Lending and monitoring: Big Tech vs Banks.*

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Abstract

We show that by lending to merchants and monitoring them, an e-commerce platform can price-discriminate between merchants with high and low financial constraints: the platform offers credit priced below market rates and designed to select merchants with lower capital or collateral while simultaneously increasing the platform's access fees. The credit market then becomes endogenously segmented with banks focusing on less financially constrained borrowers. Lending by the platform expands with its monitoring efficiency but can arise even when the platform is less efficient than banks at monitoring. Platform credit benefits more financially constrained merchants as well as consumers, but can hurt less financially constrained merchants if cross-side network effects with consumers are too small. The platform's propensity to offer credit and the financial inclusion of more constrained merchants depends on the platform's market power in its core business.

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1 Introduction

The expansion of big tech platforms into credit has been a major shift in an activity traditionally dominated by banks. Cornelli et al. (2023) report that in 2018 credit issuance from big tech platforms has reached USD 397 billion globally and overcome other types of fintech lenders (estimated at USD 297 billion). Evidence suggests that credit provided by commercial platforms is particularly crucial for smaller and more financially constrained firms (Hau et al. (2019)). At the same time, a growing concern is that the entry of big techs into credit may contribute to an already dominant competitive position, creating digital monopolies across markets (Croxson et al. (2022)). Questions abound: What is the relationship between Big Tech's traditional platform business and their more recent foray into credit? Does big tech credit substitute for bank credit, or do big techs target different customers, possibly neglected by traditional banks? Is big tech credit beneficial or detrimental to social welfare? The objective of this paper is to shed light on some determinants of big techs' credit activity, and to assess the welfare consequences of big techs' credit provision supply.

One explanation for the spectacular growth of big tech's credit is that large platforms are more efficient at providing credit. In particular, platforms may have an advantage over banks when screening borrowers ex ante based on a wider access to data (Berg et al. (2020)). Platforms may also have an advantage ex post in monitoring borrowers and enforcing repayments either by directly seizing cash-flows or through the threat of exclusion from the platform (Liu et al. (2022)). However, beyond efficiency, e-commerce platforms may also have different *incentives* to provide credit than the banking system. Where a bank evaluates the profitability of granting a loan solely based on the cash-flows this loan will generate, a platform may internalize that access to credit allows merchants to develop, and generate traffic or trading on the platform. This additional benefit can be amplified by the network effects inherent to multi-sided businesses. In this paper, we study how the nature of platforms' commercial activities and their competitive positions affect their decisions to enter the credit market, and conversely how providing credit affects the management of platforms' commercial activities.

To study the interaction between commercial and credit activities, we develop a model in which a platform sets access prices to attract consumers and sellers (merchants) to trade on the platform. Selling on the platform requires an initial outlay from merchants corresponding to a development cost or a working capital need (e.g., inventory). To fund this initial outlay merchants can borrow from a competitive banking system or from the platform itself if it enters the credit market. Each merchant's output is subject to moral hazard which, in the spirit of Holmström and Tirole (1997), can be mitigated through costly monitoring by the lender. As a result, merchants' ability to raise funds depends on their initial capital or more generally on the collateral they can pledge, as well as on the efficiency of the monitoring technology. Both the platform and banks have access to a monitoring technology but we allow the platform's monitoring efficiency to be higher or lower than the banks'. In this setting, we study the platform *joint* decision to set access fees for consumers and merchants and to offer credit to merchants.

A benchmark case is when only banks can provide credit. In that case, we obtain the standard result of Holmström and Tirole (1997) that less financially constrained merchants (those with sufficiently large initial capital) raise credit that does not require lender monitoring. Intuitively, their stake alone is high enough to preserve their incentives. For merchants with lower capital, monitoring by the lender mitigates moral hazard and allows access to credit despite a lower stake in the project. However, because monitoring by the lender is costly and the cost is passed on to merchants, more financially constrained merchants face less favorable credit terms. Finally, merchants with capital below a certain threshold are denied credit and do not access the platform. The platform's pricing decision then results from the following trade-off. If the platform sets a high access price, it increases its revenue per merchant, but it raises the minimum capital required for merchants to obtain credit. If the platform sets a lower price, it increases the number of merchants who can obtain financing, and thus the number of transactions on the platform, but decreases the revenue per merchant.

This interaction between the platform's access fee and merchants' financial constraints is key to understand the platform's motives in the credit market. To become active in the credit market, the platform needs to offer at least one type of credit contract priced below the banks' competitive contracts. While this could expand the range of merchants that join the platform, if *all* merchants take that contract, then credit and access fees are perfect substitute for the platform: providing credit at more favorable conditions is equivalent to lowering merchants' access fee. It follows that the platform's entry in the credit market is related to its ability to direct credit at a subset of merchants. We show that when offering credit, the platform optimally targets marginal merchants that are denied credit by traditional banks while charging a higher access fee than if only banks could provide funding. In doing so, the platform indirectly engages in price discrimination: all merchants pay the higher access fee but only the more constrained merchants benefit from below-market-rate credit. Through this implicit subsidy and monitoring by the platform, platform credit preserves these more constrained merchants' incentives despite the higher access fee. Platform credit is cheaper for these merchants than what they could obtain from banks, but more expensive than what less constrained merchants that do not require monitoring obtain from banks. This is the product of an incentive compatibility constraint which ensures that *only* the more constrained merchants take the platform's contract. Indeed, capital (collateral) is verifiable but not observable. That is, a borrower cannot lie about having more capital than she actually has, but can lie about having less. As a result, if the contract offered by the platform became too attractive, it would also be taken by merchants that can borrow from banks without monitoring, in which case the platform would lose the ability to price-discriminate through credit. Note that there is room for bank credit to remain cheaper and therefore for this incentive compatibility constraint to hold because banks focus on credit that does not require monitoring and is therefore fundamentally less costly than platform credit.

Through the platform's incentive to price-discriminate, the model endogenously generates segmentation where the platform focuses on the more financially constrained merchants. Consistent with the idea that Big Tech lending relaxes the financial constraints of underserved borrowers, lending by the platform operates at an extensive margin: the mass of merchants that access credit is higher than in the benchmark where only banks can provide credit. However, platform credit is not a pure complement to bank credit: because the platform improves the terms for credit that requires monitoring, it captures part of the market banks hold when the platform is not lending. The amount of credit the platform provides expands with the efficiency of its monitoring technology, but the price-discrimination benefit implies that the platform may enter the credit market even in cases where its monitoring technology is inferior to that of the banking sector. This contrasts with the more common explanation that platform's entry into the credit market is driven by an inherent technological advantage over banks at screening or monitoring. Even in cases where the platform is more efficient than banks at monitoring, the price-discrimination motive remains, which implies that the platform monitoring costs and the platform access fees are tied: access fees go up as the platform becomes more efficient at monitoring and gains market share in the credit market.

We then investigate the welfare implications of the platform's credit provision. Because the platform broadens the merchant base by targeting rationed merchants, consumers benefit from more interactions with the merchants' side and are therefore better off with platform credit.

Financially constrained merchants are also better off for two reasons. First, some merchants receive credit from the platform who could not access funding if only banks were present in the credit market. Second, merchants who borrow from the platform obtain better conditions not only than what they can get from banks when the platform lends, but also than what they could get if only banks were present in the credit market. This credit "subsidy" overcomes the increase in access price. Finally, for merchants with high capital, there are two opposing effects. On the one hand, they face higher access fees consistent with the platform's price discrimination motive. On the other hand, platform credit leads to higher merchants' participation, which in turn can lead to higher consumers' participation. We show that these cross-side network effects can be (but are not necessarily) strong enough that sellers with high capital also benefit from the platform entering the credit market. Note finally that price-discrimination through credit entails a deadweight loss: because the platform raises access fees, some merchants that could have borrowed without monitoring from banks have to turn to the platform once it enters the market. That is, platform's credit with monitoring substitutes for bank's credit without monitoring and the platform's monitoring cost is a social loss. An additional social loss materializes when the platform is less efficient at monitoring than banks but enters the credit market nevertheless. We show that in cases where cross-side network effects are small, this can lead to a decrease in total welfare.

In the last part of the paper, we relate the platform's incentive to enter the credit market to the market power it holds as a gateway between merchants and consumers. We show that an increase in the platform's market power leads to an expansion of its lending activity. Intuitively, the benefits of price discrimination are higher when the competitive pressure on the platform's fees is lower. This, however, does not imply that lower platform market power necessarily leads to fewer merchants receiving credit. In fact, as long as the platform remains active in the credit market, the opposite happens. Because of competitive pressure, the platform lowers its fees which allows more merchants to obtain credit from banks. This increase in bank credit overcomes the decline in platform credit. On the other hand, if competitive pressure intensifies and the platform is not very efficient at monitoring, the platform may leave the credit market altogether. This causes a discontinuity where the amount of merchants that receive funding abruptly drops. Overall, the analysis suggests that the issue of the financial inclusion of small constrained firms is tied not only to the structure of the credit market but also to the pricing power of large e-commerce platforms.

This paper lies at the intersection of a literature in industrial organization on two-sided markets and a literature in corporate finance on moral hazard and financial constraints. On the platform side, our model leverages the tractability of Rochet and Tirole (2003) but introduces fixed costs on each side that generate cross-side network effects similar to Armstrong (2006). On the corporate finance side, our model uses Holmström and Tirole (1997) as a building block to generate both financial constraints through a moral hazard problem and to capture monitoring as a way to mitigate this problem. Our paper is also related to a literature on trade credit or more generally vendor credit that investigates the motives for commercial firms to extend credit to their clients. Within that stream, the closest paper to ours is Brennan et al. (1988) which theoretically shows that vendor's credit can be motivated by price discrimination when clients are credit constrained.[1] There are two main differences with our approach. First, in Brennan et al. (1988), financing frictions are created by ex-ante adverse selection instead of ex-post moral hazard in our setup. Adverse selection implies that the pool of borrowers funded by the vendor is less risky than the pool that receives funding if only banks extend credit. By contrast, moral hazard in our setup predicts that at the extensive margin the platform extends credit to observationally more risky borrowers (i.e., with lower collateral) consistent with empirical evidence on platform credit. Moral hazard also highlights the key function of platform monitoring. Second, the two-sided nature of the platform in our setup implies feedback effects between the side that receives credit (merchant) and the other side (consumers). This two-way interaction affects both the platform's incentive to provide funding and the welfare implications for both sides.[2]

Our paper is also related to a growing literature on Fin Tech and more specifically on the rise of credit provided by e-commerce platforms. Liu et al. (2022) provides an overview of the big tech's business model in the credit market which is consistent with ex-post monitoring and the ability to enforce debt contract terms being a key determinant of platform credit. Hau et al. (2019) and Frost et al. (2019) provide evidence that big tech credit flows to more financially constrained merchants. On the theory side Huang (2021) and Li and Pegoraro (2022) explore the idea that platforms have a more direct access to merchants' cash-flows than banks since

[1] See Petersen and Rajan (1997) for the literature on trade credit including a review of empirical evidence consistent with a price discrimination motive.

[2] Other theories of trade credit rely on the supplier having superior information about its clients (Biais and Gollier (1997)) or on clients having lower incentives to divert the inputs they directly receive from supplier than the cash they borrow to buy these inputs (Burkart and Ellingsen (2004)).

these cash-flows are generated through the platform. In Li and Pegoraro (2022), this ability to capture merchants' revenues gives the platform an edge for borrowers that are perceived as more likely to try and abscond with their profits and are therefore less likely to have access to bank credit. Our key difference with these papers is that we jointly model the platform's decision to provide credit and to set access fees. Credit market segmentation with the platform serving more financially constrained merchants is then driven by this global pricing strategy and does not require the platform to have superior monitoring abilities. Endogenizing platform pricing allows us to evaluate cross-side network effects and their welfare implications, as well as the relationship between the platform's incentive to enter the credit market and its overall market power. On the other hand, we abstract from ex-ante asymmetric information in the credit market and from information acquisition by the platform analyzed in Huang (2021) and in Li and Pegoraro (2022). Gambacorta et al. (2022) also study Big Tech's informational advantage over banks in the credit market and show that when this advantage is large, it may trigger privacy concerns from potential borrowers. Finally, Gambacorta et al. (2023) develop a model where a platform uses credit to price-discriminate between incumbents and more risky innovative entrants. The main difference with our approach is that their model does not incorporate financial frictions and therefore speaks to the platform's incentives to favor entry by innovators rather than to the financial inclusion of constrained borrowers.[3]

The remainder of the paper is organized as follows: Section 2 presents the model. The case with bank financing only is analyzed in Section 3 while the case with platform financing is analyzed in Section 4. Section 5 develops an extension in which consumers' demand depends on the number of merchants present on the platform, which generates cross-side network effects. Section 6 discusses the relationship between the platform's activity in the credit market and its market power as a gateway between merchants and consumers.

2 Model

Our model of a two-sided market borrows from Rochet and Tirole (2003). Consider a platform serving two groups of agents, consumers and merchants. There is a continuum of consumers indexed by $i \in (0, 1)$ who derive value V_i^c from transacting with each merchant. V_i^c is distributed

[3] See also Vives and Ye (2022) and He et al. (2023), for broader models of competition between banks and Fin Tech firms.

according to the cumulative distribution function $F^c(.)$ over $[0, \overline{V^c}]$. There is a continuum of merchants indexed by $j \in (0,1)$ who, for simplicity, generate the same profit V^m from each transaction with a consumer. When providing a transaction service, the platform charges a per-transaction price (or fee, both terms are used interchangeably hereafter) P^c to consumers and P^m to merchants, and incurs a per-transaction cost $\tau > 0$. Denote N^c the number of consumers on the platform.

To transact on the platform, a merchant needs to invest in a risky project with an outcome that can be "success" or "failure". If the project fails, the merchant cannot participate to the platform. The project's initial outlay is $I > 0$. Merchant j has wealth A_j distributed according to the cumulative distribution function $F^m(.)$ over $(0, A^{max})$. Assume that both distribution functions have a monotone hazard rate: $\frac{1-F^c(.)}{f^c(.)}$ and $\frac{1-F^m(.)}{f^m(.)}$ are both decreasing.[4] We assume that A_j is not observable, that is, a merchant can always claim to have less funds than what he actually possesses. In our model, A can equivalently be interpreted as collateral that the merchant can pledge and that can be costlessly transferred to a lender upon default.

The investment project is subject to moral hazard. Following Holmström and Tirole (1997), we assume that each merchant can pick one of three types of projects. Project choice is not observable. The *good* project succeeds with probability $p_h > 0$ and yields no private benefit to the merchant. The *bad* project succeeds with probability $p_l \equiv p_h - \Delta_p$ with $\Delta_p > 0$ and yields a small private benefit $b > 0$ to the merchant. Finally the *Bad* project also succeeds with probability p_l, and yields a large private benefit $B > b$ to the merchant. The three projects are summarized in the table below:

Project's type	good	bad	Bad
Private Benefit	0	b	B
Prob. of Success	p_h	p_l	p_l

To satisfy his investment need, a merchant can borrow money from investors, which can be banks, or the platform itself. Both the bank and the platform can monitor the merchant to prevent him from choosing the large private benefit project. The monitoring costs are, respectively, $\gamma_p \geq 0$ for the platform, and $\gamma_b \geq 0$ for the bank.

The project's value depends on the number of consumers on the platform N^c, as well as on

[4]This familiar condition ensures that a monopolist's objective function is concave.

the price per transaction P^m charged by the platform. The following assumptions ensure that only the good project can be profitable.

Assumption 1. $p_h V^m - \gamma_b > I$.

Assumption 1 implies that it can be profitable for a merchant to obtain financing with monitoring. It states that choosing the good project generates a strictly positive NPV when the bank monitors the merchant, the mass of consumers is maximal ($N^c = 1$) and the price paid per transaction is null ($P^m = 0$).

Assumption 2. $p_l(V^m + \overline{V}^c) + B < I$.

Assumption 2 states that the bad project generates a negative surplus for the merchant for any platform fee P^m, even if all consumers (of mass 1) join the platform and trade with the merchant.

The timing of the model is as follows. At date 1, the platform sets fees P^m and P^c. At date 2, investors make financial offers to merchants, specifying an amount of money lent $(I - A)$ and a repayment R. At date 3, the investor, i.e. the bank or the platform, exerts monitoring or not, depending on the contract accepted. At date 4, each merchant chooses the project type. Finally, transactions occur on the platform for successful projects.

3 Equilibrium with bank financing only

We start with a benchmark where only a competitive banking sector can provide financing to merchants.

