Red Nacional de
Investigadores
en Economía

Banks or Fintechs? A Roadmap for Regulation

Francisco Jesús Guerrero López (Universidad de San Andrés)

Paula Margaretic (Universidad de Chile)

Lucía Quesada (Universidad de San Andrés)

Federico Sturzenegger (Universidad de San Andrés)

DOCUMENTO DE TRABAJO N° 327

Junio de 2024

Citar como:
Guerrero López, Francisco, Paula Margaretic, Lucía Quesada, Federico Sturzenegger (2024). Banks or Fintechs? A Roadmap for Regulation. Documento de trabajo RedNIE N°327.

Banks or Fintechs? A Roadmap for Regulation

Francisco Jesus Guerrero Lopez * Paula Margaretic† Lucía Quesada‡
Federico Sturzenegger§

February 2024

Abstract

In recent years, traditional banks have faced increasing competition from digital banks, fintechs, and big tech companies. This paper builds a framework to discuss optimal regulation within this more complex competitive landscape. To achieve this, we establish a model where banks compete with a single fintech. All players choose the degree of specialization. Banks hold a geographical advantage for some customers, while the fintech reaches all customers equally. Due to fixed costs, the market operates under imperfect competition, leading to parameter values where the regulator may seek to exclude non-bank intermediaries and others where the regulator may prefer to exclude banks, shifting intermediation exclusively to big tech companies. These distinct patterns align with observed competition in financial markets, where competition with big tech companies is intense in the customer business and less so in corporate lending. Our model contributes to the argument that, for certain types of lending, banking regulation tends to be overly restrictive towards non-bank intermediaries, resulting in significant welfare losses.

*Universidad de San Andrés
†Universidad de Chile (Facultad de Economía y Negocios, Departamento de Administración)
‡Universidad de San Andrés
§Universidad de San Andrés, fsturzenegger@udesa.edu.ar.

1 Introduction

In recent years, traditional banks have faced increasing competition from digital banks, fintechs, and big tech companies.[1] This has led to significant (sometimes heated) debates on banking regulation. The central question is whether non-banking institutions should be permitted to accept deposits and extend credit, or if these activities should be restricted exclusively to traditional banking institutions. The way regulators have responded to these developments varies across countries. In general, the mantra in the sector is that only regulated banks should be allowed to capture deposits to be used for financial intermediation. In some countries, fintech laws have been issued, restricting financial intermediation only to banks. In some cases, non-banking institutions are forced to keep their assets fully liquid, not only inhibiting lending but virtually knocking off their profitability. In other cases, regulators have been more open to new forms of competition opening the door for fintechs to become financial institutions (as in China) through a banking license (in some cases with higher capital requirements, as in the US or Europe, Zamil and Lawson (2022)).

This paper builds a framework to discuss optimal regulation in this richer competitive environment. To do so, we establish a model in which financial intermediaries offer a differentiated product. In our setup, traditional banks position themselves symmetrically around a Salop circle. The innovation (following Madden and Pezzino (2011)) is the introduction of a fintech inside the circle that is equidistant from all clients on the perimeter. Financial intermediaries have to pay a fixed cost, which deviates from the conditions of perfect competition. Also, the market equilibrium may deviate from the social optimum. Because intermediaries encounter a downward-sloping demand curve, the market equilibrium leads to excessive entry by traditional banks and lower specialization levels. This, in turn, provides consumers with less utility. From a social planning perspective, a more favorable outcome would involve fewer banks and higher specialization.

We show that there are parameter values for which the Planner wants to exclude non-bank

[1] Fintechs are typically associated with firms that provide specific financial services, such as lending or payments, while big tech companies, such as Amazon, Google, Meta, Mercado Libre, have enormous scale economies and incorporate financial products alongside their primary activities. For brevity, in what follows, we will refer to fintechs collectively as non-bank financial intermediaries.

intermediaries from the market. But we also show that for other parameter values, the Planner wants to exclude *banks* and shift intermediation exclusively to fintechs. The difference plays out as a tradeoff between specialization gains provided by the banks and the cost of intermediation (larger for traditional banks, as each one pays an independent fixed cost of operation). In fact, there are regions where the fixed costs of banks are so large that the market is underserved by traditional banks but could be naturally served by the fintech. In this parameter region, there is a significant welfare loss from not allowing the fintech to participate in financial intermediation.

While our model focuses on the welfare gain of these new forms of competition, it provides a nice fit with current competition patterns in the industry. Where specialization is more relevant for customers, it is more difficult for fintechs to displace traditional banks. For example, in large corporate lending, banks have a specialization advantage relative to fintechs in that they provide a very large suite of products: lending, payroll, special accounts for employees, international trade payments, etc. Additionally, large corporates do not rely on big techs for sales. Therefore, the knowledge of these companies by big techs is limited. In fact, these firms are typically served by traditional banks. The opposite occurs for small firms and retail customers. For these types of clients, big techs know more about them, enabling them to offer superior products to their clients. Consequently, in our model, it is reasonable to expect that fintech competition is more likely to occur in these areas.

While not the focus of this paper, the debate on the nature of institutions providing financial intermediation extends beyond competition in the product market. A substantial body of literature provides reasons why regulated banking institutions should exclusively participate in this market. These reasons range from the imperative to prevent banking crises to addressing liquidity needs and managing challenges associated with asymmetric information (Freixas and Rochet (2008); Bolton et al. (2007); Hellwig (2000); Freixas et al. (2000); Diamond and Dybvig (1986); Goldstein and Pauzner (2005), among others).[2] The arguments for regulation, by extension, have been interpreted as a natural justification for excluding non-banking institutions from financial intermediation, as if

[2] In our model, we assume the existence of banks and fintechs based on the literature that justifies their presence.

non-banks (or non-regulated entities) should be more prone to asymmetric information or liquidity runs. However, we find no empirical support for such claims, or it has not yet been provided. Consider, for example, Mercado Libre, a big tech company in Latin America that offers payment services through a wallet. Its assets lack deposit insurance, yet, Mercado Libre's net worth exceeds the total deposits in Argentina's financial sector. Thus, an argument needs to be made to argue that the money in these accounts is at a higher risk than in traditional banks.

The paper is structured as follows. Section 2 reviews the literature, while Section 3 introduces the model. Section 4 compares the market equilibrium with the one where there are only banks. In turn, Section 5 examines the social optimum and the decentralized equilibrium in the general setting. Section 6 connects the heterogeneity of commercial borrowers in financial markets with our model results to derive some policy implications. Section 7 examines whether our main findings remain robust when not assuming an explicit function for the returns of the investment project. Finally, Section 8 concludes with some policy implications of the model's results. Proofs are relegated to the appendix.

2 Literature review

Our paper is built on Madden and Pezzino (2011) who study an oligopolistic market in which consumers located around the perimeter of a Salop circle buy either from firms around this perimeter or from a firm located at the center of the circle. In their model, perimeter firms compete locally with the central firm and with neighboring firms on the perimeter; in contrast, the central firm competes with all the perimeter firms. This paper diverges from Madden and Pezzino (2011) in a fundamental aspect: in our model, both banks and fintechs, which lend to entrepreneurs for financing their investment projects, endogenously determine their degree of specialization. In our model, specialization enhances entrepreneurs' returns on investments.[3] We allow for different combinations of fixed costs and marginal costs associated with specialization. This parameter diversity not

[3] While geographical localization is a natural way to conceptualize specialization, it can also encompass the types of clients served or the nature of activities in which clients are engaged.

only results in a more intricate array of equilibrium configurations and potential market failures but also enables us to tailor our regulatory recommendations based on the specific types of clients involved.

Our paper connects to two strands of literature. First, it is linked to the growing theoretical literature on fintech disruption. Second, it is connected to the literature examining the regulatory framework for fintechs and big techs. Regarding the first strand, consider He et al. (2023); Vives and Ye (2021); Parlour et al. (2022), who investigate the competitive environment of fintech companies competing with traditional banks in originating loans and in payment systems (Vives (2019); Berg et al. (2022) offer reviews of digital disruption in banking).[4]

He et al. (2023) study how open banking, that is, sharing banks' customer transaction data, affects lending competition between a traditional bank and a fintech. In their model, bank and fintech conduct independent creditworthiness tests before offering loans to borrowers, who can be of high or low credit quality. The fintech has limited customer data compared to banks. However, it is equipped with superior data analytical algorithms. Assuming that open data improves the fintech's screening ability,[5] the paper shows that the higher screening ability of the fintech following open banking helps high-credit quality borrowers. However, it can also hinder competition and leave all borrowers worse off if the screening ability gap between bank and fintech augments significantly the competitive advantage of fintech. In such a scenario, the fintech ends up enjoying a greater market power than the bank had before; both types of borrowers are worse off whereas industry profits increase.

In turn, Parlour et al. (2022) investigate the impact of fintech competition in payment services when a monopolistic bank in the loan market uses payment data to learn about consumers' credit quality. Competition from fintech payment providers disrupts this information spillover. The paper demonstrates that fintech competition: i) may lead to an increase in the bank's price for payment

[4]For empirical evidence, consider Gopal and Schnabl (2022); Buchak et al. (2018); Fuster et al. (2019); Liu et al. (2022); Babina et al. (2022).

[5]In their model, screening ability refers to the joint outcome of data availability and data analysis techniques. Open data provides the fintech with previous financial and credit transactions of customers. This, combined with the fintech's superior algorithms, leads to the fintech's enhanced screening ability.

services; ii) promotes financial inclusion for consumers of payment services that were previously unbanked; iii) may hurt borrowers with a strong bank preference but with low credit quality; iv) has an ambiguous effect in the loan market. The model described in Parlour et al. (2022) is interesting as it applies well to the payment services that big techs provide, such as Amazon or Mercado Libre in Latin America, thanks to which they learn information about consumers' credit quality (mainly small and medium-sized enterprises).

This literature typically has a non-perfectly competitive market structure. In this context, the impact of fintech entry may have ambiguous effects on consumers and welfare. Our model yields similar conclusions. In our case, the entry of a fintech may result in reduced competition in equilibrium by diminishing the market for traditional banks. However, as in their setups, there are parameter values for which consumer welfare is enhanced by the introduction of fintech firms. Furthermore, we share with this literature the conclusion that competition between banks and fintech companies critically hinges on the market structure and the fixed and variable costs among participants. These factors explain the various competitive environments observed in different countries. We expand upon the existing research by highlighting that there exists no universally optimal choice of policies to regulate fintechs. Indeed, we demonstrate that in regions where banks do not operate (e.g. when their fixed costs of operation are too large), allowing fintechs to provide financial intermediation is welfare-improving.

Second, our paper is connected to the literature searching for a regulatory framework for fintechs and big techs (Zingales et al., 2022; Zamil and Lawson, 2022; Ehrentraud et al., 2022; Carstens et al., 2021). On the one hand, this literature documents that in the recent past, big techs and large diversified fintechs have obtained banking licenses in various jurisdictions (mainly, Asia, and in particular, China; the United Kingdom, and to a lesser extent, the European Union and the United States), facilitated by an enabling regulatory environment (Zamil and Lawson, 2022). Table A1, in the Appendix, summarizes these regulatory developments by country. On the other hand, these studies emphasize that while fintechs and big techs offer several benefits for consumers (superior technology, user-friendly customer interfaces that improve users' experiences, and financial inclusion), their business models may entail some risks (stemming from potential anti-competitive behavior and impediments to consolidated supervision, Zamil and Lawson (2022)). These risks may justify the search for regulation for these firms.

In this regard, the literature tends to recommend two specific regulatory approaches for big techs and fintechs. The first approach is segregation, which consists of minimizing risks arising from group interdependencies between financial and non-financial activities by imposing specific ring-fencing rules. The second approach is inclusion, which aims at creating a new regulatory category for big tech groups and larger fintechs with significant financial activities. Regulatory requirements would be imposed for the group as a whole, including the big tech parent. Moreover, some scholars call for an international (Zingales et al., 2022) or at least regional regulation (Ehrentraud et al., 2022) for big techs and large and diversified fintechs. The rationale for this is that these firms tend to operate at a global scale; therefore, it is necessary to have a supranational authority to regulate them. We add to this literature by proposing a theoretical framework to discuss the optimal regulation for fintechs and big techs that is flexible enough to accommodate imperfect competition, and differences in firms' technological, spatial, and informational features.

