not an Amazon Store Card or Prime Store Card member?
Learn more about the card

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 approach is problematic because:
  - credit provision and brokerage fees are jointly determined by the platform where cross-subsidization is plausible
  - platform can subsidize credit usage, then charge a high transaction fee to extract surplus
  - given that credit is highly subsidized, challenge to regulate credit fee

- 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 potential distortions? How to regulate?

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

Preview of results

Microfoundation of payment

- Means of payment: money v.s. credit.
  - Money: money-holding costs, e.g., inflation (passed on to sellers)
  - Credit: lump-sum cost paid by sellers
- Some sellers have higher matching capacity
  - e.g., better inventory / advertising capacities, goods of higher quality etc.
- Directed search environment
  - prices, matching capacities, accepted means of payment all observable
- In equilibrium, sellers with higher matching capacity attract <u>more buyers</u> and charge <u>higher prices</u> $\Rightarrow$ sellers incur higher money-holding costs $\Rightarrow$ greater incentive to adopt credit

Preview of results (continue)

A monopolist platform operates the market

- platform optimizes by choosing transaction fee and credit usage fee
- credit usage is subsidized and even *for free* in some cases
- coexistence of monetary and credit payments on platform

Payment modes and inefficiency in credit provision

- as nominal rate increases, distortions are non-monotonic:

$$\underbrace{\text{Pure Money}}_{\text{efficient}} \Rightarrow \underbrace{\text{Money and Credit}}_{\text{undersupply}} \Rightarrow \underbrace{\text{Pure Credit}}_{\text{oversupply} \Rightarrow \text{undersupply}}$$

Literature

Coexistence of credit and money

- Dong and Huangfu (2021), Wang, Wright and Liu (2020), Andolfatto, Berentsen and Martin (2019), Lotz and Zhang (2016), Gu, Mattesini and Wright (2016), Ferraris and Watanabe (2012), Nosal and Rocheteau (2011), Sanches and Williamson (2010), Telyukova and Wright (2008), Berentsen, Camera and Waller (2007), Chiu and Wong (2022)

Hybrid or dual-mode of platforms

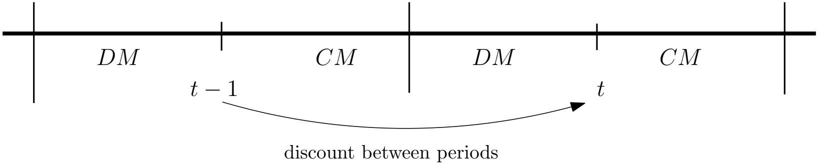
- Tirole and Bisceglia (2023), Madsen and Vellodi (2023), Gautier, Hu and Watanabe (2023), Etro (2023), Shopova (2023), Hagiu, Teh and Wright (2022), Anderson and Bedre-Defolie (2022), Kang and Muir (2022), Padilla, Perkins and Piccolo (2022), Zennyo (2022)

This talk

- 1. Micro-foundation of Payment
- 2. Platform Economy
- 3. Distortions
- 4. Regulations
- 5. Discussions

I. The Microfoundation of Payment

Set-ups: A variant of Lagos and Wright (2005)



- Each period: DM then CM; agents discount between periods
- CM: Walrasian / buyers work and prepare money / sellers produce the good for DM & set up means of payment
- DM: trade an *indivisible* good
  - 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
- 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 capacity $\xi \in [\underline{\xi}, \bar{\xi}]$, $\bar{\xi} < 1$.
  - 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 price and accepted payment methods in DM.
2. Observing prices, means of payment and ξ's, **buyers** simultaneously decide which submarket of sellers 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:

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

If a seller opts for monetary payment ...

- The seller's problem:

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

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

- The optimized profits:

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

Money-holding costs are passed on to the seller.

Adopting credit tech or not...

- A seller's maximized profit

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

- A seller opts for credit payment if

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

- $\Delta\pi(\xi, i)$ 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 of

$$\text{participation:} \quad \max\{\pi_c(\xi) - \phi, \pi_m(\xi, i)\} \geq \kappa,$$
$$\text{credit adoption:} \quad \phi \leq \Delta\pi(\xi, i).$$

- Notations

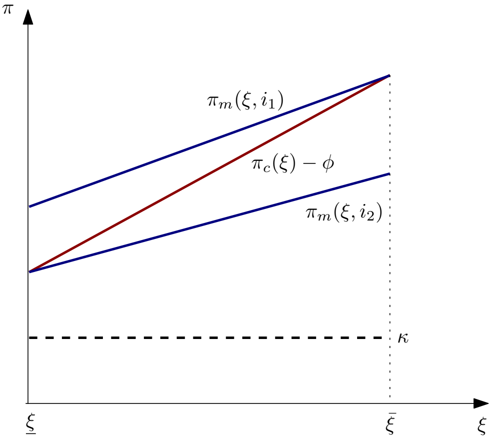
$$\xi_l: \quad \text{the lowest } \xi \text{ of participating sellers,}$$
$$\hat{\xi}: \quad \text{the threshold to adopt credit.}$$

- Assumption: production cost is low:

$$\kappa < \pi_c(\underline{\xi}) - \phi,$$

so all sellers participate in the DM.

