

From Cash to Buy-Now-Pay-Later

Impacts of platform-provided credit on market efficiency

Han Han¹ Bo Hu² Makoto Watanabe³

¹Peking University

²Fudan University

³KIER, Kyoto University

Kyoto Spring Workshop, March 13, 2024

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)

**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.





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.



- 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

Distortions 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), 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), Hagi, 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

0 Intro
○○○○○○○○○

1 Payment
●○○○○○○○

2 Platform Economy
○○○○○○○○○○

3 Distortions
○○○○○

4 Regulations
○○○○

5 Discussions
○○○

References

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:

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

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

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:

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

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

- 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:

$$\text{under credit: } \pi_c(\xi) = \xi \alpha(x_c) u - x_c k,$$

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

- 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

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

Adopt credit: $\phi \leq \Delta\pi(\xi, i).$

- Notations

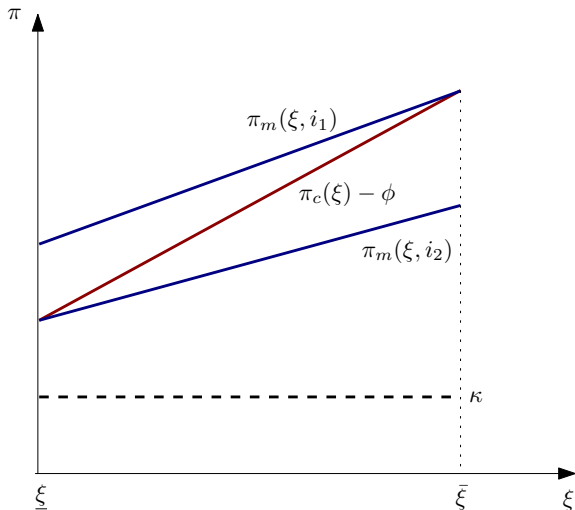
ξ_l : the lowest ξ of participating sellers,

$\hat{\xi}$: 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 $i \leq i_1$ ($i \geq i_2$).



0 Intro
○○○○○○○○○

1 Payment
○○○○○○○○○

2 **Platform Economy**
●○○○○○○○○○

3 Distortions
○○○○○

4 Regulations
○○○○○

5 Discussions
○○○○

References

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

Credit Entry

- The platform's problem:

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

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

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

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:

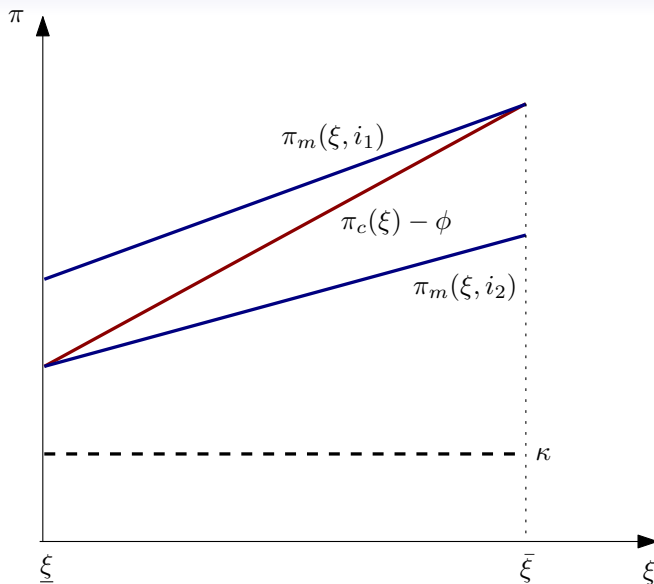
$$\begin{aligned}\Pi_m(i) = \max_{(t, \phi) \in \mathbb{T}} & \left\{ \int_{\xi_l}^{\hat{\xi}} t \pi_m(\xi, i) dG(\xi) + \int_{\hat{\xi}}^{\bar{\xi}} (t \pi_c(\xi) + f - \phi) dG(\xi) \right\} \\ \text{s.t. } & (1 - t) \pi_m(\xi_l, i) = \kappa, \\ & (1 - t) \pi_c(\hat{\xi}) - f = (1 - t) \pi_m(\hat{\xi}, i).\end{aligned}$$