3 The model

We model the banking industry assuming two types of suppliers of financial services: "traditional banks" and a "fintech". The main characteristic of the first group is that banks provide a sort of specialization. While geographical localization is a natural way of thinking about specialization, it can also refer to the types of clients served or the type of activities in which clients are engaged. The fintech or digital bank, on the contrary, accesses all clients identically (typically via the phone or other electronic means).

The way we model this dichotomy is by placing traditional banks along a Salop circle with a perimeter equal to one while the fintech (or digital bank) is an inner circle that can be closer or farther away from the outer circle. We assume there are N banks and either one or no fintech (we denote this as $c = 1$ or $c = 0$, respectively). There is a mass equal to 1 of entrepreneurs that are uniformly distributed on the perimeter of the circle. Figure 1 shows the spatial configuration of our banking industry.

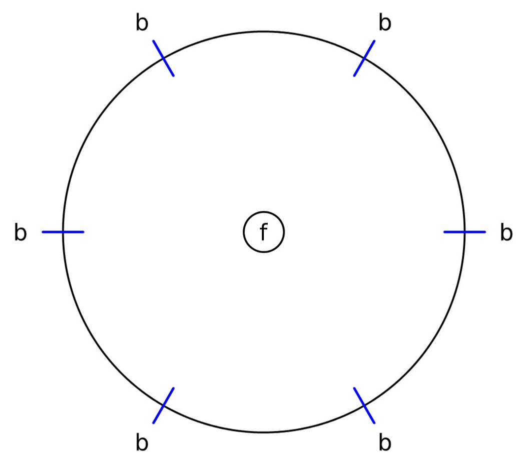

Figure 1: The Salop circle with six perimeter banks and a fintech in the inner circle

Each entrepreneur has an idea for an investment project with a return of A in autarky. However, entrepreneurs lack the funds to cost the unit amount that the project entails, so they need to borrow from a financial intermediary i. Financial intermediaries provide services to entrepreneurs that increase the project's return. These services are increasing in the financial intermediary's degree of specialization, which we denote as θ_i and will be endogenously chosen.

Each entrepreneur has the option of undertaking or not a project. We assume that the benefit of undertaking the project (which is A in autarky) is sufficiently attractive so entrepreneurs always prefer implementing it. Consider an entrepreneur j that decides to borrow from a financial intermediary i which is located at a distance x_{ij} from her location. We assume that the entrepreneur's utility if she borrows from this financial intermediary, is:

$$H_{ji} = A\left(1 + \sqrt{\theta_i}\right) - r_i - \theta_i\, x_{ij}, \tag{1}$$

The first term in equation (1) represents the entrepreneur's gross return from undertaking the project and borrowing from a financial intermediary, which equals the return in autarky A multiplied by the value of the bank's specialization services, $\left(1 + \sqrt{\theta_i}\right)$. The second term is the interest rate that the entrepreneur has to pay to the financial intermediary, r_i. The third one corresponds to the dis-utility or transportation cost of traveling the distance x_{ij}.

Intuitively, equation (1) indicates that the higher the degree of specialization θ_i, the better the financial intermediary satisfies the needs of the entrepreneurs located closer to its own location. However, this also implies that the bank is a poorer intermediary for entrepreneurs situated farther away. This is because the utility of entrepreneurs decreases linearly with the distance from the financial intermediary at a rate given by the bank's degree of specialization. Figure 2 shows how the choice of specialization works. A high level of specialization implies a larger increase in productivity for contiguous entrepreneurs, but a relatively faster decline for those located further away.

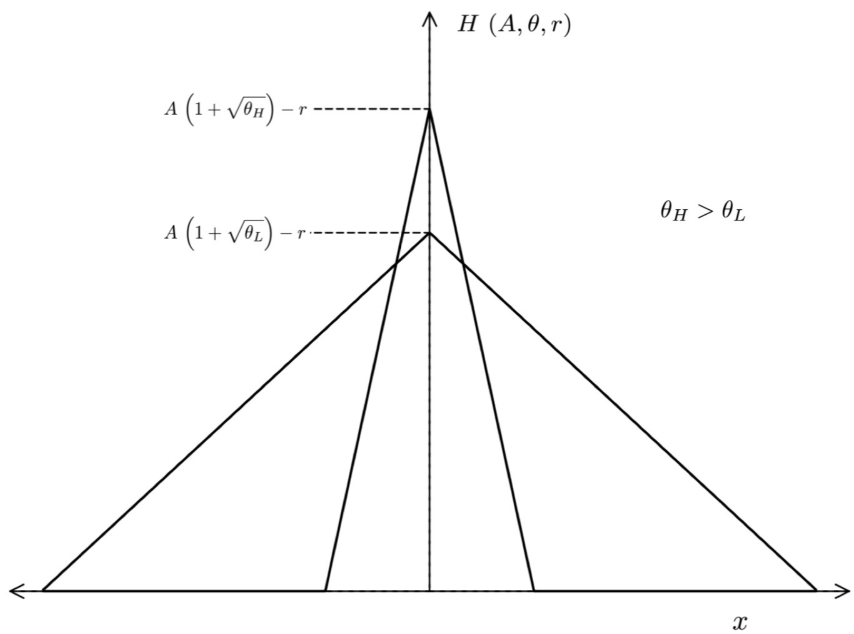

Figure 2: Project returns with different values of θ

Banks are identical and, in equilibrium, will be located symmetrically on the circle's perimeter. We denote a representative bank with subindex $i = p$.[6] As said, the financial services they provide

[6]We use the subindex p for banks to indicate they are located in the perimiter of the product space.

are locationally specialized, that is, they are more valuable for entrepreneurs located close to the bank than for clients located further away. We interpret the distribution of banks around the Salop circle as spatial product differentiation. Intuitively, this is consistent with bank branching and regional location of financial institutions (Schargrodsky and Sturzenegger, 2000).[7]

Conversely, the fintech, denoted with subindex $i = f$, is located at a distance δ from all entrepreneurs. We conceptualize the fintech as a non-traditional financial institution that uses alternative communication channels with the client, and has different scorecards and costs. Given its position in the circle, it is perceived equally by all entrepreneurs.

We assume there is free entry into the banking industry; in contrast, at most one fintech can exist in the market.[8] A financial intermediary i lends to an entrepreneur at an interest rate r_i (r_p if the lender is the bank or r_f if it is the fintech). In turn, financial intermediaries obtain funding from an external market at an exogenous rate ρ.[9] To enter the market, financial intermediaries must pay a fixed cost: banks incur the fixed cost of F, whereas the fintech pays G. Specialization is an endogenous decision; however, we assume that there are costs to specialization. In particular, we assume that financial intermediaries have marginal specialization costs, which we denote as τ_p for banks and τ_f for the fintech. For simplicity, we suppose that these marginal costs are constant.

With these assumptions, the profit functions for banks and the fintech, π_p and π_f, respectively, become

$$\pi_p = 2(r_p - \tau_p\theta_p - \rho)x - F \quad (2)$$

$$\pi_f = 2N(r_f - \tau_f\theta_f - \rho)\left(\frac{1}{2N} - x\right) - G \quad (3)$$

Starting with equation (2), its first parenthesis corresponds to the net income that a bank obtains from lending to each entrepreneur, which is formed by the interest rate r_p it charges net of the cost of specialization, $\tau_p\theta_p$, and the cost it has to pay for the external funds it borrows. Defining x as

[7]Nevertheless, the model is equally applicable to financial intermediaries that concentrate their lending in specific economic sectors. In that situation, location in the circle would correspond to particular activities and these would be changing smoothly around the circle.

[8]Entry of more than one fintech would leave them without income due to Bertrand competition (Bouckaert, 2000).

[9]Note that we do not model the existence of financial intermediaries, we simply assume that they exist. There is extensive literature justifying their existence for several reasons: asymmetric information and maturity transformation, among others, (Gorton and Winton, 2003; Dowd, 1996).

the solution to

$$A\left(1+\sqrt{\theta_p}\right)-r_p-\theta_p x=A\left(1+\sqrt{\theta_f}\right)-r_f-\theta_f\delta \quad (4)$$

i.e. as the location of the consumer who is indifferent between borrowing from its nearest bank or from the fintech, $2x$ is the fraction of the total demand served by a given bank and F is the fixed cost that each bank has to pay. Knowing that $2Nx$ is the total loan demand served by banks, total banks' profits are

$$2N(r_p-\tau_p\theta_p-\rho)x-NF. \quad (5)$$

In turn, equation (3) shows the profit function of the fintech which differs from the profit of a typical bank in that its demand is now $2N(\frac{1}{2N}-x)$, which is the residual demand provided the banks do not serve the whole credit market. The fintech has to pay the fixed cost G.

3.1 The Central Planner's problem

The Central Planner wants to maximize total welfare, which is obtained by adding the consumer and producer surpluses. The endogenous variables in this problem are the degrees of specialization, θ_p and θ_f, the number of banks, N, and whether the fintech should be allowed to intermediate, c.

To determine the social optimum, we first solve the Central Planner's problem assuming that only banks provide financial intermediation. We then introduce the fintech. Finally, we compare the two optimal solutions depending on the values of F and G.

3.1.1 The Central Planner's problem with only banks

To solve the Central Planner's problem, we start by defining the consumer and bank surpluses, which we denote as CS_p and PS_p. Note that to minimize transportation costs, it is socially optimal that the demand of each bank is exactly equal to $\frac{1}{N}$. Thus, from the specifications above, consumer and producer surpluses are

$$CS_p = 2N\left(\left(A\left(1+\sqrt{\theta_p}\right)-r_p\right)\frac{1}{2N}-\frac{\theta_p}{8N^2}\right) \tag{6}$$

$$= A\left(1+\sqrt{\theta_p}\right)-r_p-\frac{\theta_p}{4N}, \tag{7}$$

and

$$PS_p = 2N\left(r_p-\tau_p\,\theta_p-\rho\right)\frac{1}{2N}-N\,F. \tag{8}$$

Total welfare with only banks, which we denote as W^{OB}, can be expressed as,

$$W^{OB} = A\left(1+\sqrt{\theta_p}\right)-\frac{\theta_p}{4N}-\tau_p\,\theta_p-\rho-N\,F. \tag{9}$$

The values of θ_p and N that maximize total welfare are,

$$\theta_p = \frac{\left(A-\sqrt{F}\right)^2}{4\,\tau_p^2}, \tag{10}$$

and

$$N = \frac{A-\sqrt{F}}{4\,\tau_p\,\sqrt{F}}. \tag{11}$$

This is indeed the solution for the Central Planner as long as the number of firms in Equation (11) is greater than 1. Indeed, Equations (10) and (11) show that both the optimal degree of specialization θ_p and the optimal number of banks N decrease with the marginal cost of providing specialization, τ_p and with the fixed cost F. Intuitively, when F (or τ_p) increases, the Central Planner prefers a smaller number of banks. With fewer banks, a lower degree of specialization is optimal, as each bank needs to serve customers who are located relatively farer away. Note in addition that if F is sufficiently large, N becomes smaller than 1, which makes no sense in economic terms.[10] The latter hence suggests that there is a limit on F above which the Central Planner prefers that no financial intermediation is provided. We come back to this limit in Section 3.1.3.

