Fintech Disruption, Banks, and Credit (Dis-)Intermediation: When Do Foes Become Friends?

February 10, 2023

We build a financial intermediation model wherein bank and fintech intermediaries differ in their enforcement technology, reliance on collateral, and funding cost and compete or partner within frictional credit markets. The model explains the emergence and coexistence of three forms of lending associated with: (i) standalone banks, (ii) standalone fintechs, and (iii) bank-fintech partnerships. Fintech disruption enhances market competition and facilitates credit intermediation to previously underserved borrowers, but crowds out bank-captive borrowers as banks experience low profitability and get displaced. In equilibrium, fintech entry and the prevalence of partnerships do not necessarily benefit all borrowers, leading to ambiguous aggregate credit and welfare effects.

JEL Classification: D83, G21, G28, J20.

Keywords: Credit Intermediation; Financial Technology; Limited Commitment; Search and Matching.

1 Introduction

The advent of financial technology is rapidly redefining and transforming credit intermediation, as fintech and BigTech lenders become more prominent sources of financing for small and medium-sized businesses. These developments raise several questions pertaining to the impact of these new entrants on the industrial organization of lending markets and whether they are associated with credit expansion or substitution (Tang (2019), Erel and Liebersohn (2020), Gopal and Schnabl (2021)). They also highlight the emergence of a tiered funding structure whereby nonbanks make loans funded through or sold to conventional banks, and the coexistence of multiple forms of interaction — namely competition and partnership — among intermediaries (Navaretti et al. (2018), Enriques and Ringe (2020)).

Standalone fintech and BigTech intermediaries differ substantially from traditional banks along several dimensions.[1] In this paper, we focus on one key competitive edge: their ability to harness proprietary data, to lower search and information acquisition costs and better monitor their borrowers' operations and cash flows. We argue that this data advantage provides a relatively powerful enforcement technology that can help alleviate agency frictions and physical collateral constraints (Gambacorta et al. (2020)). For example, BigTech intermediaries such as Paypal, Square, Amazon, Kakao, Mercado Libre, or Ant Financials hold a privileged position within the supply chain that provides them with direct access to a borrower's business operations and digital footprint. Thus, they can assess streams of borrowers' cash flows, thanks to constant contact and real-time monitoring through payment systems upstream. Also, these borrowers can lose the benefit of utilizing BigTechs' platforms for sales and cash management upon contract breaches; agency frictions are therefore subdued even without requiring sizable collateral.[2]

This superior technology-enabled enforceability can further expand the financial contracting space

[1] We use the words fintech and BigTech interchangeably throughout the paper to represent tech-based non-traditional lending intermediaries.

[2] For example, Amazon's lending arm provides credit to merchants active on its e-commerce platform based on sales, customer, and payment data, and has the ability to withhold sales proceeds or inventory whenever a credit event occurs, effectively rendering its debt senior to that of other debtholders. Among others, Amazon also partnered with Bank of America, Goldman Sachs, and American Express through lending programs aiming to provide term loans and lines of credit to its merchants. Apple and Google also have similar partnerships with Goldman Sachs and Citigroup, respectively.

through higher cash-flow pledgeability, allowing for more credit to become available to traditionally underserved borrowers with limited collateral. However, such credit expansion may be limited in scope when fintechs are financially constrained or face high funding costs (Ben-David et al. (2021)) hindering their ability to provide competitive offers or when borrowers express strong preferences for banking services. Thus, banks and fintech lenders have incentives to cooperate through partnership arrangements, giving rise to a new division of intermediation activities.

Several questions arise in this context: How does fintech entry affect the industrial organization of credit markets, contractual terms, and bank profits? Which borrowers benefit the most from the new credit environment? Under what conditions does fintech alleviate frictions and foster financial inclusion? We attempt to address these important open questions within a parsimonious credit intermediation model featuring banks and fintechs within a frictional loan market. One of our stated objectives is to examine the aggregate gains from fintech entry and to determine whether they substitute or complement banks. Another is to explore how the interplay of enforcement and funding cost disparities determines the composition of active intermediaries, credit allocation, and contractual loan terms. We also investigate the ways in which fintech characteristics can affect financial inclusion outcomes and borrower welfare.

At the heart of our paper is the distinction between financial contracts offered by banks and fintechs stemming from their enforcement and funding cost characteristics. Our model considers two forms of frictions plaguing credit markets: search frictions between borrowers and banks, and borrowers' limited commitment. In the spirit of Boualam (2019), these two frictions have direct effects on the extensive and intensive margins of credit, respectively. Search frictions impact the entrepreneur's ability to match with a lender in the first place, while imperfect enforcement ties credit availability to collateral and cash flow pledgeability. The interaction between these two margins in turns yields novel insights into the economic forces shaping the industrial organization of credit markets in response to fintech disruption.

Our model features two types of borrowers: bank-captive borrowers who can search only for bank loans and non-captive borrowers who can search for both bank and fintech loans. Borrowers apply to banks and negotiate contractual terms subject to an enforcement constraint, while taking into account a potential outside option derived from fintech-financed loans. Banks, however, can observe the borrowers' types only after matching. One unique feature of our economy is that banks and fintech lenders may either compete directly for borrowers or form partnerships. Partnership arrangements stem from a double coincidence of wants and pair banks' funding cost advantage with fintechs' enforcement technology advantage. Naturally, the level of bank entry and the composition of lending options are determined in equilibrium. Because such composition alters the borrowers' outside option value, contractual terms, and ultimately lenders' profitability and entry, our model generates rich feedback effects across the extensive and intensive margins of credit and captive and non-captive borrowers.

In the baseline setting, the interior equilibrium works as follows. Our banks are indifferent about whether they participate directly in credit markets or indirectly via partnering with fintech intermediaries. In the latter case, they negotiate an endogenous fee through Nash bargaining. We solve for the equilibrium mass of banks entering the credit market, direct (standalone) vs. indirect (partnership) lending shares, contractual terms of loan offers, and fintech platform fee. Despite its complexity, our model remains tractable and we provide a relatively simple characterization of the markets and economic forces at play.

Results. Our model provides novel insights pertaining to the interaction between bank and fintech intermediaries and the implications for borrowers' access to credit (extensive margin) and credit supply (intensive margin). One salient result is that fintech disruption generates ambiguous effects on aggregate credit and welfare, despite enhancing credit market competition, implying that not all borrowers benefit. Banks' ability to accept pledgeable collateral and to retain a subgroup of borrowers limits fintech entrants from overtaking the credit market. Yet, competitive pressures stemming from fintech entry — while potentially beneficial to certain borrowers — cause a decline in bank profitability, followed by significant bank displacement. When faced with greater competition from fintech lenders, banks start to retreat from credit markets, with surviving banks focused on serving captive borrowers only. Furthermore, this flight to captivity is accompanied by a wave of bank-fintech partnerships as more banks gradually transition to becoming passive fund providers to fintech intermediaries. Thus, even though fintech entry fosters the financial inclusion of collateral-strapped entrepreneurs, it may also lead to a decline in the number of matched borrowers and less credit supply at the aggregate level.

The efficiency of credit market allocation is linked to enforcement and funding gaps and to partnership costs. When banks possess a significant funding cost advantage, gains from trade can be achieved, giving rise to bank-fintech partnerships and to increased credit flows through fintech platforms. This dynamic accelerates when banks can easily match with fintech partners and outsource their credit enforcement technology. However, as banks reallocate their funds to fintechs, captive borrowers — with strong preferences toward bank loans — may be negatively impacted and experience lower credit access.

We highlight five key results. First, we find that fintech entry is unambiguously beneficial for borrowers who had been previously credit-rationed due to the low pledgeability of assets in place. Their enforcement technology makes extending loans to these underserved borrowers profitable for fintech lenders. This naturally incentivizes banks to partner with fintech lenders to take advantage of their enforcement superiority, and such increase in partnership loans further elevates credit availability to borrowers.

Second, the model can help explain why, how, and when new forms of lending arise upon fintech disruption. Depending on the overall degree of borrower captivity and the level of their pledgeable collateral, three distinct credit-market regimes may arise endogenously: (i) full competition, (ii) full partnership, and (iii) coexistence of competition and partnerships between banks and fintechs. The sustainability of each regime hinges on the degree of lenders' competitive advantages and partnership costs. For example, when fintech lenders can access relatively low funding costs, banks must pay higher fees to their potential fintech partners, thus limiting the attractiveness of such arrangements. In contrast, when banks monopolize all external funding, bank-fintech partnerships are more likely to arise.

Third, even though fintech may crowd out banks in certain markets, they also effectively relax the agency friction between banks and borrowers. This potentially increases the credit supplied by banks. The share of unsecured lending may also increase overall with declining loan to value (i.e., less collateral per unit of capital lent) as the limited commitment problem subsides.

Fourth, the emergence of fintech has macro implications, in terms of promoting more inclusive growth, resilience to shocks affecting collateral values, and efficient allocation of credit toward more productive projects. Captive borrowers who rely strictly on bank lending may, however, be rationed as banks shift their funds toward indirect lending. Hence, in general, fintech entry is most welcome in an economy with scarce physical collateral and tech-savvy borrowers.

Fifth, as borrowers become less captive, standalone banks gradually transition into partnerships. Because partnerships augment the total surplus per loan by effectively combining banks' and fintechs' advantages, a social planner focused on borrower welfare should unequivocally promote their formation when the economy is (mostly) populated with tech-savvy entrepreneurs. In general, however, credit provision and borrower welfare do not necessarily go hand in hand. When fintech-induced bank displacement is severe, the reduction in aggregate credit supply could outweigh the benefit of providing attractive loan terms through partnerships. Our paper, therefore, attempts to lay out conditions under which borrower welfare improves or worsens upon fintech disruption.

Literature review. Our paper belongs to a growing body of research on financial technology and credit markets. Vives (2019) and Berg et al. (2021) provide an excellent survey of the literature.

Fintech. Recent empirical research has highlighted the increasing importance of fintech lenders and analyzed their interaction with banks across different credit settings (e.g., Buchak et al. (2018), Cornaggia et al. (2018), Fuster et al. (2019), Tang (2019), Frost et al. (2019), Hau et al. (2019), Balyuk et al. (2020), Beaumont et al. (2020), Di Maggio et al. (2021), and Gopal and Schnabl (2021)). Our model explores theoretically the implications of fintech entry for the organizational structure of credit markets, in connection with lender and borrower characteristics. The impact of fintech entry on the competitive structure of credit markets has so far been studied with a theoretical focus on the informational structure and the potential informational advantage or complementarity of fintech at the screening stage. He et al. (2021) study credit market competition in the context of open banking, and Parlour et al. (2020) examine the payment role; both papers relate to ours. Ghosh et al. (2021) also study the connection between fintech lending and the informational role of cashless payments, while Vives and Ye (2021) build a spatial bank competition model in order to study the impact of information technology on monitoring, bank competition, and financial stability.[3] In contrast, our approach abstracts from credit risk considerations per se and differs from the existing literature insofar as we argue that fintech and BigTech intermediaries have a cash-flow enforceability edge over traditional banks, which we interpret as stemming from an informational and real-time monitoring advantage obtained *throughout* a lending relationship. To our knowledge, our theory is among the first to emphasize this aspect and analyze its implications.[4] Our model also uniquely allows for a rich contracting environment and organizational structure wherein both competition and partnership regimes can coexist.[5]

Banks and nonbanks. Other papers have introduced models that incorporate multiple types of financiers. These models mainly feature banks and nonbanks with different costs of capital (e.g., conglomerates (Bond (2004)), venture capital (Ueda (2004)), or shadow banks (Hanson et al. (2015))). Among others, Donaldson et al. (2021) explore the ways in which funding cost differences across bank and nonbanks impact the financing and project choice of entrepreneurs. In contrast, our model emphasizes the role of debt enforcement as a key specificity of nonbank lenders. Our paper also explores aspects beyond credit market competition, and allows for intermediation chains whereby banks and fintechs can partner before reaching the credit market. Our paper is also related to Gissler et al. (2020), who show empirically that increased competition leads to different responses among banks and nonbanks. On the one hand, bank numbers decline but the profitability of surviving banks increases; on the other hand, nonbank lenders respond more aggressively as borrowers' riskiness goes up.

[3] Also related is Vallee and Zeng (2019), who focus on the information production role of marketplace platforms and highlight the existence of a tradeoff between borrower screening and information provision to creditors.

[4] We acknowledge a contemporaneous study by Huang (2021) who shares similar enforcement assumptions for banks and fintechs and who focuses instead on the role of information acquisition and adverse selection for fintech expansion.

[5] In that sense, our paper is related to Jiang (2020), who estimates a structural model wherein banks fund and also simultaneously compete with shadow banks within mortgages markets.

Financial contracts and the role of collateral and cash flow pledgeability. The banking literature has examined the role of collateral in business lending extensively, starting with seminal works such as Besanko and Thakor (1987) and Kiyotaki and Moore (1997). Here, we build on the financial contract modelling of Rocheteau et al. (2018) and focus on enforcement constraints that can account for both cash-flow and collateral pledgeability. In particular, we argue that fintech lenders possess a better cash flow enforcement technology relative to that of traditional banks.[6] In essence, fintech's superior ability to enforce repayment is similar to that associated with merchant cash advance and trade credit (Cunat (2007)), albeit the source of such advantage may reside in the integration of borrower business operations and the threat of exclusion from a platform's sales and payment services and sales garnishment, instead of the threat of goods supply interruption.

Organization. The rest of the paper is organized as follows. Section 2 presents the baseline model and the properties of loan contracts. Section 3 analyzes the bank-only equilibrium. Section 4 introduces fintech lenders and studies ensuing credit market implications. Section 5 characterizes equilibrium properties and borrower welfare. Section 6 discusses empirical predictions while Section 7 concludes. All proofs are relegated to the appendix.

2 Baseline Model

Our model is in discrete time and abstracts from discounting. The economy features frictional credit markets with entrepreneurs and potentially two types of lenders, banks and fintechs, as illustrated in Figure 1. Credit markets are subject to search frictions impacting access to a lender (i.e., extensive margin) and imperfect enforcement impacting contractual terms (i.e., intensive margin).

[6] Our model also relates to the existing debate about firms' transition to a more intangible form of collateral (Dell'Ariccia et al. (2021)) and highlights that the rise in intangible collateral may not necessarily reduce credit in the presence of powerful debt enforcement alternatives. It also connects to Gertler et al. (2021), who explore the implications of digital collateral.

2.1 Entrepreneurs

Entrepreneurs are of fixed mass $\bar{\mathcal{E}} = 1$. They are endowed with a project but are penniless and thus search for credit in order to start production. They have a decreasing-return-to-scale technology $f(y, \kappa)$ that is twice-continuously differentiable and strictly increasing in capital input $\kappa \in \mathbb{R}_+$ and productivity $y \in \mathbb{R}_+$, and strictly concave in κ. Further $f(y, \kappa) \geq 0$ for all $(y, \kappa) \in \mathbb{R}_+ \times \mathbb{R}_+$ and $f(y, 0) = 0$. We also assume that capital input fully depreciates upon production. In addition, all borrowers are assumed to have access to pledgeable, illiquid assets with value C, but no liquid wealth. For simplicity, credit is for one period and borrowers and lenders exit the market after the loan is supplied. Absent any credit match, the entrepreneur stays inactive and her project vanishes.

2.2 Bank and Fintech Intermediaries

The economy consists of banks with equilibrium mass $\bar{\mathcal{B}}$ and fintech intermediaries with mass $\bar{\mathcal{F}} = 1$. Depending on market conditions, fintech intermediaries can either act as direct lenders, or offer allocation services to banks through their platforms. The key features distinguishing the two types of intermediaries are summarized in the following set of assumptions:

- **Credit enforcement:** We assume that bank and fintech lenders differ in their enforcement technologies to address problems of limited commitment. Upon meeting a borrower, banks consider both collateral value C and cash flow pledgeability in their lending decision. Enforcement intensity governs the pledgeable fraction χ_b of output. Conversely, fintech intermediaries consider cash flow pledgeability only and are characterized by an enforcement technology with $\chi_f > \chi_b$. This assumption reflects that fintech lenders — through their business relationships with borrowers — are upstream in the payment chain, can better monitor firm sales and activities in real time, and are thus inherently able to react faster and at no cost in the event of a default.

