Lending Competition and Funding Collaboration

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Abstract

We examine competition and collaboration between banks and fintech firms in a market with adverse selection. Banks have cheaper funding, while fintechs have better screening technology. Our innovation is to allow the bank to lend to the fintech, i.e., to finance its competitors. This partnership lowers fintech funding costs and reduces bank competition incentives. Lenders collaborate when average borrower quality is low but compete when it's high. While partnership funding always benefits the fintech, it increases the bank's profits only when the average borrower quality is low and benefits the borrowers only when the average quality is high.

Keywords: fintech, lending competition, partnership funding, adverse selection, winner's curse, financial inclusion.

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1 Introduction

The rise of fintech lenders has posed serious challenges to traditional banks. According to Gopal and Schnabl (2022), the increased lending from fintechs has crowded lending by traditional banks after the 2008 financial crisis. Buchak et al. (2018) documented the increased market share of fintech lenders and, more broadly, shadow banks in the residential mortgage between 2007 and 2015. Recent evidence shows that fintech lenders receive abundant venture investments and finance themselves primarily with credit from banks (Puri et al., 2024; Jiang et al., 2020; Acharya et al., 2024). In fact, many of these lenders obtain funding from the *same* banks they compete with.[1] Why do banks finance and, therefore, collaborate with their competitors?

One answer is that these fintech lenders have superior lending technologies, and banks, by financing competitors, get to share the surplus created by these technologies.[2] Indeed, most fintech lenders describe their business models as relying on cutting-edge artificial intelligence and machine learning developments, which enable them to assess better small businesses' creditworthiness.[3] Yet, fintech firms are constrained by the higher funding costs of their primary owners, mostly venture capital firms, hedge funds, and wealthy individuals. By contrast, traditional banks have arguably cheaper funding due to reasons such as deposit insurance, implicit government guarantee, broad branch networks, and better diversification. Given the respective comparative advantage, it is natural for the two types of lenders to collaborate. However, it remains less clear when the two types of lenders compete and when they collaborate. Moreover, how does such collaborative partnership funding affect the borrowers' payoff, lenders' profits, and overall efficiency?

[1]In Appendix B, we describe the case of OnDeck – a top fintech lender – who joins forces with Utah-based Celtic Bank – a top ten SBA (Small Business Administration) lender – to provide loans to small businesses. Additional examples include Avant and WebBank, Greensky and Fifth Third Bank, Funding Circle and British Business Bank, and many others.

[2]There are also alternative explanations, such as regulatory arbitrage and/or convenience benefits, which we discuss formally later in the paper. See Section 6 for details.

[3]Berg et al. (2020) show that digital footprints can be informative in predicting consumer default in addition to traditional credit scores. Frost et al. (2019) show that machine learning and data from e-commerce platforms are better at predicting losses. Also see Gambacorta et al. (2020), Agarwal et al. (2020), Di Maggio et al. (2022).

This paper develops a model to study these questions, building upon the comparative advantages of banks (cheaper funding) and fintech firms (better screening technology). The lenders compete directly for borrowers under adverse selection, while fintech firms can also obtain bank funding. Our model highlights two important channels that arise from partnership funding. On the one hand, the reduced funding cost increases the fintech firm's competitiveness – competition channel. On the other hand, partnership funding offers the bank an alternative avenue to earn profits, reducing its incentives to compete in direct lending – collusion channel. The relative magnitudes of these channels depend on the degree of adverse selection, leading to different levels of collaboration and competition across markets. Partnership funding always benefits fintech firms but may reduce borrowers' payoff via the collusion channel or bank profits via the competition channel. We show that higher competition in the partnership funding market weakens the collusion channel. However, it could still hurt the borrowers due to increased adverse selection in the direct lending market. In contrast, restricting the fintech firms' ability to partner with their direct competitors while only allowing partnerships with third-party banks unambiguously increases borrowers' payoff.

Let us be more specific. We model borrowers with high or low-quality projects, where only high-quality projects have positive net present value (NPV). Banks have lower funding costs but cannot differentiate borrower types, while fintech firms have higher costs but possess screening technology.[4] Fintech's information advantage creates a winner's curse problem for banks. Whenever the bank wins the competition, it will likely lend to a low-quality borrower and suffer losses. Our model, therefore, resembles common-value auctions under asymmetric information (Milgrom and Weber, 1982) and their applications to bank lending (Broecker, 1990; Hauswald and Marquez, 2003), allowing for heterogeneous information technology (Von Thadden, 2004) and funding costs as in Dell'Ariccia and Marquez (2004). A main departure of our model is that we allow banks to lend to fintech firms, who can borrow a fraction of their funding to reduce costs. The presence of partnership funding enables both collaboration and competition for borrowers.

Our first result shows how collaboration and competition between lenders vary with borrower

[4]We assume only fintech firms have the screening ability to simplify the analysis. Our main results hold if banks can also screen, as long as fintechs maintain a relative information advantage.

pool quality. In low-quality pools, collaboration dominates: banks avoid direct lending due to likely losses, while fintechs' screening technology identifies rare high-quality borrowers. Banks make profits by offering partnership funding to fintechs. In high-quality pools, competition prevails: screening becomes less critical, and banks' funding advantage dominates. Banks lend to all borrowers, and fintech's presence forces lower rates. In intermediate-quality pools, competition and collaboration coexist as fintech information advantage and bank funding advantage are comparable, resulting in lending by both parties.

Our findings suggest fintech firms optimally target markets with moderate average borrower quality. Specifically, fintechs' profits exhibit a non-monotonic relationship with the average quality of the borrower pool. In low-quality pools, the scarcity of good borrowers limits lending volume and profitability. In high-quality pools, the intensified bank competition erodes fintech profit margins. Thus, fintech firms achieve the highest profitability in intermediate-quality markets.

Our second result examines the impact of partnership funding on equilibrium payoffs. Partnership funding always increases fintech profits via both competition and collusion channels. Somewhat surprisingly, partnership funding can reduce borrower and bank payoffs. The collusion channel dominates in low-quality markets with low competition: partnership funding increases bank profits but reduces borrower payoffs. In high-quality markets where competition is already high, the collusion channel is weak, and the competition channel dominates: it erodes bank profits but benefits borrowers through lower rates. These results imply that policymakers concerned with financial inclusion may have an opportunity to influence outcomes by regulating the partnership funding between banks and fintechs.

Our third result analyzes the lenders' incentives to establish partnership funding. We show that the fintech firm prefers to receive partnership funding from its direct competitor to benefit from softer competition generated by the collusion channel. At the same time, a competitor bank strictly prefers to provide partnership funding to its competitor instead of allowing the fintech to borrow from a third-party bank. As a result, partnership funding between direct competitors arises endogenously. We also find that, due to higher profits from partnership funding, banks might be better off competing against fintech firms with better screening technology despite facing stronger adverse selection.

Finally, we consider two alternative ways of improving borrowers' surplus. We show that stronger competition in the partnership funding market, while weakening the collusion channel, might nevertheless hurt borrowers in some markets. Stronger competition in the partnership funding market reduces fintech's funding cost. But more aggressive bidding by the privately informed fintech creates a stronger winner's curse for bank lending. In markets where adverse selection is severe, the bank reduces direct lending volume and raises interest rates. As a result, the borrowers might receive lower payoffs despite the increased competitiveness of partnership funding. In contrast, a shift in the source of the partnership funding away from a competing bank to a third-party bank without changing the degree of funding market competitiveness unambiguously increases borrowers' surplus. Such a shift eliminates the collusion channel without affecting the degree of adverse selection in the direct lending market.

The rest of the paper is organized as follows: Section 2 describes the model setup, Section 3 characterizes equilibrium, Section 4 highlights the effects of partnership funding on equilibrium outcomes, Section 5 extends the baseline model and discusses robustness of the main results, Section 6 provides broader discussion and places the paper in the literature, and Section 7 concludes.

2 The Model

We introduce a model with two dates $t = 0, 1$ and three sets of players. All players are risk-neutral, have limited liabilities, and do not discount the future. One bank and one fintech firm compete to lend to borrowers while also potentially engaging in partnership funding. Figure 1 illustrates the model structure.

2.1 Borrowers and Projects

We model a continuum $i \in [0, 1]$ of penniless borrowers of two types: high and low. The borrower's type is private information only known by the borrower herself. Let μ be the fraction

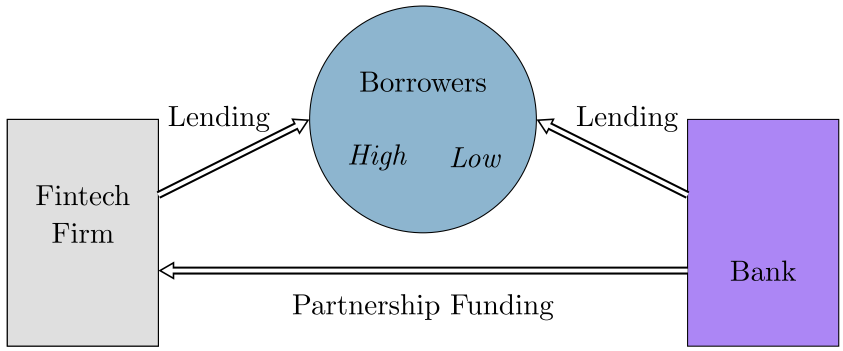

Figure 1: Model Overview

of high-type borrowers. Each borrower is infinitesimal and has access to a fixed-scale investment technology that requires \$1 at $t = 0$. Once the investment is made, the project generates R with probability p_{θ_i} and 0 with probability $1 - p_{\theta_i}$, where $\theta_i \in \{h, l\}$ stands for the borrower's type. For the rest of the paper, we assume without loss of generality that $p_h = 1$ and $p_l = p \in (0, 1)$. In our model, borrowers shall be interpreted as either small businesses or consumers who seek personal loans.

2.2 Lenders, Partnership Funding, and Screening

One bank and one fintech firm compete to lend to borrowers. To raise \$1, the bank needs to pay a gross interest payment r_B to its financiers, whereas the fintech firm needs to pay a total cost of r_F. We assume $r_F > r_B \geq 1$ to reflect the bank has a funding advantage due to factors like deposit insurance and government guarantees.

Even though the fintech firm has a funding disadvantage, it can borrow from the bank to (partially) offset the disadvantage. Specifically, the fintech firm can borrow a fraction $\lambda \leq 1$[5] of its funding from the bank and finance the remaining $1 - \lambda$ using its own funding. This fraction can be motivated in various ways, such as inter-bank relationship development, search friction, or agency frictions that require the fintech firm to have enough skin in the game. Let α and $1 - \alpha$ be the

[5]In the baseline model, we treat λ as an exogenous parameter. However, in Section 4.1, we characterize optimal λ from the point of view of each market participant.

bargaining power of the fintech firm and the bank.

Whereas the bank has a funding advantage, the fintech firm has a better screening technology. Specifically, we assume the bank can not screen any borrower, whereas the fintech firm has a costless screening technology. In particular, the technology generates a private signal on each borrower, either good g or bad b (we assume that the signals are *i.i.d.* across borrowers). For the baseline analysis, we assume that screening generates a perfect signal.[6] Moreover, for notational convenience, we define

$$P(\tilde{\mu}) = \tilde{\mu} + (1 - \tilde{\mu})p, \ \forall\tilde{\mu} \tag{1}$$

as the conditional probability of producing R if the average quality is $\tilde{\mu}$. We introduce the following assumption, which implies that for both lenders, a borrower's project has a positive NPV under a good signal but has a negative NPV under a bad signal.

Assumption 1. *The funding costs satisfy*

$$r_F < R, \ r_B > p \cdot R. \tag{2}$$

2.3 Timing and Equilibrium

The timing goes as follows.

- $t = 0$
  - The fintech firm screens borrowers, then both lenders simultaneously make interest rate offers which borrowers accept or reject.
  - The partnership funding market opens, and the fintech firm can borrow a maximum fraction of λ of its funding from the bank.[7]

[6] Section 4.2 shows that results are robust when screening is subject to type-I or type-II error.

[7] In Online Appendix C.6 , we solve a version of the model where the partnership funding market opens prior to the lending competition. We show that the equilibrium identified later is robust to such an alternative timing arrangement. One notable difference is that with ex-ante bargaining the bank chooses not to establish partnership funding in markets with high average quality of the borrowers. The ability to commit not to partner with the fintech reduces the strength of the competitive force generated by the partnership funding.

- $t = 1$
  - The project's outcome is realized. The borrower repays the loan, and the fintech firm repays the partnership funding.

There are no active decisions to be made at $t = 1$. At $t = 0$, the result in the funding market is straightforward. Let ℓ_F and ℓ_B be the lending volume extended by the fintech firm and the bank at the lending stage. Since the partnership market operates after the lending market, the lending decisions at this point are sunk. The partnership funding determines only the funding source for the ℓ_F loans that the fintech has extended to borrowers.

For each \$1 loan extended by the fintech, the partnership funding generates a surplus of $\lambda(r_F - r_B) > 0$. Hence, the lenders always choose to partner whenever $\ell_F > 0$. According to Nash Bargaining, this surplus is split via a partnership funding rate $\rho = \alpha r_B + (1-\alpha) r_F$. As a result, the fintech firm borrows $\lambda \ell_F$ from the bank at the rate ρ and finances the remaining $(1-\lambda)\ell_F$ using its own funding. Let us define

$$r_E = \lambda\rho + (1-\alpha) r_F = \lambda\alpha r_B + (1 - \lambda\alpha) r_F \tag{3}$$

as the effective funding cost of the fintech firm. For each \$1 loan made by the fintech firm, the bank makes expected profits

$$\Pi_B = \lambda(\rho - r_B) = \lambda(1-\alpha)(r_F - r_B) \tag{4}$$

through partnership funding.

Let R_B and R_F be the gross interest rate offer made to the borrower by the bank and the fintech firm, respectively. Clearly, $R_B \in [0, R] \cup \{+\infty\}$, $R_F \in [0, R] \cup \{+\infty\}$, and both offers can be stochastic[8]. When $R_F \to +\infty$ ($R_B \to +\infty$), the fintech firm (bank) does not make an offer. As a result, it is convenient to define the cumulative distribution functions (CDFs) $F_B(\cdot)$ and $F_F(\cdot)$

[8] When the bank (or fintech firm) offer is stochastic, each borrower i receives an $i.i.d.$ realization $R_B(i)$ (or $R_F(i)$) from the offer distribution. This result allows us to use the exact law of large numbers in the cross-section of borrowers and obtain bank profits, borrower surplus, and welfare that are deterministic.

to be the strategies of the bank and fintech firm. The borrower's decision is straightforward: she should accept the offer with the lower interest rate. For simplicity, we assume whenever there is a tie, the borrower opts to accept the offer from the bank. This assumption can be motivated by the other non-pecuniary services offered by the bank, and it is made without loss of generality. Results are unchanged under alternative tie-breaking rules (see Remark 1).

Let $\tilde{V}_B(i)$ and $\tilde{V}_F(i)$ be bank's and fintech firm's the expected payoff from lending to an individual borrower $i \in [0,1]$. We have

$$\tilde{V}_F(i) = \mathbb{1}_{R_B(i)>R_F(i)} \cdot \Big[(p + (1-p)\mathbb{1}_{\theta_i=h})R_F - r_E\Big] \tag{5}$$

$$\tilde{V}_B(i) = \mathbb{1}_{R_B(i)\leq R_F(i)} \cdot \Big[(p + (1-p)\mathbb{1}_{\theta_i=h})R_B - r_B\Big]. \tag{6}$$

Let us define V_B and V_F as the bank's and fintech firm's profits from lending to borrowers. Aggregating across all borrowers, we have

$$V_J = \int_0^1 \tilde{V}_J(i)di, \text{ and} \qquad \ell_J = \int_0^1 \mathbb{1}_{R_J(i)>R_{J'}(i)}di \qquad \text{for } J \neq J' \in \{F, B\}.$$

We look for a Bayesian Nash Equilibrium, where the fintech firm's interest rate offer $R_F \sim F_F(\cdot)$ maximizes V_F and the bank's interest rate offer $R_B \sim F_B(\cdot)$ maximizes $V_B + \ell_F \Pi_B$. In particular, (5) shows that while making the interest offer, the fintech firm takes into account that it has an effective rate of r_E instead of r_F. Meanwhile, the bank also takes into account that if it loses borrowers to the fintech firm, it still profits from lending to the fintech firm through offering partnership funding. Therefore, it aims to maximize $V_B + \ell_F \Pi_B$.

2.4 Modeling Discussion

Modeling choice behind partnership funding. The partnership funding market is modeled as a Nash-bargaining game between the fintech firm and the bank to study different degrees of interbank funding competition by varying the bargaining power. Moreover, it offers a way to split the surplus between the two parties and determines the interest rates in the partnership funding. We analyze competition in the partnership funding market in Section 4.4.

Merger and firm boundary. Note that we have taken the structure of financial intermediation as given. While the two lenders could potentially merge to combine their advantages, several factors prevent this outcome. Beyond organizational frictions and regulatory constraints, the inalienability of human capital might also play a crucial role. The fintech's value largely stems from intangible assets like algorithms and machine learning expertise, which rely on specific human capital that could leave post the merger. This makes bank acquisition of fintechs challenging. Though a deeper analysis of optimal bank boundaries lies beyond our scope, we discuss why the lenders do not always collude in Section 6.1.

3 Solution

3.1 Competition and Collaboration

Let us start by putting a lower bound on the bank's payoff and, therefore, its interest-rate bid in the lending competition. When the bank does not make an offer (equivalently $R_B \to +\infty$), the fintech firm lends to the borrower with probability μ, that is, when the realized signal from screening is good. Subsequently, the bank's expected profit from partnership funding is $\mu\Pi_B$, where Π_B has been defined in (4). Meanwhile, by offering an interest rate R_B and winning the lending competition, the bank's expected profits are at most $P(\mu)R_B - r_B$, where $P(\mu)$ defined in (1) is the probability that the representative borrower will repay the loan. Whenever a bank makes a potentially winning bid in the lending competition, it must be that

$$P(\mu)R_B - r_B \geq \mu\Pi_B \Rightarrow R_B \geq \underline{R}_B := \frac{r_B + \mu\Pi_B}{P(\mu)} \tag{7}$$

Depending on the parameters, $\underline{R}_B$ may be greater or less than R. For the rest of this paper, we refer to $\underline{R}_B$ as the bank's *curse-free bid* because it is the lowest bid by the bank, if there is no winner's curse effect.

Similarly, there is a lower bound on the fintech firm's bid in the lending competition. Clearly, a fintech firm may only bid after it has received a good signal about the borrower. An offer R_F generates expected profits $R_F - r_E$. Meanwhile, the fintech firm receives zero by not making an offer (or equivalently, $R_F \to +\infty$). Therefore, R_F must satisfy

$$1 \cdot R_F - r_E \geq 0 \Rightarrow R_F \geq \underline{R}_F := \frac{r_E}{1} = r_E. \tag{8}$$

Clearly, $\underline{R}_F < R$ follows from Assumption 1 and $r_E < r_F$. For the rest of this paper, we refer to $\underline{R}_F$ as the fintech firm's *break-even bid*.

A comparison between $\underline{R}_B$ and $\underline{R}_F$ highlights the relative advantages of the bank and the fintech firm. Comparing the denominators, $P(\mu) < 1$ reflects the fintech firm's information advantage. Comparing the numerators, $r_B < r_E$ captures the bank's funding advantage, and a lower r_B further increases the advantage. Finally, the term $\mu\Pi_B$ captures the bank's potential partnership funding profits, which are the profits if the fintech firm manages to lend to all borrowers with a good signal (so $\ell_F = \mu$).

The equilibrium outcome depends on the comparison between $\underline{R}_B$ and $\underline{R}_F$. Let us elaborate.

Case 1 $\underline{R}_B \leq \underline{R}_F$: dominating funding cost advantage

Knowing that the fintech firm's bid always exceeds $\underline{R}_F$, the bank would never make any bid $R_B < \underline{R}_F$. Interestingly, the bank would never make an interest-rate offer strictly above $\underline{R}_F$, either. This is because the bank is able and has the willingness to avoid the winner's curse effect when its funding advantage dominates the informational disadvantage.

Lemma 1. *If $\underline{R}_B \leq \underline{R}_F$, the bank offers an interest rate $\underline{R}_F$ and lends with probability* 1.

Given Lemma 1, the bank adopts a pure strategy by offering an interest rate $\underline{R}_F$ and always wins over the borrower. The fintech firm, even though it never wins the lending competition, must also offer an interest rate on $[\underline{R}_F, R]$. This offer deters the bank from deviating and charging an interest rate higher than $\underline{R}_F$, and the distribution of this offer is not uniquely determined.

Case 2 $\underline{R}_F < \underline{R}_B < R$: comparable funding and information advantage

Knowing that the bank's bid always exceeds $\underline{R}_B$, the fintech firm would never make any bid $R_F < \underline{R}_B$. In this case, the bank inevitably faces the winner's curse. In contrast to the previous case, both lenders must adopt mixed strategies in equilibrium.[9] Lemma A.1 in the appendix rules out the case that the bank can offer an interest rate with a positive probability mass. Therefore, in equilibrium, the bank must adopt a mixed strategy. The only way such mixing by the bank can be incentive compatible is that the fintech firm also randomizes its bid on the same interval. Our next result shows that the mixed strategies must have a continuous CDF on the interval $[\underline{R}_B, R]$.

Lemma 2. *If $\underline{R}_F < \underline{R}_B < R$, both the bank and the fintech firm adopt mixed strategies with a probability density on $[\underline{R}_B, R]$. The fintech firm must offer R with a positive probability mass.*

Given the structure of the equilibrium, the CDFs of the interest rate offers can be uniquely determined by the opposite player's indifference condition. The bank's bidding CDF F_B makes the fintech firm indifferent between bidding $\underline{R}_B$ and winning almost for sure, and bidding $\tilde{R} \in [\underline{R}_B, R]$ and winning with probability $1 - F_B(\tilde{R})$:

$$\underline{R}_B - r_E = \left(1 - F_B(\tilde{R})\right)(\tilde{R} - r_E). \tag{9}$$

With a mass probability $1 - F_B(R) > 0$, the bank does not bid.

While the fintech's bidding CDF F_F makes the bank indifferent between not bidding at all and collecting profits $\mu\Pi_B$ from the partnership funding market, and bidding any $\tilde{R} \in [\underline{R}_B, R]$. As a result, $\forall \tilde{R} \in [\underline{R}_B, R)$

$$\mu\Pi_B = (1-\mu)\left(p\tilde{R} - r_B\right) + \mu\left[F_F(\tilde{R})\Pi_B + \left(1 - F_F(\tilde{R})\right)\left(\tilde{R} - r_B\right)\right]. \tag{10}$$

With a mass probability $1 - F_F(R) > 0$, the fintech firm bids R.[10]

Case 3 $\underline{R}_F < R < \underline{R}_B$: dominating information advantage

In this remaining case, the bank strictly prefers to lose the bidding game even with the highest feasible interest rate R. As a result, the bank does not participate in the lending competition, and the fintech firm always offers R to a good-signal borrower and nothing to a bad-signal one.

[9] Mixed strategy equilibrium is not unique to our setting. It is a standard feature of settings with common values and asymmetrically informed bidders, e.g., Broecker (1990), Hauswald and Marquez (2003), Von Thadden (2004).

[10] Both numerator and denominator in (10) are negative since $\mu\Pi_B - (P(\mu)\tilde{R} - r_B) < 0$, $\forall \tilde{R} > \underline{R}_B$ and is a stronger condition than $\Pi_B - (\tilde{R} - r_B) < 0$.

Results Summary

Note that the comparison among $\underline{R}_F$, $\underline{R}_B$, and R depends on μ. Given that $\underline{R}_B$ decreases with μ,[11] let us define

$$\bar{\mu} \equiv \frac{(1-\lambda\alpha p)r_B - p(1-\lambda\alpha)r_F}{\lambda(1-\alpha p)r_B + [(1-p) - \lambda(1-\alpha p)]r_F}$$
$$\underline{\mu} \equiv \frac{r_B - pR}{(1-p)R - \lambda(1-\alpha)(r_F - r_B)}.$$

Under Assumption 1, it is clear that $0 < \underline{\mu} < \bar{\mu} \leq 1$. Simple derivations show that $\underline{R}_B \leq \underline{R}_F$ for $\mu > \bar{\mu}$, $\underline{R}_F < \underline{R}_B < R$ for $\mu \in (\underline{\mu}, \bar{\mu})$, and $\underline{R}_F < R \leq \underline{R}_B$ for $\mu \leq \underline{\mu}$. Given this result, we summarize the preceding discussion below.

