Digital Banking, Market Power and Financial Fragility

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Abstract

This paper investigates the effects of technological innovations on bank risk-taking. In a model of spatial competition for deposits with moral hazard in bank investment, it is shown that expansions in online banking present trade-offs for stability. Digitalization reduces distance frictions and the market power banks derive from their geographical reach, leading to higher deposit rates and enhancing monitoring. Intense competition may worsen (foster) stability if the lower rents from relationship banking exceed (lag behind) improvements in bank's enforcement. Risk-sensitive premiums serve to mitigate the moral hazard dilemma, amplifying this ambiguous effect on stability. These findings highlight the complex competition-stability interplay.

JEL classification: TBC.
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1 Introduction

A large body of empirical work identifies geographical proximity as a key determinant of market share for banking because of transportation costs (Petersen and Rajan [1995]; Degryse and Ongena [2005]) and quality of private information (Agarwal and Hauswald [2010]). The digitalization of financial services, though, threatens to shift the market power banks derive from the physical distance with potential customers. New advances in information technology and the COVID-19 have accelerated the digitalization trend, switching the nature of financial

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interactions from physical to remote. With online interactions, bank customers are able to operate with more distant competitors at minimum transaction expenses, reducing switching costs. This change in the model of communication between banks and its clients opens up questions on the implications of digitalization for the competition and stability of banking. Among the wide range of new technological advances, this work focuses on the expansion of digital banking.[1] I particularly interpret *digitalization* as advances of *distance friction-reducing technologies* leading to the substitution of physical to remote relationships.

To assess the effects of digitalization on bank risk-taking, I augment the spatial model of Hotelling [1929] with monitoring and moral hazard. In the model, banks compete à la Betrand for attracting deposits and invest directly the proceeds in risky investment projects. There is a common risk factor and project returns can be enforced by banks through a monitoring device. Bank's enforcement is private information, which creates a moral hazard problem. To protect depositors from bankruptcy, there is a Deposit Insurance Fund that charges a premium on bank risk-taking accordingly. A crucial aspect in the setting is the consideration that distance (i.e., geographic friction) plays a dual role in the banking relationship. On one hand, depositors face increasing transportation costs in distance from the branch office. This cost represents a disutility and accounts for the time and effort that customers spent to maintain personal interviews with bank officers or their preferences and space characteristics of the bank service.[2] On the other hand, based on the results of Agarwal and Hauswald [2010] about the facilities of customer proximity for the gathering of subjective firm-specific intelligence, I consider that bank's capacity to enforce project returns is decreasing in distance, which affects the ability banks have to obtain private information from more distant potential clients.

The main findings of the paper are the following:

- Digitalization process of financial services ameliorates the relevance of distance frictions in bank-customer relationships. For depositors, digitalization reduces transportation costs, which fosters deposit mobility across the banking system and, as such, rivalry. Online banking favors uniform pricing and higher deposit rates. For banks, digitalization erodes the relevance of proximity as information source and, as such, the advantages of intermediaries to collect and exploit local information, resulting in monitoring effectiveness and more enforcement.

[1] Digital banking can be understood as the expansion of communication tools that allow remote relationships with banks. As a way of example, mobile devices and internet application programming interfaces (APIs) have enabled online communications between banks and their customers. For an overview of the digital disruption in finance, see Vives [2019].

[2] In either way, transportation costs might be interpreted as any qualitative factor related to the physical distance between a potential depositor/investor and banks.

- Digitalization shifts the market power banks exploit from geographic proximity. Intense competition caused by advances in remote communication bank-customer relationships might be consistent with stability if gains from technological efficiency are stronger enough to dominate the classical risk-shifting effect of competition on stability. If transportation cost are more significant for depositors (competitive hypothesis), then banks will enjoy lower market power over closer customers and monitoring should fall in response to increases in deposit rates to maintain or gain market share. The perils for such a case would be less diligence and risk-taking behavior in the search for bank sources for rent subtraction. If, on the contrary, these distance frictions are more relevant for banks (monitoring hypothesis), then the geographical reach of information processors could be less affected for proximity, allowing them to enforce projects more accurately and extract more surplus from locationally distant investors.

- In terms of consistency, I further evaluate whether there is an insurance effect driving such findings. To do so, I investigate equilibrium outcomes, namely, bank's monitoring and deposit pricing under risk-sensitive premiums assuming financial disclosure. I find that, in relation to flat risk premiums, risk-adjusted premiums on deposits not only foster financial stability as Cordella and Yeyati [2002] suggest, but also reduce the negative impact that distance frictions have on monitoring and amplify the positive effect of increases in deposit coverage on monitoring. Furthermore, financial disclosure amplifies the ambiguous impact of digitalization on bank risk-taking.

Related Literature.

The papers is related to different studies that have explored the link between deposit competition and bank risk taking.[3] Two types of models can be distinguished based on the root of the market failure: limited liability (asymmetric information) and coordination problems (externality). Matutes and Vives [1996] study how fragility is due to coordination problems among depositors. In an environment with diversification economies of scale, they find that depositors expectations on bank failure yield vertical differentiation (ruled out by deposit insurance), suggesting that externalities caused by self-fulfilling beliefs and not bank competition can explain banking fragility. In presence of social costs of failure, Matutes and Vives [2000] study the implications of imperfect competition for deposits on the risk attitude of banks that operate under limited liability. In Cordella and Yeyati [2002], on the contrary, instability arises because increasing competition worsens the moral hazard problem

[3] I abstract for loan competition. For studies about the stability aspects of loan competition, see Chiappori et al. [1995], Caminal and Matutes [2002], Boyd and de Nicoló [2005], Martinez-Miera and Repullo [2010], and Arping [2017].

(non-observable risk). In contrast to Matutes and Vives [1996] and similar to Cordella and Yeyati [2002], I abstract for the self-fulfilling equilibria of the game and put the focus on moral hazard. I contribute to this literature by putting the focus on the stability aspects of digitalization on a setting of spatial competition. In particular, I show that increasing deposit competition might not be detrimental for financial stability. When distance affects both sides of the bank-customer relationship, in addition to the traditional risk-shifting effect, there is a technological effect that, in case of being sufficiently stronger, might lead to stability gains.