- **Funding costs:** Banks are deep-pocketed and have access to cheap funding normalized to 0, while fintech funding cost is given by $\delta > 0$.

- **Search costs:** Banks pay search cost k upfront to screen borrowers and evaluate pledged collateral. Conversely, fintech lenders incur no search cost, thanks to their ability to process vast amount of information collected through their operations and target appropriate borrowers.

2.3 Loan Contracts

We begin by examining the properties of financial contracts characterized by two dimensions: loan size κ and bank repayment L. The contractual terms specify the allocation of joint surplus across borrowers and lenders, assuming Kalai (1977) proportional bargaining and account for the lender's funding costs, and borrowers' enforcement constraint and disagreement point.[7] The disagreement point is null when banks are the only active lenders and is strictly positive in the presence of fintech opportunities. The contract is subject to a limited commitment problem akin to Albuquerque and Hopenhayn (2004) and Boualam (2019) and builds more specifically on the modeling approach in Rocheteau et al. (2018). These contracts are eventually embedded into a frictional credit market in the following section.

The contracting problem in its most general form can be expressed as follows:

$$\max_{\kappa,L} \quad L, \tag{1}$$

$$s.t. \quad E = f(\kappa) - (1+\delta)\kappa - L \geq \frac{1-\gamma}{\gamma}L, \tag{2}$$

$$s.t. \quad (1+\delta)\kappa + L \leq \eta(\kappa), \tag{3}$$

where E and L, represent entrepreneur and lender values obtained from the loan contract, and parameter γ represents the lender's bargaining power. The contractual terms maximize the lender's profits, assuming that the borrower receives (at least) a fraction $1-\gamma$ of the total generated surplus.[8] The bargaining solution depends on the enforcement constraint (3), which captures the fact that the total loan repayment, $(1+\delta)\kappa + L$, cannot exceed potential losses due to default, $\eta(\kappa)$. Indeed, the borrower

[7] As it is common in this type of limited commitment problem (Aruoba et al. (2007)), Nash bargaining can generate non-monotonic utilities even though joint surplus is strictly monotonic. This is generally the case when enforcement constraints become too tight. Conversely, Kalai's bargaining solution restores the monotonicity of borrower/lender utilities.

[8] Following Rocheteau et al. (2018), we write the enforcement constraint as an inequality to guarantee solution existence.

may prefer to strategically default if walking away provides her with larger benefits (i.e., avoiding bank repayment) relative to potential losses incurred (i.e., losing a fraction of output or collateral).

In equilibrium, contractual terms are determined so that the entrepreneur never defaults and always prefers to uphold the contract. This enforcement constraint is what distinguishes bank loans from fintech ones. The enforcement constraint for bank loans accounts for the fraction χ_b of output so that $\eta(\kappa) = \chi_b f(\kappa) + C$. In contrast, fintech lenders do not rely on collateral but have the ability to monitor entrepreneurs more closely and extract a larger fraction $\chi_f > \chi_b$ of the output so that $\eta(\kappa) = \chi_f f(\kappa)$.

2.3.1 Characterization of loan contracts

We start by characterizing the properties of these loan contracts, in a partial equilibrium setting, with $\eta(\kappa) = \chi f(\kappa) + C$. For a bank loan, $\chi = \chi_b$ and $\delta = 0$, while for a fintech loan, $\chi = \chi_f$ and $C = 0$.

Proposition 1.

The contractual terms (κ, L) are either first-best (κ^*, L^*) or second-best (κ^{**}, L^{**}) such that:

- *The first-best solution is given by:*

$$f'(\kappa^*) = 1 + \delta, \tag{4}$$

$$L^* = \gamma \left[f(\kappa^*) - (1+\delta)\kappa^* \right]. \tag{5}$$

- *The borrower is constrained if*

$$(1-\gamma)(1+\delta)\kappa^* + \gamma f(\kappa^*) \geq \chi f(\kappa^*) + C. \tag{6}$$

- *When the enforcement constraint binds, the contract specifies terms (κ^{**}, L^{**}) such that:*

  – *κ^{**} solves the constraint with equality:*

$$(1-\gamma)(1+\delta)\kappa^{**} + \gamma f(\kappa^{**}) = \chi f(\kappa^{**}) + C. \tag{7}$$

– $L^{**} = \gamma \left[f(\kappa^{**}) - (1+\delta)\kappa^{**} \right]$.

All else equal, there exists a threshold χ^*, such that for all $\chi \geq \chi^*$, first-best credit is supplied, with:

$$\chi^* \equiv \frac{(1-\gamma)(1+\delta)\kappa^* - C}{f(\kappa^*)} + \gamma. \tag{8}$$

The solution to the contractual terms specifies two distinct regions that depend on the enforcement level χ. When $\chi > \chi^*$, first-best capital κ^* is achieved and bank profits are at their maximum L^*. Otherwise, when $\chi \leq \chi^*$, the borrower obtains $\kappa^{**} \in [0, \kappa^*]$, with bank profits $L^{**} \in [0, L^*]$. Finally, by construction, the entrepreneur's value is as follows:

$$E = (1-\gamma) \left[f(\kappa) - (1+\delta)\kappa \right], \tag{9}$$

where $\kappa \in \{\kappa^*, \kappa^{**}\}$ depending on the entrepreneur being unconstrained or constrained, respectively.

Corollary 1.

When the entrepreneur is constrained, an increase in collateral pledged C and/or enforcement intensity χ increases total surplus, which is associated with an increase in loan size κ^{**} (i.e., $\frac{\partial \kappa^{**}}{\partial \chi} > 0$ and $\frac{\partial \kappa^{**}}{\partial C} > 0$) and loan repayment L (i.e., $\frac{\partial L^{**}}{\partial C} > 0$ and $\frac{\partial L^{**}}{\partial \chi} > 0$).

This is a straightforward implication, given that the enforcement constraint gets relaxed. In other words, when the borrower's collateral or alternatively the lender's enforcement intensity increases, the financial contract can sustain a larger amount of credit. As a consequence, the total surplus increases and so do both the lender and the borrower utilities, in the context of Kalai (1977) bargaining. Note also that with $\chi = 0$, the constrained optimal credit κ^{**} is strictly positive as long as the collateral endowment C is strictly positive, and solves for $\gamma f(\kappa^{**}) + (1-\gamma)(1+\delta)\kappa^{**} - C = 0$. Conversely, when

$C = 0$, the constrained optimal credit κ^{**} is strictly positive as long as $\chi > \gamma$. Therefore, under these environments, total surplus is strictly positive in the absence of any fixed costs to production.

The contractual terms equivalently specify a loan interest rate r as follows:

$$r = \frac{L + (1+\delta)\kappa}{\kappa} = (1+\delta)(1-\gamma) + \gamma \frac{f(\kappa)}{\kappa}. \tag{10}$$

When the borrower is unconstrained ($\kappa = \kappa^*$), interest rates are independent of collateral and enforcement parameters. When the borrower is constrained ($\kappa = \kappa^{**}$), however, the interest rates decrease with pledgable collateral or enforcement intensity. As shown in corollary 1, lenders can supply higher capital as the entrepreneur's cost of default increases. In this case, lower interest rates follow naturally as long as optimal credit supply increases at a faster pace relative to loan repayments. Figures 2 and 3 illustrate the relationship between the contractual terms and agency friction determinants, C and χ.

3 Search Equilibrium with Banks Only

We start by analyzing the properties of the benchmark equilibrium with homogenous borrowers and banks only. The loan contract is embedded within a search equilibrium, with the mass of lenders determined endogenously through bank entry.

3.1 Frictional Credit Markets

We assume that credit markets are frictional and feature random search. Both lenders and entrepreneurs participate in the credit market as long as it offers sufficiently high continuation values. We introduce a search framework to capture the variable search costs incurred when many lenders compete for borrowers, and also to endogenize the interaction between credit market conditions (i.e., extensive margin) and contractual terms (i.e., intensive margin). Specifically, we define the credit market tightness ϕ as the ratio between active bank lenders and borrowers, expressed as $\phi \equiv \frac{\bar{\mathcal{B}}}{\bar{\mathcal{E}}}$, where $\bar{\mathcal{B}}$ accounts for all active banks and $\bar{\mathcal{E}} = 1$ for all entrepreneurs. Assuming a homothetic matching function, the probability of finding a lender for an entrepreneur amounts to $\frac{m(\bar{\mathcal{B}},\bar{\mathcal{E}})}{\bar{\mathcal{E}}} = m(\phi, 1) \equiv p(\phi)$. Similarly, the probability that a lender matches with a borrower is given by $\frac{m(\bar{\mathcal{B}},\bar{\mathcal{E}})}{\bar{\mathcal{B}}} = m(1, \phi^{-1}) = q(\phi) = \phi^{-1}p(\phi)$. For simplicity, we assume that each borrower can match with at most one lender in a given time period. Banks incur a per-period search cost k associated with loan processing and screening. Banks' and entrepreneurs' continuation values evolve as follows:

$$B_0 = -k + q(\phi)B, \tag{11}$$

$$E_0 = p(\phi)E. \tag{12}$$

We assume that banks' entry cost is null, which yields the free entry condition $B_0 = 0$. Thus, banks enter the credit market until their present value of profits $q(\phi)B$ exactly equals their search cost k.

Definition 1.

The equilibrium consists of the credit market tightness ϕ and contractual loan terms (κ_b, B) such that:

- (κ_b, B) *solve the financial contracting problem (1) with $L = B$, $\delta = 0$, and $\kappa = \kappa_b$.*
- *Banks' free entry condition is satisfied.*

Proposition 2.

The equilibrium exists as long as the search cost is sufficiently small (i.e., $k \leq B$), to ensure strictly positive bank entry. Whenever it exists, the equilibrium is unique.

Given borrower characteristics, a necessary condition for bank entry imposes $k \leq B$. In other words, banks enter only those market segments that generate profits above their search costs. Given that bank profits increase with collateral, borrowers with limited pledgeability are credit rationed, unless banks' enforcement ability lets them rely significantly on entrepreneurs' cash flows.

Proposition 3.

Given a fixed bank enforcement intensity χ_b*, there exist collateral thresholds* $(C_1, C_2) \in \mathbb{R}^2_+$*, such that the equilibrium specifies market tightness* ϕ*, and bank credit,* κ_b *as follows:*

$$(\phi, \kappa_b) = \begin{cases} (0,0), & \text{if } 0 \leq C \leq C_1, \\ (\phi(\kappa_b^{**}), \kappa_b^{**}), & \text{if } C_1 < C < C_2, \\ (\phi(\kappa_b^{*}), \kappa_b^{*}), & \text{if } C \geq C_2, \end{cases}$$

where $0 < \phi(\kappa_b^{**}) < \phi(\kappa_b^{*})$*,* κ_b^{**} *is the optimal credit associated with binding enforcement constraint (7), and* κ_b^{*}*, is the first-best credit associated with equation (4) with* $\delta = 0$*.*

Figure 4 illustrates the equilibrium market tightness ϕ and contractual terms (κ, r) across a range of collateral values. The equilibrium specifies three regions: (i) no bank entry, (ii) partial rationing, and (iii) first-best outcome. Even though all projects involve positive output, agency frictions prevent borrowers with too low collateral C from receiving large credit amounts, and limits bank profits. These borrowers are excluded from credit whenever bank search costs are sufficiently high. Others with intermediate collateral levels within $[C_1, C_2]$ access banks with some probability but are partially rationed. Eventually, borrowers with sufficiently high collateral obtain first-best credit, with a higher probability.

4 Credit Markets with Bank and Fintech Intermediaries

We now introduce both types of intermediaries. Bank and fintech lenders can interact in the credit market as (i) direct competitors, or (ii) partners. Our analysis focuses on the case with $\chi_b < \chi_f$, whereby fintech lenders hold an enforcement advantage relative to banks. Conversely, we assume that banks account for borrowers' pledgable collateral and maintain a funding cost advantage. One key assumption in the model is that a share of borrowers α is captive to banks (i.e., they can apply only for bank credit), while the remaining share of borrowers $1 - \alpha$ is not captive and can potentially apply to both bank and fintech lenders, as long as the corresponding lending opportunities generate positive surplus to the involved parties.[9] Importantly, banks can distinguish between the two types of borrowers only after a credit match, thus preventing market segmentation. As demonstrated below, the existence of two distinct borrower types allows for notable feedback effects in equilibrium: it reshapes loan terms offered by banks due to fintech's competitive pressure and can potentially displace them.

In this section, we study the effects associated with fintech entry on contractual terms, credit market composition, and borrowers' access to credit. We first focus on the case wherein fintech lenders are direct bank competitors only. We then generalize the model to allow for bank-fintech partnerships.

4.1 Captive Borrowers

The concept of captive borrowers is relatively common in the literature and our assumption is motivated by well-documented facts.[10] For example, the 2018 Federal Reserve's Small Business Credit Survey (SBCS) shows that the share of credit applicants reporting online lending applications (which broadly refers to nonbank lenders) has been steadily increasing, but accounts for only about 32%.[11] Lipman and Wiersch (2019) note that the SBCS data also tend to highlight relatively higher approval rates for online lenders, but significantly low satisfaction rates when compared to those for small and large banks. They also highlight that the nonbank lending industry still experiences difficulties in attracting a wide customer base, due in part to unfavorable perception harbored by some borrowers.

Such negative perception is related to a potential lack of trust in online lenders due to the opacity and confusion around the approval process, contractual terms, and privacy concerns surrounding borrower data. It may also relate to borrowers who have strong preference for or familiarity with banking services, are entrenched in pre-established banking relationships, experience high switching costs, or are simply

[9] While we don't explicitly model borrower captivity, one way to micro-found it would be to consider borrowers with different switching costs. This is, for example, the case for borrowers with existing bank relationships and match-specific information that is not easily portable to other lenders. Such captivity may also reflect borrowers' strong preference for other banking services that may not be available with fintech. Thus, borrowers with low search intensity or high switching costs stay with banks, while others may switch whenever the benefits of the non-captive market are high. This argument is consistent with findings in mortgage markets (Allen et al. (2014)), wherein over half of the borrowers are "non-shoppers" who consider only one lender when refinancing.

[10] Other similar expressions refer to "bank affinity" (Parlour et al. (2020)) or "tech-savvy" borrowers (He et al. (2021)). We prefer the term "captive" because it better represents the fact that borrowers may not have other options.

[11] https://www.fedsmallbusiness.org/survey/2019/report-on-employer-firms.

inattentive to or lack a certain degree of sophistication. In that sense, we can also interpret non-captive borrowers as being tech-savvy, with the ability to locate and understand less traditional loan offers costlessly. Alternatively, nonbank and fintech lenders may not be present across all sectors, locations, or borrower characteristics. They may also lack relevant information, available only to banks, about borrowers with certain characteristics (e.g., offline entrepreneurs).

4.2 The Fintech Lending Opportunity

Because we focus on the implications of fintech entry for the industrial organization of credit markets, we introduce fintech lenders in a relatively parsimonious way. We assume that fintech lenders are of exogenous mass $\bar{\mathcal{F}}$ normalized to one. In addition, we assume for the sake of simplicity that borrowers can match frictionlessly with fintech and receive take-it-or-leave-it credit offers.[12] Fintech lenders are assumed to have an enforcement intensity χ_f that is higher than that of banks.[13] However, their financing is subject to funding cost $\delta > 0$ and they also require an additional loan markup $\zeta > 0$.[14]

Since their lending technology accounts only for output, financial contracts offered by fintech lenders are independent of a borrower's collateral C. Whenever feasible, they make a loan offer, with a credit amount κ_f that maximizes the entrepreneur's value subject to the enforcement constraint:

$$\max_{\kappa_f} E_f = f(\kappa_f) - (1+\delta+\zeta)\kappa_f, \tag{13}$$

$$\text{s.t.} \quad (1+\delta+\zeta)\kappa_f \leq \chi_f f(\kappa_f). \tag{14}$$

[12] These assumptions could be relaxed (e.g., allowing for bargaining between the borrower and fintech), but will not qualitatively impact the results.