Proposition 1 (Equilibrium Lending Competition and Funding Collaboration)**.** *The lending bidding game has an essentially unique equilibrium.*

1. *Collaboration: for $\mu \in [0, \underline{\mu}]$, the bank never bids, and the fintech firm lends to a good-signal borrower at a rate R and does not lend to a bad-signal borrower.*

2. *Collaboration/Competition: for $\mu \in (\underline{\mu}, \bar{\mu})$, the bank randomizes between the bids in $[\underline{R}_B, R]$ with CDF F_B characterized by (9). With probability $1 - F_B(R)$, the bank does not bid at all. The fintech firm's bid distribution on $[\underline{R}_B, R)$ follows F_F characterized by (10). With a mass probability $1 - F_F(R)$, the fintech firm bids R.*

3. *Competition: for $\mu \in [\bar{\mu}, 1]$, the bank bids $\underline{R}_F$ and lends to all borrowers with probability 1.*

Proposition 1 shows how equilibrium outcomes vary with borrower pool quality. For low quality ($\mu < \underline{\mu}$), the bank does not participate in the lending competition, and the fintech firm charges R after observing good signals. Three factors affect this decision: (a) the low quality of the pool implies that lending blindly to an average borrower is not very profitable, to begin with, (b) the

[11] We can show $\frac{dR_B}{d\mu}$ is proportional to

$$p(1-\alpha)\lambda(r_F - r_B) - (1-p)r_B < p(R - r_B) - (1-p)r_B = pR - r_B < 0.$$

winner's curse effect implies that the pool of borrowers attracted to the bank's offer is even worse than the average, further reducing potential profits from lending, and finally (c) the option to lend to the borrowers indirectly through the partnership funding market crowds out the incentives to participate in the lending competition.

For high quality ($\mu > \bar{\mu}$), banks' funding advantage dominates fintech's information advantage. In equilibrium, the bank always outbids the fintech firm in equilibrium and provides lending. Although the fintech firm does not lend, its presence prevents the bank from acting like a monopolist, introducing competition.

Finally, in the intermediate region ($\underline{\mu} < \mu < \bar{\mu}$), the information advantage of the fintech firm and the funding cost advantage of the bank are comparable. In this case, both institutions lend in equilibrium. Therefore, Proposition 1 implies that the competition between the bank and the fintech firm should only be observed by an econometrician in borrower pools whose average quality is neither too high nor too low. The bank retreats from borrower pools with low average quality, whereas the fintech firm retreats from those with high average quality.

3.2 Payoffs and Efficiency

The first-best benchmark entails banks funding only high-quality borrowers, with no funding for low-quality ones. Our equilibrium, therefore, introduces two types of inefficiency: funding inefficiency, arising from costly fintech lending, and lending inefficiency, resulting from banks' blind lending to negative NPV projects. This subsection describes the equilibrium payoff and the associated efficiencies.

When the average quality of the pool is very low $\mu < \underline{\mu}$, the fintech firm is effectively a monopolist and lends at an interest rate R after receiving a good signal. Therefore, a mass μ of all borrowers can receive funding, and all borrowers receive a zero payoff. The fintech firm makes expected profits

$$V_F = \mu \cdot (R - r_E) \,,$$

and the bank earns partnership funding profits $\mu\Pi_B$. Therefore, the (equal-weighted) total welfare is

$$W = \mu\Pi_B + \mu \cdot (R - r_E) = \mu \cdot (R - (1-\lambda)r_F - \lambda r_B)\,. \tag{11}$$

Equation (11) shows that in this region, the welfare loss is driven by the funding inefficiency, i.e., the fact that the fintech firm must finance a fraction $1-\lambda$ of its loans using its own funding, which is more costly.

When the average quality of the pool is very high $\mu > \bar{\mu}$, the bank always wins by bidding $\underline{R}_F$. In this case, the fintech firm makes zero profit, whereas a borrower of type $\theta_i \in \{h, l\}$ receives a payoff $p_{\theta_i}(R - \underline{R}_F)$. The bank receives no profits from partnership funding but earns $P(\mu)\underline{R}_F - r_B$ from directly lending to the borrowers. The resulting (equal-weighted) welfare is

$$W = P(\mu)R - r_B. \tag{12}$$

Equation (12) shows that in this region, the welfare loss is driven by lending inefficiency, i.e., low-type borrowers also receive funding.

In the intermediate region $\underline{\mu} < \mu < \bar{\mu}$, both the bank and the fintech firm actively bid and win with positive probabilities. A borrower with a good signal can always receive financing and therefore receives a payoff $V_H = \int_{\underline{R}_B}^{R}(R-\tilde{R})d\left(1-(1-F_B(\tilde{R}))\cdot(1-F_F(\tilde{R}))\right)$.[12] By contrast, a borrower with a bad signal can only be financed by the bank, so that the expected payoff is $V_L = \int_{\underline{R}_B}^{R}(R-\tilde{R})dF_B(\tilde{R})$. Under the mixed strategies, the fintech's profit must be the same as the one when it bids $\tilde{R}_F = \underline{R}_B$ and always wins:

$$V_F = \mu\Big(\underline{R}_B - r_E\Big) \tag{13}$$

Similarly, the bank's total profit must be $\mu \cdot \Pi_B$, the same as the one when it only receives profit from partnership funding. Summing up, we get the (equal-weighted) total welfare

$$W = \mu\left[R - (\lambda r_B + (1-\lambda)r_F)\int_{\underline{R}_B}^{R}\Big(1 - F_B(\tilde{R}_F)\Big)\,dF_F(\tilde{R}_F) - r_B\int_{\underline{R}_B}^{R}F_B(\tilde{R_F})dF_F(\tilde{R}_F)\right] + (1-\mu)F_B(R)(pR - r_B). \tag{14}$$

[12]Since CDF for $\Pr(\min\{R_F, R_B\} \le \tilde{R}) = 1-(1-F_F(\tilde{R}))(1-F_B(\tilde{R}))$.

The next proposition describes how equilibrium objects, bank profits, partnership funding profits, borrower and total welfare vary with the average quality of the borrower pool μ.

Proposition 2. *The bank's total profit strictly increases in μ. By contrast, the fintech firm's profit is non-monotonic in μ: it increases for $\mu < \underline{\mu}$ and decreases as μ approaches $\bar{\mu}$. The payoff of both high- and low-type borrowers increases in μ.*

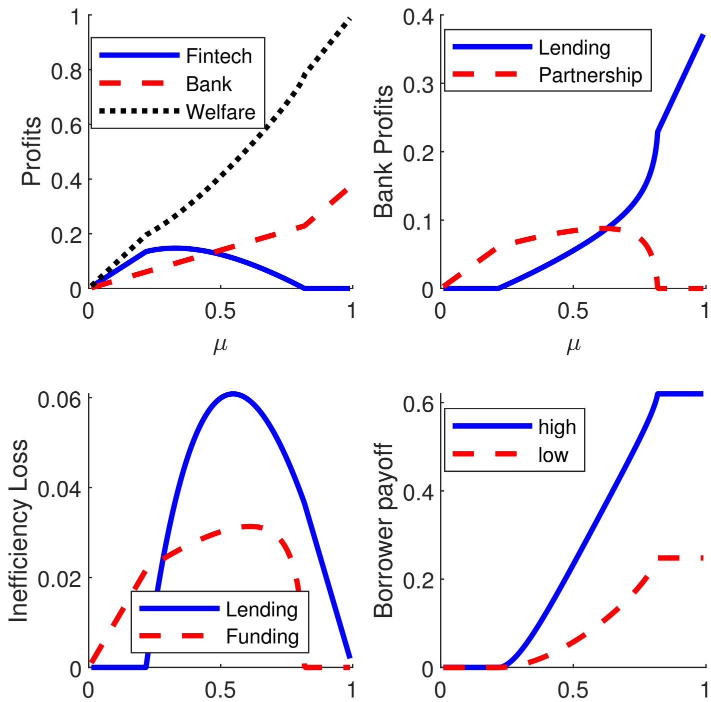

Figure 2: Profits, Welfare, and Lending under Different μ

This figure describes the equilibrium profits and welfare when the average quality of the borrower pool μ varies. The left panel plots the profits and welfare, and the right panel decomposes the bank profits into direct lending and partnership funding. The parameters in this figure are as follows: $R = 2.0$, $p = 0.1$, $r_F = 1.5$, $r_B = 1.0$, $\lambda = 0.8$, $\alpha = 0.2$.

Figure 2 plots the profits and welfare when the average quality of the borrower pool varies. The top-left panel describes the profits of the bank and the fintech firm, as well as the total welfare.

There are a few interesting observations. First, the fintech firm's profits are non-monotonic in μ: it increases for $\mu < \underline{\mu}$; for $\mu \in [\underline{\mu}, \bar{\mu}]$, it could also be non-monotonic. Intuitively, this result holds because for $\mu < \underline{\mu}$, there is no competition, and, as a result, the fintech firm is a monopoly. An increase in μ results in the fintech firm lending to and profiting from a larger pool of high-type borrowers. By contrast, for $\mu \in [\underline{\mu}, \bar{\mu}]$, there are both competition and collaboration. A higher μ in general leads to more high-type borrowers, which increases the fintech firm's potential profits. Meanwhile, a higher μ intensifies the bank's competition, which reduces the fintech firm's per-borrower profits $\underline{R}_B - r_E$. Combining these effects, the overall profits $(\mu(\underline{R}_B - r_E))$ can be non-monotonic in μ.[13] Finally, when μ rises above $\bar{\mu}$, the fintech firm completely retreats from lending and therefore makes zero profits. By contrast, the bank's total profits always increase in μ, and the slope becomes even higher for $\mu > \bar{\mu}$.

The top-right panel of Figure 2 decomposes the bank's total profits into direct lending and partnership funding. Whereas the profits from direct lending increase in μ, the profits from partnership funding are, again, non-monotonic in μ. This is because the bank's profits from partnership funding depend on the fintech's lending volume. When μ goes up, there are more high types, but the fintech also faces more lending competition.

The bottom-left panel decomposes welfare losses into lending and funding inefficiency. The red line measures funding inefficiency, defined as the equilibrium amount of fintech firm lending times $(1 - \lambda) \cdot (r_F - r_B)$. The blue line measures lending inefficiency, defined as the probability of low types being financed times $r_B - pR$. Clearly, both inefficiencies are non-monotonic in μ. On one hand, a higher μ means that the fraction of low-type borrowers gets lower. On the other hand, a higher μ increases lending competition by banks, which results in a higher probability that low types get financed. Finally, as illustrated in the bottom-right panel, the borrower's payoff increases

[13] In our model with binary borrower types, the parameter μ simultaneously represents both the mean and variance of the borrower quality distribution. The fact that payoffs do not peak when either $\mu = 0.5$ (where variance in type $\mu(1-\mu)$ is highest) or $\mu = \frac{1-2p}{2(1-p)}$ (where variance in project outcome $(\mu + (1-\mu)p)\,((1-\mu)(1-p))$ is highest) indicates that our results are not solely driven by changes in variance, but also by changes in the average borrower quality.

in μ, and the high-type borrower receives a higher payoff than a low-type borrower.

4 Implications of Partnership Funding

This section explores the effects of partnership funding. Our analysis reveals several findings. In subsection 4.1, we show that partnership funding always benefits the fintech. At the same time, borrowers and the bank can be either better off or worse off.[14] As a result, the socially optimal size of partnership funding depends on the Pareto weights of the different parties.

In the baseline model, we assume that the fintech's screening technology is perfect. Subsection 4.2 introduces both type-I and type-II errors and studies how each interacts with partnership funding. Results show that with partnership funding, type-I errors reduce profits for both lenders, while type-II errors reduce the fintech's but increase total bank profits.

Next, we examine the incentives to provide partnership funding. Subsection 4.3 shows that borrower welfare improves when partnership funding comes from a third-party bank not involved in direct lending. However, both the fintech and the competing bank prefer direct partnership arrangements between themselves rather than involving third parties. Finally, in subsection 4.4, we find that increased competition in partnership funding might counterintuitively harm borrowers.

4.1 Who Benefits from Partnership Funding

In this subsection, we explore the effect of the partnership funding between the bank and the fintech firm on the payoffs of market participants. Somewhat surprisingly, introducing partnership funding can make the borrowers or the bank worse off. We consider the two corner cases $\lambda \in \{0, 1\}$, corresponding to the situations without and with partnership funding.[15]

Proposition 3 (The Effect of Partnership Funding)**.**

1. *A type-θ borrower is better off with the partnership funding if and only if $\mu \geq \mu_\theta^*$;*

[14] The result that the bank could be worse off with partnership funding depends on the bank's lack of commitment to extend partnership funding to the fintech.

[15] In Appendix A.3 we show how a local increase in λ affects the payoff in a given market.

2. The fintech firm always receives more profits with the partnership funding;

3. The bank receives more profits with the partnership funding if and only if $\mu < \mu_B^*$;

where the thresholds μ_θ^* and μ_B^* are defined in equations (A.7) and (A.13) of Appendix.

In general, the presence of partnership funding introduces two channels. On the one hand, it reduces the fintech firm's funding cost so that it can better compete with the bank. Competition allows the lower funding cost to be passed on to borrowers. We refer to this channel as the *competition channel* for the rest of the paper. On the other hand, partnership funding allows the bank to make profits when it loses the borrower to the fintech: when the bank receives profits from partnership funding, it has lower incentives to compete with the fintech firm in the direct lending market. We refer to this channel as the *collusion channel* for the rest of the paper. Proposition 3 shows that the strength of these two channels depends on the average quality of borrowers in the market. When μ is low, there is not much competition, and the collusion channel dominates. A higher λ increases the bank's profits and reduces the borrower's payoff. By contrast, the competition channel dominates when μ is very high. The partnership funding passes through the fintech's lower funding cost, which benefits the borrower but reduces the bank's profits.

The results of Proposition 3 are illustrated in Figure 3. The top-left panel compares a high-type borrower's payoff with and without partnership funding. Results are similar for a low-type borrower. Partnership funding benefits borrowers in a high μ pool more than borrowers in a low μ pool. The top-right panel compares the fintech firm's profits. Unsurprisingly, the fintech firm is always better off with the partnership. Intuitively, both channels favor the fintech firm: the lower funding cost allows it to compete more aggressively, and the partnership funding reduces the competition from the bank. Therefore, the fintech firm is better off for any μ. Turning to the bottom-left panel. Interestingly, the bank receives higher (lower) profits with partnership funding when μ is low (high) due to the relative magnitude of the competition and the collusion channel. Finally, the bottom-right panel compares the total inefficiencies, i.e., the sum of lending and funding inefficiencies. The result is intuitive: under $\lambda = 1$, partnership funding eliminates funding inefficiency and mitigates lending inefficiency. Therefore, it leads to a lower level of total inefficiencies.

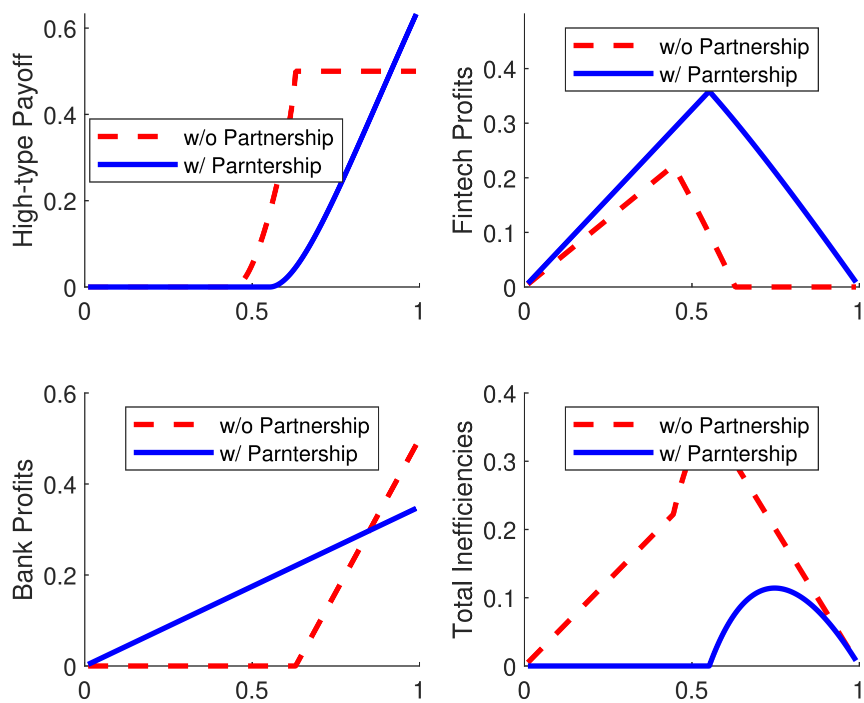

Figure 3: Profits and Welfare with and without partnership funding

This figure describes the equilibrium profits and welfare with and without partnership funding when the average quality of the borrower pool μ varies. The left panel plots the profits and welfare, and the right panel decomposes the bank profits into direct lending and partnership funding. The parameters in this figure are as follows: $R = 2.0$, $p = 0.1$, $r_F = 1.5$, $r_B = 1.0$, $\alpha = 0.2$. $\lambda = 1$ and $\lambda = 0$ respectively stand for with and without partnership funding.

The next result shows how partnership funding affects the equilibrium thresholds $\underline{\mu}$ and $\bar{\mu}$ that determine the regions of competition and collaboration.

Corollary 1. *Equilibrium cutoffs $\underline{\mu}$ and $\bar{\mu}$ are increasing in the fraction of funds λ provided via the partnership funding. When $\lambda = 1$, $\bar{\mu} = 1$ and the competition region disappears.*

An increase in the fraction of funds λ provided via partnership funding strengthens competition and collusion channels at the same time. A stronger collusion channel increases the collaboration region $[0, \underline{\mu}]$. The region of bank dominance $[\bar{\mu}, 1]$ shrinks due to both more aggressive bidding by the fintech (competition channel) and voluntary retreat of the bank (collusion channel).

Optimal Size of Partnership Funding

We conclude this subsection by examining market participants' preferences for different partnership funding arrangements. Figure 4 illustrates each party's optimal funding size depending on the average quality of the borrower pool μ. Formal proofs and derivations are in Appendix A.3.

The fintech firm always prefers $\lambda = 1$ as this reduces both its effective funding costs and bank competition. For the bank, there exists a threshold μ_B^o such that it prefers $\lambda = 1$ when $\mu < \mu_B^o$ and $\lambda = 0$ otherwise. This result reflects the relative strength of the collusion and competition channels across different borrower pools. When μ is low, the collusion channel dominates, and the bank's profits primarily derive from partnership funding, so it prefers to lend as much as possible to the fintech firm. By contrast, when μ is high, the competition channel dominates, and the bank's profits mainly come from direct lending.

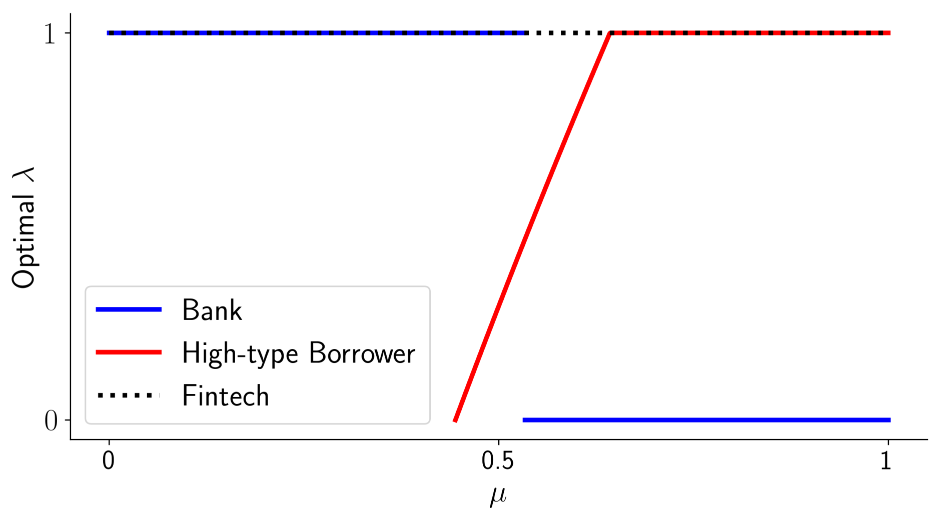

Figure 4: Optimal Size of Partnership Funding

High-type borrowers prefer $\lambda = 1$ when μ is high because partnership funding increases competition and forces the bank to reduce its equilibrium interest rate. In the intermediate region, high-type borrowers prefer an interior solution for λ. This intermediate level of partnership funding balances the competition and collusion forces: a lower λ weakens the competition channel, allowing the bank to charge a higher interest rate, while a higher λ increases the bank's collusion incentives, resulting in the higher equilibrium interest rate. Finally, when μ is low, this borrower always receives a payoff of zero and, therefore, is indifferent to the choice of λ.

4.2 Screening Technology and Partnership Funding

We now consider the model in which the fintech firm's screening technology is subject to errors

$$\Pr(b|h) = e_1, \qquad \Pr(g|l) = e_2, \tag{15}$$

where e_1 and e_2 are the probability of a type-I and type-II error, respectively. Let q_g (q_b) be the total measure of borrowers who receive a good (bad) signal. Following the law of large numbers,

$$q_g = \mu(1 - e_1) + (1 - \mu)e_2, \qquad q_b = \mu e_1 + (1 - \mu)(1 - e_2). \tag{16}$$

Conditional on a good/bad signal, the fintech firm's posterior of a borrower being a high type is

$$\mu_g = \frac{\mu\,(1 - e_1)}{q_g}, \qquad \mu_b = \frac{\mu e_1}{q_b}. \tag{17}$$

We assume $e_1 + e_2 < 1$ so that $\mu_b < \mu < \mu_g$. In addition, we modify Assumption 1 to $r_F < P(\mu_g) \cdot R$ and $r_B > P(\mu_b) \cdot R$.

Appendix A.4 solves the model, and we briefly discuss the results here. The equilibrium structure characterized in our baseline model—with collaboration, competition, and mixed regions—remains robust and can still be characterized by two thresholds in μ. However, the two types of errors have different implications for lender profits. Type-I errors (missing high-quality borrowers) reduce bank and fintech profits by decreasing the volume of good signals and lending opportunities. By contrast, type-II errors (misclassifying low-quality borrowers as high-quality) increase bank profits while reducing fintech profits. This asymmetric impact occurs because type-II errors diminish the fintech's information advantage while potentially increasing lending volume, benefiting banks through both direct lending and partnership funding.

Without partnership funding, screening errors only directly affect lending through signal quality. However, partnership funding creates an additional mechanism: type-I errors reduce the potential partnership funding size and increase bank competition incentives, while type-II errors have the opposite effect. This interaction between screening error and partnership funding represents a novel channel through which information technology affects market structure, different from traditional models of lending competition under asymmetric information.

4.3 Who Provides Partnership Funding

Next, we show that the effect of partnership funding on the equilibrium in the lending market depends on the source of the partnership funding. So far, we have assumed that partnership funding is provided by a bank that directly competes with fintech in the lending market. Instead, consider when fintech obtains funding from a non-competing third-party bank. One can think of this bank as a lender that only actively lends in a different geographical location. Borrowing from the third-party bank allows the fintech firm to reduce its funding cost from r_F to r_E without affecting the competing bank's incentives via partnership funding profits. In other words, $\Pi_B = 0$ holds for the competing bank.

Proposition 4 (Partnership Financing from a Non-Competing Bank)**.**
If the fintech firm obtains financing from a non-competing bank as opposed to a competitor bank,

1. *The fintech firm and the competing bank both receive (weakly) lower profits,*

2. *The borrowers are (weakly) better off.*

Proposition 4 highlights the fintech and the competing bank's strong preference towards establishing partnership funding arrangements despite directly competing for borrowers. Conditional on the fintech already receiving partnership funding, a competing bank would like to become the provider of such funds to benefit from the fintech's screening technology. When given a choice, the fintech is willing to switch its partnership funding provider away from non-competing to competing banks. Even if such a change does not affect fintech's funding cost, fintech's profits will be higher thanks to the collusion channel.

Non-competing bank financing isolates the effect of the fintech funding cost from the lending competition. Relative to the case without partnership funding, non-competing bank financing reduces the effective funding cost of the fintech firm without introducing the collusion channel. Borrowers benefit from the absence of the collusion channel due to increased competition between banks and fintech firms.

4.4 Competition for Partnership Funding

The collusion channel arises in our setting due to imperfect competition in the partnership funding market. An increased competition in the partnership funding market reduces bank partnership profits Π_B and incentivizes the bank to compete more aggressively in direct lending market. Despite of this fact, we show that increased competition in partnership funding does not always benefit the borrowers.

To model the competitiveness of partnership funding directly, we allow the fintech to obtain partnership funding from the incumbent competing bank and the third-party non-competing bank, up to a limit $\phi\lambda$. Parameter $\phi \in [\frac{1}{2}, 1]$ captures the degree of partnership funding competition: higher ϕ implies a more competitive market. For a fraction $(2\phi - 1)\lambda$ of its funding, the fintech can elicit (Bertrand) competition and pays r_B; for the fraction $[1 - (2\phi - 1)]\,\lambda$, it needs to bargain individually with each bank so that it pays $\alpha r_B + (1 - \alpha) r_F$; for the remaining $1 - \lambda$, it must self-finance so that the cost is r_F.[16] In such a setting, similar to Section 3, the equilibrium is characterized by two thresholds $\underline{\mu}(\phi)$ and $\bar{\mu}(\phi)$, derived in Appendix A.6, that depend on the degree of competition in partnership funding ϕ.

Our next proposition shows that a marginal increase in the competitiveness of partnership

[16]Note that if $\phi = 0.5$, which corresponds to the case that the fintech must borrow half of the partnership funding from each bank, then fintech's effective funding cost is r_E from the baseline model. If $\phi = 1$, which corresponds to the case of Bertrand competition in partnership funding, then the fintech's effective funding cost is $\lambda r_B + (1 - \lambda) r_S$. Therefore, higher ϕ captures stronger competition in partnership funding.

funding might hurt the high-type borrowers.

