BigTech Lending, Banking, and Information Portability

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Abstract

Technological change has led to increased, but segmented, information collection. Tech platforms record the information about trading histories required for providing uncollateralized credit, whereas banks specialize in making the assessment of collateral quality required for collateralized lending. We show this leads to an inefficiently segmented credit market because banks can use their private knowledge about collateral quality to threaten early liquidation and force renegotiation of joint contracts. The platform is willing to share information to make the credit market efficient and competitive because it is able to extract profits through markups in the goods market (a "loss-leader" strategy). By contrast, the bank blocks information sharing to keep rents in the credit market.

Keywords: Ledgers, interoperability, platforms, open architecture, financial inclusion, "PlatFi"

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1 Introduction

Finance requires intermediaries that collect and analyze information to effectively provide funding. Banks have traditionally played this role in the US lending system and so have developed systems for assessing collateral, finding assets, and sharing credit histories. However, a persistent criticism is that banks leave many viable borrowers unfinanced because they lack the types of projects that banks are able to evaluate. In recent years, we have seen a rapid expansion in information collection, particularly by tech platforms that have compiled extensive databases of trading histories and constructed new customer profiles. In principle, this new information could be used to fill the gaps in the lending system and increase financial inclusion. This is supported by research on machine learning default prediction that finds e-commerce platforms can effectively use "digital footprints" to predict default (e.g. Berg et al. (2020)). However, the segmentation of information across different intermediary sectors has posed difficulties. There is little information sharing between tech platforms and banks while current US regulation prevents tech platforms from offering extensive financial services without a banking license. By contrast, in China, tech platforms Alibaba and WeChatPay now play a key role in the financial system. In this paper we explore the consequences of having banks and tech platforms competing to provide financial services.

We start by developing a model to understand which types of customers banks and platforms are likely to serve. We consider an environment where entrepreneurs have projects that generate revenue partly through future production and partly through the creation of collateral that can be liquidated. Tech platforms are able to use their knowledge of trading flows to learn the revenue that a project can generate while banks are able to learn the value of collateral when the project is initiated and the liquidation value after the project has started. This means that there is sufficient information collection to provide efficient lending but the information is segmented across the different intermediaries. We show that segmented information collection leads to segmented bank and platform lending markets. The reason that the bank and the platform cannot coordinate on joint lending is because they cannot contract to efficiently assign the right to liquidate projects. If the bank does not have the liquidation right, then projects are sub-optimally continued to completion. On the other hand, if the bank is given the liquidation right, then they threaten suboptimal liquidation in order to renegotiate the contract and extract all the surplus. Consequently, the platform is unwilling to provide any joint funding to projects where the bank has a liquidation right.

The resulting equilibrium is one where banks lend to entrepreneurs with sufficiently high collateral and platforms lend to entrepreneurs with sufficiently high output revenue. This improves financial inclusion for the high output, low collateral agents. However, it also means that banks understand that the average level of production in their pool of borrowers is worse and so they become less willing to lend to medium collateral agents. This means that the introduction of the platform into the financial system changes the financial inclusion problem rather than resolving it.

In principle, efficient lending could be achieved if the bank and platform could share information in a way that could be used for contracting. In Section 3, we consider an environment in which a government sets up ex-ante a common ledger technology that allows the intermediaries to commit to such an information sharing arrangement. We study whether the bank and the platform would be willing to provide this information when they have incomplete market power in the credit market but the platform has monopoly power in the goods market. We show that the bank and the platform have very different incentives to share information. On the one hand, sharing information allows the bank to coordinate with the platform on lending to low collateral entrepreneurs. On the other hand, it decreases bank profits because they have to compete with the platform in the credit market. By contrast, the platform has a strong incentive to share information because a better functioning credit market leads to higher production, and the platform extracts rents from higher production by charging markup fees in the goods market. That is, the platform sees the credit market as an input into their trading business rather than the only source of their revenue, and hence, they are much more willing to have a more competitive credit market. In other words, the credit market is for the platform simply a "loss-leader" for increasing its mark-up charges on the platform.

Literature Review: Our paper relates to the growing literature that studies competition between traditional banks and fintech "challengers". Berg et al. (2022) provide surveys of the fintech literature.[1] Our analysis shares with several articles the

[1] Broecker (1990) and Hauswald and Marquez (2003) focus on competition between inside and

feature that traditional banks are better in valuing tangible collateral assets, while fintechs, especially platforms, possess superior techniques to seize revenue streams.

One key question is whether the fintech disruption leads to overall credit expansion or simply replace existing bank credit. Many important papers, e.g. Buchak et al. (2018), Erel and Liebersohn (2022), Fuster et al. (2019), Gopal and Schnabl (2022), Tang (2019), Fuster et al. (2022), Li and Pegoraro (2022) address this question of financial inclusion. In Boualam and Yoo (2022) fintechs have better information collection ability but higher funding costs. They grant loans to previously "unbanked" borrowers, but competition with fintechs also excludes other potential borrowers. In Parlour et al. (2022) fintechs specialize in payment services, which compete with monopolistic banks that offer both payment service and credit. As fintechs isolate valuable payment information from traditional banks, their credit extension is compromised. In our paper both credit expansion and substitution occurs, but the main focus is on the role of information portability and data sharing arrangements.

Information sharing possibly enforced by "open banking" regulation is related to our analysis. Information sharing between traditional banks, possibly by setting up a credit bureau, is the focus of early work by Pagano and Jappelli (1993) and Bouckaert and Degryse (2006). He et al. (2023) studies the information flow between banks and fintechs induced by "open banking" regulation. Fintechs ability to screen borrowers is enhanced, but fintechs may end up with excessive market power due to their superior data extraction technology. Nam (2023) documents for a German fintech lender that open banking leads to more credit extension for high-risk borrowers but also to more price discrimination. Babina et al. (2024) provides a data set of government-led open banking initiatives across various countries.

Like in our model in Bouvard et al. (2022) platforms can offer more attractive credit conditions since they can make up the forgone profits by increasing platform's access fees. In their model credit market becomes endogenously segmented with banks focussing on less financial constrained borrowers. Our paper stresses how this aspect alters information sharing incentives.

The paper is structured as follows. Section 2 outlines the baseline model with segmented information collection. Section 3 introduces market power and considers whether banks and platforms would be willing to share information. Section **??**

outside banks.

allows agents to choose the characteristics of their projects. Section **??** considers the political economy problem. Section 4 concludes.

2 Baseline Model

In this section, we outline our baseline model of segmented information collection and financial contracting by tech platforms and banks. We consider an environment where platforms have a comparative advantage in collecting information about product quality and revenue forecasts whereas banks have a comparative advantage in collecting information about the residual value of collateral. We show how this information fragmentation leads to segmentation in the credit market, which prevents the economy from resolving the problem of financial inclusion.

Setting: Time lasts for three periods: $t \in \{0, 1, 2\}$, where $t = 1$ is interpreted as an intermediate period. There is a collection of goods that are used for production and consumption. The economy is populated by a continuum of agents. There are two monopolistic intermediaries in the economy: a tech platform and a bank.

Entrepreneur production and preferences: All entrepreneurs arrive at $t = 0$. Each entrepreneur can produce a particular type of input good at unit linear disutility. At $t = 0$, each entrepreneur can transform exactly 1 input good from any other entrepreneur into a project that produces $z \sim U[0, \zeta]$ units of output goods at $t = 2$, where z draws are i.i.d. across projects. We interpret the variation in z as reflecting uncertainty about how many of useful production goods an entrepreneur can create. The project can be liquidated early for $l \in U[0, \lambda]$ goods at $t = 1$ and the completed project generates capital that can be converted to $k \sim U[0, \kappa]$ goods at time $t = 2$, where both l and k are i.i.d. across projects. So the total goods generated by the project liquidated at $t = 1$ is l and the total goods generated by the project at $t = 2$ is $z + k$. Entrepreneurs have no private knowledge about the z, l, or k for projects they create. For convenience, we impose the parametric restrictions that $\zeta \leq 2$, $\kappa \leq 2$, $\lambda \geq 1$, and $\zeta + \kappa < \lambda$ so there is no realization of (z, k) that strictly dominates every possible liquidation value.

Entrepreneurs get linear utility $u(c_2) = c_2$ from consuming c_2 units of other entrepreneur's output goods at $t = 2$. This means that entrepreneurs need to be able borrow to purchase input goods at $t = 0$ and need to trade their output goods at $t = 2$ in order to be able to consume. Entrepreneurs lack commitment, cannot seize collateral, and have no information about other entrepreneur' projects. This means that they need intermediaries to facilitate borrowing and trading.

Intermediaries and information: There are two intermediaries in the economy: a tech platform (p) and a bank (b). The tech platform controls the technology for trading goods and settling transactions. Agents have no other way to trade goods other than through the platform. We assume that the platform can infer future output z from observing the loan requests and goods orders at $t = 0$ but that the platform cannot observe the liquidation value l at $t = 1$ or collateral value at $t = 2$. The platform can borrow from agents and make loans to producers.

The bank also borrows from agents and provides funding. The bank controls a technology for learning the collateral values k at $t = 0$ and the liquidation value at $t = 1$. However, they are not able to learn z.

Absent a common ledger technology for the economy, private information about z, l, and k is non-contractible. Following the incomplete contract literature (e.g. Hart (1995)), we interpret this as soft information, in the sense that agents can show each other information but they cannot credibly reveal the information they have been shown to a court system. The role of a common ledger is make information on ledger contractible. So, the problem of contracting becomes the problem of getting information onto the ledger.

Market structure: There are deposit, loan contract, and goods markets. In the deposit market, all agents and intermediaries participate, which leads to competitive pricing.

The loan market is more complicated. The bank and platform must decide to which agents they want to offer funding contracts. A funding contract offers the entrepreneur a share $1 - \beta$ of the surplus from the project and gives the bank the remaining surplus β. If an intermediary is the only lender, then they act as a monopolist and set $\beta = 0$ to take all the surplus. If both intermediaries decide to make offers to the same entrepreneur, then a fraction ϕ^i go to intermediary $i \in \{b, p\}$, where we use the normalization that $\phi := \phi^b$ where appropriate. In this section, we take ϕ^i as given and assume that the intermediaries set monopoly pricing $\beta = 0$ with the entrepreneurs with whom they are matched. In the next section, we endogenize ϕ^i using a discrete choice model and let the banks set β to compete for entrepreneurs. We assume that at $t = 0$, the intermediaries do not observe how many offers an entrepreneur receives but does learn at $t = 1$ whether the entrepreneur received other offers. If the intermediaries coordinate and lend together, then they price as a monopolist and negotiate the terms of the contract: the division of profit and the right to liquidate the project at $t = 1$. However, commit to contracting on variables that are not on the common ledger.

