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Bank competition and risk-taking under market integration*

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Abstract

Linkages between bank competition and risk-taking are analyzed in a model where market integration is the principal driver of increased competition. Risk implications of across-market competition under banking market integration are significantly different from that of within-market competition. While both modes of competition increase the number of competitor banks, across-market competition yields a bank-customer effect that can potentially reverse any relation that prevails be- tween within-market competition and risk-taking. This result suggests that the lack of consensus in the bank competitionfinancial stability literature is not an anomaly but an inherent feature of the analysis.

JEL codes: D82, G21, L13. *Keywords:* Market integration; bank competition; risk-shifting.

1. Introduction

The Global Financial Crisis has rekindled interest in the much-studied and yet unresolved relation between bank competition and financial stability.¹ Over the past five decades, *market integration* has transformed banking from a within-market local phenomenon to span multiple erstwhile segmented markets.² Empirical studies have analyzed this progressive evolution of bank competition through geographic deregulation and the expansion of banking *across* markets. By contrast, theory on bank competition and risk-taking has largely defined increased competition as increases in the number of competitor banks *within* an individual market. While both modes of analyzing competition increase the number of competitor banks, does across-

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¹The lack of consensus is pervasive and reflected even in surveys of this literature. For example, Vives (2016) and Corbae and Levine (2018) argue that there is a significant trade-off between competition and financial stability and the OECD report Blundell-Wignall et al. (2011, p. 10), finds that "changes in business models and activities in response to competition ... proved not to be conducive to financial stability." In contrast, Carletti and Hartmann (2003) and Beck, Coyle, Dewatripont, Freixas, and Seabright (2010) argue that competition is important for financial stability and this trade-off does not generally hold.

²The term "market integration" is used as a shorthand for the removal of geographic restrictions on banking through deregulation episodes. Until the 1970s, branching restrictions both within and across state borders in the United States created local monopolies in banking (Kroszner and Strahan, 1999). Thereafter, deregulation within states allowed state-wide branching while deregulation across state lines occurred through bilateral, regional, and even national reciprocal arrangements (Amel, 1993; Strahan, 2003). Reciprocity in these agreements integrated banking markets, enabling geographic expansion of bank operations to span multiple local markets (Radecki, 1998; Morgan, Rime, and Strahan, 2004; Kroszner and Strahan, 2014). Vives (2016) describes how the European experience has followed a similar trajectory.

market competition under banking market integration have the same implications for risk-taking as withinmarket increases in the number of competitor banks?

In this paper, we model how bank competition affects risk-taking when market integration is the principal driver of increased competition. Theory has modeled competition as a within-market increase (or threat of increase) in the number of competitor banks (Besanko and Thakor, 1992; Allen and Gale, 2004; Boyd and De Nicolò, 2005; Martinez-Miera and Repullo, 2010). In practice, however, market integration has been the major driver of increased bank competition. Market integration increases not only the number of banks, but also the number of borrowers (entrepreneurs) and depositors—the potential customer base of each bank. Therefore, accounting for both changes is critical in analyzing the linkages between bank competition and financial stability.

Our results show that risk implications of across-market competition under banking market integration are significantly different from that of increases in the number of within-market competitor banks. Standard theory finds entrepreneurial risk-taking as increasing in the loan rate so that any relation between competition and loan rates translates to that between competition and risk-taking (Stiglitz and Weiss, 1981; Boyd and De Nicolò, 2005). We find that any relation between competition and risk-taking that prevails under within-market competition can be reversed under across-market competition. The richer set of results can also help understand why the weight of empirical evidence on bank competition and risk-taking has been mixed, with no clear consensus.

This paper distinguishes between two risk-incentive mechanisms from increased competition under market integration that operate through *loan rates*. First, market integration increases competition by raising the number of competitor banks, and this tends to reduce loan rates. This traditional negative relationship, that applies to both within-market and across-market competition, is termed the bank-competitor effect of increased competition on loan rates (Boyd and De Nicolò, 2005). Second, market integration also increases competition by increasing the number of entrepreneurs and depositors - customers of banks - in the integrated market. Competition increases because both deposit supply and loan demand become more elastic with the expansion in market size. Also, individual banks become small relative to the market and behave more like price takers (Novshek, 1980).³ Increasing the number of depositors makes the deposit supply schedule in the integrated market more elastic than that in segmented markets prior to integration. This reduces the (per unit) cost of loanable funds which tends to lower the equilibrium loan rate. Similarly, increasing the number of borrowers also makes the loan demand schedule more elastic. This increases loan demand at any given loan rate and tends to raise the equilibrium loan rate in the integrated market. As long as the integrating markets do not have the same customer composition or more precisely, ratio of borrowers to depositors, these changes in loan demand and deposit supply generate a bank-customer effect of increased competition on loan rates.⁴ Unlike the negative bank-competitor effect, the bank-customer effect can be positive or negative, depending on the relative changes of the deposit supply and loan demand schedules from integration. The overall effect on loan rates of increased across-market competition arising from market integration is comprised of the bank-competitor and bank-customer effects.

Initially, markets where borrowers are in relatively shorter supply compared to depositors will, prior to

³As Novshek (1980, p. 473) observes, "Firms (banks) may become small relative to the market in two ways: through changes in technology, absolute firm size (the smallest output at which minimum average cost is attained) may become small, or, through shifts in demand, the absolute size of the market (the market demand at competitive price) may become large."