Proposition 5. *A marginal increase in partnership funding market competitiveness ϕ reduces high-type borrower's expected payoff in markets with μ close to $\bar{\mu}(\phi)$, that is*

$$\frac{\partial}{\partial \phi} V_H(\mu, \phi) < 0,$$

for all $\mu \in (\hat{\mu}(\phi), \bar{\mu}(\phi)]$ where $\hat{\mu}(\phi) < \bar{\mu}(\phi)$.

Increased partnership market competitiveness ϕ generates two effects in the direct lending market. On the one hand, it weakens the collusion channel by reducing the bank partnership profits Π_B and increases competition in the direct lending market. On the other hand, it reduces fintech's effective funding cost. Lower funding cost coupled with fintech's information advantage increases the adverse selection in markets below $\bar{\mu}(\phi)$. Faced with a stronger adverse selection, the bank reduces direct lending volume and raises interest rates to avoid incurring losses. As a result, competition in the direct lending market decreases. In markets with μ close to $\bar{\mu}(\phi)$, the collusive channel is weak (since the bank does the lion's share of lending), and the adverse selection effect dominates. Consequently, the borrowers receive lower payoffs despite the increased competitiveness of partnership funding. This result is unique to the asymmetric information setting, and it is also in sharp contrast to the industrial organization approach to vertical integration, which typically predicts that the borrowers (or downstream customers) benefit from more upstream competition.

5 Extensions and Robustness

5.1 Costly Screening and Entry

Screening and Entry Cost for Fintech

In the benchmark model, we study equilibrium lending outcomes when both the bank and the fintech firm are already present in the market. We now take a step back and discuss the incentives of a fintech firm to enter a market with a given borrower quality and compete with an incumbent bank[17]. Recall that the fintech firm's profits are non-monotonic: it peaks when the average quality of the borrower pool is neither too high nor too low. The reason is, when the average quality gets too low, there are not many high-type borrowers to begin with, so the fintech firm's profits are low. By contrast, when the average quality gets too high, the competition from the bank intensifies, and the fintech firm's profits are low again. Therefore, if either screening or entry entails a cost to the fintech firm, our model predicts that the fintech firm will be active in markets where the average quality is moderate.

The equilibrium when the fintech firm has either entry or screening cost is as follows. Neither lender is active when the average quality is low, and borrowers are credit rationed. When the average quality gets a bit higher, the fintech firm charges high interest rates to high-quality borrowers, with partnership funding from the bank. Even though the perceived credit quality is low, the ex-post default rates of loans are also very low. When the average quality improves, both lenders compete to lend and collaborate via partnership funding. Because the bank lends blindly, low-quality borrowers might also receive financing. Therefore, compared to the previous region, loan defaults are more likely. Finally, only the bank lends to all borrowers when the average quality reaches the highest region. Overall, these lending patterns generate a unique empirical prediction that ex-post loan default rates are a non-monotonic function of the ex-ante perceived credit quality.

Screening Technology Adoption by Bank

Suppose that by paying a fixed cost, the bank could acquire the same screening technology as the fintech firm and eliminate its own information disadvantage. After paying the cost, the bank can always outbid the fintech firm and earn expected profits $\mu(r_E - r_B)$. The difference in the bank's expected profits with and without the screening technology is

$$\begin{cases} \mu(r_E - r_B) - \mu\Pi_B = \mu(1-\lambda)(r_F - r_B) & \mu < \bar{\mu} \\ \mu(r_E - r_B) - (P(\mu)r_E - r_B) = \mu\underbrace{(pr_E - r_B)}_{<0} + (r_B - pr_E) & \mu > \bar{\mu}. \end{cases}$$

[17] See Philippon (2016) for a broader discussion of the fintech entry.

Simple calculations show that this difference peaks at $\bar{\mu}$. Therefore, our model predicts that if there is a fixed cost to adopting the screening technology, the bank will choose to do so if the average quality of the borrower pool is neither too high nor too low. Intuitively, when μ is low, there are too few high types to begin with, so the equilibrium amount of lending is low. Meanwhile, when μ is high, the bank's informational disadvantage is less critical, so the incentives to acquire the informational technology are also lower.

5.2 Bank Competition

This subsection discusses how bank competition affects our results. We consider a model with two identical uninformed banks with funding cost r_B and one informed fintech firm with funding cost r_F. Both banks compete with the fintech firm in the direct lending market and compete against each other in the partnership funding market. In this case, the fintech firm naturally has the bargaining power in the partnership funding market, so that $r_E = \lambda r_B + (1-\lambda) r_F$ and $\Pi_B = 0$. The rest of the model can be solved similarly to the benchmark under the assumption $\alpha = 1$.

In such a setting, the three-region equilibrium structure continues to hold. Moreover, the qualitative patterns of fintech profits and borrower payoffs across different μ remain similar to the baseline model. In contrast, in equilibrium, the banks never profit for any μ. Due to the lack of partnership profits for banks, the collusion channel is absent in this model, and partnership funding only reduces the fintech's funding cost. However, the lower funding cost of the fintech always hurts the borrowers due to increased adverse selection, as discussed in Section 4.4.

5.3 Fintech Competition

Let us introduce fintech competition into the model. Specifically, we extend the benchmark model to one with one bank and two fintech firms. Results are straightforward when both fintech firms observe the same signals from one borrower. The two fintech firms engage in Bertrand competition, driving their expected profits to zero. That is, the fintech firms will offer interest rates $\underline{R}_F = \frac{r_E}{P(\mu_g)}$ upon observing a good signal but retreat from lending upon observing a bad signal. The bank, as before, would like to offer an interest rate that is at least $\underline{R}_B$. The equilibrium turns out straightforward. If $\underline{R}_B \leq \underline{R}_F$, the bank lends at an interest rate $\underline{R}_F$ and earns positive rents due to its lower funding cost. If $\underline{R}_B > \underline{R}_F$, the two fintech firms lend and offer an interest rate $\underline{R}_F$ while the bank retreats from direct lending to the partnership funding market.

Results are more interesting when the two fintech firms' signals are not perfectly correlated. In this case, the results will be isomorphic to those in the benchmark model. To see this, let us assume the two fintech firms receive signals that are conditionally independent and are subject to type-I error: a high-type borrower could receive a bad signal with probability e_1, and the distribution of this type-I error is independent across the two fintech firms.

Our next result summarizes the equilibrium, which shows that our benchmark result on collaboration and competition are robust.

Proposition 6 (Equilibrium with Fintech Competition)**.**

1. *Collaboration: for* $\mu \in [0, \underline{\mu}^{2F}]$*, the bank never bids. For each fintech firm, it offers a random random interest rate on* $[e_1 R + (1-e_1)\underline{R}_F^{2F}, R]$ *after observing a good signal and does not lend after observing a bad signal.*

2. *Collaboration/Competition: for* $\mu \in [\underline{\mu}^{2F}, \bar{\mu}^{2F}]$*, the bank offers a random interest rate in* $[\underline{R}_B^{2F}, \bar{R}_B^{2F}]$ *for some* $\bar{R}_B^{2F} < R$ *and does not bid at all with a positive prob. The fintech firm's bid distribution on* $[\underline{R}_B^{2F}, R]$*.*

3. *Competition: for* $\mu \in [\bar{\mu}^{2F}, 1]$*, the bank always bids* $\underline{R}_F^{2F}$ *and lends to all borrowers with probability* 1*.*

The thresholds $\underline{R}_B^{2F}$*,* $\bar{R}_B^{2F}$*,* $\underline{R}_F^{2F}$*,* $\underline{\mu}^{2F}$*, and* $\bar{\mu}^{2F}$ *are characterized in the Online Appendix C.2.*

Before concluding, let us briefly describe the results of the two fintech firms receiving conditionally independent signals that are subject to type-II errors. Results are largely identical to those in Proposition 6, and we can define the thresholds $\bar{\mu}^{2F}$ and $\underline{\mu}^{2F}$ similarly. Besides, there exists another threshold $\frac{e_2(r_E/R-p)}{1-p-(1-e_2)(r_E/R-p)}$ below $\underline{\mu}^{2F}$, such that if $\mu < \frac{e_2(r_E/R-p)}{1-p-(1-e_2)(r_E/R-p)}$, where fintechs would not lend even after receiving a good signal, because it is very likely that the good signal comes from a low-type borrower who populates the majority of the borrower pool.[18]

5.4 Dissecting Mean and Variance Effects

In our baseline model, the parameter μ simultaneously affects both the mean and variance of the borrower pool's quality. To understand whether the equilibrium structure is primarily driven by the first or the second moment, we augment our model by introducing uncertainty in fintech's information advantage. Specifically, we assume the fintech firm receives a signal only with probability γ but remains uninformed with probability $1-\gamma$.

This modification effectively creates a three-type setting with high (H), uninformed (U), and low (L) types occurring with probabilities $\gamma\mu$, $1-\gamma$, and $\gamma(1-\mu)$ respectively. While the first moment – the average probability of repayment – continues to be captured by $P(\mu) = \mu + (1-\mu)p$, the second moment – the variance of repayment probability – is now given by $Var[p_\theta] = \gamma\mu[1 - P(\mu)]^2 + \gamma(1-\mu)[p - P(\mu)]^2$. Therefore, we can analyze the effects of changes in mean versus variance separately.

We solve the model in Online Appendix C.3, and our analysis yields two main findings. First, our baseline results prove robust to this modification, i.e., for any given γ: (i) we observe the same three-region equilibrium structure – collaboration for low μ, both competition and collaboration for intermediate μ, and competition for high μ, as can be seen in Figure 5; (ii) the qualitative patterns of lender profits and borrower payoffs across different μ remain similar to our baseline model; and (iii) the effects of partnership funding maintain their baseline characteristics, i.e., the comparison of market participants' payoffs with and without partnership funding is similar to Proposition 3.

Second, we find that the equilibrium structure in our baseline model is primarily driven by the mean rather than variance. When we increase μ while varying γ to keep the variance constant, we obtain results similar to those from varying μ in the baseline model[19]. However, varying the

[18]When $\mu = \frac{e_2(r_E/R-p)}{1-p-(1-e_2)(r_E/R-p)}$, conditional on a good signal, we have $\left(\frac{\mu}{\mu+(1-\mu)e_2} + \frac{(1-\mu)e_2}{\mu+(1-\mu)e_2}p\right) \cdot R = r_E$.

[19]A notable difference is that the fintech profits can be decreasing in μ in the low μ region. This happens because the probability that the fintech can discover the high-type borrower $\mu \cdot \gamma(\mu)$ decreases in μ when μ is low along the

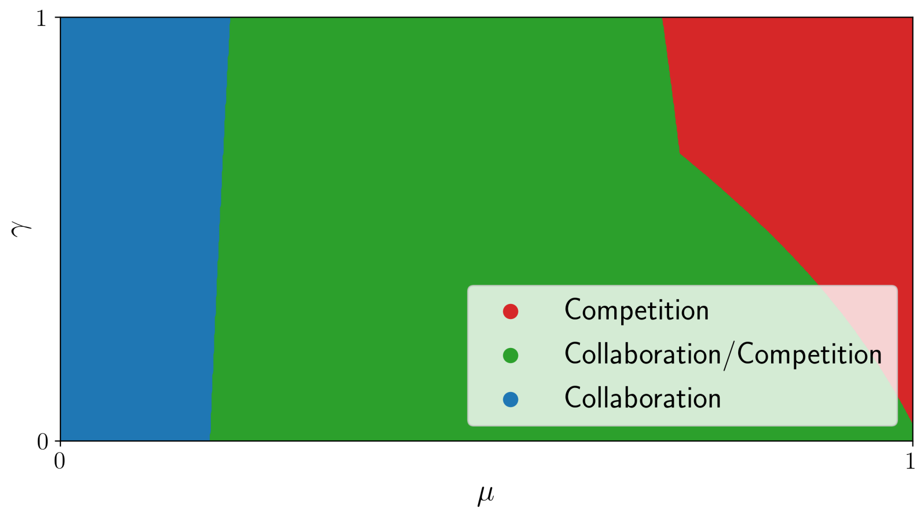

Figure 5: Equilibrium regions in the model with three types

This figure describes the equilibrium lending outcomes as a function of the average quality of the borrower pool μ and probability of fintech receiving informative signal γ. The parameters in this figure are as follows: $R = 2.0$, $p = 0.4$, $r_F = 1.5$, $r_B = 1.0$, $\alpha = 0.5$, and $\lambda = 0.9$.

variance (γ) alone while keeping the mean (μ) constant produces more nuanced effects on lending competition. When μ is low, higher γ reduces lending competition as increased adverse selection leads banks to retreat from direct lending and focus on partnership funding. Conversely, when μ is high, higher γ can intensify lending competition. This second effect arises in markets with high (but not maximum) μ and low γ, where banks initially lend only to U and L-type borrowers, while fintech firms capture H-type borrowers. As γ increases, adverse selection makes lending to U and L-type borrowers less profitable, pushing banks to compete for all borrower types rather than accepting the segmented market structure.

6 Discussion and Related Literature

6.1 Why Don't Lenders Always Collude?

Given the model's setup, it is natural to anticipate the two lenders colluding and always collaborating. The collusion outcome, which corresponds in our model to the first-best, is as follows: the fintech firm charges an interest rate of R to a high-type borrower and does not lend to a low-type borrower. Moreover, all the funding comes from the bank, and the bank and fintech firm split the collusion profits. This arrangement features only collaboration, which is our equilibrium for $\mu < \underline{\mu}$.

This subsection shows that the collusion outcome cannot be implemented for $\mu \geq \underline{\mu}$[20]. Throughout, we assume $\lambda = 1$ and $\alpha = 0$, so the fintech firm can, in principle, finance the entire loan by borrowing from the bank at an interest rate r_B.[21] Note that $\bar{\mu} = 1$ under $\lambda = 1$, so that the equilibrium is characterized by one threshold $\underline{\mu}$: there is collaboration for $\mu < \underline{\mu}$, whereas both collaboration and competition exist for $\mu > \underline{\mu}$.

Why wouldn't the two lenders collude for $\mu > \underline{\mu}$? The bank's profits from collusion are at most $\mu(r_F - r_B)$, since for each \$1 borrowed from the bank, the fintech firm cannot commit to sharing more than $r_F - r_B$ of profits with the bank (otherwise, the fintech prefers to finance the loan using

path of constant variance.

[20]For model details, see Online Appendix C.1.

[21]A lower λ and a higher α would make collusion more difficult.

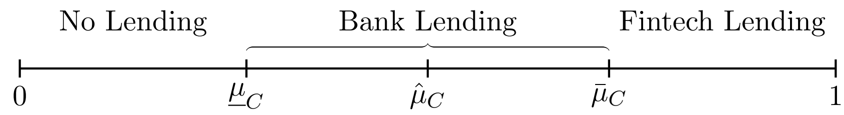

Figure 6: Equilibrium Illustration under convenience benefits

its own funding). Instead of sticking to the collusive outcome, the bank may deviate and privately offer an interest R to all borrowers and undercut the fintech. Such deviation generates profits close to $P(\mu)R - r_B$, which exceed $\mu(r_F - r_B)$ for any $\mu > \underline{\mu}$. Given this, the bank always has incentives to deviate from the collusion arrangement if $\mu > \underline{\mu}$.

To summarize, two factors prevent the collusion outcome under $\mu > \underline{\mu}$. First, the bank may have incentives to deviate, offer an interest rate slightly below R, and lend to all borrowers. Second, the fintech always has the option to use its own funding, which essentially sets a cap on the bank's shared profits from collusion. We supplement the details in Online Appendix C.1.

6.2 Convenience Benefits and Sticky Banking Relationships

We interpret borrowers as either consumers or small-business owners who, in practice, may value non-pecuniary benefits from different lenders. For example, it has been well-documented that the rise of fintech lending has been partially attributed to the convenience and speed offered by these lenders (Jiang, 2019). This section shows that the equilibrium results differ if the fintech firm only has convenience advantages. In contrast, the results are qualitatively unchanged if it has both convenience and informational advantages. Online Appendix C.4 contains formal results and proofs.

Fintech Convenience Benefits without Screening Advantage

Consider first when the fintech firm has no informational advantage but offers convenience benefits $\Delta_F > 0$, requiring bank bids to satisfy $R_B < R_F - \Delta_F$ to win borrowers.

The equilibrium features three thresholds $\{\underline{\mu}_C, \hat{\mu}_C, \bar{\mu}_C\}$: no lending occurs below $\underline{\mu}_C$, bank lending dominates between $\underline{\mu}_C$ and $\bar{\mu}_C$, and fintech lending prevails above $\bar{\mu}_C$. Banks enjoy monopoly profits below $\hat{\mu}_C$, while they face competition above it. This structure contrasts sharply with our baseline model in Proposition 1, as convenience benefits generate profits $P(\mu) \cdot \Delta_F$ that increase with μ, leading fintech firms to dominate high-quality markets. Figure 6 illustrates the equilibrium market.

Fintech Convenience Benefits with Screening Advantage

Next, we turn to the case of the fintech firm, which has both convenience benefits and informational advantages. When the convenience benefits are not too big,[22] the equilibrium turns out very similar to the one described by Proposition 1, with the only exception that $\bar{\mu}$ is defined as the threshold such that $R_B = \underline{R}_F - \Delta_F$ holds. Intuitively, the convenience benefit reduces the fintech firm's effective funding cost by Δ_F, further increasing its competitiveness.

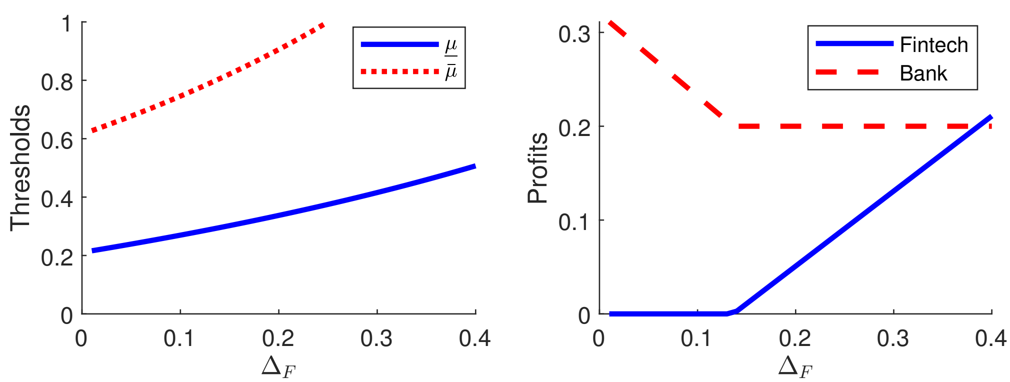

Figure 7: Comparative Statics in fintech benefit Δ_F ($\mu = 0.8$).

Remark 1. *As $\Delta_F \downarrow 0$, results converge to our benchmark model with ties favoring fintech firms, demonstrating robustness to tie-breaking rules.*

Sticky Banking Relationships

Banks may offer their own convenience benefits $\Delta_B > 0$ through branch networks and payment services. Now we consider the case that the bank offers non-pecuniary benefits in that the fintech

[22] More precisely, when $(1 - p)(r_E - \Delta_F) > \Pi_B$.

firm can only outbid the bank if its bid satisfies $R_F < R_B - \Delta_B$, where $\Delta_B > 0$. When these benefits are moderate ($\underline{R}_F + \Delta_B \leq R$), the equilibrium structure remains similar to Section 3 but with adjusted thresholds and bidding strategies. Figure 8 illustrates how bank benefits affect market structure and profits. The broader takeaway from this exercise is that the convenience benefit essentially offers monopoly power to the bank, which stifles lending competition.

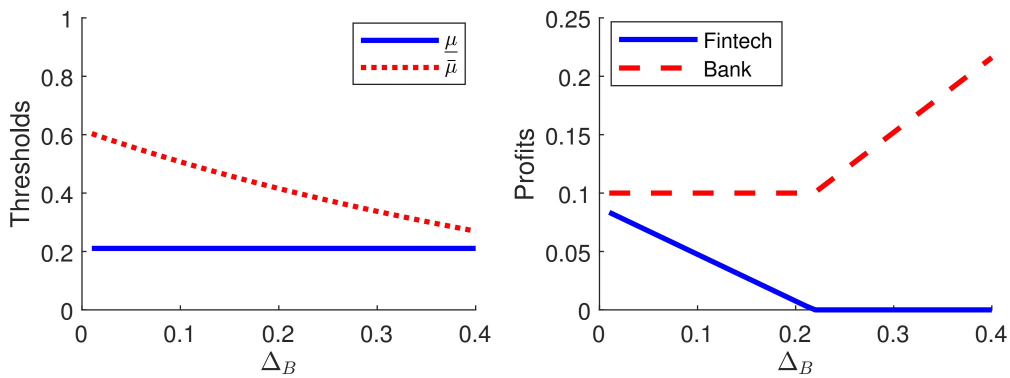

Figure 8: Comparative Statics in bank benefit Δ_B ($\mu = 0.4$).

6.3 Regulatory Benefits

Regulatory requirements are often cited as a primary factor in banks' reduced lending to specific borrowers. While a model with regulatory costs for banks lending to risky borrowers could generate equilibrium patterns similar to Proposition 1, it would yield distinct empirical predictions regarding credit quality.

A regulation-focused model would predict that fintech firms lend to low-quality borrowers, leading to higher ex-post default rates than bank loans. In contrast, our model predicts that while fintech firms target borrowers with low average observable quality, their superior screening ability should result in lower ex-post default rates than bank credit. These contrasting predictions about default patterns provide a basis for empirical tests to differentiate between regulatory costs and information asymmetry as driving forces behind observed lending patterns.

6.4 Cream Skimming

The literature on lending competition under asymmetric information has highlighted the cream-skimming effect, where informed lenders capture high-quality borrowers *first*, leaving uninformed lenders with an adversely selected pool (e.g., Fishman and Parker (2015), Bolton et al. (2016)). While these models rely on sequential lending, our framework features simultaneous lending and generates different results.

To explore these differences, we adapt our model to a two-stage game where the fintech firm first makes offers based on noisy signals[23], followed by bank offers to remaining borrowers. This sequential setting differs from our model in two ways. First, the fintech firm gains a first-mover advantage regardless of borrower pool quality. Second, sequential timing eliminates the direct impact of partnership funding on the bank's bidding strategies, the collusion channel in the benchmark model. The collusion channel disappears because the set of borrowers funded by the fintech and, consequently, the magnitude of the partnership profits are determined in the first stage. In the second stage, the bank can only lend to the remaining borrowers, and its interest rate offer does not affect the magnitude of partnership lending.

This sequential structure generates distinct predictions. First, high-quality markets feature only fintech lending due to the first-mover advantage, contrary to our benchmark model. Second, partnership funding affects bank profits differently across market segments: it increases profits in both high and low-quality markets (through first-mover advantage and screening benefits, respectively). Still, it can reduce profits in intermediate-quality markets by strengthening cream-skimming effects. This contrasts with our baseline model, where partnership funding reduces bank profits in high-quality markets but increases them in intermediate-quality ones. Detailed solutions are provided in Appendix C.5[24].

[23] With perfectly informative signals, the equilibrium is independent of the average quality of the pool. The fintech always cream-skims all the good borrowers, leaving only the bad borrowers to the banks. As a result, the bank refuses to lend.

[24] In Appendix C.5 we also solve a cream-skimming version of the model where the second stage bidding features two perfectly competitive banks and discuss the differences in implications of such setup relative to our baseline

6.5 Related Literature

Literature on Lending Competition under Asymmetric Information. Our modeling framework builds upon the literature on common-value auctions with asymmetric information (Milgrom and Weber, 1982), particularly its applications to bank lending in Broecker (1990), Hauswald and Marquez (2003), Dell'Ariccia and Marquez (2004), and Von Thadden (2004). We depart from this literature by introducing partnership funding that enables collaboration between lenders, allowing us to analyze how competitive and collaborative forces vary with borrower pool quality.

Moreover, we highlight the interaction between private information and partnership funding that generates novel results. For example, banks may prefer competing against fintechs with better screening technology despite facing a stronger winner's curse, as shown in Section 4.2.

Literature on Fintech Lending. Our paper contributes to the literature on fintech lending by analyzing the interaction between competition and collaboration with traditional banks. While empirical studies document fintech lending substituting for bank lending (Tang, 2019; De Roure et al., 2022), we also introduce a collaboration force. Two other papers also emphasized the collaboration between banks and fintech. Puri et al. (2024) show that banks make venture investments in fintech startups to reduce direct competition for customers and facilitate strategic business collaboration. These empirical findings support our model's theoretical assumptions. Jiang (2019) examines partnership funding in a context without adverse selection, where banks and shadow banks provide differentiated products. By contrast, our model focuses on information asymmetry, yielding new insights into market competition and collaboration. As shown in subsection 6.2, our model differs from Jiang (2019) in several predictions: patterns of fintech entry, relative default rates, and the impact of partnership funding on borrowers' surplus.

Several recent theoretical papers have studied the relationship between traditional banks and emerging lender types. Huang (2022) analyzes competition between a traditional bank and fintech, who rely on different lending technologies (collateral for bank and information for fintech). In

model.

contrast, in our model, both the fintech firm and the bank lend based on information but differ in the quality of information acquisition technology and funding costs. Li and Pegoraro (2023) study competition between a bank and a big-tech platform where the platform has the superior ability to enforce the debt repayments under moral hazard. Relative to both papers, we allow the lenders to also collaborate via the partnership funding market. Boualam and Yoo (2022) also examine bank-fintech competition and partnership. While their study emphasizes differences in enforcement technology, our paper focuses on information technology disparities. Vives and Ye (2024) apply a spatial model to study the competition between banks that rely on physical lending distance and fintechs that do not. Our paper also emphasizes the collaboration between the two lenders. More broadly, our paper is also related to the recent literature on open banking, which allows customers to share information across lenders (He et al., forthcoming; Goldstein et al., 2022). These papers highlight the potential downsides of consumer data portability. We do not allow for information sharing but instead focus on the effects of partnership funding and the welfare implications. Similarly, our analysis presents a cautionary tale of how the presence of partnership funding can hurt borrowers. Our paper is also related to Corbae and Gofman (2019), whereby a funding-constrained bank commits not to compete by lending funds to a competitor. In our paper, the bank still has the funding to compete after lending funds to a competitor.