[13] We interpret χ_f as being intermediary-specific. In particular, a BigTech lender may have a significantly higher enforcement ability relative to a standalone fintech with no other business ties to borrowers. χ_f may also be subject to the borrower's decision to be more or less transparent and/or reliant on her intermediaries. For example, Rishabh and Schäublin (2021) highlight that borrowers may manipulate the reporting of their sales proceeds by using cash rather than digital payments as a way to evade fintech enforcement.

[14] It is important to distinguish between the parameters δ and ζ here. As we will see later, funding cost δ becomes null upon partnership with a bank. Loan markup ζ is a fixed characteristic of the fintech loan and reflects the return required by fintech stakeholders in addition to other non-interest expenses related to customer acquisition and operating costs.

The contract specifies an optimal credit κ_f such that:

$$\kappa_f = \begin{cases} \kappa_f^* : f'(\kappa_f^*) = (1+\delta+\zeta), & \text{if } \frac{\kappa_f^*}{f(\kappa_f^*)} \leq \frac{\chi_f}{1+\delta+\zeta} \\ \kappa_f^{**} : (1+\delta+\zeta)\kappa_f^{**} = \chi_f f(\kappa_f^{**}), & \text{otherwise.} \end{cases} \tag{15}$$

Eventually, we can write the continuation values associated with the fintech lender and entrepreneur as:

$$F = \zeta\kappa_f, \tag{16}$$

$$E_f = f(\kappa_f) - (1+\delta+\zeta)\kappa_f. \tag{17}$$

4.3 Fintech Intermediaries as Direct Competitors

Under the competition-only regime, fintech lenders are assumed to have access to outside funding at cost $\delta > 0$ and can compete directly with banks. They match with the fraction $1-\alpha$ of non-captive borrowers whenever bank loans are either infeasible or borrowers have been rejected.

Lemma 1. *For $\delta + \zeta > 0$, the first-best level of credit supplied by banks κ_b^* is strictly higher than that supplied by fintech intermediaries κ_f^*.*

This is a direct implication derived from equations (4) and (15). All else equal, the first-best level of credit supplied decreases with the lender's funding cost and loan markup. In line with the model assumption, banks can supply a larger credit amount than their fintech counterparts.

4.3.1 Bank Loans With Fintech Entry

Fintech entry yields different implications across captive and non-captive borrowers. On the one hand, the contractual terms for captive borrowers remain unchanged. On the other hand, the existence of viable fintech lending opportunities raises the non-captive borrower's disagreement point in the bargaining process, and ultimately forces banks to offer more favorable contractual terms.

Lemma 2. *All else equal, non-captive borrowers receive bank loan offers with better contractual terms relative to captive borrowers.*

Lemma 2 confirms this simple intuition that a fintech-disrupted credit market is more accommodative to non-captive borrowers. As mentioned above, fintech lending opportunities effectively assign more bargaining power to non-captive borrowers when negotiating with their matched banks. In particular, the contractual terms are adjusted for non-captive borrowers such that the limited commitment constraint of equation (6) for bank loans becomes:

$$(1-\gamma)\kappa_b + \gamma f(\kappa_b) \leq \chi_b f(\kappa_b) + C + \gamma E_f, \tag{18}$$

with bank profits $B = \gamma\left[f(\kappa_b) - \kappa_b - E_f\right]$, and the entrepreneurial value from the bank loan $E_b = (1-\gamma)(f(\kappa_b) - \kappa_b) + \gamma E_f$.

Lemma 3. *For $\alpha \in [0,1)$, banks offer first-best credit to a wider range of borrowers upon fintech entry.*

As evident from equation (18), the higher disagreement point induced by fintech lenders enters the enforcement constraint in the same way as pledged collateral value, leading to a less binding constraint for a wider range of collateral values. Intuitively, since the borrower can extract an additional value, γE_f, at the expense of the bank, the contractual terms become more favorable, as the enforcement constraint relaxes and repayment rate declines. Thus, the first-best level of credit is achievable for lower collateral and enforcement levels when compared to the bank-only economy.

Proposition 4.

Assuming that $\delta + \zeta > 0$ is sufficiently high, there exists a unique collateral threshold $C_f \geq 0$ for non-captive borrowers such that:

- *For all $C > C_f$, bank lending is more valuable to the entrepreneur (i.e., $E_b > E_f$).*
- *For all $0 \leq C \leq C_f$, fintech lending is more valuable to the entrepreneur (i.e., $E_f \geq E_b$).*

Unsurprisingly, fintech lending becomes less valuable to the entrepreneur as the enforcement advantage over bank lending declines. For example, fintech's enforcement advantage hardly benefits entrepreneurs with high collateral because the agency friction due to entrepreneurs' limited commitment is already low. Thus, high-collateral borrowers prefer bank loans, while low-collateral ones prefer fintech loans.

Corollary 2. *C_f declines with funding cost δ, loan markup ζ, and bank enforcement intensity χ_b.*

4.3.2 Credit Market Equilibrium

Next we examine the implications of fintech disruption for equilibrium credit market conditions and entrepreneurs' welfare. As fintech disruption reshapes the contractual terms of bank loans (i.e., intensive margin of bank credit) for non-captive borrowers, bank profitability declines, leading to an adjustment in their credit market entry (i.e., extensive margin of bank credit). Therefore, the degree of fintech disruption and corresponding competitive pressures, reflected by E_f, also feed back onto captive borrowers. It is a key determinant of the overall composition of credit and borrowers' welfare.

Entrepreneurial value. With probability α, the entrepreneur is captive to banks and receives E_b^0 with probability $p(\phi)$. With probability $1 - \alpha$, the borrower is tech-savvy and can apply to both bank and fintech loans. In this case, the latter receives an improved bank loan offer with probability $p(\phi)$, and accepts it only if $E_b \geq E_f$. The entrepreneur's *ex-ante* value can be summarized as follows:

$$\begin{aligned} E_0 &= p(\phi)\left[\alpha E_b^0 + (1-\alpha)\max\{E_b, E_f\}\right] + (1-p(\phi))(1-\alpha)E_f, \\ &= \alpha p(\phi) E_b^0 + (1-\alpha)\left[p(\phi)\max\{E_b, E_f\} + (1-p(\phi))E_f\right], \end{aligned} \tag{19}$$

where captive borrowers' value E_b^0 is an outcome of a solution to the contracting problem in (1)–(3) with $\delta = 0$ and $\chi = \chi_b$, as characterized in equation (9).

Bank entry. With a share α of captive borrowers, bank entry condition satisfies:

$$0 = -k + q(\phi)\left[\alpha B^0 + (1-\alpha)B \times \mathbb{1}_{E_b \geq E_f}\right], \tag{20}$$

where B^0 represents banks loan profits from captive borrowers, which is derived from the contracting problem in (1)–(3) with $\delta = 0$ and $\chi = \chi_b$. Clearly, the *ex-ante* bank profits depend on the degree of fintech disruption when $\alpha < 1$. Moreover, if the economy consists of borrowers with limited collateral, then fintechs' enforcement edge over banks strengthens and fintech lenders could eventually dominate the market share of non-captive borrowers (i.e., $E_f > E_b$) or pose a credible threat to banks by improving the outside option for borrowers.

Because banks have to offer more favorable terms upon fintech entry, their profits diminish even when they maintain their market share over non-captive borrowers (i.e., $E_f \leq E_b$). Such profit decline feeds back into the extensive margin, leading to banks retreating from the credit market. Ultimately, the scarcity of bank loans reduces captive borrowers' *ex-ante* welfare, while non-captive borrowers are not necessarily worse off, for banks' displacement in the credit market is at least partially offset by the availability of fintech loans.

Proposition 5. *Fintech Disruption's Effect on Bank Entry*

1. *When bank borrowers are unconstrained, mass of bank entrants,* $\bar{\mathcal{B}}$*, decreases with fintech entry.*

2. *When bank borrowers are constrained:*

- $\bar{\mathcal{B}}$ *decreases with fintech entry, if* $f'(\kappa_b) \leq \frac{1}{\chi_b}$.
- $\bar{\mathcal{B}}$ *increases with fintech entry, if* $f'(\kappa_b) > \frac{1}{\chi_b}$ *and* E_f *is sufficiently close to* 0.

Proposition 5 highlights a more nuanced effect. Indeed, fintech disruption does not always erode bank profits. From equation (18), fintech entry effectively relaxes the agency friction for non-captive borrowers and can in fact enable banks to funnel larger credit amounts to initially restricted borrowers whose marginal product of capital is high. Banks, therefore, can obtain higher profits despite fintech entry, if the cost of offering favorable contractual terms to non-captive borrowers is outweighed by the benefit of attenuated agency friction (i.e., E_f is close to 0). Corollary 3 follows immediately.

Corollary 3. *There exists a unique* E_f^* *such that for* $E_f > E_f^*$, *fintech entry reduces bank entry.*

4.4 Fintech Intermediaries as Partners

Beyond the competition setting, we examine conditions favoring the emergence of bank-fintech partnerships. Intermediary partnerships are common in credit markets and are not surprising in the context of bank and fintech lenders, given the advantages and limitations of each party. Enriques and Ringe (2020) provide a thorough analysis of the multiple forms of interactions and contractual arrangements between banks and fintechs. Our model can be interpreted as related to partnership forms such as (i) banking-as-a-service (BaaS), whereby the bank offers the fintech's clients banking services under its license; and (ii) software-as-a-service (SaaS), whereby the fintech provides its technology and platform to the bank. Our model, however, is agnostic as to potential issues, pertaining to the identity of the "true lender" when loans are originated by the bank and are then immediately sold to the fintech partner.

Bank-fintech partnerships are particularly relevant in environments where fintechs cannot access low-cost funding.[15] In this case, fintech lenders licence their credit platform to banks against an endogenously determined fee, playing a more passive role and serving as a pass-through between banks and borrowers. This cooperative arrangement puts forward the idea of credit re-intermediation through platforms (Boot et al. (2021)) and redefines the roles within the intermediation chain, with banks acting as deposit collectors, and fintech intermediaries acting as credit allocators or matching platforms. Our analysis examines the determinants behind (i) profit sharing between bank/fintech and (ii) banks' allocation between direct vs. indirect lending, along with implications for (iii) credit terms and borrower welfare.

4.4.1 Partnership Markets

Our modeling approach proceeds as follows. Banks and fintech intermediaries first meet in the partnership market before becoming active in credit markets. We assume that banks bear the cost of searching for fintech platforms through which to allocate funds, as is generally the case in practice. These costs reflect resources spent for the selection, negotiation, implementation, and monitoring of contractual arrangements with the fintech partner.[16] Indeed, when bank-fintech partnerships are considered as "material" outsourcing arrangements from a banking regulatory standpoint, they must be governed by the banks' risk management framework and internal compliance requirements.[17]

We assume that this cost depends on the ratio of bank to fintech participants active in the partnership market and is determined by a continuous and strictly increasing function $c_p(\cdot)$ over $\mathbb{R}_+$. Given that the mass of fintechs $\bar{\mathcal{F}}$ is normalized to one, the partnership cost can be expressed as $c_p \equiv c_0 + c(\omega\bar{\mathcal{B}})$, where

[15] The ability to secure funding is usually viewed as a key constraint preventing fintech/BigTech credit provision and a major reason for partnerships. Other fintech players may turn to securitization and the originate-to-distribute model as a way to reduce their reliance on outside funding. This aspect is outside the scope of the paper.

[16] The partnership implementation can also be costly from the fintech standpoint, but we abstract from it in the model. Indeed, a fintech seeking a banking partner is also subject to diligence costs, and the development of a compliance management system in order to meet any legal requirements commanded by the bank. Resources are also devoted to identify and select the banking partner with the appropriate knowledge and experience in commercial lending.

[17] As noted in Enriques and Ringe (2020), "[W]here the outsourcing operation is material ..., a number of additional requirements apply. For example, the outsourcing institution is required to carry out appropriate due diligence to ensure that the outsourcee is suitable and has, inter alia, the business reputation, expertise and capacity to perform the outsourced functions. A written outsourcing agreement is mandated, following a detailed set of requirements. Amongst other things, this agreement has to provide that both the bank and the supervisory authority are in a position to effectively monitor the outsourcee, including having access to its premises, as well as having examination and information powers."

ω represents the share of banks participating in the partnership market while the $1-\omega$ share lends directly. We also assume that bank-fintech matches are one-to-one and formed immediately. Thus, the mass of bank-fintech matches is simply given by $\min(\omega\bar{\mathcal{B}}, 1)$. Finally, we assume that any unmatched fintech lender can always be funded through an outside financier at rate $\delta > 0$.

4.4.2 Credit Market Equilibrium

Our analysis assumes $\omega\bar{\mathcal{B}} \leq \bar{\mathcal{F}} = 1$, for simplicity, and focuses on the nontrivial case where fintech disruption leads to a decline in bank entrants, which allows for partnerships and feedback effects in general equilibrium.[18] We denote fintech profits, F^p and F^c, following equation (16), and entrepreneurial profits from fintech loans, E_f^p and E_f^c, following equation (17), with $\delta = 0$ (i.e., partner) and $\delta > 0$ (i.e., standalone), respectively. Credit markets now consist of three potential loan opportunities supplied by: (i) standalone banks, (ii) standalone fintechs, and (iii) bank-fintech partnerships. Our credit search assumptions remain in place. We also assume that borrowers receiving and accepting a fintech offer are randomly assigned to partnered or standalone intermediaries, with probability $\mu = \omega\bar{\mathcal{B}}$, and $1-\mu$, respectively. With a modified set of accessible loans, entrepreneurs' *ex-ante* welfare becomes as follows:

$$E_0 = p(\tilde{\phi}) \left[\alpha E_b^0 + (1-\alpha)\max\{E_b, \tilde{E}_f\}\right] + (1-p(\tilde{\phi}))(1-\alpha)\tilde{E}_f, \tag{21}$$

where bank credit market tightness $\tilde{\phi} = (1-\omega)\bar{\mathcal{B}}$, and $\tilde{E}_f = \mu E_f^p + (1-\mu)E_f^c$.

Similar to the case when fintechs compete directly with banks, non-captive borrowers' access to partnership loans elevates their disagreement point in bank loan bargaining. Furthermore, because the funding cost is reduced to 0, loan terms offered by partnerships are more favorable relative to those of independent fintechs (i.e., $E_f^p > E_f^c$). What naturally follows is the decline of standalone bank profits and entry, and an increase in the share of fintechs and partnerships. Thus, non-captive borrowers' disagreement point increases even more, giving rise to a feedback effect, as highlighted in Figure 5. Next we provide

[18] As this will become clear throughout the analysis, and echoing proposition 5, the opposite case is unlikely to generate partnerships in general equilibrium, as long as the entrepreneurial value remains very small.

further details and analyze how the acceleration of partnership formation impacts borrower welfare.

4.4.3 Endogenous Fintech Platform Fee

The platform fee f is assumed to be paid after the bank-fintech match and after funds are allocated to borrowers. It is determined through Nash bargaining between bank and fintech intermediaries, such that the bargaining outcome maximizes the product of the corresponding gains from the partnership:

$$\max_f (F^p - f)^\nu (f - F^c)^{1-\nu}.$$

The first term in the maximization problem represents the net surplus of banks in the partnership market, while the second term represents that of the fintech intermediaries, with $0 < \nu < 1$ denoting the bargaining power of the bank. The solution to the bargaining problem is the fintech platform fee:

$$f = (1 - \nu)F^p + \nu F^c. \tag{22}$$

Note that the platform fee is always positive as long as $\chi_f > 0$ and $\delta > 0$, ensuring the feasibility of fintech loans and the participation of fintech lenders.[19]

4.4.4 Banks' Decision to Partner with Fintech Intermediaries

Banks optimally decide to participate in the partnership market if their expected profit exceeds that from operating as standalones. *Ex-ante*, partnership-seeking banks accrue:

$$B_0^p = (1 - p(\tilde{\phi}) \times \mathbb{1}_{E_b \geq \tilde{E}_f})(1 - \alpha)(F^p - f) - c_p. \tag{23}$$

Using equation (22), the partnership condition, $B_0^p \geq 0$, is equivalent to:

$$(1 - p(\tilde{\phi}) \times \mathbb{1}_{E_b \geq \tilde{E}_f})(1 - \alpha)\nu(F^p - F^c) \geq c_p. \tag{24}$$

[19]The timing of the fee does not qualitatively alter our results. We can also write the Nash bargaining problem in terms of a fintech financing cost charged by banks. The division of surplus in the two approaches are equivalent as long as we abstract from the possibility of default and other regulatory costs that may lead to different treatments across lender types.