Substituting the optimal values of θ_p and N (equations (10) and (11), respectively) in the total

[10]This is because a fraction of a bank would imply a total fixed cost that is smaller than F.

welfare, the optimal welfare with only banks, W^{OB}, becomes:

$$W^{OB} = A + \frac{\left(A - \sqrt{F}\right)^2}{4\,\tau_p} - \rho, \qquad N > 1. \tag{12}$$

When the number of banks in equation (11) is smaller than 1, the Central Planner has to choose whether to have only one bank or no bank at all. It prefers only one bank in the system as long as the welfare with one bank is positive. Letting $N = 1$ in equation (9) and maximizing with respect to θ_p gives that with $N = 1$, the maximum welfare is

$$W^{OB} = A + \frac{A^2}{1 + 4\tau_p} - \rho - F, \qquad N = 1. \tag{13}$$

Finally, if

$$F > A + \frac{A^2}{1 + 4\tau_p} - \rho$$

the Central Planner chooses not to have banks in the system, as even a single bank would lead to negative welfare.

3.1.2 The Central Planner's problem under coexistence (banks and fintech)

If both banks and the fintech coexist, the consumer surpluses of entrepreneurs borrowing from the bank or from the fintech, with the latter being denoted as CS_f, become

$$CS_p = 2\,N\left[\left(A\left(1 + \sqrt{\theta_p}\right) - r_p\right)x - \theta_p\,\frac{x^2}{2}\right], \tag{14}$$

and

$$CS_f = 2\,N\left[A\,\left(1 + \sqrt{\theta_f}\right) - r_f - \theta_f\,\delta\right]\left(\frac{1}{2\,N} - x\right) \tag{15}$$

$$= A\,\left(1 + \sqrt{\theta_f}\right) - r_f - \theta_f\,\delta - 2\,N\left[A\,\left(1 + \sqrt{\theta_f}\right) - r_f - \theta_f\,\delta\right]x, \tag{16}$$

where the term in brackets in equation (15) equals the entrepreneur's utility when borrowing from the fintech.

The corresponding bank and fintech surpluses, which we denote as PS_p and PS_f, respectively, become

$$PS_p = 2N(r_p - \tau_p \theta_p - \rho)x - NF, \tag{17}$$

and

$$PS_f = 2N(r_f - \tau_f \theta_f - \rho)\left(\frac{1}{2N} - x\right) - G. \tag{18}$$

Adding equations (14), (49), (16) and (51), total welfare under coexistence is,

$$W^{CO} = A\left(1 + \sqrt{\theta_f}\right) - \theta_f(\tau_f + \delta) + 2N\left(\left(A\left(\sqrt{\theta_p} - \sqrt{\theta_f}\right) - \tau_p \theta_p + (\tau_f + \delta)\theta_f\right)x - \theta_p \frac{x^2}{2}\right) - NF - G - \rho, \tag{19}$$

with x defined such that

$$A\left(1 + \sqrt{\theta_p}\right) - \tau_p \theta_p - \rho - \theta_p x = A\left(1 + \sqrt{\theta_f}\right) - \tau_f \theta_f - \rho - \theta_f \delta. \tag{20}$$

Then, the optimal values of the endogenous variables θ_p and θ_f become

$$\theta_p = \frac{A^2}{4\tau_p(\tau_f + \delta)}, \tag{21}$$

and

$$\theta_f = \frac{A^2}{4(\tau_f + \delta)^2}. \tag{22}$$

Given the optimal values of θ_p and θ_f, the location of the indifferent entrepreneur becomes

$$x = 2\sqrt{\tau_p}\left(\sqrt{\tau_f + \delta} - \sqrt{\tau_p}\right). \tag{23}$$

Plugging equations (22) and (23) into (54), the resulting total welfare under coexistence becomes,

$$W^{CO}(x) = A + \frac{A^2}{4(\tau_f + \delta)} + N\left(A^2\left(1 - \frac{\sqrt{\tau_p}}{\sqrt{\tau_f + \delta}}\right)^2 - F\right) - G - \rho. \tag{24}$$

The key feature of this equation is that it is linear in N. This means that the optimal number of banks is always a corner solution.

If $F > A^2\left(1 - \frac{\sqrt{\tau_p}}{\sqrt{\tau_f+\delta}}\right)^2$, maximizing equation (24) implies $c = 1$ and $N = 0$. This is because total welfare is decreasing in the number of banks. Conversely, if $F \leq A^2\left(1 - \frac{\sqrt{\tau_p}}{\sqrt{\tau_f+\delta}}\right)^2$, the Central

Planner sets N at its maximum value, i.e.,

$$N = \frac{1}{2x}, \tag{25}$$

and all the demand is served by banks. Therefore, equation (24) provides a first starking result: the social optimum is dichotomous. The Central Planner prefers all entrepreneurs to be served either by traditional banks or by a fintech. It finds no benefit in having them coexist.

Why is the Central Planner dichotomous? Notice that equations (21) and (22) indicate that the degrees of specialization, θ_p and θ_f, are independent of the number of banks. Furthermore, the distance to the fintech remains constant. As a result, the distance along the circle until reaching a point of indifference between the fintech and alternative offers also remains constant. This characteristic allows us to compute the total welfare for clients from the fintech and for clients of the banks within this invariant range. If the welfare for an entrepreneur is greater when using the fintech, the Central Planner will prefer the fintech. Notably, this principle applies uniformly to any client along the circle, leading the Planner to aim to serve the entire market with the fintech. Conversely, if the welfare derived from the banks within this interval is higher, this will also hold true for any point on the circle, prompting the Planner to favor the banks.

3.1.3 Welfare comparison

We now examine the conditions under which the Central Planner prefers the optimal allocation with only banks or with only a fintech. To do so, we compare the optimal welfare with only banks, W^{OB} (in equations (12) and (13)), with the resulting welfare with only a fintech, W^{OF}, which is obtained by setting $N = 0$ in equation (24):

$$W^{OF} = A + \frac{A^2}{4(\tau_f + \delta)} - \rho - G. \tag{26}$$

As stated above, when $F \leq A^2 \left(1 - \frac{\sqrt{\tau_p}}{\sqrt{\tau_f + \delta}}\right)^2$, the Central Planner always prefers that banks serve the whole market. Otherwise, the Planner needs to compare the two solutions W^{OB} and W^{OF}.

The comparison between W^{OB} and W^{OF} leads to a decision rule for the Central Planner which depends on the fintech's fixed cost, G. Precisely, when $G \leq \Omega$, which is explicitly defined in Proposition 1, the Central Planner prefers that only the fintech serves the market; otherwise, it may prefer that only the perimeter banks serve the market (provided F is sufficiently small) or that there is no financial intermediary at all. The next proposition states the Central Planner's optimal allocation:

Proposition 1: The social optimum is:

$$\begin{cases} c = 0 \text{ and } N \geq 1 & if \quad G > \Omega \text{ and } F \leq A + \frac{A^2}{1+4\tau_p} - \rho \\ c = 1 \text{ and } N = 0 & if \quad G < \Omega \\ c = 0 \text{ and } N = 0 & if \quad G > \Omega \text{ and } F > A + \frac{A^2}{1+4\tau_p} - \rho \end{cases}$$

with Ω being as in equation (27) when $\tau_f + \delta \geq \tau_p$:

$$\Omega = \left\{ \begin{array}{lll} 0 & if & F < \min\left\{\frac{A^2}{(1+4\tau_p)^2}; A^2\left(1 - \frac{\sqrt{\tau_p}}{\sqrt{\tau_f+\delta}}\right)^2\right\} \\ \frac{A^2}{4(\tau_f+\delta)} - \frac{(A-\sqrt{F})^2}{4\tau_p} & if & A^2\left(1 - \frac{\sqrt{\tau_p}}{\sqrt{\tau_f+\delta}}\right)^2 \leq F < \frac{A^2}{\left(4\tau_p+1\right)^2} \\ \frac{A^2}{4(\tau_f+\delta)} - \frac{A^2}{1+4\tau_p} + F & if & \frac{A^2}{\left(4\tau_p+1\right)^2} \leq F < A + \frac{A^2}{1+4\tau_p} - \rho \\ A + \frac{A^2}{4\left(\tau_f+\delta\right)^2} - \rho & if & F \geq A + \frac{A^2}{1+4\tau_p} - \rho \end{array} \right\} \tag{27}$$

or as in (28) when $\tau_f + \delta \leq \tau_p$:

$$\Omega = \left\{ \begin{array}{lll} \frac{A^2}{4(\tau_f+\delta)} - \frac{(A-\sqrt{F})^2}{4\tau_p} & if & F < \frac{A^2}{\left(4\tau_p+1\right)^2} \\ \frac{A^2}{4(\tau_f+\delta)} - \frac{A^2}{1+4\tau_p} + F & if & \frac{A^2}{\left(4\tau_p+1\right)^2} \leq F < A + \frac{A^2}{1+4\tau_p} - \rho \\ A + \frac{A^2}{4\left(\tau_f+\delta\right)^2} - \rho & if & F \geq A + \frac{A^2}{1+4\tau_p} - \rho \end{array} \right\} \tag{28}$$

Sketch of the proof: To derive Ω and the conditions under which each of these three allocations is optimal, we start by solving $W^{OF} > W^{OB}$ (provided F is not too big, to be determined). The inequality leads to a possible value of Ω, which we denote as Ω_1

$$\Omega_1 = \frac{A^2}{4(\tau_f + \delta)} - \frac{(A - \sqrt{F})^2}{4\tau_p}, \tag{29}$$

which appears in equations (27) and (28). However, when $G > \Omega$, there are additional restrictions to consider. The first one is that the optimal number of banks in the system is a decreasing function of F, as established in equation (11). Indeed, the optimal value of F for which there is only one bank is

$$F = \frac{A^2}{\left(4\,\tau_p + 1\right)^2}. \tag{30}$$

Since having a fraction of a bank does not make any sense in economic terms, this level of F imposes a restriction on the Central Planner's problem. This is because, above that level of F, there are no banks in the system and the Central Planner's problem turns out to be to determine whether $W^{OF} > 0$. Indeed, when $F > \frac{A^2}{(4\tau_p+1)^2}$ and provided $G > \Omega$, the Planner prefers that no financial intermediary is present in the market. This condition hence leads to the second value in the piece-wise function of Ω, which we denote as Ω_2:[11]

$$\Omega_2 = A + \frac{A^2}{4\left(\tau_f + \delta\right)^2} - \rho. \tag{31}$$

To sum up, the next figure depicts the socially optimal market structure, which depends on the values of F and G:

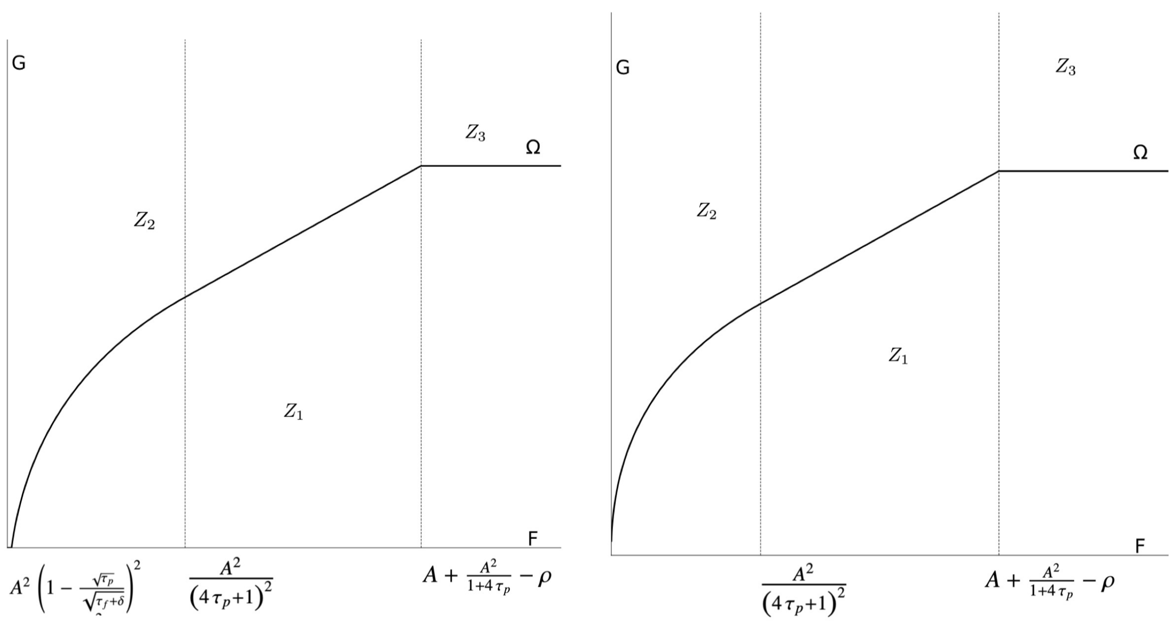

Figure 3: Representation of Ω when $\tau_f + \delta \geq \tau_p$ (left) and when $\tau_f + \delta \leq \tau_p$ (right)

[11] The value of Ω_2 is obtained from setting $N = x = 0$ in equation (54) and solving for $W^{OF} > 0$.