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

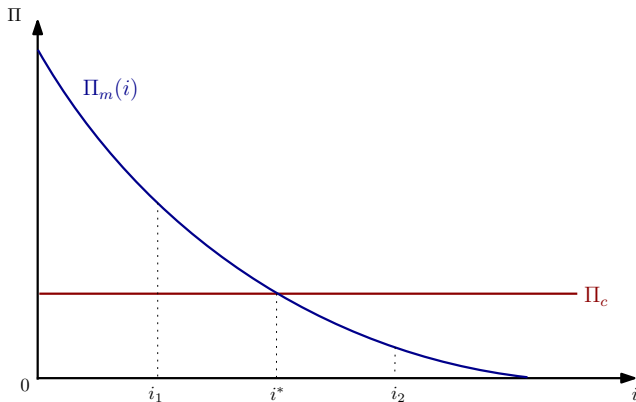
lemma $\Pi_m(i)$ decreases in i with

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



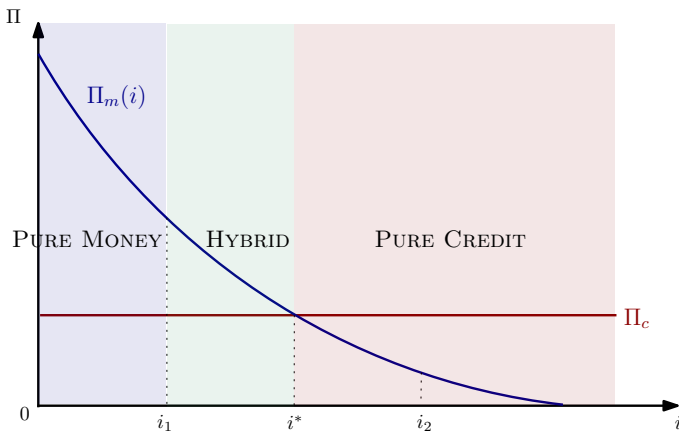
Platform profit-maximization

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



Platform mode

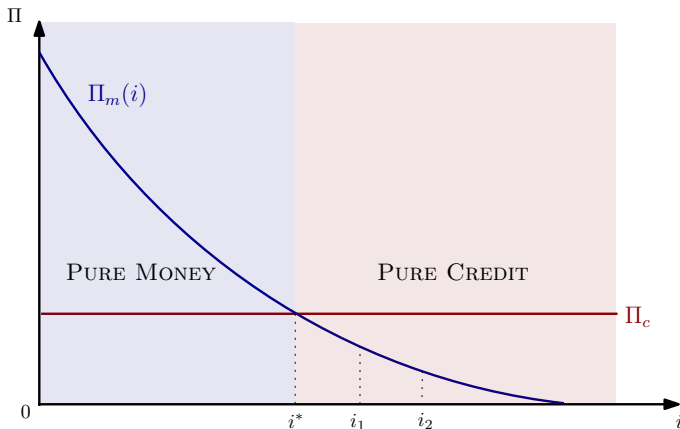
Propos. $\exists! i^* \in (0, i_2], \Pi_m(i^*) = \Pi_c$.



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

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

0 Intro
○○○○○○○○○

1 Payment
○○○○○○○○○

2 Platform Economy
○○○○○○○○○○○

3 Distortions
●○○○○○

4 Regulations
○○○○○

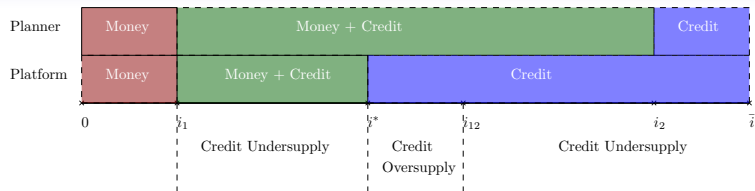
5 Discussions
○○○○

References

III. Distortions

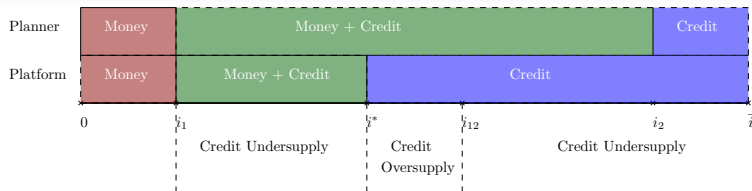
Distortions on two margins

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

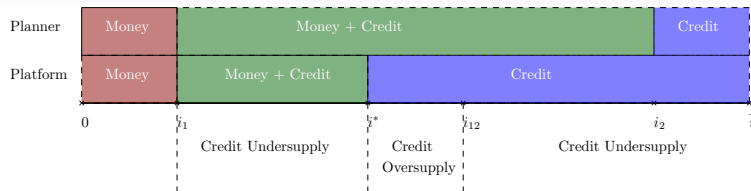
Propos. Credit provision is always too low compared to the efficient level.

proof. Fix ξ_l , platform's profits:

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

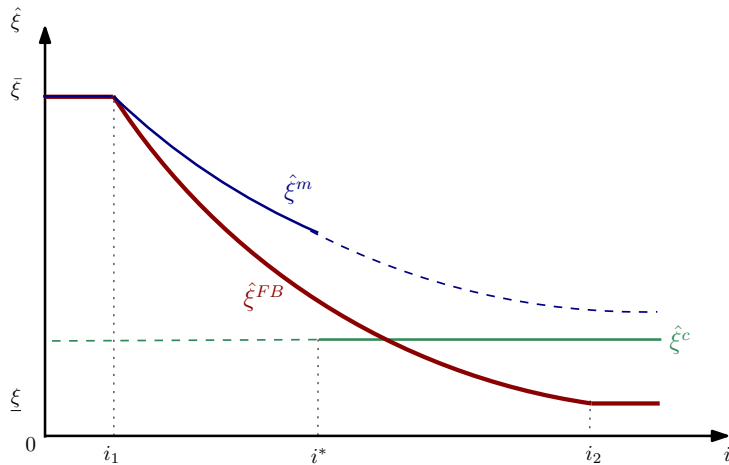
F.O.C yields

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



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 $\Rightarrow \xi_l^c$ is independent of i .
- Oversupply and undersupply of credit coexist.