Condition (24) holds with equality in an interior equilibrium wherein both direct and indirect bank lending coexist, and helps pin down the share of partnering banks.

Definition 2.

The interior equilibrium consists of (i) bank and entrepreneur values obtained from bank loans (B^0, E_b^0) *and* (B, E_b)*, (ii) fintech and entrepreneur values obtained from fintech loans* (F^p, E_f^p) *and* (F^c, E_f^c)*, and (iii) market tightness,* ϕ*, and share of partnering banks,* ω*, such that:*[20]

- (B^0, E_b^0) *and* (B, E_b) *solve the contracting problem (1) subject to enforcement constraints (3) and (18), respectively, with* $E_f = \tilde{E}_f$.
- (F^p, E_f^p) *and* (F^c, E_f^c) *solve the contracting problem (13) with* $\delta = 0$ *and* $\delta > 0$*, respectively.*
- (ϕ, ω) *jointly solve:*

$$k = q(\phi(1-\omega))\left[\alpha B^0 + (1-\alpha)B \times \mathbb{1}_{E_b \geq \tilde{E}_f}\right], \tag{25}$$

$$c_p = (1 - p(\phi(1-\omega)) \times \mathbb{1}_{E_b \geq \tilde{E}_f})(1-\alpha)\nu(F^p - F^c). \tag{26}$$

Proposition 6.

The equilibrium exists for sufficiently small k *or* c_0.

Bank-fintech partnerships, like independent fintech competitors, increase the outside option for non-captive borrowers and reduce profits for standalone banks, thereby imposing a negative externality. Interestingly, a non-trivial size of partnership lending arises in equilibrium for a wide range of parameter values. This is due largely to significant competitive advantages that banks and fintech lenders have over one another, rendering partnership lending attractive. Intuitively, the share of banks seeking fintech partnerships increases with bank bargaining power ν in the partnership market and credit search costs

[20]Given that the mass of entrepreneurs, $\mathcal{E}$, equals one, market tightness, ϕ, and measure of entrant banks, $\bar{\mathcal{B}}$, are equal.

k for standalone banks, while it decreases with borrower captivity α, and partnership costs c_p. Hence, when faced with borrowers who are more tech-savvy on average, banks may very swiftly move from being standalone competitors against fintech lenders to full partners with them, with potential implications for contractual terms, credit allocation, and aggregate borrower welfare. For example, our model predicts that highly productive and low collateral borrowers benefit from favorable terms and increased market share of partnership due to relaxed agency friction. Conversely, low productivity and high collateral borrowers may suffer from limited credit access as bank lending shrinks.

That the formation of bank-fintech partnerships is a likely equilibrium outcome suggests increased sustainability of bank-originated credit through partnerships. It could even lead to a new or increased bank presence in certain market segments. Fintech entry, coupled with the option to partner up whenever beneficial, allows banks to retain control and outsource matching and debt enforcement technology at low costs. Thus, even a mild level of fintech disruption can trigger significant shifts in credit market composition and lending opportunities therein.

As fintech's competitive advantage strengthens, standalone banks may retire completely so that the equilibrium supports full bank-fintech partnership (i.e., all entrant banks lend indirectly through a fintech partner). In the limiting case, if a bank cannot derive sufficient revenues from captive borrowers alone to recover search costs, then no bank chooses to maintain standalone status, either because revenues from non-captive borrowers are not fundamentally profitable (i.e., bank loan profits decline below the search costs) or because all non-captive entrepreneurs opt out from standalone bank loans in favor of more valuable fintech loans. Even though banks may still participate in credit markets exclusively as fintech partners (i.e., $\omega = 1$), all captive borrowers are rationed. In this equilibrium case, the total measure of banks participating in credit markets through partnerships is determined through:

$$c_p(\omega \bar{B}) = (1 - \alpha)\nu(F^p - F^c). \tag{27}$$

Contractual terms and bank profits. An interior partnership equilibrium $0 < \omega < 1$ implies that standalone banks can still generate sufficient profit above their credit search costs, despite providing better contractual terms to matched non-captive borrowers. The more banks transition from standalone to partnership, the higher partnership's competitive pressure on standalone banks. Therefore, borrowers matched with standalone banks are better off, yet such bank loan offers become more scarce. These borrowers may even secure the first-best credit despite having relatively low collateral, thanks to partnership-induced competitive pressure effectively relaxing the agency friction.

Corollary 4. *For $0 < \omega < 1$, standalone banks generate higher ex-ante revenues than fintech-partnered banks if and only if $k \geq c_p$.*

Corollary 4 is a straightforward implication of Proposition 6. The equilibrium essentially requires both standalone and partnered banks to break even, meaning that both the free entry condition for standalone banks (20) and the indifference condition (24) are satisfied. It follows directly from the fact that in order for standalone banks to switch to partnership ($\omega > 0$), they must be incentivized either by higher revenue or lower cost. Thus, in equilibrium, the wider the gap between search and partnership costs, the wider the revenue gap between indirect and direct lending.

5 Equilibrium Properties

Building on the previous section, we examine the conditions that shape the credit market. As documented above, banks' decision to compete or partner with fintechs critically depends on the pool of borrowers and on the funding and enforcement gaps between the two intermediaries, among others.

We will assume throughout this section that borrowers' outside option $\tilde{E}_f$ stemming from fintechs and bank-fintech partnerships is sufficiently high, so that the presence of fintech leads to banks' retreat from credit markets, as shown in proposition 5.

5.1 Credit Market Composition

Given the startling rise of fintech lending platforms in recent years, the most important determinant in shaping a new credit market equilibrium is arguably the way in which incumbent banks respond fintech disruption. Depending on market, lender, and borrower characteristics, the equilibrium mix consists of (i) standalone banks, (ii) standalone fintech intermediaries, and (iii) bank-fintech partnerships.

Proposition 7.

1. *The share of partnered banks, ω, decreases with the degree of borrower captivity, α.*
2. *All else equal, there exists a threshold $\alpha^* \in [0, 1]$, such that:*
   - *For $\alpha > \alpha^*$, we have a full competition regime (i.e., $\omega = 0$).*
   - *In addition, for $\alpha = 0$, if the equilibrium share of partnered banks $\omega < 1$, then for $\alpha \leq \alpha^*$, standalone and partnered banks coexist in equilibrium. Otherwise, there exists a threshold $\alpha^{**} \leq \alpha^* \in [0, 1]$, such that, (i) for $\alpha^{**} \leq \alpha \leq \alpha^*$, standalone and partnered banks coexist in equilibrium, and (ii) for $\alpha < \alpha^{**}$, we have a full partnership regime (i.e., $\omega = 1$).*

Proposition 7 examines the effect of borrower captivity on lender composition and choice. Unsurprisingly, when the economy consists predominantly of captive borrowers, bank profits are sufficiently high relative to partnership cost c_p, favoring their standalone operations. However, as more borrowers endorse fintech, banks gradually become fintech partners as this option becomes more valuable *ex-ante*.

Corollary 5. *Equilibrium partnership depends on funding (δ) and enforcement (χ) gaps:*

- *Low (high) fintech funding costs lead to fewer (more) bank-fintech partnerships.*
- *Higher enforcement advantage of fintech platforms fosters partnerships, particularly when borrowers lack collateral and the share of non-captive borrowers is high.*

Corollary 5 relates the prevalence of bank-fintech partnerships to widening funding and enforcement gaps, all else equal. In the model, if the funding gap shrinks, then banks need to pay a higher fee f, making partnership less attractive. If the enforcement gap widens, then both partnerships and standalone fintechs generate relatively higher output (F^p and F^c, respectively). This lifts up both the revenue and cost of partnerships for banks, but the former always dominates the latter since the increase in partnership revenue F^p is only offset partially by higher platform f, as long as the fintech bargaining power is strictly less than 1. Therefore, the net surplus of partnerships, which is determined by the gap between revenue gains of partnerships and standalone fintechs $F^p - F^c$, increases, so encouraging more partnership formations and credit market efficiency.

We analyze the equilibrium across submarkets of borrowers characterized by different collateral levels. These submarkets are treated independently, given that borrower collateral is assumed to be observable *ex-ante*. Figures 6 - 8 illustrate the evolution of bank entrants, lender composition, contractual terms, and partnership platform fee as a function of borrower collateral and the share of captive borrowers.

5.2 Credit Allocation and Aggregate Credit

Financial technology firms are often touted as a key source of credit provision for underserved borrowers and a champion of financial inclusion. We show through the lens of our model that while this is partly the case, fintech entry may also significantly hurt certain bank-captive borrowers who may not have access to fintech lending. The existence of this category of borrowers, coupled with feedback through the extensive margin, generates a new form of financial exclusion by shifting the credit rationing problem from low-collateral to bank-captive borrowers, creating a *two-speed* credit market.[21] In the context of our model, captive borrowers are further rationed compared to the competition-only regime. The possibility of partnership further amplifies this feedback effect because the efficiency gain enables lenders

[21] In essence, some emerging economies with low banking activity may also be associated with low captivity. In this case, fintech entry may provide a leap forward in terms of credit provision with minimal effects on captive borrowers.

to offer more favorable loan terms to non-captive borrowers than if they were standalone competitors. This ultimately decreases standalone bank entry and limits the credit access of captive borrowers.

5.2.1 Extensive Margin

With the total mass of borrowers normalized to $\bar{\mathcal{E}} = 1$, the mass of matched borrowers, m, is given by:

$$m = \alpha p(\tilde{\phi}) + (1 - \alpha). \tag{28}$$

When α tends toward 0, m tends toward 1, since all borrowers are covered by either the bank or the fintech. Intuitively, the matching probability increases from $p(\tilde{\phi}) < 1$ to 1, as borrowers become less captive. Conversely, as α tends to toward 1, borrowers are only served by banks, and m thus tends toward $p(\phi)$. However, m need not be monotonic in α and the sign of $\frac{\partial m}{\partial \alpha} = p(\tilde{\phi}) + \alpha \frac{\partial p(\tilde{\phi})}{\partial \alpha} - 1$ can be ambiguous throughout the range of α values. This sign depends particularly on the level of the matching probability $p(\tilde{\phi})$ and its sensitivity to α changes, $\frac{\partial p(\tilde{\phi})}{\partial \alpha}$. For example, an increase in α is in general associated with increased bank profitability and entry (see proposition 7), leading to $\frac{\partial p(\tilde{\phi})}{\partial \alpha} \geq 0$. Thus, when the term $\alpha \frac{\partial p(\tilde{\phi})}{\partial \alpha}$ is sufficiently large relative to $p(\phi) - 1$, $\frac{\partial m}{\partial \alpha}$ becomes positive.

5.2.2 Intensive Margin

While frictionless matching between non-captive borrowers and fintech allocators broaden the credit market along the extensive margin, the overall effect on aggregate credit is ambiguous and depends essentially on whether the fintech loans are more or less valuable to the entrepreneurs relative to bank loans. Thus, at the aggregate level, the effect of fintech entry on credit is ambiguous and depends on the share of captive borrowers and countervailing effects along both margins:

$$\begin{aligned}
\bar{\kappa} &= \bar{\kappa}_b + \bar{\kappa}_f, \\
\bar{\kappa}_b &= p(\phi) \left[\alpha \kappa_b^0 + (1 - \alpha) \kappa_b \mathbb{1}_{E_b > \tilde{E}_f} \right], \\
\bar{\kappa}_f &= (1 - \alpha) \tilde{\kappa}_f \left[1 - p(\phi) \mathbb{1}_{E_b > \tilde{E}_f} \right],
\end{aligned}$$

with $\phi = (1-\omega)\bar{\mathcal{B}}$ and $\tilde{\kappa}_f = \mu\kappa_f(\delta = 0)+(1-\mu)\kappa_f(\delta > 0)$. It is straightforward to show that $\bar{\kappa}_b$ decreases while $\bar{\kappa}_F$ increases. Which effect eventually dominates depends on the gap between credit offered by banks and fintechs. Fintech entry also helps reduce disparities across borrowers with different collateral levels along two dimensions. First, fintech terms are homogeneous and independent of collateral. Second, the existence of a homogeneous fintech option can also improve bank loans significantly and narrow down the gap in contractual terms across borrowers with different collateral values.

5.3 Borrower Welfare

As we have seen so far, the equilibrium market share associated with each lender depends on characteristics associated with intermediaries, borrowers, and credit markets. However, the properties of the extensive margin (i.e., the mass of borrowers linked to each lender) may significantly differ from those of the intensive margin (i.e., amount of intermediated credit), given that each lender-borrower pair optimally settles on different credit sizes. This begs the question of how aggregate borrower welfare evolves with fintech entry and which borrowers really benefit from it.

Proposition 8. *Aggregate borrower welfare E_0 is non-monotonic with respect to $\tilde{E}_f$.*

Proposition 8 reveals that fintech disruption is not always beneficial to the aggregate welfare of borrowers. Echoing proposition 5, when limited commitment restrains severely credit provision, fintech entry benefits borrowers by both expanding lending options and relaxing agency frictions, thereby leading to more bank entry. In addition, when the majority of borrowers are tech-savvy (i.e., α close to 0) and standalone banks provide first-best credit, fintech entry, combined with the possibility of partnership, unequivocally improves borrowers' welfare. However, for intermediate values of α, fintech disruption can result in a sizeable welfare loss for captive borrowers when standalone banks retreat from credit markets *en masse*. Moreover, non-captive borrowers are more likely to be serviced by partnerships or standalone fintechs whose loans may be suboptimal, relative to standalone bank offers (i.e., $E_b \geq \tilde{E}_f$).

6 Empirical Implications and Discussion

Our model has implications for the structure of credit markets, the composition of borrowers and lenders, and contractual terms. We first explore the empirical predictions pertaining to credit markets.

6.1 Search Costs, Bargaining Power, Bank Entry, and Credit Competition

Recent evidence documents the connection between credit market competition and fintech expansion. For example, Claessens et al. (2018) and Frost et al. (2019) empirically examine determinants behind credit provision by fintech lenders in relation to banking competition, regulatory schemes, and macroeconomic conditions. Both find that fintech credit expansion is positively associated with their competitive advantage and less stringent regulation, and with higher economy-wide productivity and output.

Our theory links bank entry and competition in credit markets to two structural parameters governing search costs and bank bargaining power. In line with the empirical results, one central prediction is that banks' participation in credit markets declines when they incur search costs that are relatively high compared to their loan profits. This is, for example, the case when the market consists of borrowers with limited pledgeable collateral who thus can access only small loan amounts. As a consequence, limited bank entry favors a more prominent role for fintech and bank-fintech partnerships, especially when borrowers generate high output and fintechs face low statutory requirements to compete for them.

We also note a more subtle and ambiguous relationship when it comes to bank bargaining power. On the one hand, a higher bank bargaining power leads to less favorable terms for the borrowers, but more bank entry as loan profits increase. On the other hand, in the presence of competitive fintech offers, greater bank bargaining power can significantly reduce the attractiveness of bank loans, ultimately leading to less bank entry. The latter would more likely occur in an environment where minimal within-bank competition renders banks semi-monopolistic, as discussed in Frost et al. (2019).

Given that the unit cost of financial intermediation has remained relatively stable (Philippon (2015)) despite financial innovation, implying limited within-bank competition, our model addresses the entry of a new breed of challengers with significant technological advantages. Thus, license requirements and regulations of new competitors which raise operational costs and markups can serve as an important barrier to entry. In the same vein, borrower preferences toward banking services and the ability of banks to retain their customers also serve as barriers to competition in the context of our model.

6.2 Industrial Organization of Credit Markets

In our model, the emergence and coexistence of competition and/or partnership between different types of intermediaries depend on their relative strengths, materialized by enforcement and funding gaps, and on costs associated with partnership formation and the bargaining power of each party.