The paper also belongs to the literature studying the effects of digitalization in banking stability. There is evidence on how IT advances helped to reduce the expertise distance friction. Petersen and Rajan [2002] find a lower importance of distance frictions in bank lending for the U.S. after the adoption of information and credit scoring technologies several decades ago. Berger [2003] documents the reduction of bank rents from location and inside information after IT advances. Granja et al. [2022] also document the persistence of this long-run trend toward greater average distances between bank and their customers over the preceding 20 years. Furthermore, another evidence on lower relevance of distance frictions in current banking business models is branch closing. For the U.S., Benmelech et al. [2023] document that while total bank deposits almost doubled between 2016 and 2022, the number of bank branches declined by approximately 15 percent, which is a risk for bank runs.

At the theoretical front, Vives and Ye [2021] focus on the impact of IT on lender competition and show that if IT advances reduce the influence of lender-borrower distance on monitoring costs, lending competition intensifies but stability is lowered. I complement this study by focusing instead on the effects of *distance friction-reducing technologies* on the bank-depositor relationship. Koont et al. [2023] evaluate the stability consequences of digital banking and find that online banking fosters instability by affecting negatively the value of the bank's deposit franchise. My results differ from these studies by showing that the negative impact of digitalization on bank risk-taking might not be realized in scenarios where distance plays a dual role for banking relationships, particularly if the stability gains from IT advances are more significant than the risk-shifting effects caused by intense competition, which calls for the empirical identification of both effects.

The organization of the paper is as follows. Section 2 characterizes the model. Section 3 presents the results in a symmetric equilibrium with risk-flat insurance and non-observable monitoring. Section 4 evaluates the impact of digitalization on equilibrium outcomes for the benchmark setting. Section 5 extends the model by considering risk-sensitive premiums and financial disclosure. Finally, Section 6 concludes.

2 Model framework

Consider a risk-neutral economy à la Hotelling [1929] represented by the unit segment. It is inhabited by a unit mass of uniformly distributed households and $N = 2$ banks, denoted by $i = \{A, B\}$, located at the extremes on the line segment $(0, 1)$.

2.1 Investment

In each location there is a household formed by an individual *firm* and *investor*. Firms are endowed with a risky production technology that yields a random return $\tilde{R}$. There is a common risk factor and firms default with probability $p \in (0, 1)$ across all locations. Investors have access to a monetary endowment, normalized to one. Bank i has no capital but is endowed with a monitoring technology to enforce project returns. To motivate the need for banks in this economy, assume that investment projects must be enforced to be implemented. For this reason, direct finance is not feasible and investors do not allocate their monetary endowment into the production technology of the firm situated in the same location. Instead, investors decide whether to allocate their funds to bank i in exchange for a return r_i or to invest in a risk-free asset and obtain a reservation utility ν. This allocation choice will depend on the deposit rate set by bank i and the differentiation services it provides. In case the investors participate as depositors, bank i invests deposits into firm's project and investment occurs.

2.2 Product differentiation

Households incur into transportation costs $t \in \mathbb{R}^+$ from *approaching* to the bank branch location. Transportation costs might be rationalized because, in practice, some customers might prefer to operate with closeby financial intermediaries for physical proximity. Assume that this cost is linearly increasing in distance and equal across households. Letting denote x as the physical distance that exists between the household and bank i, a household incurs into a cost equivalent tx for visiting physically bank i and $t(1 - x)$ for bank j, $\forall i \neq j$ and $i = \{A, B\}$.

In addition, households are also exposed to what I call *learning* costs, captured by the parameter $z \in \mathbb{R}^+$, which are derived from the adoption of new technology-based tools or use of application program interfaces (APIs) for the remote interaction with bank i. For simplicity, I consider that there are not economies of scale in the adoption of information technologies. Total transaction costs for a household who develops a relationship with bank

i account for

$$(1-\psi)tx+\psi z, \tag{1}$$

where the parameter $\psi \in [0,1]$ captures the extent to which digital banking is employed in the economy.[4] Equation (1) states that the degree of digitalization ψ weights the "utility" that households derive from the physical proximity of banking services. Without loss of generality, I assume that $t > z$ for all $\psi \in [0,1]$. Notice that for high levels of digitalization, as $\psi \to 1$, transportation costs do not yield disutility to households since they prefer a remote relationship with the bank.

Interpretation parameter ψ. Among the wide range of conceptualizations of recent technological innovations in financial services, I interpret the parameter ψ as the relative importance of online/digital banking in the Hotelling economy. In particular, values of ψ close to 0 can be thought as a low expansion of or demand for digital services, with households preferring to operate with physically near banks and, consequently, distance frictions taking a greater importance in the bank business model. Another way to read it is that bank customers face a high disutility due to the distance from the branch. On the contrary, as ψ approaches to 1 the household values less to visit physically branches for banking consultation of lending conditions or to make use of ATM services to withdraw money. Henceforth, a high development of online banking services, with households accommodating their demand for financial services without visiting physically bank branches, diminishes the importance of distance frictions, replacing physical to remote relationships. That is to say, the bank's business model approaches to a *brick-and-mortar* model for $\psi \to 0$ and to a *digital* model for $\psi \to 1$.

Product differentiation is also derived from monitoring services. Bank i sets the level of risk of its asset portfolio by choosing the monitoring intensity m_i. Each unit of funds bank i allocates to the monitoring technology increases the succeed probability of the investment, $1-p$, in

$$m_i\Big[1-(1-\psi)x\Big] \tag{2}$$

percentage units, where the support of m_i is $[0,p]$. The interpretation of equation (2) is that the effectiveness of bank's i enforcement is decreasing in the physical distance with the household x but weighted by the degree of expansion of digital banking, ψ (i.e., how relevant is the geographical reach for the bank's business model). A plausible explanation is that

[4] For instance, a value of, say, $\psi = 0.8$ means that the 20% of the interactions between bank i and a household at distance x occur face-to-face while the remaining 80% happen online.

customer proximity facilitates information gathering and, consequently, banks have access to less subjective information on more distant potential clients (Agarwal and Hauswald [2010]), which makes harder project enforcement. Digitalization, though, also limits this distance friction. Notice that as the parameter ψ approaches to 1, distance affects less the effectiveness of monitoring. Thus, it is considered that banks are less reliable to *soft* information, or else, *hard* information is more effective as long as the bank-customer relationship becomes less physical.[5]

2.3 Insurance and incentive contracts

Assume that x and ψ are perfectly observable for all agents in the linear economy. However, the monitoring intensity selected by bank i, m_i, is private information, which introduces a moral hazard problem in the bank-customer relationship. This agency friction, namely, non-observable risk on bank's asset side, can be fully or partially mitigated with the presence of a deposit insurance scheme.