0 Intro
○○○○○○○○○

1 Payment
○○○○○○○○○

2 Platform Economy
○○○○○○○○○○○

3 Distortions
○○○○○

4 Regulations
●○○○○

5 Discussions
○○○○

References

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 it 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

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

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

- w/o restriction on t :

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

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

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

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

Jointly regulate (t, f)

The social planner's problem

$$\begin{aligned} \max_{(t, \phi) \in \mathbb{T}} & \left\{ \int_{\xi_l}^{\hat{\xi}} \pi_m(\xi, i) dG + \int_{\hat{\xi}}^{\bar{\xi}} (\pi_c(\xi, i) - \phi) dG - (1 - G(\xi_l)) \kappa \right\}, \\ \text{s.t. } & (1 - t)\pi_m(\xi_l) \geq \kappa, \quad \Delta\pi(\hat{\xi}, i) = \frac{f}{1 - t}, \quad \Pi(t, f) \geq 0. \end{aligned}$$

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

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

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

- 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

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

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

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

0 Intro
○○○○○○○○○

1 Payment
○○○○○○○○○

2 Platform Economy
○○○○○○○○○○○

3 Distortions
○○○○○

4 Regulations
○○○○○

5 Discussions
●○○○

References

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)

References I

ANDERSON, S., AND BEDRE-DEFOLIE, Ö. "Online trade platforms: Hosting, selling, or both?" *International Journal of Industrial Organization*, Vol. 84 (2022), 102861.

ANDOLFATTO, D., BERENTSEN, A., AND MARTIN, F. M. "Money, Banking, and Financial Markets." *The Review of Economic Studies*, Vol. 87, 10 (2019), pp. 2049–2086.

BERENTSEN, A., CAMERA, G., AND WALLER, C. "Money, credit and banking." *Journal of Economic Theory*, Vol. 135 (2007), pp. 171–195.

DONG, M., AND HUANGFU, S. "Money and Costly Credit." *Journal of Money, Credit and Banking*, Vol. 53 (2021), pp. 1449–1478.

ETRO, F. "Hybrid marketplaces with free entry of sellers." *Review of Industrial Organization*, Vol. 62 (2023), pp. 119–148.

References II

- GAUTIER, P., HU, B., AND WATANABE, M. "Marketmaking Middlemen." *The RAND Journal of Economics*, Vol. 54 (2023), pp. 83–103.
- GU, C., MATTESINI, F., MONNET, C., AND WRIGHT, R. "Banking: A New Monetarist Approach." *The Review of Economic Studies*, Vol. 80, 01 (2013), pp. 636–662.
- HAGIU, A., TEH, T.-H., AND WRIGHT, J. "Should platforms be allowed to sell on their own marketplaces?" *The RAND Journal of Economics*, Vol. 53 (2022), pp. 297–327.
- KANG, Z. Y., AND MUIR, E. V. "Contracting and vertical control by a dominant platform." *Unpublished manuscript, Stanford University* (2022).
- LIU, Y. "Costly Enforcement in Credit Economies." *Working paper* (2021).

References III

- LOTZ, S., AND ZHANG, C. "Money and credit as means of payment: A new monetarist approach." *Journal of Economic Theory*, Vol. 164 (2016), pp. 68–100.
- MADSEN, E., AND VELLODI, N. "Insider imitation." *Available at SSRN 3832712* (2023).
- NOSAL, E., AND ROCHETEAU, G. , 2011 *Money, payments, and liquidity*: MIT press.
- PADILLA, J., PERKINS, J., AND PICCOLO, S. "Self-Preferencing in Markets with Vertically Integrated Gatekeeper Platforms." *The Journal of Industrial Economics*, Vol. 70 (2022), pp. 371–395.
- SANCHES, D., AND WILLIAMSON, S. "Money and credit with limited commitment and theft." *Journal of Economic theory*, Vol. 145 (2010), pp. 1525–1549.

References IV

SHOPOVA, R. "Private labels in marketplaces." *International Journal of Industrial Organization* (2023), 102949.

TELYUKOVA, I. A., AND WRIGHT, R. "A model of money and credit, with application to the credit card debt puzzle." *The Review of Economic Studies*, Vol. 75 (2008), pp. 629–647.

TIROLE, J., AND BISCEGLIA, M. "Fair gatekeeping in digital ecosystems." (2023).

WANG, L., WRIGHT, R., AND LIU, L. Q. "Sticky prices and costly credit." *International Economic Review*, Vol. 61 (2020), pp. 37–70.

ZENNYO, Y. "Platform encroachment and own-content bias." *The Journal of Industrial Economics*, Vol. 70 (2022), pp. 684–710.