⁴Unless otherwise mentioned, the bank-competitor and bank-customer effects refer to changes in *loan rate*, the variable of interest, because it directly affects risk-taking. Note that these effects also change deposit rates (see Section 2.3).

integration, have lower loan rates than those where borrowers are in relatively larger supply compared to depositors. *Ceteris paribus*, what happens to loan rates when the markets are integrated depends on what happens to the relative balance between depositors and entrepreneurs in the new, integrated market. Loan rates will be lower than in the segmented market where depositors were scarce, but they may be higher than in the segmented market where depositors were plentiful, depending on the relative changes in the numbers of depositors and entrepreneurs. Therefore, the composition of the banks' customer base changes when markets are integrated—and the effect of such changes on loan rates is the bank-customer effect. When the bank-customer effect is positive (because integration increases the number of borrowers relative to depositors) and sufficiently strong to outweigh the negative bank-competitor effect, market integration reverses the traditional negative association between competition and loan rates (Boyd and De Nicolò, 2005).

Model and results. To model risk-taking, we adopt a widely used framework in theories of bank competition and risk-taking (Boyd and De Nicolò, 2005; Martinez-Miera and Repullo, 2010). Banks lend to entrepreneurs (borrowers) who invest in risky projects but have limited liability. Banks face entrepreneurial moral hazard because the borrowers' choice of project risk is unverifiable and cannot be contracted upon. Project risks are perfectly correlated across borrowers so that risk-taking by borrowers coincides with risk-taking by banks.⁵ In this environment, raising the loan rate decreases the net return on successful projects, incentivizing borrowers to seek projects less likely to succeed but with higher returns when successful (Stiglitz and Weiss, 1981). Throughout this study, competition affects risk-taking directly through loan rates and the relation between loan rates and risk-taking is positive.⁶

Combining the effect of competition on loan rates with that of loan rates on risk-taking generates implications for risk-taking in our framework. Increasing the number of competitor banks in the *segmented market equilibrium* (SME) lowers loan rates (negative bank-competitor effect), and consequently, risk-taking. Although formulated in the context of competition within an individual market, as described in Boyd and De Nicolò (2005), we show that this result extends to competitors, the increased competition tends to lower loan rates charged by banks. Because risk-taking increases with loan rates, the bank-competitor effect of both within-market and across-market competition lowers risk-taking.

We show that the association between competition and risk-taking in the SME can be reversed by a positive and sufficiently strong bank-customer effect in the *integrated market equilibrium* (IME) that outweighs the negative bank-competitor effect. Heterogeneity in the customer composition across integrating markets – specifically, the ratio of borrowers to depositors – leads to differences in customer composition between the integrated and the segmented markets. Transitioning from a lower (higher) to higher (lower) ratio of borrowers to depositors implies an increase (decrease) in loan demand relative to the supply of loanable funds – a positive (negative) bank-customer effect – that tends to increase (decrease) IME loan rates. As discussed above, changes in loan rates and risk-shifting depend on the relative strength of the bank-competitor and bank-customer effects. A negative bank-customer effect reinforces the negative bank-competitor effect of market integration on loan rates is unambiguously negative. In contrast,

⁵Although returns are perfectly correlated, bank risk-taking is determined by an optimal contracting problem as discussed in Boyd and De Nicolò (2005) instead of a portfolio choice problem as modeled in Allen and Gale (2004). Martinez-Miera and Repullo (2010) show how risk-taking can change when project risks are imperfectly correlated.

⁶In a generalized version of borrower moral hazard wherein investment (project) size is endogenously determined, Dam and Sengupta (2024) show that the association between loan rates and risk-taking can also be negative.

when the bank-customer effect is positive and sufficiently large it dominates the negative bank-competitor effect. As a result, borrowers face higher IME loan rates relative to the SME even though market integration has increased the number of competitor banks. We view this result as a reversal of the effect of increased within-market competition on loan rates.

Our results underscore the importance of incorporating market integration into any examination of competition-stability linkages. We find that within- and across-market competition have different implications for risk-taking as long as the integrating markets are heterogeneous. Heterogeneity in the ratio of entrepreneurs to depositors yields the nonzero bank-customer effect under across-market competition that can potentially reverse the relation between within-market competition and risk-taking. Evidently, the bank-customer effect highlighted here is novel and, by construction, absent under within-market competition. The empirical implications of these results are discussed in Section 4.

Bank mergers. We extend the model to capture bank mergers, the predominant form of exit that has accompanied market integration over the decades (Wheelock and Wilson, 2000; DeYoung, 2019).⁷ Regulatory barriers to competition can generate heterogeneity so that banks across different segmented markets operate at different efficiencies.⁸ Section 3 introduces this heterogeneity in terms of bank-specific operating costs (non-interest expenses) that vary by market. We use an extensive-form game wherein banks decide whether to merge and a planner or antitrust authority decides whether to allow mergers. Focusing attention on pairwise mergers, we find that mergers between pairs of unlike banks (a high-cost bank and a low-cost bank) are profitable for large efficiency gains. We model how market integration incentivizes mergers between efficient and relatively inefficient banks as has been the pattern of bank merger activity documented in numerous empirical studies.⁹ Because the bank-customer effect tends to reduce loan rates in markets that transition from higher to lower ratio of borrowers to depositors, a strong negative bank-customer effect can lower loan rates even when the number of competitor banks has not increased in the integrated market. So, the bank-customer effect also helps explain pro-competitive outcomes accompanying market integration and consolidation in the banking industry (Berger et al., 1995, 1999).