There is a Deposit Insurance Fund (DIF) run by the government (supervisor). The rationale for the DIF is to incentive banks to manage risk effectively and, in case of bank failure, ultimately cover potential loses derived from bank failures and honor with the posted rate to depositors. Assume for now uniform bank contributions as deposit insurance scheme. Particularly, the DIF implements a fair premium

$$\mu = \alpha \frac{\Big(1 - \mathbb{E}(\mathbb{P}_i)\Big)}{\mathbb{E}(\mathbb{P}_i)} \tag{3}$$

that covers up to a fraction $\alpha \in [0, 1]$ of the outstanding deposits gathered by bank i in case of bank failure, where

$$\mathbb{P}_i = 1 - p + m_i \Big[1 - (1 - \psi)x\Big]$$

shows the probability of success of an investment monitored with intensity m_i at distance x.[6] Notice that, $\forall \alpha \in (0, 1)$, $\lim_{\mathbb{E}(\mathbb{P}_i) \to 0} \mu = \infty$ and $\lim_{\mathbb{E}(\mathbb{P}_i) \to 1} \mu = 0$.

[5] See Liberti and Petersen [2018] for a wide discussion on the different forms of information.

[6] This funding arrangement for the DIF relies on an *ex-post* guarantee paid by banks in the event of bankruptcy. Another way to quote the premium might be considering that, *ex-ante*, a percentage of the deposits gathered are vault in the DIF independently of expected risk, resembling a reserve requirement or provision of funds that constraints bank's investment. See Hoelscher et al. [2006] for a comparison of the benefits and perils of *ex-ante* versus *ex-post* funding forms for a deposit insurance system. Additionally, the DIF also could set alternative insurance regimes in terms of actual risk. See Section 5 for the analysis with risk-adjusted premiums.

With a flat-based insurance regime, incentive compatibility claims for

$$r_i\Big[\mathbb{E}(\mathbb{P}_i)+\Big(1-\mathbb{E}(\mathbb{P}_i)\Big)\alpha\Big]-(1-\psi)tx-\psi z\geq\nu, \tag{4}$$

that is, investors agree to deposit their monetary endowment whenever the expected net return they obtain from deposits is at least equivalent to their reservation utility. If bank i succeeds, the investor obtains a remuneration r_i while in case of failure only perceives a remuneration from the fraction α of the funds deposited which are covered by the DIF. When equation (4) is satisfied, an investor situated at distance x prefers to allocate her monetary endowment with bank i in form of deposits than in the outside option.

2.4 Market share

Assume the deposit contract is incentive compatible (i.e., investors participate as depositors). An investor situated at distance x with bank i is indifferent among depositing their monetary endowment with bank i or j when

$$r_i\Big[\mathbb{E}(\mathbb{P}_i)+\Big(1-\mathbb{E}(\mathbb{P}_i)\Big)\alpha\Big]-(1-\psi)tx=r_j\Big[\mathbb{E}(\mathbb{P}_j)+\Big(1-\mathbb{E}(\mathbb{P}_j)\Big)\alpha\Big]-(1-\psi)t(1-x).$$

Notice it is assumed that the costs for operating remotely with both banks are the same, z. This way, the market share of bank i equals to

$$s_i(\psi)=\frac{1}{2}+\frac{r_i\Big[\mathbb{E}(\mathbb{P}_i)+\Big(1-\mathbb{E}(\mathbb{P}_i)\Big)\alpha\Big]-r_j\Big[\mathbb{E}(\mathbb{P}_j)+\Big(1-\mathbb{E}(\mathbb{P}_j)\Big)\alpha\Big]}{2(1-\psi)t},\forall i\neq j. \tag{5}$$

Assume the support of $r_i\Big[\mathbb{E}(\mathbb{P}_i)+\Big(1-\mathbb{E}(\mathbb{P}_i)\Big)\alpha\Big]-r_j\Big[\mathbb{E}(\mathbb{P}_j)+\Big(1-\mathbb{E}(\mathbb{P}_j)\Big)\alpha\Big]$ lies in the interval $[-(1-\psi)t,(1-\psi)t],\forall\psi\in[0,1],t\in\mathbb{R}^+,i,j=\{A,B\}$. For any r_i such that $r_i\Big[\mathbb{E}(\mathbb{P}_i)+\Big(1-\mathbb{E}(\mathbb{P}_i)\Big)\alpha\Big]-(1-\psi)tx+\psi z\geq\nu$, bank i can compete to attract deposits. Otherwise, it is out of the market.

2.5 Valuation

Each monetary unit invested in the firm yields an expected return

$$\widetilde{R_i}=\begin{cases}R & \text{with prob. } \mathbb{P}_i\\ 0 & \text{with prob. } 1-\mathbb{P}_i.\end{cases} \tag{6}$$

Since banks have all the bargaining power in this economy, they obtain all the surplus realized from investment projects in case of succeed, which leaves households the deposit remuneration

r_i.

Banks, at the same time, face intermediation costs. First, banks incur into *monitoring costs* from enforcing firms' investment returns. I assume a quadratic cost of monitoring. It is determined as follows

$$C(m_i) = \frac{\tau_i}{2} m_i^2, \tag{7}$$

where the parameter $\tau_i \in \mathbb{R}^+$ captures the unit cost of monitoring.

In addition, bank i also experiences *operational costs* from its intermediation activity. The physical presence of banking implies a fix cost b from running an operative branch office. Furthermore, I consider that banks also face fix costs from the digital provision of financial services, denoted by the parameter i. These costs account for...(explain). Total operational costs for bank i are thus

$$(1-\psi)b + \psi i. \tag{8}$$

Without loss of generality, consider that $b > i$. As happened with households (see equation 1), the degree of expansion of digital banking, ψ, also weights the operational costs for banks. These costs depend on the underlying demand of households for financial services. As long as $\psi \to 1$ ($\psi \to 0$), I interpret that households only relate with bank i digitally (physically) and, consequently, bank i only supplies intermediation services digitally (physically).

Hence, the valuation of bank i, denoted by V_i, with a market share s_i is

$$V_i(\psi) = \underbrace{s_i\Big[R - r_i(1+\mu)\Big]\mathbb{P}_i}_{\text{expected returns}} - \underbrace{C(m_i) - (1-\psi)b - \psi i}_{\text{intermediation costs}}. \tag{9}$$

Bank i defaults when investment proceeds cannot fulfill its obligations, namely, the commitment to pay r_i to investors and cover intermediation costs at the same time. In the bankruptcy state, the DIF covers $s_i\Big(r_i\mu - R\Big)$ and the bank i pays s_iR.

Bank's problem. The problem of bank i is to choose the optimal pair $\{m_i, r_i\}$ that maximizes its value (9) constrained to the premium on deposits (3); incentive compatibility (4); and its market share (5).