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



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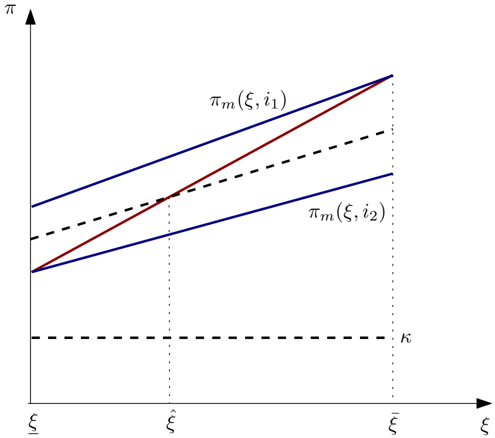


II. The Platform Economy

A monopolist platform

- Suppose the DM outlined above is operated by a platform.
- Sellers and buyers can not trade outside the platform.
- Match-making
  - the platform has a directed search environment
  - the platform charges a *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** $(t, f) \in \mathbb{T} \equiv [0,1] \times \mathbb{R}_+$**.**
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 $(1-t)\Delta\pi(\xi, i) \geq f$

To derive the platform's optimal strategy, we divide its strategy space:

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

Credit Entry

- The platform's problem:

$$\Pi_c = \max_{(t,f)\in\mathbb{T}} \int_{\xi_l}^{\bar{\xi}} (t\pi_c(\xi) + f - \phi)\, dG(\xi),$$
$$s.t.\ \ (1-t)\pi_c(\xi_l) - f = \kappa,$$
$$(1-t)\pi_m(\xi_l, i) < \kappa.$$

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

- Inserting f and t, platform faces a standard monopoly quantity trade-off:

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

Money Entry

- The platform's problem:

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

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

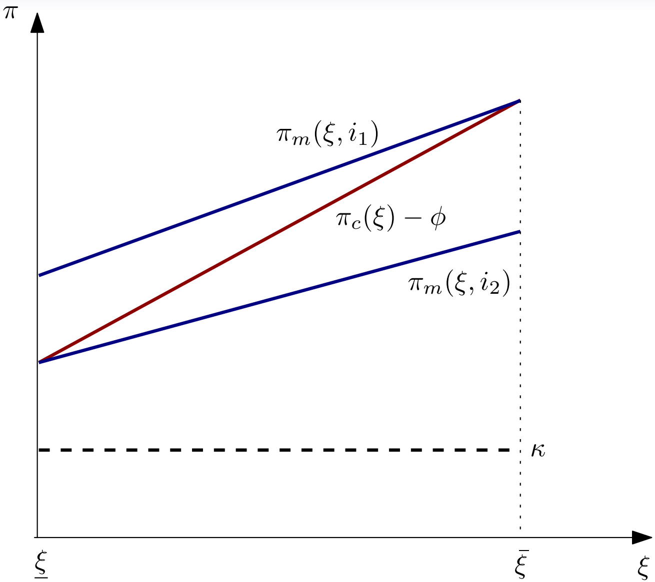
$$(1-t)\pi_c(\hat{\xi}) - f = (1-t)\pi_m(\hat{\xi},i).$$