In the goods market, the platform acts as a monopolist and charges markups at $t = 2$, although that is not relevant in this section because all surplus is taken by the intermediaries in the loan market.

We impose that all profits extract by both banks and platforms are rebated back to the households lump sum.

2.1 First Best Allocations

A central planner with full information about all projects will allocate inputs to all projects with (z, k) such that the return is greater than the opportunity cost of forgone consumption.

Proposition 1. *The first best allocation liquidates projects at $t = 1$ if $l \geq z + k$ and finances projects at $t = 0$ with (z,k) satisfying:*

$$\mathbb{E}_0[\max\{z + k, l\}] = \frac{(z + k)^2}{2\lambda} + \frac{\lambda}{2} \geq 1$$

where $\mathbb{E}_0[\cdot]$ denotes the expectation is taken over the liquidation values at $t = 1$.

Proof. See Appendix A. □

From Proposition (1), we can see that the planner finances projects satisfying:

$$z + k \geq \sqrt{\lambda(2 - \lambda)}.$$

If $\lambda = 1$, then this simplifies to $z + k \geq 1$, which says that the total guaranteed return has to be greater than the cost of financing. For $\lambda > 1$, RHS is less than one because liquidation option increases the potential return.

2.2 Traditional Banking

Under a traditional banking system, there is only one type of intermediary, a representative bank, that can observe k but not z. The bank raises deposits at expected return R^d and chooses the entrepreneurs to which they will offer take-it-or-leave-it funding contracts. The deposit market is competitive so deposit rates are set at entrepreneur indifference so $R^d = 1$. The bank is a monopolist in the lending market so funding contracts are also set at entrepreneur indifference and the bank takes the entire expected surplus.

To understand the bank's perception of expected surplus, we work through their problem using backward induction. At $t = 1$, the bank learns the liquidation value but does not know z so they choose to liquidate if:

$$\mathbb{E}_1^b[z] + k \geq l$$

where $\mathbb{E}_1^b$ denotes taking the expectation with respect to the bank's information set at 1 (i.e. without knowledge of z). At $t = 0$, the bank's perceived expected surplus from the contract is:

$$\begin{aligned}\int_0^\lambda \int_0^\zeta & \left[\mathbb{1}\{\mathbb{E}_1^b[z] + k \geq l\}(z+k) + \mathbb{1}\{\mathbb{E}_1^b[z] + k < l\}l\right] \frac{dz}{\zeta}\frac{dl}{\lambda} - 1 \\ &= \mathbb{E}_0^b\left[\max\left\{\mathbb{E}_1^b[z] + k, l\right\}\right] - 1\end{aligned}$$

where $\mathbb{E}_0^b[\cdot]$ is taken with respect to the information set of the bank at $t = 0$ (i.e. without knowledge of z or l). This means that the bank will finance any projects with positive expected surplus, as described in Proposition 2 below.

Proposition 2. *The bank finances projects with collateral k satisfying:*

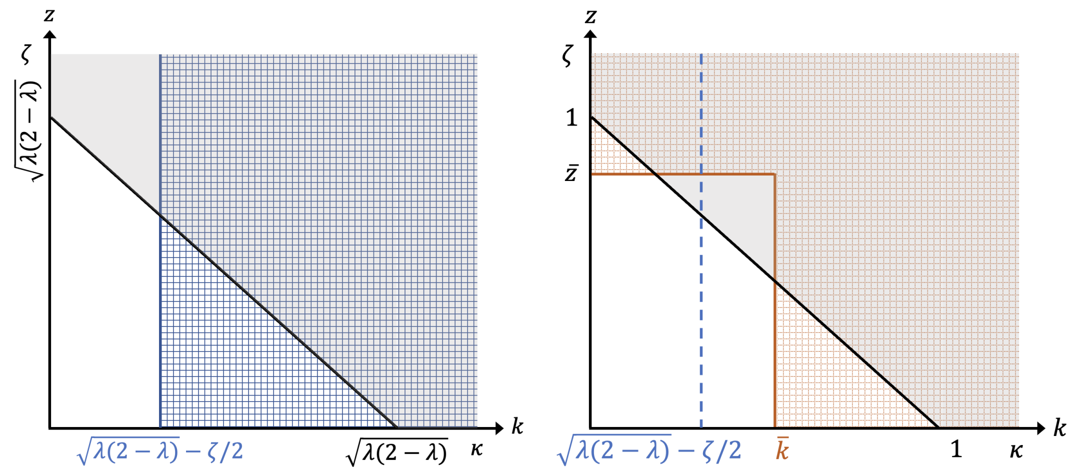
$$\mathbb{E}_0^b\left[\max\left\{\mathbb{E}_1^b[z] + k, l\right\}\right] = \frac{(\zeta/2 + k)^2}{2\lambda} + \frac{\lambda}{2} \geq 1.$$

Proof. See Appendix A □

Proposition 2 says that the bank will finance projects with k satisfying:

$$\zeta/2 + k \geq \sqrt{\lambda(2-\lambda)} \quad \Rightarrow \quad k \geq \sqrt{\lambda(2-\lambda)} - \zeta/2 =: \bar{k}.$$

Evidently, the bank funding condition differs from the first best condition because



(a) Traditional banking: The solid grey area denotes the projects that are financed by the social planner. The blue dashed area denotes the projects financed by the bank.

(b) Banking and tech platform with Segmented Markets: The solid grey area denotes the projects that are financed by the social planner. The orange dashed area denotes the projects by the bank and the platform. The blue dashed line indicates the financing threshold under the traditional banking system.

Figure 1: Projects Financed for the parametric case with $\lambda > 1$ and $\phi = 0$.

the banks cannot infer the cash flow of the firm. Instead, they make their decision based on the average cash flow, $\zeta/2$, instead of the realized cash flow z. This means that agents with $(z, k)-$projects satisfying the following condition would be funded by the planner but not by banks:

$$\sqrt{\lambda(2-\lambda)} - z \geq k \leq \sqrt{\lambda(2-\lambda)} - \frac{\zeta}{2}$$

Panel (a) in Figure 1 contrasts the banking outcome with the first best outcome. Evidently, traditional banking leads to a financial inclusion inefficiency where too few projects with high cash flows are financed and too many projects with high collateral are financed. This is because the bank has insufficient information to be able to finance socially efficient projects with high z and medium k.

2.3 Segmented Markets

Now, suppose that the tech platform enters the market. We start by considering a "segmented" market structure where agents accept loans from either a bank or a platform but never from both (we consider coordinated lending next section). Under segmentation, we guess and verify that the equilibrium will be characterized by cutoff values $\bar{k}$ and $\bar{z}$ such that the bank offers loans to agents with $k > \bar{k}$ and the tech platform offers loans to agents with $z > \bar{z}$.

Bank Problem: As before, the bank can observe collateral but not cash flows. However, it now understands that the tech platform will also offer funding to agents iff $z \geq \bar{z}$. Thus, they make a loan if:

$$\begin{aligned}
&\mathbb{P}(z \leq \bar{z})\mathbb{E}_0^b \left[\max \left\{\mathbb{E}_1^b[z|z \leq \bar{z}] + k, l\right\}\right] + \mathbb{P}(z > \bar{z})\phi\mathbb{E}_0^b \left[\max \left\{\mathbb{E}_1^b[z|z > \bar{z}] + k, l\right\}\right] \\
&\quad = \frac{\bar{z}}{\zeta}\left(\frac{1}{2\lambda}\left(\frac{\bar{z}}{2} + k\right)^2 + \frac{\lambda}{2}\right) + \phi\left(\frac{\zeta - \bar{z}}{\zeta}\right)\left(\frac{1}{2\lambda}\left(\frac{\bar{z} + \zeta}{2} + k\right)^2 + \frac{\lambda}{2}\right) \\
&\quad \geq 1 \qquad (2.1)
\end{aligned}$$

where the bank cannot update their belief about z in period 1 because they cannot observe whether the entrepreneur had other offers. The cutoff value $\bar{k}(\bar{z})$ for the bank (as a function of the platform's cutoff) satisfies (2.1) with equality.

Platform Problem: The platform solves a similar problem but is unable to liquidate the capital because they do not receive any signals about l. Thus, that make loans if:

$$\begin{aligned}
&\mathbb{P}(k \leq \bar{k})\left(z + \mathbb{E}_0^p[k; k \leq \bar{k}]\right) + (1 - \phi)\mathbb{P}(k > \bar{k})\left(z + \mathbb{E}_0^p[k; k \geq \bar{k}]\right) \\
&\quad = \frac{\bar{k}}{\kappa}\left(z + \frac{\bar{k}}{2}\right) + (1 - \phi)\left(\frac{\kappa - \bar{k}}{\kappa}\right)\left(z + \frac{\bar{k} + \kappa}{2}\right) \\
&\quad \geq 1 \qquad (2.2)
\end{aligned}$$

Proposition 3. *In equilibrium, the bank finances the project if $k \geq \bar{k}$ and the platform finances the project if $z \geq \bar{z}$, where the cutoff values $(\bar{k}, \bar{z})$ satisfy* (2.1) *and* (2.2) *with equality.*

For the special case that $\phi = 0$ (the platform gets all the entrepreneurs when both intermediaries are willing to compete for the project), then equations (2.2) and (2.1) simplify to give the explicit analytical expressions:

$$z \geq 1 - \frac{\kappa}{2} =: \bar{z}$$
$$k \geq \sqrt{\lambda \left(2\frac{\zeta}{\bar{z}} - \lambda \right)} - \frac{\bar{z}}{2} =: \bar{k}$$

Figure 1 (b) plots the projects that are financed when lending is segmented between the bank and tech platform. The orange dashed area on Panel (b) depicts the projects that would be financed with segmented banking and platform markets. Evidently, the introduction of tech platform lenders solves the financial inclusion problem for high z agents but makes the problem worse for agents with medium z and medium k. In other words, there are additional credit extensions but also some credit substitution.

2.4 Bank and Tech Platform Cooperation Without a Common Ledger

So far, we have assumed that banks and tech platforms offer loans independently. We now consider whether they can cooperate to jointly provide financing to projects that neither project is willing to finance on their own. Because there is no common ledger in the economy, the bank and platform cannot contract on privately known realizations of z and k. Instead, the feasible contracts have the following features: (a) the bank can take the collateral, (b) the tech platform can take cash flows, and (c) the contract may or may not give banks the right to liquidate the project at $t = 1$.

Proposition 4. *Let s_b and s_p denote the share of funding provided by the bank and the fund respectively. We have that:*

(i) Without the right to liquidate, the bank will offer financing, $s_b \leq k$, and the platform will offer financing, $s_p \leq z$. Thus, projects with $z + k \geq 1$ will be financed.