3 Nash equilibrium

The duopoly Nash game equilibrium can be formalized in two stages. To have a benchmark equilibrium, I focus first on the case where: (i) monitoring intensity m_i is non-observable; (ii) both banks have access to the same monitoring technology, i.e., $\tau_i = \tau_j = \tau$;[7] and (iii) the DIF has no monitoring capabilities and sets a flat premium insurance on deposits, $\alpha \in [0, 1]$. Figure 1 represents the timing of sequentially events.

Figure 1: Timeline with non-observable monitoring

DIF sets premium α.	Bank i chooses deposit rate, r_i.	Investor decides whether deposit or not. If so, to which bank.	Bank i chooses monitoring, m_i.	Investment occurs and DIF acts in case of bank failure.

First, given the flat premium α set by the DIF, bank i chooses the deposit rate r_i to attract deposits. Investors observe the deposit rates offered by bank i and, given their expectations about the success of each bank, $\mathbb{E}(\mathbb{P}_i)$, decide whether to participate in the economy as depositors or to allocate the monetary endowment into the risk-free, outside option. In the former case, the investor chooses the bank offering the highest expected return on deposits after discounting transaction costs. Second, given its market share, bank i decides the monitoring intensity m_i with which enforce project returns. Investment realizes finally and the DIF intervenes in the economy in case of bank failure. The equilibrium can be solved proceeding backwards.

3.1 Optimal monitoring

At the time of choosing monitoring effort m_i, bank i faces a trade-off since it balances the expected returns and intermediation costs of processing an additional unit of enforcement. Given the margin of intermediation, bank i knows that the larger the monitoring, the higher the expected return since the larger the probability of success of the investment project is but, in contrast, the larger the expenses derived from enforcing project returns.

Given r_i, bank i chooses the monitoring effort m_i that maximizes its valuation given by equation (9). The necessary condition that determines optimal monitoring intensity is as follows.

Proposition 1. *The optimal level of monitoring of bank i for a firm located at distance x is*

$$m_i^*(x) = \frac{s_i\Big[1 - (1 - \psi)x\Big]\Big[R - r_i(1 + \mu)\Big]}{\tau}. \tag{10}$$

The Proof of Proposition (1) results directly from deriving equation (9) with respect to the choice variable m_i. Equation (10) reflects that monitoring intensity depends on three

[7]The assumption that $\mathbb{E}(m_i) = \mathbb{E}(m_j) \equiv \mathbb{E}(m)$ abstracts the analysis for coordination failures among depositors as Matutes and Vives [1996] study.

aspects. First, it is an increasing function of the margin of intermediation weighted by market share s_i. Second, it is decreasing in τ and distance x. This is so because monitoring is less effective to more distant households. Yet, notice this effect is amplified by the expansion of the digital model of banking ψ. For high values of ψ, the impact of the geographical location of the household on monitoring falls. Third, monitoring is also a decreasing function of the premium set by the DIF.

At the time of setting optimal monitoring, m_i^*, bank i perfectly observes the location of the unit mass of investors and infer the transportation costs those potential depositors face. Next corollary shows, everything else equal, the impact of distance x on m_i.

Corollary 1. *Distance x affects negatively optimal monitoring.*

Notice that differentiating equation (10) against distance, x, yields

$$-\frac{s_i(1-\psi)\Big[R - r_i(1+\mu)\Big]}{\tau}.$$

Corollary (1) highlights that monitoring intensity of bank i is linearly decreasing in distance, being minimum in a neighborhood of the indifference location $\tilde{x}$. Hence, with a common risk factor, projects located around indifferent locations (which correspond to intermediate locations) will be more likely to default since bank's monitoring intensity is lower for more distant depositors.

3.2 Deposit pricing

I explore next how banks compete in a Bertrand fashion for gathering deposits. Since m_i is non-observable, investors will take into account deposit pricing as well as expectations on bank riskiness to choose the bank with which form a relationship. Without loss of generality, I focus, for simplicity, on the symmetric case in which $E(m_i) = E(m_j) \equiv E(m)$. The rationale behind this assumption is that, in absence of self-fulfilling events, there is not a critical reason for which investors might expect that a particular bank puts more enforcement if both intermediaries have access to the same IT, i.e., if $\tau_i = \tau_j \equiv \tau$. Given $\mathbb{E}(\mathbb{P}_i) = 1-p+\mathbb{E}(m)\Big(1-(1-\psi)x\Big)$ and $\mathbb{E}(\mathbb{P}_j) = 1-p+\mathbb{E}(m)\Big(1-(1-\psi)(1-x)\Big)$, an investor at distance x will choose the bank offering the highest expected return net of operational costs provided such contract is incentive compatible. Hence, the *best deposit rate* is the one that incentives the investor to participate as depositor and maximizes bank's valuation.

The potential market situations that might arise in equilibrium are defined below. For any $\alpha \in [0,1], \psi \in [0,1], \{t, z, v\} \in \mathbb{R}^+$ and given depositor's expectations $\mathbb{E}(\mathbb{P}_i), \mathbb{E}(\mathbb{P}_j)$, at location $x \in [0,1]$ there is:

- *Direct competition* if $r_i\Big[\mathbb{E}(\mathbb{P}_i)+\Big(1-\mathbb{E}(\mathbb{P}_i)\Big)\alpha\Big]-(1-\psi)tx-\psi z-\nu>0$, and $r_j\Big[\mathbb{E}(\mathbb{P}_j)+\Big(1-\mathbb{E}(\mathbb{P}_j)\Big)\alpha\Big]-(1-\psi)t(1-x)-\psi z-\nu>0$.

- *Local monopoly* if $r_i\Big[\mathbb{E}(\mathbb{P}_i)+\Big(1-\mathbb{E}(\mathbb{P}_i)\Big)\alpha\Big]-(1-\psi)tx-\psi z-\nu>0$, and $r_j\Big[\mathbb{E}(\mathbb{P}_j)+\Big(1-\mathbb{E}(\mathbb{P}_j)\Big)\alpha\Big]-(1-\psi)t(1-x)-\psi z-\nu<0$, or else, $r_i\Big[\mathbb{E}(\mathbb{P}_i)+\Big(1-\mathbb{E}(\mathbb{P}_i)\Big)\alpha\Big]-(1-\psi)tx-\psi z-\nu<0$, and $r_j\Big[\mathbb{E}(\mathbb{P}_j)+\Big(1-\mathbb{E}(\mathbb{P}_j)\Big)\alpha\Big]-(1-\psi)t(1-x)-\psi z-\nu>0$.