In our model, efficiency gains from pairwise mergers drive merger profitability as well as social welfare gains. We find that these efficiency gains must be sufficiently large not only for banks to find mergers profitable, but also for mergers to enhance welfare so that the antitrust authority approves such mergers.¹⁰

⁷Although bank failures are noteworthy, the dominant reason behind exits during this period was not bank failures but bank mergers. In their study of bank exits, Wheelock and Wilson (2000, p. 127) use the terms mergers and acquisitions interchangeably and find that "Since 1984, the number of acquisitions has exceeded the number of failures four-fold, even when acquisitions of insolvent banks are counted only as failures." The contrast is stronger for the period (post-1993) after their study (for example, see De Young, 2019, Figure 31-3).

⁸Market segmentation and the ensuing lack of competitive pressures have been viewed as the source of inefficiencies among banks (Koetter, Kolari, and Spierdijk, 2012). For example, Kroszner (2001, p. 38) argues that, "... branching restrictions tend to reduce the efficiency and consumer convenience of the banking system, and small banks tend to be particularly inefficient in states where branching restrictions offer them the most protection."

⁹Berger et al. (1999, p. 150) review these early studies, and conclude "The prior geographic restrictions on competition may have allowed some inefficient banks to survive. The removal of these constraints allowed some previously prohibited M&As to occur, which may have forced inefficient banks to become more efficient by acquiring other institutions, by being acquired, or by improving management practices internally."

¹⁰Salant, Switzer, and Reynolds (1983) show that for mergers to be profitable in a Cournot industry, a critical mass (about 80%) of the firms must merge. In contrast, our finding is consistent with previous research which shows that mergers under Cournot competition that do not result in a highly concentrated market are profitable only if they yield large efficiency gains (Perry and Porter, 1985). Our results also capture the classical trade-off between welfare-reducing price increase from increased market power and welfare-improving gains in efficiency (Williamson, 1968). When increased market power effect is large relative to efficiency gains, we obtain that mergers are privately but not socially optimal, which is in line with the findings of Farrell and Shapiro (1990).

However, we find that even when mergers enhance social welfare by conventional standard, they may still increase risk-taking and reduce financial stability. Accordingly, our framework presents scenarios in which the implications for welfare and risk-taking generates conflicting recommendations for merger reviews. The financial stability implications of this trade-off present a rationale behind the inclusion of the *financial stability factor* for merger reviews.¹¹

Related literature. Our theoretical contribution lies in uncovering the bank-customer effect, a previously unexplored risk-incentive mechanism, distinct from the bank-competitor effect explored in prior studies (Allen and Gale, 2004; Boyd and De Nicolò, 2005; Martinez-Miera and Repullo, 2010). Unlike increased competition from an increase in the number of banks, increased competition under market integration is not necessarily rate-reducing.¹² Because the final outcome depends on underlying conditions, namely customer composition in the integrating markets, no two deregulation (market integration) episodes are necessarily alike.¹³

In addition to competition and risk-taking, our paper also contributes to theories examining the integration of banking markets. Morgan, Rime, and Strahan (2004) extend the model of monitored financing and borrower moral hazard in Holmström and Tirole (1997) to show how integration made "state business cycles smaller, but more alike." Similar to their study, our model compares equilibria where banks compete within markets but are immobile across markets (our notion of within-market competition) with those where banks are mobile across markets (across-market competition).¹⁴ However, while they focus on the convergence of business cycles, we study how banking market integration affects risk-taking incentives.

Empirical studies are classified as conforming either to the competition-fragility view or to the competitionstability view (Berger, Klapper, and Turk-Ariss, 2017; Jiang, Levine, and Lin, 2023). Our model helps reconcile the two views: We ascertain which initial underlying conditions lead to increases or decreases in loan rates and risk-taking under deregulation. Section 4 shows how the relative strength of the bank-customer effect, the key determinant of differences in model outcomes, increases with the degree of heterogeneity in the initial customer composition of integrating markets. In particular, if the differences in initial customer composition are sufficiently large, loan rates and risk-taking can increase even when the number of competitor banks increase. However, estimating this testable prediction poses challenges because direct measures of customer composition, the ratio of borrowers to depositors, suffer from endogeneity concerns. Following Becker (2007), we argue that the fraction of seniors in the local population is a valid instrument for our customer composition measure. While this measure explains geographical segmentation in terms of loan outcomes in Becker (2007), our model predicts that it also has significant explanatory power for loan

¹¹The inclusion of the financial stability factor in Section 604(d) of the Dodd-Frank Act has been a landmark for bank merger reviews (Congress of the United States of America, 2010). "[T]he addition of a financial stability factor ... contrasts with an antitrust pre-merger review, in which the focus is solely on whether the transaction would substantially lessen competition" (Tarullo, 2014). When evaluating a proposed bank acquisition or merger, the Federal Reserve Board is now required to consider "the extent to which [the] proposed acquisition, merger, or consolidation would result in greater or more concentrated risks to the stability of the United States banking or financial system".

¹²Parlour and Rajan (2001) also find that increased lender competition can increase loan rates in a model with strategic default and non-exclusive contracts.