The two panels in Figure 3 exhibit the same three configurations described above. Zone Z_1 corresponds to the parameter configurations where the Central Planner prefers that only the fintech serves the market, which occurs when $G \leq \Omega$. In Zone Z_2, it is socially efficient that only banks provide financial intermediation, which arises when F is sufficiently small or when the fixed costs of banks and of the fintech, F and G, respectively, take intermediate values. Finally, in Zone Z_3, the fixed costs of banks and of the fintech are both so large that the Central Planner prefers that no financial intermediation is provided. The difference between the left and right panels in Figure 3 is that when $\tau_f + \delta \leq \tau_p$ (right panel), there is a range of parameters for which the Central Planner prefers that only the fintech serves the market although banks have a zero or a very small fixed cost F. This is because, in this range of parameters, the social benefit due to the lower specialization costs of the fintech outweighs the benefits banks offer even when the fixed cost of the bank is zero. The fintech is superior as long as its fixed cost is sufficiently low.

3.2 The decentralized equilibrium

In the decentralized equilibrium, financial intermediaries simultaneously determine the degrees of specialization and the interest rates that maximize their individual profits. These, together with the number of intermediaries and the fintech decision to enter the market are the endogenous variables in the system. To determine the decentralized equilibrium, we first solve the equilibrium assuming there are only banks. Next, we allow banks and fintech to coexist. Finally, we determine the conditions under which the market equilibrium with coexistence, with only banks, with only a fintech, or with no financial intermediary prevails, which depend on the range of parameters.

3.2.1 Market equilibrium with only banks

Consider a representative bank i that chooses an interest rate and a degree of specialization that maximize its profits (equation (2)). Bank i's two nearest competitors are located at a distance $\frac{1}{N}$ to the left and to the right in the circle (see Figure 1).[12] We denote by r_i and r_k (θ_i and θ_k) the interest rates (the degrees of specialization) that bank i and one of its nearest banks choose, respectively. An entrepreneur located at x is indifferent between borrowing from bank i or bank k if her utility is the same in the two cases, that is:

$$A\left(1+\sqrt{\theta_i}\right)-\theta_i x-r_i=A\left(1+\sqrt{\theta_k}\right)-\theta_k\left(\frac{1}{N}-x\right)-r_k.$$

Therefore, the location of this indifferent entrepreneur is,

$$x=\frac{A\left(\sqrt{\theta_i}-\sqrt{\theta_k}\right)-r_i+r_k+\theta_k\frac{1}{N}}{\theta_i+\theta_k}. \tag{32}$$

Note that x is half of bank i's total demand. The following Lemma summarizes the solution of the bank's maximization problem:[13]

Lemma 1: The symmetric market equilibrium with only banks follows,

$$\theta_p=\frac{\left(A-\sqrt{F}\right)^2}{4\,\tau_p^2}, \tag{33}$$

$$r_p=\frac{\left(A-\sqrt{F}\right)\left(A+\sqrt{F}\right)}{4\,\tau_p}+\rho, \tag{34}$$

and

$$N=\frac{A-\sqrt{F}}{2\,\tau_p\sqrt{F}}. \tag{35}$$

3.2.2 Market equilibrium with banks and the fintech

We now study the equilibrium when the fintech competes with the banks. In this configuration, banks and fintech choose simultaneously their degrees of specialization, θ_p and θ_f, respectively, together with the interest rates they charge, r_p and r_f, respectively, such that they maximize their profit functions (equations (2) and (3), respectively). The four first-order conditions of this maximization problem together with the zero profit condition for the banks determine the values of the

[12] The principle of maximum differentiation implies that banks would want to locate as further away from their competitors. Hence, in an equilibrium where banks choose locations, they would locate at a distance $\frac{1}{N}$ from each other.

[13] The position of the indifferent entrepreneur x enters when solving the market equilibrium.

five endogenous variables in the system: θ_p, θ_f, r_p, r_f, and N.

Competition with the fintech modifies the location of the indifferent entrepreneur which now becomes,

$$x = \frac{A\left(\sqrt{\theta_p} - \sqrt{\theta_f}\right) + r_f - r_p + \theta_f\,\delta}{\theta_p}. \tag{36}$$

This is because the fintech, located at the center of the Salop's circle, attracts first those entrepreneurs who are located far away from their nearest bank. Thus, banks do not compete directly with each other, but rather with the fintech.

Proposition 2: The market equilibrium with banks and fintech is characterized by:

$$\theta_p = \frac{\left(A - \sqrt{2\,F}\right)^2}{4\,\tau_p^2}, \tag{37}$$

$$\theta_f = \frac{A^2}{4\left(\tau_f + \delta\right)^2}, \tag{38}$$

$$r_p = \frac{A}{4}\,\frac{\left(A - \sqrt{2\,F}\right)}{\tau_p} + \rho, \tag{39}$$

$$r_f = -\frac{\left(A - \sqrt{2\,F}\right)^2}{4\,\tau_p} + \frac{A^2}{4\,(\tau_f + \delta)^2}\,(2\,\tau_f + \delta) + \rho, \tag{40}$$

and

$$N = \frac{\left(A - \sqrt{2\,F}\right)^2\,(\tau_f + \delta)}{2\,\tau_p\left((\tau_f + \delta)\left(A - \sqrt{2\,F}\right)\left(2\sqrt{2\,F} - A\right) + A^2\,\tau_p\right)}. \tag{41}$$

Proof: See the internet appendix.

The equations above show that the optimal degree of specialization and interest rate chosen by banks (θ_p and r_p, respectively), as well as the equilibrium number of banks N, all decline with the bank's fixed cost F and with the bank's marginal cost of financial specialization τ_p. Finally, the degree of specialization for the fintech, θ_f, decreases with its marginal cost of financial specialization τ_f.

3.3 Analysis of the market equilibrium

The following proposition summarizes the conditions that determine whether the market equilibrium involves coexistence, banks only, fintech only, or no financial intermediation.

Proposition 3: Depending on the values of F, G, τ_p and $\tau_f + \delta$, the following equilibrium market structure arises

$$\left\{ \begin{array}{lll} \textbf{Only banks} & c = 0 \text{ and } N > 1 & \text{if } F \leq UB_b \text{ and } G > \Gamma \\ \textbf{Coexistence} & c = 1 \text{ and } N > 1 & \text{if } F \leq \min\{UB_a, UB_b\} \text{ and } G \leq \Gamma \\ \textbf{Only fintech} & c = 1 \text{ and } N = 0 & \text{if } F > \min\{UB_a, UB_b\} \text{ and } G \leq \Gamma \\ \textbf{No intermediation} & c = 0 \text{ and } N = 0 & \text{if } F > UB_b \text{ and } G > \Gamma \end{array} \right\}$$

where

$$\begin{aligned} UB_a &= \frac{1}{2}\frac{A^2}{(1+4\,\tau_p)^2}\left(1+3\,\tau_p-\tau_p\,\sqrt{1+\frac{2+8\,\tau_p}{\tau_f+\delta}}\right)^2, \\ UB_b &= \frac{A^2}{(2\tau_p+1)^2}, \end{aligned}$$

$$\Gamma = \left\{ \begin{array}{l} 0 \quad if \quad F < \frac{A^2}{2}\left(1-\frac{\sqrt{\tau_p}}{\sqrt{\tau_f+\delta}}\right)^2 = LB \\ \Gamma_{s1} \quad if \quad \frac{A^2}{2}\left(1-\frac{\sqrt{\tau_p}}{\sqrt{\tau_f+\delta}}\right)^2 < F < \frac{1}{2}\frac{A^2}{(1+4\,\tau_p)^2}\left(1+3\,\tau_p-\tau_p\,\sqrt{1+\frac{2+8\,\tau_p}{\tau_f+\delta}}\right)^2 \\ \Gamma_{s2} \quad if \quad F \geq \frac{1}{2}\frac{A^2}{(1+4\,\tau_p)^2}\left(1+3\,\tau_p-\tau_p\,\sqrt{1+\frac{2+8\,\tau_p}{\tau_f+\delta}}\right)^2 \end{array} \right\} \tag{42}$$

when $\tau_f + \delta \geq \tau_p$ or

$$\Gamma = \left\{ \begin{array}{l} \Gamma_{s1} \quad if \quad F < \frac{1}{2}\frac{A^2}{(1+4\,\tau_p)^2}\left(1+3\,\tau_p-\tau_p\,\sqrt{1+\frac{2+8\,\tau_p}{\tau_f+\delta}}\right)^2 \\ \Gamma_{s2} \quad if \quad F \geq \frac{1}{2}\frac{A^2}{(1+4\,\tau_p)^2}\left(1+3\,\tau_p-\tau_p\,\sqrt{1+\frac{2+8\,\tau_p}{\tau_f+\delta}}\right)^2 \end{array} \right\} \tag{43}$$

when $\tau_f + \delta < \tau_p$, with

$$\Gamma_{s1} = \frac{\left(-(\tau_f+\delta)\left(A-\sqrt{2\,F}\right)^2 + A^2\,\tau_p\right)^2}{4\,(\tau_f+\delta)\,\tau_p\left((\tau_f+\delta)\left(A-\sqrt{2\,F}\right)\left(2\,\sqrt{2\,F}-A\right)+A^2\,\tau_p\right)}, \tag{44}$$

and

$$\Gamma_{s2} = \min(\rho + F, A) + \frac{A^2}{4\left(\tau_f + \delta\right)^2} - \rho. \tag{45}$$

Proof: See the internet appendix.

Proposition 4 determines a decision rule that depends on the fintech's and the banks' fixed costs, G and F, respectively. Precisely, it states that whenever the fixed cost of the fintech is sufficiently small, which occurs when $G \leq \Gamma$, the fintech serves the market in combination with banks (which occurs when F is sufficiently small) or alternatively, it is the only financial intermediary lending to entrepreneurs. On the contrary, when $G > \Gamma$, if F is sufficiently small, only banks lend to entrepreneurs. Otherwise, there is no financial intermediation at all in equilibrium. Figure 4 represents the different areas that characterize the equilibrium market structure depending on the values of F and G.