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

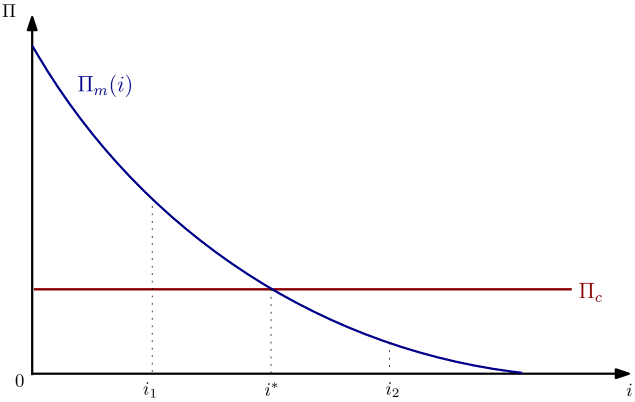
lemma $\Pi_m(i)$ decreases in i with

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


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

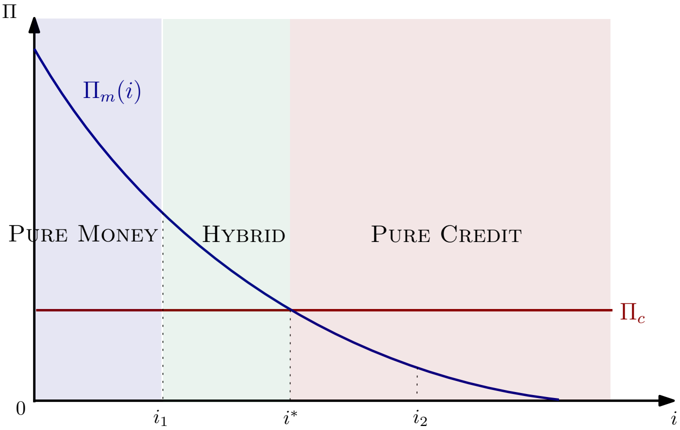
Platform profit-maximization

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



Platform payment mode

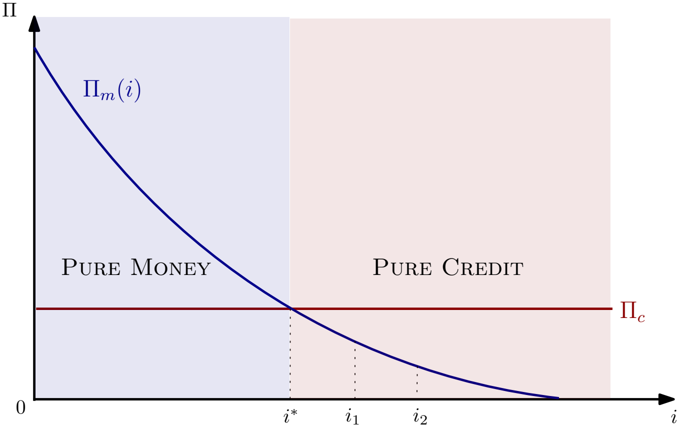
Propos. $\exists! i^* \in (0, i_2]$, $\Pi_m(i^*) = \Pi_c$.



A case that credit-entry is 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.
- At $i = i_1$, suppose the platform uses money-entry with t_m, the profit is

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

- Keeping ξ_l, and switching to credit entry allows the platform to charge a higher fee $t_c > t_m$:

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

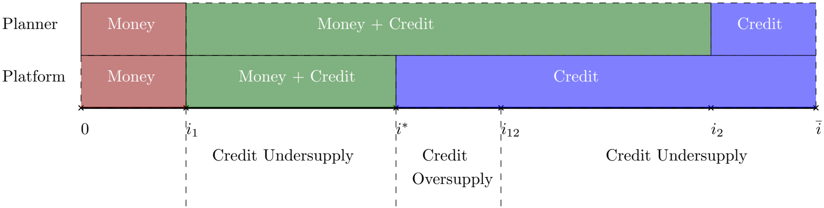
  Platform extracts a higher share of surplus at the expense of credit provision cost ϕ.

III. Distortions

Distortions on two margins

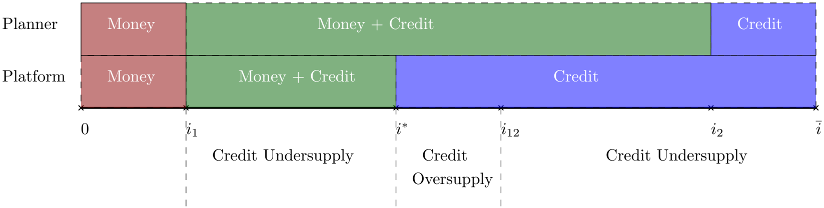
1. Entry margin: efficiency requires $\xi_I = \underline{\xi}$.
2. Credit adoption margin: efficiency requires $\phi = \Delta\pi(\hat{\xi}, i)$.

- Under Money Entry, the two margins are separate.
- Under Credit Entry, entry margin = adoption margin.



Pure Monetary Payment

- standard monopoly quantity distortion
- possibly insufficient entry of sellers



Hybrid Payment (Money + Credit)

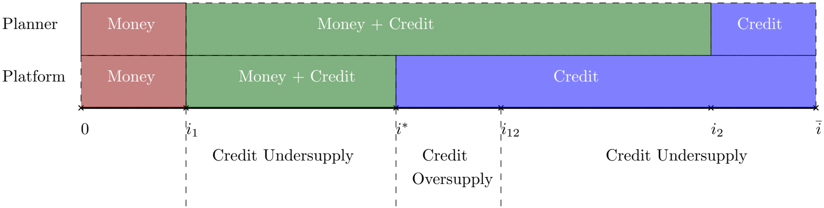
Propos. Credit provision is always too low compared to the efficient level.