6.2.1 Fintech Intermediaries as Substitutes and Complements and the Role of Collateral

Tang (2019) analyses the dual role played by nonbank intermediaries – in particular peer-to-peer platforms – acting as both substitutes and complements for banks. Other papers such as Gopal and Schnabl (2021) find that fintech lenders replaced banks almost one-to-one when banks retreated from small business lending after the 2008 financial crisis, while Hau et al. (2019) highlight their role as complements in rural regions of China where banking presence is *ex-ante* limited. Consistent with this evidence, fintech lenders can also achieve both roles in our model. The equilibrium division between the two roles depends on market, intermediary, and borrower characteristics. More specifically, proposition 6 and corollary 5 show that this critically depends on search frictions plaguing bank loan markets and on enforcement and funding gaps, which determine the relative value of fintech and bank loans. First, fintech intermediaries act as complements for all borrowers rejected by banks. Tech-driven frictionless matching between fintech lenders and borrowers enables fintechs to expand the pool of borrowers with positive Net Present Value projects. Second, when fintech loans dominate those offered by banks – as is the case for low-collateral borrowers – banks fully retreat from credit markets and a larger share of fintechs fills a substitutionary role especially if the enforcement gap widens.

Greater borrower collateral can restore banks' advantage and limit fintech expansion. This is true particularly when the evaluation of a project or collateral relies on bank expertise and cannot be easily automated (e.g., business equipment or patents). Further, since credit depends on the ability of the lender to seize and liquidate the pledged asset, the model predicts a negative relationship between creditor rights and fintech market share. Indeed, weak creditor rights limit bank entry and diminish the value of bank loans, thus expanding the substitutionary role of fintech and BigTech intermediaries that do not rely on physical collateral. This observation can help explain why fintechs are thriving more in some emerging markets.[22] In addition, data-driven and tech-enabled enforcement solutions that rely on the special nature of the borrower-lender relationship, as with BigTech lending (Gambacorta et al. (2020)), or that allow for digital collateral (Gertler et al. (2021)), confirm that the implementation of low-cost communication tools and real-time monitoring can further foster fintech credit expansion.

6.2.2 Fintech Intermediaries as Partners

One novel insight stemming from our model is the emergence of bank-fintech partnerships and a tiered financing structure, along with banks' retreat from direct lending. Bank-fintech partnerships are supported when both parties possess distinct competitive advantages, thus generating a double coincidence of wants and a surplus larger than that obtained by either party alone. Consistent with De la Mano and Padilla (2018), the widening of funding or technological gaps, combined with a larger share of tech-savvy borrowers, may lead to more bank-fintech partnerships and a re-organization of the intermediation process, pressuring banks to become "low cost manufacturers" and act as passive funding sources for loans intermediated by fintech and BigTech lenders. These effects are further amplified through the competition channel, as direct bank lending becomes even less profitable.[23] Conversely, bank-fintech partnerships may lose importance if banks can master or acquire the required technology and data, or

[22]https://www.economist.com/finance-and-economics/2020/10/08/how-the-digital-surge-will-reshape-finance.

[23]While we abstract from risk and balance sheet considerations and consider a specific form of partnership in which banks and fintechs remain independent, our model's predictions could also be interpreted in terms of mergers and acquisitions.

if the strength of fintech or BigTech balance sheets provide them with access to cheaper funding.

As we also show, in line with these authors, the proliferation of bank-fintech partnerships and the extinction of direct bank lending may become detrimental for certain borrowers (e.g., those with high collateral) that benefit from traditional banks the most.

6.3 Extensive and Intensive Margins of Credit: Macro Implications

6.3.1 Financial Inclusion

Our model suggests that fintech can broaden access to credit and enhance financial inclusion, yet it may not necessarily lead to aggregate expansion of credit supply if its entry markedly displaces conventional banks on whom bank-captive borrowers solely rely. All else equal, fintech intermediation democratizes credit supply by making it less dependent on a borrower's net worth or collateral pledgeability, and favors a credit allocation directly linked to a project productivity and output. Nevertheless, the resulting bank displacement may generate a two-speed credit market wherein tech-savvy borrowers benefit at the expense of borrowers limited to banks. While our model considers the share of bank-captive borrowers to be exogenous, it does predict that the transition path toward an environment with less preference for/ties to banks could potentially be costly, resulting from declines in both aggregate credit and social welfare may decline in the process.

Two counteracting forces are at play. Along the intensive margin, fintech competitive pressures lead surviving banks to supply larger loans at low interest rates to tech-savvy borrowers. But, at the aggregate level, the increased importance and market share of fintech loans combined with bank displacement may lead to more or less credit and, consequently, higher or lower social welfare depending on the composition of borrowers and their reliance on collateral to obtain sizable bank loans.

Such implications for aggregate credit margins and social welfare will be less pertinent if limits to financial inclusion exist. In particular, the degree of borrowers' bank captivity (or preference toward banks) can significantly contain fintech and BigTech expansion. Indeed, as Van Loo (2018) and Enriques and Ringe (2020) argue, the high degree of customer stickiness in credit markets is associated with lack of information, and search and switching costs, and provides a significant advantage to legacy banks and thus a high barrier of entry for newcomers. Limitation in terms of customer data access, coupled with difficulty in obtaining federal banking licenses have been viewed as key entry barriers. This is particularly the case for standalone fintechs that rely heavily on customers' bank account data. Conversely, BigTech companies may be able to circumvent the customer acquisition hurdle thanks to borrower data generated from other business operations, albeit such lending is constrained to existing customers. Ultimately, when fintech loans cannot fully substitute for bank loans, fintech entry and policies aimed at increasing their presence and advantages vis-a-vis banks may be ineffectual.

6.3.2 Shock Transmission

The transition toward a higher reliance on cash-flow and digital-collateral lending has significant macroeconomic implications with respect to the nature of shock transmission between banks and borrowers. Gambacorta et al. (2020) and Bilan et al. (2019) suggest that the rise in fintech lending dampens the financial accelerator due to collateral shocks and helps stabilize Small and Medium Enterprise financing. Thus, the substitution from collateral to data and fintech lending may be associated with a decline in credit sensitivity to asset price variations and a potentially weaker transmission of banking shocks and monetary policy pass-through. Our model supports this result. Conversely, shocks to firms' productivity are further amplified, leading to an even tighter link between credit cycle and output fluctuations.

6.4 Levelling the Playing Field and the Role of Fintech Regulation and Information Portability

Borrowers preferences and trust in financial technology solutions are likely to increase in the long run, rendering borrowers less bank-captive and promoting competition across lenders. However, some bank-captive borrowers with high switching costs may be particularly impacted in the short to medium term, which may call for some policy adjustments to minimize the cost of such markets transition and level the playing field across lenders.

One policy has to do with the introduction of more stringent fintech regulations and license requirements. The implementation of such policies may possibly lead to a smoother transition, as the increased costs on fintech lenders would reduce the induced competitive pressure and partially restore bank profitability margins and entry incentives.

Information portability and open banking have also been at the forefront of recent banking policy debates. While our model abstracts from information channels highlighted in the literature (He et al. (2021)), we argue that regulating borrowers' ability to share their data, as implied, e.g., by recent Privacy Acts, may accelerate the transition to more fintech/BigTech lending rather than levelling the playing field across intermediaries. First, when borrowers' captivity is related to a bank's informational advantage acquired through the bank-firm relationship, open data policies aimed at promoting the sharing of banking track record information sharing, would provide borrowers with a powerful tool to break the shackles and escape bank captivity. In this case, we may observe a rise in bank-fintech partnerships as banks become more passive. However, such policy may also come with drawbacks as any positive externality associated with bank business lending would be foregone (e.g., learning about the macroeconomy, monitoring as a way to improve the business) in a world where banks outsource all interactions to a fintech partner. Second, it is unclear whether policies that would instead target the sharing of borrower information generated at the level of fintech/BigTech intermediaries, would be very beneficial to banks. Indeed, incentives associated with the platform/ecosystem and real-time monitoring/upstream position throughout a borrower-lender relationship may matter more, relative to informational advantage at the screening stage. If this competitive advantage limits the possibility of entry for other competitors, BigTech lending may serve as a way to create strong ties with the borrower, which can increase their monopoly power and ultimately reduce the entrepreneur's welfare. Additional related policy tools may thus be relevant in this context.

7 Conclusion

We build a financial intermediation model wherein bank and fintech intermediaries compete or partner within frictional credit markets. Banks and fintechs differ in enforcement technologies and funding costs. Fintech lenders can extract a large fraction of borrowers' output directly upon default, while banks rely more on collateralized lending. Our model explains the emergence of three forms of lending: (i) standalone bank, (ii) standalone fintech, and (iii) bank-fintech partnership lending. Fintech disruption facilitates credit intermediation to previously underserved borrowers but crowds out bank-captive borrowers as traditional banks experience low profitability and become displaced. In equilibrium, fintech entry and the prevalence of bank-fintech partnerships do not necessarily benefit all borrowers, leading to ambiguous credit and welfare effects at the aggregate level.

The setting remains relatively tractable despite the presence of both agency and search frictions and multiple lender types. It could be further extended by, for example, modelling more extensively the multiple forms of interactions between BigTech or fintech intermediaries and their borrowers and ensuing financial contracting implications. In particular, as banks retreat and borrowers become more dependent on nonbank lending, fintech and BigTech intermediaries may gain significant bargaining power across the board. We leave this extension for future research.

References

Albuquerque, R., and H. A. Hopenhayn. 2004. Optimal Lending Contracts and Firm Dynamics. *The Review of Economic Studies* 71:285–315.

Allen, J., R. Clark, and J.-F. Houde. 2014. The Effect of Mergers in Search Markets: Evidence from the Canadian mortgage industry. *American Economic Review* 104:3365–96.

Aruoba, S. B., G. Rocheteau, and C. Waller. 2007. Bargaining and the Value of Money. *Journal of Monetary Economics* 54:2636–2655.

Balyuk, T., A. N. Berger, and J. Hackney. 2020. What is fueling fintech lending? The role of banking market structure. *The Role of Banking Market Structure (June 23, 2020)* .

Beaumont, P., H. Tang, and E. Vansteenberghe. 2020. *The Role of FinTech in Small Business Lending: Evidence from France*. Working Paper.

Ben-David, I., M. J. Johnson, and R. M. Stulz. 2021. Why Did Small Business Fintech Lending Dry Up During March 2020? Tech. rep., National Bureau of Economic Research.

Berg, T., A. Fuster, and M. Puri. 2021. FinTech Lending. Tech. rep., National Bureau of Economic Research.

Besanko, D., and A. V. Thakor. 1987. Collateral and Rationing: Sorting Equilibria in Monopolistic and Competitive Credit Markets. *International Economic Review* 28:671–689.

Bilan, A., H. Degryse, K. O'Flynn, and S. Ongena. 2019. *Banking and Financial Markets How Banks and Financial Technology Are Reshaping Financial Markets*. Palgrave Macmillan.

Bond, P. 2004. Bank and Nonbank Financial Intermediation. *The Journal of Finance* 59:2489–2529.

Boot, A., P. Hoffmann, L. Laeven, and L. Ratnovski. 2021. Fintech: What's Old, What's New? *Journal of Financial Stability* 53:100836.

Boualam, Y. 2019. *Credit Markets and Relationship Capital*. Working Paper.

Buchak, G., G. Matvos, T. Piskorski, and A. Seru. 2018. Fintech, Regulatory Arbitrage, and the Rise of Shadow Banks. *Journal of Financial Economics* 130:453–483.

Claessens, S., J. Frost, G. Turner, and F. Zhu. 2018. *Fintech Credit Markets Around the World: Size, Drivers and Policy Issues.* BIS Quarterly Review September.

Cornaggia, J., B. Wolfe, and W. Yoo. 2018. *Crowding Out Banks: Credit Substitution by Peer-to-peer Lending.* Available at SSRN 3000593.

Cunat, V. 2007. Trade Credit: Suppliers as Debt Collectors and Insurance Providers. *The Review of Financial Studies* 20:491–527.

De la Mano, M., and J. Padilla. 2018. Big Tech Banking. *Journal of Competition Law & Economics* 14:494–526.

Dell'Ariccia, G., D. Kadyrzhanova, C. Minoiu, and L. Ratnovski. 2021. Bank Lending in the Knowledge Economy. *The Review of Financial Studies* 34:5036–5076.

Di Maggio, M., D. Ratnadiwakara, and D. Carmichael. 2021. Invisible primes: Fintech lending with alternative data. *Available at SSRN 3937438* .

Donaldson, J. R., G. Piacentino, and A. Thakor. 2021. Intermediation Variety. *The Journal of Finance* 76:3103–3152.

Enriques, L., and W.-G. Ringe. 2020. Bank–fintech Partnerships, Outsourcing Arrangements and the Case for a Mentorship Regime. *Capital Markets Law Journal* 15:374–397.

Erel, I., and J. Liebersohn. 2020. Does fintech substitute for banks? evidence from the paycheck protection program. Tech. rep., National Bureau of Economic Research.

Frost, J., L. Gambacorta, Y. Huang, H. S. Shin, and P. Zbinden. 2019. BigTech and the Changing Structure of Financial Intermediation. *Economic Policy* 34:761–799.

Fuster, A., M. Plosser, P. Schnabl, and J. Vickery. 2019. The Role of Technology in Mortgage Lending. *The Review of Financial Studies* 32:1854–1899.

Gambacorta, L., Y. Huang, Z. Li, H. Qiu, and S. Chen. 2020. *Data vs Collateral*. CEPR Discussion Paper No. 15262.

Gertler, P., B. Green, and C. Wolfram. 2021. *Digital Collateral*. NBER Working Paper 28724.

Ghosh, P., B. Vallee, and Y. Zeng. 2021. *FinTech Lending and Cashless Payments*. Available at SSRN 3766250.

Gissler, S., R. Ramcharan, and E. Yu. 2020. The Effects of Competition in Consumer Credit Markets. *The Review of Financial Studies* 33:5378–5415.

Gopal, M., and P. Schnabl. 2021. *The Rise of Finance Companies and Fintech Lenders in Small Business Lending*. Available at SSRN 3600068.

Hanson, S. G., A. Shleifer, J. C. Stein, and R. W. Vishny. 2015. Banks as Patient Fixed-income Investors. *Journal of Financial Economics* 117:449–469.

Hau, H., Y. Huang, H. Shan, and Z. Sheng. 2019. How FinTech Enters China's Credit Market. *AEA Papers and Proceedings* 109:60–64.

He, Z., J. Huang, and J. Zhou. 2021. *Open Banking: Credit Market Competition When Borrowers Own the Data*. NBER Working Paper 28118.

Huang, J. 2021. Fintech Expansion. *Available at SSRN 3957688* .

Jiang, E. 2020. *Financing Competitors: Shadow Banks' Funding and Mortgage Market Competition*. Working paper.

Kalai, E. 1977. Proportional Solutions to Bargaining Situations: Interpersonal Utility Comparisons. *Econometrica: Journal of the Econometric Society* 45:1623–1630.

Kiyotaki, N., and J. Moore. 1997. Credit Cycles. *Journal of Political Economy* 105:211–248.

Lipman, B. J., and A. M. Wiersch. 2019. Uncertain Terms: What Small Business Borrowers Find When Browsing Online Lender Websites. Tech. rep., Board of Governors of the Federal Reserve System (US).

Navaretti, G. B., G. Calzolari, J. M. Mansilla-Fernandez, and A. F. Pozzolo. 2018. *Fintech and Banking. Friends or Foes?* Available at SSRN 3099337.

Parlour, C. A., U. Rajan, and H. Zhu. 2020. *When Fintech Competes for Payment Flows.* Available at SSRN 3544981.

Philippon, T. 2015. Has the US Finance Industry Become Less Efficient? On the Theory and Measurement of Financial Intermediation. *American Economic Review* 105:1408–1438.

Rishabh, K., and J. Schäublin. 2021. *Fintech Lending and Sales Manipulation.* Working Paper.

Rocheteau, G., R. Wright, and C. Zhang. 2018. Corporate Finance and Monetary Policy. *American Economic Review* 108:1147–86.

Tang, H. 2019. Peer-to-peer Lenders versus Banks: Substitutes or Complements? *The Review of Financial Studies* 32:1900–1938.

Ueda, M. 2004. Banks versus Venture Capital: Project Evaluation, Screening, and Expropriation. *The Journal of Finance* 59:601–621.