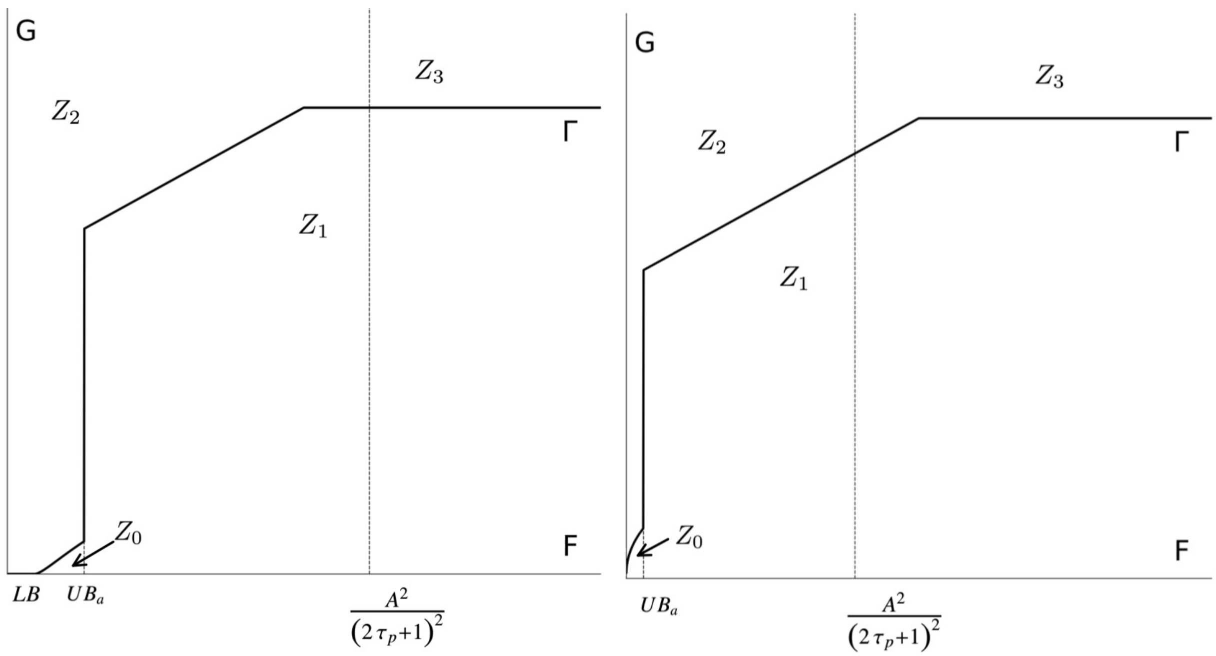

Figure 4: Representation of Γ when $\tau_f + \delta \geq \tau_p$ (left) and when $\tau_f + \delta \leq \tau_p$ (right)

To characterize the conditions under which the market equilibrium shows coexistence, only banks, only a fintech, or no financial intermediation, we start by examining the level of F above which the fintech has some demand. Precisely, for the fintech to have some income, we need the position of the indifferent entrepreneur to be $x < \frac{1}{2N}$. Otherwise, the entrepreneur would never borrow from the fintech and the fintech would have no demand. Relying on equations (36) and (41), the fintech's income is non-negative provided

$$F > \frac{A^2}{2}\left(1 - \frac{\sqrt{\tau_p}}{\sqrt{\tau_f + \delta}}\right)^2. \tag{46}$$

When this condition is not satisfied, there are so many banks that the fintech has no demand and does not enter the market. Note that this limit on F occurs only when the specialization cost of the banks is smaller than the fintech's specialization cost ($\tau_f + \delta \geq \tau_p$, left panel in Figure 4).

In Zone Z_0, both banks and fintech coexist in equilibrium. This coexistence arises due to banks' and fintech's fixed costs falling within intermediate ranges which allow them to earn non-negative profits. This holds true regardless of the specialization costs, τ_p and τ_f. In Zone Z_1, where $F > \min\{UB_a, UB_b\}$ (depending on the configuration of parameters), the fintech stands as the sole intermediary serving entrepreneurs. However, the fintech cannot set a monopolistic interest rate because doing so would trigger the entry of banks. Consequently, it chooses an interest rate equal to

$$r_f = \min\left(\rho + F; A\right) + \frac{A^2}{4\left(\tau_f + \delta\right)^2}\left(2\,\tau_f + \delta\right), \tag{47}$$

the maximum r_f that prevents banks from entering and that is accepted by the entrepreneurs. The interest rate in equation (47) modifies the fintech's decision rule as stated in Γ_{s2}. In Zone Z_2, which occurs when $F \leq \min\{UB_a, UB_b\}$ and $G > \Gamma$, the fintech's fixed cost is so substantial that it prevents the generation of profits. In contrast, the banks' fixed costs are modest enough to allow them to capture the entire market. Finally, in Zone Z_3, when F and G are sufficiently large, there is no financial intermediary in equilibrium and the entrepreneurs' utility is zero (as they lack the resources to undertake the project).

4 Market equilibrium vs. equilibrium with only banks

We now compare the market equilibrium with the current regulatory framework. In the next section, we compare the market equilibrium (including banks and the fintech) with the socially optimal market structure. Currently, the consensus view is that fintechs should not operate as banks. This is typically executed by not allowing fintechs to take deposits or by asking for a banking license to operate (for details, refer to Table A1 in the appendix). An analogy with the retail market may provide intuition. In the retail market, multiple shops (for instance, mom-and-pop stores, 7-Eleven's, supermarkets) compete with online retailing. If we were to apply banking regulations to the retail industry, it would be tantamount to prohibiting online retailing. This does not make sense, especially when considering remote areas that would not have access to traditional retail services. For instance, banning online retail in Wyoming would result in non-served customers due to its low population density. Why wouldn't a similar rationale apply to financial services?

What does our model say about this trade-off? Figure 5 is a 3D plot of the welfare differential between the market equilibrium and the market solution we obtain when only banks operate in the system.

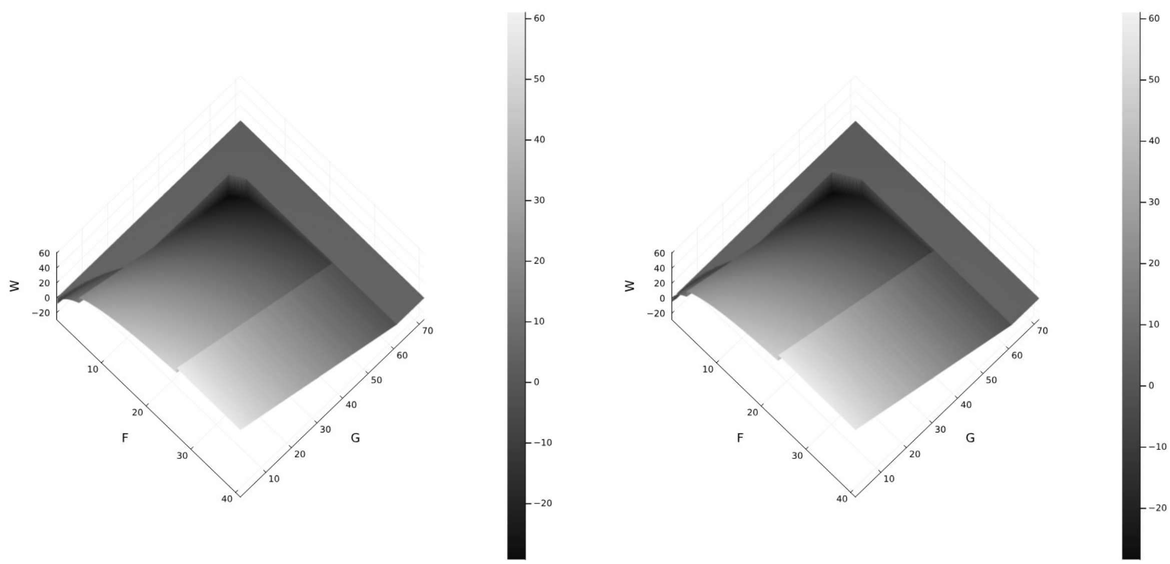

Figure 5: Welfare differential between the decentralized market equilibrium and the market solution with only banks when $\tau_f + \delta \geq \tau_p$ (left) and when $\tau_f + \delta \leq \tau_p$ (right)

To interpret Figure 5, we start by mapping its areas with the zones we described in Figure 4. To begin with, Z_0 in Figure 4 corresponds to the dark grey triangle in the lower left corner. Second, Z_1 in Figure 4 is the increasing surface in Figure 5, whereas Z_2 in Figure 4 is the area starting to the north-east of the dark grey triangle and extending as an L over the region where the welfare difference is zero. Finally, Z_3 in Figure 4 is the remaining area characterized by a zero difference where both F and G are too high.

Figure 5 shows what we expect: in regions where banks do not operate (characterized by high F), allowing fintechs increases welfare (which corresponds to the increasing surface in Figure 5). Moreover, welfare increases more, the smaller the fintech's fixed cost. The intuition is that remote regions are equally served by fintechs but they are very unreachable for traditional banks. The conclusion is straightforward: not allowing fintechs to operate in this region reduces welfare. It is interesting to draw a connection between this result and Lin and Wu (2015), who, in the context of a Salop model with heterogeneous production costs, demonstrate that a greater variance in production costs (assuming the average production cost remains constant) enhances consumer surplus and, as a result, can lead to higher social welfare.

Notice, however, that there are two regions where introducing the fintech reduces welfare. These are the dark gray areas in the upper left and lower left corners. We begin with the upper left corner. When the fintech is permitted to operate, we know from Proposition 2 that in equilibrium, banks choose a lower interest rate and a lower degree of specialization. This is the optimal response of banks to their lower market share. The decrease in market share prompts some banks to exit, resulting in a welfare loss for the beneficiaries of specialization. Naturally, customers on the periphery who switch to the fintech benefit. Therefore, there exists a trade-off between the gains of some customers and the losses of others, along with the costs of providing the service In this region, the emergence of fintech results in a significant decline in bank participation. In fact, following the introduction of competition, no banks remain. In this scenario, the loss of specialization for some customers outweighs the gains for fringe customers. The lower left region, where there is also a loss of welfare, follows the same logic, except that in the market equilibrium, both banks and fintech coexist after competition is allowed. The intuition behind this result is paradoxical: increased competition in equilibrium paradoxically leads to less competition.

To sum up, Figure 5 underlines that there are underserved regions where allowing the fintech to intermediate increases welfare. On the other extreme, there is a region where the comparative advantage of the banks is clear and there would be no entry of the fintech, so the additional competition entails no change in welfare (this is the area extending as an L where the welfare difference is zero). Finally, there are the two regions we just described where introducing a fintech is welfare decreasing.

There is ample consensus on the benefits of digital banks, and no one seems to argue against them. In our model, a digital bank operates virtually as a fintech. However, there is almost equally unanimous agreement to ban large fintechs or big techs from financial intermediation. We find this distinction, curious, to say the least. As we see above, there are regions where there is no argument (at least in terms of the services provided to clients) for not allowing the non-banking institutions to intermediate. Of course, there are solvency or liquidity risks, which have financial stability implications. In the case of big techs, however, the argument for such concerns may be weaker (Mercado Libre's assets are larger than those of the whole financial sector). The fact that there is no opposition to digital banks but there is to digital non-banking intermediaries seems to suggest that the regulatory outcome may be sensitive to other considerations rather than an attempt to increase efficiency.

5 Social optimum vs. the decentralized equilibrium

We now compare the market equilibrium with the Central Planner solution in two dimensions. On the one hand, in terms of the degree of specialization that banks and fintech choose in equilibrium relative to the socially optimal level, as well as the implied number of banks. On the other hand, we examine the optimal allocation in the decentralized equilibrium relative to the social optimum.

Starting with the degree of specialization, the Central Planner chooses a larger degree of specialization for banks, compared to the one that banks select in equilibrium (equations (10) and (37)). Indeed, the degree of specialization in the market equilibrium, θ_p^M, falls short, relative to the socially optimal level, θ_p^P, as depicted in Figure 6. Intuitively, the economic rents arising from the market power of banks and fintech foster entry beyond what the Central Planner would like. Indeed, in the region with only banks, the market delivers twice as many banks compared to what the Planner would choose. In contrast, the Planner prefers a smaller number of banks, with each bank covering a larger portion of the circle, and a higher degree of specialization.

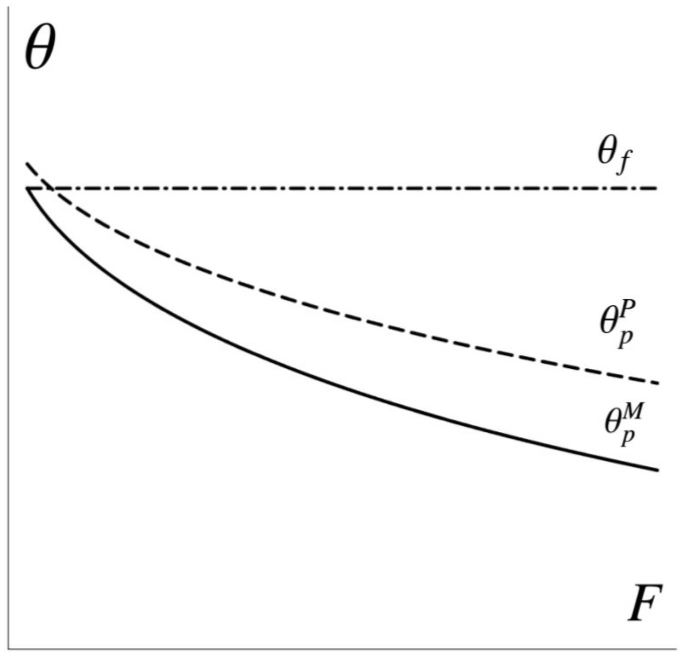

Figure 6: Specialization by banks θ_p^M, fintech θ_f and Central Planner θ_p^P.