- *Non-banking competition* if $r_i\Big[\mathbb{E}(\mathbb{P}_i)+\Big(1-\mathbb{E}(\mathbb{P}_i)\Big)\alpha\Big]-(1-\psi)tx-\psi z-\nu<0$, and $r_j\Big[\mathbb{E}(\mathbb{P}_j)+\Big(1-\mathbb{E}(\mathbb{P}_j)\Big)\alpha\Big]-(1-\psi)t(1-x)-\psi z-\nu<0$.

Three possible market situations might happen in a given location x, namely, it is covered by two banks (direct competition), one bank (local monopoly), or none (non-banking competition). Potential market areas overlap when there is direct competition across all locations. With local monopolies, though, some market areas are covered by only one bank, which reduces competition. When the deposit contract is not incentive compatible, the bank is out of the market and the location unbanked (i.e., not served by any bank), so the investors allocate their endowment into the outside option.

Let denote $x^m \in [0,1]$ as the distance below which bank i has a local monopoly. Given a flat premium α, the next Proposition characterizes the optimal deposit pricing for bank i.

Proposition 2. *For non-observable $m_i \in [0,p]$, the optimal rate on deposits set by bank i for an investor at location $x \in [0,1]$ is*

$$r_i^*(x) = min\{r_i^m(x), r_i^c(x)\},$$

where

$$r_i^m(x) = \frac{\nu}{\alpha+(1-\alpha)\mathbb{E}(\mathbb{P}_i)} \tag{11}$$

if $x \in [0, x^m)$, and

$$r_i^c(x) = \frac{R\Big(\alpha+(1-\alpha)\mathbb{E}(\mathbb{P}_i)\Big)+(1+\mu)\Big[r_j\Big(\alpha+(1-\alpha)\mathbb{E}(\mathbb{P}_j)\Big)-(1-\psi)t\Big]}{2(1+\mu)\Big(\alpha+(1-\alpha)\mathbb{E}(\mathbb{P}_i)\Big)} \tag{12}$$

if $x \in [x^m, 1-x^m)$.

Proof. The Proof of Proposition (2) is very intuitive. If there is no direct competition at location x, bank i will operate as monopolist in the area and choose the rate at which the investor breaks even, which is given by $r_i^m(x)$ (the superscript m refers to a local monopoly market situation). Notice that for any investor at location $x \in [0, x^m]$ bank i will provide the same deposit remuneration $r_i^m(x)$ independently of the distance. For any $\alpha \in [0,1]$, investors will accept this deposit contract since $r_i^m \geq \nu$. On the contrary, if there is direct competition (referred by the superscript c) at location x, both banks are active and bank i will choose the deposit rate that maximizes its valuation. Differentiating bank's i value function (9) with respect to r_i, constrained to equations (3), (4) and (5), yields the necessary condition (12) that denotes the best deposit rate bank i can offer to an investor at location x in response to the rate offered by bank j. $\square$

Proposition 2 shows that, when monitoring is not observable, deposit pricing is also set in terms of depositor's expectations (in addition to transportation costs). Yet, this effect is neutralized for full deposit insurance coverage ($\alpha = 1$), in whose case investors do not have incentives to discipline banks because of repayment certainty. In what follows I concentrate the analysis on the equilibrium with direct competition. The next corollaries derive several results from a comparative static perspective.

Corollary 2. *Deposit rates are decreasing in transportation costs, t.*

Proof. The first order derivative of optimal deposit pricing under direct competition against the parameter t yields

$$\frac{\partial r_i^c(x)}{\partial t} = -\frac{(1-\psi)}{2\Big(\alpha + (1-\alpha)\mathbb{E}(\mathbb{P}_i)\Big)},$$

which takes negative sign $\forall \alpha \in [0,1]$ and non-degenerate distribution for parameter ψ. $\square$

Corollary 2 reflects the negative relationship between transportation costs and deposit pricing. Banks extract rents from the geographical proximity of potential depositors. An increase in transportation costs, indeed, makes more costly for investors to approach to more distant banks, which increases switching costs and allow the closeby bank to obtain a larger surplus from the bank-customer relationship by lowering the pricing of deposits.

Corollary 3. *Deposit insurance, α, pushes deposit pricing down.*

Proof. Notice that for $\alpha = 0$, deposit pricing takes value $\frac{R\mathbb{E}(\mathbb{P}_i)+r_j\mathbb{E}(\mathbb{P}_j)-(1-\psi)t}{2\mathbb{E}(\mathbb{P}_i)}$, whose numerator is lower and denominator higher than in the case with full insurance, namely, $\alpha = 1$, in which case it equals to $\frac{R\mathbb{E}(\mathbb{P}_i)+\Big(r_j-(1-\psi)t\Big)\Big(1-\mathbb{E}(\mathbb{P}_i)\Big)}{2}$. Thus, it is clear that $\frac{\partial r_i^c(x)}{\partial \alpha} < 0$. $\square$

Corollary 3 states that increases in the limit of coverage deposit insurance permits reduce the remuneration on deposits. This detrimental impact on banks' deposit interest rates occurs as deposit insurance diminishes the returns demanded by depositors. Indeed, notice that for full insurance ($\alpha = 1$) the moral hazard effect is ruled out for deposit pricing. This result is consistent with...see empirical evidence.

I turn next to assess the impact of distance x on deposit pricing r_i under direct competition.

Corollary 4. *For any $\alpha \in [0, 1]$, deposit rates are monotonically increasing in distance.*

Proof. Differentiating equation (12) against distance x yields

$$\frac{(1-\psi)}{\Big[2(1+\mu)\Big(\alpha+(1-\alpha)\mathbb{E}(\mathbb{P}_i)\Big)\Big]^2}\Bigg\{-\frac{\partial\mathbb{E}(\mathbb{P}_i)}{\partial x}\Big[2(1+\mu)^2(1-\alpha)\Big]\Big[r_j\Big(\alpha+(1-\alpha)\mathbb{E}(\mathbb{P}_j)\Big)-(1-\psi)t\Big]$$
$$-\frac{\partial\mu}{\partial x}2R\Big[\alpha+(1-\alpha)\mathbb{E}(\mathbb{P}_i)\Big]^2+\frac{\partial\mathbb{E}(\mathbb{P}_j)}{\partial x}2(1+\mu)^2(1-\alpha)\Big(\alpha+(1-\alpha)\mathbb{E}(\mathbb{P}_j)\Big)\Bigg\}.$$