Literature on Industrial Organization. Finally, our paper relates to the industrial organization literature on vertical mergers and foreclosure. In this literature, foreclosure refers to a situation in which a firm merges with its supplier and uses its market power to restrict its competitors' access to (or raise their costs of) intermediate goods. By controlling the supply through a vertical merger, the firm can weaken competition in the downstream market. In our model, the bank operates as a vertically integrated firm with a lending unit competing with fintech firms and an upstream funding unit. The bank can strategically soften competition in the downstream lending market by charging a higher rate for partnership funding. This connects to the work by Ordover et al. (1990), Chen (2001), and Jiang (2019) on the collusive effects of vertical integration. Notably, Chen (2001) shows that a rival firm might prefer an integrated firm as a supplier despite higher costs – paralleling our finding that fintech firms choose partnership funding from competing banks over non-competing ones, even at higher costs. Our paper extends this literature by incorporating asymmetric information in the downstream direct market. This allows us to analyze how the collusion channel endogenously interacts with the competition channel under varying degrees of adverse selection. Moreover, in Section 4.4, we show that increased competition in the upstream market might hurt the borrowers in the downstream market – a finding unique to our asymmetric information setting.

6.6 Empirical Predictions

Our model generates several interesting and testable implications on fintech lending, bank competition, and their interactions through partnership funding. We summarize them below.

On fintech entry and competition patterns. Our model predicts that fintech firms will primarily enter markets with moderate average borrower quality. When average borrower quality is low, banks tend to avoid direct lending competition and instead offer partnership funding to fintech firms. Conversely, in high-quality markets, banks still dominate in direct lending. The most active competition between banks and fintechs should be observable in markets with intermediate borrower quality, where their relative advantages in screening and funding costs are most closely balanced. Finally, our model predicts that banks are most likely to develop their own machine-learning-based screening technology to catch up with the fintech if their lending concentrates on moderate average borrower quality.

On loan performance by different lenders. Despite targeting borrowers with lower average observable quality, fintech loans should have lower ex-post default rates than bank loans due to superior screening technology. Our model also predicts that the overall default rate could be non-monotone in observable credit quality due to varying market shares of bank and fintech lending. Moreover, when screening is imperfect, Type-II errors (misclassifying low-quality borrowers as high-quality) benefit banks through direct lending and partnership funding channels.

On partnership funding. Our model predicts that both fintech firms and competing banks should prefer direct partnership arrangements between themselves rather than involving third-party banks, as this allows them to internalize competitive externalities. Moreover, partnership funding between competing lenders should be more prevalent in markets with lower average borrower quality, where banks find direct lending less attractive. Finally, when partnership funding comes from non-competing banks, borrower interest rates should be lower compared to funding from competing banks.

7 Conclusion

Motivated by the rise of fintech firms in the financial industry, we developed a theory examining competition and collaboration between fintech firms and traditional banks. Our model reveals that collaboration occurs when borrower pool quality is low, while competition emerges when quality is high. Partnership funding enhances fintech competitiveness and reduces bank competition, benefiting borrowers only when pool quality is sufficiently high. Banks profit more in low-quality scenarios.

Our model assumes low-type projects have negative NPV, which is plausible in bank lending contexts. Results can be different if even those projects can have positive NPV. In such cases, when average quality is very low, the winner's curse effect diminishes, potentially making banks the dominant lenders. This scenario offers an interesting alternative perspective, though less plausible in typical bank lending situations.

Our model does not have aggregate uncertainty. Given this, the law of large numbers implies that the profits of both lenders are deterministic. Therefore, there is no associated risk of default on partnership funding. Extending the model with aggregate shocks and more dynamics can be an interesting future direction.

For tractability, our model assumes binary distributions for borrower types and project cash flows. The results remain qualitatively similar if we allow continuous cash flows with binary borrower types, or continuous borrower types with binary project outcomes. This consistency stems from the lenders' risk-neutral focus on expected profits. However, the model becomes significantly more complex if both borrower types and fintech screening signals are continuous. These simplifications enable us to maintain analytical clarity while preserving the essential insights of our study.

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A Appendix

A.1 Proofs of Results from Section 3.

Proof of Lemma 1

Proof. We prove by contradiction. There are two cases: $\hat{R}_B \in (\underline{R}_F, R)$ and $\hat{R}_B = R$.

Suppose the bank bids some $\hat{R}_B \in (\underline{R}_F, R)$ with a probability mass Δ_B, then for any $\varepsilon > 0$, the fintech firm must bid with a strictly positive probability on $(\hat{R}_B, \hat{R}_B + \varepsilon]$. If instead there exists an ε^* such that $F_B(\hat{R}_B + \varepsilon^*) - F_B(\hat{R}_B) = 0$, then the bank earns strictly higher profits by bidding $\hat{R}_B + \frac{\varepsilon^*}{2}$ compared to bidding $\hat{R}_B$, a contradiction. Next we show, that instead of bidding $\hat{R}_B + \varepsilon$ the fintech could undercut the bank and bid $\hat{R}_B - \varepsilon$ and increase its expected proffits. By bidding $\hat{R}_B + \varepsilon$, a fintech firm with a good signal receives profits $\left(1 - F_B(\hat{R}_B + \varepsilon)\right)(\hat{R}_B + \varepsilon) - r_E$. By bidding $\hat{R}_B - \varepsilon$, a fintech firm with a good signal receives profits $\left(1 - F_B(\hat{R}_B - \varepsilon)\right)(\hat{R}_B - \varepsilon) - r_E$. The difference between the two $\left(1 - F_B(\hat{R}_B - \varepsilon)\right)(\hat{R}_B - \varepsilon) - \left(1 - F_B(\hat{R}_B + \varepsilon)\right)(\hat{R}_B + \varepsilon) \to \Delta_B \hat{R}_B > 0$ as $\varepsilon \downarrow 0$, a deviation.

Suppose the bank bids $\hat{R}_B = R$ with a probability mass Δ_B. Then bidding $R - \varepsilon$ strictly dominates R for the fintech firm. Therefore, the fintech firm never bids R in equilibrium. As a result, by bidding R, the bank only lends to a borrower with a bad signal and makes a loss, a contradiction.

To rule out intervals, we prove by contradiction. Let (R_1, R_2) be the interval where the right boundary R_2 is closest to R.[25] This implies the bank is indifferent between any bid $\hat{R}_B \in (R_1, R_2)$. Then the fintech firm must also bid on the same interval (R_1, R_2) without any gaps $(\hat{R}_1, \hat{R}_2)$. Otherwise, bidding $\hat{R}_2$ strictly dominates $\hat{R}_1$ for the bank.

Next, it must be that $R_2 = R$. If not, bidding R is dominated by bidding R_2 from the perspective of the fintech firm (it implies the same win probability with higher conditional profits).

Finally, we show that $R_2 = R$ leads to a contradiction. Depending on whether the fintech firm bids R with a probability mass or not, there are two cases. If the fintech firm does not bid R

[25] Since we have ruled out mass probabilities, the same result holds if the interval is half-open or open.

with a probability mass, then by bidding R the bank almost surely lends to a borrower with a bad signal, which results in a loss - a contradiction. If the fintech firm bids R with a probability mass, by bidding R, it can only win if the bank does not bid at all with a positive probability (since the ties are broken in favor of the bank, and any bank bid $R_B \leq R$ would win against fintech firm's $R_F = R$). The fact that not bidding is part of the bank's equilibrium strategy is a contradiction because not bidding and getting zero expected profits is strictly dominated by bidding $\underline{R}_F$ and receiving positive expected profits. Hence, by bidding R the fintech firm never wins and receives zero profits. Since the fintech firm is indifferent between any bids it makes it must be that fintech firm makes zero profits for any bid $R_F \in (R_1, R)$. This is possible only if the fintech firm never wins for any of those bids which is impossible when the bank is also bidding in (R_1, R) without mass points. □

Lemma A.1. *If $\underline{R}_F < \underline{R}_B < R$, the bank can not offer an interest rate with a positive probability mass.*

Proof of Lemma A.1

Proof. The proof is the same as Lemma 1. □

Proof of Lemma 2

Proof. We begin by arguing that the fintech firm must also adopt a mixed strategy when receiving a good signal. Suppose on the contrary that the fintech firm chooses a pure strategy $R_F \in [\underline{R}_B, R]$ when receiving a good signal, and do not bid when receiving a bad signal. Then, any bid of the bank $R_B \in (R_F, R]$ wins if and only if the borrower is of the low type, which incurs a loss. This is the winner's curse problem, implying that the bank cannot attach positive probability on bidding $(R_F, R]$. On the other hand, if the bank only attaches positive probability on bidding $[\underline{R}_B, R_F]$ then bidding R_F generates 0 profits for the fintech firm and it has an incentive to deviate to $R_F - \varepsilon$ to get positive expected profits. This is a contradiction. Hence, the fintech firm has to play a mixed strategy.

We follow similar steps as the proof in Lemma 1 to show that there are no holes, and the right boundary of the interval must be R. Therefore, when both institutions randomize their bids, the interval is $[R_1, R]$ for $R_1 \geq \underline{R}_B$ since the bank must make non-negative profits.

When both the bank and the fintech firm randomize their bids in $[R_1, R_2]$, it must be that $R_2 = R$. Otherwise, offering R_2 is strictly dominated by bidding R and the fintech firm would prefer to bid R instead of mixing in $[R_1, R_2]$. Randomizing by both parties in $[R_1, R]$ also implies that the fintech firm must have a positive mass of bids at R. This is to assure the bank's incentive by alleviating the winner's curse problem. Absent such a mass, when the bank's bid gets close to R, almost surely it can only win when the fintech firm receives a bad signal, which results in a loss.

To pin down R_1 we exploit the indifference condition of the fintech firm. On the one hand, the fintech firm can bid R_1 and win the bidding game almost for sure, generating expected profits $P(\mu_g)R_1 - r_E > 0$. On the other hand, the fintech firm can bid R and win whenever the bank bids above R (or, equivalently, does not bid), generating expected profits $(1 - F_B(R)) \cdot (P(\mu_g)R - r_E)$. Indifference between the two options implies that $F_B(R) < 1$, i.e., that the bank does not bid at all with a positive probability. This can only happen when the bank is indifferent between winning and losing for every bid it submits. As a result, $R_1 = \underline{R}_B$. □

Proof of Proposition 1

Proof. Lemma 1 establishes the equilibrium structure for $\underline{R}_B < \underline{R}_F$, Lemma A.1 establishes the equilibrium structure for $\underline{R}_F < \underline{R}_B < R$, and the equilibrium structure for case $\underline{R}_F < R < \underline{R}_B$ is described in the main text of the paper.

Under Assumption 1, it is clear that $0 < \underline{\mu} < \bar{\mu} \leq 1$. Simple derivations show that $\underline{R}_B \leq \underline{R}_F$ for $\mu > \bar{\mu}$, $\underline{R}_F < \underline{R}_B < R$ for $\mu \in (\underline{\mu}, \bar{\mu})$, and $\underline{R}_F < R \leq \underline{R}_B$ for $\mu \leq \underline{\mu}$. The results of Proposition 1 follows directly from the above. □

Proof of Proposition 2

Proof. Start with total bank profits:

$$V_B + V_P = \begin{cases} \mu \Pi_B & \text{for } \mu \leq \bar{\mu} \\ P(\mu) r_E - r_B & \text{for } \mu \geq \bar{\mu} \end{cases} \tag{A.1}$$

where we used that for $\mu < \underline{\mu}$ we have $V_B = 0$ and $V_P = \mu \Pi_B$. For $\mu \in (\underline{\mu}, \bar{\mu})$ the bank is indifferent between losing and winning the bidding competition, hence the total profits are equal to profits when the bank always loses, i.e. $\mu \Pi_B$. Finally, for $\mu > \bar{\mu}$ the bank always bids $\underline{R}_F = r_E$ and wins. Clearly, $V_B(\mu) + V_P(\mu)$ is continuous and increasing.

Next, turn to fintech firm profits:

$$V_F = \begin{cases} \mu(R - r_E) & \text{for } \mu \leq \underline{\mu} \\ \mu(\underline{R}_B - r_E) & \text{for } \mu \in (\underline{\mu}, \bar{\mu}) \\ 0 & \text{for } \mu \geq \bar{\mu} \end{cases} \tag{A.2}$$

Clearly, V_F is positive and increasing for $0 < \mu < \underline{\mu}$. And it equal to 0 for $\mu > \bar{\mu}$. So, overall it is non-monotone.

In $\mu \in (\underline{\mu}, \bar{\mu})$ the fintech firm's profits are

$$\begin{aligned} V_F &= \mu(\underline{R}_B - r_E) \\ &= \mu \left(\frac{r_B + \mu \Pi_B}{p + \mu(1-p)} - r_E \right) \\ &= \mu \frac{r_B + \mu \Pi_B - (p + \mu(1-p) r_E}{p + \mu(1-p)} \\ &= \mu \frac{r_B - p r_E - \mu((1-p) r_E - \Pi_B)}{p + \mu(1-p)} \\ &\sim a \cdot \mu \cdot \frac{b - \mu}{\mu + c} \end{aligned}$$

At $\mu = \bar{\mu}$ the fintech firm profit should be decreasing in μ, since $V_F(\bar{\mu}) = 0$ and $V_F(\mu) > 0$ for $\mu < \bar{\mu}$. Given the shape of V_F as a function of μ (linear minus a $1/\mu$ term) the fintech firm profits can either be (a) decreasing everywhere in $(\underline{\mu}, \bar{\mu})$ or (b) be hump-shaped, i.e., increasing in $(\underline{\mu}, \mu^*)$ and decreasing in $(\mu^*, \bar{\mu})$.

Next we consider the borrower surplus. To prove that it is increasing in μ we will rely on first order dominance of the cdfs F_B and F_F.

$$F_B(x) = \frac{x - \underline{R}_B}{x - \underline{R}_F} = \frac{x - \underline{R}_B(\mu)}{x - r_E}$$

Since $\underline{R}_B(\mu)$ is decreasing in μ, we have $F_B(x)$ is increasing in μ. Hence F_B at μ' dominates F_B at $\mu < \mu'$ in the FOSD sense.

Similarly,

$$F_F(x) = \frac{P(\mu)x - r_B - \mu\Pi_B}{\mu(x - r_B - \Pi_B)}$$
$$1 - F_F(x) = \frac{1-\mu}{\mu} \cdot \frac{r_B - px}{x - r_B - \Pi_B}.$$

Since $(1-\mu)/\mu = 1/\mu - 1$ is decreasing in μ, $F_F(x)$ is increasing in μ. Hence F_F at μ' dominates F_F at $\mu < \mu'$ in the FOSD sense.

Since both cdfs increase in the FOSD with μ, both types of borrowers prefer lower rates to higher, their surplus is increasing in μ.

$\square$

A.2 Analysis of Section 4.1 (Who Benefits from Partnership Funding)

Proof of Corollary 1.

Proof. Direct calculations give

$$\frac{d\bar{\mu}}{d\lambda} = \frac{(r_F - r_B)[(1-p\alpha)r_B - p(1-\alpha)r_F]}{\{\lambda(1-\alpha p)r_B + [(1-p) - \lambda(1-\alpha p)]r_F\}^2}$$

Notice that

$$(1-p\alpha)r_B - p(1-\alpha)r_F > \left(\frac{(1-p\alpha)p(1-\lambda\alpha)}{1-\lambda\alpha p} - p(1-\alpha)\right) r_F = \frac{(1-p)p\alpha(1-\lambda)}{1-\lambda\alpha p} r_F > 0,$$

as a result $\frac{d\bar{\mu}}{d\lambda} > 0$.

The comparative statics $\frac{d\underline{\mu}}{d\lambda} > 0$ is fairly obvious since λ shows up only in the denominator.

When $\lambda = 1$ we have

$$\bar{\mu} = \frac{(1-\alpha p)r_B - p(1-\alpha)r_F}{(1-\alpha p)r_B + [(1-p)-(1-\alpha p)]r_F} = 1.$$

$\square$

Proof of Proposition 3.

Proof. First, establish the cutoffs of different lending regions. Define $\underline{\mu}_\lambda$ as a solution to

$$\underline{R}_B(\mu, \lambda) = R \tag{A.3}$$

and $\bar{\mu}_\lambda$ as a solution to

$$\underline{R}_B(\mu, \lambda) = \underline{R}_F(\mu, \lambda). \tag{A.4}$$

Then

$$\underline{\mu}_0 = \frac{r_B/R - p}{1-p} \qquad \bar{\mu}_0 = \frac{r_B/r_F - p}{1-p} \qquad \underline{\mu}_1 = \frac{r_B/R - p}{1-p-(1-\alpha)(r_F - r_B)/R} \qquad \bar{\mu}_1 = 1 \tag{A.5}$$

1. Start with borrowers.

   Two cases are possible. If at $\bar{\mu}_0 < \underline{\mu}_1$ then only the fintech firm participates and bids R in which case the both types of borrowers get a zero payoff. Clearly, they are better at $\mu = \bar{\mu}_0$ without the partnership funding market.

   If $\bar{\mu}_0 > \underline{\mu}_1$ then both parties bid with CDFs F_B and F_F at $\mu = \bar{\mu}_0$ with $\lambda = 1$ and the high type's payoff is

$$V_H = R - \mathbf{E}[\min(\tilde{R}_B, \tilde{R}_F)]. \tag{A.6}$$

First, let's simplify the expected minimal bid:

$$\begin{aligned}
&\mathbf{E}[\min(\tilde{R}_F, \tilde{R}_F)] = \int_{\underline{R}_B}^{R} xd[1-(1-F_F(x))(1-F_B(x))] \\
&= -\int_{\underline{R}_B}^{R} xd[(1-F_F(x))(1-F_B(x))] \\
&= R(F_F(R)-F_F(R-))(1-F_B(R-)) - \int_{\underline{R}_B}^{R-} xd[(1-F_F(x))(1-F_B(x))] \\
&= R(F_F(R)-F_F(R-))(1-F_B(R-)) - x[(1-F_F(x))(1-F_B(x))]\Big|_{\underline{R}_B}^{R-} \\
&+ \int_{\underline{R}_B}^{R-} [(1-F_F(x))(1-F_B(x))]dx \\
&= \underbrace{R(F_F(R)-F_F(R-))(1-F_B(R-)) - R[(1-F_F(R-))(1-F_B(R-))]}_{=0} + \underline{R}_B \\
&+ \int_{\underline{R}_B}^{R-} [(1-F_F(x))(1-F_B(x))]dx \\
&= \underline{R}_B + \int_{\underline{R}_B}^{R-} [(1-F_F(x))(1-F_B(x))]dx.
\end{aligned}$$

The high-type borrower in a pool characterized by $\bar{\mu}_0$ is better off without the partnership funding market if

$$\begin{aligned}
r_F &< \underline{R}_B + \int_{\underline{R}_B}^{R-} [(1-F_F(x))(1-F_B(x))]dx \\
r_F - \underline{R}_B &< \int_{\underline{R}_B}^{R-} [(1-F_F(x))(1-F_B(x))]dx.
\end{aligned}$$

We evaluate the LHS at $\bar{\mu}_0$:

$$r_F - \underline{R}_B = r_F - \frac{r_B + \bar{\mu}_0 \Pi_B}{r_B/r_F} = -\frac{\bar{\mu}_0 \Pi_B}{r_B/r_F} < 0.$$

For the RHS, we know it is positive, so the inequality always holds at $\bar{\mu}_0$.

For the low-type borrower, the payoff with partnership funding market is

$$
\begin{aligned}
V_L(\lambda = 1) &= (1 - F_B(R)) \cdot p(R - \mathbf{E}[\tilde{R}_B \,|\tilde{R}_B < \infty]) \\
&< p(R - \mathbf{E}[\tilde{R}_B \,|\tilde{R}_B < \infty]) \\
&< p(R - \mathbf{E}[\min(\tilde{R}_F, \tilde{R}_B)]) \\
&< p(R - r_F) \\
&= V_L(\lambda = 0).
\end{aligned}
$$

We have established that when $V_\theta(\lambda = 1) < V_\theta(\lambda = 0)$ at $\mu = \bar{\mu}_0$. For $\mu > \bar{\mu}_0$ borrower's surplus $V_\theta(\lambda = 0)$ is constant, while $V_\theta(\lambda = 1)$ is strictly increasing.

When $\mu = 1$ the bank always bids r_E and always wins. With $\lambda = 1$ we have $r_E = r_B$ and with $\lambda = 0$ we have $r_E = r_F$, hence $V_\theta(\lambda = 1) > V_\theta(\lambda = 0)$. As a result, there exists $\mu^*_\theta > \bar{\mu}_0$ such that

$$V_\theta(\lambda = 1, \mu^*_\theta) = V_\theta(\lambda = 0, \mu^*_\theta). \tag{A.7}$$

Borrowers are better off with partnership funding market for $\mu > \mu^*_\theta$ and better off without partnership funding market for $\mu < \mu^*_\theta$

For $\underline{\mu}_1 < \mu < \bar{\mu}_0$ we have non-trivial bidding by both bank and fintech firm regardless of λ. Hence the payoff of the low type player is determined via the expected minimal bid

$$\mathbf{E}[\min(\tilde{R}_F, \tilde{R}_F)] = \underline{R}_B + \int_{\underline{R}_B}^{R-} [(1 - F_F(x))(1 - F_B(x))]dx. \tag{A.8}$$

To see how the expected minimal bid varies with λ notice that we need to take only the derivative inside of the integral since the derivative w.r.t. $\underline{R}_B$ in the above expression cancels out.

Recall that

$$F_B(x) = \frac{x - \underline{R}_B}{x - r_E}.$$

Since $\underline{R}_B$ is increasing in λ and r_E is decreasing in λ, the cdf $F_B(x)$ is decreasing in λ. As a result, $1 - F_B(x)$ term is increasing in λ.

Similarly

$$\frac{\partial}{\partial \mu} F_F(x) \sim \frac{\partial}{\partial \Pi_B} F_F(x) \sim \frac{px - r_B}{()^2} < 0.$$

As a result, the term $1 - F_F(x)$ is increasing in μ.

Hence, the whole integral above is increasing in μ (it is a product of two non-negative increasing terms). Since the expected minimum bid is increasing in μ the payoff of the high type is decreasing in μ.

For the low type the welfare comparison comes from the fact that $F_B(x)$ is decreasing in λ. Hence $F_B(x)$ for $\lambda = 0$ dominates in the FOSD sense $F_B(x)$ for $\lambda = 1$. Since the low type prefers lower bids, it prefers the cdf F_B at $\lambda = 0$.

2. Next, consider the fintech firm. For $\lambda = 1$ the fintech firm profits are given by

$$V_F = \begin{cases} \mu(R - r_E) & \text{for } \mu \leq \underline{\mu}_1 \\ \mu(\underline{R}_B - r_E) & \text{for } \mu \geq \underline{\mu}_1 \end{cases} \tag{A.9}$$

with $r_E = \alpha r_B + (1-\alpha) r_F$ and $\underline{R}_B = \frac{r_B + \mu(1-\alpha)(r_F - r_B)}{P(\mu)}$. Note that $V_F = 0$ at $\mu = 0$ and at $\mu = 1$ and reaches it's maximum at $\mu = \underline{\mu}_1$.

For $\lambda = 0$ the fintech firm profits are given by

$$V_F = \begin{cases} \mu(R - r_F) & \text{for } \mu \leq \underline{\mu}_0 \\ \mu\left(\frac{r_B}{P(\mu)} - r_F\right) & \text{for } \mu \in (\underline{\mu}_0, \bar{\mu}_0) \\ 0 & \text{for } \mu \geq \bar{\mu}_0 \end{cases} \tag{A.10}$$

Note that $V_F = 0$ at $\mu = \bar{\mu}_0$ and reaches it's maximum at $\mu = \underline{\mu}_0$.

Comparison of V_F with and without the partnership funding market is obvious: for $\lambda = 1$ V_F starts with a higher slope, at $\mu = 0$, reaches its peak later (at $\underline{\mu}_1 > \underline{\mu}_0$) and stays positive for longer. Moreover, for $\mu \in [\underline{\mu}_1, \bar{\mu}_0]$, we have

$$V_F(\lambda = 1) - V_F(\lambda = 0) = \mu(\underline{R}_B - r_E) - \mu\left(\frac{r_B}{P(\mu)} - r_F\right).$$

To show this is positive, we need

$$\begin{aligned}
\underline{R}_B - r_E &> \frac{r_B}{P(\mu)} - r_F \\
\frac{r_B + \mu(1-\alpha)(r_F - r_B)}{P(\mu)} - r_E &> \frac{r_B}{P(\mu)} - r_F \\
r_B + \mu(1-\alpha)(r_F - r_B) - P(\mu) r_E &> r_B - P(\mu) r_F \\
\mu(1-\alpha)(r_F - r_B) &> P(\mu)\left(r_E - r_F\right).
\end{aligned}$$

The last inequality holds because the LHS is positive whereas the RHS is negative. Hence, it dominates V_F for $\lambda = 0$ everywhere.