We now compare the Central Planner and the market equilibrium solutions with the aid of Figure 7. The figure shows two panels. In the left panel, banks are relatively more efficient; in the right one, they are not. The parameters are chosen to illustrate the richness of cases that our specification allows. Below, we will pivot from this benchmark to analyze how optimal regulatory rules change as we move the relative efficiency of banks and fintech.

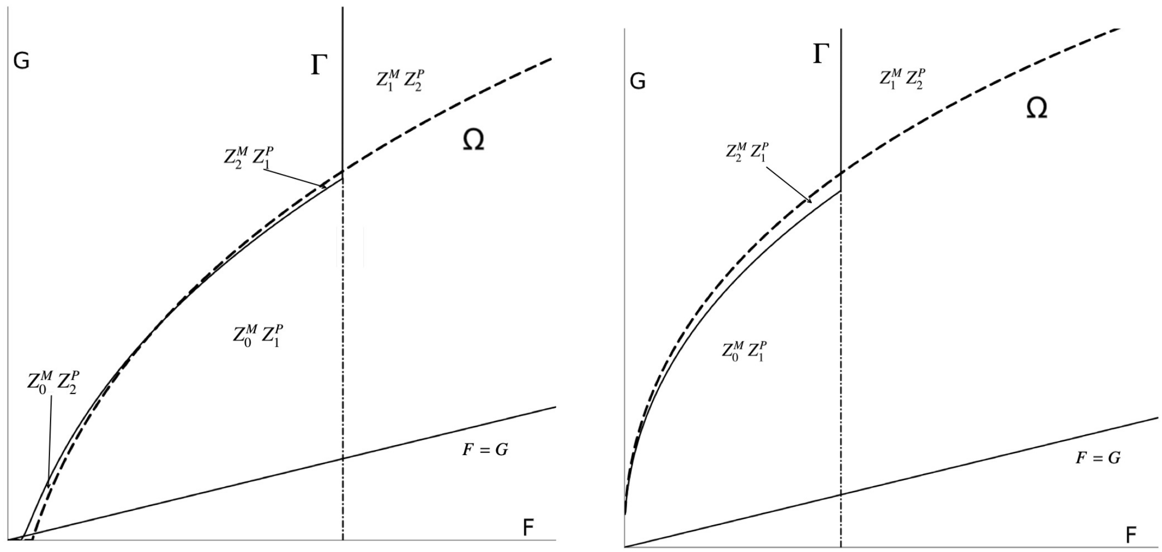

Figure 7: Comparing the Central Planner and the Market Equilibrium solutions when $\tau_f + \delta \geq \tau_p$ (left) and when $\tau_f + \delta \leq \tau_p$ (right)

The panels display two curves and one line. The dashed curve (curve Ω) represents the Central Planner's choice. It is important to recall that the Central Planner's solution is dichotomous: it selects to serve the market either exclusively with banks or exclusively with fintech. The solid curve (curve Γ) represents the decentralized market equilibrium. Additionally, the graph features one vertical dashed line. This line denotes the frontier for banks in the market equilibrium. To the right of this line, the market solely operates with the fintech. To the left of it, there is coexistence below the solid line, and only banks operate above that line.

The Figure exhibits large areas where the market equilibrium and the Central Planner's solutions coincide.[14] Above the upper envelope of the dashed and solid lines, the market and the Central Planner prefer an outcome where only banks (on the perimeter of the circle) provide financial services. This is a region where, relative to the specialization abilities of each type of provider, fixed costs of fintechs relative to banks appear large. Moreover, when the fixed costs of banks are relatively higher than those of the fintech, the market equilibrium involves only fintech and this is also the preference for the Central Planner (region to the right of the vertical line in Figure 7).

[14]The market equilibrium and the Central Planner's choice coincide in terms of the market configuration. However, they may not coincide in terms of the values of endogenous variables, such as the number of banks and their degree of specialization.

Of course, the region where the fintech is preferred depends on its relative efficiency. If τ_f decreases, both curves shift to the left. For example, Figure 8 (assuming $\tau_f = 0.29$) illustrates that, while keeping the axes for the G and F parameters constant, the region where both the market and the Central Planner operate exclusively with fintech expands.

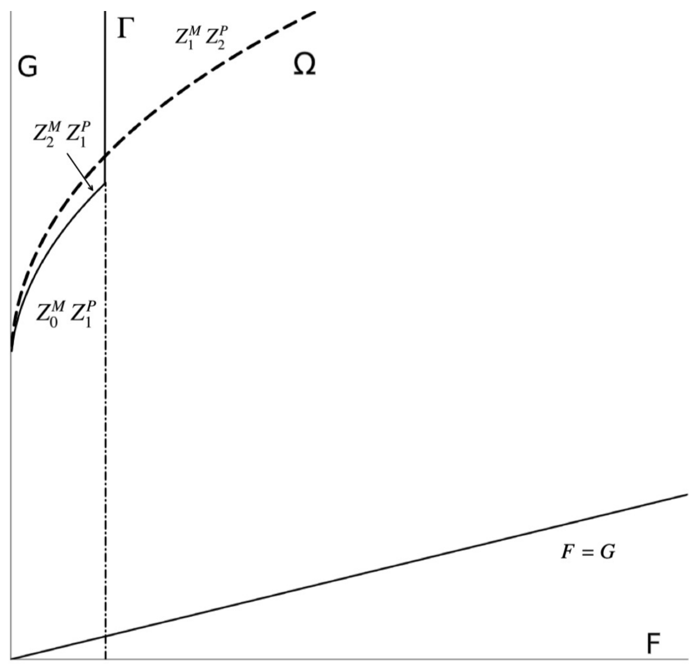

Figure 8: Comparing the Central Planner and the Market Equilibrium solutions when $\tau_p \geq \tau_f + \delta$

Conversely, when banks become more efficient, the Planner prefers to rely mostly on banks, causing the curves to shift to the right, as demonstrated in Figure 9.

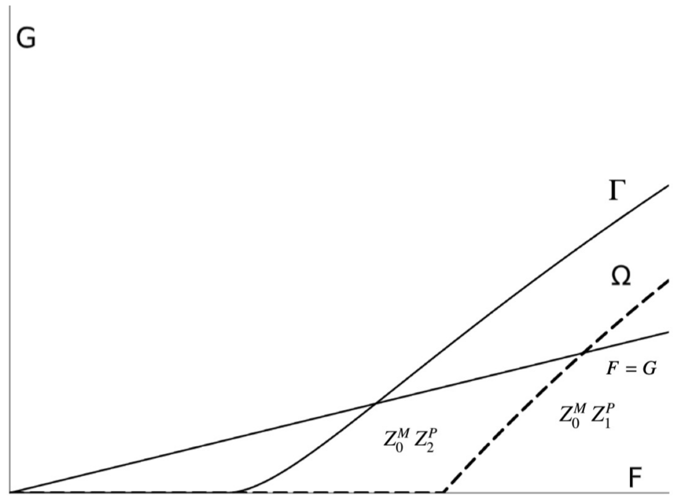

Figure 9: Comparing the Central Planner and the Market Equilibrium solutions when $\tau_p \leq \tau_f + \delta$

However, there are also areas in which there is a divergence between the market equilibrium and the Social Planner's choice. We now focus on these cases. Figure 7 depicts four areas of market inefficiencies. In region $Z_0^M Z_2^P$, the Planner prefers a financial sector with only banks, while there is coexistence in the decentralized equilibrium. The mirror image is region $Z_0^M Z_1^P$ where the Planner prefers to operate through the fintech. In turn, in region $Z_2^M Z_1^P$, the Planner prefers the fintech, while the market operates through banks. Finally, region $Z_1^M Z_2^P$ is such that the market operates with the fintech whereas the Planner prefers only banks.

In what follows, we provide some intuition for each of these cases. Starting with the area $Z_1^M Z_2^P$, the irruption of the fintech drives out banks from the market because it limits the gains from specialization to a point that does not allow banks to pay their (high) fixed cost. However, the Planner would prefer a situation with only banks (although not as many as in the decentralized equilibrium) and more gains from specialization. This is the mirror image of the welfare loss from the irruption of the fintech that we discussed in the previous section.

In region $Z_2^M Z_1^P$, the opposite occurs. With lower fixed costs for the fintech, the Central Planner eventually crosses the tipping point where it prefers the fintech. However, in the market equilibrium, banks are the only financial intermediaries. Notice that the smaller fixed costs of banks and fintech (relative to region $Z_1^M Z_2^P$) have two implications for welfare. On the one hand, banks become more attractive (they cost a lower fixed cost). On the other hand, lower fixed costs foster more entry (remember entry is above the optimal level chosen by the Planner). When fixed costs of banks are low (as in region $Z_0^M Z_2^P$), the first effect prevails as indicated by the fact that even with a zero fixed cost for the fintech, the optimal choice for the Planner implies operating only with banks. However, when F is larger, such as in region $Z_2^M Z_1^P$, the gains from specialization are smaller and are not worth the extra fixed costs of banks. Therefore, the Central Planner prefers that only the fintech provides financial intermediation.

In the large region $Z_0^M Z_1^P$, the Central Planner would prefer to forbid banks from lending. The reason for this is that their fixed costs are large. In the decentralized equilibrium, banks can support these fixed costs with rents, but the gains from specialization that they provide do not justify these fixed costs (remember that the specialization provided by banks declines with the fixed cost). Now, the regulatory implication is the opposite: regulators should not allow banks to operate and should trust the full brunt of financial intermediation to fintechs.

Our results imply that under certain parameter configurations, the market equilibrium exhibits too much entry, relative to the social optimum. This result is similar to Salop (1979), who shows that under free entry, the market equilibrium implies the overprovision of varieties. The reason why this happens is that when a new firm enters the market, it creates a negative externality on its competitors, who see their market share (and profits) shrink (business-stealing). The same logic applies to our model and is exacerbated when the fintech enters the market, as the business-stealing effect impacts all the banks in the perimeter at the same time.

Guo and Lai (2017) analyze competition between heterogeneous brick-and-mortar retailers and an online retailer when consumers are non-uniformly distributed. They show that, when the online retailer enters the market, brick-and-mortar retailers move to the most densely populated areas, while rural areas are served only by the online retailer. Our model provides a complementary explanation: rural areas would be only served by the fintech (or big tech) as long as banks' fixed costs in such areas are sufficiently high.

Finally, the right-hand panel of Figure 7 assumes that the fintech is relatively more efficient.

This panel highlights three regions of discrepancies. The region where the Central Planner prefers banks to manage the lending business but the fintech actually enters the market disappears in this configuration (Zone $Z_0^M Z_2^P$ in the left panel), as banks can competitively outperform the fintech in that region. The remaining three regions are the ones we have already discussed.

6 Linking commercial borrowers' heterogeneity with the model results

We now connect the market inefficiencies we describe in the previous section with the type of commercial borrowers in the financial market. The aim of the analysis is to highlight what are the implications of our model for the competition between banks, on the one hand, and fintechs, and big tech companies, on the other hand.

To begin with, we can reasonably argue that banks hold an advantage in tailoring their products to large firms, while smaller firms may be better served by fintechs and big techs. Big tech companies, in particular, possess detailed knowledge of small businesses' daily sales through retail platforms and have a deeper understanding of clients compared to traditional banks, thanks to their superior data analytical algorithms and processing technologies (He et al., 2023). Connecting this characterization with the model's parameters involves considering the fixed and variable costs of banking and non-banking institutions. In our model, we argue that fintechs have an advantage in serving small businesses by assuming that they have smaller fixed and variable costs compared to banks.