¹³Studies exploring this possibility and conducting separate assessments for each deregulation event (or group of deregulation events) have found the effects to be heterogeneous (Jayaratne and Strahan, 1996; Wall, 2004; Huang, 2008)

¹⁴Similar to the SME and the IME in our model, Morgan, Rime, and Strahan (2004) compare the intrastate banking regime with the interstate banking regime. However, our model also extends to market integration within state borders. For example, the SME in our model extends to situations where banking markets within a state are segmented, such as those under unit banking laws (Kroszner and Strahan, 1999). Relative to unit banking, statewide (intrastate) banking would be captured by the IME in our model. In short, our model captures integration of banking markets both within and across state lines.

rate changes from deregulation. In addition, the bank-customer effect also explains how deregulation can yield pro-competitive outcomes despite consolidation in the banking industry (Berger et al., 1995, 1999). Until now, empirical work has explained these outcomes in terms of the trade-off between market power and efficiency gains (Jayaratne and Strahan, 1998; Sapienza, 2002). However, more work is needed to determine the relative contribution of the bank-customer effect uncovered in our model.

2. The model

Our goal is to demonstrate that the risk implications of within-market competition are different from those of across-market competition. An increase in within-market competition can be brought about, for example, by promoting *de novo* entry. Even when markets are segmented, lowering set-up costs (e.g. charter fees and paid-in capital requirements) can increase competition within a given market (Carlson, Correia, and Luck, 2022).¹⁵ On the other hand, deregulation of entry barriers between geographic markets can also increase the number of competitor banks by allowing banks outside the region to enter the market. If this deregulation occurs on a reciprocal basis, banking markets become integrated in that banks have access to customers across erstwhile segmented markets (Morgan et al., 2004).

We adopt a framework widely used in theoretical studies of bank competition and risk-taking. Following Boyd and De Nicolò (2005), we assume that banks are fully financed by insured deposits (they have no equity and do not transact in the interbank market) and that investment returns are perfectly correlated (see endnote 19). We introduce two additional features to this framework. First, we consider the integration of two (or more) *heterogenous* banking markets. Markets are heterogeneous in terms of *customer composition*, or more precisely, the *ratio of borrowers to depositors*. As a result, market integration not only increases the number of competitor banks – the traditional source of increased competition – but also expands deposit supply and loan demand asymmetrically. The latter alters the composition of borrowers and depositors in the integrated market in a way that is fundamentally different from a simple increase in the number of banks. Second, the deposit supply function is *upward-sloping* so that banks pay a higher deposit rate to finance an increase in lending.¹⁶ A generalized version shows that the model's results hold more broadly (see Appendix 6).

Consider two banking markets or regions indexed by $j = 1, 2.^{17}$ Market j has $a_j > 0$ depositors, $b_j > 0$ entrepreneurs, and the same number of $n \ge 1$ banks.¹⁸ All agents are risk-neutral. Entrepreneurs have access to a set of risky projects, each requiring unit investment that must be borrowed from a bank. Projects yield a stochastic return θ when successful, with probability $p(\theta) \equiv 1 - \theta/\lambda$ where $\lambda > 1$, and 0 when not, where $\theta \in [0, \lambda]$, the "riskiness" of the project, is not verifiable, and therefore, non-contractible (borrower moral hazard). Returns are perfectly correlated, and riskier projects yield a higher return in case

¹⁵Carlson et al. (2022, p. 464) study competition *within* segmented markets: "The National Banking Era constitutes a close-toideal empirical laboratory to study the causal effects of banking competition . . . the prevalence of unit banking ensures that banking markets are local and well defined, which allows us to compare different, arguably independent markets."

¹⁶Allen and Gale (2004) and Boyd and De Nicolò (2005) also assume an upwardly-sloping deposit supply. If we assumed instead a perfectly elastic deposit supply, then loan rates would be the same even when loan demand varied across markets (see Appendix B for details). Microfoundations for the deposit supply function are provided in Appendix A.

¹⁷We consider markets segmented due to institutional, non-economic barriers such as geography, legislation, or regulation.

¹⁸Appendix 6 analyzes the case where integrating markets no longer have the same number of banks.

of success.¹⁹ Given the loan rate in region j, r_j , each borrower solves

$$\theta_j \equiv \theta(r_j) = \underset{\theta}{\operatorname{argmax}} \left\{ (1 - \theta/\lambda)(\theta - r_j) \right\} = \frac{\lambda + r_j}{2}.$$
(1)

Higher loan rates reduce borrower margins and incentivize borrowers to take higher risk. The incentive compatibility constraint (1) implies a positive association between loan rates and risk-shifting under borrower moral hazard (Stiglitz and Weiss, 1981; Boyd and De Nicolò, 2005).²⁰ Throughout this study, the effect of competition on risk-taking operates directly through loan rates, wherein borrowers optimally choose higher risk when charged higher loan rates by banks.

Next, we turn to how loan rates are determined in a competitive equilibrium. We use a model of Cournot competition, in which banks choose loan volumes subject to an upward sloping supply-of-funds schedule. We assume that integrating markets are heterogenous in terms of their customer composition, $\xi_j \equiv b_j/a_j$, the ratio of borrowers to depositors in market j. Without loss of generality, there are more borrowers relative to depositors in market 1, so that $\xi_1 < \xi_2$. We begin by characterizing deposit rates, loan rates, and risk-shifting for each segmented market and show how competition affects rates and risk-taking in the *segmented market equilibrium* (SME). Next, we solve for the equilibrium when the segmented markets are integrated into a single banking market and analyze the effects of competition on rates and risk-shifting in the *integrated market equilibrium* (IME). Finally, we compare the effect of competition on rates and risk-shifting between the SME and the IME.