(ii) With the right to liquidate, the bank will offer financing up to $\mathbb{E}[\max\{l, k\}]$ but the platform will not jointly finance any projects. In this case, projects will

only be financed if the bank can finance them alone $k \geq \bar{k}$ or the platform can finance them alone $z \geq \bar{z}$, where $(\bar{z}, \bar{k})$ satisfy (2.1) *and* (2.2)*.*

Proof. (i) Without the right to liquidate, the bank will only offer financing up to the value of collateral, k, because they cannot liquidate. The tech platform will only offer financing up to the value of cash flows, z. So, together, they are willing provide financing to project so long as $z + k \geq 1$.

(ii) With the right to liquidate, the bank will offer joint financing up to $\mathbb{E}_0^b[\max\{l, k\}]$ (and individual financing if equation (2.1) is satisfied). However, in the subgame at $t = 1$, the bank will threaten to liquidate unless the platform pays z. Since the platform gets nothing if liquidation occurs, they will accept the offer. Thus, in any joint contract where the bank has the right to liquidate, the platform gets zero and so will not participate. Thus, the platform will finance up to z if the bank has no liquidation right and nothing if the bank does have a liquidation right. □

The intuition for the results is the following. If the bank does not have a liquidation right, then they cannot end the project early if l is realized to be high. Thus, they will only put up k funding. However, if the bank has right to liquidate the project early, then it not only liquidates the project when l is high, but also it will threaten to liquidate the project at $t = 1$ and extort the platform's revenue. That is, there is a "hold-up" problem because the parties are unable to contract on the private value of l and so have to give the bank discretion over whether to liquidate the project. Thus, the platform will only participate in joint financing if the bank does not have a liquidation right. Thus, there is now way that the bank the platform can contract on their own to resolve the information segmentation problem.

In particular, Proposition 4 says that if $z + k < 1$, then the hold up problem prevents any cooperative lending and so the intermediaries only consider making loans independently. That is, it offers a theory for why introducing a tech platform leads to the segmented markets from the previous section. For the rest of the paper, we impose parametric restrictions so that we are always in this case.

2.5 Common Record Keeping

This section identifies a problem with segmented information: it leads to segmented and inefficient lending because intermediaries cannot contract on the known set of information in the economy. This problem would be solved if the government (or a private player) could costlessly force all agents to share information. In this case, agents could write funding contracts that are conditional on the information set of the economy and efficient lending would be achieved.

Of course, the government cannot costlessly extract information from the intermediaries in the economy. Throughout the rest of the paper, we explore the difficulties of incentivizing the bank and platform to set up an information sharing system.

3 Information Sharing and Incentive Compatibility

The previous section highlighted that information sharing between tech platforms and the banking sector is important for resolving financial inclusion problems. We now introduce a government that creates a record keeping system where intermediaries in the economy can share project and contract information. In principle, this allows the banks and platform to integrate into a ledger system that makes their private information contractible. However, there are two features of environment that make information sharing difficult. First, participation in the information sharing system is voluntary so the banks and tech platforms may choose to stay away from the record keeping system. Second, banks and platforms potentially have market power, and so behave strategically to maximize profits. We show that the platform is typically very willing to share lending information because they can also extract surplus through markups in the goods market. By contrast, banks face a trade-off between expanding lending capacity and losing market power.

3.1 Environment Changes

The government introduces a common ledger record keeping technology. At time $t = 0$, the bank and tech platform can decide whether to join the ledger system and share information. Once information is on the ledger it is contractible. So, if both the bank and platform share information with the ledger, then all variables (z, k, l) are contractible.

We enrich the market for funding contracts to endogenize ϕ and β from the previous section. We retain the assumption that an intermediary has monopoly pricing power when they are the only intermediary that offers a contract. However, we now allow for imperfect competition when both intermediaries can offer contracts. If both intermediaries decide to make offers to the same entrepreneur, then the entrepreneur solves a discrete choice problem to decide from which intermediary to accept the contract. Formally, when agents get offered a share of the surplus $1-\beta_i$ by intermediary i, then they get utility:

$$\epsilon_{ij}(1-\beta_i)(z+k)$$

where ϵ_{ij} is an i.i.d. draw from a Type II extreme value distribution with scale parameter ξ.

Allowing the entrepreneurs to choose their lender potentially reduces the market power of the intermediaries in the loan market and so the entrepreneurs potentially retain some surplus from the credit market. This means that the market power in the goods market becomes relevant. In the goods market, the platform acts as a monopolist and charges markups at $t=2$. This means that the platform has two ways to extract profit, through the loans and through the goods market, while the bank can only extract profit through the loan market.

3.2 Entrepreneur Problem

If only one intermediary offers a loan, then the entrepreneur accepts the contract so long as $1-\beta \geq 0$. If both intermediaries offer a loan, then entrepreneur j solves the discrete choice problem:

$$\max_i \left\{\epsilon_{ij}(1-\beta_i)(z+k)\right\}.$$

This implies that the fraction of entrepreneurs that accept intermediary i is given by:

$$\phi^i(\beta_i;\beta_{-i}) = \frac{(1-\beta_i)^\xi}{\sum_{i'}(1-\beta_{i'})^\xi}.$$

This formula nests the previous section for the special case that $\xi = 0$ and $\phi = 1/2$.[2] At the other limit $\xi \to \infty$, ϕ becomes the step function:

$$\phi(\beta_b, \beta_p) = \begin{cases} 0, & \text{if } \beta_b > \beta_p \\ [0,1], & \text{if } \beta_b = \beta_p \\ 1, & \text{if } \beta_b < \beta_p \end{cases} \tag{3.1}$$

and so there is essentially Bertrand competition between the intermediaries.

3.3 Intermediary Problems For A Given Information Arrangement

We start by considering the intermediary problems for a given information structure. The intermediaries now have to consider both the extensive margin (whether to make a contract) and the intensive margin (how to compete on prices in the contract market). To help make this clear (and ultimately consider different types of information sets at $t = 0$), we set up the intermediary problems more generally.

We start with the bank problem. Let $\mathcal{F}_0^b$ denote the information set for the banks at $t = 0$. Let ι_b denote an indicator function adapted to $\mathcal{F}_0^b$ denoting which entrepreneurs the bank chooses to offer loan contracts (the extensive margin). Let β_b denote a contract share function adapted to $\mathcal{F}_0^b$ and offered by the bank to entrepreneurs to which it is willing to lend (the intensive margin). Then, the problem of the bank is to choose:

$$\max_{\iota_b, \beta_b} \mathbb{E}_0^b \left[\iota_b \phi(\beta_b, \beta_p) \beta_b \pi_b\right] \tag{3.2}$$

where the expectation $\mathbb{E}_0^b[\cdot]$ is taken with respect to the bank's information $\mathcal{F}_0^b$ set at $t = 0$ and π_b is the profit that the bank gets from the project.

The platform problem is more complicated because intermediaries are no longer monopolists in the credit market and so the entrepreneurs can get surplus in the credit market that the platform can extract through fees in the goods market because they have monopoly control over the trading technology. This means that we need to consider platform profit in both the loan market and the goods market. Let $(\mathcal{F}_0^p, \iota_p, \beta_b)$ denote the information set, offer indicator function, and contract share function respectively for the platform. Then, the problem of the platform is to

[2] Although technically, type II extreme value distribution mean is not defined for $\xi = 1$

choose:

$$\max_{\iota_p,\beta_p} \Big\{ \mathbb{E}_0^p \left[\iota_p (1-\phi(\beta_p,\beta_p))\beta_p \pi_p \right] + \mathbb{E}_0^p \left[\iota_p (1-\phi(\beta_b,\beta_p))(1-\beta_p)\pi_p \right] + \mathbb{E}_0^p \left[\iota_b \phi(\beta_b,\beta_p)(1-\beta_b)\pi_b \right] \Big\}$$

where the expectation $\mathbb{E}_0^p[\cdot]$ is taken with respect to the platform's information $\mathcal{F}_0^b$. The first term is the profit that the platform gets in the loan market. The second term is the profit that the platform gets in the goods market from contracts that it has made. The final term is the profit that the platform gets in the goods market from contracts that the bank has made. Combining the first two terms we can get the expression:

$$\max_{\iota_p,\beta_p} \left\{ \mathbb{E}_0^p \left[\iota_p (1-\phi(\beta_p,\beta_p))\pi_p \right] + \mathbb{E}_0^p \left[\iota_b \phi(\beta_b,\beta_p)(1-\beta_b)\pi_b \right] \right\} \tag{3.3}$$

which says that platform can always get all the surplus on the loans that it makes but only $1-\beta_b$ of the surplus from contracts that the bank makes. Conceptually, this is because it always gets all the surplus in the goods market but not all the surplus in the credit market when the bank makes the contracts. These observations give the bank a strong incentive to set competitive prices in the loan market, as outlined in Proposition 5.

Proposition 5 ("Loss-Leading" Policy)**.** *If $\mathcal{F}_0^b = \mathcal{F}_0^p$ and $\pi_p = \pi_b$ for all projects, then the platform sets $\beta_p = 0$.*

Proof. If $\mathcal{F}_0^b = \mathcal{F}_0^p$ and $\pi_p = \pi_b$, then the platform's objective function becomes:

$$\max_{\iota_p,\beta_p} \left\{ \mathbb{E}_0^p \left[\left(\iota_p (1-\phi(\beta_p,\beta_p)) + \iota_b \phi(\beta_b,\beta_p)(1-\beta_b) \right) \pi_p \right] \right\}$$

Since the banks and platforms have the same information and project profitability, they want to finance the same projects and so $\iota_p = \iota_b$. In this case, the expression is maximized by setting $\beta_p = 0$ and attracting the maximum possible entrepreneurs. □

From expressions (3.2), (3.3), and Proposition 5 we can see that bank and platform have very different incentives when competing in the credit market. The bank derives all its profit from making loan contracts so it faces the standard trade-off between taking a higher share of the surplus and attracting a greater proportion of the entrepreneurs. By contrast, the platform can derive profits from both the loan market and the goods market. This means that for its own contracts it only cares about attracting as many entrepreneurs as possible. This is reflected in the first term of (3.3), which is maximised when $\beta_p = 0$, which allows the platform to attract the maximum possible entrepreneurs. This can be thought of as a type of **loss-leading strategy**: the platform offers generous terms in the loan market to attract customers because it knows it can get the surplus back by exploiting its control over the goods market. The reason that the platform doesn't always want to set $\beta_p = 0$ is because it also gets a fraction $(1 - \beta_b)$ of surplus from contracts made by the bank. This is reflected in the second term of (3.3), which is maximised for $\beta_b = 1$. So, the platform only wants to deviate from $\beta_p = 0$ if the bank is sufficiently better at making loans that the platform would rather take $(1-\beta_b)$ from the surplus on bank loans rather than all the surplus on the contracts they finance themselves. In the next section, we should that this has strong implications for whether the intermediaries want to share information.