3.1 Consumers

Suppose N^m merchants choose to invest to become active in on the platform. If the platform charges a price P^c per consumer transaction, consumer i's total utility from transacting on the platform is $p_h N^m (V_i^c - P^c)$. Therefore, consumer i transacts on the platform if and only if $V_i^c > P^c$, which pins down the number of consumers present on the platform,

$$N^c(P^c) \equiv 1 - F^c(P^c). \tag{1}$$

Note that for the moment, the number of consumers active on the platform, N^c, depends on the price P^c but not on the number of merchants N^m. This is because consumers attribute the same value to each transaction with a merchant and face no fixed cost to join the platform. We will relax this assumption in Section 5 to study two-way cross-side network effects. However, even in this baseline setup, the welfare of consumers depends on the number of merchants N^m. On the other side of the platform, merchants face an investment cost and their ability to join the platform therefore depends on the number of active consumers, as we show now.

3.2 Merchants

The project's payoff upon success is $N^c(V^m - P^m)$, net of the platform transaction fee. Suppose first that the bank offers a contract that does not require monitoring with a repayment R. That contract is viable for the bank only if the merchant to choose the good project, which translates into the incentive compatibility constraint:

$$\begin{aligned} & p_h(N^c(V^m - P^m) - R) \geq p_l(N^c(V^m - P^m) - R) + B \\ \Leftrightarrow \quad & R \leq N^c(V^m - P^m) - \tfrac{B}{\Delta_p}. \end{aligned} \tag{2}$$

The right hand side of Eq. 2 is the familiar pledgeable income, i.e., the maximum payoff the bank can attain while ensuring that the merchant chooses the good project. Because the banking sector is competitive, banks break even in expectation:

$$p_h R = I - A. \tag{3}$$

Eq. 3 and Eq. 2 imply that the merchant can only raise funds with a contract that does not require bank monitoring if

$$A \geq I - p_h \left(N^c(P^c)(V^m - P^m) - \frac{B}{\Delta_p} \right) \equiv \overline{A}(P^m, P^c). \tag{4}$$

As mentioned earlier, the minimum level of wealth required, $\overline{A}(P^m, P^c)$, depends on the number of consumers on the platform $N^c(P^c)$, therefore on the transaction fee P^c. To make the financing problem non trivial, we further assume that merchants cannot obtain financing without investing some of their wealth, as in Holmström and Tirole (1997),

Assumption 3. $p_h \left(V^m - \frac{B}{\Delta_p} \right) < I$.

Assumption 3 implies $\overline{A}(P^m, P^c) > 0$ for any number of consumers and platform fees. Finally, since the banking sector is competitive, the merchant pockets the project's net present value (NPV) if he can obtain financing,

$$p_h N^c(P^c)(V^m - P^m) - I. \tag{5}$$

Suppose next that the bank offers a contract that requires monitoring. Following the same reasoning as before, the pledgeable income is then equal to

$$N^c(P^c)(V^m - P^m) - \frac{b}{\Delta_p},$$

and the bank's participation breakeven condition is now

$$p_h R - \gamma_b = I - A.$$

Therefore, the merchant can only raise funds with monitoring if

$$A \geq I + \gamma_b - p_h \left(N^c(V^m - P^m) - \frac{b}{\Delta_p} \right) \equiv \underline{A}(P^m, P^c), \tag{6}$$

and his expected payoff is then

$$p_h N^c(V^m - P^m) - I - \gamma_b. \tag{7}$$

Because the monitoring cost is passed on to the merchant, a debt contract that require monitoring is more expensive than one that does not, as can be seen from comparing (7) and (5). It follows that merchants with initial wealth higher than $\overline{A}(P^m, P^c)$ who can access debt without monitoring strictly prefer it. Therefore bank monitoring is relevant in this model only if $\underline{A}(P^m, P^c) < \overline{A}(P^m, P^c)$, i.e., only if monitoring expands the range of merchants who access funding. This is equivalent to

Assumption 4. $\gamma_b < \frac{p_h}{\Delta_p}(B - b)$.

Assumption 4 states that the cost of monitoring is lower than the increase in the pledgeable income. We then obtain the same configuration as in Holmström and Tirole (1997):

- Merchants with $A \geq \overline{A}(P^m, P^c)$ get funding from the bank without monitoring;
- Merchants with $\underline{A}(P^m, P^c) \leq A < \overline{A}(P^m, P^c)$ get funding from the bank with monitoring;
- Merchants with $A < \underline{A}(P^m, P^c)$ do not get funding.

It follows that the number of merchants on the platform is

$$N^m(P^m, P^c) = 1 - F^m(\underline{A}(P^m, P^c)). \tag{8}$$

Finally, note that we are omitting an incentive compatibility constraint on the lender's side ensuring that the bank has an incentive to monitor once a contract that requires monitoring is taken by a merchant. This is because a version of the argument in Diamond (1984) applies here: to the extent that banks finance multiple imperfectly correlated projects, diversification within each bank lowers the incentive cost of delegating monitoring to banks. In our setup where each bank can finance a mass of atomistic independently distributed projects, that incentive cost can be taken zero, i.e., banks only need to be compensated for the monitoring cost γ_b (see also Holmström and Tirole (1997) for a discussion of this point). Note that if the cost of monitoring incentives was higher for banks, for instance because of correlation between projects, this would provide another reason why the platform may want to provide credit. In that case, the platform would be a more efficient monitor because it internalizes each project's success both through the financial contract and the platform fee, while a bank only considers the financial contract. We are shutting down this channel for now.

3.3 Platform's optimal pricing strategy

Last, we derive the optimal transaction fees (P^c, P^m) charged by the platform, in the case in which financing is only provided by banks.

Denote π the platform's profit. The platform solves the following program:

$$\max_{P^c, P^m} \pi = p_h N^m(P^m, P^c) N^c(P^c)(P^m + P^c - \tau), \tag{9}$$

where $N^c(P^c)$ and $N^m(P^m, P^c)$ are defined in Eq. 1 and Eq. 8 respectively. The first order condition with respect to P^m yields

$$(1 - F^m(\underline{A}(P^m, P^c))) - f^m(\underline{A}(P^m, P^c)) p_h (1 - F^c(P^c))(P^m + P^c - \tau) = 0. \tag{10}$$

The first term represents the increase in profit when the platform charges a high price P^m to all merchants who access the platform. The second term represents the decrease in profit when the platform charges a higher price P^m and worsens financial frictions. As P^m increases, the minimal level of wealth necessary to obtain financing $\underline{A}(P^m, P^c)$ increases. Some merchants become credit rationed and cannot offer services through the platform, which reduces the latter's profit. Equation (10) reflects this tension and illustrates how the platform's pricing strategy interacts with financial frictions. If there was no moral hazard, the second term would not be there, and the platform would set P^m at its maximal value (i.e., $V^m - \frac{I}{p_h N^c}$).

The first order condition with respect to P^c yields

$$\begin{aligned}&(1-F^c(P^c))(1-F^m(\underline{A}(P^m,P^c)))-f^c(P^c)(1-F^m(\underline{A}(P^m,P^c)))(P^m+P^c-\tau)\\&-p_h f^m(\underline{A}(P^m,P^c))f^c(P^c)(V^m-P^m)(1-F^c(P^c))(P^m+P^c-\tau)=0\end{aligned} \tag{11}$$

The first term represents the increase in profit when charging a higher price to all consumers. The second term represents the decrease in profit from losing some consumers whose valuation falls below the transaction fee P^c. The third term represents the decrease in profit due to financial frictions: when the platform charges a higher consumer fee, it decreases the number of consumers present on the platform, which reduces the pledgeable income so that some merchants become credit rationed.

Rearranging (11) and (10) leads to the following proposition.

Proposition 1. *The optimal fee charged to consumers P^{c*} is defined by*

$$\frac{1-F^c(P^{c*})}{f^c(P^{c*})}=V^m+P^{c*}-\tau. \tag{12}$$

The optimal fee charged to merchants P^{m*} is defined by

$$P^{m*}=\frac{1-F^m(\underline{A}(P^{m*},P^{c*}))}{p_h N^{c*} f^m(\underline{A}(P^{m*},P^{c*}))}-P^{c*}+\tau, \tag{13}$$

where $N^{c*}\equiv 1-F^c(P^{c*})$.

Because of the monotone hazard rate assumption on $F^c(.)$, Eq. 12 uniquely defines the optimal transaction fee for consumers, P^{c*}. The fact that P^{c*} does not depend on the number of merchants relates to our earlier observation that the consumers' transaction value does not depend on the number of transactions they perform. In other words, the platform cannot induce more transactions from each consumer by modifying P^c and P^c only depends on the distribution of consumers' valuation per transaction. This feature of the model changes in Section 5 when we introduce cross-side network effects for consumers

Next, using (12) and the monotone hazard rate assumption on $F^m(.)$, Eq. 13) uniquely defines the optimal transaction fee for merchants, P^{m*}. Finally from Eq. 13) and Eq. 9, we can express the platform's profit under bank financing as

$$\pi^*\equiv[1-F^m(\underline{A}(P^{m*},P^{c*}))]\frac{1-F^m(\underline{A}(P^{m*},P^{c*}))}{f^m(\underline{A}(P^{m*},P^{c*}))}. \tag{14}$$

Through the financing constraint, the platform faces the familiar monopoly problem. On the one hand, increasing the price P^m raises the margin on merchants but tightens the financing constraints, hence merchants' demand. This could give an incentive to the platform to enter the credit market and offer financing to merchants, which we explore in the next section.

4 Equilibrium with bank and platform financing

We now consider the case in which the platform can also provide financing to merchants. Note that the competitive banking sector can still offer the type of contracts described in the previous section: one with a repayment $\overline{R} = \frac{1}{p_h}(I + \gamma_b - \underline{A}(P^m, P^c))$ and merchant's investment $\underline{A}(P^m, P^c)$ that requires monitoring, and one with repayment $\underline{R} = \frac{1}{p_h}(I - \overline{A}(P^m, P^c))$ and merchant's investment $\overline{A}(P^m, P^c))$ that does not require monitoring. However, since these contracts are contingent on the platform fees P^m and P^c they might differ from the previous section to the extent that entering the credit market modifies the platform's equilibrium price structure.

Without loss of generality, the platform's offer takes the form $\mathcal{C}_p = (\mathcal{R}, \mathcal{A})$ where $\mathcal{R}$ is a repayment to the platform in case of success and $\mathcal{A}$ is the merchant's investment. We assume as a tie-breaking rule that if a merchant is indifferent between bank financing and platform financing, he chooses the former. This assumptions is immaterial for equilibrium payoffs but implies that the platform will not fund merchants through a contract that is also offered (at zero cost) by the competitive banking sector. Note that this could alternatively be ruled out by assuming an arbitrarily small wedge between the platform's cost of contracting or funding and the cost of the banking sector (see, e.g., Li and Pegoraro (2022)).

4.1 The platform's optimization problem

The platform now optimizes jointly on the fees charged to consumers and merchants to access the platform, P^m and P^c, and on the financial contracts it offers. Like the banking sector, the platform could offer several contracts. We start by narrowing down the space of financial contracts the platform can profitably offer.

4.1.1 Optimal platform credit contracts

A first intermediate result is that the platform does not have an incentive to offer contracts that do not require monitoring.

Lemma 1. *The platform does not profit from offering credit without monitoring.*

Proof. See Appendix. □

There are several cases to consider. Clearly, the platform cannot gain at offering a contract such that $\mathcal{A} \geq \overline{A}$. To be accepted by merchants, any such contract needs to grant merchants more than the corresponding project's NPV, i.e., it needs to subsidize merchants. So the platform makes losses on this contract, without increasing the number of merchants financed, and the platform's profit π decreases. The proof of Lemma 1 next shows that the platform never gains at offering a contract without monitoring such that $\mathcal{A} < \overline{A}$. Indeed, if $\underline{A} \leq \mathcal{A} < \overline{A}$, the platform makes losses on its financial contract without expanding the merchant base, and is better off not offering this contract. Last, if $\mathcal{A} < \underline{A}$, so that the platform increases the mass of active merchants, the contract is accepted by all merchants with wealth larger than $\mathcal{A}$. Since the platform then subsidizes all merchants, it is equivalent to letting the banking sector fund merchants but lowering the merchant's fee P^{m*}. Hence offering financing does not increase the platform's profit.

This intermediate result is a first instance where the importance of jointly considering the platform fee setting and credit offering comes to the front. Although offering credit can broaden the merchant's base it cannot be a net benefit for the platform if it is a perfect substitute for another instrument the platform already controls, the merchant fee P^m.

Suppose now the platform offers a contract with monitoring to merchants whose wealth is at least equal to $\mathcal{A}$. We show next that $\mathcal{A}$ is such that if this contract is taken by some merchants, then it is available for all merchants who can borrow from banks.

Lemma 2. *If in equilibrium some merchants are financed by the platform, then the amount lent by the platform, $I - \mathcal{A}$, satisfies $\mathcal{A} < \underline{A}(P^m, P^c)$.*

To understand Lemma 2, suppose the platform enters the credit market without expanding the range of merchants that obtain financing $\mathcal{A} > \underline{A}(P^m, P^c)$. Then offering credit does not affect the platform's revenue from charging fees (P^m, P^c) to merchants, and the platform should therefore make the same decisions on the credit side as a stand-alone bank. Next, consider two cases. Either the platform is less efficient than the bank at monitoring, $\gamma_p \geq \gamma_b$, and the platform cannot profitably enter a competitive credit market. Or the platform is more efficient than the bank at monitoring, $\gamma_p < \gamma_b$ and it is then optimal for the platform to capture (at least) the entire demand banks are willing to serve, i.e., we must have $\mathcal{A} \leq \underline{A}(P^m, P^c)$.

A key consequence of Lemma 2 is that the *marginal* merchant is borrowing from the platform if the platform finds it profitable to enter the credit market. In that case, the mass of merchants who invest is given by $1 - F^m(\mathcal{A})$ consistent with the idea that one reason the platform uses credit is to expand its merchant's base. On the other hand, the platform never finds it optimal to attract *all* merchants with this contract. In other words, the platform designs the contract that attracts the more financially constrained merchants in such a way that it is dominated by competitive banks' contracts for the less financially constrained firms.

Lemma 3. *If the platform offers a contract with monitoring, this contract is such that merchants with wealth higher than $\overline{A}(P^m, P^c)$ prefer to be financed by banks.*

To understand Lemma 3, note first that offering credit affects the platform's income from collecting fees P^m and P^c only through its impact on the mass of active merchants, i.e., only through $\mathcal{A}$. It follows that for a given $\mathcal{A}$ (and given P^m and P^c), the platform should set the repayment $\mathcal{R}$ that maximizes its financial income:

$$\mathcal{R} = (1 - F(P^c))(V^m - P^m) - \frac{b}{\Delta_p},$$

and pays off the agency rent $p_h \frac{b}{\Delta_p}$ to the agent. In that case the platform's per-merchant financial income (gross of the monitoring cost γ_p) is

$$\varphi(\mathcal{A}, P^m, P^c) \equiv p_h \mathcal{R} - (I - \mathcal{A}) = p_h(1 - F^c(P^c))(V^m - P^m) - p_h \frac{b}{\Delta_p} - (I - \mathcal{A}), \tag{15}$$

and the optimization problem of the platform on the credit side boils down to choosing a single variable $\mathcal{A}$. On the merchant's side, the total payoff from taking the platform contract (if $A \geq \mathcal{A}$) is then

$$p_h(1 - F(P^c))(V^m - P^m) - I - \varphi(\mathcal{A}, P^m, P^c).$$

But merchants with $A \geq \overline{A}(P^m, P^c)$ can borrow from banks and secure an expected payoff equal to

$$p_h(1 - F(P^c))(V^m - P^m) - I.$$

It follows that if $\varphi(\mathcal{A}, P^m, P^c) < 0$, the platform's contract dominates banks' contracts for firms with $A \geq \overline{A}(P^m, P^c)$. As a result, all merchants accept the platform contract. To see why this is suboptimal for the platform, suppose the platform starts lowering P^m keeping $\mathcal{A}$ constant, which from Eq. 15 raises its financial income. As long as $\varphi(\mathcal{A}, P^m, P^c) < 0$, this has no effect on the platform profit because what the platform loses by charging a lower price P^m is exactly offset by a decrease in the financing subsidy (an increase in $\varphi(\mathcal{A}, P^m, P^c)$) necessary to preserve incentives for merchants above $\mathcal{A}$ to work. However, at the point where $\varphi(\mathcal{A}, P^m, P^c)$ turns positive, the platform makes a strict gain: total revenue (fees net of funding costs) from merchants who borrow with monitoring is still unchanged, but the platform economizes the monitoring cost γ_p on all the merchants who accepted the contract with monitoring when P^m was higher, and now turn to banks.