proof. Fix ξ_l, platform's profits:

$$\int_{\xi_l}^{\bar{\xi}} t\pi_m(\xi, i)dG(\xi) + \int_{\hat{\xi}}^{\bar{\xi}} \Big(t\Delta\pi(\xi, i) + \underbrace{(1-t)\Delta\pi(\hat{\xi}, i)}_{f} - \phi\Big) dG(\xi).$$

F.O.C yields

$$\Delta\pi(\hat{\xi}^m, i) > \phi \;\Leftrightarrow f > (1-t)\phi.$$

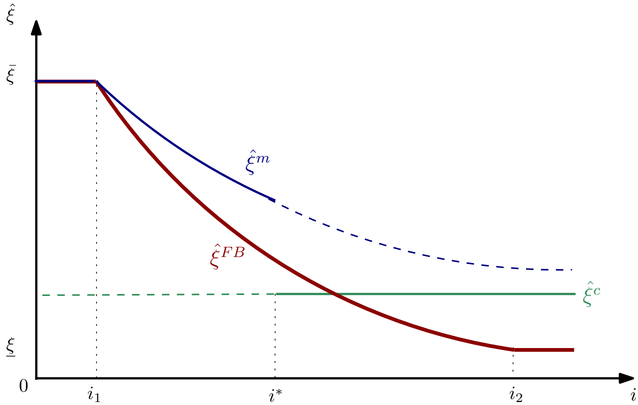


Pure Credit Payment

- ξ_l 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 is independent of i.
- Oversupply and undersupply of credit coexist.

Non-monotonic distortions of credit provision

- Credit adoption thresholds: $\hat{\xi}^{FB}$ (first best), $\hat{\xi}^{m}$ (money-entry), $\hat{\xi}^{c}$ (credit-entry)
- Comparing $\hat{\xi}^{m}$ and $\hat{\xi}^{c}$ with $\hat{\xi}^{FB}$, we observe that as i increases, credit is initially undersupplied, then oversupplied, and eventually undersupplied.



IV. Regulations

Regulate f or t Separately

Cap f (Credit Usage Fee)

- Capping $f = \phi$ may not resolve credit inefficiency.
- Under hybrid payment, $\frac{f}{1-t} > \phi$, yet often $f < \phi$.
- Under pure credit payment, $f = 0$.

Cap t (Transaction Fee)

- Capping t leads the platform to raise f to compensate for the loss.
- The effect on credit provision is unclear; credit provision could either increase or decrease.

- Using credit-entry strategies, the platform maximizes

$$\int_{\xi_l}^{\bar{\xi}} \Big(t\pi^c(\xi) + f - \phi\Big) dG(\xi),$$
$$\text{s.t.} \quad (1-t)\pi^c(\xi_l) - f = \kappa.$$

- 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

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

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

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

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

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

- 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

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

5. Discussions

Proportional Credit Usage Fee

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

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

- We assume that

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

which ensures high ξ sellers have higher incentives to adopt credit.

- A sufficient condition for this is that $\pi_m(\xi, i)$ is log-submodular:

$$\frac{\Delta\pi(\xi, i)}{\pi_c(\xi)} \approx -\frac{\partial \log \pi^m(\xi, i)}{\partial i} \Rightarrow \frac{\partial^2 \log \pi^m(\xi, i)}{\partial i \partial \xi} < 0.$$

Equilibrium and Distortions

Our results continue to hold.

- Social planner solution requires
$$f = (1 - t)\phi.$$
- $\exists! i^* \in (0, i_2]$, $\Pi_m(i^*) = \Pi_c$. And $\exists \bar{\phi} > 0$. If $\phi < \bar{\phi}$, then $i^* < i_1$.
- Under hybrid payment, credit provision is always too low compared to the efficient level.
- Under pure credit payment, credit provision can be too high or too low compared to the efficient level.

Spinning credit provision off from the platform

- Suppose the two businesses are isolated, and the platform's credit sector competes with third-party credit providers à la Bertrand, then $f = \phi$.
- PLATFORM suffers from the spin-off.
    - when money-entry is more profitable, $f = \phi$ is set too high compared to profit maximization;
    - when credit-entry is more profitable, credit-entry is not feasible anymore
- The impact on welfare is ambiguous.
    - Since f is NOT subsidized anymore, the credit usage is even lower
    - The platform has a lower incentive to increase t which improves the efficiency of the entry margin.
    - The credit sector is smaller, and thus extract less from the extra value $t \int_{\hat{\xi}}^{\bar{\xi}} \Delta\pi(\xi, i) dG(\xi)$.

Takeaways

- A microfoundation of payment:

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

- The monopolist platform may provide too much or too little credit compared to the planner's solution. The distortion is non-monotonic with nominal interest rater.

- To ensure efficient credit provision, brokerage and credit provision should be jointly regulated with $f = (1 - t)\phi$.

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