3. Next, consider the bank. When $\lambda = 1$, then the total bank profits are

$$V_B + V_P = \mu \Pi_B = \mu(1-\alpha)(r_F - r_B). \tag{A.11}$$

For $\mu < \underline{\mu}_1$ this is correct since $V_B = 0$ and for $\mu > \underline{\mu}_1$ this is correct since the bank is indifferent between winning and losing the bidding game.

When $\lambda = 0$, then the total bank profits are

$$V_B + V_P = \begin{cases} 0 & \text{for } \mu \leq \bar{\mu}_0 \\ P(\mu) r_F - r_B & \text{for } \mu \geq \bar{\mu}_0 \end{cases} \tag{A.12}$$

For $\mu < \underline{\mu}_0$ this is correct since $V_B = V_P = 0$ and for $\mu \in (\underline{\mu}_0, \bar{\mu}_0)$ this is correct since the bank is indifferent between winning and losing the bidding game. Finally, for $\mu > \bar{\mu}_0$ the bank simply bids r_F and always wins.

To compare the total profits of the bank, we only need to check that at $\mu = 1$ the bank is better off without the partnership funding markets. This is true, since $r_F - r_B > (1-\alpha)(r_F - r_B)$. Hence, there exists a $\mu_B^* \in (\bar{\mu}_0, 1)$ such that

$$\mu_B^*(1-\alpha)(r_F - r_B) = P(\mu_B^*) r_F - r_B \tag{A.13}$$

and the bank is better off without partnership funding market for $\mu > \mu_B^*$ and is better off with partnership funding market for $\mu < \mu_B^*$.

4. Finally, consider overall welfare.

   Welfare is clearly higher with $\lambda = 1$ vs. $\lambda = 0$. With $\lambda = 1$ the high type projects are always funded at a cost r_B, hence the funding inefficiency does not exist, while it strictly positive for $\lambda = 0$.

   Similarly, lending inefficiency with $\lambda = 1$ is also smaller, since the probability that the bank bids $F_B(x)$ is decreasing in λ.

$\square$

A.3 Analysis of Section 4.1 (Optimal Size of Partnership Funding)

Proof. Throughout this proof we write $\bar{\mu}(\lambda)$ and $\underline{\mu}(\lambda)$ to highlight that equilibrium thresholds depend on the volume of partnership λ.

Fintech preferred λ_F^o. The fintech's profit is

$$V_F = \begin{cases} \mu(R - r_E(\lambda)), & \mu < \underline{\mu}(\lambda) \\ \mu(\underline{R}_B(\mu) - r_E(\lambda)), & \mu \in [\underline{\mu}(\lambda), \bar{\mu}(\lambda)] \\ 0, & \mu > \bar{\mu}(\lambda) \end{cases}$$

Clearly, for any μ we have the fintech's profit is increasing in λ, hence its preference is

$$\lambda_F^o = 1.$$

Bank preferred λ_B^o. The total bank's profit is

$$V_B + V_P = \begin{cases} \mu\lambda(1-\alpha)(r_F - r_B), & \mu \le \bar{\mu}(\lambda) \\ P(\mu) r_E(\lambda) - r_B, & \mu > \bar{\mu}(\lambda). \end{cases}$$

Clearly, the bank's profit in increasing in λ when $\mu < \bar{\mu}(\lambda)$ and is decreasing in λ when $\mu > \bar{\mu}(\lambda)$. Moreover, $\bar{\mu}(\lambda)$ is increasing in λ. Hence, for a given μ the bank's payoff either is always increasing in λ (when $\mu \ge \bar{\mu}(0)$), or is always decreasing in λ (when $\mu \ge \bar{\mu}(1)$), or is V-shaped in λ (when $\mu \in (\bar{\mu}(0), \bar{\mu}(1))$). Consequently, the bank-optimal $\lambda \in \{0, 1\}$.

Comparing the bank payoffs for $\lambda = 0$ and $\lambda = 1$ explicitly, it is easy to shows that there exists μ_B^o such that the bank-optimal λ_B^o is

$$\lambda_B^o = \begin{cases} 1, & \mu \leq \mu_B^o \\ 0, & \mu > \mu_B^o, \end{cases}$$

where

$$\mu_B^o = \frac{r_B - p r_F}{(1-p)r_F - (1-\alpha)(r_F - r_B)}$$

solves

$$\mu_B^o(1-\alpha)(r_F - r_B) = [\mu_B^o + (1-\mu_B^o)p]r_F - r_B.$$

High-type borrower preferred λ_H^o. The high-type borrower's payoff can be written as

$$V_H = \begin{cases} 0, & \mu < \underline{\mu}(\lambda) \\ R - \mathrm{E}[\min(\tilde{R}_F, \tilde{R}_B)], & \mu \in [\underline{\mu}(\lambda), \bar{\mu}(\lambda)] \\ R - r_E(\lambda), & \mu > \bar{\mu}(\lambda) \end{cases}$$

where the $\tilde{R}_B$ and $\tilde{R}_F$ are stochastic bank and fintech bids with CDFs

$$F_B(\tilde{R}) = \frac{\tilde{R} - \underline{R}_B}{\tilde{R} - r_E}, \; \tilde{R} \in [\underline{R}_B, R]$$
$$F_F(\tilde{R}) = \frac{\mu \Pi_B - \left(P(\mu)\tilde{R} - r_B\right)}{\mu\left[\Pi_B - \left(\tilde{R} - r_B\right)\right]}, \; \tilde{R} \in [\underline{R}_B, R).$$

The bank bidding cdf is decreasing in λ (since r_E is increasing and $\underline{R}_B(\lambda)$) are decreasing), i.e., the distribution of bids for high λ first-order stochastic dominates the distribution of bids for lower λ). The fintech's bidding cdf is also decreasing in λ (it takes a form of $(\lambda - a)/(\lambda - b)$ with $a < b$), i.e., the distribution of bids for high λ first-order stochastic dominates the distribution of bids for lower λ).

Since both of the bidding distributions are first-order stochastically increasing, the high-type borrower payoff is decreasing in λ for $\mu \in [\underline{\mu}(\lambda), \bar{\mu}(\lambda)]$. It is clearly increasing in λ for $\mu > \bar{\mu}(\lambda)$.

Since both cut-offs $\underline{\mu}(\lambda)$ and $\bar{\mu}(\lambda)$ are increasing in λ, the high-type borrower optimal λ is either 0, or 1, or $\bar{\lambda}$ such that $\bar{\mu})(\bar{\lambda}) = \mu$. The high-type borrower optimal λ is

$$\lambda_H^o = \begin{cases} 0, & \mu < \bar{\mu}(0), \\ \bar{\lambda}(\mu), & \mu \in [\bar{\mu}(0), \bar{\mu}(1)], \\ 1, & \mu > \bar{\mu}(1), \end{cases}$$

where

$$\bar{\lambda} = \frac{r_B - pr_F - \mu(1-p)r_F}{(r_B - r_F)[\alpha p + \mu(1-\alpha)p]}$$

solves

$$\mu = \frac{(1 - \bar{\lambda}\alpha p)r_B - p(1 - \bar{\lambda}\alpha)r_F}{\bar{\lambda}(1-\alpha p)r_B + [(1-p) - \bar{\lambda}(1-\alpha p)]r_F}.$$

□

A.4 Analysis of Section 4.2 (Screening Technology and Partnership Funding)

In this subsection, we examine how the two types of errors, e_1 and e_2 affect the equilibrium outcome and welfare.

Corollary A.1 shows the effect that type-I error e_1 has on equilibrium outcomes and lenders' profits. Intuitively, a higher type-I error e_1 reduces the likelihood of good signals, and as a result, it also reduces the equilibrium amount of lending by the fintech firm. Lower fintech firm lending volume implies lower demand for partnership funding and lower partnership funding profits for the bank. Consequently, the bank has more incentives to compete with the fintech firm than offering partnership funding. With lower e_1, the bank faces a stronger winners curse, but its profits are nevertheless higher. In this case, the bank prefers to compete against a fintech with a more precise screening technology despite facing a stronger winner's curse. This effect highlights the novelty of the interaction between the adverse selection created by fintech's information advantage and partnership funding and separates our paper from the literature that focuses on information technology and lending competition (Hauswald and Marquez, 2003).

Corollary A.2 shows the effect that type-II error e_2 has on equilibrium outcomes and lenders' profits .An increase in type-II error has two effects. First, it reduces the average quality of the pool conditional on good signal μ_g. As a result, the fintech firm's informational advantage is mitigated, and it bids less aggressively (direct effect). Second, higher e_2 increases the likelihood of observing the good signal q_g. Keeping the bidding strategies fixed would translate into an increase in the volume of fintech firm lending and, consequently, partnership funding profits, reducing the bank's incentives to compete (indirect effect).

Total bank profits are affected in the same direction by both forces. The bank benefits from a less competitive fintech firm and from a higher potential partnership funding market. Hence, its profits are increasing in e_2. For the fintech firm, the two forces are working in opposite directions. However, the direct channel dominates, and the fintech firm profits are decreasing in e_2. To see the intuition, consider the two corner cases $\mu = \bar{\mu}_2$ and $\mu = \underline{\mu}_2$. As discussed earlier, partnership funding profits are zero at $\mu = \bar{\mu}_2$, and the indirect channel is absent. Hence the fintech firm profits are decreasing in e_2 due to the direct effect. At $\mu = \underline{\mu}_2$, the partnership funding profits are high, and the indirect effect should increase the probability of the fintech firm winning the bidding game. However, the fintech firm wins it with a probability 1, to begin with. Hence the indirect effect is muted and the profits are decreasing due to the direct effect again.

Formal analysis follows below.

Assumption 1 imposes an upper and lower bound on μ. Specifically,

$$\mu \in \left[\frac{(r_F/R - p)e_2}{(1-e_1-e_2p)-(1-e_1-e_2)r_F/R}, \frac{(1-e_2)(r_B/R-p)}{(e_1-(1-e_2)p)+(1-e_1-e_2)r_B/R}\right].$$

The lower bound comes from $r_F < P(\mu_g) \cdot R$ and the upper bound comes from $r_B > P(\mu_b) \cdot R$.

Let us start with type-I error $e_1 > 0$ and $e_2 = 0$ so that a fintech firm might receive a bad signal when facing a high-type borrower. In this case, $q_g = \mu(1-e_1)$, $q_b = \mu e_1 + (1-\mu)$, $\mu_g = 1$, and $\mu_b = \frac{\mu e_1}{q_b}$. The equilibrium is still characterized by two thresholds $\{\bar{\mu}_1, \underline{\mu}_1\}$, and we have the following results.

Corollary A.1. *With type-I error, the equilibrium consists of three regions: collaboration for*

$\mu < \underline{\mu}_1$, collaboration/competition for $\mu \in (\underline{\mu}_1, \bar{\mu}_1)$, and competition $\mu > \bar{\mu}_1$ similar to Proposition 1. Both thresholds $\bar{\mu}_1$ and $\underline{\mu}_1$ decrease with e_1.

Moreover, equilibrium fintech firm profits and bank profits are (weakly) decreasing in e_1 in every region.

Proof. With type-I error $e_1 > 0$ the fintech is still sure that it is facing a high-type borrower upon receiving a good signal, i.e., $\mu_g = 1$. Hence, the threshold $\underline{R}_F = r_E$ remains unchanged.

However, curse-free bid of the bank $\underline{R}_B$ is affected through the expected partnership profits. Instead of bidding for all high-type borrowers (μ) the fintech only bids for those that are identified by the good signal ($(1-e_1)\mu$) hence,

$$P(\mu)R_B - r_B \geq (1-e_1)\mu\Pi_B \Rightarrow R_B \geq \underline{R}_B := \frac{r_B + (1-e_1)\mu\Pi_B}{P(\mu)}$$

Direct comparison of $\underline{R}_B$ vs. $\underline{R}_F$ and $\underline{R}_B$ vs. R give rise to the $\bar{\mu}$ and $\underline{\mu}$ respectively:

$$\bar{\mu}_1 = \frac{r_B(1-\lambda\alpha p) - p(1-\lambda\alpha)r_F}{(1-p)r_E - (1-e_1)\lambda(1-\alpha)(r_F - r_B)}$$
$$\underline{\mu}_1 = \frac{r_B - pR}{(1-p)R - (1-\alpha)(1-e_1)(r_F - r_B)}.$$

Equilibrium construction closely follows the proof of Proposition 1 via Lemmas 1 and 2.

Comparative statics of $\bar{\mu}_1$ and $\underline{\mu}_1$ in e_1 is obvious - both thresholds are decreasing in e_1.

Next, turn to equilibrium profits. For $\mu < \underline{\mu}_1$ the fintech's and bank's profits are

$$V_F = (1-e_1)\mu(R - r_E) \qquad V_B + V_P = (1-e_1)\mu\Pi_B$$

respectively, and both are decreasing in e_1.

For $\underline{\mu}_1 < \mu < \bar{\mu}_1$ the fintech's and bank's profits are

$$V_F = (1-e_1)\mu(\underline{R}_B - r_E) \qquad V_B + V_P = (1-e_1)\mu\Pi_B$$

respectively, and both are decreasing in e_1 because $\underline{R}_B$ is also decreasing in e_1.

For $\mu > \bar{\mu}_1$ the fintech's and bank's profits are

$$V_F = 0 \qquad V_B + V_P = P(\mu)r_E - r_B$$

respectively - the are not affected by e_1. ∎

Now, we turn to the case of type-II error $e_1 = 0$ and $e_2 > 0$, so that a fintech firm might receive a good signal when facing a low-type borrower. In this case, $q_g = \mu + (1-\mu)e_2$, $q_b = (1-\mu)(1-e_2)$, $\mu_g = \frac{\mu}{q_g}$, and $\mu_b = 0$. The equilibrium is again characterized by two thresholds $\{\bar{\mu}_2, \underline{\mu}_2\}$, and we have the following results.

Corollary A.2. *With type-II error, the equilibrium consists of three regions: collaboration for $\mu < \underline{\mu}_2$, collaboration/competition for $\mu \in (\underline{\mu}_2, \bar{\mu}_2)$, and competition $\mu > \bar{\mu}_2$ similar to Proposition 1. The upper threshold $\bar{\mu}_2$ is decreasing in e_2 and the lower threshold $\underline{\mu}_2$ is increasing with e_2.*

Moreover, for e_2 small enough, equilibrium fintech firm profits are decreasing and bank profits are increasing in e_2 in every region.

Proof. With type-II error $e_2 > 0$ the fintech is no longer sure that it is facing a high-type borrower upon receiving a good signal, i.e., $\mu_g = \mu/[\mu + e_2(1-\mu)] < \mu$. Hence, the fintech's zero profit bid is $\underline{R}_F = \frac{r_E}{P(\mu_g)}$.

The curse-free bid of the bank $\underline{R}_B$ is affected through the expected partnership profits. Instead of bidding for only high-type borrowers (μ) the fintech bids for all borrowers those that are identified by the good signal ($\mu + e_2(1-\mu)$) hence,

$$P(\mu)R_B - r_B \geq [\mu + e_2(1-\mu)]\Pi_B \Rightarrow R_B \geq \underline{R}_B := \frac{r_B + [\mu + e_2(1-\mu)]\Pi_B}{P(\mu)}$$

Direct comparison of $\underline{R}_B$ vs. $\underline{R}_F$ and $\underline{R}_B$ vs. R give rise to the $\bar{\mu}$ and $\underline{\mu}$ respectively:

$$\begin{aligned}\bar{\mu}_2 &= \frac{(1-\lambda\alpha p)r_B - p(1-\lambda\alpha)r_F + e_2\Pi_B}{\lambda(1-\alpha p)r_B + [1-p-\lambda(1-\alpha p)]r_F + e_2\Pi_B}\\ \underline{\mu}_2 &= \frac{r_B - pR + e_2\Pi_B}{(1-p)R - \Pi_B + e_2\Pi_B}.\end{aligned}$$

Explicit derivations show that $\underline{\mu}_2$ is increasing in e_2 (since collaborating is becoming more attractive for the bank) and $\bar{\mu}_2$ is decreasing in e_2 (since fintech is becoming less competitive).

Equilibrium construction closely follows the proof of Proposition 1 via Lemmas 1 and 2.

Next, turn to equilibrium profits. For $\mu < \underline{\mu}_2$ the fintech's and bank's profits are

$$V_F = \mu(R - r_E) + e_2(1-\mu)(pR - r_E) \qquad V_B + V_P = [\mu + e_2(1-\mu)]\Pi_B$$

respectively. Bank's profits are increasing in e_2 due to higher volume of partnership lending and fintech's profits are decreasing in e_2 since low-type borrowers are negative NPV.

For $\underline{\mu}_2 < \mu < \bar{\mu}_2$ the fintech's and bank's profits are

$$V_F = \mu(\underline{R}_B - r_E) + e_2(1-\mu)(p\underline{R}_B - r_E) \qquad V_B + V_P = [\mu + e_2(1-\mu)]\Pi_B$$

respectively. Bank's profits are increasing in e_2 due to higher volume of partnership lending. Fintech's profits are decreasing because

$$\frac{d}{de_2}V_F = (1-\mu)\left(\mu\frac{\Pi_B}{P(\mu)} + (p\underline{R}_B - r_E) + e_2 p\frac{(1-\mu)\Pi_B}{P(\mu)}\right) < 0$$

for small enough e_2.

For $\mu > \bar{\mu}_1$ the fintech's and bank's profits are

$$V_F = 0 \qquad V_B + V_P = P(\mu)\frac{r_E}{P(\mu_g)} - r_B$$

respectively. Clearly, bank's profit is increasing in e_2. □

A.5 Analysis of Section 4.3 (Who Provides Partnership Funding)

The bank's curse-free bid becomes $\underline{R}_B = \frac{r_B}{P(\mu)}$, whereas the fintech firm's break-even bid $\underline{R}_F$ stays unchanged. The two critical thresholds in the average quality are

$$\underline{\mu}_{NC} = \frac{r_B/R - p}{1-p} < \underline{\mu} \qquad \bar{\mu}_{NC} = \frac{r_B/r_E - p}{1-p} < \bar{\mu},$$

where the subscripts NC stand for non-competing.

Proof of Proposition 4

Proof. Start with the fintech firm. In case of borrowing from a non-competing bank, fintech's profits are

$$V_F^{NC} = \begin{cases} \mu(R - r_E) & \text{for } \mu < \underline{\mu}_{NC}; \\ \mu\left(\frac{r_B}{P(\mu)} - r_E\right) & \text{for } \mu \in [\underline{\mu}_{NC}, \bar{\mu}_{NC}]; \\ 0 & \text{for } \mu > \bar{\mu}_{NC}. \end{cases}$$

And in case of a partnership the profits are

$$V_F = \begin{cases} \mu(R - r_E) & \text{for } \mu < \underline{\mu}; \\ \mu\left(\frac{r_B + \mu\Pi_B}{P(\mu)} - r_E\right) & \text{for } \mu \in [\underline{\mu}, \bar{\mu}]; \\ 0 & \text{for } \mu > \bar{\mu}. \end{cases}$$

Both profit functions have a hump shape, and have the same linear part for μ close to 0. However, V_F has a longer linear part ($\underline{\mu} > \underline{\mu}_{NC}$), has a higher non-linear part ($(r_B + \mu\Pi_B)/P(\mu) > r_B/P(\mu)$), and hits zero later ($\bar{\mu} > \bar{\mu}_{NC}$). Hence, we have $V_F(\mu) \geq V_F^{NC}(\mu)$ for all $\mu \in [0, 1]$. Moreover, for $\mu \in (\underline{\mu}_{NC}, \bar{\mu})$ the profits in case of partnership are strictly higher, i.e., $V_F(\mu) > V_F^{NC}(\mu)$.

Next, consider the bank. With third party financing the total bank profits are given by

$$V_B^{NC} + V_P^{NC} = \begin{cases} 0, & \text{if } \mu < \bar{\mu}^{NC} \\ P(\mu)r_E - r_B, & \text{if } \mu > \bar{\mu}^{NC} \end{cases}$$

And in case of a partnership the profits are

$$V_B + V_P = \begin{cases} \mu\Pi_B & \text{if } \mu < \bar{\mu}; \\ P(\mu)r_E - r_B, & \text{if } \mu > \bar{\mu} \end{cases}$$

Both profit functions have a piece-wise linear shape, and are equal to each other for $\mu > \bar{\mu}$. However, in case of partnership lending the bank earns positive profits for $\mu < \bar{\mu}_{NC}$ (as opposed to 0) and has higher joint direct and partnership profits if $\mu \in (\bar{\mu}_{NC}, \bar{\mu})$. Hence, we have $V_B + V_P(\mu) \geq V_B^{NC} + V_P^{NC}(\mu)$ for all $\mu \in [0, 1]$. Moreover, for $\mu \in (0, \bar{\mu})$ the profits in case of partnership are strictly higher, i.e., $V_B + V_P(\mu) > V_B^{NC} + V_P^{NC}(\mu)$.

Finally, consider the borrowers who face the bid distributions

$$F_F^{NC}(x) = \frac{P(\mu)x - r_B}{\mu(x - r_B)} \qquad F_B^{NC}(x) = \frac{x - r_B/P(\mu)}{x - r_E}$$
$$F_F(x) = \frac{P(\mu)x - r_B - \mu\Pi_B}{\mu(x - r_B - \Pi_B)} \qquad F_B(x) = \frac{x - (r_B + \mu\Pi_B)/P(\mu)}{x - r_E}$$

Moving from third party lending to the case with partnership funding reduces both F_F and F_B in the FOSD sense. Hence the borrowers suffer from higher bids by both the fintech firm and the bank. $\square$

A.6 Analysis of Section 4.4 (Competition for Partnership Funding)

In total, the fintech's effective funding cost is

$$r_E^\phi = (2\phi - 1)\lambda r_B + 2(1-\phi)\lambda[\alpha r_B + (1-\alpha)r_F] + (1-\lambda)r_S.$$

Partnership funding from the non-competing bank also reduces the competing bank's expected profits in partnership lending. Specifically, these profits are

$$\Pi_B^\phi = (1-\phi)\lambda(1-\alpha)(r_F - r_B).$$

If $\phi = \frac{1}{2}$ so that the competing bank can only provide at most half of the partnership funding, its profits are also halved compared to the benchmark model, i.e., $\Pi_B^{\frac{1}{2}} = \frac{1}{2}\Pi_B$. Meanwhile, if both banks can provide all the partnership funding so that $\phi = 1$, these profits are zero, i.e., $\Pi_B^1 = 0$.

The rest of the analysis closely follows that in Section 3. Specifically, the bank's curse-free bid is $\underline{R}_B^\phi = \frac{r_B + \mu\Pi_B^\phi}{P(\mu)}$, whereas the fintech's break-even bid becomes $\underline{R}_F^\phi = r_E^\phi$. The two thresholds in average quality are

$$\bar{\mu}^\phi = \frac{r_B - pr_E^\phi}{(1-p)r_E^\phi - (1-\phi)\lambda(1-\alpha)(r_F - r_B)}$$
$$\underline{\mu}^\phi = \frac{r_B - pR}{(1-p)R - (1-\phi)\lambda(1-\alpha)(r_F - r_B)}$$

Proof of Proposition 5

Proof. When the partnership funding market competitiveness is ϕ then borrowers at $\bar{\mu}(\phi)$ are funded only by the bank at a rate r^ϕ.

When the partnership funding market competitiveness is ϕ' then borrowers at $\bar{\mu}(\phi)$ are inside of the collaboration-competition region and can be funded by either lender. The lenders' bidding cdfs are given by

$$F_B^{\phi'}(x) = \frac{x - \underline{R}_B^{\phi'}(\mu)}{x - r_E^{\phi'}}$$
$$F_F^{\phi'}(x) = \frac{P(\mu)x - r_B - \mu\Pi_B^{\phi'}}{\mu(x - r_B - \Pi_B^{\phi'})}$$

Consider ϕ' sufficiently close enough to ϕ, i.e. $\phi' = \phi + \varepsilon$ and do a Taylor expansion:

$$\begin{aligned} r_E^{\phi'} &= r_E^{\phi} - 2\varepsilon\lambda(1-\alpha)(r_F - r_B) \\ \Pi_B^{\phi'} &= \Pi_B^{\phi} - \varepsilon\lambda(1-\alpha)(r_F - r_B) \\ \underline{R}_B^{\phi'} &= \underline{R}_B^{\phi} - \frac{\mu}{P(\mu)}\varepsilon\lambda(1-\alpha)(r_F - r_B) \end{aligned}$$

Next do a Taylor expansion of the bank's CDF:

$$F_B^{\phi'}(x) = F_B^{\phi}(x) - \frac{(x - r_E^{\phi})\frac{\mu}{P(\mu)} + 2(x - \underline{R}_B^{\phi}(\mu))}{(x - r_E^{\phi})^2}\varepsilon\lambda(1-\alpha)(r_F - r_B)$$

That is, the bank's bidding CDF FOSD increases, i.e., the bank offers higher interest rates.

Finally, do a Taylor expansion of the fintech's CDF:

$$F_F^{\phi'}(x) = F_F^{\phi}(x) + (1-\mu)\frac{r_B - px}{(x - r_B - \Pi_B^{\phi})^2}\varepsilon\lambda(1-\alpha)(r_F - r_B)$$

While the fintech's bidding CDF FOSD decreases.