Lemma 3 highlights again the importance of considering credit provision and fee setting as a joint problem for the platform. It also shows how credit introduces an additional instrument that allows the platform to treat more constrained merchants differently from the less constrained ones. Importantly, the platform's ability to segment the market in this way is related to its monitoring ability as we show next.

4.1.2 Optimizing credit and fees

Using Lemmas 1, 2 and 3 we can now write the platform's optimization problem when it can offer financing: the platform needs to optimize on fees P^m and P^c, as well as on a funding threshold $\mathcal{A}$, subject to the constraints ensuring that only merchants that need to be monitored accept the platform's contract, and subject to the constraint that the platform's profit is larger than with bank financing only.

The platform picks fees P^m, P^c and $\mathcal{A}$ to solve

$$\begin{aligned} \max_{P^m, P^c, \mathcal{A}} \pi(P^m, P^c, \mathcal{A}) \quad = \quad & [1 - F^c(P^c)](1 - F^m(\mathcal{A}))p_h(P^m + P^c - \tau) \\ & + [F^m(\overline{A}(P^m, P^c))) - F^m(\mathcal{A})](\varphi(\mathcal{A}, P^m, P^c) - \gamma_p), \end{aligned} \tag{16}$$

$$\text{s.t.} \qquad \varphi(\mathcal{A}, P^m, P^c) \geq 0 \tag{17}$$

$$\varphi(\mathcal{A}, P^m, P^c) \leq \gamma_b \tag{18}$$

$$\pi(P^m, P^c, \mathcal{A}) \geq \pi^* \tag{19}$$

Condition (17) ensures that merchants who can obtain bank financing without monitoring (i.e. with wealth $A \geq \overline{A}(P^m, P^c)$) prefer to accept the bank's offer rather than the platform's contract with monitoring. Condition (18) ensures that merchants who need to be monitored (i.e. with wealth $A < \overline{A}(P^m, P^c)$) prefer to borrow from the platform. Last, Condition (19) ensures that the platform's profit increases compared to the case in which only banks provide financing.

Denote by λ_φ, $\lambda_\mathcal{A}$ and λ_π the multipliers associated to the constraints (17), (18), and (19) respectively. The first order conditions of the above defined Lagrangian with respect to P^m, P^c and $\mathcal{A}$ are

$$1 - F^m(\overline{A}(P^m, P^c)) + f^m(\overline{A}(P^m, P^c))(\varphi(\mathcal{A}, P^m, P^c) - \gamma_p) = \frac{\lambda_\varphi - \lambda_\mathcal{A}}{1 + \lambda_\pi} \tag{20}$$

$$f^m(\mathcal{A})\left[p_h(1 - F^c(P^c))(P^m + P^c - \tau) + \varphi(\mathcal{A}, P^m, P^c) - \gamma_p\right] + F^m(\mathcal{A}) - F^m(\overline{A}(P^m, P^c)) = \frac{\lambda_\varphi - \lambda_\mathcal{A}}{1 + \lambda_\pi} \tag{21}$$

$$\frac{1 - F^c(P^c)}{f^c(P^c)} = P^c + V^m - \tau \tag{22}$$

Corollary 1. *The optimal price set for consumers is the same with platform financing as with bank financing only.*

The proof of Corollary 1 is straightforward when comparing Equations (12) and (22). As earlier, this result stems from the price charged to consumers not affecting the number of transactions each consumer undertakes.

The optimal price set for merchants, as well as the platform financial contract, depend on which constraints are binding. If (19) is binding, there is no platform financing, and the optimal pricing strategy is defined as in Proposition 1. To build intuition, suppose (19) is not binding, i.e., suppose it is profitable for the platform to enter the credit market, and consider three cases.

Consider first that constraints (17) and (18) are both not binding, i.e., $\lambda_\varphi = 0$, $\lambda_\mathcal{A} = 0$.

The first order condition for P^m, (20), then writes

$$1 - F^m(\overline{A}(P^m, P^c)) + f^m(\overline{A}(P^m, P^c))(\varphi(\mathcal{A}, P^m, P^c) - \gamma_p) = 0.$$

The trade-off faced by the platform when setting P^m is the following: by increasing P^m, it extracts more profit from all merchants who obtain financing without monitoring $(1-F^m(\overline{A}(P^m, P^c)))$. At the same time, the threshold $\overline{A}(P^m, P^c)$ increases and some merchants who previously obtained financing without monitoring now turn to the platform's financial contract. The platform loses $\varphi(\mathcal{A}, P^m, P^c) - \gamma_p$ on each of these merchants. Depending on the distribution of merchants, it can be that the latter effect dominates the former, which prevents the platform from increasing P^m.

The first order condition for $\mathcal{A}$, (21), writes

$$f^m(\mathcal{A})\left[p_h(1 - F^c(P^c))(P^m + P^c - \tau) + \varphi(\mathcal{A}, P^m, P^c) - \gamma_p\right] + F^m(\mathcal{A}) - F^m(\overline{A}(P^m, P^c)) = 0$$

The trade-off faced by the platform when setting $\mathcal{A}$ is the following: when decreasing $\mathcal{A}$, the platform increases the subsidy provided to each merchant who accepts the platform's offer. At the same time, more merchants borrow from the platform, which increases the platform fees. So for these additional merchants, the platform loses $\varphi(\mathcal{A}, P^m, P^c) - \gamma_p$ but gains $p_h(1 - F^c(P^c))(P^m + P^c - \tau)$. The optimal $\mathcal{A}$ is such that the net gain from attracting new merchants is exactly offset by the loss from providing the subsidy to all merchants $F^m(\mathcal{A}) - F^m(\overline{A}(P^m, P^c))$.

Rearranging (20) and (21), we obtain

$$P^m = \frac{1 - F^m(\mathcal{A})}{p_h(1 - F(P^c))f^m(\mathcal{A})} + \frac{1 - F^m(\overline{A}(P^m, P^c))}{p_h(1 - F(P^c))f^m(\overline{A}(P^m, P^c))}(1 - \frac{f^m(\overline{A}(P^m, P^c))}{f^m(\mathcal{A})}) - P^c + \tau,$$

and

$$\mathcal{A} = \frac{F^m(\overline{A}(P^m, P^c)) - F^m(\mathcal{A})}{f^m(\mathcal{A})} - p_h(1 - F^c(P^c))(V^m + P^c - \tau) + p_h\frac{b}{\Delta_p} + I + \gamma_p,$$

where P^c is defined by (22).

Constraints (17) and (18) can never bind at the same time. Consider next that (17) is binding while (18) is not, i.e. $\varphi(\mathcal{A}, P^m, P^c) = 0$ and $\lambda_{\mathcal{A}} = 0$. The optimal price set for merchants is implicitly defined by

$$P^m = \frac{1 - F^m(\mathcal{A})}{p_h(1 - F(P^c))f^m(\mathcal{A})} + \frac{\gamma_p}{p_h(1 - F(P^c))}(1 - \frac{f^m(\overline{A}(P^m, P^c))}{f^m(\mathcal{A})}) - P^c + \tau,$$

and $\mathcal{A}$ is given by the constrain (17), that is,

$$\mathcal{A} = I - p_h(1 - F^c(P^c))(V^m - P^m) - p_h\frac{b}{\Delta_p}. \tag{23}$$

Consider finally that (18) is binding while (17) is not, i.e. $\underline{A}(P^m, P^c) = \mathcal{A}$ and $\lambda_\varphi = 0$. The optimal price set for merchants and the platform's financial contract are defined implicitly as follows:

$$P^m = \frac{1 - F^m(\mathcal{A})}{p_h(1 - F(P^c))f^m(\mathcal{A})} + \frac{(\gamma_p - \gamma_b)}{p_h(1 - F(P^c))}(1 - \frac{f^m(\overline{A}(P^m, P^c))}{f^m(\mathcal{A})}) - P^c + \tau$$

$$\mathcal{A} = I + \gamma_b - p_h(1 - F^c(P^c))(V^m - P^m) - p_h\frac{b}{\Delta_p}$$

In that case, see that if $\gamma_p = \gamma_b$, we are back to the bank financing case, i.e., P^m is defined as in Equation (13).

4.2 Platform's optimal pricing and financing strategy

To obtain explicit solutions, we focus on the case where A follows a uniform distribution, $A \sim \mathcal{U}[0, A^{max}]$, which generates a linear demand from merchants.[5] We further assume that A^{max} is large enough, in a sense we make precise in the Appendix. This ensures that solutions for P^m and $\mathcal{A}$ are interior.[6]

Let us first rewrite the platform's optimal fees and equilibrium profit when only banks provide financing. Using (13), the platform's optimal merchant fee under bank financing writes

$$P^{m*} = \frac{1}{2}(V^m - P^{c*} + \tau) - \frac{1}{2p_h N^{c*}}\left(p_h \frac{b}{\Delta_p} + I + \gamma_b - A^{max}\right) \tag{24}$$

where P^{c*} is still defined by (12). Next, the minimal wealth required by banks to provide financing is

$$\underline{A}(P^{m*}, P^{c*}) = \frac{1}{2}\left[I + \gamma_b + p_h \frac{b}{\Delta_p} + A^{max} - p_h N^{c*}(V^m + P^{c*} - \tau)\right]. \tag{25}$$

Last, using Equation (14), the platform's profit under bank financing now writes

$$\pi^* = \frac{(A^{max} - \underline{A}(P^{m*}, P^{c*}))^2}{A^{max}}. \tag{26}$$

It is worth noting that the impact of an improvement in banks' monitoring technology has an ambiguous impact on merchants' welfare. From (24), a decrease in γ_b leads to an increase in P_m: intuitively, reducing financial frictions makes merchants' demand less price-elastic. This price increase harms merchants who borrow without monitoring. On the other hand, a lower γ_b has an overall positive effect for the more constrained merchants:

$$\frac{\partial}{\partial \gamma_b}[p_h N^c(V^m - P^m) - \gamma_b] = -p_h N^c \frac{\partial P^m}{\partial \gamma_b} - 1 = -\frac{\gamma_b}{2}.$$

Let us now turn to the case in which the platform can offer financing. The platform maximizes

$$\begin{aligned}
\max_{P^m, P^c, \mathcal{A}} \hat{\pi}(P^m, P^c, \mathcal{A}) \quad &= \quad \frac{1}{A^{max}}[(A^{max} - \mathcal{A})p_h(1 - F^c(P^c))(P^m + P^c - \tau) && (27)\\
&\quad\quad + (\overline{A}(P^m, P^c) - \mathcal{A})(\varphi(\mathcal{A}, P^m, P^c) - \gamma_p)] \\
\text{s.t.} \quad & \quad\quad \varphi(\mathcal{A}, P^m, P^c) \geq 0 && (28)\\
& \quad\quad \varphi(\mathcal{A}, P^m, P^c) \leq \gamma_b && (29)\\
& \quad\quad \hat{\pi}(\mathcal{A}, P^m, P^c) \geq \pi^*. && (30)
\end{aligned}$$

[5]The results in Proposition 2 below generalize to the case where $f^m(.)$ is non-increasing, i.e., there are relatively more constrained than non-constrained merchants.

[6]See Proof of Proposition 2.

We denote P^{m**}, P^{c**} and $\mathcal{A}^{**}$ the solutions to the above program.[7]

Proposition 2. *Suppose A is uniformly distributed. There exists $\overline{\gamma}_p > \gamma_b$ such that the platform offers financing if and only if $\gamma_p \leq \overline{\gamma}_p$. When the platform offers financing, it charges a higher fee to merchants and expands the range of merchants who receive funding relative to the benchmark case in which only banks can provide funding: $P^{m**} > P^{m*}$ and $\mathcal{A}^{**} < \underline{A}(P^{m*}, P^{c*})$.*

Proof. See Appendix. □

Proposition 2 combines two motives for platforms to enter the credit market. The first one is straightforward: when platforms are more efficient at monitoring than banks, i.e., $\gamma_p < \gamma_b$, they can capture the corresponding efficiency gain ($\gamma_b - \gamma_p$ per funded merchant) while at the same time offering credit to more merchants. In particular, the monitoring cost threshold $\overline{\gamma}_p$ below which the platform is willing to provide funding is increasing in γ_b: when the banking system is more inefficient, the platform is more likely to step in.

In addition, entering the credit market allows the platform to engage in a form of price discrimination. Financial frictions create differences in valuations across merchants, based on their financial wealth. Wealthier merchants borrow without monitoring, and capture a larger payoff than poorer merchants who borrow with monitoring. Ideally, the platform would like to set different fees based on these different valuations. When this is not possible, the platform can indirectly discriminate merchants through its credit contract. This second benefit explains why the platform provides credit even when it is *less* efficient than the banking sector at monitoring creditors: $\overline{\gamma}_p > \gamma_p > \gamma_b$.

Formally, we show that the equilibrium financial contract offered by the platform is loss-making when incorporating the monitoring cost:

$$\varphi(\mathcal{A}, P^{m**}, P^{c**}) < \gamma_p.$$

That is, the platform uses subsidized credit to lower the overall charge $p_h N^c P^m + \varphi(\mathcal{A}, P^{m**}, P^{c**})$ supported by the more financially constrained, thereby expanding equilibrium demand: $\mathcal{A}^{**} < \underline{A}(P^{m*}, P^{c*})$. Importantly, this subsidy only benefits merchants who need monitoring, which gives the platform an incentive to increase P^m in order to extract more surplus from less financially constrained merchants, who borrow from the banking sector without monitoring. Note that these wealthier merchants are still better off than the more financially constrained

[7] From Corollary 1, we know that $P^{c**} = P^{c*}$ and we will use both notations interchangeably.

merchants who need monitoring: their financing cost is zero while it is positive (equal to $\varphi(\mathcal{A}, P^{m**}, P^{c**})$) for merchants with $A < \overline{A}(P^{m**}, P^{c**})$. However they are worse off than when only banks can provide funding. We formalize this intuition in the following corollary.

Corollary 2. *Relative to the benchmark case in which only banks provide funding, when the platform provides funding,*

- *merchants with wealth $A_j > \overline{A}(P^{m*}, P^{c*})$ are strictly worse off,*
- *merchants with wealth $\overline{A}(P^{m*}, P^{c*}) > A_j > \mathcal{A}^{**}$ are strictly better off,*
- *consumers are strictly better off.*

There are four categories of merchants. From Lemma 3, merchants with wealth $A_j > \overline{A}(P^{m**}, P^{c**})$ still borrow from the bank and their welfare decreases because of the price hike. Merchants with wealth $\overline{A}(P^{m**}, P^{c**}) > A_j > \overline{A}(P^{m*}, P^{c*})$ borrow without monitoring from banks when the platform cannot offer credit. However, once the platform enters the credit market and raises P^m, they cannot borrow from banks anymore and turn to the platform. The combination of the price hike and the higher cost of funding leads to a net loss of

$$p_h(1 - F^c(P^{c**}))(P^{m**} - P^{m*}) + \varphi(\mathcal{A}, P^m, P^c).$$

Note that this loss is not just a transfer from merchants to the platform: it entails an additional monitoring cost which is a deadweight loss.

Merchants with wealth $\overline{A}(P^{m*}, P^{c*}) > A_j > \underline{A}(P^{m*}, P^{c*})$ move from borrowing from banks with monitoring to borrowing from the platform. They now face a higher fee, but benefit from subsidized funding, which overall yield a strictly positive net gain:

$$-p_h(1 - F^c(P^{c**}))(P^{m**} - P^{m*}) - \varphi(\mathcal{A}, P^m, P^c) + \gamma_b] = [\underline{A}(P^{m*}, P^{c*}) - \mathcal{A}^{**}] > 0.$$

Finally, merchants with wealth $\underline{A}(P^{m*}, P^{c*}) > A_j > \mathcal{A}^{**}$ who could not get funded without the platform can now borrow and become active and are therefore strictly better off.

Consumers face the same per-transaction price P^{c*} whether the platform provides credit or not, but because the number of merchants N^m expand, their overall payoff, $p_h N^m (V^c - P^{c*})$, goes up.