3.4 Information Sharing Bertrand Competition ($\xi = \infty$) with a Common Ledger

We now consider whether intermediaries would want to share information with the platform. This means that we need to characterize the equilibrium across the different information sharing arrangements: full information sharing, no information sharing, bank only information sharing, and platform only information sharing. We focusing on the limit $\xi \to \infty$, in which case ϕ becomes the step function (3.1) and there is essentially Bertrand competition between the intermediaries. We start with this case because it leads to explicit β choices. We summarize the main results in Proposition 6 below.

Proposition 6. *The optimal intermediary contract share functions under the different possible information sharing arrangements have the equilibria:*

		Platform (β_p)	
		Share	Not Share
Bank (β_b)	Share	$(\beta_b(z,k), \beta_p(z,k)) = (0,0)$	$(\beta_b(k), \beta_p(z,k)) = (1,0)$
	Not Share	$(\beta_b(z,k), \beta_p(z)) = (\mathbb{1}\{z \le \bar{z}\}, 0)$	$(\beta_b(k), \beta_p(z)) = (1,0)$

For the case (S, S) this is a unique equilibrium. For the other cases, there could be other equilibria. The value to the different intermediaries under the different information sharing arrangements is:

		Platform (V^p)	
		Share	Not Share
Bank (V^b)	Share	$(0, V_{max})$	$(V^b(S,N), V^p(S,N))$
	Not Share	$(V^b(N,S), V^p(N,S))$	$(V^b(N,N), V^p(N,N))$

where V_{max} denotes the planner surplus:

$$V_{max} = \int_0^{\zeta} \int_{\sqrt{\lambda(2-\lambda)}-z}^{\kappa} \left(\frac{(z+k)^2}{2\lambda} + \frac{\lambda}{2} - 1 \right) \frac{dk}{\kappa} \frac{dz}{\zeta}$$

and $V^i(a, b)$ denotes the value to intermediary i when the bank chooses $a \in (S, N)$ and the platform chooses $b \in (S, N)$. We have that:

1. *The bank gains zero value from complete information sharing.*
2. *The platform gains maximum value from complete information sharing:*

$$V^p(N,N), V^p(S,N), V^p(N,S) \le V_{max}$$

3. *There is no equilibrium in which both the bank and the platform share information. The two possible equilibria are: (N, S) and (N, N).*

Proof. We prove these results systemically in Appendix B.1 and discuss the key parts of the proof in this section. □

Proposition 6 illustrates that voluntary information sharing will not lead to a full information common ledger because the bank is unwilling to share information.

This arises because the bank and the platform have different incentives to compete in the loan market. The bank relies on the loan market to make profits whereas the platform can compete away profits in the loan market and get them back in the goods market. Thus, the platform wants the full information ledger so it can better compete in the loan market while the bank wants to withhold information in order to extract profits in the loan market.

Understanding the reasoning behind Proposition 6 is involved because there are many cases to consider. However, it also brings many insights about what enables and what blocks intermediary cooperation on information sharing. We leave the full proof to Appendix B.1. In this section we discuss key sections of the proof: what the equilibrium looks like under full information sharing, why intermediaries choose different strategies when we move away from full information sharing, and the trade-offs that the intermediaries face when choosing their information sharing arrangement at $t = 0$.

3.4.1 Equilibrium with full information sharing

In this case, all variables $(z,\ k,\ l)$ are contractible and $(z,\ k)$ are observed at $t = 0$. So, both bank and platform decisions are a function of (z, k). We guess and verify that the bank and platform both only finance efficient projects satisfying:

$$\iota_b = \iota_p = \mathbb{1}\left\{z + k \geq \sqrt{\lambda(2-\lambda)}\right\}$$

where $\mathbb{1}\{\cdot\}$ denotes an indicator function for whether the statement inside the brackets is true.

Bank problem: in response to the platform policy $(\iota_p(z,k), \beta_p(z,k))$, the bank solves:

$$V^b(S,S) = \max_{\iota_b,\beta_b} \int_0^{\zeta}\int_0^{\kappa} \iota_b(z,k)\phi(\beta_b(z,k),\beta_p(z,k))\beta_b(z,k)(\mathbb{E}_0[\max\{z+k,l\}]-1)\frac{dkdz}{\kappa\zeta}$$

This bank problem has two main differences compared to the problem in Section 2. First, the bank knows that the platform has the same information and will compete on the same set of projects so there is no platform specific cutoff $z \geq \bar{z}$. Second, the bank needs to internalize how their contract price impacts the discrete choice problem of the households. The bank chooses to finance efficient projects and, since ϕ is a step function, undercut the platform price:

$$
\begin{aligned}
\iota_b(z,k) &= \mathbb{1}\{\mathbb{E}_0[\max\{z+k,l\}] \geq 1\} = \mathbb{1}\left\{\frac{(z+k)^2}{2\lambda} + \frac{\lambda}{2} \geq 1\right\} \\
\beta_b(z,k) &= \beta_p(z,k) - \epsilon
\end{aligned}
$$

where ϵ is infinitesimally small (i.e. the bank wants to offer a β slightly lower than the platform's β).

Platform problem: in response to bank policy $(\iota_b(z,k), \beta_b(z,k))$, the platform solves:

$$
\begin{aligned}
V^p(S,S) = \max_{\iota_p,\beta_p} \Big\{ \int_0^\zeta \int_0^\kappa \Big[&\iota_p(z,k)(1-\phi(\beta_b(z,k),\beta_p(z,k))) \\
&+ \iota_b(z,k)(1-\beta_b(z,k))\phi(\beta_b(z,k),\beta_p(z,k))\Big](\mathbb{E}_0[\max\{z+k,l\}]-1)\frac{dk}{\kappa}\frac{dz}{\zeta}\Big\}
\end{aligned}
$$

where the first term is the total surplus from the projects financed by the platform and the second term is the surplus from projects financed by the bank that the platform can extract through the goods market. The platform also chooses to finance efficient projects and offer a competitive price in the loan market (which coincides with the conditions for Proposition 5 being satisfied):

$$
\begin{aligned}
\iota_p(z,k) &= \mathbb{1}\{\mathbb{E}_0[\max\{z+k,l\}] \geq 1\} = \mathbb{1}\left\{\frac{(z+k)^2}{2\lambda} + \frac{\lambda}{2} \geq 1\right\} \\
\beta_p(z,k) &= 0
\end{aligned}
$$

Equilibrium: From the best response functions, we can see that the Nash equilibrium is given by "Bertrand" competition in the loan market that lets the platform extract all the surplus in the economy from the goods market:

$$
\begin{aligned}
\beta_b(z,k) = \beta_p(z,k) &= 0 \\
V^b &= 0 \\
V^p &= \int_0^\zeta \int_{\sqrt{\lambda(2-\lambda)}-z}^\kappa \left(\frac{(z+k)^2}{2\lambda} + \frac{\lambda}{2} - 1\right)\frac{dk}{\kappa}\frac{dz}{\zeta}
\end{aligned}
$$

3.4.2 Equilibrium with no information sharing: (for the main text)

In this case, the economy is in the information segmentation case from Section 2 where the inability to coordinate on liquidation rights means that the bank can only contract on (k, l) and the platform can only contract on z. We guess and verify there is an equilibrium where:

$$\iota_b = \mathbb{1}\{k \geq \bar{k}\}, \qquad \iota_p = \mathbb{1}\{z \geq \bar{z}\}$$

Bank problem: in response to platform policy $(\beta_p(k),\ \iota_p(k))$ the bank solves:

$$\begin{aligned} V^b(N, N) = \max_{\bar{k}, \beta_b} \Bigg\{ \int_{\bar{k}}^{\kappa} \beta_b(k) \int_0^{\lambda} \int_0^{\zeta} \Bigg(& \mathbb{1}\{z \leq \bar{z}\}\Big((\mathbb{1}\{\mathbb{E}_1^b[z|z \leq \bar{z}] + k \geq l\}(z + k) \\ & + (\mathbb{1}\{\mathbb{E}_1^b[z|z \leq \bar{z}] + k < l\}l\Big) \\ & + \mathbb{1}\{z > \bar{z}\}\phi(\beta_b(k), \beta_p(z))\Big((\mathbb{1}\{\mathbb{E}_1^b[z|z \leq \bar{z}] + k \geq l\}(z + k) \\ & + (\mathbb{1}\{\mathbb{E}_1^b[z|z \leq \bar{z}] + k < l\}l\Big)\Bigg) \frac{dz}{\zeta} \frac{dl}{\lambda} \frac{dk}{\kappa} \Bigg\} \end{aligned}$$

The first term is the profit that the bank gets when it is the only lender and the second term is the profit that the bank gets when it ends up competing with the platform. After evaluating the expectations, we can define the profit on a loan to an entrepreneur with collateral k by:

$$\begin{aligned} W^b(\beta_b, k; \beta_p) := \beta_b \Bigg[& \frac{\bar{z}}{\zeta} \left(\left(\frac{\bar{z}}{2} + k \right)^2 + \frac{\lambda}{2} - 1 \right) \\ & + \frac{1}{2\lambda} \left(\frac{\bar{z} + \zeta}{2} + k \right) \left(\int_{\bar{z}}^{\zeta} \phi(\beta_b(k), \beta_p(z)) \left(2z - \left(\frac{\bar{z} + \zeta}{2} \right) + k \right) \frac{dz}{\zeta} \right) \Bigg] \end{aligned}$$