2.1. The segmented market equilibrium

The SME of market j is a Cournot equilibrium with a_j depositors, b_j borrowers and n banks. Inverse deposit supply and loan demand in market j are

$$R_j(D_j/a_j) = rac{D_j}{a_j} \quad ext{and} \quad r_j(L_j/b_j) = \lambda - rac{L_j}{b_j},$$

respectively, where $D_j = \sum_{i=1}^n D_{ij}$ and $L_j = \sum_{i=1}^n L_{ij}$ are region j's aggregate deposit and loan volumes, respectively.²¹ Using the above loan demand function and the incentive constraint (1), the probability of success is increasing in aggregate loan volumes as

$$P(L_j/b_j) \equiv 1 - \frac{\theta(r_j(L_j/b_j))}{\lambda} = \frac{L_j}{2\lambda b_j}.$$

As banks lend more, the aggregate interest rate falls and that leads to less risk-taking by entrepreneurs.

Banks also pay a flat rate deposit insurance premium, normalized to zero.²² In the absence of bank

¹⁹The assumption that entrepreneurs' returns are perfectly correlated follows from Boyd and De Nicolò (2005) and is equivalent to the assumption of bank portfolios comprising perfectly correlated risks (Allen and Gale, 2004). The risk associated with each project can in general be decomposed into a systemic and idiosyncratic component. With a large number of projects, the idiosyncratic component can be perfectly diversified away. This assumption helps focus the analysis on the common component representing systemic risks.

²⁰If borrowers choose investment (project) size, (Dam and Sengupta, 2024) show that the association between loan rate and risk-shifting can be negative. We abstract from such considerations here for brevity and simplicity.

²¹In Appendix A, inverse deposit supply and inverse loan demand are derived as functions of supply-of-funds per depositor, D_j/a_j , and loan volume per borrower, L_j/b_j , respectively.

²²Similar to Allen and Gale (2004, p. 461) we assume "deposits are insured so the supply of funds is independent of the riskiness of the banks' portfolios." A positive deposit insurance premium does not change our results, so we normalize the deposit premium to zero.

equity and an interbank market, all of bank *i*'s deposits are invested in loans so that $L_{ij} = D_{ij}$. It follows that $L_j = D_j$ for j = 1, 2. Bank *i* in region *j* chooses L_{ij} to maximize expected profits as follows

$$\max_{L_{ij}} \quad \frac{L_j}{2\lambda b_j} \left(\lambda - \frac{L_j}{b_j} - \frac{L_j}{a_j}\right) L_{ij},\tag{2}$$

where expected profit equals expected interest margin, $P(L_j/b_j)(r_j(L_j/b_j) - R_j(L_j/a_j))$, times the amount lent, L_{ij} .

Lemma 1 There is a unique symmetric Cournot equilibrium of market j = 1, 2 wherein $L_j = nL_{ij}$ for all *i*, and the deposit rate, loan rate, and risk-shifting in market *j* are given by

$$R_j = \lambda \cdot \frac{n+1}{n+2} \cdot \frac{\xi_j}{1+\xi_j},\tag{3}$$

$$r_j = \lambda \left(1 - \frac{n+1}{n+2} \cdot \frac{1}{1+\xi_j} \right),\tag{4}$$

$$\theta_j \equiv \theta(r_j) = \lambda \left(1 - \frac{1}{2} \cdot \frac{n+1}{n+2} \cdot \frac{1}{1+\xi_j} \right),\tag{5}$$

respectively.

The SME interest margins, $r_j - R_j = \lambda/(n+2)$, are the same for the two markets.²³ It follows from $\xi_1 < \xi_2$ that $R_1 < R_2$, $r_1 < r_2$ and $\theta_1 < \theta_2$. The segmented market where depositors are relatively scarce (market 2) has a higher deposit rate, a higher loan rate, and higher risk-shifting than the market where depositors are relatively plentiful (market 1).

Proposition 1 The SME loan rate and risk-shifting decrease with competition in any segmented market.

Increased competition in any segmented market is defined as an increase in the number of banks. Competition can increase in any of the segmented markets if local banking authorities lower fixed set-up costs (Mankiw and Whinston, 1986; Carlson et al., 2022). With increased competition, that is, more banks within any segmented market, aggregate loan volumes increase. This lowers loan rates, which increases borrowers' profit margins, and consequently, reduces borrowers' incentive to take risk.

2.2. The integrated market equilibrium

Now consider that market 1 and market 2 are integrated to form a single banking market comprising $a_1 + a_2$ depositors, $b_1 + b_2$ borrowers, and 2n banks.²⁴ Inverse deposit supply and inverse loan demand in the integrated market are

$$R(D/(a_1 + a_2)) = \frac{D}{a_1 + a_2} \quad \text{and} \quad r(L/(b_1 + b_2)) = \lambda - \frac{L}{b_1 + b_2}, \tag{6}$$

²³Interest margins depend only on the number of banks because the deposit supply and loan demand functions are linear. Nonlinear functions would yield interest margins that depend on both the number of banks and customer composition (see Appendix 6).

²⁴We assume no entry and exit of banks with market integration. Section 3 models exit in the form of bank mergers.

respectively, where D and L are the aggregate deposit and loan volumes in the integrated market, respectively.²⁵ Inverse deposit supply and loan demand of the integrated market are the horizontal sums of the individual inverse deposit supply and loan demand schedules of the segmented markets, respectively. Competition increases with the expansion in market size because deposit supply and loan demand become more elastic in the integrated market compared to each segmented market.