Vallee, B., and Y. Zeng. 2019. Marketplace lending: A New Banking Paradigm? *The Review of Financial Studies* 32:1939–1982.

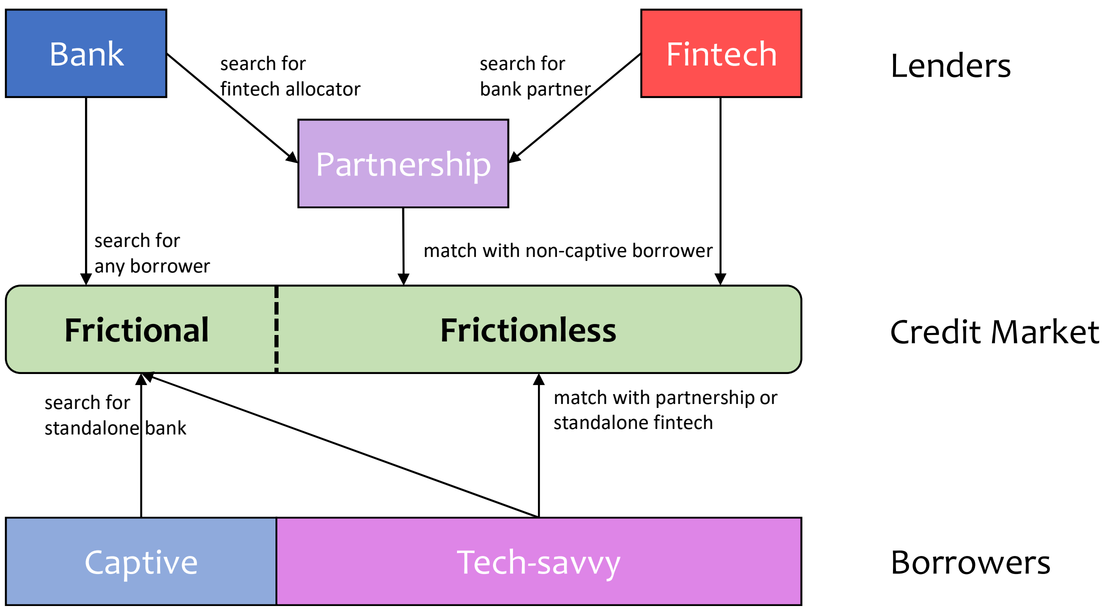
Van Loo, R. 2018. Making Innovation More Competitive: The Case of Fintech. *UCLA Law Review* 65:232.

Vives, X. 2019. Digital Disruption in Banking. *Annual Review of Financial Economics* 11:243–272.

Vives, X., and Z. Ye. 2021. *Information Technology and Bank Competition.* Available at SSRN 3863988.

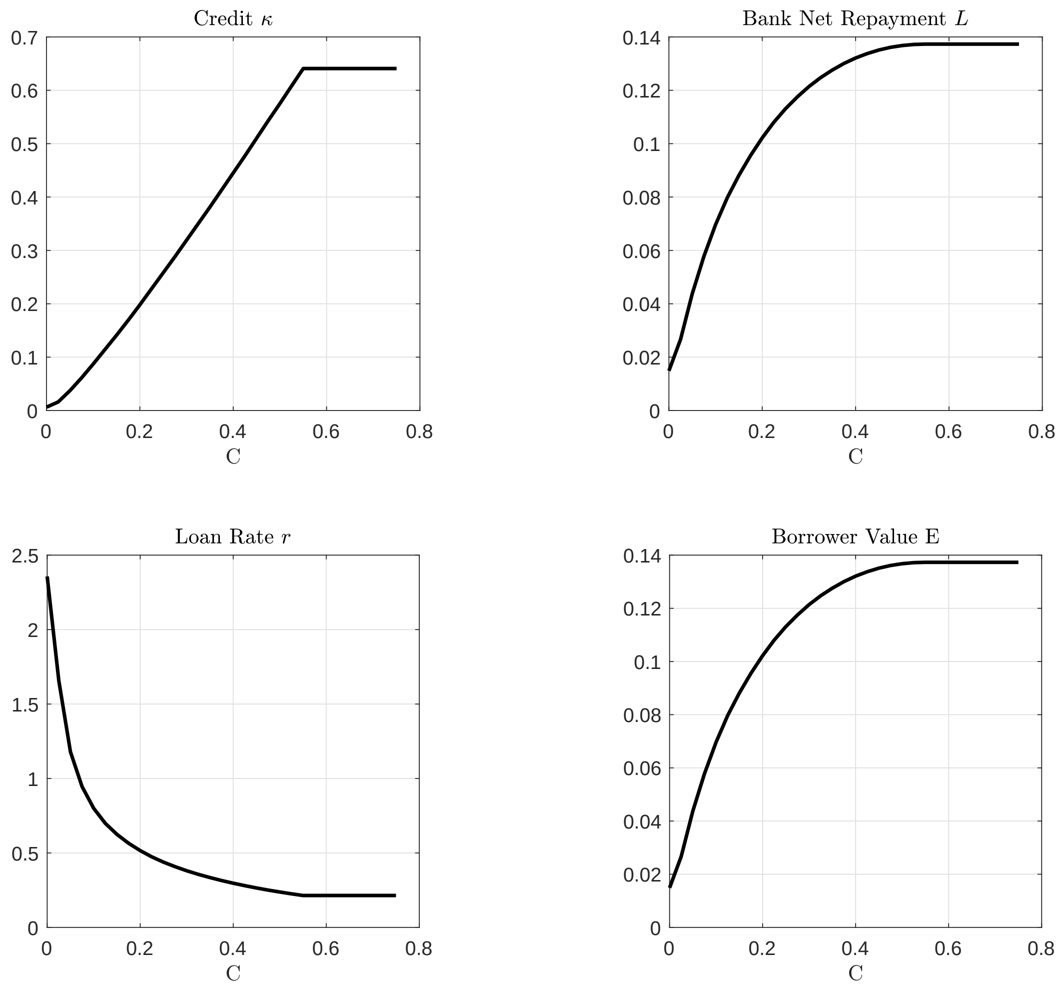
A Tables & Figures

Figure 1: Market Description



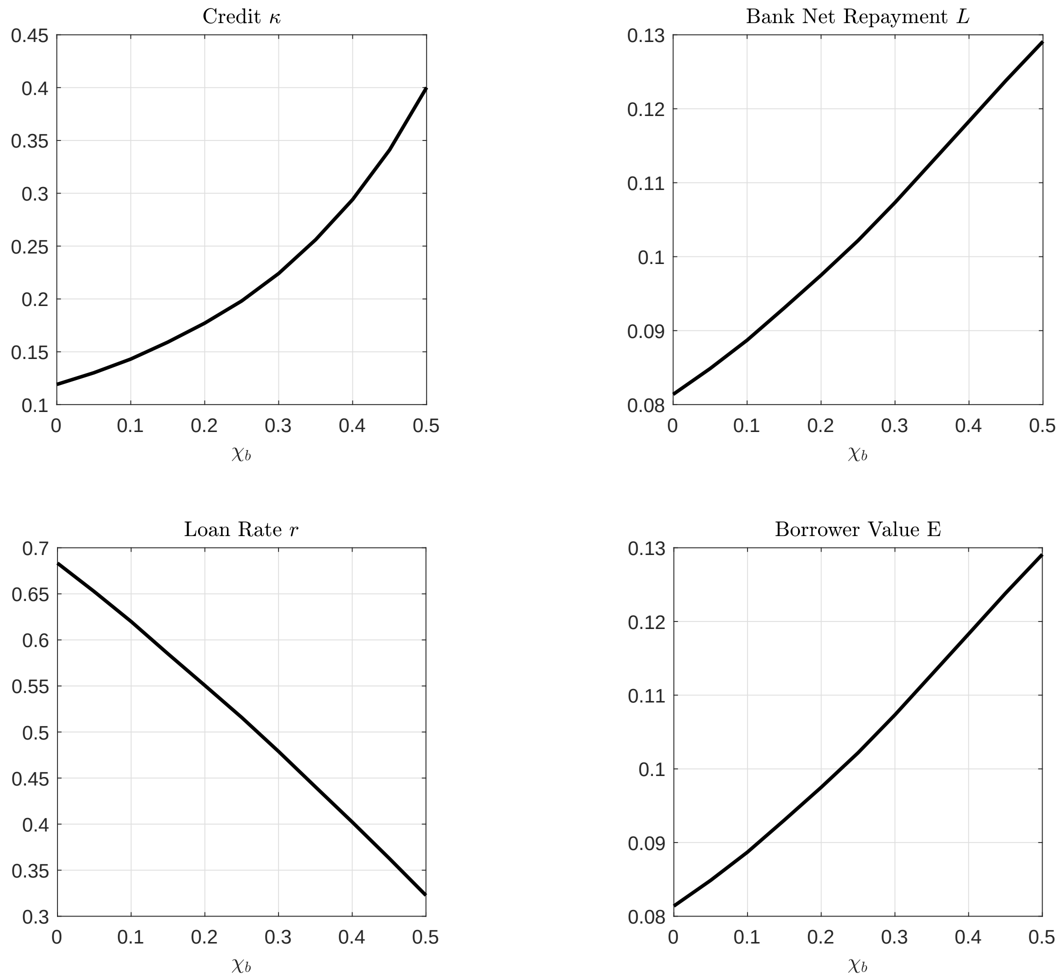
Notes: The diagram depicts the interaction of all agents in the full-fledged model.

Figure 2: Contractual Terms – Comparative Statics for Collateral



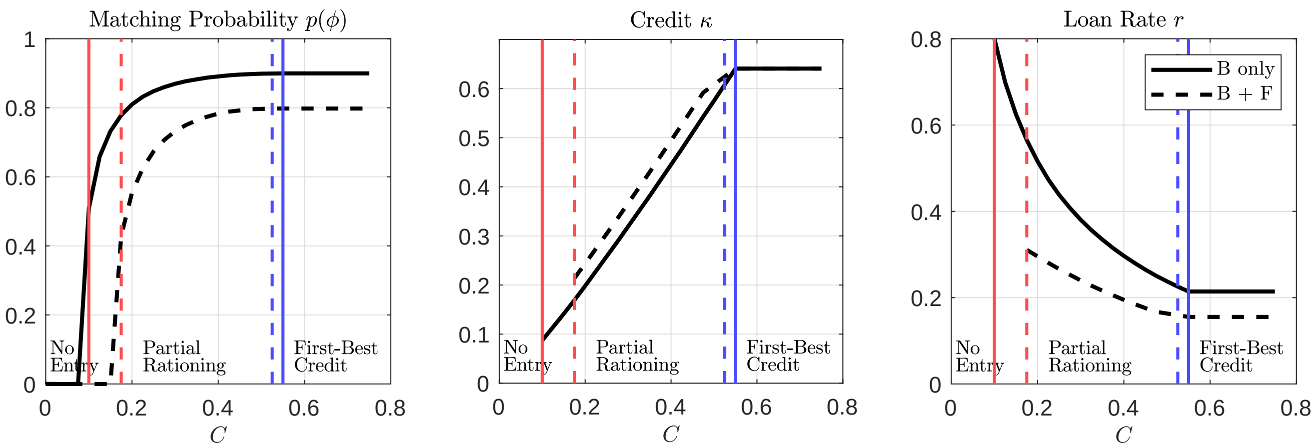
Notes: This figure shows the contractual terms as a function of borrower collateral C. The numerical application assumes a decreasing-return-to-scale production function, $f(\kappa) = y\kappa^{\rho}$, with $y = 1.25$ and $\rho = 0.7$, a CES matching function, such that $p(\phi) = \phi(1 + \phi^{\gamma_m})^{-\frac{1}{\gamma_m}}$, and $q(\phi) = (1 + \phi^{\gamma_m})^{-\frac{1}{\gamma_m}}$, with $\gamma_m = 2$, and a partnership cost function, $c_p(x) = c_0 + c_1 x$, with $c_0 = 1\text{e}{-4}$ and $c_1 = 0.005$. The remaining model parameters are: $k = 0.06$, $\chi_b = 0.25$, $\chi_f = 0.5$, $\zeta = 0.075$, $\delta = 0.075$, $\gamma = 0.5$, and $\nu = 0.5$.

Figure 3: Contractual Terms – Comparative Statics for Enforcement Intensity



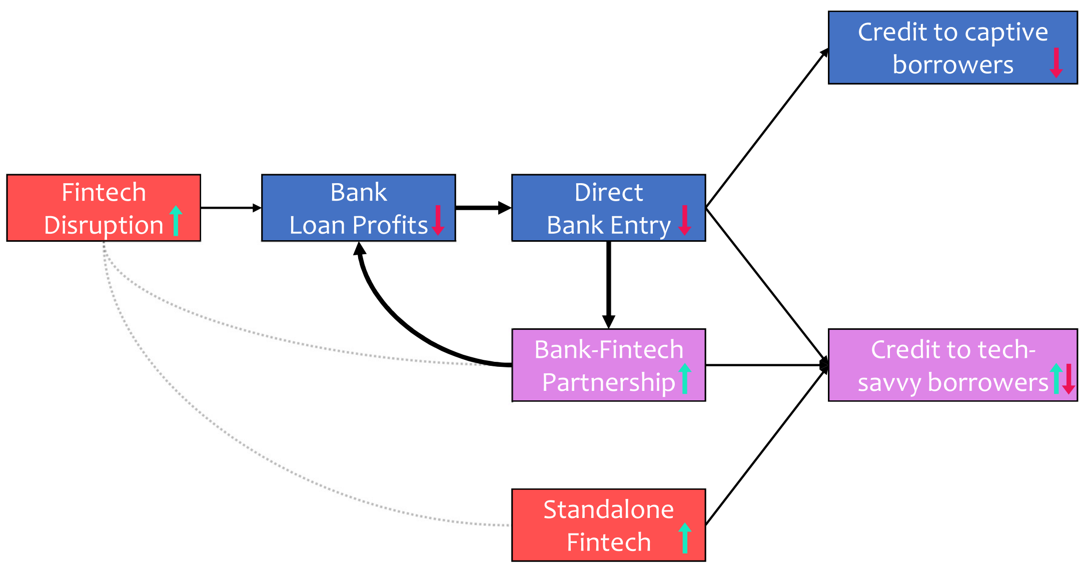
Notes: This figure shows the contractual terms as a function of bank enforcement intensity χ_B. The numerical application assumes a decreasing-return-to-scale production function, $f(\kappa) = y\kappa^\rho$, with $y = 1.25$ and $\rho = 0.7$, a CES matching function, such that $p(\phi) = \phi(1 + \phi^{\gamma_m})^{-\frac{1}{\gamma_m}}$, and $q(\phi) = (1 + \phi^{\gamma_m})^{-\frac{1}{\gamma_m}}$, with $\gamma_m = 2$, and a partnership cost function, $c_p(x) = c_0 + c_1 x$, with $c_0 = 1\text{e}{-4}$ and $c_1 = 0.005$. The remaining model parameters are: $k = 0.06$, $\chi_b = 0.25$, $\chi_f = 0.5$, $\zeta = 0.075$, $\delta = 0.075$, $\gamma = 0.5$, and $\nu = 0.5$.