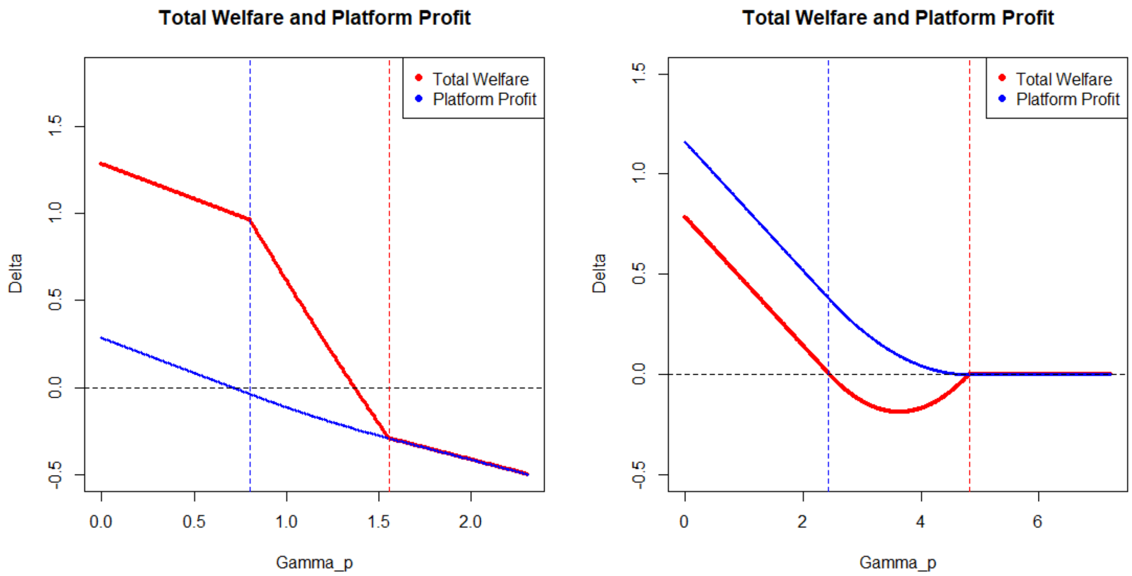
4.3 Platform credit and welfare

The result of Corollary 2 suggests that the impact of platform's financing on social welfare is ambiguous. When the platform enters the credit market, the social welfare (that includes the payoffs of merchants, consumers and the platform) changes by

$$\begin{aligned}
\Delta W &= \left[p_h(1-F^c(P^{c*}))(V^m+P^{c*}-\tau)-I-p_h\frac{(V^c-P^{c*})^2}{2}\right]\frac{\underline{A}(P^{m*},P^{c*})-\mathcal{A}^{**}}{A^{max}} \\
&- (\gamma_p-\gamma_b)\frac{\overline{A}(P^{m*},P^{c*})-\underline{A}(P^{m*},P^{c*})}{A^{max}} \\
&- \gamma_p\frac{(\overline{A}(P^{m**},P^{c*})-\overline{A}(P^{m*},P^{c*}))+(\underline{A}(P^{m*},P^{c*})-\mathcal{A}^{**})}{A^{max}}.
\end{aligned}$$

In the above equation, the first line represents the social gain due to the credit expansion. The second line represents the gain or loss for merchants who switch from a bank contract with monitoring, to a platform contract. The monitoring cost changes by $\gamma_p - \gamma_b$. If $\gamma_p > \gamma_b$, there is a deadweight loss due to the platform being less efficient at monitoring than the bank. If at the opposite $\gamma_p < \gamma_b$, there is a social gain. The third line represents the deadweight loss associated with merchants who used to borrow without monitoring and now turn to platform financing (with $\overline{A}(P^{m**}, P^{c*}) > A > \overline{A}(P^{m*}, P^{c*})$), as well as newly financed merchants (with $\underline{A}(P^{m*}, P^{c*}) > A > \mathcal{A}^{**}$).

We now provide two numerical solutions to illustrate that the platform's entry in the credit market can either increase or decrease social welfare.



(a) Social welfare always increases with platform financing

(b) Social welfare may decrease with platform financing

Figure 1: Impact of platform financing on social welfare

In the two graphs above, the red solid line shows how the impact of platform financing on social welfare (i.e. ΔW) changes with γ_p, the blue solid line shows how the change in platform profit when the latter provides financing (i.e. $\Delta \pi = \pi^{**} - \pi^{*}$) varies with γ_p. To the left of the vertical blue dotted line, Constraint (17) is binding. To the right of the vertical red dotted line, Constraint (18) is binding.

Figure (1a) is plotted when assigning the following parameter values: $p_h = 0.8, p_l = 0.2, V^m = 10, \overline{V}^c = 8.5, \tau = 6, B = 2.6, b = 1.4, \gamma_b = 0.5, I = 1, A^{max} = 4$, and when assuming a uniform distribution for the consumer's valuation $V_i^c \sim U[0, \overline{V}^c]$. From the figure, we can see that social welfare always increases when the platform provides financing, although the impact is lower as γ_p increases.

Figure (1b) is plotted when assigning the following parameter values: $p_h = 0.8, p_l = 0.2, V^m = 10, \overline{V}^c = 8.5, \tau = 6, B = 2.6, b = 1.4, \gamma_b = p_h \frac{B-b}{p_h - p_l} = 1.6, I = 5.1, A^{max} = 5$, and when assuming that all consumers derive the same value $V_i^c = \overline{V}^c$ per transaction. This assumption mutes the impact of platform's financing on the consumers' payoff as the platform always charges $P^c = \overline{V}^c$, regardless of whether it provides financing or not. And we set $\gamma_b = p_h \frac{B-b}{p_h - p_l}$ so that no merchant who used to borrow from the bank with monitoring now turns to borrow from the platform. From the figure, we can see that when γ_p is small, social welfare increases when the platform provides financing, but as γ_p increases, there exists a parameter region when social welfare is lower with platform financing. This is because the deadweight loss due to platform's monitoring being less efficient than bank's monitoring more than compensates the social gain of having more merchants accessing the platform.

4.4 Impact of platform's monitoring efficiency

Our analysis suggests that both the number of merchants who access the platform, as well as the transaction fees they are charged, change with the platform's monitoring efficiency. We formalize the impact of γ_p on equilibrium platform size and pricing in the proposition below.

Proposition 3. *When the platform becomes more efficient at monitoring (when γ_p goes down),*

- *It provides more credit to merchant, i.e. $\overline{A}(P^m, P^c) - \mathcal{A}$ increases,*
- *It charges a higher fee P^{m**} to merchants.*

The results of Proposition 3 are illustrated in Fig. 2. To the left of the threshold $\hat{\gamma}_p$, Constraint (17) is binding: When monitoring costs are low, the platform would like to grant more credit to rationed merchants, but cannot do so without attracting also the wealthier merchants. To the right of $\overline{\gamma}_p$, the platform stops providing financing and only banks are active on the credit market.

The right panel of Fig. 2 illustrates the impact of γ_p on the provision of credit, measured by $\mathcal{A}$. As long as the platform is active on the credit market ($\gamma_p \leq \overline{\gamma}_p$), more merchants obtain financing than with bank financing only ($\mathcal{A} < \underline{A}(P^{m*})$), but the number of additional merchants who obtain financing decreases with γ_p: The platform provides less credit when its cost of doing so increases.

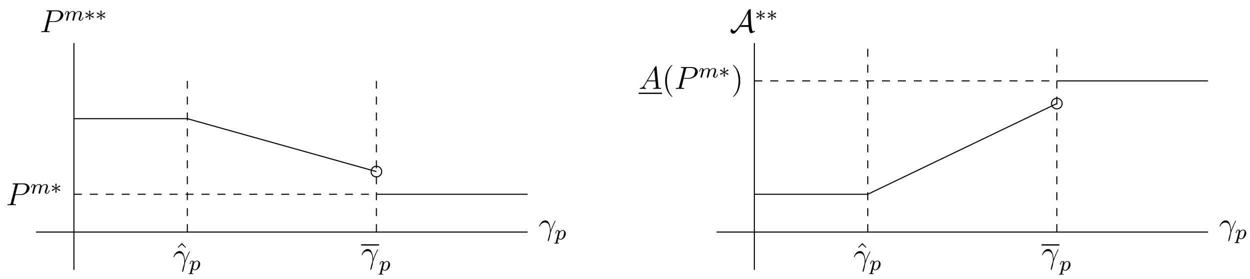


Figure 2: Impact of monitoring cost on credit and fees

The left panel of Fig. 2 illustrates the impact of monitoring costs on merchants' transaction fees. One can see from the curve that the fee charged to merchants is always higher when the platform provides credit ($P^{m**} > P^{m*}$), and that it decreases with monitoring costs. The intuition for that second result can be seen from the platform first-order condition with respect to the price P^m:

$$\frac{\partial \pi}{\partial P^m} = 1 - F^m(\overline{A}(P^m, P^c)) + f^m(\overline{A}(P^m, P^c))(\varphi(\mathcal{A}, P^m, P^c) - \gamma_p).$$

Keeping $\mathcal{A}$ constant, increasing P^m has a benefit that is directly proportional to the mass of unconstrained merchants, $1 - F^m(\overline{A}(P^m, P^c))$, who can borrow from the banking sector and end up paying a higher fee. That benefit is independent from γ_p. But increasing P^m also generates a cost $\varphi(\mathcal{A}, P^m, P^c) - \gamma_p$ that corresponds to the marginal merchant with $A = \overline{A}(P^m, P^c)$ becoming unable to borrow from the banking system (given a higher fee P^m) and turning to the platform. That loss $\varphi(\mathcal{A}, P^m, P^c) - \gamma_p$ becomes more severe when γ_p increases, hence a platform that is less efficient at monitoring has lower incentives to increase its fee.

5 Cross-side network effects

5.1 Setup

In the analysis above, consumers' willingness to pay only depends on their per-transaction surplus V^c. In particular, the number of merchants N^m is irrelevant to consumers' demand. This drives the result that equilibrium pricing on the consumers' side is not affected by the platform's ability to provide credit, even though platform credit leads to higher participation on the merchants' side. We show here that introducing network effects for consumers creates cross-side network effects: There is a feedback loop between consumers' and merchants' decisions to join the platform.

A natural way to make the number of merchants relevant to consumers' decisions is to introduce a fixed cost κ for consumers to join the platform. This can capture a monetary cost such as internet access, or a cognitive cost of understanding the functioning of the platform and merchants' offering. While this addition to the original model may seem minimal, it makes the analytical derivation of the results more challenging because it creates a feedback loop between consumers and sellers' decisions to join the platform. To preserve some tractability, we restrict attention to a 2-point distribution for consumers' (per transaction) valuation: It is equal to $\overline{V}^c$ with probability q and to $\underline{V}^c < \overline{V}^c$ with probability $1 - q$. As in Section 4.2, A is uniform over $(0, A^{max})$. To focus on the case in which the platform's entry in the credit market has the strongest impact, we present here the case in which the platform is relatively efficient at monitoring, and assume that the following assumption holds:[8]

Assumption 5.

$$\gamma_p \leq \frac{p_h}{2} \left[q(V^m + \underline{V}^c - \tau) - \frac{2B - b}{\Delta_p} - \frac{I - A^{max}}{p_h} \right].$$

Assumption 5 ensures that the platform has strong incentives to subsidize low-wealth merchants in order to increase merchants' fees, irrespective of whether the platform attracts all consumers, or high-valuation consumers only.

Note that given a mass N^m of sellers, consumers join the platform if and only if

$$N^m(V^c - P^c) \geq \kappa \Leftrightarrow P^c \leq V^c - \frac{\kappa}{N^m}. \tag{31}$$

Equation (31) makes it apparent that with a fixed cost κ, for a given price P^c, consumers' participation now depends on the number of merchants N^m.

5.2 Bank financing

As in the previous section, we start with the benchmark in which only banks provide financing. As earlier, the platform profit is

$$p_h N^m N^c (P^m + P^c - \tau).$$

[8] We show in Appendix B1 that the analysis extends to the case in which the platform's monitoring cost in higher (and in particular higher than the bank's monitoring cost γ_b).

Because of the binomial distribution of V^c, a marginal change in P^m does not affect N^c (although a large one might). We can therefore consider two cases: i) the case in which the platform attracts all consumers separately, ii) and the case in which it only attracts consumers with a high valuation $\overline{V}^c$. In both cases, optimal pricing on the consumer side is given by the first-order condition with respect to P^c below:

$$P^c(V^c, N^m) = V^c - \frac{\kappa}{N^m}, \tag{32}$$

where $N^c = q$ if $V^c = \overline{V}^c$ and $N^c = 1$ if $V^c = \underline{V}^c$.

The first-order condition with respect to P^m is then

$$\frac{\partial N^m}{\partial P^m}(P^m + P^c - \tau) + N^m \left(1 + \frac{\partial P^c}{\partial P^m}\right) = 0 \tag{33}$$

Note that this expression recognizes that through its effect on N^m, P^m affects pricing P^c on the consumers' side (from Equation (32)). From this first-order condition, we get a first interim lemma.

Lemma 4. *Optimal pricing by the platform is such that*

$$P^c = V^c - \frac{\kappa}{N^m},$$

$$P^m = \frac{1}{2}(V^m - V^c + \tau) - \frac{1}{2p_h N^c}\left(I + \gamma_b + p_h \frac{b}{\Delta_p} - A^{max}\right),$$

$$N^m = \frac{1}{2A^{max}}\left(p_h N^c(V^m + V^c - \tau) + A^{max} - \left(I + \gamma_b + p_h \frac{b}{\Delta_p}\right)\right) \tag{34}$$

where either $V^c = \overline{V}^c$ and $N^c = q$ or $V^c = \underline{V}^c$ and $N^c = 1$.

Proof. See Appendix. □

Now, Lemma 4 delivers optimal pricing up to the choice by the platform to include or exclude low-valuation consumers. Intuitively, the platform should choose the latter when the proportion of high-valuation consumers q is large enough. This point is established in the next lemma.

Lemma 5. *There exists $\underline{q}$ in $(0, 1)$ such that $N^c = q$ if $q > \underline{q}$ and $N^c = 1$ if $q < \underline{q}$.*

Proof. See Appendix. □

Combining Lemma 4 and Lemma 5 gives the platform's equilibrium pricing strategy in the benchmark with bank financing only.

5.3 Platform financing

Turn now to the case in which the platform can also provide funding. As in the case with bank financing (see Lemma 4), we can derive the platform's optimal choice conditional on either including or excluding low-valuation consumers in closed form. Then comparing the platform's profit in each case, we can show the counterpart to Lemma 5. The derivation combines elements from the benchmark bank financing case in Section 3 with elements from the baseline model with platform financing in Section 4. So the details are left to the Appendix and we only state here an intuitive result.

Lemma 6. *The platform enters the credit market and there exists* $\overline{q} \in (0, 1)$ *such that* $N^c = q$ *if* $q > \overline{q}$ *and* $N^c = 1$ *otherwise.*

Proof. See Appendix. □

We show now that platform financing affects consumers not only at the intensive margin (for consumers who already participated under bank financing) but also at the extensive margin. That is, when the platform becomes active in the credit market, more consumers join the platform than when the platform is inactive.

Proposition 4. *When the platform offers financing, the mass of consumers who join the platform expands relative to the case with bank financing only, i.e.,* $\overline{q} > \underline{q}$.

Proof. See Appendix. □

From Proposition 4, the mass of consumers who join the platform is the same when the platform provides funding as under bank financing if either $q > \overline{q}$ or if $q < \underline{q}$. Indeed, when $q > \overline{q}$, only high-valuation consumers are present irrespective of whether the platform offers financing or not. When $q < \underline{q}$, the platform prefers to attract all consumers, again irrespective of whether it provides financing or not. However, in the intermediate region $q \in (\underline{q}, \overline{q})$, more consumers become active under platform financing. This is because the platform attracts more merchants when it provides financing, which in turn makes it profitable to set a lower consumers' fee and attract also low-valuation consumers. This strategy is less profitable under bank financing because less merchants have access to the platform, reducing low-valuation consumers' willingness to pay the fixed cost κ of using the platform. Therefore, cross-side network effects are amplified when the platform can offer financing.

5.4 Welfare

We proceed in two steps. We start with the case in which $q < \underline{q}$ or $q > \underline{q}$. When q is extreme, there is no participation externality: the mass of active consumers does not depend on the platform's entry into the credit market, as in the baseline model. We then show that the welfare results from the baseline model extend, even though the platform's entry into the credit market now affects pricing not only on the merchants' side but also on the consumers' side. We next turn to the intermediate case $q \in (\underline{q}, \overline{q})$ to focus the impact of participation externality on welfare.