At $\mu = \mu(\phi)$ the probability of bank lending is of the order $1 + O(\varepsilon)$ while the probability of fintech lending is of the order $O(\varepsilon)$. Hence, the change in the borrower's expected payoff is driven (up to the first order effect) by the bank's bidding CDF[26]. Due to the FOSD increase of the bank's bidding CDF the expected payoff goes down.

This argument proves that

$$\frac{\partial}{\partial\phi}V_H(\mu,\phi) < 0,$$

for $\mu = \bar{\mu}(\phi)$.

Moreover, the partial derivative $\frac{\partial}{\partial\phi}V_H(\mu,\phi)$ is continuous in competition-collaboration region. Hence, there exists $\hat{\mu}(\phi) \in (\underline{\mu}(\phi), \bar{\mu}(\phi))$ such that the partial derivative is negative for all $\mu \in (\hat{\mu}(\phi), \bar{\mu}(\phi))$.

□

[26]Since fintech wins with probability proportional to ε, it's bid can be approximated by F_F^{ϕ} which has a mass point of 1 on r_E^{ϕ}. But r_E^{ϕ} is rate offered by the bank at $\bar{\mu}(\phi)$ when partnership funding competition is ϕ. Hence, the change of the high-type borrower's expected payoff is zero when fintech wins.

B Case Studies

We present some real-world cases of competition and collaboration between banks and fintech firms.

OnDeck

OnDeck is an online small business lending company in the United States. Enova International acquired it in 2020. Below, we will describe the credit products and funding structure of OnDeck.

Credit products. OnDeck offers both term loans (a general lien on business assets) and (unsecured) credit lines to small businesses with low to fair credit history. The first loan was made in 2007. The limit of the credit lines varies between \$6,000 and \$100,000, with a 12-month repayment schedule that is reset after each drawdown. The size of the term loans varies between \$5,000 and \$250,000, with a repayment schedule of up to 12 months. Both programs have a nice feature of instant or same-day funding transfers, which is a big advantage over the standard ACH bank transfers that can take up to three business days.

Borrower eligibility. OnDeck imposes the following minimum requirements: 1 year in business, a personal FICO score of 625, an annual revenue of \$100,000, and a business bank account. Both credit programs have a starting APR of around 29.9%. As of March 31, 2022, the average APR for credit lines is 48.9%, and the one for term loans is 62.1%.

Credit allocation criteria. OnDeck has a proprietary small business credit scoring system, named "OnDeck Score", to assess the creditworthiness of a small business in real-time. The OnDeck Score uses machine learning and other statistical techniques to automate and optimize credit assessment, and the algorithm evolves continuously. The data include both information submitted by the customer and data from third parties. The data points include customer bank activity shown on their bank statements, government filings, tax and census data, reputation, and social data. Moreover, borrowers with an excellent payment history on prior loan products with OnDeck can enjoy the lowest rates. OnDeck claims that their OnDeck Score system is much more accurate in assessing credit risks than using only personal credit scores.

Competition and collaboration with banks. Several banks have collaborations with OnDeck, albeit in different forms. These include:

- Direct funding through credit lines. In 2013, it received a credit line from Deutsche Bank, Key Bank, and Square 1 Bank. In 2016 and 2018, OnDeck received revolving credit lines from Credit Suisse. In 2019, OnDeck established a revolving credit facility of $85 million with SunTrust Bank, Silicon Valley Bank, MB Financial Bank, and Congressional Bank.

- Funding partnerships. OnDeck partners with Celtic, a Utah-Chartered Bank, in making small-business loans. During the pandemic, they provide emergency relief loans to small businesses through the Paycheck Protection Program. The loans can be issued by either OnDeck or by Celtic Bank.[27] The website of OnDeck (https://www.ondeck.com/resources/top-10-faqs) suggests that whether OnDeck or Celtic issues the loan depends mostly on the state where the business is located and other attributes. It remains unclear what these other attributes are. The borrowing firm will figure this out before it signs the loan agreement. According to the 10-K Form filed by Enova in 2021, if Celtic issues the loan, OnDeck receives marketing fees, while the issuing bank (Celtic) receives origination fees and certain program fees. Meanwhile, OnDeck may also purchase these loans from Celtic. According to the 10-Q form filed by Enova in 2020 Q1, OnDeck purchased loans of $109.7 million from Celtic in the three months that ended March 31, 2020. If OnDeck originates the loan or if OnDeck purchases the loan, it is exposed to default risks.

  Besides Celtic, JP Morgan Chase also had a three-year partnership with OnDeck which began in 2015 but ended early in 2019. This partnership is also about small business loans. In 2019, JP Morgan Chase launched its own small business lending platform called "Quick Accept". This platform could be seen as a competitor to OnDeck.

- Interestingly, the Celtic bank also provides financing for small businesses. In fact, the Celtic bank has ranked in the top ten SBA lenders nationally every year since 2013.[28] It issues loans to small firms from hundreds of industries nationwide.[29] Interestingly, the website of the Celtic bank does not explicitly mention its partnership with OnDeck.

[27] https://www.ondeck.com/short-term-loans
[28] https://www.celticbank.com/company
[29] https://www.celticbank.com/

C Online Appendix

C.1 Analysis of Section 6.1 (Why Don't Lenders Collude?)

Suppose that if the bank and fintech firm cannot reach an agreement over the collusion contract, then they proceed to compete using their own funding, i.e., the bank and fintech firm can commit to shut down partnership funding market. Then the IR constraints can be rewritten as

$$\hat{V}_B + \hat{V}_i \geq V_B + V_i \quad \Leftrightarrow \quad \mu(r_C - r_B) \geq 0 \tag{IR_B}$$

$$\hat{V}_F \geq V_F \quad \Leftrightarrow \quad \mu(R - r_C) \geq \mu\left(\frac{r_B}{P(\mu)} - r_F\right). \tag{IR_F}$$

for $\mu \in \left[\frac{r_B/R-p}{1-p}, \frac{r_B/r_F-p}{1-p}\right]$ and

$$\hat{V}_B + \hat{V}_i \geq V_B + V_i \quad \Leftrightarrow \quad \mu(r_C - r_B) \geq P(\mu)r_F - r_B \tag{IR_B}$$

$$\hat{V}_F \geq V_F \quad \Leftrightarrow \quad \mu(R - r_C) \geq 0. \tag{IR_F}$$

for $\mu \in \left(\frac{r_B/r_F-p}{1-p}, 1\right]$.

The IC constraint of the bank remain the same in both regions:

$$\hat{V}_B + \hat{V}_i \geq P(\mu)R - r_B \quad \Leftrightarrow \quad \mu(r_C - r_B) \geq P(\mu)R - r_B. \tag{IC_B}$$

In the region $\left[\frac{r_B/R-p}{1-p}, \frac{r_B/r_F-p}{1-p}\right]$ collusion generates surplus of $\mu\,(R - r_B) - (P(\mu)r_F - r_B)$ while the bank deviation is $P(\mu)R - r_B - (P(\mu)r_F - r_B)$. Since $\mu(R - r_B) > P(\mu)R - r_B$, in this region there is always enough surplus to sustain collusion.

However, when μ is close to 1, (IC_B) implies that the collusion rate r_C needs to be close to R in order to prevent the bank deviation. This feature contradicts the fintech firm IC constraint $r_C \leq r_F$ - it would prefer to avoid using costly $r_C \approx R$ bank funding and instead rely on its own $r_F < R$ funding source.

C.2 Analysis of Section 5.3 (Fintech Competition)

Let us first provide the specific thresholds.

$$\begin{aligned}
\underline{R}_B^{2F} &= \frac{r_B + \mu(1-e_1^2)\Pi_B}{\mu + (1-\mu)p} \\
\underline{R}_F^{2F} &= r_E \\
\bar{\mu}^{2F} &= \frac{r_B - pr_E}{r_E(1-p) - (1-e_1^2)\Pi_B} \\
\underline{\mu}^{2F} &= \frac{r_B - p[e_1 R + (1-e_1)r_E]}{(1-p)[e_1 R + (1-e_1)r_E] - (1-e_1^2)\Pi_B}.
\end{aligned}$$

The threshold $\bar{R}_B^{2F}$ is determined from Equation (C.15) and (C.21) later in this subsection.

Similar to the analysis of Section 3. Define $\underline{R}_B^{2F}$ as the lowest rate the bank is willing to bid in the absence of the winner's curse:

$$P(\mu)\underline{R}_B^{2F} - r_B = \mu(1-e_1^2)\Pi_B \Rightarrow \underline{R}_B^{2F} := \frac{r_B + \mu(1-e_1^2)\Pi_B}{\mu + (1-\mu)p},$$

where e_1 is the Type I error. With only Type I error, conditional on receiving a good signal, a fintech is certain that it is facing a high-quality borrower. Consequently, the lowest rate it is willing to offer is

$$\underline{R}_F^{2F} = r_E.$$

The signals that the two competing fintechs receive generate three events: (g, g) - both fintechs receive good signals, (b, b) - both fintechs receive bad signals, and (g, b) - fintechs receive conflicting signals. The ex-ante probabilities of these events and the corresponding posteriors are as follows:

$$\begin{aligned}
&q_{gg} = \mu(1-e_1)^2 \qquad q_{bg} = \mu e_1(1-e_1) \qquad q_{bb} = \mu e_1^2 + (1-\mu) \\
&\mu_{gg} = \mu_{bg} = 1 \qquad\qquad\qquad\qquad\qquad \mu_{bb} = \frac{\mu e_1^2}{q_{bb}}
\end{aligned}$$

Throughout, we assume e_1 is sufficiently low such that even a single negative signal turns the project into negative NPV. Consequently, fintechs will bid only after a positive signal.

Proof of Proposition 6

Proof. Start with **Case 3**: suppose that $\underline{R}_B^{2F} < \underline{R}_F^{2F}$ or, equivalently, that

$$\mu \geq \bar{\mu}^{2F} := \frac{r_B - pr_E}{(1-p)r_E - (1-e_1^2)\Pi_B}. \tag{C.14}$$

In this parametric region, the bank has a dominant cost advantage. The bank always bids $\underline{R}_F^{2F}$ and wins. Fintechs bid in $(\underline{R}_F^{2F}, R]$ make zero profits and sometimes do not participate.

We only need to satisfy the bank's indifference constraint so that the bank does not bid above $\underline{R}_F^{2F}$:

$$\begin{aligned}P(\mu)\underline{R}_F^{2F} - r_B \geq q_{gg}[(1-F_F(\tilde{R}))^2(\tilde{R}-r_B) + (1-(1-F_F(\tilde{R}))^2)\Pi_B] \\ + 2q_{bg}[(1-F_F(\tilde{R}))(\tilde{R}-r_B) + F_F(\tilde{R})\Pi_B] + q_{bb}[P(\mu_{bb})\tilde{R}-r_B].\end{aligned}$$

In the case that the constraint binds, we get $F_F(\underline{R}_F^{2F}) = 0$ and $F_F(R) < 1$. The remaining mass $1 - F_F(R)$ is the probability that each fintech lender does not participate.

Case 2: next, suppose that $\underline{R}_F^{2F} < \underline{R}_B^{2F} \leq e_1 R + (1-e_1)\underline{R}_F^{2F}$ or, equivalently, $\underline{\mu}^{2F} \leq \mu < \bar{\mu}^{2F}$. In this parametric region bank's cost advantage and fintechs' information advantage are comparable in magnitudes. We construct a mixed strategy equilibrium: the bank bids in $[\underline{R}_B^{2F}, \bar{R}_B^{2F}]$ and a mass probability of not bidding and receiving $\mu(1-e_1^2)\Pi_B$ that are identical to the outside option, fintech lenders bid in $[\underline{R}_B^{2F}, R]$ and make positive profits.

In region $[\underline{R}_B^{2F}, \bar{R}_B^{2F}]$, everyone bids. The bank's indifference condition is:

$$\begin{aligned}\mu(1-e_1)^2\Pi_B = q_{gg}[(1-F_F(\tilde{R}))^2(\tilde{R}-r_B) + (1-(1-F_F(\tilde{R}))^2)\Pi_B] \\ + 2q_{bg}[(1-F_F(\tilde{R}))(\tilde{R}-r_B) + F_F(\tilde{R})\Pi_B] + q_{bb}[P(\mu_{bb})\tilde{R}-r_B]. \quad \text{(C.15)}\end{aligned}$$

We start with bank's IC, for $\tilde{R} = \underline{R}_B^{2F}$ it holds when

$$F_F(\underline{R}_B^{2F}) = 0.$$

Then we keep solving it for any $\tilde{R}$ in the interval to pin down $F_F(\tilde{R})$ for $\tilde{R} \in [\underline{R}_B^{2F}, \bar{R}_B^{2F}]$.

Next, consider the fintech's indifference condition in $\tilde{R} \in [\underline{R}_B^{2F}, \bar{R}_B^{2F}]$:

$$\underline{R}_B^{2F} - r_E = (1-F_B(\tilde{R})) \cdot [(1-e_1)(1-F_F(\tilde{R})) + e_1](\tilde{R}-r_E). \quad \text{(C.16)}$$

Fintech's IC then pins down the bank's bidding CDF F_B:

$$\frac{\underline{R}_B^{2F} - r_E}{\tilde{R}-r_E} \cdot \frac{1}{(1-e_1)(1-F_F(\tilde{R}))+e_1} = 1 - F_B(\tilde{R}),\ \tilde{R} \in [\underline{R}_B^{2F}, \bar{R}_B^{2F}]. \quad \text{(C.17)}$$

In the region $[\bar{R}_B^{2F}, R]$ only the fintechs bid, so only their condition is tight:

$$\underline{R}_B^{2F} - r_E = (1-F_B(\bar{R}_B^{2F})) \cdot [(1-e_1)(1-F_F(\tilde{R})) + e_1](\tilde{R}-r_E) \quad \text{(C.18)}$$

$$\frac{1}{1-e_1} \cdot \left(\frac{\underline{R}_B^{2F} - r_E}{\tilde{R}-r_E} \cdot \frac{1}{1-F_B(\bar{R}_B^{2F})} - e_1 \right) = 1 - F_F(\tilde{R}).$$

Since we also need to have $F_F(R) = 1$ and cannot have a mass probability at R (otherwise fintechs would undercut each other), it must be that

$$\frac{\underline{R}_B^{2F} - r_E}{R - r_E} \cdot \frac{1}{e_1} = 1 - F_B(\bar{R}_B^{2F}) \tag{C.19}$$

Since $F_B(\bar{R}_B^{2F}) \geq 0$ the last equation pins down $\underline{\mu}^{2F}$ as:

$$\frac{\underline{R}_B^{2F} - r_E}{R - r_E} \cdot \frac{1}{e_1} \leq 1$$

$$\mu \geq \underline{\mu}^{2F} := \frac{r_B - p[e_1 R + (1 - e_1) r_E]}{(1 - p)[e_1 R + (1 - e_1) r_E] - (1 - e_1)^2 \Pi_B}$$

Moreover, plugging (C.19) into (C.18), we get

$$\frac{e_1}{1 - e_1} \left(\frac{R - r_E}{\tilde{R} - r_E} - 1 \right) = 1 - F_F(\tilde{R}), \ \tilde{R} \in [\bar{R}_B^{2F}, R]. \tag{C.20}$$

At $\bar{R}_B^{2F}$ the CDF F_F needs to satisfy the bank's IC (C.15) and the equation above, i.e.

$$\frac{e_1}{1 - e_1} \left(\frac{R - r_E}{\bar{R}_B^{2F} - r_E} - 1 \right) = 1 - F_F(\bar{R}_B^{2F}) \tag{C.21}$$

simultaneously. Notice that this constraint always pins down $\bar{R}_B^{2F}$ in $[\underline{R}_B^{2F}, R]$. Since the solution of (C.15) is an increasing in $\tilde{R}$ functions that satisfies $F_F(\underline{R}_B^{2F}) = 0$ and $F_F(R) > 1$. While $\frac{e_1}{1-e_1} \left(\frac{R - r_E}{\tilde{R} - r_E} - 1 \right)$ is a decreasing function of $\tilde{R}$ with an above 1 value at $\underline{R}_B^{2F}$ (corresponding F_F is negative) and 0 at R (corresponding F_F equals to 1).

To make sure that this construction is an equilibrium we only need to verify that the bank does not want to bid in $(\bar{R}_B^{2F}, R]$. This holds by construction since $\bar{R}_B^{2F}$ is the intersection of the bank's IC with the CDF F_F implied by the fintech's IC (which is higher). Higher CDF implies a stronger winner's curse and makes the outside option more attractive relative to bidding. Technically, this follows from the single crossing of the two curves defined by equations (C.15) and (C.20) which we show below.

Case 1: finally, suppose that $\underline{R}_B^{2F} > e_1 R + (1 - e_1) \underline{R}_F^{2F}$ or, equivalently, $\mu < \underline{\mu}^{2F}$. In this parametric region, fintechs' information advantage and resulting winner's curse dissuade the bank from participating in the market.

We construct a mixed strategy equilibrium: the bank never bids and fintech lenders bid in $[\underline{R}, R]$ and make positive profits with $\underline{R} = (1 - e_1) \underline{R}_F^{2F} + e_1 R$. Since fintechs play a mixed strategy, their IC constraint should bind fintech's indifference condition:

$$\underline{R} - r_E = [(1 - e_1)(1 - F_F(\tilde{R})) + e_1](\tilde{R} - r_E), \tag{C.22}$$

which gives

$$F_F(\tilde{R}) = \frac{\tilde{R} - \underline{R}}{\tilde{R} - r_E} \cdot \frac{1}{1 - e_1}. \tag{C.23}$$

The lower bound of the fintechs' bidding distribution is pinned down implicitly by

$$F_F(R) = 1. \tag{C.24}$$

Hence $\underline{R} = (1 - e_1)\underline{R}_F^{2F} + e_1 R$.

To ensure the bank's non-participation we must have the following:

$$\begin{aligned} \mu(1 - e_1)^2 \Pi_B > q_{gg}&[(1 - F_F(\tilde{R}))^2(\tilde{R} - r_B) + (1 - (1 - F_F(\tilde{R}))^2)\Pi_B] \\ &+ 2q_{bg}[(1 - F_F(\tilde{R}))(\tilde{R} - r_B) + F_F(\tilde{R})\Pi_B] \\ &+ q_{bb}[P(\mu_{bb})\tilde{R} - r_B] \end{aligned} \tag{C.25}$$

for all $\tilde{R} \in [\underline{R}_B^{2F}, R]$. This inequality holds here by extending the argument from Case 2. It follows directly from the single crossing of the two curves defined by equations (C.15) and (C.20) which we show below.

Single Crossing of the Two CDFs. We will now verify that the two CDF curves defined by equations (C.15) and (C.20) satisfy single crossing property. The first CDR define by (C.15) is

$$\begin{aligned} \mu(1 - e_1)^2 \Pi_B = q_{gg}&[(1 - F_1(x))^2(x - r_B) + (1 - (1 - F_1(x))^2)\Pi_B] \\ &+ 2q_{bg}[(1 - F_1(x))(x - r_B) + F_1(x)\Pi_B] \\ &+ q_{bb}[P(\mu_{bb})x - r_B] \end{aligned} \tag{C.26}$$

Take d/dx to get

$$\begin{aligned} 0 = &\, q_{gg}(1 - F_1(x))^2 + 2q_{gg}[\Pi_B - (x - r_B)](1 - F_1(x))F_1'(x) \\ &+ 2q_{bg}(1 - F_1(x)) + 2q_{bg}[\Pi_B - (x - r_B)]F_1'(x) \\ &+ q_{bb}P(\mu_{bb}) \end{aligned} \tag{C.27}$$

and rewrite it as

$$(x - r_B - \Pi_B)F_1'(x) - (1 - F_1(x)) = \frac{q_{bb}P(\mu_{bb}) - q_{gg}(1 - F_1(x))[x - r_B - \Pi_B]F_1'(x)}{q_{gg}(1 - F_1(x)) + 2q_{bg}} \tag{C.28}$$

The second CDF define by (C.20) is

$$e_1(R - r_E) = [(1 - e_1)(1 - F_2(x)) + e_1](x - r_E), \tag{C.29}$$

With d/dx equals to

$$0 = (1 - e_1)(1 - F_2(x)) + e_1 - (1 - e_1)(x - r_E)F_2'(x) \tag{C.30}$$

or

$$(x - r_E)F_2'(x) - (1 - F_2(x)) = \frac{e_1}{1 - e_1} \tag{C.31}$$

We want to show that $F_2'(x) > F_1'(x)$ whenever $F_2(x) = F_1(x)$. Notice that for small p and e_1 the r.h.s. of (C.28) is smaller than the r.h.s. of (C.31) because $q_{bb}P(\mu_{bb}) \sim e_1^2$. At the same time, the second term in the l.h.s. of (C.28) $1 - F_1$ is the same as the second term in the l.h.s. of (C.31) $1 - F_2$. Finally, recall that $x - r_E < x - r_B - \Pi_B$. Hence, a smaller multiplier $x - r_E$ on $F_2'(x)$ in (C.31) results in bigger r.h.s. than (C.28) - this is only possible if $F_2'(x) > F_1'(x)$.

□

C.3 Analysis of Section 5.4 (Dissecting Mean and Variance Effects)

The following section characterizes the equilibrium outcome and lenders' profits in the case when fintech gets a perfectly informative signal with probability γ. Although changing μ in the main version of our model affects both the average quality of the pool and the degree of adverse selection (via variance), changing γ affects only the degree of adverse selection.

Here is a quick summary of the results obtained in the model with γ:

1. The three region structure of the equilibrium (collaborate for low μ, compete and collaborate for intermediate μ, bank dominance for high μ) remains the same for all $\gamma \in (0, 1]$

2. For a fixed γ the profit functions of the lenders (for different μ) look qualitatively similar to the case of the main model, i.e., $\gamma = 1$: bank's profits are increasing in μ and fintech's profits peak in the competition-collaboration region.[30]

3. Partnership funding has similar effect on lender's profits across all $\gamma > \underline{\gamma}$. That is, fintech prefers to partner with the bank ($\lambda = 1$) instead of competing without partnership ($\lambda = 0$). While the bank prefers partnership ($\lambda = 1$) only when μ is sufficiently high.

4. Variance effect: For a fixed μ, increasing γ (an increase in adverse selection) could decrease or increase the amount of lending competition. The former happens when the average quality μ of the pool is sufficiently small: higher adverse selection forces the bank to retreat from direct lending and rely more on partnership funding. The latter happens when the average quality of the pool is sufficiently large. Higher adverse selection reduces the bank's profits from lending to U and L types only and increases its incentives to capture the whole market by undercutting fintech.

5. Mean effect: to isolate the effect of the mean we can adjust $\gamma = \gamma(\mu)$ to keep the variance $Var(p_\theta)$ constant. Along such an iso-variance curve the lending pattern is similar to our main model: bank dominance when the average pool quality is high, competition and collaboration for intermediate quality, and collaboration only in low quality pools.

Augment the baseline model so that fintech gets a perfectly informative signal with probability γ, and with probability $1 - \gamma$ it gets no signal at all. With such a modification the model effectively becomes a 3

[30] Unlike the main model, for $\gamma \in (0, 1)$ the profits of the lender's might be discontinuous in μ. The discontinuity occurs due to a discrete change in the bank's outside option depending on whether the fintech is willing to bid after receiving an uninformative signal.

type model $\theta \in \{H, U, L\}$ with probabilities of repayment

$$p_H = 1, \qquad p_U = \mu + (1-\mu)p, \qquad p_L = p,$$

and prior

$$\Pr(\theta = H) = \gamma\mu, \qquad \Pr(\theta = U) = 1 - \gamma, \qquad \Pr(\theta = L) = \gamma(1-\mu).$$

Define the H break-even bids for the fintech

$$\underline{R}_F^H = \frac{r_E}{1}$$

Since in the partnership funding stage the lending decision is sunk, the fintech would have to lend to U type regardless of whether it receives partnership funding. In this case partnership funding generates surplus $\lambda(r_B - r_F)$ and we can define the U break-even bid for the fintech as

$$\underline{R}_F^U = \frac{r_E}{p_U} = \frac{r_E}{\mu + (1-\mu)p}. \tag{C.32}$$

When $\underline{R}_F^U \geq R$ the fintech does not bid for the U type with certainty and when $\underline{R}_F^U < R$ the fintech could bid for the U type. This is what determines the following two cases.

Case 1: $\mu < \mu^*$, i.e., $\underline{R}_F^U > R$ In this case the fintech bids only after the G signal and never bids after a U signal or B signal.