When the fixed costs of banks are considerably higher than those of the fintech, we know from Section 5 that the market equilibrium and the Central Planner's solution coincide, resulting in no market inefficiency. However, when the positive difference between the fixed costs of banks and those of the fintech is not so large, market inefficiencies (that is, discrepancies between the market equilibrium and the Central Planner solution) arise. These correspond to regions $Z_0^M Z_1^P$ and $Z_2^M Z_1^P$ in Figure 7. Indeed, in the area $Z_0^M Z_1^P$, the Planner prefers a financial sector with only the fintech, while there is coexistence in the decentralized equilibrium. In turn, in region $Z_2^M Z_1^P$, the Planner prefers the fintech, while the market operates through banks. This is regardless whether we assume that the fintech is more efficient or less efficient than banks in terms of variable costs (as depicted in the right and left panels of Figure 7, respectively).

In this market configuration, the reason for the Central Planner's preference against the banks lies on their excessive fixed costs (compared to those of the fintech) from a social standpoint. As the model shows, since the degree of specialization decreases with the fixed costs, the social benefits of specialization that banks could offer do not compensate their (higher) total fixed costs. Consequently, the Planner should opt to entrust full financial intermediation to fintechs, resulting in welfare gains for small and medium-sized firms.[15] Whether these borrowers were underserved initially or not served at all by the fintech (areas of the market equilibrium Z_0^M or Z_2^M, respectively, in Figure 7) depends on the jurisdiction under consideration, remaining an empirical question.

Conversely, banks tend to dominate large business financing, as their expertise remains unchallenged by newcomers, whether fintechs or big tech companies. Revisiting this reality in light of our model summarized in Figure 7, this corresponds to the area above the upper envelope of the dashed and solid lines, where both the market and the Central Planner prefer that only banks provide financial services. Intuitively, in this region, the fixed costs of banks appear smaller compared to those of the fintech. As a result, the Planner should favor banks to lend to this type of borrowers, as is commonly observed in financial markets.

To summarize, the discussion underscores significant differences in the social benefits of specialization between large firms and small or micro-businesses. We conclude that much of the excitement surrounding fintechs and big techs is concentrated in the retail sector, where traditional banks face disadvantages. According to our model, in this context, financial intermediation should be expanded to include these non-banking institutions, potentially leading to significant welfare gains. Small and medium-sized firms are likely to benefit from this expansion.

[15] Of course, in this analysis, we do not consider the *ex-post* consequences of allowing the fintech to be the only financial intermediary. This is out of the scope of this paper.

7 Generalizing our results

The aim of this section is to demonstrate that our main qualitative findings presented in Propositions 1 and 3 remain robust when we assume a generic function for the returns of the investment project of the entrepreneurs. Specifically, we now suppose that the utility of entrepreneur j when borrowing from financial intermediary i is given by the function

$$H_{ji} = V(\theta_i) - r_i - \theta_i x_{ij},$$

where $V(\cdot)$ represents a generic return function for the project. This function must satisfy strict positivity, strict monotonicity, and strict concavity, ensuring that $V' > 0$ and $V'' < 0$. We maintain all other assumptions from Section (3).

Section A1.1 in the appendix provides a detailed proof of this analysis. Here, we discuss the main conclusions. Starting with the Central Planner problem, we show that with the generic return function $V(\cdot)$, the Social Planner's optimal solution never involves coexistence between banks and the fintech. This is because the endogenous variables $\hat{x}$, θ_p and θ_f are independent of the number of banks N. Consequently, the total surplus under coexistence, W^{CO}, is linear in N, and the socially optimal structure remains dichotomous, as shown when assuming a specific return function from undertaking the investment project (equation (1)).

In contrast, in the market equilibrium, we continue to find that the coexistence of banks and the fintech is a possible optimal solution. This is because the Nash equilibrium of this sub-game depends on N – the derivatives of θ_p, r_p and r_f with respect to N are not zero. Therefore, we conclude that assuming a specific function for the return function as in equation (1) is without loss of generality and that our quality results remain robust, provided the generic function $V(\cdot)$ is strict positive, strictly monotone, and strict concave.

8 Conclusions

In recent years, the banking sector has faced intensified competition from digital banks, fintechs, and big tech companies, sparking debates on banking regulation. The central question revolves around whether non-banking institutions should be permitted to engage in deposit-taking and lending activities, or if such activities should be reserved solely for traditional banks. Regulatory responses vary globally, with some countries restricting financial intermediation to banks and others adopting more open approaches, such as granting fintechs banking licenses.

This paper presents a framework for discussing optimal regulation within this competitive landscape. It establishes a model where financial intermediaries offer differentiated products, with traditional banks positioned symmetrically around a Salop circle. A key innovation is the inclusion of a fintech equidistant from all clients. The model considers fixed costs and market equilibrium deviations from the social optimum, driven by downward-sloping demand curves, leading to excessive entry by traditional banks and lower specialization levels.

The study reveals parameters where the Central Planner favors excluding either non-bank intermediaries or banks. It identifies regions where traditional banks' high fixed costs result in underserved markets, potentially benefiting from fintech participation. While the model focuses on welfare gains from new competition, it aligns with industry competition patterns, showing fintechs' potential in areas where specialization is less relevant, such as small business and retail sectors.

Indeed, these distinct parameter combinations serve as proxies for the diverse regulatory and institutional frameworks observed across different countries. It also provides insights into why there has been more tension in some dimensions of financial market competition between banks and fintechs and not in others. Finally, the paper challenges traditional arguments for excluding non-bank intermediaries, emphasizing the need for empirical evidence to support such claims, especially given the success of big tech companies like Mercado Libre operating in the financial sector.

References

Tania Babina, Greg Buchak, and Will Gornall. Customer data access and fintech entry: Early evidence from open banking. 2022.

Tobias Berg, Andreas Fuster, and Manju Puri. Fintech lending. *Annual Review of Financial Economics*, 14:187–207, 2022.

Patrick Bolton, Xavier Freixas, and Joel Shapiro. Conflicts of interest, information provision, and competition in the financial services industry. *Journal of Financial Economics*, 85(2):297–330, 2007.

Jan Bouckaert. Monopolistic competition with a mail order business. *Economics Letters*, 66(3): 303–310, 2000.

Greg Buchak, Gregor Matvos, Tomasz Piskorski, and Amit Seru. Fintech, regulatory arbitrage, and the rise of shadow banks. *Journal of financial economics*, 130(3):453–483, 2018.

Agustín Carstens, Stijn Claessens, Fernando Restoy, and Hyun Song Shin. Regulating big techs in finance. *Hyun Song, Regulating Big Techs in Finance (August 2, 2021)*, 2021.

Douglas W Diamond and Philip H Dybvig. Banking theory, deposit insurance, and bank regulation. *The journal of business*, 59(1):55–68, 1986.

Kevin Dowd. Why financial intermediaries exist. chapter 4, pages 114–120. Palgrave Macmillan, 1996. URL `https://EconPapers.repec.org/RePEc:pal:palchp:978-1-349-24856-8_4`.

Johannes Ehrentraud, Denise Garcia Ocampo, and Camila Quevedo Vega. *Regulating fintech financing: digital banks and fintech platforms*. Bank for International Settlements, Financial Stability Institute, 2020.

Johannes Ehrentraud, Jamie Lloyd Evans, Amélie Monteil, and Fernando Restoy. *Big tech regulation: in search of a new framework*. Financial Stability Institute, Bank for International Settlements, 2022.

Xavier Freixas and Jean-Charles Rochet. *Microeconomics of banking*. MIT press, 2008.

Xavier Freixas, Bruno M Parigi, and Jean-Charles Rochet. Systemic risk, interbank relations, and liquidity provision by the central bank. *Journal of money, credit and banking*, pages 611–638, 2000.

Andreas Fuster, Matthew Plosser, Philipp Schnabl, and James Vickery. The role of technology in mortgage lending. *The Review of Financial Studies*, 32(5):1854–1899, 2019.

Itay Goldstein and Ady Pauzner. Demand–deposit contracts and the probability of bank runs. *the Journal of Finance*, 60(3):1293–1327, 2005.

Manasa Gopal and Philipp Schnabl. The rise of finance companies and fintech lenders in small business lending. *The Review of Financial Studies*, 35(11):4859–4901, 2022.

Gary Gorton and Andrew Winton. Chapter 8 - financial intermediation. In George M. Constantinides, Milton Harris, and René M. Stulz, editors, *Corporate Finance*, volume 1 of *Handbook of the Economics of Finance*, pages 431–552. Elsevier, 2003. doi: https://doi.org/10.1016/S1574-0102(03)01012-4. URL `https://www.sciencedirect.com/science/article/pii/S1574010203010124`.

Wen-Chung Guo and Fu-Chuan Lai. Prices, Locations and Welfare when an Online Retailer Competes with Heterogeneous Brick-And-Mortar Retailers. *The Journal of Industrial Economics*, 65(2):439–468, 2017.

Zhiguo He, Jing Huang, and Jidong Zhou. Open banking: Credit market competition when borrowers own the data. *Journal of financial economics*, 147(2):449–474, 2023.

Martin F. Hellwig. Financial Intermediation with Risk Aversion. *Review of Economic Studies*, 67 (4):719–742, 2000.

Mei Lin and Ruhai Wu. Production cost heterogeneity in the circular city model. *Operations research letters*, 43(4):401–404, 2015.

Lei Liu, Guangli Lu, and Wei Xiong. The big tech lending model. Technical report, National Bureau of Economic Research, 2022.

Paul Madden and Mario Pezzino. Oligopoly on a Salop Circle with Centre. *The B.E. Journal of Economic Analysis & Policy*, 11(1):1–30, 2011.

Christine A Parlour, Uday Rajan, and Haoxiang Zhu. When fintech competes for payment flows. *The Review of Financial Studies*, 35(11):4985–5024, 2022.

Steven C. Salop. Monopolistic Competition with Outside Goods. *Bell Journal of Economics*, 10 (1):141–156, 1979.

Ernesto Schargrodsky and Federico Sturzenegger. Banking regulation and competition with product differentiation. *Journal of Development Economics*, 63(1):85–111, 2000.

Xavier Vives. Digital disruption in banking. *Annual Review of Financial Economics*, 11:243–272, 2019.

Xavier Vives and Zhiqiang Ye. Information technology and bank competition. 2021.

Raihan Zamil and Aidan Lawson. *Gatekeeping the Gatekeepers: when Big Techs and Fintechs Own Banks: Benefits, Risks and Policy Options*. Bank for International Settlements, Financial Stability Institute, 2022.

Luigi Zingales et al. *Regulating big tech*. Bank for International Settlements, Monetary and Economic Department, 2022.

A1 Appendix

A1.1 Proof of the analysis in Section 7

In this section, we show that the qualitative results obtained in previous sections do not change when we assume a more general function for the returns of the investment project. In particular, we assume that entrepreneur j's utility when she borrows from financial intermediary i is

$$H_{ji} = V(\theta_i) - r_i - \theta_i x_{ij},$$

where $V(\cdot)$ is the return of the project. We assume that the function V is strictly positive, strictly increasing and strictly concave, so that $V' > 0$ and $V'' < 0$.[16] We maintain all the remaining assumptions.

A1.1.1 Centralized Economy

To begin with, we show that with a generic return function, the Social Planner's optimal structure never involves coexistence between banks and fintech.