Figure 4: Extensive & Intensive Margins of Bank Credit in Equilibrium



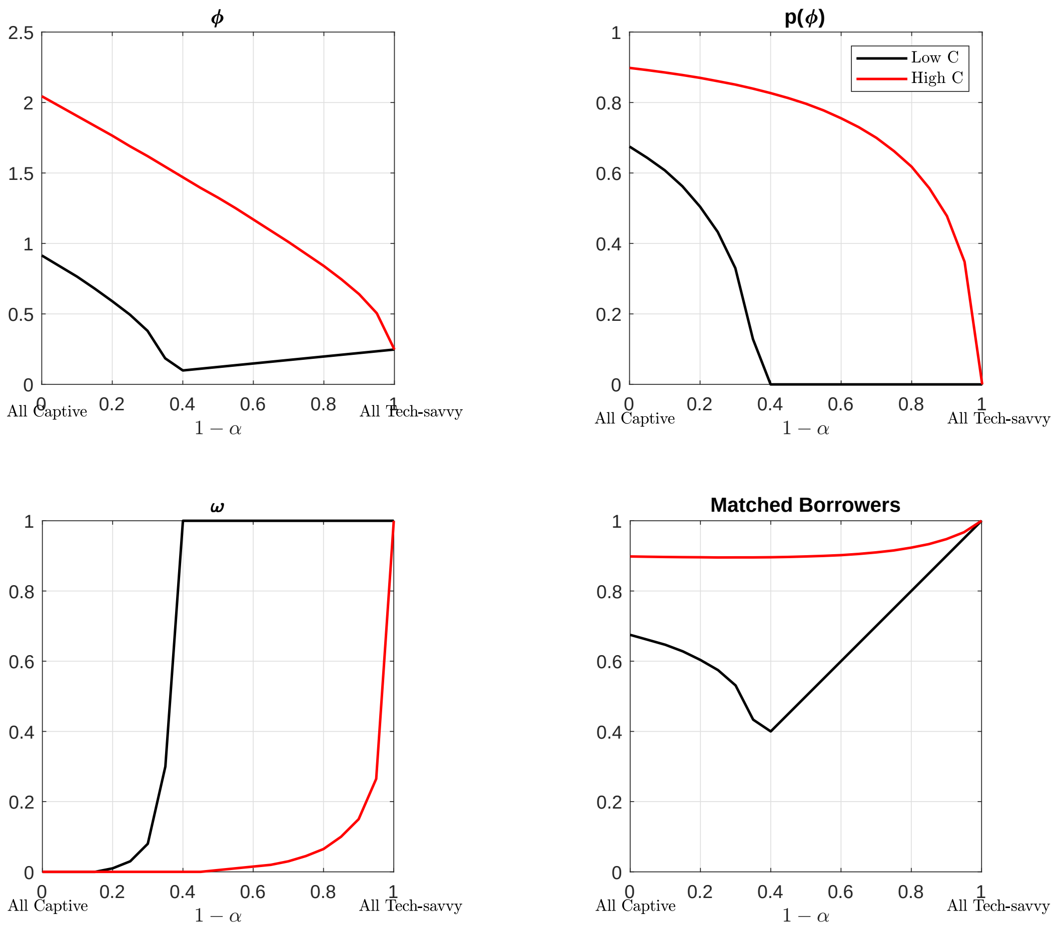
Notes: This figure shows the equilibrium extensive margin (i.e., matching probability $p(\phi)$) and intensive margin (i.e., credit per borrower κ^* and loan rate r^*) for bank credit for the (i) Bank only (solid lines) and (ii) Bank + Fintech (dashed lines) cases, as a function of borrower collateral C. The red lines represent the thresholds between full ("No entry") and partial credit rationing, while the blue lines represent the thresholds between partial rationing and first best credit.No entry The numerical application assumes a decreasing-return-to-scale production function, $f(\kappa) = y\kappa^\rho$, with $y = 1.25$ and $\rho = 0.7$, a CES matching function, such that $p(\phi) = \phi(1 + \phi^{\gamma_m})^{-\frac{1}{\gamma_m}}$, and $q(\phi) = (1 + \phi^{\gamma_m})^{-\frac{1}{\gamma_m}}$, with $\gamma_m = 2$, and a partnership cost function, $c_p(x) = c_0 + c_1 x$, with $c_0 = 1\text{e}{-4}$ and $c_1 = 0.005$. The remaining model parameters are: $k = 0.06$, $\chi_b = 0.25$, $\chi_f = 0.5$, $\zeta = 0.075$, $\delta = 0.075$, $\gamma = 0.5$, and $\nu = 0.5$.

Figure 5: Bank Feedback Loop and Credit Market Implications of Fintech Disruption



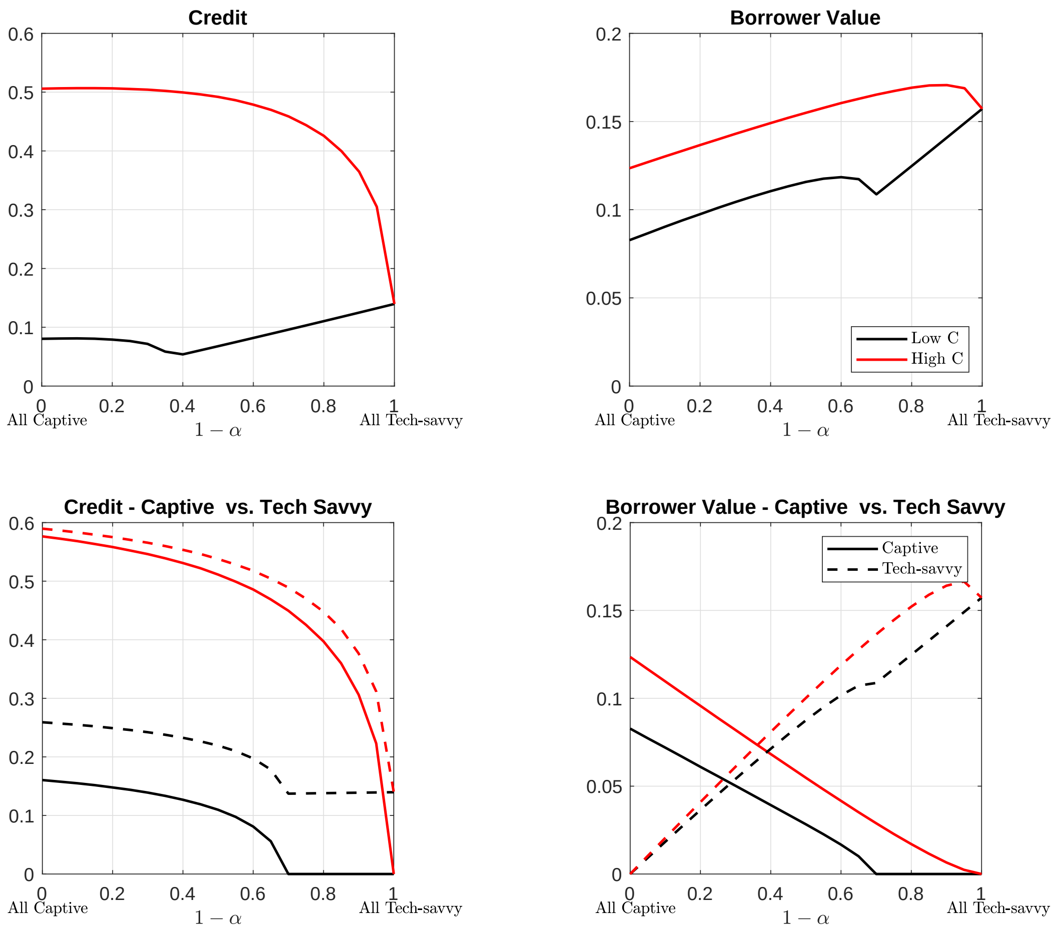
Notes: The diagram depicts the feedback loop impacting bank profits, direct market entry, and partnerships, and credit market implications upon fintech disruption.

Figure 6: Equilibrium Properties – Extensive Margin



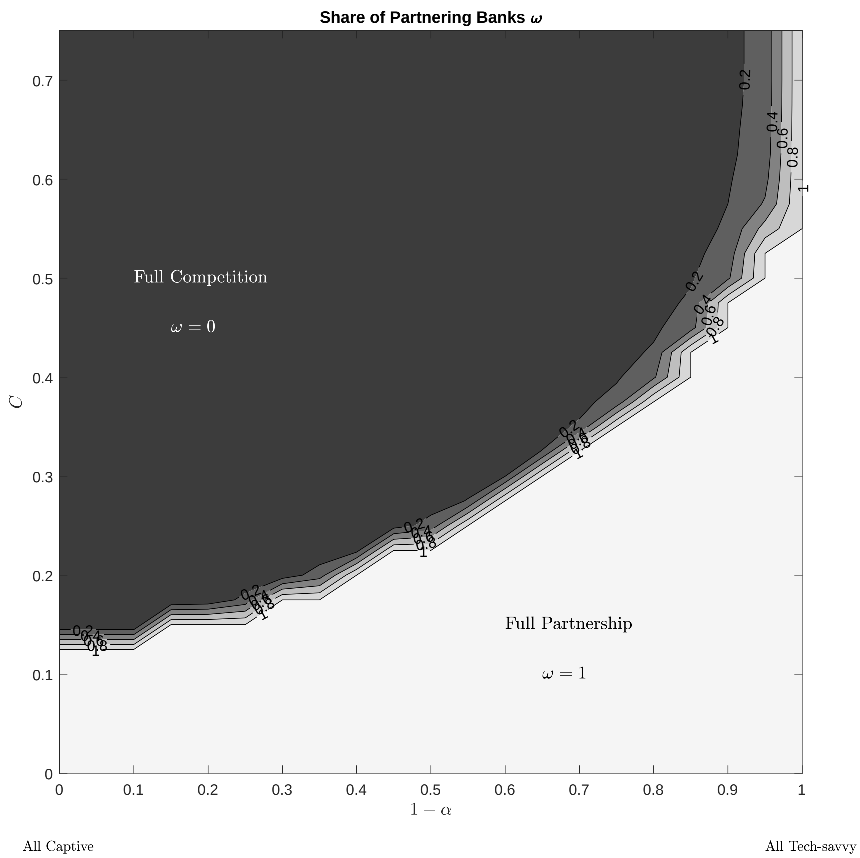
Notes: This figure shows the evolution of variables associated with the extensive margin of credit with respect to the share of captive borrowers α. The x-axis is shown with respect to $1-\alpha$, so as the left-hand-side bound represents the case with all captive borrowers, and the right-hand-side bounds represents the case of associated with all teach-savvy borrowers. The numerical application assumes a decreasing-return-to-scale production function, $f(\kappa) = y\kappa^{\rho}$, with $y = 1.25$ and $\rho = 0.7$, a CES matching function, such that $p(\phi) = \phi(1+\phi^{\gamma_m})^{-\frac{1}{\gamma_m}}$, and $q(\phi) = (1+\phi^{\gamma_m})^{-\frac{1}{\gamma_m}}$, with $\gamma_m = 2$, and a partnership cost function, $c_p(x) = c_0 + c_1 x$, with $c_0 = 1\text{e}{-4}$ and $c_1 = 0.005$. The remaining model parameters are: $k = 0.06$, $\chi_b = 0.25$, $\chi_f = 0.5$, $\zeta = 0.075$, $\delta = 0.075$, $\gamma = 0.5$, and $\nu = 0.5$.

Figure 7: Equilibrium Properties – Intensive Margin and Surplus Split Across Agents



Notes: This figure shows the evolution of variables associated with credit and borrower values with respect to the share of captive borrowers α. The x-axis is shown with respect to $1-\alpha$, so as the left-hand-side bound represents the case with all captive borrowers, and the right-hand-side bounds represents the case of associated with all teach-savvy borrowers. The top panels report variables aggregated across all borrowers, while the bottom panels reports variables for captive (solid lines) and tech-savvy (dashed lines) borrowers separately. The numerical application assumes a decreasing-return-to-scale production function, $f(\kappa) = y\kappa^{\rho}$, with $y = 1.25$ and $\rho = 0.7$, a CES matching function, such that $p(\phi) = \phi(1+\phi^{\gamma_m})^{-\frac{1}{\gamma_m}}$, and $q(\phi) = (1+\phi^{\gamma_m})^{-\frac{1}{\gamma_m}}$, with $\gamma_m = 2$, and a partnership cost function, $c_p(x) = c_0 + c_1 x$, with $c_0 = 1\text{e}{-4}$ and $c_1 = 0.005$. The remaining model parameters are: $k = 0.06$, $\chi_b = 0.25$, $\chi_f = 0.5$, $\zeta = 0.075$, $\delta = 0.075$, $\gamma = 0.5$, and $\nu = 0.5$.

Figure 8: Competition vs. Partnership Regimes in Equilibrium



Notes: This figure shows the regime sustained among lenders in equilibrium, as a function of collateral C and the share of bank-captive borrowers α. The x-axis is shown with respect to $1-\alpha$, so as the left-hand-side bound represents the case with all captive borrowers, and the right-hand-side bounds represents the case of associated with all teach-savvy borrowers. The numerical application assumes a decreasing-return-to-scale production function, $f(\kappa) = y\kappa^{\rho}$, with $y = 1.25$ and $\rho = 0.7$, a CES matching function, such that $p(\phi) = \phi(1+\phi^{\gamma_m})^{-\frac{1}{\gamma_m}}$, and $q(\phi) = (1+\phi^{\gamma_m})^{-\frac{1}{\gamma_m}}$, with $\gamma_m = 2$, and a partnership cost function, $c_p(x) = c_0 + c_1 x$, with $c_0 = 1\text{e}{-4}$ and $c_1 = 0.005$. The remaining model parameters are: $k = 0.06$, $\chi_b = 0.25$, $\chi_f = 0.5$, $\zeta = 0.075$, $\delta = 0.075$, $\gamma = 0.5$, and $\nu = 0.5$.

B Proofs

Proof for Proposition 1

Proof. If unconstrained, the solution to the contracting problem in (1) is simply $\kappa = \kappa^*$, such that

$$f'(\kappa^*) = 1 + \delta.$$

If κ^* violates equation (6), then there must exist $0 < \kappa^{**} < \kappa^*$ such that κ^{**} satisfies equation (6) with equality, as long as $C > 0$ or $\chi > 0$. Therefore, $\kappa = \kappa^{**}$ in a constrained optimum. □

Proof for Corollary 1

Proof. When the entrepreneur is constrained, the equilibrium κ^{**} satisfies equation (6) with equality. Hence, $\frac{(1-\gamma)(1+\delta)\kappa^{**}-C}{f(\kappa^{**})} + \gamma = \chi$. Taking derivatives with respect to χ of both sides,

$$\left((1-\gamma)(1+\delta) \left[\frac{f(\kappa^{**}) - \kappa^{**} f'(\kappa)}{f(\kappa^{**})^2} \right] + \frac{C f'(\kappa^{**})}{f(\kappa^{**})^2} \right) \frac{\partial \kappa^{**}}{\partial \chi} = 1.$$

Because $f(\kappa) \geq 0$ for all $\kappa \geq 0$ and is concave (i.e., decreasing returns to scale (DRS)), $f(\kappa) - \kappa f'(\kappa) > 0$ for $\kappa > 0$. Therefore, $\frac{\partial \kappa^{**}}{\partial \chi} > 0$.