So when the bank observes a project with collateral k, they decide whether to set $\beta_b(k) = 1$ to extract maximum rents from the market where they are a monopolist or set $\beta_b = \min_z\{\beta_p(z)\} - \epsilon$ to undercut the platform:

$$\beta_b(k) = \begin{cases} 1, & \text{if } W^b(1, k; \beta_p) > W^b(\min_z\{\beta_p(z)\} - \epsilon, k; \beta_p) \\ \min_z\{\beta_p(z)\} - \epsilon, & \text{otherwise} \end{cases}$$

and they finance the project if:

$$\iota_b = \mathbb{1}\{\max_{\beta_b} W^b(\beta_b, k) \geq 0\}$$

Platform problem: in response to bank policy $(\beta_b(k),\ \iota_b(k))$ the platform solves:

$$\begin{aligned}
V^p(N,N) = \max_{\bar{z},\beta_p} \Bigg\{ \int_{\bar{z}}^{\zeta} \int_0^{\lambda} \int_0^{\kappa} \Bigg(& \mathbb{1}\{k \leq \bar{k}\}(z+k) \\
& + \mathbb{1}\{k > \bar{k}\}(1 - \phi(\beta_b(k), \beta_p(z))(z+k) \Bigg) \frac{dk}{\kappa} \frac{dl}{\lambda} \frac{dz}{\zeta} \\
+ \int_0^{\zeta} \int_{\bar{k}}^{\kappa} (1 - \beta_p(k)) \int_0^{\lambda} \Bigg(& \mathbb{1}\{z \leq \bar{z}\}\Big((\mathbb{1}\{\mathbb{E}_1^b[z|z \leq \bar{z}] + k \geq l\}(z+k) \\
& + (\mathbb{1}\{\mathbb{E}_1^b[z|z \leq \bar{z}] + k < l\}l\Big) \\
& + \mathbb{1}\{z > \bar{z}\}\phi(\beta_b(k), \beta_p(z))\Big((\mathbb{1}\{\mathbb{E}_1^b[z|z \leq \bar{z}] + k \geq l\}(z+k) \\
& + (\mathbb{1}\{\mathbb{E}_1^b[z|z \leq \bar{z}] + k < l\}l\Big)\Bigg) \frac{dl}{\lambda} \frac{dk}{\kappa} \frac{dz}{\zeta}
\end{aligned}$$

The first term is the surplus from the loans that they make. The second term is the surplus from the loans made by the bank that they can recover in the goods market. Again, denote the profit from a contract to an entrepreneur with cash flow z by:

$$\begin{aligned}
W^p(\beta_p, z; \beta_b) = & \frac{\bar{k}}{\kappa}\left(z + \frac{\bar{k}}{2}\right) + \left(\frac{\kappa - \bar{k}}{\kappa}\right) \int_{\bar{k}}^{\kappa} (1 - \phi(\beta_b(k), \beta_p(z)))(z+k) \frac{dk}{\kappa} \\
& + \mathbb{1}\{z \leq \bar{z}\} \int_{\bar{k}}^{\kappa} (1 - \beta_b(k)) \left(\frac{1}{2\lambda}\left(\frac{\bar{z}}{2} + k\right)\left(2z - \frac{\bar{z}}{2} + k\right) + \frac{\lambda}{2}\right) \frac{dk}{\kappa} \\
& + \mathbb{1}\{z > \bar{z}\} \int_{\bar{k}}^{\kappa} (1 - \beta_b(k))\phi(\beta_b(k), \beta_p(z)) \left(\frac{1}{2\lambda}\left(\frac{\bar{z}+\zeta}{2} + k\right)\left(2z - \frac{\bar{z}+\zeta}{2} + k\right) + \frac{\lambda}{2}\right) \frac{dk}{\kappa}
\end{aligned}$$

So when the platform observes a project with cash flow z, they decide whether to set $\beta_b < \beta_p$ to undercut the bank or whether to set $\beta_b > \beta_p$ to let the bank make the loans:

$$\beta_p(z) = \begin{cases} [0, \min_k\{\beta_b(k)\} - \epsilon], & \text{if } W^p(0, z; \beta_b) > W^b(1, z; \beta_b) \\ [\max_k\{\beta_b(k)\} + \epsilon, 1], & \text{otherwise} \end{cases}$$

and their financing decision is:

$$\iota_p = \mathbb{1}\left\{\max_{\beta_p} W^p(\beta_p, z; \beta_b) \geq 0\right\}$$

Equilibrium: The profit sharing choices $(\beta_b(k), \beta_p(z)) = (1, 0)$ denote a Nash equilibrium. Why? The bank has no incentive to deviate because the only way they can attract customers is to also set $\beta_b(k) = 0$, which means they earn no profit. Likewise, the platform has no incentive to deviate because when $\beta_b(k) = 1$ they earn no surplus from the projects that the bank initiates and so they they simply set $\beta_p(z)$ to maximise the fraction of entrepreneurs they attract.

For a given project (z, k), there is potentially also a continuum of equilibria with $(\beta_b(k), \beta_p(z) = (b, b + \epsilon)$ satisfying:

$$W^b(b, k; b + \epsilon) > W^b(1, k; b + \epsilon), \qquad W^p(b + \epsilon, z; b) > W^p(b - \epsilon, z; b)$$

This equilibrium can only occur is the platform prefers that the banks provide the credit contracts. In this case, if the bank takes a sufficiently small fraction of the surplus, then the platform may prefer to let the bank provide the credit contracts and then extract the surplus back in the goods market.

Why is there no another Nash equilibrium? We can see that $\beta_b(k), \beta_p(z) \in (0, 1)$ with $\beta_b(k) > \beta_p(z)$ cannot be an equilibrium because then $\phi = 0$ so the platform would rather deviate and set $\beta_b(k) = 1$. Finally, $\beta_p(z) = 0$ cannot be an equilibrium because the bank can then always benefit from switching to $\beta_p(z) = 1$.

3.4.3 Equilibria with other information sharing arrangements

We relegate to the appendix the details of the last two cases: when only the platform shares information and when only the bank shares information. Here we discuss the high level intuition.

Only the platform shares information: In this case, the bank can contract on all variables (z, k, l) while the platform can only contract on z. In equilibrium, the bank and platform compete in the following markets:

$$\iota_b = \mathbb{1}\left\{z + k \geq \sqrt{\lambda(2 - \lambda)}\right\}, \qquad \iota_p = \mathbb{1}\{z \geq \bar{z}\}$$

As we show in Appendix B.1, the value functions look similar to the no-information sharing case but must take into account that now the bank makes efficient contracting decisions. Unlike for the case with no information sharing, there is no longer an equilibrium where $(\beta_b(z,k), \beta_p) = (1, 0)$. This is because the bank can condition their strategy on z and so can act as a monopolist for $z \leq \bar{z}$ and compete in the market for $z > \bar{z}$. This means that the choices $(\beta_b(z,k), \beta_p) = (\mathbb{1}\{z \leq z\}, 0)$ can instead be an equilibrium.

Only the bank shares information: In this case, the bank can contract on all variables (z, k, l) while the platform can only contract on z. In equilibrium, the bank and platform compete in the following markets:

$$\iota_b = \mathbb{1}\left\{z + k \geq \sqrt{\lambda(2-\lambda)}\right\}, \qquad \iota_p = \mathbb{1}\{z \geq \bar{z}\}$$

As we show in Appendix B.1, the value functions look similar to the no-information sharing case but must take into account that now the platform makes efficient contracting decisions. Like for the case of full information sharing, there is an equilibrium with $(\beta_b(k), \beta_p(z,k)) = (1, 0)$.

3.4.4 Information Sharing Decisions:

Platform choice: If the bank is sharing information, then the platform prefers to share information because then they get the entire surplus in the market. If the bank is not sharing information, then the platform shares if $V^p(N,S) > V^p(N,N)$. If the equilibrium for (N,N) is $(\beta_b(z,k), \beta_p) = (1,0)$ and the equilibrium for (N,S) is $(\beta_b(z,k), \beta_p) = (\mathbb{1}\{z \leq z\}, 0)$, then the condition on the platform sharing information is:

$$\begin{aligned}
&\int_{\bar{z}}^{\zeta} \left(\frac{\bar{k}(z)}{\kappa} \left(z + \frac{\bar{k}(z)}{2} \right) + \int_{\bar{k}(z)}^{\kappa} \frac{1}{2}(z+k)\frac{dk}{\kappa} \right) \frac{dz}{\zeta} \\
&\quad + \int_0^{\zeta} \left[\mathbb{1}\{z > \bar{z}\} \int_{\bar{k}(z)}^{\kappa} \frac{1}{2} \left(\frac{1}{2\lambda} \left(\frac{\bar{z}+\zeta}{2} + k \right) \left(2z - \frac{\bar{z}+\zeta}{2} + k \right) + \frac{\lambda}{2} \right) \frac{dk}{\kappa} \right] \frac{dz}{\zeta} \\
&\geq \int_{\bar{z}}^{\zeta} \left(\frac{\bar{k}}{\kappa} \left(z + \frac{\bar{k}}{2} \right) + \int_{\bar{k}}^{\kappa} (z+k) \frac{dk}{\kappa} \right) \frac{dz}{\zeta}
\end{aligned}$$

We can see the trade-offs for the platform:

1. Sharing information changes which entrepreneurs the bank is willing to finance. In particular, it allows the bank to make loans to a greater number of entrepreneurs, which decreases platform profit.

2. Sharing information changes price competition in the credit market. Without any information sharing, the bank sets monopoly pricing across the entire market and only lends to the entrepreneurs who are bank-dependent. With information sharing, the bank sets a conditional strategy that only sets monopoly pricing in the part of the market where platform does not compete. In this sense, sharing information induces the bank to compete on price which decreases intermediary surplus in the credit market and gives the platform more surplus to extract in the goods market. This increases platform value.

3. Sharing information makes bank financing more efficient and so increases the aggregate surplus in the economy. This also increases platform value.

Bank choice: If the platform is sharing information, then the bank prefers to not share information. If the platform is not sharing information, then the platform does not share if $V^b(S,N) < V^b(N,N)$, which holds since:

$$\int_{\bar{k}}^{\kappa} \left(\frac{\bar{z}(k)}{\zeta} \left(\left(\frac{\bar{z}(k)}{2} + k \right)^2 + \frac{\lambda}{2} - 1 \right) \frac{dk}{\kappa} \leq \int_{\bar{k}}^{\kappa} \left(\frac{\bar{z}}{\zeta} \left(\left(\frac{\bar{z}}{2} + k \right)^2 + \frac{\lambda}{2} - 1 \right) \frac{dk}{\kappa}$$

The reason that information sharing hurts the bank is because they can only get profit through the loan market and so loose revenue when the give the platform more information that allows them to compete in more of the loan market.

3.5 Alternative Arrangements

Proposition 6 shows that simply offering a common ledger for information sharing is insufficient for resolving financial inclusion. We now consider a collection of policies that can resolve the difficulty.

Benevolent Regulation: A benevolent social planner in our economy would force the bank to share information into a common ledger to achieve first best contracting.

Political Lobbying: We now suppose that instead of a benevolent social planner there is a government policy maker that runs a second price auction where the winning bidder can set information policy. We interpret this as the outcome under political lobbying. An immediate corollary from Proposition 6 is that the platform would win the second price auction and choose information sharing.