We start by defining consumer and producer surpluses when banks and fintech coexist in the market. Similar to Section 3, we define $\hat{x}$ as the entrepreneur who is indifferent between borrowing from the bank and the fintech. Consumer and producer surpluses are then defined as:

$$CS_p^{CO} = 2\,N \int_0^{\hat{x}} [V(\theta_p) - r_p - \theta_p\, x]\, dx = 2N\left((V(\theta_p) - r_p)\hat{x} - \theta_p \frac{\hat{x}^2}{2}\right). \tag{48}$$

$$PS_p^{CO} = 2\,N\,(r_p - \tau_p\,\theta_p - \rho)\,\hat{x} - N\,F \tag{49}$$

$$CS_f = 2\,N \int_{\hat{x}}^{\frac{1}{2N}} \left(V(\theta_f) - r_f - \theta_f\,\delta\right)\, dx \;= V(\theta_f) - r_f - \theta_f\,\delta - 2\,N\left[V(\theta_f) - r_f - \theta_f\,\delta\right]\hat{x} \tag{50}$$

[16]For the specification in Section 3, $V(\theta) = A\left(1 + \sqrt{\theta}\right)$.

$$PS_f = 2\,N\,(r_f - \tau_f\,\theta_f - \rho)\left(\frac{1}{2\,N} - \hat{x}\right) - G \tag{51}$$

Combining equations (48) and (49), we obtain that total surplus generated by banks is

$$2\,N\,\hat{x}\left[V(\theta_p) - \tau_p\,\theta_p - \rho\right] - N\,\left(\theta_p\,\hat{x}^2 + F\right) \tag{52}$$

Combining equation (50) with (51), we obtain that the surplus generated by the fintech is

$$V(\theta_f) - \theta_f\,(\delta + \tau_f) - \rho - 2\,N\,\left[V(\theta_f) - \theta_f\,(\tau_f + \delta) - \rho\right]\,\hat{x} - G \tag{53}$$

Therefore, total surplus under coexistence is the sum of (52) and (53):

$$W^{CO} = V(\theta_f) - \theta_f\,(\tau_f + \delta) + 2\,N\left((V(\theta_p) - V(\theta_f) - \tau_p\,\theta_p + \tau_f\,\theta_f + \theta_f\,\delta)\,\hat{x} - \theta_p\,\frac{\hat{x}^2}{2}\right) - N\,F - G - \rho \tag{54}$$

From equation (54), it becomes clear that, if the endogenous variables $\hat{x}$, θ_p and θ_f are independent of the number of banks N, W^{CO} is linear in N, just as when assuming a specific function for the returns of the investment project (equation 1). We show in what follows that this is the case.

The Social Planner chooses $\hat{x}$, θ_p and θ_f to maximize W^{CO}. We then obtain the first order conditions as:

$$\frac{\partial W^{CO}}{\partial \hat{x}} = V(\theta_p) - V(\theta_f) - \tau_p\,\theta_p + \tau_f\,\theta_f + \theta_f\,\delta - \theta_p\,\hat{x} = 0, \tag{55}$$

$$\frac{\partial W^{CO}}{\partial \theta_p} = 2N\left[(V'(\theta_p) - \tau_p)\hat{x} - \frac{\hat{x}}{2}\right] = 0, \tag{56}$$

$$\frac{\partial W^{CO}}{\partial \theta_f} = (1 - 2N\hat{x})\left[V'(\theta_f) - (\tau_f + \delta)\right] = 0. \tag{57}$$

Under coexistence, we have that $N > 0$ and $\hat{x} < \frac{1}{2N}$, so the first order conditions can be rewritten as

$$\frac{\partial W^{CO}}{\partial \hat{x}} = V(\theta_p) - V(\theta_f) - \tau_p\,\theta_p + \tau_f\,\theta_f + \theta_f\,\delta - \theta_p\,\hat{x} = 0, \tag{58}$$

$$\frac{\partial W^{CO}}{\partial \theta_p} = (V'(\theta_p) - \tau_p)\hat{x} - \frac{\hat{x}}{2} = 0, \tag{59}$$

$$\frac{\partial W^{CO}}{\partial \theta_f} = V'(\theta_f) - (\tau_f + \delta) = 0. \tag{60}$$

We see that the three conditions are independent of N and, therefore, so are the three endogenous variables. Hence, social welfare under coexistence is linear in N and the socially optimal structure is dichotomic.

A1.1.2 Market Equilibrium

In the market equilibrium under coexistence, banks and the fintech choose their interest rates and degree of specialization to maximize their profits, π_p and π_f defined as in Section 3:

$$\pi_p = 2\,(r_p - \tau_p\,\theta_p - \rho)\,\hat{x}(\theta_p, \theta_f, r_p, r_f) - F, \tag{61}$$

$$\pi_f = 2\,N\,(r_f - \theta_f\,\tau_f - \rho)\left(\frac{1}{2\,N} - \hat{x}(\theta_p, \theta_f, r_p, r_f)\right) - G, \tag{62}$$

where, as in Section 3,

$$\hat{x}(\theta_p, \theta_f, r_p, r_f) = \frac{V(\theta_p) - V(\theta_f) + \theta_f\,\delta + r_f - r_p}{\theta_p}. \tag{63}$$

We look for the Nash equilibrium of the game in which each bank and the fintech simultaneously choose the interest rate and the degree of specialization.

The first order conditions for a typical bank are:

$$\frac{\partial \pi_p}{\partial r_p} = \hat{x} - (r_p - \tau_p\,\theta_p - \rho)\,\frac{1}{\theta_p} = 0, \tag{64}$$

$$\frac{\partial \pi_p}{\partial \theta_p} = -\tau_p\,\frac{V(\theta_p) - V(\theta_f) + \theta_f\,\delta + r_f - r_p}{\theta_p} \tag{65}$$

$$+(r_p - \tau_p\,\theta_p - \rho)\left(\frac{V'(\theta_p)\,\theta_p - (V(\theta_p) - V(\theta_f) + \theta_f\,\delta + r_f - r_p)}{\theta_p^2}\right) = 0. \tag{66}$$

Combining, rearranging terms and using the definition of $\hat{x}$ we obtain:

$$r_p - \tau_p\,\theta_p - \rho = \theta_p \hat{x}, \tag{67}$$

$$V'(\theta_p) - \hat{x} = \tau_p. \tag{68}$$

The first order conditions for the fintech are:

$$\frac{\partial \pi_f}{\partial r_f} = \left(\frac{1}{2N} - \hat{x}\right) - (r_f - \tau_f\,\theta_f - \rho)\,\frac{1}{\theta_p} = 0, \tag{69}$$

$$\frac{\partial \pi_f}{\partial \theta_f} = \left(r_f - \tau_f\,\theta_f - \rho\right)\left(\frac{V'(\theta_f) - \delta}{\theta_p}\right) - \tau_f\left(\frac{1}{2N} - \frac{V(\theta_p) - V(\theta_f) + \theta_f\,\delta + r_f - r_p}{\theta_p}\right) = 0. \tag{70}$$

Once again, combining, rearranging terms and using the definition of $\hat{x}$ we obtain:

$$r_f - \tau_f\,\theta_f - \rho = \left(\frac{1}{2N} - \hat{x}\right)\theta_p, \tag{71}$$

$$V'(\theta_f) = \tau_f + \delta \tag{72}$$

The Nash equilibrium is obtained by solving (67), (68), (71) and (72) for r_p, θ_p, r_f and θ_f.

Using (67), (71) and the definition of $\hat{x}$ we find that

$$r_p - r_f = \frac{2\left(V(\theta_p) - V(\theta_f)\right) - \frac{\theta_p}{2N} + 2\,\theta_f\,\delta + \tau_p\,\theta_p - \theta_f\,\tau_f}{3}, \tag{73}$$

and, therefore,

$$\hat{x} = \frac{V(\theta_p) - V(\theta_f) - \tau_p\theta_p + (\tau_f + \delta)\theta_f)}{3\theta_p} + \frac{1}{6N}. \tag{74}$$

A necessary condition for a market equilibrium with coexistence is that both banks and the fintech have positive demand, so that they are able to cover their fixed costs. This implies,

$$0 < \hat{x} < \frac{1}{2N}, \tag{75}$$

or

$$-\frac{1}{6N} < \frac{V(\theta_p) - V(\theta_f) - \tau_p\theta_p + (\tau_f + \delta)\theta_f}{\theta_p} < \frac{1}{N}. \tag{76}$$

Finally, we show how the Nash equilibrium of this subgame depends on the number of banks, N.

First, it is easy to see from equation (72) that θ_f is independent of the number of banks.

We differentiate equations (67), (68) and (71) with respect to N and obtain the following system of equations:

$$\frac{dr_f}{dN} + \left(V'(\theta_p) + \tau_p\right)\frac{d\theta_p}{dN} - 2\frac{dr_p}{dN} = 0 \tag{77}$$

$$\frac{dr_f}{dN} + \left(\tau_p - \theta_p V''(\theta_p)\right)\frac{d\theta_p}{dN} - \frac{dr_p}{dN} = 0 \tag{78}$$

$$\frac{dr_f}{dN} + \frac{1}{2}\left(V'(\theta_p) - \frac{1}{2N}\right)\frac{d\theta_p}{dN} - \frac{1}{2}\frac{dr_p}{dN} = -\frac{\theta_p}{4N^2}. \tag{79}$$

Call D the matrix of this system. Then we can show that

$$|D| = V'(\theta_p) - \tau_p - \frac{1}{4N} + \frac{3}{2}\theta_p V''(\theta_p), \tag{80}$$

which, using equation (68) can be written as

$$|D| = \frac{1}{2}\left(\hat{x} + \left(\hat{x} - \frac{1}{2N}\right) + 3\theta_p V''(\theta_p)\right). \tag{81}$$

The first term is positive, while the other two are negative. Therefore, we cannot determine the sign of this determinant for the general case.

Finally, we can show that

$$\frac{dr_f}{dN} = -\frac{1}{|D|}\frac{\theta_p}{2N^2}\left(V'(\theta_p) + \theta_p V''(\theta_p)\right), \tag{82}$$

$$\frac{d\theta_p}{dN} = -\frac{1}{|D|}\frac{\theta_p}{4N^2}, \tag{83}$$

$$\frac{dr_p}{dN} = -\frac{1}{|D|}\frac{\theta_p}{4N^2}\left(V'(\theta_p) + \theta_p V''(\theta_p)\right). \tag{84}$$

In sum, the Nash equilibrium of the subgame depends on the number of banks.

A1.2 Additional tables

Figure A1: Summary of regulatory schemes to big tech companies by country

Country| Big tech	Requirement to have a banking license	Capital requirement	Property limit	Antitrust practices	Fintech Law
China	Yes	(=)	Yes	Yes	Yes
Hong kong	Yes	(=)	No	Yes	Yes
Singapur	Yes	(+)	No	Yes	Yes
United States	Yes	(+)	No	Yes	Yes
Korea	Yes	(-)	Yes	Yes	Yes
United Kingdom	Yes	(=)	No	No	No
European Union	Yes	(+)	No	Yes	Yes
Germany	Yes	(+)	No	Yes	No
Taiwan	Yes	(=)	No	Yes	Yes
Japan	Yes	(=)	No	Yes	Yes
Egipto	Yes	(=)	Yes	Yes	Yes
Canada	Yes	(=)	No	Yes	No
Mexico	Yes	(=)	No	Yes	Yes
Suiza	Yes	(-)	No	Yes	Yes
Turquia	Yes	(=)	No	Yes	Yes
Italy	Yes	(+)	No	Yes	No
Malaysia	Yes	(+)	No	Yes	Yes
Brazil	Yes	(-)	No	Yes	Yes
Nigeria	Yes	(-)	No	Yes	Yes
India	Yes	(=)	No	Yes	Yes
Peru	Yes	(=)	No	Yes	No
Kenia	Yes	(=)	No	Yes	No
Colombia	Yes	(-)	No	Yes	No

Source: Own elaboration based on the following research: Zamil and Lawson (2022); Ehrentraud et al. (2022, 2020); Carstens et al. (2021). Capital requirement: (=), (+) or (-) means equal, greater or smaller capital requirements than a traditional bank. Property limit indicates whether there is any restrictions on ownership by the non-financial company.

A1.3 Internet appendix

Supplementary analyses associated with this article can be found in the online version at https://drive.google.com/file/d/1q6evPjENbsI24HJnDgbyxXCBb7E1GMHr/view?usp=sharing.