In this region, the bank has three choices now:

1. lend to all directly (at the rate at most $\underline{R}_F^H$) and receive no partnership funding
2. lend to U and L (at the rate R) and receive partnership funding from H
3. lend to no-one directly and receive partnership funding from H

The comparison between 1 and 3 boils down to

$$\begin{aligned}
(\mu + (1-\mu)p)\underline{R}_F^H - r_B \quad &vs. \quad \gamma\mu\Pi_B \\
\underline{R}_F^H \quad &vs. \quad \frac{r_B + \gamma\mu\Pi_B}{(\mu + (1-\mu)p)} =: \underline{R}_B^H
\end{aligned}$$

The comparison between 2 and 3 boils down to

$$\begin{aligned}
(1-\gamma)(p_U R - r_B) + \gamma(1-\mu)(pR - r_B) + \gamma\mu\Pi_B \quad &vs. \quad \gamma\mu\Pi_B \\
[(1-\gamma)p_U + \gamma(1-\mu)p]R \quad &vs. \quad [1 - \gamma + \gamma(1-\mu)]r_B \\
R \quad &vs. \quad \frac{[1-\gamma+\gamma(1-\mu)]r_B}{(1-\gamma)p_U + \gamma(1-\mu)p} =: \underline{R}_F^U
\end{aligned}$$

The comparison between 1 and 2 boils down to

$$(\mu+(1-\mu)p)\underline{R}_F^H - r_B \quad vs. \quad (1-\gamma)(p_U R - r_B) + \gamma(1-\mu)(pR - r_B) + \gamma\mu\Pi_B$$
$$\gamma\mu(\underline{R}_F^H - r_B) \quad vs. \quad [(1-\gamma)p_U + \gamma(1-\mu)p](R - \underline{R}_F^H) + \gamma\mu\Pi_B$$
$$\gamma\mu(\underline{R}_F^H - r_B - \Pi_B) \quad vs. \quad [(1-\gamma)p_U + \gamma(1-\mu)p](R - \underline{R}_F^H)$$

Recall that $r_E = \lambda\rho + (1-\lambda)r_F$ and $\Pi_B = \lambda(\rho - r_B)$ and as a result $\underline{R}_F^U(\mu) > \underline{R}_B^H(\mu)$.

Consider all possible sub-cases:

Sub-case 1.1 $1 > 3, 1 > 2$ **[Bank always lends to** HUL**]** In this case lending directly (option 1) is the dominant option. The bank bids $\underline{R}_F^H$, always wins and receives no partnership funding. The fintech bids $\underline{R}_F^H$ after good signal and does not bid otherwise. The bank does not deviate to a higher interest rate, since it loses H type borrowers, and in the best-case scenario (when it bids R and gets U and L) it still prefers $1 > 2$.

Lenders' profits are

$$V_F = 0 \qquad V_B + V_P = [\mu + (1-\mu)p]\underline{R}_F^H - r_B \tag{C.33}$$

Sub-case 1.2 $2 > 1, 2 > 3$ **[Bank always lends to** UL **and lenders c&c for** H**]** Here option 2 is the dominant one. That is, the bank strictly prefers to forgo the H type and bid R lending only to U and L as opposed to not bidding at all or undercutting the fintech at r_E and lending to HUL.

Effectively the bank wants to split the market and charge R to UL as long as the fintech charges r_E to H. However, the bank just bidding R cannot be an equilibrium. If the bank were to only bid R and lend to UL, the fintech would not bid r_E for the high types, instead it would bid $R - \varepsilon$. But then the bank could decrease the bid to $R - 2\varepsilon$, profitably undercut the fintech, and lend to HUL.

Hence, the bank cannot completely give up on the H types in equilibrium and need to put the price pressure on the fintech to prevent it charging R to the H types. In the conjectured equilibrium (similar to Sub-cases 2.2) the fintech and the bank bid in $[R^*, R]$ where $R^* \in (r_E, R)$ is pinned down by

$$[\mu + (1-\mu)p]R^* - r_B = (1-\gamma)(p_U R - r_B) + \gamma(1-\mu)(pR - r_B) + \gamma\mu\Pi_B. \tag{C.34}$$

That is, the bank is indifferent between charging R^* while lending to HUL and charging R while lending to UL only.

The fintech's bidding cdf, i.e., $\Pr(\tilde{F} < x)$ for $x \in (R^*, R)$ is pinned down by the bank's indifference for bidding x vs. R^*:

$$[\mu + (1-\mu)p]R^* - r_B = (1-\gamma)(p_U x - r_B) + \gamma(1-\mu)(px - r_B) \\ + \gamma\mu[\Pr(\tilde{F} \geq x)(x - r_B) + \Pr(\tilde{F} < x)\Pi_B] \tag{C.35}$$

Notice that the $\Pr(\tilde{F} < R^*) = 0$ and the cdf is continuous at R^*, hence, the fintech has no mass point of bidding at R^*.

At R we have

$$\begin{aligned} &(1-\gamma)(p_U R - r_B) + \gamma(1-\mu)(pR - r_B) \\ &+\gamma\mu[\Pr(\tilde{F} \geq R)(x - r_B) + \Pr(\tilde{F} < R)\Pi_B] = [\mu + (1-\mu)p]R^* - r_B \\ &\qquad = (1-\gamma)(p_U R - r_B) + \gamma(1-\mu)(pR - r_B) + \gamma\mu\Pi_B \end{aligned}$$

Hence, $\Pr(\tilde{F} < R) = 1$ and the fintech does not have a mass point of bidding at R.

The bank bidding cdf, on the other hand, is pinned down by fintech's indifference

$$R^* - r_E = \Pr(\tilde{B} > x) \cdot (x - r_E) \qquad x \in (R^*, R). \tag{C.36}$$

Notice that the $\Pr(\tilde{B} > R^*) = 1$, i.e., the bank has no mass point of bidding at R^*, and $\Pr(\tilde{B} = R) = (R^* - r_E)/(R - R_E) > 0$, hence the bank has a mass point of bidding at R.

In such construction the bank bids in $(R^*, R]$ and the fintech bids in (R^*, R). None of the lenders want to deviate to any bid $x < R^*$ (since it is strictly dominated by bidding R^*). Both of the lenders are indifferent between following their mixed strategies and deviate to bidding R^* (by construction). Finally, the fintech's deviation to bidding R is strictly unprofitable due to the bank's bidding mass point at R and borrowers preferring the bank in case of a tie (bidding $R - \varepsilon$ is always better than bidding R).

The Lenders' profits are

$$V_F = \gamma\mu(R^* - r_E) \qquad V_B + V_P = (1-\gamma)(p_U R - r_B) + \gamma(1-\mu)(pR - r_B) + \gamma\mu\Pi_B \tag{C.37}$$

Sub-case 1.3 $1 < 3, 2 < 3$ Here option 3 is the dominant one. That is, the bank strictly prefers to step away from direct lending as opposed to lending to UL at R or lending to HUL at r_E.

Sub-case 1.3a $1 < 3, 2 < 3, \underline{R}_B^H \geq R$ **[Lenders only collaborate]** If the bank does not bid, then absent competition the fintech would charge R. If

$$\begin{aligned}(\mu + (1-\mu)p)R - r_B &\leq \gamma\mu\Pi_B \\ R &\leq \frac{r_B + \gamma\mu\Pi_B}{(\mu + (1-\mu)p)} =: \underline{R}_B^H \\ R &\leq \underline{R}_B^H\end{aligned}$$

Then non-bidding by the bank is an equilibrium (this is complete collaboration case). The equilibrium profits are:

$$V_F = \gamma\mu(R - r_E) \qquad V_B + V_P = \gamma\mu\Pi_B \tag{C.38}$$

Sub-case 1.3b $1 < 3, 2 < 3, \underline{R}_B^H < R$ **[Bank sometimes lends to UL lenders c&c for H]** If, however, $\underline{R}_B^H < R$ then non-bidding by the bank is not an equilibrium. We can construct an equilibrium similar to our competition-collaboration case of the main paper. In such equilibrium, the bank bids in $(\underline{R}_B^H, R)$ and has a mass point of not bidding at all, and the fintech bids in $(\underline{R}_B^H, R]$ with a mass point at R.

The equilibrium profits are:

$$V_F = \gamma\mu(\underline{R}_B^H - r_E) \qquad V_B + V_P = \gamma\mu\Pi_B \tag{C.39}$$

Case 2: $\mu > \mu^*$, i.e., $\underline{R}_F^U < R$. In this case the fintech could bid after the U signal as well.

In this region the bank has three choices now:

1. lend to all directly (at the rate at most $\underline{R}_F^H$) and receive no partnership funding
2. lend to U and L (at the rate at most $\underline{R}_F^U$) and receive partnership funding from H
3. lend to no-one directly and receive partnership funding from H and U

The comparison between 1 and 3 boils down to

$$\begin{aligned}(\mu + (1-\mu)p)\underline{R}_F^H - r_B \quad &vs. \quad [\gamma\mu + (1-\gamma)]\Pi_B \\ \underline{R}_F^H \quad &vs. \quad \frac{r_B + [\gamma\mu + (1-\gamma)]\Pi_B}{(\mu + (1-\mu)p)} =: \underline{R}_B^H\end{aligned}$$

The comparison between 2 and 3 boils down to

$$
\begin{aligned}
(1-\gamma)(p_U \underline{R}_F^U - r_B) + \gamma(1-\mu)(p\underline{R}_F^U - r_B) + \gamma\mu\Pi_B \quad &vs. \quad [\gamma\mu + (1-\gamma)]\Pi_B \\
[(1-\gamma)p_U + \gamma(1-\mu)p]\underline{R}_F^U \quad &vs. \quad [1-\gamma+\gamma(1-\mu)]r_B + (1-\gamma)\Pi_B \\
\underline{R}_F^U \quad &vs. \quad \frac{[1-\gamma+\gamma(1-\mu)]r_B + (1-\gamma)\Pi_B}{(1-\gamma)p_U + \gamma(1-\mu)p} =: \underline{R}_B^U
\end{aligned}
$$

The comparison between 1 and 2 boils down to

$$
\begin{aligned}
(\mu + (1-\mu)p)\underline{R}_F^H - r_B \quad vs. \quad (1-\gamma)(p_U \underline{R}_F^U - r_B) + \gamma(1-\mu)(p\underline{R}_F^U - r_B) + \gamma\mu\Pi_B \\
\gamma\mu(\underline{R}_F^H - r_B) \quad vs. \quad [(1-\gamma)p_U + \gamma(1-\mu)p](\underline{R}_F^U - \underline{R}_F^H) + \gamma\mu\Pi_B \\
\gamma\mu(\underline{R}_F^H - r_B - \Pi_B) \quad vs. \quad [(1-\gamma)p_U + \gamma(1-\mu)p](\underline{R}_F^U - \underline{R}_F^H)
\end{aligned}
$$

These inequalities give rise to the following cases.

Sub-case 2.1 $1 > 3, 1 > 2$ **[Bank always lends to HUL]** In this case lending directly (option 1) is the dominant option. The bank bids $\underline{R}_F^H$, always wins and receives no partnership funding. The fintech bids $\underline{R}_F^H$ after good signal and $\underline{R}_F^U$ after no signal to prevent the bank's deviations to higher interest rates.

Lenders' profits are

$$
V_F = 0 \qquad V_B + V_P = [\mu + (1-\mu)p]\underline{R}_F^H - r_B \tag{C.40}
$$

Sub-case 2.2 $2 > 1, 2 > 3$ **[Bank lends to UL and lenders c&c for H]** Here option 2 is the dominant one. That is, the bank strictly prefers to forgo the H type and bid $\underline{R}_F^U$ lending only to U and L as opposed to not bidding at all or undercutting the fintech at r_E and lending to HUL.

Effectively the bank wants to split the market and charge $\underline{R}_F^U$ to UL as long as the fintech charges r_E to H. However, the bank just bidding $\underline{R}_F^U$ cannot be an equilibrium. If the bank were to only bid $\underline{R}_F^U$ and lend to UL, the fintech would not bid r_E for the high types, instead it would bid $\underline{R}_F^U - \varepsilon$. But then the bank could decrease the bid to $\underline{R}_F^U - 2\varepsilon$, profitably undercut the fintech, and lend to HUL.

Hence, the bank cannot completely give up on the H types in equilibrium and need to put the price pressure on the fintech to prevent it charging $\underline{R}_F^U$ to the H types. In the conjectured equilibrium (similar to Sub-cases 1.2) the fintech and the bank bid in $[R^*, \underline{R}_F^U]$ where $R^* \in (r_E, \underline{R}_F^U)$ is pinned down by

$$
[\mu + (1-\mu)p]R^* - r_B = (1-\gamma)(p_U \underline{R}_F^U - r_B) + \gamma(1-\mu)(p\underline{R}_F^U - r_B) + \gamma\mu\Pi_B \tag{C.41}
$$

That is, the bank is indifferent between charging R^* while lending to HUL and charging $\underline{R}_F^U$ while lending to UL only.

The fintech's bidding cdf, i.e., $\Pr(\tilde{F} < x)$ for $x \in (R^*, \underline{R}_F^U)$ is pinned down by the bank's indifference for bidding x vs. R^*:

$$\begin{aligned}[\mu + (1-\mu)p]R^* - r_B = (1-\gamma)(p_U x - r_B) + \gamma(1-\mu)(px - r_B) \\ + \gamma\mu[\Pr(\tilde{F} \geq x)(x - r_B) + \Pr(\tilde{F} < x)\Pi_B]\end{aligned} \tag{C.42}$$

Notice that the $\Pr(\tilde{F} < R^*) = 0$ and the cdf is continuous at R^*, hence, the fintech has no mass point of bidding at R^*.

At $\underline{R}_F^U$ we have

$$\begin{aligned}&(1-\gamma)(p_U \underline{R}_F^U - r_B) + \gamma(1-\mu)(p\underline{R}_F^U - r_B) \\ &+\gamma\mu[\Pr(\tilde{F} \geq \underline{R}_F^U)(x - r_B) + \Pr(\tilde{F} < \underline{R}_F^U)\Pi_B] = [\mu + (1-\mu)p]R^* - r_B \\ &\qquad = (1-\gamma)(p_U \underline{R}_F^U - r_B) + \gamma(1-\mu)(p\underline{R}_F^U - r_B) + \gamma\mu\Pi_B\end{aligned}$$

Hence, $\Pr(\tilde{F} < \underline{R}_F^U) = 1$ and the fintech does not have a mass point of bidding at $\underline{R}_F^U$.

The bank bidding cdf, on the other hand, is pinned down by fintech's indifference

$$R^* - r_E = \Pr(\tilde{B} > x) \cdot (x - r_E) \qquad x \in (R^*, \underline{R}_F^U). \tag{C.43}$$

Notice that the $\Pr(\tilde{B} > R^*) = 1$, i.e., the bank has no mass point of bidding at R^*, and $\Pr(\tilde{B} = \underline{R}_F^U) = (R^* - r_E)/(\underline{R}_F^U - R_E) > 0$, hence the bank has a mass point of bidding at $\underline{R}_F^U$.

In such construction the bank bids in $(R^*, \underline{R}_F^U]$ and the fintech bids in $(R^*, \underline{R}_F^U)$ after the good signal. None of the lenders want to deviate to any bid $x < R^*$ (since it is strictly dominated by bidding R^*). Both of the lenders are indifferent between following their mixed strategies and deviate to bidding R^* (by construction). The fintech's deviation to bidding $\underline{R}_F^U$ after the good signal is strictly unprofitable due to the bank's bidding mass point at $\underline{R}_F^U$ and borrowers preferring the bank in case of a tie (bidding $\underline{R}_F^U - \varepsilon$ is always better than bidding $\underline{R}_F^U$). To prevent the bank from bidding above $\underline{R}_F^U$ the fintech bids $\underline{R}_F^U$ after the U signal but this bid never wins.

The Lenders' profits are

$$V_F = \gamma\mu(R^* - r_E) \qquad V_B + V_P = (1-\gamma)(p_U \underline{R}_F^U - r_B) + \gamma(1-\mu)(p\underline{R}_F^U - r_B) + \gamma\mu\Pi_B \tag{C.44}$$

Sub-case 2.3 $1 < 3, 2 < 3$ Here option 3 is the dominant one. That is, the bank strictly prefers to step away from direct lending as opposed to lending to UL at $\underline{R}_F^U$ or lending to HUL at r_E.

If the bank were not to bid, the fintech would bid R after both H and U signals. The bank prefers to stay out if and only if both $\underline{R}_B^H \geq R$ and $\underline{R}_B^U > R$.

However, we have

$$R > \underline{R}_F^U = \frac{r_E}{\mu + (1-\mu)p} > \frac{r_B + [\gamma\mu + (1-\gamma)]\Pi_B}{\mu + (1-\mu)p} = \underline{R}_B^H > r_E,$$

hence no bidding by the bank cannot be an equilibrium.

We have two possible sub-cases depending on R_B^U vs R:

Sub-case 2.3a $1 < 3, 2 < 3, \underline{R}_B^U \geq R$ **[Bank sometimes lends to L lenders c&c for HU]** In this case the bank does not want to lend to UL even at the rate of R. Construct the equilibrium as follows: after the U signal the fintech bids R. And after the H signal the bank mixes in $(\underline{R}_B^H, R]$ with a mass point at R while the bank mixes in $(\underline{R}_B^H, R)$ with a mass point of no bidding at all.

To make the fintech after the H signal indifferent the bank's bidding cdf solves

$$\underline{R}_B^H - r_E = \Pr(\tilde{B} > x) \cdot (x - r_E). \tag{C.45}$$

Now check the incentives of the fintech after U signal. It is supposed to always bid R but could deviate to $x \in (\underline{R}_B^U, R)$:

$$\begin{aligned}
\Pr(\tilde{B} > x)(p_U x - r_E) \quad &vs. \quad \Pr(\tilde{B} > R)(p_U R - r_E) \\
\frac{\Pr(\tilde{B} > x)}{\Pr(\tilde{B} > R)} \quad &vs. \quad \frac{p_U R - r_E}{p_U x - r_E} \\
\frac{R - r_E}{x - r_E} \quad &vs. \quad \frac{p_U R - r_E}{p_U x - r_E} \\
\frac{R - r_E}{x - r_E} \quad &< \quad \frac{p_U R - r_E}{p_U x - r_E}
\end{aligned}$$

Hence, the fintech after U signal does not want to deviate to $x \in (\underline{R}_B^U, R)$ from R. Moreover, it does not to deviate to any rate below $\underline{R}_B^U$ either since it is strictly dominated by charging $\underline{R}_B^U$ (which in turn is dominated by charging R).

The fintech's cdf after the H signal is pinned down by the bank's indifference condition:

$$\begin{aligned}
[\gamma\mu + (1-\gamma)]\Pi_B = {} & (1-\gamma)(p_U x - r_B) + \gamma(1-\mu)(px - r_B) \\
& + \gamma\mu[\Pr(\tilde{F} \geq x)(x - r_B) + \Pr(\tilde{F} < x)\Pi_B].
\end{aligned} \tag{C.46}$$

The lenders' profits are

$$V_F = \gamma\mu(\underline{R}_B^H - r_E) + (1-\gamma) \cdot \frac{\underline{R}_B^H - r_E}{R - r_E}(p_U R - r_E) \tag{C.47}$$

$$V_B + V_P = [\gamma\mu + (1-\gamma)]\Pi_B \tag{C.48}$$

Sub-case 2.3b $1 < 3, 2 < 3, \underline{R}_B^U < R$ **[Bank sometimes lends to** L **lenders c&c for** HU**]** In this case we have $r_E < \underline{R}_B^H < \underline{R}_F^U < \underline{R}_B^U < R$. Here the previous equilibrium construction does not work since bidding R and lending to UL strictly dominates non-lending for the bank. Construct the equilibrium as follows: after the H signal the fintech bids in $(\underline{R}_B^H, \underline{R}_B^U]$ with a mass point at $\underline{R}_B^U$. To make the fintech after H signal indifferent the the bank bidding cdf in the region $(\underline{R}_B^H, \underline{R}_B^U]$ satisfies

$$\underline{R}_B^H - r_E = \Pr(\tilde{B} > x) \cdot (x - r_E). \tag{C.49}$$

After the U signal the fintech would bid in $(\underline{R}_B^U, R]$ with a mass point at R (which the bank also does not want to undercut). To make the fintech after U signal indifferent the the bank bidding cdf in the region $(\underline{R}_B^U, R]$ satisfies

$$p_U \underline{R}_B^U - r_E = \Pr(\tilde{B} > x \,|\, \tilde{B} > \underline{R}_B^U) \cdot (p_U x - r_E). \tag{C.50}$$

Bank's bidding cdf makes sure that the fintech after H and after U signal is indifferent where to bid in its own equilibrium bidding region. Moreover, mixing of the bank makes sure that after the U signal the fintech does not want to bid below $\underline{R}_B^U$ (just like in protected against downward deviations from R in case 2.3a). Finally, we need to check that after H signal the fintech does not want to bid x above $\underline{R}_B^U$:

$$\begin{aligned}
\Pr(\tilde{B} > \underline{R}_B^U)(\underline{R}_B^U - r_E) \quad &vs. \quad \Pr(\tilde{B} > x)(x - r_E) \\
\Pr(\tilde{B} > \underline{R}_B^U \,|\, \tilde{B} > \underline{R}_B^U)(\underline{R}_B^U - r_E) \quad &vs. \quad \Pr(\tilde{B} > x \,|\, \tilde{B} > \underline{R}_B^U)(x - r_E) \\
\frac{\Pr(\tilde{B} > \underline{R}_B^U \,|\, \tilde{B} > \underline{R}_B^U)}{\Pr(\tilde{B} > x \,|\, \tilde{B} > \underline{R}_B^U)} \quad &vs. \quad \frac{x - r_E}{\underline{R}_B^U - r_E} \\
\frac{p_U x - r_E}{p_U \underline{R}_B^U - r_E} \quad &vs. \quad \frac{x - r_E}{\underline{R}_B^U - r_E} \\
\frac{p_U x - r_E}{p_U \underline{R}_B^U - r_E} \quad &> \quad \frac{x - r_E}{\underline{R}_B^U - r_E}
\end{aligned}$$

Hence, given the bank bidding strategy the fintech does not want to deviate from the equilibrium mixing after either U or H signal.

The fintech's cdf after the H signal in region $(\underline{R}_B^H, \underline{R}_B^U]$ should make the bank indifferent between winning and losing H type:

$$[\gamma\mu + (1-\gamma)]\Pi_B = (1-\gamma)(p_U x - r_B) + \gamma(1-\mu)(px - r_B) \\ + \gamma\mu[\Pr(\tilde{F} \geq x)(x - r_B) + \Pr(\tilde{F} < x)\Pi_B]. \tag{C.51}$$

The fintech's cdf after the H signal in region $(\underline{R}_B^H, \underline{R}_B^U]$ should make the bank indifferent between bidding and not bidding at all:

$$[\gamma\mu + (1-\gamma)]\Pi_B = (1-\gamma)(p_U x - r_B) + \gamma(1-\mu)(px - r_B) \\ + \gamma\mu[\Pr(\tilde{F} \geq x)(x - r_B) + \Pr(\tilde{F} < x)\Pi_B]. \tag{C.52}$$

The fintech's cdf after the U signal in region $(\underline{R}_B^U, \underline{R}_B^R]$ should make the bank indifferent between bidding and not bidding at all:

$$[\gamma\mu + (1-\gamma)]\Pi_B = \gamma\mu\Pi_B + \gamma(1-\mu)(px - r_B) \\ + (1-\gamma)[\Pr(\tilde{F} \geq x)(p_U x - r_B) + \Pr(\tilde{F} < x)\Pi_B]. \tag{C.53}$$

The lenders' profits are

$$V_F = \gamma\mu(\underline{R}_B^H - r_E) + (1-\gamma) \cdot \frac{\underline{R}_B^H - r_E}{R - r_E}(p_U \underline{R}_B^U - r_E) \tag{C.54}$$

$$V_B + V_P = [\gamma\mu + (1-\gamma)]\Pi_B \tag{C.55}$$

C.4 Analysis of Subsection 6.2 (Convenience Benefits and Sticky Banking Relationships)

Fintech firm has the convenience benefits only. Consider the model in which the fintech firm does not have information advantage and only has the convenience advantage. That is, both bank and fintech firm share a common prior that the fraction of high-type borrowers in the pool is μ. Moreover, when faced with a bid R_B from a bank and R_F from a fintech firm the borrowers will choose the bank whenever $R_B < R_F - \Delta_F$. The partnership funding market allows the fintech firm to obtain funding at a lower rate and creates an additional source of profits for the bank. Similar to the main model the fintech firm's effective funding rate is r_E and the per loan partnership funding profits of the bank are Π_B.

Define the following thresholds: $\underline{\mu}_C < \hat{\mu}_C$ as the solutions of

$$R \cdot P(\underline{\mu}_C) = r_B \qquad \text{and} \qquad R \cdot P(\hat{\mu}_C) = r_E$$

respectively.

For $\mu < \underline{\mu}_C$ we have $R \cdot P(\mu) < r_B < r_E$, hence neither lender participates.

For $\mu \in (\underline{\mu}_C, \hat{\mu}_C)$ we have $r_B < R \cdot P(\mu) < r_E$, hence only the bank participates and charges a rate R.

For $\mu > \hat{\mu}_C$ we have $r_B < r_E < R \cdot P(\mu)$, hence both lenders could participate. Who wins the bidding game depends on the size of the fintech firm's convenience advantage. Due to the presence of the partnership funding market when $\mu > \hat{\mu}_C$, the lowest rate the bank is willing to charge is $\underline{R}_B(\mu) \equiv \frac{r_B + \Pi_B}{P(\mu)}$ (the outside option is to retreat to the partnership funding market) and the fintech firm is willing to go as low as $\underline{R}_F(\mu) \equiv \frac{r_E}{P(\mu)}$ (the outside option is not participating and generating zero profit). Note that for $\mu > \hat{\mu}_C$ we have $\underline{R}_B(\mu) \leq \underline{R}_F(\mu) < R$ and the inequality is strict whenever $\lambda < 1$. The fintech firm can undercut the bank whenever $\underline{R}_F(\mu) < \underline{R}_B(\mu) + \Delta_F$ or, equivalently, whenever $P(\mu)\Delta_F > (1-\lambda)(r_F - r_B)$. This inequality gives rise to a cut-off $\bar{\mu}_C$ such that for $\mu > \bar{\mu}_C$ the fintech firm is able to successfully undercut the bank and lend, and for $\mu \in (\hat{\mu}_C, \bar{\mu}_C)$ the bank is able to undercut the fintech firm and lend. In particular, $\overline{\mu}_C$ is given by

$$\overline{\mu}_C \equiv \frac{(1-\lambda)(r_F - r_B)}{\Delta_F(1-p)} - \frac{p}{1-p}.$$

Hence, generically, the equilibrium has four regions: $\mu < \underline{\mu}_C$ - no lending (N); $\mu \in (\underline{\mu}_C, \hat{\mu}_C)$ - monopoly bank lending (MB); $\mu \in (\hat{\mu}_C, \bar{\mu}_C)$ - competitive bank lending (CB); $\mu \in (\bar{\mu}_C, 1]$ - competitive fintech lending (CF).