Corollary 1. *The outcome of a second price auction is that the government forces information sharing and production is efficient.*

The intuition for the result is that information sharing generates surplus because production is more efficient. The platform fully internalizes this surplus creation so in a"fair" political lobbying process the platform will pay to get an information sharing ledger created. In our model, this looks like an attractive outcome. However, there are two extensions that might break this result: (i) the platform markups may create distortions and (ii) the political lobbying process may not be fair.

Platform Ledger: An alternative option is for the platform to setup its own ledger and invite new banks to form, share information on the ledger, and use the information on the ledger. This could be viewed as similar to what Alibaba did with Ant Financial in China.

4 Conclusion

Our model studies a financial sector with traditional banks and tech platform. Banks specialize in learning about collateral, where is the platform has superior technology to grant credit against future revenue since goods trading occurs on this platform. Having the tech platform participate in the loan market alleviates financial inclusion problem so long as both the bank and the platform participate in an information sharing system. The platform will lobby for this information sharing system so that it can reduce bank profits in the loan market and increase its markup revenue in the goods market. This highlights that FinTech regulators need to consider competition across the loan and goods market together.

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A Additional Proofs for Section 2

Proof of Proposition 1. We have that:

$$\begin{aligned}
\mathbb{E}_0[\max\{z+k,l\}] &= \int_0^\lambda \max\{z+k,l\}\frac{dl}{\lambda} \\
&= \begin{cases} \int_0^{z+k}(z+k)\frac{dl}{\lambda} + \int_{z+k}^{\lambda} l\frac{dl}{\lambda}, & \text{if } z+k \le \lambda \\ \int_0^{\lambda}(z+k)\frac{dl}{\lambda}, & \text{if } z+k > \lambda \end{cases} \\
&= \begin{cases} \frac{(z+k)^2}{2\lambda} + \frac{\lambda}{2}, & \text{if } z+k \le \lambda \\ z+k, & \text{if } z+k > \lambda \end{cases}
\end{aligned}$$

The parametric restriction $\zeta + \kappa \le \lambda$ implies that $z + k \le \lambda$ and so the first case applies. □

Proof of Proposition 2. We have that the bank profit from financing a project is:

$$\begin{aligned}
&\mathbb{E}_0[\max\{\mathbb{E}_1^b[z]+k,l\}] \\
&\quad= \int_0^\lambda \int_0^\zeta \left[\mathbb{1}\{\mathbb{E}_1^b[z]+k \ge l\}(z+k) + \mathbb{1}\{\mathbb{E}_1^b[z]+k < l\}l\right]\frac{dz}{\zeta}\frac{dl}{\lambda} - 1 \\
&\quad= \int_0^\lambda \max\{\zeta/2+k,l\}\frac{dl}{\lambda} \\
&\quad= \begin{cases} \int_0^{\zeta/2+k}(\zeta/2+k)\frac{dl}{\lambda} + \int_{\zeta/2+k}^{\lambda} l\frac{dl}{\lambda}, & \text{if } \zeta/2+k \le \lambda \\ \int_0^{\lambda}(z+k)\frac{dl}{\lambda}, & \text{if } \zeta/2+k > \lambda \end{cases} \\
&\quad= \begin{cases} \frac{(\zeta/2+k)^2}{2\lambda} + \frac{\lambda}{2}, & \text{if } \zeta/2+k \le \lambda \\ \zeta/2+k, & \text{if } \zeta/2+k > \lambda \end{cases}
\end{aligned}$$

The parametric restriction $\zeta + \kappa \le \lambda$ implies that $\zeta/2 + k \le \lambda$ and so the first case applies. □

B Additional Proofs From Section 3

B.1 Proof of Proposition 6

In this Appendix we go through the different cases in Proposition 6 in more detail.

B.1.1 Equilibrium with full information sharing

In this case, all variables $(z,\, k,\, l)$ are contractible and $(z,\, k)$ are observed at $t = 0$. So, both bank and platform decisions are a function of (z, k). We guess and verify that the bank and platform both only finance efficient projects satisfying:

$$\iota_b = \iota_p = \mathbb{1}\left\{z + k \geq \sqrt{\lambda(2-\lambda)}\right\}$$

where $\mathbb{1}\{\cdot\}$ denotes an indicator function for whether the statement inside the brackets is true.

Bank problem: in response to the platform policy $(\iota_p(z, k), \beta_p(z, k))$, the bank solves:

$$V^b(S,S) = \max_{\iota_b,\beta_b} \int_0^\zeta \int_0^\kappa \iota_b(z,k)\phi(\beta_b(z,k),\beta_p(z,k))\beta_b(z,k)(\mathbb{E}_0[\max\{z+k,l\}]-1)\frac{dkdz}{\kappa\zeta}$$

This bank problem has two main differences compared to the problem in Section 2. First, the bank knows that the platform has the same information and will compete on the same set of projects so there is no platform specific cutoff $z \geq \bar{z}$. Second, the bank needs to internalize how their contract price impacts the discrete choice problem of the households. Since ϕ is a step function, the bank chooses to finance efficient projects and undercut the platform price:

$$\iota_b(z,k) = \mathbb{1}\{\mathbb{E}_0[\max\{z+k,l\}] \geq 1\} = \mathbb{1}\left\{\frac{(z+k)^2}{2\lambda} + \frac{\lambda}{2} \geq 1\right\}$$
$$\beta_b(z,k) = \beta_p(z,k) - \epsilon$$

where ϵ is infinitesimally small (i.e. the bank wants to offer a β slightly lower than the platform's β).

Platform problem: in response to bank policy $(\iota_b(z,k), \beta_b(z,k))$, the platform solves:

$$V^p(S,S) = \max_{\iota_p,\beta_p} \Big\{ \int_0^\zeta \int_0^\kappa \Big[\iota_p(z,k)(1-\phi(\beta_b(z,k),\beta_p(z,k))) + \iota_b(z,k)(1-\beta_b(z,k))\phi(\beta_b(z,k),\beta_p(z,k))\Big](\mathbb{E}_0[\max\{z+k,l\}]-1)\frac{dk}{\kappa}\frac{dz}{\zeta}\Big\}$$

where the first term is the total surplus from the projects financed by the platform and the second term is the surplus from projects financed by the bank that the platform can extract through the goods market. The platform chooses to finance efficient projects and offer a competitive price in the loan market (which coincides with the conditions for Proposition 5 being satisfied):

$$\iota_p(z,k) = \mathbb{1}\{\mathbb{E}_0[\max\{z+k,l\}] \geq 1\} = \mathbb{1}\left\{\frac{(z+k)^2}{2\lambda} + \frac{\lambda}{2} \geq 1\right\}$$
$$\beta_p(z,k) = 0$$

Equilibrium: From the best response functions, we can see that the Nash equilibrium is given by "Bertrand" competition in the loan market that lets the platform extract all the surplus in the economy from the goods market:

$$\beta_b(z,k) = \beta_p(z,k) = 0$$
$$V^b = 0$$
$$V^p = \int_0^\zeta \int_{\sqrt{\lambda(2-\lambda)}-z}^\kappa \left(\frac{(z+k)^2}{2\lambda} + \frac{\lambda}{2} - 1\right)\frac{dk}{\kappa}\frac{dz}{\zeta}$$

B.1.2 Equilibrium with no information sharing: (for the appendix)

In this case, the economy is in the information segmentation case from Section 2 where the inability to coordinate on liquidation rights means that the bank can only contract on (k,l) and the platform can only contract on z. We guess and verify there is an equilibrium where:

$$\iota_b = \mathbb{1}\{k \geq \bar{k}\}, \qquad \iota_p = \mathbb{1}\{z \geq \bar{z}\}$$

Bank problem: in response to platform policy $(\beta_p(k),\ \iota_p(k))$ the bank solves:

$$
\begin{aligned}
V^b(N,N) = \max_{\bar{k},\beta_b} \Bigg\{ \int_{\bar{k}}^{\kappa} \beta_b(k) \int_0^{\lambda} \int_0^{\zeta} \Bigg(& \mathbb{1}\{z \leq \bar{z}\}\Big((\mathbb{1}\{\mathbb{E}_1^b[z|z \leq \bar{z}] + k \geq l\}(z+k) \\
& + (\mathbb{1}\{\mathbb{E}_1^b[z|z \leq \bar{z}] + k < l\}l\Big) \\
& + \mathbb{1}\{z > \bar{z}\}\phi(\beta_b(k), \beta_p(z))\Big((\mathbb{1}\{\mathbb{E}_1^b[z|z \leq \bar{z}] + k \geq l\}(z+k) \\
& + (\mathbb{1}\{\mathbb{E}_1^b[z|z \leq \bar{z}] + k < l\}l\Big)\Bigg) \frac{dz}{\zeta}\frac{dl}{\lambda}\frac{dk}{\kappa} \Bigg\} \\
= \max_{\bar{k},\beta_b} \Bigg\{ \int_{\bar{k}}^{\kappa} \beta_b(k) \Bigg[& \frac{\bar{z}}{\zeta}\left(\left(\frac{\bar{z}}{2}+k\right)^2 + \frac{\lambda}{2} - 1\right) \\
+ \frac{1}{2\lambda}\left(\frac{\bar{z}+\zeta}{2}+k\right) & \left(\int_{\bar{z}}^{\zeta} \phi(\beta_b(k), \beta_p(z)) \left(2z - \left(\frac{\bar{z}+\zeta}{2}\right) + k\right)\frac{dz}{\zeta}\right)\Bigg]\frac{dk}{\kappa}\Bigg\}
\end{aligned}
$$

The first term is the profit that the bank gets when it is the only lender and the second term is the profit that the bank gets when it ends up competing with the platform. We define the profit on a loan to an entrepreneur with collateral k by:

$$
\begin{aligned}
W^b(\beta_b, k; \beta_p) := \beta_b \Bigg[& \frac{\bar{z}}{\zeta}\left(\left(\frac{\bar{z}}{2}+k\right)^2 + \frac{\lambda}{2} - 1\right) \\
& + \frac{1}{2\lambda}\left(\frac{\bar{z}+\zeta}{2}+k\right)\left(\int_{\bar{z}}^{\zeta} \phi(\beta_b(k), \beta_p(z)) \left(2z - \left(\frac{\bar{z}+\zeta}{2}\right) + k\right)\frac{dz}{\zeta}\right)\Bigg]
\end{aligned}
$$