5.4.1 No participation externality

We assume here that $q < \underline{q}$ or $q > \overline{q}$. In that case, because the mass of consumers is independent from the platform being active in the credit market, the analysis of the merchants' side is as in the baseline model. The entry of the platform in the credit market leads to higher merchant participation but also a higher price P^m. The welfare effect is negative for the less constrained merchants (those who can borrow without monitoring when the platform is not active) but positive for the more constrained ones. The analysis of the consumers' side exhibits one difference: the price P^c now depends on the platform's activity in the credit market:

$$P^c = V^c - \frac{\kappa}{N^m}, \tag{35}$$

where V^c is either $\overline{V}^c$ or $\underline{V}^c$, although it does not depend on the platform providing credit (since $q < \underline{q}$ or $q > \overline{q}$). This immediately implies that when the platform provides credit, the access fee P^c is higher for consumers since merchant participation N^m is higher than under bank financing only. Intuitively, a higher mass of merchants relaxes the participation constraint of consumers by spreading the fixed cost κ over a larger number of transactions. However, as in the baseline model, consumers' welfare improves when the platform provides credit. To illustrate this point, consider the case in which $q < \underline{q}$. Then, from Equation (35), high-valuation consumers' welfare is

$$N^m(\overline{V}^c - P^c) = N^m(\overline{V}^c - \underline{V}^c) - \kappa,$$

which is strictly higher under platform financing since the number of merchants N^m is higher. More generally, all types of consumers are at least weakly better off with platform financing. We summarize this in the next proposition

Proposition 5. *If $q < \underline{q}$ or $q > \overline{q}$, the welfare implications of the platform entering the credit market are as in the baseline model (see Corollary 2).*

5.4.2 Participation externality

We now turn to the case in which $q \in (\underline{q}, \overline{q})$. In this case, the mass of active consumers is q under bank financing and 1 when the platform provides credit. As in the previous section, consumers are better off when the platform offers funding. In particular, high-type consumers' welfare goes up by

$$N^m_{pf}(\overline{V}^c - \underline{V}^c),$$

where N^m_{pf} is the equilibrium mass of active merchants when the platform is active and therefore charges merchants a price P^m_{pf}. Similarly, we let N^m_{bank}, P^m_{bank} and P^c_{bank} denote equilibrium participation and fees when only banks are active.

The novelty relative to the baseline case comes from the merchants' side. In the baseline case, unconstrained merchants with $A > \overline{A}(P^{m*}, P^{c*})$ are always worse off when the platform enters into the credit market because it provides an indirect form of price-discrimination (see Corollary 2). With participation externalities, the impact on these merchants' payoff of the platform providing credit is

$$p_h(V^m - P^m_{pf}) - p_h q(V^m - P^m_{bank}). \tag{36}$$

With participation externality, the platform fee still goes up for merchants: $P^m_{pf} > P^m_{bank}$. Note that this price difference now compounds two effects. First, price discrimination is still at work: offering funding allows the platform to charge higher prices to less constrained merchants without losing more constrained merchants. In addition, because the number of consumers increases under platform credit, joining the platform becomes more profitable for merchants everything else equal, which allows the platform to further increase prices. Now, despite this price increase, unconstrained merchants can potentially be better off because, as is apparent from (36), the mass of consumers is 1 when the platform provides funding versus only q when it does not. The key question is therefore which of the price effect or the participation effect dominates.

Define[9]

$$\overline{\gamma}_b \equiv 2p_h\left((1-\underline{q})(V^m - \tau) + \underline{V}^c - \underline{q}\overline{V}^c\right). \tag{37}$$

[9]Although $\overline{q}$ is an endogenous variable, it does not depend on γ_b, and so neither does $\overline{\gamma}_b$ which is therefore a proper upper bound for γ_b.

We show the following result.

Proposition 6. *Suppose $q \in (\underline{q}, \overline{q})$. Then, if $\gamma_b < \overline{\gamma}_b$, there exists $\hat{q}(\gamma_b) \in (\underline{q}, \overline{q}]$ such that when the platform provides funding,*

- *if $q < \hat{q}(\gamma_b)$, merchants with $A > \overline{A}(P^m_{bank}, P^c_{bank})$ are strictly better off than if only banks provide funding,*
- *if $q > \hat{q}(\gamma_b)$, merchants with $A > \overline{A}(P^m_{bank}, P^c_{bank})$ are strictly worse off than if only banks provide funding.*

If $\gamma_b > \overline{\gamma}_b$, merchants with $A > \overline{A}(P^m_{bank}, P^c_{bank})$ are worse off than if only banks provide funding.

Proof. See Appendix. □

The results of Proposition 6 can be interpreted as follows. When banks' monitoring cost is low, the platform can charge a high merchant price P^m_{bank} under bank financing without losing too many merchants (recall that P^m decreases with γ_b). The increase in the price the platform charges to merchants when providing credit is then relatively lower, and unconstrained merchants are not hurt too much by platform financing. In addition, when q is low, the impact of consumers' participation when the platform provides credit is large, which benefits unconstrained merchants. When both effects are present jointly, unconstrained merchants are better off with platform financing.

6 Market Power

6.1 Setup

In this section, we explore how the platform's incentive to enter the credit market is related to the market power it exerts on merchants. To introduce and calibrate this market power in the model we assume that merchants and consumers have an alternative mode of transaction. Specifically, they can by-pass the platform and directly transact with each other. We make three additional assumptions that streamline the analysis. First, we assume that merchants are single-homers: they need to decide ex-ante whether they want to transact on the platform or off the platform. Another way to state this assumption is that the investment I is specific to the distribution channel they choose. Then since consumers interact with a given seller only once, duplicating the investment to be present both on and off-platform would be inefficient. consumers on the other hand can simultaneously trade on and off the platform, i.e., they are multi-homers, consistent with the assumption that they do not support any cost for joining one particular channel. We assume the required investment I does not depend on the distribution channel but we capture the technological superiority of the platform through a lower per-transaction cost. That is, every transaction off-platform generates a cost $\tau + \Delta\tau$, where $\Delta\tau > 0$ captures the platform's technological advantage, which we will refer to as its *market power*. Finally, whenever a merchant and a consumer meet off-platform, they Nash-bargain over the surplus with each player having equal bargaining power. This implies the surplus the merchant and the consumer get per off-platform meeting is

$$\frac{1}{2}(V^m + V^c - \tau - \Delta\tau). \tag{38}$$

Consider first consumers' decision to transact offline. This only requires (38) to be positive, i.e., $\tau + \Delta\tau \leq V^m + V^c$. We will assume this inequality to be true as otherwise the off-platform channel become irrelevant. Then since consumers multihome, there is a mass one of consumers for each merchant that sets up shop off-platform. For a merchant who can borrow from a bank without monitoring, choosing to sell on platform is more profitable than selling off the platform if

$$p_h(V^m - P^m) - I > \frac{p_h}{2}(V^m + V^c - \tau - \Delta\tau) - I \Leftrightarrow P^m \leq V^m - \frac{(V^m + V^c - \tau - \Delta\tau)}{2} \equiv \overline{P}^m(\Delta\tau).$$

That is, the possibility for merchants to sell off-platform limits the platform's ability to increase the price P^m or else lose all merchants who can borrow without monitoring, which is never optimal if A^{max} is large enough.[10] Note that the price cap $\overline{P}^m(\Delta\tau)$ increases with the platform's market power $\Delta\tau$.

6.2 Analysis

The platform's optimal fee if only banks can finance and there is no constraint on P^m is $P^{m*} < V^m$ given by (24). Since $\overline{P}^m(\Delta\tau)$ tends to V^m for $\Delta\tau$ large enough and $\overline{P}^m(\Delta\tau)$ is strictly

[10]If consumers were not homogeneous, then $\overline{P}^m(\Delta\tau)$ would depend on P^c through the mass of consumers willing to buy on-platform that can be different from the mass of consumers willing to buy off-platform. While preliminary analysis suggests this section's results would be similar, this remains to be formally checked in a subsequent version.

increasing in $\Delta\tau$, there exists a unique $\underline{\Delta}\tau$ such that $\overline{P}^m(\underline{\Delta}\tau) = P^{m*}$. In the rest of this section, we focus on the case where $\Delta\tau > \underline{\Delta}\tau$, i.e., the platform's profit under bank lending only is as in the baseline case in Section 4.2.[11]

Consider now the case where the platform can provide funding. Recall from Proposition 2 that the platform equilibrium (unconstrained) price P^{m**} when it provides funding is strictly larger than the price P^{m*} when it does not (Section 4.2). Therefore if we define $\overline{\Delta}\tau$ as the solution to $\overline{P}^m(\overline{\Delta}\tau) = P^{m**}$, we get that $\overline{\Delta}\tau > \underline{\Delta}\tau$. If $\Delta\tau \geq \overline{\Delta}\tau$, the constraint $P^m \leq \overline{P}^m(\Delta\tau)$ is not binding and we are back to the analysis of the baseline model leading to Proposition 2. The novel case is when the platform's market power is low enough, $\Delta\tau < \overline{\Delta}\tau$, that at optimum, $P^m \leq \overline{P}^m(\Delta\tau)$ binds. In that case, the merchant's fee is pinned down by the constraint, therefore the platform's profit if it provides funding is[12]

$$\begin{aligned} \Pi(\gamma_p, \Delta\tau) \quad \equiv \quad & \max_{P^m, P^c, \mathcal{A}} \frac{1}{A^{max}}[(A^{max} - \mathcal{A})p_h(\overline{P}^m(\Delta\tau) + V^c - \tau) \qquad (39) \\ & +(\overline{A}(\overline{P}^m(\Delta\tau), V^c) - \mathcal{A})(\varphi(\mathcal{A}, \overline{P}^m(\Delta\tau), V^c) - \gamma_p)] \\ & \text{s.t. } \varphi(\mathcal{A}, \overline{P}^m(\Delta\tau), V^c) \geq 0 \qquad (40) \end{aligned}$$

Because the constraint $P^m \leq \overline{P}^m(\Delta\tau)$ is binding, we know that $\Pi(\gamma_p, \Delta\tau)$ is lower than the unconstrained platform profit $\pi(\mathcal{A}^{**}, P^{m**}, P^{c**})$ in the baseline model. Furthermore, since $\Pi(., \Delta\tau)$ is decreasing, the threshold $\overline{\gamma}'_p(\Delta\tau)$ above which the platform stops providing funding is strictly lower than $\overline{\gamma}_p$ defined in Proposition 2. Finally, since $\Pi(\gamma_p, .)$ is increasing, $\overline{\gamma}'_p(\Delta\tau)$ also increases in $\Delta\tau$ and tends to $\overline{\gamma}_p$ when $\Delta\tau$ tends to $\overline{\Delta}\tau$. That is, for a high enough platform monitoring cost, lower market power makes it less likely that the platform enters the credit market at all.

Now suppose the platform does find it profitable to provide credit, that is, $\Delta\tau$ is high enough that $\gamma_p < \overline{\gamma}'_p(\Delta\tau)$. Further, suppose (40) is not binding. Then consider the first-order derivative of the objective function (39) with respect to $\mathcal{A}$,

$$-\left(p_h(\overline{P}^m(\Delta\tau) + V^c - \tau) + \varphi(\mathcal{A}, \overline{P}^m(\Delta\tau), V^c) - \gamma_p\right) + (\overline{A}(\overline{P}^m(\Delta\tau), V^c) - \mathcal{A})\frac{\partial\varphi}{\partial\mathcal{A}}. \qquad (41)$$

[11]If $\Delta\tau < \underline{\Delta\tau}$, the analysis of the case where the platform provides funding in equilibrium is unchanged. However, the point at which the platform stops lending might change. This point needs to be formalized in a subsequent version.

[12]We can show as in the proof of Proposition 2 that the constraint $\varphi(\mathcal{A}, P^m, P^c) \leq \gamma_b$ that ensures merchants with $A < \overline{A}(P^m, P^c)$ prefer platform credit to bank credit is never binding. Recall also that consumers are homogenous therefore $P^c = V^c$.

The first term in (41) captures the benefit of lowering $\mathcal{A}$, that is, each marginal merchant generates an additional revenue of $p_h(\overline{P}^m(\Delta\tau) + V^c - \tau) + \varphi(\mathcal{A}, \overline{P}^m(\Delta\tau), V^c) - \gamma_p$. Importantly, this term does not depend on $\overline{P}^m(\Delta\tau)$ once expliciting $\varphi(\mathcal{A}, \overline{P}^m(\Delta\tau), V^c)$ using (15). Intuitively, a higher fee P^m increases the platform direct revenue but decreases the platform's financial income φ by the same amount. It follows that the impact of $\overline{P}^m(\Delta\tau)$ on the platform' marginal incentive to lower $\mathcal{A}$ runs through the second term in (41), that captures the effect of $\mathcal{A}$ on the platform's financial revenue. We know that $\frac{\partial\varphi}{\partial\mathcal{A}} > 0$, i.e., lowering the funding threshold $\mathcal{A}$ reduces the platform's financial revenue. This financial revenue is generated from the range of merchants with $A \in [\overline{A}(\overline{P}^m(\Delta\tau), V^c), \mathcal{A}]$. The key observation is that $\overline{A}(., V^c)$ is increasing: increasing P_m makes it more difficult for merchants to obtain funding (without monitoring) from banks therefore increases the range of merchants that borrow from the platform. But then a cap on P_m reduces this range, thereby making it less costly at the margin to lower $\mathcal{A}$ and thus the financial income per merchant. It follows that conditional on the platform being willing to enter the credit market, lower market power $\Delta\tau$ leads to further financial inclusion, i.e., the platform offers funding to more financially constrained merchants (merchants with lower A). This, however, does not imply that lower market power leads to more funding by the platform since it also leads to more merchants borrowing from banks. In fact, using (41), we can show

$$\frac{\partial[\overline{A}(\overline{P}^m(\Delta\tau), V^c) - \mathcal{A})]}{\partial\Delta\tau} = \frac{1}{2}p_h > 0.$$

That is, when the platform's market power weakens, it finances fewer merchants. Using the expression for φ in (15), it is straightforward to check that if (40) binds then $\mathcal{A}$ is also increasing in $\overline{P}^m(\Delta\tau)$. In that case however, the mass of merchants financed by the platform is constant. This leads us to the next Proposition.

Proposition 7. *Lower market power $\Delta\tau$ induces the platform to provide funding to fewer merchants. However, for γ_p large enough, the effect of $\Delta\tau$ on the total mass of merchants that access credit from banks or the platform is non-monotonic: lower market power first leads to an expansion of credit (a decrease in $\mathcal{A}$), then to a contraction as the platform exits the credit market.*

7 Conclusion

We develop a model in which an e-commerce platform can benefit from offering credit to merchants in addition to access to its commercial services. By jointly charging a higher access fee and offering better credit terms, the platform endogenously selects to offer credit to the more financially constrained merchants. Wealthier merchants still prefer to borrow from banks that provide cheaper funding by avoiding monitoring costs. This enables the platform to price discriminate between more and less financially constrained merchants. This indirect price discrimination leads to higher trading volume on the platform and justifies the platform's entry into the credit market even in cases where it is less efficient than banks at monitoring. The platform's incentives to provide credit are related to its market power as a gateway between merchants and consumers. Our model suggests that the issue of the financial inclusion of small constrained firms is inherently related to the dominant competitive position that major e-commerce platforms occupy.

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Appendix A: Proofs

Proof of Lemma 1

Suppose the platform offers a contract without monitoring such that $\mathcal{A} < \overline{A}$ and $R = \underline{R}$, where $\overline{A}$ is the minimum merchant's investment required by the bank without monitoring, for given transaction fees P^m and P^c. In that case, the loss incurred by the platform for each merchant accepting the contract is

$$L(\mathcal{A}, P^c, P^m) \equiv \overline{A} - \mathcal{A}.$$

Clearly, all merchants with $A \geq \overline{A}$ accept the platform contract, as they obtain the project's NPV, $p_h N^c(V^m - P^m) - I$, plus $\overline{A} - \mathcal{A}$.

Consider now merchants with $\mathcal{A} \leq A < \overline{A}$. All these merchants are better off accepting the platform contract. We now show that the platform is worse off by providing financing. We need to distinguish two cases.

- If $\mathcal{A} \geq \underline{A}$, where $\underline{A}$ is the minimum merchant's investment required by the bank with monitoring, for given transaction fees P^m and P^c. Then, the platform's contract does not increase the merchant base, so that the platform's profit is strictly lower. To see this, consider the platform's profit:

$$\begin{aligned} \pi &= p_h N^m N^c(P^m + P^c - \tau) - (1 - F^m(\mathcal{A}))L(\mathcal{A}, P^m, P^c) \\ &= p_h[1 - F^c(P^c)][1 - F^m(\underline{A})](P^m + P^c - \tau) - (1 - F^m(\mathcal{A}))L(\mathcal{A}, P^m, P^c) \end{aligned} \tag{42}$$

  The first term in (42) is the same as with bank financing, while the second term is strictly decreasing in $\mathcal{A}$.