Similarly, taking derivatives with respect to C of both sides yields,

$$\left[(1-\gamma)(1+\delta) + (\gamma - \chi) f'(\kappa^{**}) \right] \frac{\partial \kappa^{**}}{\partial C} = 1.$$

If $\gamma > \chi$, $\frac{\partial \kappa^{**}}{\partial C} > 0$ follows. If $\gamma \leq \chi$, we know from equation (6) that $(1-\gamma)(1+\delta)\kappa^{**} - (\chi - \gamma) f(\kappa^{**}) = C \geq 0$. Hence, $(1-\gamma)(1+\delta)\kappa^{**} \geq (\chi - \gamma) f(\kappa^{**})$, which implies $(1-\gamma)(1+\delta) \geq (\chi - \gamma)\frac{f(\kappa^{**})}{\kappa^{**}} > (\chi - \gamma) f'(\kappa^{**})$ because $f(\kappa)$ is DRS. Again, $\frac{\partial \kappa^{**}}{\partial C} > 0$ follows. Finally, because $L^{**} = \gamma \left[f(\kappa^{**}) - (1+\delta)\kappa^{**} \right]$, $\frac{\partial \kappa^{**}}{\partial \chi} > 0$ and $\frac{\partial \kappa^{**}}{\partial C} > 0$ prove $\frac{\partial L^{**}}{\partial \chi} > 0$ and $\frac{\partial L^{**}}{\partial C} > 0$. □

Proof for Proposition 2

Proof. Because $0 \leq p(\phi) \leq 1$ and $0 \leq q(\phi) \leq 1$, the equilibrium exists if and only if $k \leq B$. Note, also, that the matching probability for banks $q(\phi)$ monotonically increases with ϕ, so that there exists unique ϕ (thus, unique $\bar{\mathcal{B}}$) that satisfies equation (11). □

Proof for Proposition 3

Proof. By corollary 1, as C decreases, $\kappa_b^{**} < \kappa_b^*$ decreases. Hence, $B = \gamma\left[f(\kappa_b^{**}) - \kappa_b^{**}\right]$ decreases, as C decreases, because $\frac{\partial B}{\partial \kappa_b} > 0$ for $\kappa_b < \kappa_b^*$. With sufficiently low $0 \leq C \leq C_1$ such that $\kappa_b^{**}(C_1)$, derived from equation (7) with $\chi = \chi_b$ and $\delta = 0$, satisfies $\frac{k}{\gamma} = f(\kappa_b^{**}(C_1)) - \kappa_b^{**}(C_1)$, no banks enter the credit market. When $C_1 < C < C_2$ where $\kappa_b^{**}(C_2)$, derived from equation (7) with $\chi = \chi_b$ and $\delta = 0$, is equal to κ_b^*, there will be positive entry of banks until they break even, implied by equations (11) and bank entry, $B_0 = 0$, and they provide κ_b^{**} of capital to borrowers. Obviously, when $C \geq C_2$, more banks enter and they manage to supply the first-best level of capital to matched entrepreneurs. □

Proof for Lemma 1

Proof. First-best capital κ_b^* of bank-financed loans satisfies $f'(\kappa_b^*) = 1$, while first-best capital κ_f^* of fintech-financed loans satisfies $f'(\kappa_f^*) = 1 + \delta + \zeta$. Given that function $f(\cdot)$ is decreasing-return-to-scale, $\kappa_b^* > \kappa_f^*$ if and only if $\delta + \zeta > 0$. □

Proof for Lemma 2

Proof. From proposition 1, standalone banks derive $B = \gamma[f(\kappa_b) - \kappa_b]$ by intermediating credit to captive borrowers where $\kappa_b = \kappa^*(\delta = 0)$ if unconstrained, or $\kappa_b = \kappa^{**}(\delta = 0)$, if constrained. Captive borrowers receive $E_b^0 = (1 - \gamma)[f(\kappa_b) - \kappa_b]$, which stays the same even after fintech entry. Because non-captive borrowers have access to fintech-financed loans, the disagreement point increases and forces banks to offer more favorable contractual terms. More specifically, non-captive borrowers end up receiving

$E_b = (1-\gamma)[f(\kappa_b)-\kappa_b]+\gamma E_f > E_b^0$ with $E_f \geq 0$ and higher κ_b due to effectively relaxed agency friction (see equation (18) and definitions that follow). □

Proof for Lemma 3

Proof. The equivalent of C_2 in proposition 3 in this case is denoted as $\tilde{C}_2$ which solves equation (18) when $\kappa_b = \kappa_b^*$ with equality. Note that the only difference of this equality from the equation that determined C_2 is $E_f \geq 0$, which relaxes the enforcement constraint. Therefore, $C_2 \geq \tilde{C}_2$. □

Proof for Proposition 4

Proof. $E_b - E_f = (1-\gamma)[f(\kappa_b)-\kappa_b]+\gamma E_f - E_f = (1-\gamma)\left[(f(\kappa_b) - \kappa_b) - (f(\kappa_f) - (1+\delta+\zeta)\kappa_f)\right]$, where κ_b solves the financial contracting problem (1) with $L = B$ and $\delta = 0$ subject to equations (3) and (18) and κ_f solves the problem (13) subject to equation (14). The equilibrium κ_f is orthogonal to C, so the second parenthesis is fixed. By corollary 1, the first parenthesis increases with C and is maximized at $\kappa_b = \kappa_b^*$. With sufficiently high $\delta + \zeta$, the first term exceeds the second so that $E_b > E_f$. As C decreases, however, the first term monotonically decreases. Therefore, there exists a unique collateral level C_f such that it renders $E_b = E_f$. Hence, $E_b < E_f$ if and only if $C < C_f$. □

Proof for Corollary 2

Proof. This follows directly from proposition 4. E_f falls with δ and ζ, and E_b increases with χ_b. With lower E_f, bank loans become more attractive to borrowers, and hence lower C_f. □

Proof for Proposition 5

Proof. If banks were already supplying the first-best capital κ_b^* to borrowers, they will continue providing κ_b^* after fintech entry, as it lowers agency friction even further. With $E_f \geq 0$, $B^0 = \gamma\left[f(\kappa_b^*) - \kappa_b^*\right] \geq \gamma\left[f(\kappa_b^*) - \kappa_b^* - E_f\right] = B$. Less bank entry follows to break even (i.e., lower ϕ).

If borrowers were constrained, we know that from equation (18), $(1-\gamma)\kappa_b - (\chi_b - \gamma)f(\kappa_b) = C + \gamma E_f$ must hold after fintech entry. Thus, because $C \geq 0$ and $E_f \geq 0$, we have $(1-\gamma)\kappa_b \geq (\chi_b - \gamma)f(\kappa_b)$ for any constrained optimum κ_b. Because $f(\kappa)$ is is decreasing-return-to-scale, $1 - \gamma + \gamma f'(\kappa_b) > \chi_b f'(\kappa_b)$ must hold. This proves that it is feasible to have situations in which the order of $\chi_b f'(\kappa_b)$ and 1 flips.

Now, rearranging (18) gives $\gamma\left[f(\kappa_b) - \kappa_b - E_f\right] = \chi_b f(\kappa_b) - \kappa_b + C$. Note that $LHS = B$. Denote κ_b^{**} as the constrained optimal capital provided by banks to all borrowers before fintech entry, where it satisfies $B^0 = \gamma\left[f(\kappa_b^{**}) - \kappa_b^{**}\right] = \chi_b f(\kappa_b^{**}) - \kappa_b^{**} + C$. Corollary 1 implies $\frac{\partial \kappa_b}{\partial E_f} \geq 0$, so as E_f increases from 0 with fintech entry, RHS would increase if $f'(\kappa_b^{**}) > \frac{1}{\chi_b}$ as the new credit amount increases from κ_b^{**}. Notice that RHS is identical to RHS of the first equation, which equals B. Hence, $B \geq B^0$ materializes if E_f is sufficiently close to 0 and $f'(\kappa_b^{**}) \geq \frac{1}{\chi_b}$, leading to higher entry of banks (i.e., higher ϕ). Otherwise, if $f'(\kappa_b^{**}) < \frac{1}{\chi_b}$, then any fintech entry regardless of its disruptiveness (i.e., E_f) results in lesser entry of banks (i.e., lower ϕ). □

Proof for Corollary 3

Proof. This follows directly from proposition 5. $E_f^* = 0$ if the first-best credit was being supplied even before fintech entry. Denote κ_b as pre-fintech constrained optimal credit (i.e., solution to $\gamma(f(\kappa_b) - \kappa_b) = \chi_b f(\kappa_b) - \kappa_b + C$) and $\tilde{\kappa}_b$ as post-fintech constrained optimal credit (i.e., solution to $\gamma(f(\tilde{\kappa}_b) - \tilde{\kappa}_b - E_f) = \chi_b f(\tilde{\kappa}_b) - \tilde{\kappa}_b + C$). Because $\tilde{\kappa}_b$ is a monotonically increasing function w.r.t. $\tilde{E}_f$ and $\chi_b f(\tilde{\kappa}_b) - \tilde{\kappa}_b + C$ starts to decrease with sufficiently high κ_b, there exists a unique $E_f^* \geq 0$ such that for $E_f > E_f^*$, $\chi_b f(\tilde{\kappa}_b) - \tilde{\kappa}_b + C \leq \chi_b f(\kappa_b) - \kappa_b + C$. □

Proof for Proposition 6

Proof. If k is sufficiently small such that $k < \alpha B^0 + (1-\alpha)B(\phi = 0) = \alpha B^0 + (1-\alpha)\gamma(f(\kappa_b) - \kappa_b - E_f^c)$, then the equilibrium $\phi(1-\omega)$ must increase to satisfy equation (25), and hence $\phi > 0$ regardless of $\omega \in (0,1)$. Similarly, if c_0 is sufficiently small such that $c_0 < (1-\alpha)\nu(F^p - F^c)$, then the equilibrium $\phi(1-\omega)$ must increase to satisfy equation (26), and hence $\phi > 0$ regardless of $\omega \in (0,1)$. Therefore, we establish $\phi > 0$ for sufficiently small k or c_0.

Now, using $p(\phi) = \phi q(\phi)$ for any $\phi > 0$, equations (25) and (26) can be combined into

$$c_0 + c_1(\omega\phi) = \left(1 - \frac{(1-\omega)\phi k}{\alpha B^0 + (1-\alpha)\gamma(f(\kappa_b) - \kappa_b - E_f^c - \omega\phi(E_f^P - E_f^c))}\right)(1-\alpha)\nu(F^p - F^c),$$

if the equilibrium $\tilde{E}_f$ is strictly greater than E_b. For any given $\phi > 0$, $-\infty \leq LHS \leq \infty$ and $\frac{\partial LHS}{\partial \omega} > 0$, while $\lim_{\omega \to -\infty} RHS = \lim_{\omega \to \infty} RHS = \left(1 - \frac{k}{(1-\alpha)\gamma(E_f^p - E_f^c)}\right)(1-\alpha)\nu(F^p - F^c)$ by L'hôpital's rule and

$$\frac{\partial RHS}{\partial \omega} = \phi \frac{\alpha B^0 + (1-\alpha)\gamma\left[f(\kappa_b) - \kappa_b - E_f^c - \phi(E_f^p - E_f^c)(\omega + k(1-\omega))\right]}{\left[\alpha B^0 + (1-\alpha)\gamma(f(\kappa_b) - \kappa_b - E_f^c - \omega\phi(E_f^P - E_f^c))\right]^2},$$

which switch signs as ω increases. Therefore, if k is small enough so that

$$c_0 < \left(1 - \frac{k}{(1-\alpha)\gamma(E_f^p - E_f^c)}\right)(1-\alpha)\nu(F^p - F^c),$$

(or c_0 is small enough to satisfy the inequality), then the continuity of both LHS and RHS w.r.t. ω guarantees at least one crossing. If the crossing(s) happens at $\omega < 0$ or $\omega > 1$, the equilibrium ω is set to 0 and 1, respectively, and ϕ is determined through equations (25) and (26). Finally, the equilibrium (ϕ, ω) has to satisfy $E_b \geq \tilde{E}_f$. If $E_b < \tilde{E}_f$, then $\phi(1-\omega)$ and $\phi\omega$ is uniquely defined by equations (25) and (26), respectively, so that the equilibrium not only exists but also is unique. □

Proof for Corollary 4

Proof. By proposition 6, the *ex-ante* revenues for standalone and fintech-partnered banks are RHS of equations in the proposition, respectively. Hence, the ordering of revenues for the two is fully determined by that of k and c_p. □

Proof for Proposition 7

Proof. If α is close to 1, then the upper bound for the RHS in equation (26) becomes $(1-\alpha)\nu(F^p - F^c)$. If α increases further, then this upper bound decreases, and with $c_0 > 0$, there must exist $\alpha^* > 0$ such that if $\alpha \geq \alpha^*$, then $\omega = 0$.

Conversely, when α decreases, the likelihood of matching with non-captive borrowers for partnerships increases as long as standalone banks do not enter more. From proposition 5, we have shown conditions under which standalone banks may enter more upon fintech disruption. In the general equilibrium of the economy with partnerships, however, such case simplifies to a limiting equilibrium with $\omega = 0$. That is, if a decrease in α effectively relaxes standalone banks' limited commitment friction (by lifting the disagreement point through competitive pressures from partnership formation), this will be immediately followed by less banks willing to partner up with fintechs to the extent that all banks remain as standalones in a general equilibrium. Therefore, ω lifts off from 0 only if α is sufficiently lower from 1 such that the fintech disruptiveness due to partnership is intense to discourage further entry of standalone banks to the credit market.

Therefore, ω increases as α decreases, so there must exist $0 \leq \alpha^{**} \leq \alpha^*$ such that for $\alpha^{**} \leq \alpha \leq \alpha^*$, standalone and partnership banks coexist (i.e., $0 < \omega < 1$), and for $0 \leq \alpha < \alpha^{**}$, we have a full partnership regime (i.e., $\omega = 1$). □

Proof for Corollary 5

Proof. Because lower funding cost for standalone fintechs means higher F^c, banks have to pay higher partnership fee f by equation (22). Obviously, higher f discourages partnership formation.

Recall, $B = \gamma \left[f(\kappa_b) - \kappa_b - \tilde{E}_f \right]$. Higher enforcement gap translates to lower $f(\kappa_b) - \kappa_b$ or higher $\tilde{E}_f$ or both. Hence, $\phi(1-\omega)$ drops. Moreover, $F^p - F^c = \zeta(\kappa_f^p - \kappa_f^c)$ increases as χ_f increases in a constrained optimum (i.e., equation (14) holds with equality) because $f(\cdot)$ is DRS and $\delta > 0$. The resulting increase in the RHS of equation (26), which will be enlarged with low α and $\phi(1-\omega)$, warrants the equilibrium increase in $\omega\bar{\mathcal{B}}$—the equilibrium mass of partnership lending. □

Proof for Proposition 8

Proof. We will show conditions under which E_0 may increase or decrease with $\tilde{E}_f$. From proposition 5, we know that under $f(\kappa_b) \geq \frac{1}{\chi_b}$, $\tilde{\phi}$ may increase with $\tilde{E}_f$ sufficiently close to 0. In this case, $E_0 = p(\tilde{\phi}) \left[\alpha E_b^0 + (1-\alpha) \max\{E_b, \tilde{E}_f\} \right] + (1 - p(\tilde{\phi}))(1-\alpha)\tilde{E}_f$ increases with $\tilde{E}_f$ in both $E_b \geq \tilde{E}_f$ and $E_b < \tilde{E}_f$ cases, simply because $p(\tilde{\phi})$ increases with $\tilde{\phi}$.

Now, consider an economy where matched borrowers receive first-best capital from any lenders and $E_b \geq \tilde{E}_f$. Then, B, and so $\tilde{\phi}$, decrease monotonically with $\tilde{E}_f$. The sensitivity of $\tilde{\phi}$ to changes in $\tilde{E}_f$ is critical to determine the sign of $\frac{\partial E_0}{\partial \tilde{E}_f}$. From equation (25), $\frac{\partial q(\tilde{\phi})}{\partial \tilde{E}_f} = \frac{q(\tilde{\phi})(1-\alpha)\gamma}{\alpha B^0 + (1-\alpha)B} > 0$. Because $\frac{\partial q(\tilde{\phi})}{\partial \tilde{E}_f} = \frac{\partial q(\tilde{\phi})}{\partial \tilde{\phi}} \frac{\partial \tilde{\phi}}{\partial \tilde{E}_f}$, $\frac{\partial \tilde{\phi}}{\partial \tilde{E}_f} < 0$ since $\frac{\partial q(\tilde{\phi})}{\partial \tilde{\phi}} < 0$. This is immediately followed by $\frac{\partial p(\tilde{\phi})}{\partial \tilde{E}_f} = \frac{\partial p(\tilde{\phi})}{\partial \tilde{\phi}} \frac{\partial \tilde{\phi}}{\partial \tilde{E}_f} < 0$ because $\frac{\partial p(\tilde{\phi})}{\partial \tilde{\phi}} > 0$.

Recall, equation (21):

$$
\begin{aligned}
E_0 &= p(\tilde{\phi}) \left[\alpha E_b^0 + (1-\alpha) \max\{E_b, \tilde{E}_f\} \right] + (1 - p(\tilde{\phi}))(1-\alpha)\tilde{E}_f, \\
\frac{\partial E_0}{\partial \tilde{E}_f} &= \underbrace{\frac{\partial p(\tilde{\phi})}{\partial \tilde{E}_f} \left[\alpha E_b^0 + (1-\alpha)(E_b - \tilde{E}_f) \right] - (1-\alpha)(1+\gamma)p(\tilde{\phi})}_{<0} + \underbrace{1-\alpha}_{>0},
\end{aligned} \tag{29}
$$

where equation (29) reveals the possibility of it being negative. To see this, simply consider the case with $p(\tilde{\phi}) \approx 1$. Therefore, the sign of $\frac{\partial E_0}{\partial \tilde{E}_f}$ is ambiguous and critically depends on model parameters.

□