So when the bank observes a project with collateral k, they decide whether to set $\beta_b(k) = 1$ to extract maximum rents from the market where they are a monopolist or set $\beta_b = \min_z\{\beta_p(z)\} - \epsilon$ to undercut the platform:

$$
\beta_b(k) = \begin{cases} 1, & \text{if } W^b(1, k; \beta_p) > W^b(\min_z\{\beta_p(z)\} - \epsilon, k; \beta_p) \\ \min_z\{\beta_p(z)\} - \epsilon, & \text{otherwise} \end{cases}
$$

and they finance the project if:

$$
\iota_b = \mathbb{1}\{\max_{\beta_b} W^b(\beta_b, k) \geq 0\}
$$

Platform problem: in response to bank policy $(\beta_b(k),\ \iota_b(k))$ the platform solves:

$$
\begin{aligned}
V^p(N,N) = \max_{\bar{z},\beta_p} \Bigg\{ \int_{\bar{z}}^{\zeta} \int_0^{\lambda} \int_0^{\kappa} \Bigg(& \mathbb{1}\{k \le \bar{k}\}(z+k) \\
& + \mathbb{1}\{k > \bar{k}\}(1-\phi(\beta_b(k),\beta_p(z))(z+k) \Bigg) \frac{dk}{\kappa}\frac{dl}{\lambda}\frac{dz}{\zeta} \\
+ \int_0^{\zeta} \int_{\bar{k}}^{\kappa} (1-\beta_p(k)) \int_0^{\lambda} \Bigg(& \mathbb{1}\{z \le \bar{z}\}\Big((\mathbb{1}\{\mathbb{E}_1^b[z|z \le \bar{z}] + k \ge l\}(z+k) \\
& + (\mathbb{1}\{\mathbb{E}_1^b[z|z \le \bar{z}] + k < l\}l \Big) \\
& + \mathbb{1}\{z > \bar{z}\}\phi(\beta_b(k),\beta_p(z))\Big((\mathbb{1}\{\mathbb{E}_1^b[z|z \le \bar{z}] + k \ge l\}(z+k) \\
& + (\mathbb{1}\{\mathbb{E}_1^b[z|z \le \bar{z}] + k < l\}l \Big) \Bigg) \frac{dl}{\lambda}\frac{dk}{\kappa}\frac{dz}{\zeta} \\
= \max_{\bar{z},\beta_p} \Bigg\{ \int_{\bar{z}}^{\zeta} \Bigg(\frac{\bar{k}}{\kappa}\left(z + \frac{\bar{k}}{2}\right) + \int_{\bar{k}}^{\kappa} & (1-\phi(\beta_b(k),\beta_p(z)))(z+k)\frac{dk}{\kappa} \Bigg) \frac{dz}{\zeta} \\
+ \int_0^{\zeta} \Bigg[\mathbb{1}\{z \le \bar{z}\} \int_{\bar{k}}^{\kappa} & (1-\beta_b(k)) \left(\frac{1}{2\lambda}\left(\frac{\bar{z}}{2} + k\right)\left(2z - \frac{\bar{z}}{2} + k\right) + \frac{\lambda}{2} \right) \frac{dk}{\kappa} \\
+ \mathbb{1}\{z > \bar{z}\} \int_{\bar{k}}^{\kappa} & (1-\beta_b(k))\phi(\beta_b(k),\beta_p(z)) \left(\frac{1}{2\lambda}\left(\frac{\bar{z}+\zeta}{2} + k\right)\left(2z - \frac{\bar{z}+\zeta}{2} + k\right) + \frac{\lambda}{2} \right) \frac{dk}{\kappa} \Bigg] \frac{dz}{\zeta} \Bigg\}
\end{aligned}
$$

Again, denote the profit from a contract to an entrepreneur with cash flow z by:

$$
\begin{aligned}
W^p(\beta_p, z; \beta_b) = & \frac{\bar{k}}{\kappa}\left(z + \frac{\bar{k}}{2}\right) + \left(\frac{\kappa - \bar{k}}{\kappa}\right) \int_{\bar{k}}^{\kappa} (1-\phi(\beta_b(k),\beta_p(z)))(z+k)\frac{dk}{\kappa} \\
& + \mathbb{1}\{z \le \bar{z}\} \int_{\bar{k}}^{\kappa} (1-\beta_b(k)) \left(\frac{1}{2\lambda}\left(\frac{\bar{z}}{2} + k\right)\left(2z - \frac{\bar{z}}{2} + k\right) + \frac{\lambda}{2} \right) \frac{dk}{\kappa} \\
& + \mathbb{1}\{z > \bar{z}\} \int_{\bar{k}}^{\kappa} (1-\beta_b(k))\phi(\beta_b(k),\beta_p(z)) \left(\frac{1}{2\lambda}\left(\frac{\bar{z}+\zeta}{2} + k\right)\left(2z - \frac{\bar{z}+\zeta}{2} + k\right) + \frac{\lambda}{2} \right) \frac{dk}{\kappa}
\end{aligned}
$$

So when the platform observes a project with cash flow z, they decide whether to set $\beta_b < \beta_p$ to undercut the bank or whether to set $\beta_b > \beta_p$ to let the bank make the loans:

$$\beta_p(z) = \begin{cases} [0, \min_k\{\beta_b(k)\} - \epsilon], & \text{if } W^p(0, z; \beta_b) > W^b(1, z; \beta_b) \\ [\max_k\{\beta_b(k)\} + \epsilon, 1], & \text{otherwise} \end{cases}$$

and their financing decision is:

$$\iota_p = \mathbb{1}\left\{\max_{\beta_p} W^p(\beta_p, z; \beta_b) \geq 0\right\}$$

Equilibrium: The profit sharing choices $(\beta_b(k), \beta_p(z)) = (1, 0)$ denote a Nash equilibrium. Why? The bank has no incentive to deviate because the only way they can attract customers is to also set $\beta_b(k) = 0$, which means they earn no profit. Likewise, the platform has no incentive to deviate because when $\beta_b(k) = 1$ they earn no surplus from the projects that the bank initiates and so they they simply set $\beta_p(z)$ to maximise the fraction of entrepreneurs they attract.

For a given project (z, k), there is potentially also a continuum of equilibria with $(\beta_b(k), \beta_p(z) = (b, b + \epsilon)$ satisfying:

$$W^b(b, k; b + \epsilon) > W^b(1, k; b + \epsilon), \qquad W^p(b + \epsilon, z; b) > W^p(b - \epsilon, z; b)$$

This equilibrium can only occur is the platform prefers that the banks provide the credit contracts. In this case, if the bank takes a sufficiently small fraction of the surplus, then the platform may prefer to let the bank provide the credit contracts and then extract the surplus back in the goods market.

Why is there no another Nash equilibrium? We can see that $\beta_b(k), \beta_p(z) \in (0, 1)$ with $\beta_b(k) > \beta_p(z)$ cannot be an equilibrium because then $\phi = 0$ so the platform would rather deviate and set $\beta_b(k) = 1$. Finally, $\beta_p(z) = 0$ cannot be an equilibrium because the bank can then always benefit from switching to $\beta_p(z) = 1$.

B.1.3 Equilibrium when only the platform shares information (for the appendix):

In this case, the bank can contract on all variables (z, k, l) while the platform can only contract on z. We guess and verify that there is an equilibrium where:

$$\iota_b = \mathbb{1}\left\{z + k \geq \sqrt{\lambda(2 - \lambda)}\right\}, \qquad \iota_p = \mathbb{1}\{z \geq \bar{z}\}$$

Bank problem: In response to platform policy ($\beta_p(z)$, $\iota_p(z)$), the bank problem is to solve:

$$V^b(N,S) = \max_{\iota_b,\beta_b} \int_0^\zeta \int_0^\kappa \iota_b(z,k)\beta_b(z,k)\Big(\mathbb{1}\{z \leq \bar{z}\}\mathbb{E}_0^b[\max\{z+k,l\}-1] \\ + \mathbb{1}\{z > \bar{z}\}\phi(\beta_b(z,k),\beta_p(z))\mathbb{E}_0^b[\max\{z+k,l\}-1]\Big)\frac{dk}{\kappa}\frac{dz}{\zeta}$$

so the bank chooses to finance the projects:

$$\iota_b(z,k) = \{\mathbb{E}_0^b[\max\{z+k,l\} \geq 1\}$$

and chooses profit shares:

$$\max_{\beta_b} \begin{cases} \beta_b(z,k), & \text{if } z \leq \bar{z} \\ \beta_b(z,k)\phi(\beta_b(z,k),\beta_p(z)), & \text{if } z > \bar{z} \end{cases}$$

So, the bank chooses to act as a monopolist in the part of the market that they control and compete in the part of the market where the platform is also issuing loans:

$$\beta_b(z,k) = \begin{cases} 1, & \text{if } z \leq \bar{z} \\ \beta_p(z) - \epsilon, & \text{if } z > \bar{z} \end{cases}$$

Platform problem: Let $\bar{k}(z) := \sqrt{\lambda(2-\lambda)} - z$. The platform problem, in response to bank policy $(\beta_b(z,k),\ \iota_b(z,k))$ is to solve:

$$
\begin{aligned}
V^p(N,S) = \max_{\bar{z},\beta_p} \Bigg\{ \int_{\bar{z}}^{\zeta} \int_0^{\lambda} \int_0^{\kappa} \Bigg(& \mathbb{1}\{k \leq \bar{k}(z)\}(z+k) \\
& + \mathbb{1}\{k > \bar{k}(z)\}(1-\phi(\beta_b(z,k),\beta_p(z))(z+k)\Bigg) \frac{dk}{\kappa}\frac{dl}{\lambda}\frac{dz}{\zeta} \\
+ \int_0^{\zeta} \int_{\bar{k}(z)}^{\kappa} (1-\beta_p(k)) \int_0^{\lambda} \Bigg(& \mathbb{1}\{z \leq \bar{z}\}\Big((\mathbb{1}\{\mathbb{E}_1^b[z|z \leq \bar{z}] + k \geq l\}(z+k) \\
& + (\mathbb{1}\{\mathbb{E}_1^b[z|z \leq \bar{z}] + k < l\}l\Big) \\
& + \mathbb{1}\{z > \bar{z}\}\phi(\beta_b(z,k),\beta_p(z))\Big((\mathbb{1}\{\mathbb{E}_1^b[z|z \leq \bar{z}] + k \geq l\}(z+k) \\
& + (\mathbb{1}\{\mathbb{E}_1^b[z|z \leq \bar{z}] + k < l\}l\Big)\Bigg)\frac{dl}{\lambda}\frac{dk}{\kappa}\frac{dz}{\zeta} \\
= \max_{\bar{k},\beta_b} \Bigg\{ \int_{\bar{z}}^{\zeta} \Bigg(\frac{\bar{k}(z)}{\kappa}\left(z + \frac{\bar{k}(z)}{2}\right) & + \int_{\bar{k}(z)}^{\kappa} (1-\phi(\beta_b(z,k),\beta_p(z)))(z+k)\frac{dk}{\kappa}\Bigg)\frac{dz}{\zeta} \\
+ \int_0^{\zeta} \Bigg[\mathbb{1}\{z \leq \bar{z}\} \int_{\bar{k}(z)}^{\kappa} & (1-\beta_b(z,k))\left(\frac{1}{2\lambda}\left(\frac{\bar{z}}{2}+k\right)\left(2z - \frac{\bar{z}}{2}+k\right)+\frac{\lambda}{2}\right)\frac{dk}{\kappa} \\
+ \mathbb{1}\{z > \bar{z}\} \int_{\bar{k}(z)}^{\kappa} & (1-\beta_b(z,k))\phi(\beta_b(z,k),\beta_p(z))\left(\frac{1}{2\lambda}\left(\frac{\bar{z}+\zeta}{2}+k\right)\left(2z-\frac{\bar{z}+\zeta}{2}+k\right)+\frac{\lambda}{2}\right)\frac{dk}{\kappa}\Bigg]\frac{dz}{\zeta}\Bigg\}
\end{aligned}
$$