Given that banks are exclusively deposit-financed, $L_i = D_i$ holds for all banks in the integrated market.²⁶ This yields the market clearing condition, L = D. Each bank *i* solves

$$\max_{L_{i}} \quad \frac{L}{2\lambda(b_{1}+b_{2})} \left(\lambda - \frac{L}{b_{1}+b_{2}} - \frac{L}{a_{1}+a_{2}}\right) L_{i}.$$
(7)

Lemma 2 There is a unique symmetric Cournot equilibrium of the integrated market wherein $L = 2nL_i$ for all *i*, and the deposit rate, loan rate, and risk-shifting are given by

$$R^* = \lambda \cdot \frac{2n+1}{2n+2} \cdot \frac{\xi^*}{1+\xi^*},$$
(8)

$$r^* = \lambda \left(1 - \frac{2n+1}{2n+2} \cdot \frac{1}{1+\xi^*} \right),$$
(9)

$$\theta^* \equiv \theta(r^*) = \lambda \left(1 - \frac{1}{2} \cdot \frac{2n+1}{2n+2} \cdot \frac{1}{1+\xi^*} \right),$$
(10)

respectively, where $\xi^* \equiv \frac{b_1+b_2}{a_1+a_2} \in (\xi_1, \xi_2)$ is the ratio of borrowers to depositors in the integrated market.

The IME interest margin, $r^* - R^* = \lambda/(2n + 2)$, also depends only on the number of banks, 2n, and is lower than the SME margin. Because agents have identical preferences under within- and across-market competition, the problem in (7) and the IME in Lemma 2 are isomorphic to the problem in (2) and the SME in Lemma 1, respectively. Despite this similarity, risk implications of within-market and across-market competition are different as shown below.

2.3. Effect of increased competition under market integration

Market integration increases competition in two ways. First, the number of competitor banks increases so that each bank faces competition from more rivals in the integrated market. Second, as horizontal sums of their segmented market components, deposit supply and loan demand schedules in the integrated market become more elastic with expanding market size. Both deposit and loan markets become more competitive with market integration as individual banks become small relative to the market.²⁷

²⁵We assume no additional costs for customers (borrowers and depositors) switching banks. As banks obtain information on borrower quality during the course of a lending relationship, switching banks is beset with problems of information asymmetry. These costs apply universally to all switching customers in segmented as well as integrated markets, not just to those switching from local to non-local banks when markets integrate (Broecker, 1990; Sharpe, 1990). We abstract from these considerations.

²⁶With a leverage restriction, banks must finance loans with a combination of deposits (debt) and equity. Imposing this equity requirement would lower loan rates and risk-shifting than if banks were exclusively deposit-financed. Another way to relax the assumption of fully deposit-financed banks is to introduce an interbank market. Qualitatively, however, the main results of Section 2.3 would remain unchanged under both modifications. The proofs are available upon request.

²⁷Integration of economies in models of intra-industry trade not only increases the measure of consumers but also expands their choice (Krugman, 1979). Although each consumer can potentially transact with more firms upon integration, consumers spend less on each variety because products are horizontally differentiated. This prompts some firms to exit the integrated market. Such exits do not occur in our setting because we assume bank products, namely deposits and loans, are not differentiated.

The bank-competitor and the bank-customer effects. We explain the effect of competition on risk-taking under market integration through its effect on loan rates. With the positive association in (1), the effect of competition on loan rates is analogous to the effect of competition on risk-taking. From (4) and (9), the effect of increased competition from market integration on loan rates can be decomposed as

$$r^{*} - r_{j} = \underbrace{-\lambda \cdot \frac{1}{1 + \xi^{*}} \left(\frac{2n+1}{2n+2} - \frac{n+1}{n+2}\right)}_{\text{Bank-competitor effect}} + \underbrace{\lambda \cdot \frac{n+1}{n+2} \left(\frac{1}{1 + \xi_{j}} - \frac{1}{1 + \xi^{*}}\right)}_{\text{Bank-customer effect with respect to market }j}.$$
(11)

The first term denotes the effect of an increase in the number of banks (from n to 2n), which we term the *bank-competitor effect* of increased competition on loan rates. This effect is always negative. The second term denotes the effect of changes in the customer composition (from ξ_j to ξ^*), which we term the *bank-customer effect* of increased competition on loan rates.

When integrating markets are homogenous (same ξ_j), effect of across-market competition is the same as that of within-market competition, namely, that of an increase in n, the number of competitor banks. Setting $\xi_1 = \xi_2$ yields $\xi^* = \xi_1 = \xi_2$, and the bank-customer effect is zero. Consequently, the effect of increased competition from market integration comprises only the negative the bank-competitor effect. In this way, a special case of market integration, namely, $\xi_1 = \xi_2$, yields predictions of traditional theories on within-market competition and risk-taking (Boyd and De Nicolò, 2005).²⁸

When the integrating markets are not homogenous ($\xi_1 \neq \xi_2$), market integration creates an additional bank-customer effect that stems from changes in the composition of borrowers and depositors. Given $\xi_1 < \xi_2$, we obtain $\xi_1 < \xi^* < \xi_2$, and the bank-customer effect with respect to markets 1 and 2 must have opposite signs: negative for market 2 and positive for market 1. For banks in market 2, transitioning from a higher to a lower ratio of borrowers to depositors implies reduced loan demand relative to deposit supply, and this tends to reduce loan rates from their SME values. This negative bank-customer effect reinforces the negative bank-competitor effect, and the overall effect of across-market competition for market 2 is unambiguously negative. So, we must have $r^* < r_2$. Accordingly, the negative bank-customer effect is a *sufficient condition* for a negative association between competition and loan rates.