To sign the expression above, notice that $\frac{\partial\mathbb{E}(\mathbb{P}_i)}{\partial x} = -\mathbb{E}(m)(1-\psi) < 0$ while $\frac{\partial\mathbb{E}(\mathbb{P}_j)}{\partial x} = \mathbb{E}(m)(1-\psi) > 0$ and $\frac{\partial\mu}{\partial x} = -\frac{\alpha}{\mathbb{E}(\mathbb{P}_i)^2} < 0$, which shows the positive relationship between the competitive deposit rate and distance, as desired. □

Corollary 4 captures a positive correspondence between bank-customer distance and deposit rates. Notice that r_i^m fixes the lower bound for deposit remuneration, while the maximum deposit rate occurs at the indifference distance $\tilde{x}$, given by $r_i^c(\tilde{x})$. Consistent with evidence on spatial deposit competition, banks have to bid more aggressive to attract the deposits of distant investors, which increases deposit rate. That is to say, the lower the distance, the lower the transportation costs faced by depositors, and the lower the rate banks have to remunerate to attract such investor because the larger switching costs she faces.

Yet, it is pointworthy that the positive relationship between distance and deposit pricing reflected in Corollary 4 derives from the non-observability of bank's monitoring. Although distance ameliorates the effectiveness of bank's enforcement, the DIF sets the insurance premium μ irrespective of bank's riskiness (i.e., flat-based tax on risk). This explains that when m_i is not observable (nor verifiable), deposit rates only capture bank physical proximity as the differentiation service provided by banks.

4 Digitalization

We next perform a comparative static exercise to observe the explicit impact of parameter ψ on equilibrium outcomes, namely, deposit pricing r_i and enforcement m_i. The expansion in the use of digital banking services (due to either demand or supply driven factors), shifts the relationship between distance and equilibrium values for monitoring and deposit rates. That is to say, digitalization lessens the relevance of bank proximity as a differentiation service and, consequently, erodes the impact of distance frictions at both sides of the bank-customer relationship.

It is still assumed that bank's monitoring is not disclosed and there is direct competition in a given location x. Everything else equal, partial effects derive the following result.

Lemma 1. *In a symmetric equilibrium, at any distance $x \in [0, \frac{1}{2}]$, expansions in online banking lead to higher monitoring and deposit rates.*

Proof. Differentiating equation (10) with respect to ψ yields $\frac{1}{\tau}\Big\{s_i x[R - r_i(1+\mu)]\Big\} > 0$, while the partial effect of ψ on r_i equals to

$$\frac{1}{2(1+\mu)\Big(\alpha+(1-\alpha)\mathbb{E}(\mathbb{P}_i)\Big)^2}\Bigg\{2r_j(1-\alpha)(1+\mu)^2\Big[\Big(\alpha+(1-\alpha)\mathbb{E}(\mathbb{P}_i)\Big)\mathbb{E}(m_j)(1-x)$$
$$-\Big(\alpha+(1-\alpha)\mathbb{E}(\mathbb{P}_j)\Big)\mathbb{E}(m_i)x\Big] + 2t(1+\mu)\Big[\alpha+(1-\alpha)\Big(1+\mathbb{E}(\mathbb{P}_i)-\psi\Big)\Big]\Bigg\}$$

since $\frac{\partial \mathbb{E}(\mathbb{P}_i)}{\partial \psi} = \mathbb{E}(m_i)x$ and $\frac{\partial \mathbb{E}(\mathbb{P}_j)}{\partial \psi} = \mathbb{E}(m_j)(1-x)$.

Assume a symmetric equilibrium. If banks have access to the same monitoring technology, it is expected that, for a given distance x, $\mathbb{E}(m_i) = \mathbb{E}(m_j) \equiv \mathbb{E}(m)$.

Then, $\frac{\partial r_i}{\partial \psi}$ turns into

$$\frac{2(1+\mu)}{2(1+\mu)\Big(\alpha+(1-\alpha)\mathbb{E}(\mathbb{P}_i)\Big)^2}\Bigg\{(1+\mu)r_j\mathbb{E}(m)\theta(x) + 2t(1+\mu)\Big[\alpha+(1-\alpha)\Big(1+\mathbb{E}(\mathbb{P}_i)-\psi\Big)\Big]\Bigg\},$$

where the term $\theta(x)$ equals to

$$(1-2x)\Big\{\alpha+(1-\alpha)\Big[1-p+\mathbb{E}(m)\Big]\Big\}.$$

Clearly, for $x=0$, $\theta(0) = \alpha+(1-\alpha)\Big[1-p+\mathbb{E}(m)\Big]$ and

$$\frac{\partial r_i}{\partial \psi} = \frac{t\Big[\alpha+(1-\alpha)\Big(1+\mathbb{E}(\mathbb{P}_i)-\psi\Big)\Big]}{\Big(\alpha+(1-\alpha)\mathbb{E}(\mathbb{P}_i)\Big)^2} > 0$$

while for $x = \frac{1}{2}$, $\theta(\frac{1}{2}) = 0$ and

$$\frac{\partial r_i}{\partial \psi} = \frac{\alpha(1-\alpha)t\Big[2 - p + \mathbb{E}(m)(1-\psi x) - \psi\Big]}{\Big(\alpha + (1-\alpha)\mathbb{E}(\mathbb{P}_i)\Big)^2} > 0$$

for any $p \in [0,1], \psi \in [0,1]$.

Thus, at any distance $x \in [0, \frac{1}{2}]$ can be obtained that $sign\Big\{\frac{\partial r_i}{\partial \psi}\Big\} > 0$. □

Lemma (1) reflects the partial effects of expansions in the digital model of banking on equilibrium outcomes. On one side, given r_i, digitalization boosts banks enforcement from the lower importance of customer proximity for information collection. A rationale for this is that digitalization replaces soft to hard information. Depositors located further away from bank i are more susceptible to switch since they obtain lower deposit rate remuneration from the less distant bank j. That is to say, more distant depositors are the *primary targets for rent extraction*, which incentives bank's enforcement. On the other side, keeping m_i constant, as distance matters less, the communication in the bank-customer relationship becomes less physical-intensive and pushes deposit pricing up due to increasing competition. In consequence, as transportation costs become less important for depositors, distance frictions are minimized and banks have to bid more aggressively to either capture more distant investors or else, maintain geographically closer depositors. As result deposit rates raise from the intense competition caused by more communication relationships.

Taking into account total effects, we derive the following result.