- If $\mathcal{A} \leq \underline{A}$, then the platform contract increases the number of merchants who can obtain financing. In that case, the platform ends up financing all merchants.

$$\begin{aligned} \pi &= p_h[1 - F^m(\mathcal{A})]N^c(P^m + P^c - \tau) - (1 - F^m(\mathcal{A}))L(\mathcal{A}, P^m, P^c) \\ &= p_h[1 - F^c(P^c)][1 - F^m(\mathcal{A})](P^m + P^c - \tau) - (1 - F^m(\mathcal{A}))L(\mathcal{A}, P^m, P^c) \end{aligned} \tag{43}$$

  First order conditions

$$\frac{\partial \pi}{\partial P^m} = p_h[1 - F^c(P^c)][1 - F^m(\mathcal{A})] - [1 - F^m(\mathcal{A})]p_h[1 - F^c(P^c)] = 0 \tag{44}$$

$$\frac{\partial\pi}{\partial\mathcal{A}} = p_h[1-F^c(P^c)](-f^m(\mathcal{A}))(P^m+P^c-\tau)+f^m(\mathcal{A})L(\mathcal{A},P^m,P^c)+[1-F^m(\mathcal{A})]=0$$

$$\Leftrightarrow P^m = \frac{1-F^m(\mathcal{A})+f^m(\mathcal{A})L(\mathcal{A},P^m,P^c)}{p_h[1-F^c(P^c)]f^m(\mathcal{A})} - P^c + \tau \tag{45}$$

$$\frac{\partial\pi}{\partial P^c} = 0 \Leftrightarrow P^c = \frac{1-F^c(P^c)}{f^c(P^c)} - V^m + \tau \tag{46}$$

Equation (44) always holds, thus as long as the relationship between P^m and $\mathcal{A}$ satisfies equation (45), the platform's profit reaches its maximum. Let $\mathcal{A} = \underline{A}^*$, and get the value of P^{m**} from equation (45)

$$P^{m**} = \frac{1-F^m(\underline{A}^*)+f^m(\underline{A}^*)L(\underline{A}^*,P^{m*},P^c)}{p_h[1-F^c(P^c)]f^m(\underline{A}^*)} - P^c + \tau$$

Rewrite equation (43)

$$\Leftrightarrow \pi = [1-F^m(\underline{A}^*)]\frac{1-F^m(\underline{A}^*)}{f^m(\underline{A}^*)}$$

which is the same as the platform's profit under the bank financing case (i.e. equation (14)). Since the profit doesn't increase, the platform has no incentive to provide funding.

□

Proof of Lemma 2

Suppose the platform offers a contract $\mathcal{C}^p = (R^p, \mathcal{A})$ where R^p is the merchant repayment in case of success and $\mathcal{A}$ is the minimum investment from the merchant. The platform can only benefit from offering $\mathcal{C}^p$ if the contract is more attractive to some merchants than the contract $\mathcal{C}^b = (R^b, A^*(P^m, P^c))$ that banks offer:

$$\begin{aligned} & p_h(N^c(V^m-P^m)-R^b)-\underline{A}(P^m,P^c) < p_h(N^c(V^m-P^m)-R^p)-\mathcal{A} \\ \Leftrightarrow \quad & p_hR^P+\mathcal{A} \le p_hR^b+\underline{A}(P^m,P^c) \\ \Leftrightarrow \quad & p_hR^P+\mathcal{A} \le I+\gamma_b \end{aligned} \tag{47}$$

where the last inequality follows from banks breaking even. If it is optimal for the platform to set $\mathcal{A} > \underline{A}(P^m, P^c)$, then the platform should maximize its revenue from financial contracts since offering funding does not affect the mass of merchant that join the platform, $1 - F(\underline{A}(P^m, P^c)$, therefore does not affect the platform's revenues from charging fees (P^m, P^c). It follows that (47) is binding, i.e., the platform's revenu from offering $\mathcal{C}^p$ is then

$$[F(\overline{A}(P^m,P^c))-F(\mathcal{A})](p_hR^P-(I-\mathcal{A})-\gamma_p) = [F(\overline{A}(P^m,P^c))-F(\mathcal{A})](\gamma_b-\gamma_p).$$

Therefore if $\gamma_b \leq \gamma_p$, offering a financial contract with $\mathcal{A} > \underline{A}(P^m, P^c)$ does not improve the platform's payoff, and if $\gamma_b > \gamma_p$, $\mathcal{A} > \underline{A}(P^m, P^c)$ is strictly dominated by $\mathcal{A} = \underline{A}(P^m, P^c)$. □

Proof of Lemma 3

Suppose the platform offers a contract such that $\varphi(\mathcal{A}, P^m, P^c) < 0$. The platform overall profit is then

$$\begin{aligned} & [1 - F^m(\mathcal{A})] \left[(1 - F^c(P^c))p_h(P^m + P^c - \tau) + \varphi(\mathcal{A}, P^m, P^c) - \gamma_p\right] && (48) \\ = \; & [1 - F^m(\mathcal{A})] \left[(1 - F^c(P^c))p_h(V^m + P^c - \tau) - p_h\frac{b}{\Delta p} - (I - \mathcal{A}) - \gamma_p\right] && (49) \end{aligned}$$

Note (49) does not depend on P^m and consider two cases. First, suppose $\varphi(\mathcal{A}, 0, P^c) < 0$. Then the platform strategy is akin to charging 0 to merchants and getting a strictly negative profit from providing credit which cannot be optimal. Second, suppose $\varphi(\mathcal{A}, 0, P^c) \geq 0$. Then since $\varphi(\mathcal{A}, ., P^c)$ is decreasing, there exists $P^{m'} < P^m$ such that $\varphi(\mathcal{A}, P^{m'}, P^c) = 0$ and (49) (and therefore (48)) is unchanged. But given $(\mathcal{A}, P^{m'}, P^c)$ merchants with $A > \overline{A}(P^{m'}, P^c)$ borrow from banks, which yields a profit for the platform equal to

$$\begin{aligned} & [1 - F^m(\mathcal{A})](1 - F^c(P^c))p_h(P^{m'} + P^c - \tau) - [F^m(\overline{A}(P^{m'}, P^c)) - F^m(\mathcal{A})]\gamma_p \\ > \; & [1 - F^m(\mathcal{A})] \left[(1 - F^c(P^c))p_h(P^{m'} + P^c - \tau) - \gamma_p\right] \\ = \; & [1 - F^m(\mathcal{A})] \left[(1 - F^c(P^c))p_h(P^m + P^c - \tau) + \varphi(\mathcal{A}, P^m, P^c) - \gamma_p\right], \end{aligned}$$

where the last expression is (48). This shows $\varphi(\mathcal{A}, P^m, P^c) < 0$ cannot be optimal for the platform. □

Proof of Proposition 2

As mentioned in the main text, we assume A^{max} is large enough that we get interior solutions for $\mathcal{A}$ and P^m. Specifically,

$$A^{max} \geq \max\{\underline{A}_2^{max}, \underline{A}_3^{max}, \underline{A}_4^{max}\}$$

where

$$\underline{A}_1^{max} \equiv -p_h\frac{b}{\Delta_p} + p_h[1 - F^c(P^{c*})](V^m + P^{c*} - \tau) - I, \tag{50}$$

$$\underline{A}_2^{max} \equiv -p_h\frac{B + b}{\Delta_p} - \gamma_p + 2p_h[1 - F^c(P^{c*})](V^m + P^{c*} - \tau) - 2I, \tag{51}$$

$$\underline{A}_3^{max} \equiv p_h \frac{2B-b}{\Delta_p} - (p_h[1-F^c(P^{c*})](V^m + P^{c*} - \tau) - I)\,, \tag{52}$$

We already know from Section 4, Corollary 1 that pricing on the consumers' side does not change, i.e., the platform charges $P^{c**} = P^{c*}$ where P^{c*} is the unique solution to

$$\frac{1-F^c(P^c)}{f^c(P^c)} = V^m + P^c - \tau. \tag{53}$$

Consider next the optimization program (27) and ignore constraints (29) and (30) for the moment. First-order conditions with respect to P^m and $\mathcal{A}$ are respectively

$$\frac{p_h(1-F^c(P^c))}{A^{max}}[A^{max} - \overline{A}(P^m, P^c) + \varphi(\mathcal{A}, P^m, P^c) - \gamma_p] + \lambda p_h[1-F(P^c)] = 0, \tag{54}$$

$$-\frac{1}{A^{max}}[p_h(1-F^c(P^c))(P^m + P^c - \tau) + \varphi(\mathcal{A}, P^m, P^c) - \gamma_p - \overline{A}(P^m, P^c) + \mathcal{A}] - \lambda = 0, \tag{55}$$

where λ is the Lagrange multiplier associated with constraint (28).

Note that second-order condition are satisfied,

$$\frac{\partial^2 \hat{\pi}}{\partial P^{m2}} = -2\frac{p_h(1-F^c(P^{c**}))}{A^{max}}\left(p_h(1-F^c(P^{c**}))\right) < 0, \qquad \frac{\partial^2 \hat{\pi}}{\partial \mathcal{A}^2} = -\frac{2}{A^{max}} < 0,$$

$$\text{and } \frac{\partial^2 \hat{\pi}}{\partial P^{m2}}\frac{\partial^2 \hat{\pi}}{\partial \mathcal{A}^2} - (\frac{\partial^2 \hat{\pi}}{\partial P^m \partial \mathcal{A}})^2 = 4\left(\frac{p_h(1-F^c(P^{c**}))}{A^{max}}\right)^2 - \left(\frac{p_h(1-F^c(P^{c**}))}{A^{max}}\right)^2 > 0$$

i.e., $\hat{\pi}(., P^{c**}, .)$ is strictly concave.

We then delineate two cases that depend on a threshold

$$\hat{\gamma}_p \equiv \frac{p_h}{2}\left[(1-F^c(P^{c**}))(V^m + P^{c**} - \tau) - \frac{2B-b}{\Delta_p} - \frac{I - A^{max}}{p_h}\right] \geq -\frac{\gamma_b}{2}, \tag{56}$$

where the inequality of follows from (52).

Case 1: The platform monitoring cost γ_p is large: $\gamma_p \geq \hat{\gamma}_p$

We first show that if $\gamma_p \geq \hat{\gamma}_p$, then (28) is not binding. To see this note that if (28) does not bind, solutions to the platform's optimization problem are given by (54) and (55) with $\lambda = 0$, which yields

$$P^{m**} = \frac{1}{3}(2V^m - P^{c**} + \tau) - \frac{1}{3p_h(1-F^c(P^{c**}))}\left(p_h\frac{B+b}{\Delta_p} + \gamma_p + 2I - 2A^{max}\right), \tag{57}$$

$$\mathcal{A}^{**} = A^{max} - \frac{p_h}{3}\left[2(1-F^c(P^{c**}))(V^m + P^{c**} - c) - \left(\frac{B+b}{\Delta_p} + \frac{\gamma_p}{p_h} + 2\frac{I - A^{max}}{p_h}\right)\right]. \tag{58}$$

Plugging these expressions into (15) yields

$$\varphi(\mathcal{A}, P^m, P^{c*}) = \frac{2}{3}(\gamma_p - \hat{\gamma}_p), \tag{59}$$

which is positive if $\gamma_p \geq \hat{\gamma}_p$. That is, the solutions to the unconstrained optimization problem satisfy (28), which is therefore not binding.

Next, combine (24), (57) and (59) to show

$$P^{m**} - P^{m*} = \frac{1}{2}(1 - F^c(P^{c**}))(\gamma_b - \varphi(\mathcal{A}, P^{m**}, P^{c*})). \tag{60}$$

Similarly, combine (25), (58) and (59) to show

$$\underline{A}(P^{m*}, P^{c*}) - \mathcal{A}^{**} = \frac{1}{2}(\gamma_b - \varphi(\mathcal{A}^{**}, P^{m**}, P^{c*})). \tag{61}$$

Suppose $\gamma_p = \frac{3}{2}\gamma_b + \hat{\gamma}_p > \gamma_b$, then $\varphi(\mathcal{A}, P^m, P^{c*}) = \gamma_b$ and

$$\hat{\pi}(P^{m**}, P^{c**}, \mathcal{A}^{**})|_{\gamma_p = \frac{3}{2}\gamma_b + \hat{\gamma}_p} = \pi^* - [\overline{A}(P^{m**}, P^{c**}) - \underline{A}(P^{m**}, P^{c**})](\gamma_p - \gamma_b) < \pi^*.$$

Suppose $\gamma_p = \gamma_b$, then $\varphi(\mathcal{A}, P^m, P^{c*}) = \frac{2}{3}(\gamma_b - \hat{\gamma}_p) < \gamma_b$. Furthermore, since $\hat{\pi}(., P^{c**}, .)$ reaches a maximum at $\hat{\pi}(P^{m**}, P^{c**}, \mathcal{A}^{**})$, $P^{m**} > P^{m*}$ and $\mathcal{A}^{**} < \underline{A}(P^{m*}, P^{c*})$, the strict concavity of $\hat{\pi}(., P^{c**}, .)$ implies

$$\hat{\pi}(P^{m**}, P^{c**}, \mathcal{A}^{**})|_{\gamma_p = \gamma_b} > \hat{\pi}(P^{m*}, P^{c**}, \underline{A}(P^{m*}, P^{c*})|_{\gamma_p = \gamma_b} = \pi^*$$

Finally, using the envelope theorem,

$$\frac{\partial \hat{\pi}(P^{m**}, P^{c**}, \mathcal{A}^{**})}{\partial \gamma_p} = \mathcal{A}^{**} - \overline{A}(P^{m**}, P^{c**}) < 0.$$

It follows there is a unique $\overline{\gamma}_p$ such that

$$\hat{\pi}(P^{m**}, P^{c**}, \mathcal{A}^{**})|_{\gamma_p = \overline{\gamma}_p} = \pi^*,$$

and $\gamma_b < \overline{\gamma}_p < \frac{3}{2}\gamma_b + \hat{\gamma}_p$, which implies (29) never binds. Therefore if $\gamma_p > \overline{\gamma}_p$, the optimization problem has no solution, i.e., the platform gives up financing. If $\gamma_p \leq \overline{\gamma}_p$, (29) does not bind, the optimum is given by (57) and (58), and (60) and (61) imply $P^{m**} > P^{m*}$ and $\mathcal{A}^{**} < \underline{A}(P^{m*}, P^{c*})$.

Case 2: The platform monitoring cost γ_p is small: $\gamma_p < \hat{\gamma}_p$

Then (28) is binding. It follows that $\varphi(\mathcal{A}, P^m, P^c) = 0$ in equilibrium. Using (54) and (55) with $\varphi(\mathcal{A}, P^m, P^c) = 0$, we get

$$A^{max} - \mathcal{A} = p_h(1 - F^c(P^c))(P^m + P^c - \tau),$$

$$p_h(1 - F^c(P^c))(V^m - P^m) - p_h\frac{b}{\Delta_p} - (I - \mathcal{A}) = 0,$$

which yields

$$P^{m**} = \frac{1}{2}(V^m - P^{c**} + \tau) - \frac{1}{2p_h(1 - F^c(P^{c**}))}\left(p_h\frac{b}{\Delta_p} + I - A^{max}\right) > P^{m*} \tag{62}$$

$$\mathcal{A}^{**} = I - \frac{p_h}{2}\left[(1 - F^c(P^{c**}))(V^m + P^{c*} - \tau) - \frac{b}{\Delta_p} + \frac{I - A^{max}}{p_h}\right] < \underline{A}(P^{m*}, P^{c*}) \tag{63}$$

□

Proof of Lemma 4

We have discussed P^c in the text. From Equation (32), the first-order condition (33) writes

$$\frac{\partial N^m}{\partial P^m}(P^m + P^c - \tau) + N^m\left(1 + \frac{\kappa}{(N^m)^2}\frac{\partial N^m}{\partial P^m}\right) = 0. \tag{64}$$

Using

$$N^m = \Pr[A \geq \underline{A}] = 1 - F^m(\underline{A}), \tag{65}$$

$$\underline{A} = I + \gamma_b - p_h\left(N^c(V^m - P^m) - \frac{b}{\Delta_p}\right), \tag{6}$$

and the uniform distribution of A over $(0, A^{max})$, Equation (64) becomes

$$-\frac{1}{A^{max}}p_h N^c(P^m + P^c + \frac{\kappa}{N^m} - \tau) + N^m = 0,$$

and using (32) again,

$$-\frac{1}{A^{max}}p_h N^c(P^m + V^c - \tau) + N^m = 0. \tag{66}$$

Using Equations (65) and (6) again to substitute into Equation (66) yields P^m. □

Proof of Lemma 5

Let

$$\overline{\pi}_{bank}(q) \equiv \max_{P^m} p_h N^m q(P^m + P^c(\overline{V}^c, N^m) - \tau)$$

and

$$\underline{\pi}_{bank} \equiv \max_{P^m} p_h N^m (P^m + P^c(\underline{V}^c, N^m) - \tau)$$

be the platform's profits under the optimal pricing defined in Lemma 4 when it respectively excludes and includes low-valuation consumers. The envelope theorem implies

$$\overline{\pi}'_{bank}(.) > 0.$$

Furthermore

$$0 = \overline{\pi}_{bank}(0) < \underline{\pi}_{bank} < \overline{\pi}_{bank}(1),$$

where the last inequality follows from $P^c(\underline{V}^c, N^m) < P^c(\overline{V}^c, N^m)$. Therefore by continuity, there is a unique $\underline{q}$ such that

$$\overline{\pi}_{bank}(\underline{q}) = \underline{\pi}_{bank}.$$

If $q < \underline{q}$, then $\overline{\pi}_{bank}(q) < \underline{\pi}_{bank}$, and if $q > \underline{q}$, then $\overline{\pi}_{bank}(q) > \underline{\pi}_{bank}$. □

Proof of Lemma 6

Step 1: Optimal choice of P^m and $\mathcal{A}$ for a given $N^c \in \{q, 1\}$.