Depending on the model parameters either of the regions (CB) or (CF) maybe be absent depending on how $\bar{\mu}_C$ compares with 1 and $\hat{\mu}_C$. If $\bar{\mu}_C \geq 1$, or $\Delta_F \leq (1-\lambda)(r_F - r_B)$, then the region (CF) is absent. If

$\bar{\mu}_C \leq \hat{\mu}_C$, or $\Delta_F \geq (1-\lambda)(r_F - r_B) \cdot \frac{R}{r_E}$, then the region (CB) is absent. In the remaining case $\bar{\mu}_C \in (\hat{\mu}_C, 1)$ both regions (CB) and (CF) are present.

Fintech Convenience Benefits with Screening Advantage. The logic of Proposition 1 goes through in case fintech has additional convenience benefits.

To proceed, we need to assume the fintech firm's convenience benefit is small enough compared with the financing cost, i.e., $(1-p)(r_E - \Delta_F) - \Pi_B > 0$. There are three cases:

1. When $\underline{R}_B(\mu) + \Delta_F \geq R$, or
$$\mu \leq \underline{\mu} \equiv \frac{r_B - p(R - \Delta_F)}{(1-p)(R-\Delta_F) - \Pi_B},$$
the bank never lends and only derives profit from the partnership; the fintech firm offers a rate R if and only if the good signal arrives.

2. When $\underline{R}_F < \underline{R}_B(\mu) + \Delta_F < R$, or or $\mu \in (\underline{\mu}, \overline{\mu})$ with
$$\overline{\mu} \equiv \frac{r_B - p(r_E - \Delta_F)}{(1-p)(r_E - \Delta_F) - \Pi_B},$$
the bank retreats from the competition with a positive probability mass, and the fintech firm's support of mixed strategy starts with $\underline{R}_B + \Delta_F$.

3. When $\underline{R}_B(\mu) + \Delta_F < \underline{R}_F$, or $\mu \in [\overline{\mu}, 1)$ the bank always outbids the fintech firm and offers an interest rate $\underline{R}_F - \Delta_F$.

Sticky Banking Relationships. Suppose now that the bank has a convenience benefit $\Delta_B > 0$, i.e., it wins the bid as long as $R_B + \Delta_B < R_F$; while the fintech firm retains the informational advantage as in the benchmark model. This setting essentially lowers the minimal bid of the bank and extends the range of beliefs that the bank can undercut the fintech firm. We can follow the logic of Proposition 1:

1. When $\underline{R}_B(\mu) \geq R$ (low average quality, dominant information advantage), or
$$\mu \leq \underline{\mu} \equiv \frac{r_B - pR}{(1-p)R - \Pi_B},$$
the bank never lends and only derives profit from the partnership; the fintech firm offers a rate R if and only if the good signal arrives;

2. When $\underline{R}_F + \Delta_B < \underline{R}_B(\mu) < R$ (intermediate quality, comparable banking and information advantage), or $\mu \in (\underline{\mu}, \overline{\mu})$ with
$$\overline{\mu} \equiv \frac{r_B - p(r_E + \Delta_B)}{(1-p)(r_E + \Delta_B) - \Pi_B},$$

the bank retreats from the competition with a positive probability mass, and the bank's support of mixed strategy starts with $\underline{R}_B$.

3. When $\underline{R}_B(\mu) \leq \underline{R}_F + \Delta_B$ (high average quality, dominant banking advantage), or $\mu \in [\overline{\mu}, 1)$, the bank always outbids the fintech firm and offers an interest rate $\min\{\underline{R}_F + \Delta_B, R\}$.

Note that in the third range, $\Pi_B \equiv 0$ because the fintech firm never lends, and that $\underline{R}_B(\mu)$ should have been changed accordingly to $r_B/P(\mu)$. However, the original condition $\underline{R}_B(\mu) \leq \underline{R}_F + \Delta_B$ implies $r_B/P(\mu) < \underline{R}_F + \Delta_B$, since Π_B jumps to 0 at the cutoff. As a result, this does not impact the discussion of the cutoffs of μ.

C.5 Analysis of Section 6.4 (Cream Skimming Model)

We modify the timing of events as follows:

- Stage 1
  1. The fintech observes a signal $s \in \{b, g\}$ for every borrower and offers an interest rate.
  2. Each borrower either accepts or rejects the offer. The fintech will fund those who accept.
- Stage 2
  1. The bank offers an interest rate to borrowers who remained.
  2. Each borrower either accepts or rejects the offer. The bank will fund those who accept.
  3. The fintech can turn to the bank to get partnership funding.

Suppose the fintech's signal s satisfies

$$\Pr(s = b \,|\, h) = e_1 \qquad \Pr(s = g \,|\, b) = 0.$$

In other words, we only consider the possibility of false negatives ($e_1 > 0$), but the analysis easily extends to the case with false positives ($e_2 > 0$).[31] The posterior beliefs, after observing the good and the bad signals are

$$\mu_g = 1 \qquad \mu_b = \frac{\mu e_1}{\mu e_1 + (1 - \mu)}.$$

For the rest of the analysis, we will separately study the case of one bank and two banks.

C.5.1 One fintech and one bank

Being the monopoly lender in the second stage, the bank either offers the interest rate of R or does not offer anything. Whenever the quality of the remaining pool is good enough, the bank offers R and extracts all the surplus from borrowers; otherwise, it does not offer anything.

In anticipation of the bank's strategy, the fintech always offers R after observing the good signal, and this offer is always accepted.[32] As a result, borrowers' surplus is always zero. Whether the fintech makes

[31] When $e_1 = 0$ fintech perfectly identifies all high quality borrowers and lends to them at rate R. Bank anticipate the rejected pool consists only of low-quality borrowers and refuse to lend.

[32] While the borrower might be indifferent between receiving funding from the fintech or the bank at the rate R the fintech can always bid $R - \varepsilon$ to break this indifference.

an interest-rate offer after a bad signal and whether the bank bids for the remaining pool depend on the comparison between the maximum expected repayment $P(\mu_b)R$ and the lenders' funding costs. There are three cases.

Case 1: $P(\mu_b)R < r_B < r_E$**.** In this case, the fintech does not bid after a bad signal, and the bank does not offer an interest rate to the remaining pool. Lenders' profits are:

$$V_F = \mu(1-e_1)[R-r_E] \qquad V_B + V_P = \mu(1-e_1)\Pi_B,$$

where V_P are the bank's profits from partnership funding.

Case 2: $r_B < P(\mu_b)R < r_E$**.** In this case, the fintech does not bid after a bad signal, but the bank offers R to the remaining pool. Lenders' profits are:

$$V_F = \mu(1-e_1)[R-r_E] \qquad V_B + V_P = (\mu e_1 + 1 - \mu)[P(\mu_b)R - r_B] + \mu(1-e_1)\Pi_B$$

Case 3: $r_B < r_E < P(\mu_b)R$**.** In this case, the fintech offers R after a bad signal. The bank is also willing to offer R, but the remaining pool is empty. This equilibrium is supported by the belief that any borrower who rejects the fintech's offer is at least as good as the one getting the bad signal. Lenders' profits are:

$$V_F = P(\mu)R - r_E \qquad V_B + V_P = \Pi_B$$

We plot in Figure C.1 lenders' profits with and without partnership funding. Clearly, with partnership funding, the fintech always receives higher profits and the bank always receives higher profits when μ is either very high or is very low. For intermediate values of μ bank's profits can be higher without partnership funding (when α is high).

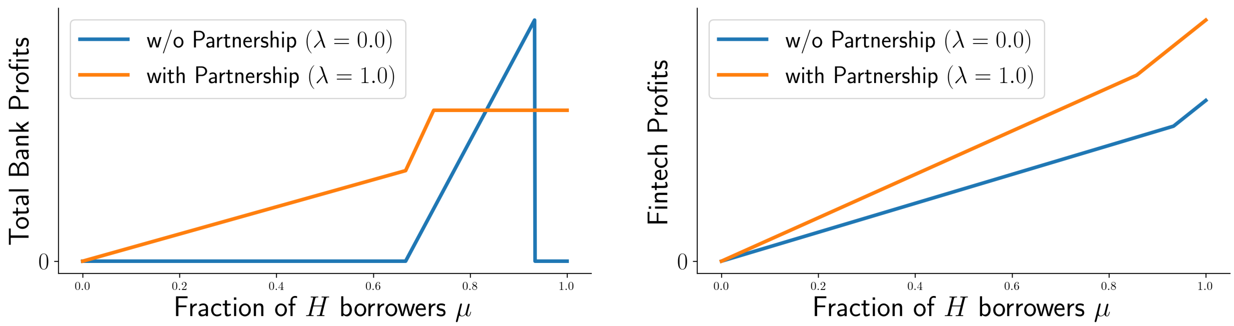
C.5.2 One fintech and two banks

In the second stage, banks compete away their direct lending profits to zero. They either bid the break-even bid

$$\underline{R}_B(\mu') = \frac{r_B}{P(\mu')},$$

where μ' is the average quality of the remaining pool or do not offer any interest rate.

With two banks, we need to reexamine r_E and Π_B. If the two banks can perfectly compete in the market for partnership funding, the bargaining power of the fintech $\alpha = 1$ hence $r_E = \lambda r_B + (1-\lambda)r_F$ and $\Pi_B = 0$.



(a) Bank profits

(b) Fintech profits

Figure C.1: Lenders' profits with and without partnership funding μ ($e_1 = 0.1$)

An alternative is that one of the two banks can sign an exclusive partnership agreement with the fintech so that r_E and Π_B would remain the same for a given α.

The equilibrium depends on how $\underline{R}_B(\mu_b)$ compares to R and r_E. Again, there are three cases.

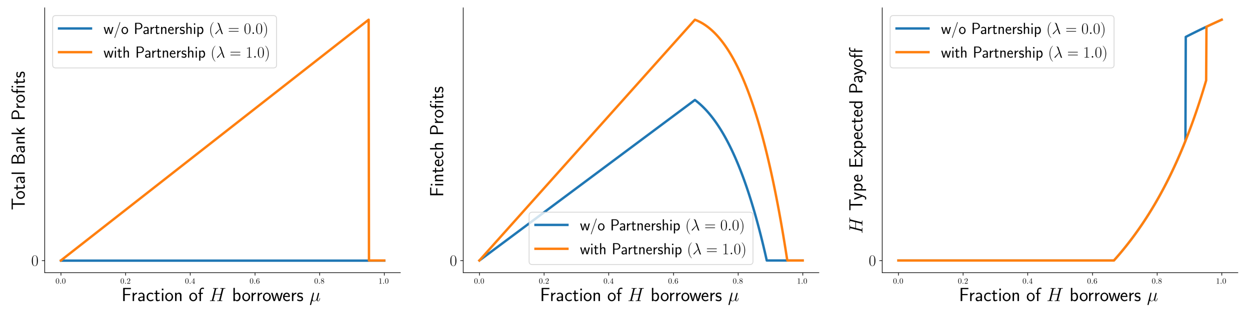
Case 1: $r_E < R < \underline{R}_B(\mu_b)$. In this case, the banks do not make interest rate offers to the remaining pool of quality μ_b. The fintech would also not make an interest rate offer after a bad signal. Following the good signal, the fintech offers R. Lenders' profits and the high-type borrower's payoff are

$$V_F = \mu(1 - e_1)[R - r_E] \qquad V_B + V_P = \mu(1 - e_1)\Pi_B \qquad V_H = 0.$$

Case 2: $r_E < \underline{R}_B(\mu_b) < R$. In this case, the banks would make interest offers to the remaining pool of quality μ_b. Given the interest rate $\underline{R}_B(\mu_b)$, the fintech would not make offers upon receiving a bad signal ($\underline{R}_B(\mu_b) < \underline{R}_F(\mu_b) \coloneqq r_E/P(\mu_b)$). Following the good signal, the fintech would offer $\underline{R}_B(\mu_b)$ to prevent the H types from going to the banks (this is profitable since $\underline{R}_B(\mu_b) > r_E$). Lenders' profits and the high-type borrower's payoff are

$$V_F = \mu(1 - e_1)[\underline{R}_B(\mu_b) - r_E] \qquad V_B + V_P = \mu(1 - e_1)\Pi_B \qquad V_H = R - \underline{R}_B(\mu_b).$$

Case 3: $\underline{R}_B(\mu_b) < r_E < R$. In this case, the banks would make interest offers to the remaining pool if the quality were μ_b. Given the interest rate $\underline{R}_B(\mu_b)$, the fintech would not make offers after observing the bad signal. Moreover, even following the good signal, the fintech would make losses at the rate $\underline{R}_B(\mu_b) < r_E$.



(a) Bank profits (b) Fintech profits (c) High type payoff

Figure C.2: Payoffs with and without partnership funding μ ($e_1 = 0.1, \alpha = 0.5$)

If the fintech never makes offers to anyone, the quality of the remaining pool is μ. For a rejected pool of higher quality ($\mu > \mu_b$) the banks are willing to bid $\underline{R}_B(\mu)$ which is lower than $\underline{R}_B(\mu_b)$ and, hence, smaller than r_E. In equilibrium, the banks offer $\underline{R}_B(\mu)$ in the second stage. Given this interest rate, the fintech does not lend in the first stage as well. In equilibrium, the banks offer $\underline{R}_B(\mu)$ in the second stage, and all borrowers accept. Lenders' profits and the high-type borrower's payoff are

$$V_F = 0 \qquad V_B + V_P = 0 \qquad V_H = R - \underline{R}_B(\mu).$$

We plot in Figure C.2 lenders' profits and the high-type borrower's payoff with and without partnership funding. In these graphs, $\alpha = 0.5$. When $\alpha = 1$, i.e., the banks perfectly compete away profits in the partnership funding market, then the fintech profits and high type payoff look qualitatively similar. However, the banks' profits are zero regardless of λ. Once again, with partnership funding, the bank always receives lower profits, and the fintech always receives higher profits.

C.6 Ex-Ante Bargaining Over Partnership Rate

Suppose that the bank and the fintech first decide on whether to partner (keeping the size of the partnership λ fixed) and the partnership rate ρ. Whether the lenders partner or not depends on the total size of the lenders' profits, while the partnership rate ρ should be used to split the surplus in the α and $1-\alpha$ proportions.

We assume limited commitment to partnership funding on the side of the fintech, that is if $\rho > r_F$ the fintech would use its own funding sources as opposed to partnership funding.

Outside Option. Once we flip the timing, failure to establish partnership relationship leads to competition with $\lambda = 0$ just as in the out base-line model. The lenders' profits are

$$V_F = \begin{cases} \mu(R - r_F), \\ \mu\left(\frac{r_B}{\mu+(1-\mu)p} - r_F\right), \\ 0, \end{cases} \qquad V_B + V_P = \begin{cases} 0, & \text{if } \mu < \underline{\mu}(0) \\ 0, & \text{if } \mu \in (\underline{\mu}(0), \bar{\mu}(0)) \\ (\mu + (1-\mu)p)r_F - r_B, & \text{if } \mu > \bar{\mu}(0) \end{cases}$$

Partnership Profits. Once the parties agree on λ and ρ then the lender's profits are

$$V_F = \begin{cases} \mu(R - r_E), \\ \mu\left(\frac{r_B+\mu\lambda(\rho-r_B)}{\mu+(1-\mu)p} - r_E\right), \\ 0, \end{cases} \qquad V_B + V_P = \begin{cases} \mu\lambda(\rho - r_B), & \text{if } \mu < \underline{\mu}(\lambda, \rho) \\ \mu\lambda(\rho - r_B), & \text{if } \mu \in (\underline{\mu}(\lambda, \rho), \bar{\mu}(\lambda, \rho)) \\ (\mu + (1-\mu)p)r_E - r_B, & \text{if } \mu > \bar{\mu}(\lambda, \rho) \end{cases}$$

where $r_E = \lambda\rho + (1-\lambda)r_F$ and $\underline{\mu}(\lambda, \rho)$ solves

$$\frac{r_B + \mu\lambda(\rho - r_B)}{\mu + (1-\mu)p} = R$$
$$\underline{\mu}(\lambda, \rho) = \frac{r_B - Rp}{R(1-p) - \lambda(\rho - r_B)}$$

and $\bar{\mu}(\lambda, \rho)$ solves

$$\frac{r_B + \mu\lambda(\rho - r_B)}{\mu + (1-\mu)p} = r_E$$
$$\bar{\mu}(\lambda, \rho) = \frac{r_B - [\lambda\rho + (1-\lambda)r_F]p}{[\lambda\rho + (1-\lambda)r_F](1-p) - \lambda(\rho - r_B)}.$$

Case 1: $\mu < \underline{\mu}(0)$. Here the equilibrium outcome is the same with and without partnership. The total surplus generated is:

$$S = \mu(r_F - r_E) + \mu\lambda(\rho - r_B) = \mu\lambda(r_F - r_B).$$

And the split of profits is achieved via $\rho^*(\mu) = \alpha r_B + (1-\alpha) r_F$.

Case 2: $\mu \in (\underline{\mu}(0), \underline{\mu}(\lambda, \rho))$**.** Here the equilibrium outcome depends on whether the lenders establish partnership funding or not. The total surplus generated is

$$\begin{aligned}
S &= -\mu \left(\frac{r_B}{\mu + (1-\mu)p} - r_F \right) + \mu\lambda(\rho - r_B) + \mu(R - r_E) \\
&= -\mu \left(\frac{r_B}{\mu + (1-\mu)p} - R \right) + \mu\lambda(\rho - r_B) + \mu(r_F - r_E) \\
&= \mu \left(R - \frac{r_B}{\mu + (1-\mu)p} \right) + \mu\lambda(r_F - r_B)
\end{aligned}$$

And the corresponding ρ solves

$$\rho^*(\mu) = \alpha r_B + (1-\alpha) r_F + \frac{1-\alpha}{\lambda} \left(R - \frac{r_B}{\mu + (1-\mu)p} \right) > \alpha r_B + (1-\alpha) r_F. \tag{C.56}$$

Case 3: $\mu \in (\underline{\mu}(\lambda, \rho), \bar{\mu}(0))$**.** Here the equilibrium outcome is the same with and without partnership. The total surplus generated is:

$$\begin{aligned}
S &= \mu \left(\frac{\mu\lambda(\rho - r_B)}{\mu + (1-\mu)p} + r_F - r_E \right) + \mu\lambda(\rho - r_B) \\
&= \mu \left(\frac{\mu\lambda(\rho - r_B)}{\mu + (1-\mu)p} \right) + \mu\lambda(r_F - r_B)
\end{aligned}$$

And the corresponding ρ solves $(1-\alpha)S = \mu\lambda(\rho - r_B)$, or equivalently

$$(1-\alpha)\mu \frac{(\rho - r_B)}{\mu + (1-\mu)p} + (1-\alpha)(r_F - r_B) = \rho - r_B.$$

Rearranging the terms yields

$$\rho^*(\mu) = \min \left[\frac{\alpha r_B + (1-\alpha) r_F - (1-\alpha)\mu r_B / (\mu + (1-\mu)p)}{1 - (1-\alpha)\mu / (\mu + (1-\mu)p)}, r_F \right] \tag{C.57}$$

Notice that the surplus generated by the partnership is increasing in ρ and hence is maximized at $\rho = r_F$. At the same time the bank's partnership profits are also maximized at $\rho = r_F$. Hence, if at $\rho = r_F$ the $(1-\alpha)S$ is greater than $\mu\lambda(r_F - r_B)$ (which happens when α is small), then partnership rate is $\rho^* = r_F$, i.e., due to the limited commitment of the fintech to use partnership funding at a rate $\rho > r_F$ the fintech gets more than α share of the surplus.

Case 4: $\mu \in (\bar{\mu}(0), \bar{\mu}(\lambda, \rho))$**.** Here the equilibrium outcome depends on the collaboration. The total surplus generated is:

$$\mu \left(\frac{r_B + \mu\lambda(\rho - r_B)}{\mu + (1-\mu)p} - r_E \right) + \mu\lambda(\rho - r_B) - [(\mu + (1-\mu)p) r_F - r_B].$$

and the corresponding ρ^* solves

$$\mu\lambda(\rho^* - r_B) = (\mu + (1-\mu)p)r_F - r_B + (1-\alpha)S.$$

or, equivalently,

$$\rho^*(\mu) = \left[r_B + \frac{(1-\alpha)\mu\left(\frac{r_B}{\mu+(1-\mu)p} - r_F\right) + \alpha((\mu+(1-\mu)p)r_F - r_B) + (1-\alpha)\mu\lambda(r_F - r_B)}{\mu\lambda[1-(1-\alpha)\mu/(\mu+(1-\mu)p)]}, r_F \right]. \quad \text{(C.58)}$$

Notice that the surplus generated by the partnership is increasing in ρ and is therefore maximized at $\rho = r_F$. At the same time, the bank's partnership profits are also maximized at $\rho = r_F$. Hence, if at $\rho = r_F$ $(1-\alpha)S$ is greater than $\mu\lambda(r_F - r_B)$ (which happens when α is small), then the partnership rate is $\rho^* = r_F$, that is, due to the limited commitment of the fintech to use partnership funding at a rate $\rho > r_F$ the fintech gets more than α share of the surplus. If $\rho^*(\mu) = r_F$ for some $\mu' < 1$, then $\rho^*(\mu) = r_F$ for all $\mu > \mu'$ in this region.

Case 5: $\mu > \bar{\mu}(\lambda, \rho)$. Partnership funding either hurts the joint lenders' profits (if $\rho < r_F$) or has no impact on lenders' profits (if $\rho = r_F$ since the bank dominates the market and offers rate r_F). In either case the lenders are weakly better off not establishing partnership funding.

Equilibrium partnership rate and the corresponding payoffs are shown in Figure C.3. Notice that qualitatively equilibrium structure, the shape of payoffs and the effect of partnership are similar to our baseline model. Notable difference is that in the region $\mu > \bar{\mu}(\lambda, r_F)$ the partnership funding rate $\rho = r_F$ and the equilibrium together with payoffs are exactly the same with in without partnership funding. In our model with ex-post bargaining, which implies $\rho = \alpha r_B + (1-\alpha)r_F$, the bank is worse off with partnership funding when μ is sufficiently high. This difference is not driven by timing of bargaining but rather by bank's commitment power to not fund the fintech after the lending stage of the game. If we endow the bank with such commitment power in the baseline model then the difference between setups with ex-ante and ex-post bargaining would reduce to the exact determination of the partnership rate ρ.

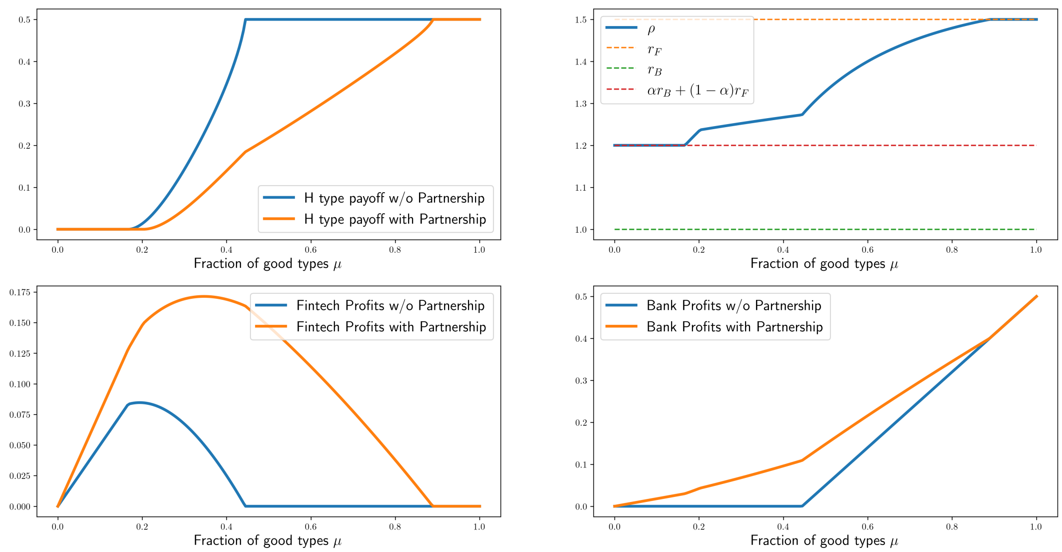


Figure C.3: Equilibrium payoffs and partnership funding rate with ex-ante bargaining.

The parameters in this figure are as follows: $R = 2.0$, $p = 0.4$, $r_F = 1.5$, $r_B = 1.0$, $\alpha = 0.6$, and $\lambda = 0.9$.