Proposition 3. *Digitalization has an ambiguous effect on stability.*

Proof. Total differentiation yields

$$\frac{dm_i}{d\psi} = \frac{\partial m_i}{\partial \psi} + \frac{\partial m_i}{\partial r_i}\frac{\partial r_i}{\partial \psi}.$$

From Lemma (1), it is known that $\frac{\partial m_i}{\partial \psi} > 0$ and $\frac{\partial r_i}{\partial \psi} > 0$. To prove the ambiguous sign of $\frac{dm_i}{d\psi}$, it must be the case that $\frac{\partial m_i}{\partial r_i} < 0$. From Proposition (1), it can be easily check that its differentiation equals to $-\frac{s_i(1+\mu)\Big[1-(1-\psi)x\Big]}{\tau} < 0$, as desired. □

Proposition (3) states that digitalization presents tradeoffs on financial fragility. The equilibrium value for bank's monitoring moves in two opposite directions as the bank-customer relationship becomes more digital. From one side, there is a *technological effect* capturing stability gains from monitoring enhancement. When the importance of transportation costs (distance) for the bank's information generating process is reduced, banks are capable to process more accurate information at a given distance x, which incentives the bank to raise the enforcement with which investment projects are monitored. As Lemma (1) states, this technological effect improves project success and, as such, promotes stability. From the other side, there is a *competition effect* that reflects *stability loses* from rivalry. As the bank-customer relationship turns to be less physical, depositors face lower switching costs and the bank enjoys less local market power, which forces to raise deposit rates for competitive purposes. In consequence, banks extract less surplus from its intermediation and are forced to reduce monitoring to adjust its lower information rents.

Testable implications. Putting together these two effects yields an ambiguous relationship between digitalization and bank risk-taking. At the theoretical grounds of this result is that digitalization eliminates the distance effect and, consequently, the market power banks derive from their geographical location, but its net effect on financial stability is unclear. Thus, which one of these two channels dominates is likely to be an empirical question. If transportation cost are more significant for depositors (competitive hypothesis), then banks will enjoy lower market power over closer customers and monitoring should fall in response to increases in deposit rates to maintain or gain market share. The perils for such a case would be less diligence and risk-taking behavior in the search for bank sources for rent subtraction. If, on the contrary, these distance frictions are more relevant for banks (monitoring hypothesis), then the geographical reach of information processors could be less affected for proximity, allowing them to enforce projects more accurately and extract more surplus from locationally distant investors. If this were the case, in line with Hauswald and Marquez [2006], banks could use in a lower extent local information to create adverse selection for rivalry intermediaries. Indeed, banks could strategically employ higher monitoring levels to informationally capture more distant potential investors as long as distance frictions play a lower prominent role.

5 Risk-adjusted insurance

Next, I relax the assumption of non-observability of bank's monitoring and flat-insurance premium on deposits. Instead, I explore outcomes in a symmetric equilibrium when: (i) the DIF verifies monitoring intensity m_i; and (ii) acting as supervisor, sets a tax that is sensitive on bank's riskiness. The focus here is to evaluate the impact of digitalization on competition and stability under risk-fair insurance premiums and risk observability. In other words, the aim is to figure out whether there is an insurance effect driving previous results. Notice that contrary to a flat-based insurance regime (which prices a tax in terms of expected risk-taking), a risk-adjusted insurance premium is set once the monitoring effort m_i has been decided and thereby based on observable risk, $\mathbb{P}_i$. The timing of events is now as follows

Figure 2: Timeline with observable monitoring

Bank i chooses deposit rate, r_i.	Investor decides whether deposit or not. If so, to which bank.	Bank i chooses monitoring, m_i.	DIF observes m_i and sets premium $\rho(m_i)$.	Investment occurs and DIF acts in case of bank failure.

With a slight abuse of notation, let denote now the *ex-post* insurance premium by ρ. Since the DIF observes bank's monitoring, such premium equals to

$$\rho(m_i) = \alpha\left(\frac{1-\mathbb{P}_i}{\mathbb{P}_i}\right) = \alpha\left(\frac{p - m_i\Big(1-(1-\psi)x\Big)}{1-p+m_i\Big(1-(1-\psi)x\Big)}\right). \tag{13}$$

Lemma 2. *ρ is a decreasing and convex function of bank's monitoring, m_i.*

To see this, notice that first and second order derivatives correspond, respectively, to

$$\frac{\partial \rho}{\partial m_i} = -\frac{\alpha\Big(1-(1-\psi)x\Big)}{\Big[1-p+m_i\Big(1-(1-\psi)x\Big)\Big]^2}$$

and

$$\frac{\partial^2 \rho}{\partial m_i^2} = \frac{\alpha\Big(1-(1-\psi)x\Big)^2}{\Big[1-p+m_i\Big(1-(1-\psi)x\Big)\Big]^4}.$$

Equilibrium, as in Section 3, can be solved backwards. The only difference is about the timing of events, with the DIF having information on the bank's i choice m_i. As such, now bank i can adjust the risk premium to be paid by setting different levels of monitoring. The following Proposition states the optimal monitoring with risk-adjusted premium.

Proposition 4. *With risk fair premium, bank i monitors a household at distance x with an enforcement given by*

$$m_i^*(x) = \frac{\Big(1-(1-\psi)x\Big)}{\tau}\left\{r_i\left[\alpha\frac{s_i}{\mathbb{P}_i} + (1-\alpha)\frac{\Big[R-r_i(1+\rho)\Big]}{2(1-\psi)t}\right] + s_i\Big[R-r_i(1+\rho)\Big]\right\}. \tag{14}$$

Proof. Given deposit pricing r_i and r_j, differentiating bank's i valuation

$$V_i = s_i\Big[R-r_i(1+\rho)\Big]\mathbb{P}_i - C(m_i) - (1-\psi)b - \psi i,$$

where $s_i = \frac{(1-\psi)t + r_i\Big(\alpha+(1-\alpha)\mathbb{P}_i\Big) - r_j\Big(\alpha+(1-\alpha)\mathbb{P}_j\Big)}{2(1-\psi)t}$ and $\mathbb{P}_i = 1 - p + m_i\Big(1-(1-\psi)x\Big)$, against the choice variable m_i, yields expression (14). □

Remark. Fair risk premiums foster monitoring in comparison to flat risk premiums. Comparing Propositions (1) and (4), it can be observed that banks allocate more attention to monitoring when the DIF sets the insurance premium *ex-post*. In particular, when insurance premiums are sensitive to risk, bank's i monitoring increases in $r_i\left[\alpha\frac{s_i}{\mathbb{P}_i} + (1-\alpha)\frac{\left[R-r_i(1+\rho)\right]}{2(1-\psi)t}\right]$ units. This reflects that the observability of bank riskiness fosters monitoring and reduces the moral hazard effect caused by deposit insurance. Furthermore, it is easy to show that increases in the outstanding deposit coverage, α, lead to more monitoring with risk fair premium rather than with flat premiums. This is so because banks internalize at some extent the larger risk taking they incur due to less monitoring intensity.