To simplify notation we write V^c in the following program, omitting that V^c is a function of N^c: $V^c = \overline{V}^c$ if $N^c = q$ and $V^c = \underline{V}^c$ if $N^c = 1$. The platform's optimization program conditional on being active on the credit market is:

$$\max_{P^m, \mathcal{A}} \frac{1}{A^{max}} [(A^{max} - \mathcal{A}) p_h N^c (P^m + P^c - \tau) + (\overline{A}(P^m, P^c) - \mathcal{A})(\varphi(\mathcal{A}, P^m, P^c) - \gamma_p)] \tag{67}$$

s.t.

$$\varphi(\mathcal{A}, P^m, P^c) \geq 0 \tag{68}$$

$$\varphi(\mathcal{A}, P^m, P^c) \leq \gamma_b. \tag{69}$$

As in the proof of Proposition 2, we can show that under Assumption 5, Constraint (68) binds and therefore (69) does not bind. First-order conditions with respect to P^m and $\mathcal{A}$ are

$$N^m - \frac{1}{A^{max}} \left[\gamma_p + (\overline{A} - \mathcal{A})\right] = -\lambda \tag{70}$$

$$-\frac{1}{A^{max}}\left[p_h N^c(P^m + P^c - \tau + \frac{\kappa}{N^m}) - \gamma_p - (\overline{A} - \mathcal{A})\right] = \lambda, \tag{71}$$

where λ is the Lagrange multiplier associated with Constraint (68). Using $P^c + \frac{\kappa}{N^m} = V^c$, $N^m = \frac{A^{max} - \mathcal{A}}{A^{max}}$, $\varphi(\mathcal{A}, P^m, P^c) = 0$ and substituting $\overline{A}$, we get

$$N^m = \frac{A^{max} - \mathcal{A}}{A^{max}} = \frac{1}{2A^{max}}\left(p_h N^c(V^m + V^c - \tau) + A^{max} - I - p_h \frac{b}{\Delta_p}\right), \tag{72}$$

$$P^m = \frac{1}{2}(V^m - V^c + \tau) - \frac{1}{2p_h N^c}\left(I + p_h \frac{b}{\Delta_p} - A^{max}\right). \tag{73}$$

Step 2: Existence of platform financing.

Let $\overline{\pi}_{pf}(q)$ be the solution to (67) when $N^c = q$ and $V^c = \overline{V}^c$, and $\underline{\pi}_{pf}$ be the solution to (67) when $N^c = 1$ and $V^c = \underline{V}^c$. As in the proof of Proposition 2, Assumption 5 implies

$$\overline{\pi}_{pf}(q) > \overline{\pi}_{bank}(q) \text{ and } \underline{\pi}_{pf} > \underline{\pi}_{bank}.$$

Therefore

$$\pi_{pf} \equiv \max\{\overline{\pi}_{pf}(q), \underline{\pi}_{pf}\} > \max\{\overline{\pi}_{pf}(q), \underline{\pi}_{pf}\} \equiv \pi_{bank}, \tag{74}$$

i.e., the platform's profit with platform financing is strictly higher than the platform's profit with only bank financing.

Step 3: Optimal pricing.

Using the same arguments as in the proof of Lemma 5, there exists a unique $\overline{q}$ such that $\overline{\pi}_{pf}(\overline{q}) = \underline{\pi}_{pf}$. Furthermore, $\overline{\pi}_{pf}(q) > \underline{\pi}_{pf}$ if $q > \overline{q}$ and $\overline{\pi}_{pf}(q) < \underline{\pi}_{pf}$ if $q < \overline{q}$. □

Proof of Proposition 4

Consider first the bank-financing case. Equation (66) is equivalent to

$$\frac{1}{A^{max}} p_h N^c(P^m + P^c + \frac{\kappa}{N^m} - \tau) = N^m,$$

which implies that the platform's profit under bank financing is

$$\pi_{bank} = A^{max}(N^m_{bank})^2 - p_h N^c \kappa,$$

where N^m_{bank} is given by Equation (34). We use the notation

- $\overline{N}^m_{bank}(q)$ for the solution to Equation (34) with $N^c = q$ and $V^c = \overline{V}^c$,
- $\underline{N}^m_{bank}$ for the solution to Equation (34) with $N^c = 1$ and $V^c = \underline{V}^c$.

Similarly, using Equations (70) and (71), we get the platform profit when the platform can provide funding:

$$\pi_{pf} = A^{max}(N^m_{pf})^2 - p_h N^c \kappa - p_h \frac{(B-b)\gamma_p}{\Delta_p A^{max}},$$

where N^m_{pf} is given by Equation (72). We use the notation

- $\overline{N}^m_{pf}(q)$ for the solution to Equation (72) with $N^c = q$ and $V^c = \overline{V}^c$,
- $\underline{N}^m_{pf}$ for the solution to Equation (72) with $N^c = 1$ and $V^c = \underline{V}^c$.

Then $\overline{\pi}_{pf}(\overline{q}) = \underline{\pi}_{pf}$ is equivalent to

$$(\underline{N}^m_{pf})^2 - (\overline{N}^m_{pf}(\overline{q}))^2 = (1-\overline{q})\frac{p_h\kappa}{A^{max}} \Leftrightarrow (\underline{N}^m_{pf} - \overline{N}^m_{pf}(\overline{q}))(\underline{N}^m_{pf} + \overline{N}^m_{pf}(\overline{q})) = (1-\overline{q})\frac{p_h\kappa}{A^{max}}. \quad (75)$$

From Equations (34) and (72), we have $\underline{N}^m_{pf} > \underline{N}^m_{bank}$ and $\overline{N}^m_{pf}(\overline{q}) > \overline{N}^m_{bank}(\overline{q})$, therefore

$$\underline{N}^m_{pf} + \overline{N}^m_{pf}(\overline{q}) > \underline{N}^m_{bank} + \overline{N}^m_{bank}(\overline{q}). \quad (76)$$

Furthermore

$$\underline{N}^m_{bank} - \overline{N}^m_{bank}(\overline{q}) = \frac{p_h}{2A^{max}}((1-\overline{q})(V^m - \tau) + \underline{V}^c - \overline{q}\overline{V}^c)$$

and

$$\underline{N}^m_{pf} - \overline{N}^m_{pf}(\overline{q}) = \frac{p_h}{2A^{max}}((1-\overline{q})(V^m - \tau) + \underline{V}^c - \overline{q}\overline{V}^c),$$

that is,

$$\underline{N}^m_{pf} - \overline{N}^m_{pf}(\overline{q}) = \underline{N}^m_{bank} - \overline{N}^m_{bank}(\overline{q}). \quad (77)$$

Then using Equations (75), (76) and (77), we have

$$(\underline{N}^m_{bank})^2 - (\overline{N}^m_{bank}(\overline{q}))^2 < (\underline{N}^m_{pf})^2 - (\overline{N}^m_{pf}(\overline{q}))^2 = (1-\overline{q})\frac{p_h\kappa}{A^{max}},$$

and therefore

$$\overline{\pi}_{bank}(\overline{q}) > \underline{\pi}_{bank}. \quad (78)$$

Since from the proof of Lemma 5, $\overline{\pi}_{bank}(.)$ is strictly increasing and $\overline{\pi}_{bank}(\underline{q}) = \underline{\pi}_{bank}$, Equation (78) implies

$$\underline{q} < \overline{q}.$$

□

Proof of Proposition 6

As in the proof of Proposition 5, we start from

$$\frac{1}{A^{max}} p_h N^c (P^m + P^c + \frac{\kappa}{N^m} - \tau) = N^m,$$

which holds both in the bank and the platform financing cases. Using $P^c = V^c - \frac{\kappa}{N^m}$ and rearranging we get

$$p_h N^c (V^m - P^m) = p_h N^c (V^m + V^c - \tau) - A^{max} N^m.$$

It follows that Equation (36), i.e., the welfare difference for a merchant with $A > \overline{A}(P^m_{bank}, P^c_{bank})$ between the cases with and without platform credit is

$$p_h((1-q)(V^m - \tau) + \underline{V}^c - q\overline{V}^c) - A^{max}(N^m_{pf} - N^m_{bank}) \tag{79}$$

Using (34) and (72), Equation (79) becomes

$$p_h((1-q)(V^m - \tau) + \underline{V}^c - q\overline{V}^c) - \frac{\gamma_b}{2}, \tag{80}$$

which is decreasing in q over $(\underline{q}, \overline{q})$. It follows that if $\gamma_b > \overline{\gamma}_b$, Equation (79) is always negative. If $\gamma_b < \overline{\gamma}_b$, then either

$$p_h((1-\overline{q})(V^m - \tau) + \underline{V}^c - \overline{q}\overline{V}^c) - \frac{\gamma_b}{2} < 0,$$

and $\hat{q}(\gamma_b) \in (\underline{q}, \overline{q})$, or $q(\gamma_b) = \overline{q}$. □

Proof of Proposition 7

Define $\underline{\Delta}\tau$ as the solution to $\overline{P}^m(\underline{\Delta}\tau) = P^{m*}$, $\overline{\Delta}\tau$ as the solution to $\overline{P}^m(\overline{\Delta}\tau) = P^{m**}$ (where P^{m**} is the equilibrium **constrained** price in Proposition 2), $\overline{\overline{\Delta}}\tau$ as the solution to $\overline{P}^m(\overline{\overline{\Delta}}\tau) = P^{m**}$ (where P^{m**} is the equilibrium **unconstrained** price in Proposition 2).

Recall from Proposition 2 that the platform charges a higher price when it provides credit (i.e. $P^{m**} > P^{m*}$). And the equilibrium constrained price is smaller than the equilibrium unconstrained price. Since $\overline{P}^m(\Delta\tau)$ is strictly increasing in $\Delta\tau$, we get $\underline{\Delta}\tau < \overline{\Delta}\tau < \overline{\overline{\Delta}}\tau$.

Case 1: If $\Delta\tau \geq \overline{\overline{\Delta}}\tau$, the constraint $P^m \leq \overline{P}^m(\Delta\tau)$ is not binding and we are back to the analysis of the baseline model leading to Proposition 2. The platform's decision to enter into the credit market does not depend on $\Delta\tau$.

Case 2: If $\overline{\Delta}\tau \leq \Delta\tau \leq \overline{\overline{\Delta}}\tau$, the constraint $P^m \leq \overline{P}^m(\Delta\tau)$ is not binding when only the bank provides credit. Then we focus on the situation where the platform also provides credit and delineate 2 cases depending on a threshold:

$$\hat{\gamma}_p' \equiv \frac{1}{2}p_h(V^m + V^c - \tau + \Delta\tau) - p_h\frac{B-b}{\Delta_p}$$

Case 2.1: The platform monitoring cost γ_p *is large:* $\gamma_p \geq \hat{\gamma}_p'$

We first show that if $\gamma_p \geq \hat{\gamma}_p'$, then (40) is not binding. To see this, note that if (40) is not binding, then under the condition $\Delta\tau \leq \overline{\overline{\Delta}}\tau$, the constraint $P^m \leq \overline{P}^m(\Delta\tau)$ is binding. Solving the platform's objective function (39) yields

$$\mathcal{A} = \frac{1}{2}\left[-\frac{3}{2}p_h(V^m + V^c - \tau) + p_h\frac{\Delta\tau}{2} + 2I + p_h\frac{B+b}{\Delta_p} + \gamma_p\right] \tag{81}$$

together with (15) and $P^m = \overline{P}^m(\Delta\tau)$ yields

$$\varphi(\mathcal{A}, P^m, P^{c*}) = \frac{1}{2}(\gamma_p - \hat{\gamma}_p'), \tag{82}$$

which is positive if $\gamma_p \geq \hat{\gamma}_p'$.

From (81), we see that $\mathcal{A}$ is increasing in $\Delta\tau$, i.e. $\frac{\partial\mathcal{A}}{\partial\Delta\tau} = \frac{p_h}{4} > 0$. Therefore, lower market power $\Delta\tau$ gives more merchants access to credit. However, $\frac{\partial\left[\overline{A}(\overline{P}^m(\Delta\tau), V^c) - \mathcal{A}\right]}{\partial\Delta\tau} = \frac{p_h}{4} > 0$, which means a lower market power $\Delta\tau$ also induces more merchants to borrow from the banks. Even if more merchants have access to credit, the platform provides funding to fewer merchants.

The platform's profit increases with $\Delta\tau$:

$$\frac{\partial\pi(\gamma_p, \Delta\tau)}{\partial\Delta\tau} = \frac{p_h}{2A^{max}}\left[A^{max} - \overline{A}(\overline{P}^m(\Delta\tau), V^c) + \varphi(\mathcal{A}, \overline{P}^m(\Delta\tau), V^c) - \gamma_p\right] > 0$$

which is always positive according to the first-order condition of the platform's profit with respect to P^m. Precisely, when the constraint on P^m is not binding (i.e. $P^m = \overline{P}^m(\overline{\overline{\Delta}}\tau)$), solving the first-order condition with respect to P^m (i.e. $\frac{\partial\pi}{\partial P^m} = 0$) leads to $A^{max} - \overline{A}(P^m, V^c) + \varphi(\mathcal{A}, P^m, V^c) - \gamma_p = 0$. Then when the platform has to charge a lower price $P^m = \overline{P}^m(\Delta\tau) < \overline{P}^m(\overline{\overline{\Delta}}\tau)$ due to the competitive pressure from off-platform, we must have $\frac{\partial\pi}{\partial P^m}|_{P^m = \overline{P}^m(\Delta\tau)} > 0$, which in turn leads to $A^{max} - \overline{A}(\overline{P}^m(\Delta\tau), V^c) + \varphi(\mathcal{A}, \overline{P}^m(\Delta\tau), V^c) - \gamma_p > 0$.

A lower market power $\Delta\tau$ leads to a decrease in the platform's profit. Therefore, there exists a $\hat{\Delta}\tau$ below which the platform exits the credit market. When $\hat{\Delta}\tau < \overline{\Delta}\tau$, the platform always enters the credit market and a lower market power leads to an expansion of credit (a decrease in $\mathcal{A}$). When $\overline{\Delta}\tau < \hat{\Delta}\tau < \overline{\overline{\Delta}}\tau$, the platform enters the credit market only if $\hat{\Delta}\tau < \Delta\tau < \overline{\overline{\Delta}}\tau$. A lower market power first leads to an expansion of credit, then to a contraction as the platform exits the credit market. When $\hat{\Delta}\tau > \overline{\overline{\Delta}}\tau$, the platform never enters the credit market, the number of merchants that have access to credit is irrelavent to the platform's market power.

Case 2.2: The platform monitoring cost γ_p is small: $\gamma_p < \hat{\gamma}'_p$

Then constraint (40) is binding. And under the condition $\Delta\tau \geq \overline{\Delta}\tau$, the constraint $P^m \leq \overline{P}^m(\Delta\tau)$ is not binding. Then the platform's decision to enter into the credit market does not depend on $\Delta\tau$, we are then back to the analysis of the baseline model leading to Proposition 2.

Case 3: If $\underline{\Delta}\tau \leq \Delta\tau \leq \overline{\Delta}\tau$, the constraint $P^m \leq \overline{P}^m(\Delta\tau)$ is not binding when only the bank provides credit, and it's binding when the platform also provides credit. We still delineate 2 cases depending on whether the constraint (40) is binding or not:

Case 3.1: The platform monitoring cost γ_p is large: $\gamma_p > \hat{\gamma}'_p$

We are back to the analysis in Case 2.1.