For banks in market 1, transitioning from a lower to a higher ratio of borrowers to depositors implies increased loan demand relative to deposit supply, and this tends to raise loan rates. The overall effect depends on the relative strengths of the negative bank-competitor effect, the first term in (11), and the *positive* bank-customer effect with respect to market 1, the second term in (11). If the positive bankcustomer effect is not sufficiently strong, the negative bank-competitor effect dominates, and we get $r^* < r_1$. However, if the positive bank-customer effect with respect to market 1 is sufficiently strong, it dominates the negative bank-competitor effect and we get $r_1 < r^*$. Therefore, the positive bank-customer effect is a *necessary condition* for a positive association between competition and loan rates.

Using the incentive compatibility constraint (1), the effect of increased competition from market integration on loan rates and risk-taking is summarized as follows.

Proposition 2 When market 2 has a higher ratio of borrowers to depositors compared to market 1, that is $\xi_1 < \xi_2$, the IME loan rate and risk-taking

²⁸A notable special case is one where the integrating markets are identical (i.e., $a_1 = a_2$ and $b_1 = b_2$). Integrating multiple identical markets is equivalent to *replicating a single market* as described in Allen and Gale (2004).

- (a) are always lower than their SME values in market 2, $r^* < r_2$ and $\theta^* < \theta_2$;
- (b-i) are lower than their SME values in market 1, $r^* < r_1$ and $\theta^* < \theta_1$, if the positive bank-customer effect with respect to market 1 is sufficiently weak;
- (b-ii) are higher than their SME values in market 1, $r^* > r_1$ and $\theta^* > \theta_1$, if the positive bank-customer effect with respect to market 1 is sufficiently strong.

That loan rates can increase from the SME to the IME in market 1 despite an increase in the number of competitor banks is key to understanding how the implications of across-market competition are different from within-market competition. Because the bank-competitor effect in (11) captures the effect of within-market competition, the result indicates that a strong and positive bank-customer effect under across-market competition can reverse the effects of within-market competition leading to increases in loan rates and risk-taking in market 1.

Effect on deposit rates. From (3) and (8), the effect of increased competition from market integration on deposit rates can be decomposed as

$$R^* - R_j = \underbrace{\lambda \cdot \frac{\xi^*}{1 + \xi^*} \left(\frac{2n+1}{2n+2} - \frac{n+1}{n+2}\right)}_{-\xi^* \times \text{ Bank-competitor effect}} + \underbrace{\lambda \cdot \frac{n+1}{n+2} \left(\frac{1}{1 + \xi_j} - \frac{1}{1 + \xi^*}\right)}_{\text{Bank-customer effect with respect to market }j}.$$
(12)

Unlike the bank-competitor effect in (11), the first term in (12) is positive, indicating that banks tend to raise deposit rates as more banks compete for deposits.²⁹ In contrast, the bank-customer effect is the same in both (11) and (12): negative for market 2 and positive for market 1. Following arguments similar to those for (11), we obtain that the positive bank-customer effect with respect to market 1 reinforces the positive effect of within-market competition, the first term in (12), so that the effect of across-market competition on deposit rates is unambiguously positive for market 1. However, the two terms in (12) have opposite signs for market 2 and depending on the relative strengths of these terms, the effect of across-market competition on deposit rates can be positive or negative for market 2. We summarize as follows.

Corollary 1 When market 2 has a higher ratio of borrowers to depositors than market 1, that is $\xi_1 < \xi_2$, the IME deposit rate

- (a) is always higher than its SME value in market 1, $R^* > R_1$;
- (b-i) is higher than its SME value in market 2, $R^* > R_2$, if the negative bank-customer effect with respect to market 2 is sufficiently weak;
- (b-ii) is lower than its SME value in market 2, $R^* < R_2$, if the negative bank-customer effect with respect to market 2 is sufficiently strong.

Conventional wisdom argues that deposit rates increase with competition (Allen and Gale, 2004). However, with a sufficiently strong bank-customer effect, we find that deposit rates can decrease in one of the integrating markets even when the number of competing banks increase.

To summarize, across-market competition under market integration has the potential to alter customer composition which affects loan and deposit rates in ways beyond a simple increase in the number of banks.

²⁹The bank-competitor effect for deposit rates is $-\xi^*$ times the (negative) bank-competitor effect for loan rates.

When the bank-customer effect is sufficiently strong to outweigh the bank-competitor effect, we obtain $r_1 < r^* < r_2$ and $R_1 < R^* < R_2$. Market integration helps borrowers in market 2 by lowering loan rates but hurts borrowers in market 1 by raising them. The converse holds for depositors. Depositors in market 1 (market 2) get higher (lower) rates on their deposits. In sum, market integration affects borrowers and depositors asymmetrically: In markets where borrowers are relatively scarce (plentiful) prior to integration, market integration makes borrowers pay higher (lower) loan rates whereas depositors receive higher (lower) rates on their deposits. Accordingly, across-market competition can yield differences in outcomes between borrowers and depositors in ways that is not captured in models of within-market competition wherein the effect of increased competition is comprised entirely of the bank-competitor effect that benefits all customers.

We conclude this discussion with two important caveats.

Remark 1 We have assumed throughout that borrower risk-taking increases with loan rates (Stiglitz and Weiss, 1981). In companion work, Dam and Sengupta (2024) find that endogenous loan (project) size can potentially change this relation. Nevertheless, Dam and Sengupta (2024) still find that across-market competition can reverse the effect of increased within-market competition on loan rates and risk-taking. In other words, the main results of the paper are robust to whether risk-taking increases or decreases with loan rates.