Corollary 5. *The negative impact of distance x on monitoring m_i is less prominent under a fair risk premium than a flat-based tax on deposits.*

Proof. To prove this, note first that the first order derivative of expression (14) against distance, x, yields

$$-\frac{(1-\psi)}{\tau}\left\{s_i\Big[R-r_i(1+\rho)\Big] + (1-\alpha)\frac{r_i\Big[R-r_i(1+\rho)\Big]}{2(1-\psi)t} + \alpha\frac{r_i s_i}{\mathbb{P}_i}\left[1 - m_i\frac{\Big(1-(1-\psi)x\Big)}{\mathbb{P}_i}\right]\right\},$$

which is clearly larger than the effect of distance on monitoring for the case where the DIF sets the insurance premium irrespective of bank risk, as can be seen from Corollary (1). □

Hence, risk fair premiums on deposits not only foster financial stability as Cordella and Yeyati [2002] suggest, but also reduce the negative impact that distance frictions have on monitoring and amplify the positive effect of increases in deposit coverage on monitoring. From a policy perspective, although these results support the implementation of risk-sensitive premiums on deposits, it is still common to find jurisdictions operating under a flat-based regime (in many cases due to the difficulties derive from the observation of bank risk, see Demirgüç-Kunt et al. [2015]). It is also noteworthy the case of the U.S., where the FDIC charges deposit premiums following a risk-adjusted approach but refunds premiums to banks when the reserves of the deposit insurance fund exceed a certain threshold in relation to the magnitude of insured deposits, which dissuades banks to follow a proper due diligence.[8]

[8]See the critique of Acharya et al. [2010] on the efficient setting of deposit insurance premiums.

I explore next deposit pricing under fair risk insurance. For simplicity, I focus on the case of direct competition. A household at distance x will form a relationship with the bank from which derives a higher expected utility. With risk-sensitive premiums, depositors will take into account deposit pricing (as in Section 3) but also anticipate bank's i monitoring.

Solving for r_i leads the optimal deposit pricing

$$r_i^*(x) = \frac{R\Big(\alpha + (1-\alpha)\mathbb{P}_i(m_i^*)\Big) + (1+\rho(m_i^*))\Big[r_j\Big(\alpha + (1-\alpha)\mathbb{P}_j\Big) - (1-\psi)t\Big]}{2(1+\rho(m_i^*))\Big(\alpha + (1-\alpha)\mathbb{P}_i(m_i^*)\Big)} \tag{15}$$

with m_i^* given by equation (14).

In comparison to expression (11), optimal deposit pricing is now sensitive to changes in bank's monitoring m_i, which amplifies the comparative static analysis explained by Corollaries 2-4. How responsive are deposit rates to distance when the DIF sets risk-adjusted insurance premiums? Differentiating necessary condition (15) against x yields

$$\frac{1}{\Big[2(1+\rho)\Big(\alpha+(1-\alpha)\mathbb{P}_i\Big)\Big]^2}\Bigg\{\frac{\partial \mathbb{P}_i}{\partial x}\Bigg[-2(1+\rho)^2(1-\alpha)\Big[r_j\Big(\alpha+(1-\alpha)\mathbb{P}_j\Big)-(1-\psi)t\Big]\Bigg]$$
$$+\frac{\partial \rho}{\partial x}\Big[-2R\Big(\alpha+(1-\alpha)\mathbb{P}_i\Big)^2\Big]+\frac{\partial \mathbb{P}_j}{\partial x}\Big[2r_j(1-\alpha)(1+\rho)^2\Big(\alpha+(1-\alpha)\mathbb{P}_i\Big)\Big]\Bigg\}$$

which takes positive sign since $\frac{\partial \mathbb{P}_i}{\partial x} < 0$, $\frac{\partial \mathbb{P}_j}{\partial x} > 0$, and $\frac{\partial \rho}{\partial x} < 0$. Note that with risk-adjusted premiums these partial derivatives take the form $\frac{\partial \mathbb{P}_i}{\partial x} = -m_i^*(1-\psi) + \frac{\partial m_i^*}{\partial x}\Big[1-(1-\psi)x\Big]$ and $\frac{\partial \mathbb{P}_j}{\partial x} = m_j^*(1-\psi) + \frac{\partial m_j^*}{\partial x}\Big[1-(1-\psi)(1-x)\Big]$, with $\frac{\partial m_i^*}{\partial x} < 0$ and $\frac{\partial m_i^*}{\partial x} > 0$, including an additional term that captures the response of monitoring to distance. This implies that the positive relationship between distance and deposit pricing is larger when insurance premiums are risk-sensitive. The rationale is that distance affects less monitoring intensity (as Corollary (5) states), which makes banks more stable and pushes up deposit pricing at any location x.

Comparative statics.

Finally, I develop a comparative static exercise to assess the effects of digitalization on bank risk-taking under risk-adjusted premiums on deposits. We derive the following result.

Proposition 5. *Risk-sensitive premiums amplify the effects of digitalization on stability and deposit pricing.*

Proof. TBC. □

6 Conclusion

I have showed that intense competition caused by advances in remote communication bank-customer relationships might be consistent with stability if gains from technological efficiency are stronger enough to dominate the classical risk-shifting effect of competition on stability. I have also proved that this trade-off for stability not only holds with risk-sensitive insurance premiums on deposits but it is also amplified with financial disclosure. These results illustrate the classical complex competition-stability link. Specifically, when distance plays a dual role in the bank-customer relationship, the spectrum of potential outcomes regarding the interplay between competition and stability widens, reflecting the generalized idea in this strand of literature that *different models provide different answers* (Allen and Gale [2004]).

In policy terms, the understanding of potential effects of IT-distance technologies on stability is of first order importance. In light of the banking turmoil after the collapse of Silicon Valley in 2023, some voices claimed that poor performance of banks might be explained by low branch density (Benmelech et al. [2023]), disintermediation concerns (Chiu et al. [2023]) or lower deposit franchise value (Koont et al. [2023]). Yet, if banks exploit lower market concentration in deposit markets, as the evidence of Begenau and Stafford [2023] suggest, it is not clear that more competition caused by digitalization could lead to more instability.

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