Again, denote the profit from a contract to an entrepreneur with cash flow z by:

$$
\begin{aligned}
W^p(\beta_p,z) = \frac{\bar{k}}{\kappa}\left(z+\frac{\bar{k}(z)}{2}\right) &+ \left(\frac{\kappa-\bar{k}(z)}{\kappa}\right)\int_{\bar{k}(z)}^{\kappa}(1-\phi(\beta_b(z,k),\beta_p(z)))(z+k)\frac{dk}{\kappa} \\
&+ \mathbb{1}\{z \leq \bar{z}\}\int_{\bar{k}(z)}^{\kappa}(1-\beta_b(z,k))\left(\frac{1}{2\lambda}\left(\frac{\bar{z}}{2}+k\right)\left(2z-\frac{\bar{z}}{2}+k\right)+\frac{\lambda}{2}\right)\frac{dk}{\kappa} \\
&+ \mathbb{1}\{z > \bar{z}\}\int_{\bar{k}(z)}^{\kappa}(1-\beta_b(z,k))\phi(\beta_b(z,k),\beta_p(z))\left(\frac{1}{2\lambda}\left(\frac{\bar{z}+\zeta}{2}+k\right)\left(2z-\frac{\bar{z}+\zeta}{2}+k\right)+\frac{\lambda}{2}\right)\frac{dk}{\kappa}
\end{aligned}
$$

So when the platform observes a project with cash flow z, they decide whether to set $\beta_b < \beta_p$ to undercut the bank or whether to set $\beta_b > \beta_p$ to let the bank make the loans:

$$\beta_p(z) = \begin{cases} [0, \min_k\{\beta_b(k)\} - \epsilon], & \text{if } W^p(0,z) > W^b(1,z) \\ [\max_k\{\beta_b(k)\} + \epsilon, 1], & \text{otherwise} \end{cases}$$

and their financing decision is:

$$\iota_p = \mathbb{1}\{\max_{\beta_p} W^p(\beta_p, z) \geq 0\}$$

Equilibrium: Unlike for the case with no information sharing, there is no longer an equilibrium where $(\beta_b(z,k), \beta_p) = (1,0)$. This is because the bank can condition their strategy on z and so can act as a monopolist for $z \leq \bar{z}$ and compete in the market Instead, the choices $(\beta_b(z,k), \beta_p) = (\mathbb{1}\{z \leq z\}, 0)$ can be an equilibrium.

B.1.4 Equilibrium when only the bank shares information (for the appendix):

In this case, the bank can contract on (k,l) and the platform can contract on all variables. We guess and verify that there is an equilibrium where:

$$\iota_b = \mathbb{1}\{k \geq \bar{k}\}, \qquad \iota_p = \mathbb{1}\left\{z + k \geq \sqrt{\lambda(2-\lambda)}\right\}$$

Bank problem: Let $\bar{z}(k) = \sqrt{\lambda(2-\lambda)} - k$. The bank problem, in response to platform policy $(\beta_p(z,k),\ \iota_p(z,k))$ is to solve:

$$V^b(S,N) = \max_{\bar{k},\beta_b} \Bigg\{ \int_{\bar{k}}^{\kappa} \beta_b(k) \int_0^{\lambda} \int_0^{\zeta} \Bigg(\mathbb{1}\{z \le \bar{z}(k)\} \Big((\mathbb{1}\{\mathbb{E}_1^b[z|z \le \bar{z}(k)] + k \ge l\}(z+k)$$

$$+ (\mathbb{1}\{\mathbb{E}_1^b[z|z \le \bar{z}(k)] + k < l\}l \Big)$$
$$+ \mathbb{1}\{z > \bar{z}(k)\}\phi(\beta_b(k), \beta_p(z)) \Big((\mathbb{1}\{\mathbb{E}_1^b[z|z \le \bar{z}(k)] + k \ge l\}(z+k)$$
$$+ (\mathbb{1}\{\mathbb{E}_1^b[z|z \le \bar{z}(k)] + k < l\}l \Big) \Bigg) \frac{dz}{\zeta} \frac{dl}{\lambda} \frac{dk}{\kappa} \Bigg\}$$
$$= \max_{\bar{k},\beta_b} \Bigg\{ \int_{\bar{k}}^{\kappa} \beta_b(k) \Bigg[\frac{\bar{z}(k)}{\zeta} \left(\left(\frac{\bar{z}(k)}{2} + k \right)^2 + \frac{\lambda}{2} - 1 \right)$$
$$+ \frac{1}{2\lambda} \left(\frac{\bar{z}(k)+\zeta}{2} + k \right) \left(\int_{\bar{z}(k)}^{\zeta} \phi(\beta_b(k), \beta_p(z,k)) \left(2z - \left(\frac{\bar{z}(k)+\zeta}{2} \right) + k \right) \frac{dz}{\zeta} \right) \Bigg] \frac{dk}{\kappa} \Bigg\}$$

We define the profit on a loan to an entrepreneur with collateral k by:

$$W^b(\beta_b, k; \beta_p) := \beta_b \Bigg[\frac{\bar{z}(k)}{\zeta} \left(\left(\frac{\bar{z}(k)}{2} + k \right)^2 + \frac{\lambda}{2} - 1 \right)$$
$$+ \frac{1}{2\lambda} \left(\frac{\bar{z}(k)+\zeta}{2} + k \right) \left(\int_{\bar{z}(k)}^{\zeta} \phi(\beta_b(k), \beta_p(z,k)) \left(2z - \left(\frac{\bar{z}(k)+\zeta}{2} \right) + k \right) \frac{dz}{\zeta} \right) \Bigg]$$

So when the bank observes a project with collateral k, they decide whether to set $\beta_b(k) = 1$ to extract maximum rents from the market where they are a monopolist or set $\beta_b = \min_z\{\beta_p(z)\} - \epsilon$ to undercut the platform:

$$\beta_b(k) = \begin{cases} 1, & \text{if } W^b(1,k;\beta_p) > W^b(\min_z\{\beta_p(z)\} - \epsilon, k; \beta_p) \\ \min_z\{\beta_p(z)\} - \epsilon, & \text{otherwise} \end{cases}$$

and they finance the project if:

$$\iota_b = \mathbb{1}\{\max_{\beta_b} W^b(\beta_b, k; \beta_p) \ge 0\}$$

Platform problem: In response to bank policy $(\beta_b(k), \iota_b(k))$, the platform solves:

$$V^p(S,N) = \max_{\iota_p,\beta_p} \left\{ \int_0^\zeta \int_0^\kappa \left(\iota_p(z,k)(1-\phi(\beta_b(z,k),\beta_p(z,k)))(\mathbb{E}_0[\max\{z+k,l\}]-1) \right.\right.$$

$$+ (1-\beta_b(k))\Big(\mathbb{1}(z \le \bar{z}(k))(\max\{\mathbb{E}_1^b[z|z \le \bar{z}(k)]+k,l\}-1)$$

$$\left.\left. + \mathbb{1}(z > \bar{z}(k))(\phi(\beta_b(k),\beta_p(z,k))(\max\{\mathbb{E}_1^b[z|z > \bar{z}(k)]+k,l\}-1)\Big)\right)\frac{dk}{\kappa}\frac{dz}{\zeta}\right\}$$

$$= \max_{\iota_p,\beta_p} \left\{ \int_0^\zeta \int_0^\kappa \left(\iota_p(z,k)(1-\phi(\beta_b(z,k),\beta_p(z,k)))\left(\frac{(z+k)^2}{2\lambda}+\frac{\lambda}{2}-1\right) \right.\right.$$

$$+ (1-\beta_b(k))\left(\mathbb{1}(z \le \bar{z}(k))\left(\left(\frac{\bar{z}(k)}{2}+k\right)^2+\frac{\lambda}{2}-1\right)\right.$$

$$\left.\left.\left. + \mathbb{1}(z > \bar{z}(k))\phi(\beta_b(k),\beta_p(z,k))\left(\frac{1}{2\lambda}\left(\frac{\bar{z}(k)+\zeta}{2}+k\right)^2+\frac{\lambda}{2}-1\right)\right)\right)\frac{dk}{\kappa}\frac{dz}{\zeta}\right\}$$

The platform chooses to finance efficient projects:

$$\iota_p(z,k) = \mathbb{1}\{\mathbb{E}_0[\max\{z+k,l\}] \ge 1\} = \mathbb{1}\left\{\frac{(z+k)^2}{2\lambda}+\frac{\lambda}{2} \ge 1\right\}$$

Define the profit per contract by:

$$W^p(\beta_p,z,k) = (1-\phi(\beta_b(z,k),\beta_p(z,k)))\left(\frac{(z+k)^2}{2\lambda}+\frac{\lambda}{2}-1\right)$$

$$+ (1-\beta_b(k))\left(\mathbb{1}(z \le \bar{z}(k))\left(\left(\frac{\bar{z}(k)}{2}+k\right)^2+\frac{\lambda}{2}-1\right)\right.$$

$$\left. + \mathbb{1}(z > \bar{z}(k))\phi(\beta_b(k),\beta_p(z,k))\left(\frac{1}{2\lambda}\left(\frac{\bar{z}(k)+\zeta}{2}+k\right)^2+\frac{\lambda}{2}-1\right)\right)$$

They set a price:

$$\beta_b = \begin{cases} \beta_p - \epsilon, & \text{if } W^p(\beta_p-\epsilon,z,k) > W^b(\beta_p+\epsilon,z,k) \\ \beta_p+\epsilon, & \text{otherwise} \end{cases}$$

Equilibrium: Similar to the case with no information sharing, one Nash equilibrium is $(\beta(k), \beta(z, k)) = (1, 0)$. There there are also a continuum of other equilibria.