Case 3.2: The platform monitoring cost γ_p is small: $\gamma_p < \hat{\gamma}'_p$

Then constraint (40) is binding. And under the condition $\Delta\tau \leq \overline{\Delta}\tau$, the constraint $P^m \leq \overline{P}^m(\Delta\tau)$ is also binding. $\varphi(\mathcal{A}, \overline{P}^m(\Delta\tau), V^c) = 0$ gives

$$\mathcal{A} = -\frac{1}{2}p_h(V^m + V^c - \tau - \Delta\tau) + I + p_h\frac{b}{\Delta_p}$$

which is increasing in $\Delta\tau$, i.e. $\frac{\partial\mathcal{A}}{\partial\Delta\tau} = \frac{p_h}{2} > 0$. Therefore, lower market power $\Delta\tau$ gives more merchants access to credit. However, $\frac{\partial\left[\overline{A}(\overline{P}^m(\Delta\tau), V^c) - \mathcal{A}\right]}{\partial\Delta\tau} = 0$, which means a lower market power $\Delta\tau$ does not affect the number of merchants that borrow from the banks. Thanks to the expansion of platform credit, more merchants have access to credit.

The platform's profit still increases with $\Delta\tau$:

$$\frac{\partial\pi(\gamma_p, \Delta\tau)}{\partial\Delta\tau} = \frac{p_h}{2A^{max}}\left[A^{max} - \mathcal{A} - p_h(\overline{P}^m(\Delta\tau) + V^c - \tau)\right] > 0, \tag{83}$$

this is because the first-order condition with respect to P^m and $\mathcal{A}$ gives

$$\frac{p_h}{A^{max}}[A^{max} - \overline{A}(\overline{P}^m(\Delta\tau), P^c) + \varphi(\mathcal{A}, \overline{P}^m(\Delta\tau), P^c) - \gamma_p] + \lambda p_h > 0, \tag{84}$$

$$-\frac{1}{A^{max}}[p_h(\overline{P}^m(\Delta\tau) + P^c - \tau) + \varphi(\mathcal{A}, \overline{P}^m(\Delta\tau), P^c) - \gamma_p - \overline{A}(\overline{P}^m(\Delta\tau), P^c) + \mathcal{A}] - \lambda = 0, \tag{85}$$

where λ is the Lagrange multiplier associated with constraint (40). The inequality in condition (84) comes from the fact that P^m is binding at $\overline{P}^m(\Delta\tau)$.

Rearranging equation (84) and (85), we obtain $A^{max} - \mathcal{A} - p_h(\overline{P}^m(\Delta\tau) + V^c - \tau) > 0$, which gives equation (83) to be positive.

From (83), we conclude that a lower market power $\Delta\tau$ leads to a decrease in the platform's profit. Therefore, there exists a $\hat{\Delta}\tau$ below which the platform exits the credit market. When $\hat{\Delta}\tau < \underline{\Delta}\tau$, the platform always enters the credit market and a lower market power leads to an expansion of credit (a decrease in $\mathcal{A}$). When $\underline{\Delta}\tau < \hat{\Delta}\tau < \overline{\Delta}\tau$, the platform enters the credit market only if $\hat{\Delta}\tau < \Delta\tau < \overline{\Delta}\tau$. A lower market power first leads to an expansion of credit, then to a contraction as the platform exits the credit market. When $\hat{\Delta}\tau > \overline{\Delta}\tau$, the platform never enters the credit market, the number of merchants that have access to credit is irrelevant to the platform's market power.

Case 4: If $\Delta\tau \leq \underline{\Delta}\tau$, the constraint $P^m \leq \overline{P}^m(\Delta\tau)$ is binding in both cases (i.e. bank financing and platform financing). When platform also provides funding, the analysis is the same as what we did in the case 3 (when $\underline{\Delta}\tau \leq \Delta\tau \leq \overline{\Delta}\tau$). When only the bank provides funding, the bank charges $P^m = \overline{P}^m(\Delta\tau)$ and the platform's profit is

$$\Pi(\Delta\tau) \equiv \frac{A^{max} - \mathcal{A}}{A^{max}} p_h(\overline{P}^m(\Delta\tau) + V^c - \tau)$$

Still, a lower market power $\Delta\tau$ gives more merchants access to credit:

$$\underline{A}(\overline{P}^m(\Delta\tau), V^c) = I + \gamma_b + p_h(\frac{b}{\Delta_p} - \frac{V^c + V^c - \tau - \Delta\tau}{2})$$

$$\frac{\partial \underline{A}(\overline{P}^m(\Delta\tau), V^c)}{\partial \Delta\tau} = \frac{p_h}{2}$$

Comparing the platform's profit with and without platform financing, we show that the platform may exit the credit market if its market power $\Delta\tau$ is too low:

Case 4.1: The platform monitoring cost γ_p is large: $\gamma_p > \hat{\gamma}_p'$

Then constraint (40) is not binding.

$$\begin{aligned}\frac{\partial\left[\Pi(\gamma_p, \Delta\tau) - \Pi(\Delta\tau)\right]}{\partial \Delta\tau} \quad &= \quad \frac{p_h}{2A^{max}}[\varphi(\mathcal{A}, \overline{P}^m(\overline{\Delta}\tau), V^c) - \gamma_p + \underline{A}(\overline{P}^m(\Delta\tau), V^c) - \overline{A}(\overline{P}^m(\Delta\tau), V^c) \\ &\quad + p_h(\overline{P}^m(\Delta\tau) + V^c - \tau)] \end{aligned} \tag{86}$$

where $\Pi(\gamma_p, \Delta\tau)$ is the platform's profit when the platform also provides funding, $\Pi(\Delta\tau)$ is the platform's profit when only the bank provides funding.

By solving $\frac{\partial \Pi(\gamma_p, \Delta\tau)}{\partial \mathcal{A}} = 0$, we obtain $p_h(\overline{P}^m(\Delta\tau) + V^c - \tau) + \varphi(\mathcal{A}, \overline{P}^m(\overline{\Delta}\tau), V^c) - \gamma_p = \overline{A}(\overline{P}^m(\Delta\tau), V^c) - \mathcal{A}$, with which we can rearrange equation 86:

$$\frac{\partial\left[\Pi(\gamma_p, \Delta\tau) - \Pi(\Delta\tau)\right]}{\partial \Delta\tau} = \frac{p_h}{2A^{max}}[\underline{A}(\overline{P}^m(\Delta\tau), V^c) - \mathcal{A}] > 0,$$

equation above is always positive since platform financing expands the range of merchants that can obtain funding.

Case 4.2: The platform monitoring cost γ_p is small: $\gamma_p < \hat{\gamma}'_p$

Then constraint (40) is binding. We obtain directly

$$\frac{\partial\left[\Pi(\gamma_p, \Delta\tau) - \Pi(\Delta\tau)\right]}{\partial \Delta\tau} = \frac{p_h}{2A^{max}}[\underline{A}(\overline{P}^m(\Delta\tau), V^c) - \mathcal{A}] > 0,$$

A lower market power $\Delta\tau$ reduces the platform's profit both in the bank financing case and in the platform financing case. With a lower market power, $\Pi(\gamma_p, \Delta\tau)$ gets closer to $\Pi(\Delta\tau)$, the platform is less likely to enter the credit market. There exists a $\hat{\Delta}\tau$ below which the platform exists the credit market. When $\hat{\Delta}\tau > \underline{\Delta}\tau$, the platform never enters the credit market, the number of merchants that have access to credit does not depend on the platform's market power. When $\hat{\Delta}\tau < \underline{\Delta}\tau$, the platform enters the credit market only if $\hat{\Delta}\tau < \Delta\tau < \underline{\Delta}\tau$. A lower market power first leads to an expansion of credit, then to a contraction as the platform exits the credit market.

Appendix B: Robustness

B1. Cross-side effects with high monitoring costs

The case we examined in the text is when the incentive compatibility constraint $\varphi(\mathcal{A}, P^m, P^c)$ is always binding. In this appendix, we make the following assumption which ensure this constraint never binds and the solution is interior:

Assumption 6.

$$\min\{\gamma_p, \gamma_b\} \geq \frac{p_h}{2}\left[(V^m + \overline{V}^c - \tau) - \frac{2B - b}{\Delta_p} - \frac{I - A^{max}}{p_h}\right]$$

Note that this assumption does not affect the case in which only banks provide funding which is analyzed in Section 5.2. Turn now to the case in which the platform can also provide funding. The analysis follows the same steps as the one in the main text.

Lemma 7. *There exists $\overline{\gamma}'_p$ and $\overline{q}$ such that $N^c = q$ if $q > \overline{q}$ and $N^c = 1$ otherwise. Platform offers credit only if $\gamma_p < \overline{\gamma}'_p$.*

Proof.

Step 1: optimal choice of P^m and $\mathcal{A}$ for a given $N^c \in \{q, 1\}$.

To simplify notation we write V^c in the following program, omitting that V^c is a function of N^c: $V^c = \overline{V}^c$ if $N^c = q$ and $V^c = \underline{V}^c$ if $N^c = 1$. The platform optimization program conditional on being active on the credit market is:

$$\max_{P^m, \mathcal{A}} \frac{1}{A^{max}}[(A^{max} - \mathcal{A})p_h N^c(P^m + P^c - \tau) + (\overline{A}(P^m, P^c) - \mathcal{A})(\varphi(\mathcal{A}, P^m, P^c) - \gamma_p)] \tag{87}$$

s.t.

$$\varphi(\mathcal{A}, P^m, P^c) \geq 0 \tag{88}$$

$$\varphi(\mathcal{A}, P^m, P^c) \leq \gamma_b \tag{89}$$

As in the proof of Proposition 2, we can show that if Assumption 6 is satisfied, then the constraints (88) and (89) do not bind. First-order conditions with respect to P^m and $\mathcal{A}$ are

$$N^m + \frac{1}{A^{max}}\left[\varphi(\mathcal{A}, P^m, P^c) - \gamma_p - (\overline{A} - \mathcal{A})\right] = 0 \tag{90}$$

$$p_h N^c(P^m + P^c - \tau + \frac{\kappa}{N^m}) + \varphi(\mathcal{A}, P^m, P^c) - \gamma_p - (\overline{A} - \mathcal{A}) = 0 \tag{91}$$

Using $P^c + \frac{\kappa}{N^m} = V^c$, $N^m = \frac{A^{max} - \mathcal{A}}{A^{max}}$, and substituting $\varphi(.)$ and $\overline{A}$, we get

$$N^m = \frac{A^{max} - \mathcal{A}}{A^{max}} = \frac{1}{A^{max}} \left(p_h \frac{2N^c}{3}(V^m + V^c - \tau) - \frac{1}{3}\left(p_h \frac{b+B}{\Delta_p} + \gamma_p + 2I - 2A^{max} \right)\right), \quad (92)$$

$$P^m = \frac{1}{3}(2V^m - V^c + \tau) - \frac{1}{3p_h N^c}\left(\frac{b+B}{\Delta_p} + \frac{\gamma_p}{p_h} + 2\frac{I - A^{max}}{p_h} \right). \quad (93)$$

Step 2: Existence of platform financing.

Let $\overline{\pi}_{pf}(q)$ be the solution to (87) when $N^c = q$ and $V^c = \overline{V}^c$, and $\underline{\pi}_{pf}$ be the solution to (87) when $N^c = 1$ and $V^c = \underline{V}^c$. As in the proof of Proposition 2 we can show that if $\gamma_p = \gamma_b$ then

$$\overline{\pi}_{pf}(q) > \overline{\pi}_{bank}(q) \text{ and } \underline{\pi}_{pf} > \underline{\pi}_{bank}.$$

Furthermore $\overline{\pi}_{pf}(q)$ and $\underline{\pi}_{pf}$ are strictly decreasing in γ_p while $\overline{\pi}_{bank}(q)$ and $\underline{\pi}_{bank}$ are independent from γ_p. It follows that if $\gamma_p = \gamma_b$,

$$\pi_{platform} \equiv \max\{\overline{\pi}_{pf}(q), \underline{\pi}_{pf}\} > \max\{\overline{\pi}_{pf}(q) \equiv \pi_{bank}, \underline{\pi}_{pf}\}, \quad (94)$$

i.e., the platform's profit with platform financing is strictly higher than the platform's profit with only bank financing. This implies also that $\pi_{platform}$ is strictly decreasing in γ_p, therefore Eq. 74 holds for γ_p below a threshold $\overline{\gamma}'_p$. Therefore the platform is active in the credit market for $\gamma_p < \overline{\gamma}'_p$.

Step 3: Optimal pricing

Using the same arguments as in the proof of Lemma 5, there exists a unique $\overline{q}$ such that $\overline{\pi}_{pf}(\overline{q}) = \underline{\pi}_{pf}$. Furthermore, $\overline{\pi}_{pf}(q) > \underline{\pi}_{pf}$ if $q > \overline{q}$ and $\overline{\pi}_{pf}(q) < \underline{\pi}_{pf}$ if $q < \overline{q}$. □

The next result shows that as in the case studied in the main text, platform funding can expand the range of consumers who become active. It is therefore the counterpart of Proposition 5.

Proposition 8. *When the platform offers financing, the mass of consumers who join the platform expands relative to the case with bank financing only, i.e.,* $\overline{q} > \underline{q}$.

Proof. Consider first, the bank-financing case, Eq. 33 is equivalent to

$$\frac{1}{A^{max}} p_h N^c (P^m + P^c + \frac{\kappa}{N^m} - \tau) = N^m,$$

which implies that the platform's profit under bank financing is

$$\pi_{bank} = A^{max}(N^m_{bank})^2 - p_h N^c \kappa,$$

where N^m_{bank} is given by Eq. 34. We use the notation

- $\overline{N}^m_{bank}(q)$ for the solution to Eq. 34 with $N^c = q$ and $V^c = \overline{V}^c$,

- $\underline{N}^m_{bank}$ for the solution to Eq. 34 with $N^c = 1$ and $V^c = \underline{V}^c$.

Similarly, using Eq. 90 and Eq. 91, we get the platform profit when the platform can provide funding:

$$\pi_{pf} = A^{max}(N^m_{pf})^2 - p_h N^c \kappa - p_h \frac{(B-b)\gamma_p}{\Delta_p A^{max}},$$

where N^m_{pf} is given by Eq. 92. We use the notation

- $\overline{N}^m_{pf}(q)$ for the solution to Eq. 72 with $N^c = q$ and $V^c = \overline{V}^c$,

- $\underline{N}^m_{pf}$ for the solution to Eq. 72 with $N^c = 1$ and $V^c = \underline{V}^c$.

Then $\overline{\pi}_{pf}(\overline{q}) = \underline{\pi}_{pf}$ is equivalent to

$$(\underline{N}^m_{pf})^2 - (\overline{N}^m_{pf}(\overline{q}))^2 = (1-\overline{q})\frac{p_h\kappa}{A^{max}} \Leftrightarrow (\underline{N}^m_{pf} - \overline{N}^m_{pf}(\overline{q}))(\underline{N}^m_{pf} + \overline{N}^m_{pf}(\overline{q})) = (1-\overline{q})\frac{p_h\kappa}{A^{max}} \quad (95)$$

From Eq. 34 and Eq. 92, we have $\underline{N}^m_{pf} > \underline{N}^m_{bank}$ and $\overline{N}^m_{pf}(\overline{q}) > \overline{N}^m_{bank}(\overline{q})$, therefore

$$\underline{N}^m_{pf} + \overline{N}^m_{pf}(\overline{q}) > \underline{N}^m_{bank} + \overline{N}^m_{bank}(\overline{q}) \quad (96)$$

Furthermore

$$\underline{N}^m_{bank} - \overline{N}^m_{bank}(\overline{q}) = \frac{p_h}{2A^{max}}((1-\overline{q})(V^m - \tau) + \underline{V}^c - \overline{q}\overline{V}^c)$$

and

$$\underline{N}^m_{pf} - \overline{N}^m_{pf}(\overline{q}) = \frac{2p_h}{3A^{max}}((1-\overline{q})(V^m - \tau) + \underline{V}^c - \overline{q}\overline{V}^c),$$

which implies

$$\underline{N}^m_{pf} - \overline{N}^m_{pf}(\overline{q}) > \underline{N}^m_{bank} - \overline{N}^m_{bank}(\overline{q}). \quad (97)$$

Then using Eq. 95, Eq. 96 and Eq. 97 we have

$$(\underline{N}^m_{bank})^2 - (\overline{N}^m_{bank}(\overline{q}))^2 < (\underline{N}^m_{pf})^2 - (\overline{N}^m_{pf}(\overline{q}))^2 = (1-\overline{q})\frac{p_h\kappa}{A^{max}},$$

and therefore

$$\overline{\pi}_{bank}(\overline{q}) > \underline{\pi}_{bank}. \quad (98)$$

Since from the proof of Lemma 5, $\overline{\pi}_{bank}(.)$ is strictly increasing and $\overline{\pi}_{bank}(\underline{q}) = \underline{\pi}_{bank}$, Eq. 98 implies

$$\underline{q} < \overline{q}.$$

□