Remark 2 The bank-customer effect is also relevant for decreases in n through bank exits (for more details, see discussion in the Section 3 below). With fewer banks and more market power for each bank, the negative bank-competitor effect tends to raise loan rates. Now, the bank-competitor effect reinforces the positive bank-customer effect with respect to market 1 but runs against the negative bank-customer effect with respect to market 1 but runs against the negative bank-customer effect with respect to market 2. In contrast to Boyd and De Nicolò (2005), our model predicts that deregulation can yield pro-competitive outcomes such as lower loan rates in market 2, even though the number of banks has decreased.

3. Bank mergers

We extend the model to show how market integration incentivizes bank mergers and analyze their implications for risk-taking. Empirical evidence on industry consolidation in banking motivates our choice of exit. During 1984-1993, the number of bank mergers and acquisitions in the United States exceeded the number of failures four-fold "even when acquisitions of insolvent banks are counted only as failures" (Wheelock and Wilson, 2000, p. 127). In short, mergers have been the predominant mode of exit.

We introduce efficiency gains into our model by incorporating bank heterogeneity in terms of their operating costs (non-interest expenses), so that operating costs of bank i in market j = 1, 2 are

$$C_{ij}(D_{ij}) = c_j D_{ij},$$

where $c_j \ge 0$ is the constant (market-specific) marginal operating cost of all banks in market j.³⁰ The motivation for differences in marketwise operational efficiencies are attributed to regional differences in regulation (protection) that provided banks with local market power. Kroszner (2001) argues that, prior to

³⁰Given the assumption that all loans are deposit-financed, it is innocuous to assume that costs depend only on deposit volumes (as opposed to both loans and deposits as in Klein, 1971).

the relaxation of location restrictions, geographic variation in U.S. banks' cost efficiencies could be linked to variations in the degree of protection across the different banking jurisdictions (cf. endnote 8). Given this setup, if we assume instead that banks are heterogenous (in terms of operating costs) within the same segmented market, it can create incentives for merger between a high-cost bank and a low-cost bank. Any pair of dissimilar banks can merge to capture potential efficiency gains (as described below in Section 3.2). In light of this, our assumption of within-market homogeneity is in the interest of simplicity and tractability: It captures the notion that competition and consolidation within each segmented market has exhausted all within-market efficiency gains prior to integration.

We distinguish between *in-market mergers* between like banks with same operating costs wherein the merged entity operates with the same cost as its predecessors (zero efficiency gains), and *across-market mergers* between unlike banks with dissimilar operating costs wherein the merged entity operates as a low-cost bank (full efficiency gains).³¹ We show that as long as mergers between homogenous banks do not yield efficiency gains, a merger between a pair of banks is profitable only if the pre-merger market structure is a duopoly (Lemma 7(a) in Appendix B). We assume that antitrust authorities deny approvals for mergers that yield monopolies, so that n > 2 in any segmented market. We also show that in a market with the same number of low-cost and high-cost banks, any pairwise merger between banks with same operating costs is never profitable (Lemma 7(b) in Appendix B).

In addition to variations in customer composition, $\xi_1 < \xi_2$, bank operating efficiencies generate an additional source of market heterogeneity. We assume $c_1 = 0$ and $c_2 = c > 0$ so that banks in the market with higher ratio of borrowers to depositors (market 2) are also the inefficient ones. In terms of exposition, this is the simplest case. The consequences of relaxing this assumption will become clear towards the end of this analysis and is discussed below (see endnotes 32 and 35).

Lemma 3 The symmetric SME loan rate and risk-shifting in market j = 1, 2 are given by

$$r_{j}(c_{j}) = \lambda - (\lambda - c_{j}) \cdot \frac{n+1}{n+2} \cdot \frac{1}{1+\xi_{j}} \quad \text{and} \quad \theta_{j}(c_{j}) = \lambda - \frac{1}{2}(\lambda - c_{j}) \cdot \frac{n+1}{n+2} \cdot \frac{1}{1+\xi_{j}}, \tag{13}$$

respectively.

With $c_1 = 0$, the SME loan rate and risk-taking in market 1 are the same as obtained in Lemma 1. But market 2 loan rates and risk-shifting are not only higher than those in market 1 (because of higher relative loan demand $\xi_1 < \xi_2$), but also higher than their values in Lemma 1 because higher operating costs also contribute to higher loan rates.³²

Market integration yields n low-cost and n high-cost banks. We analyze a sequential game between a social planner (antitrust authority) that moves first and decides whether to allow mergers. Banks maximize profits and decide whether to merge given the planner's decision. Mergers occur if the planner permits banks to merge and banks find mergers profitable. Otherwise, high- and low-cost banks compete in a

³¹Although not modeled, the assumption that across-market mergers yield greater efficiency gains than in-market mergers is grounded in theories of asymmetric information. Synergies from across-market mergers of dissimilar banks incorporate transfers of local market knowledge and are relatively greater. The assumptions of zero efficiency gains from in-market and full efficiency gains from across-market mergers are a normalization of the relatively greater synergies from across-market mergers.

³²The simplification that both effects operate in the same direction is easily modified. If instead, we had for example, $\xi_1 < \xi_2$ but $c_1 > c_2$, market 2 loan rates would be higher or lower than market 1 rates depending on the relative strength of the two effects (former has higher relative loan demand but the latter has higher operating cost). While the alternative assumption complicates the solution, it does not qualitatively alter the mechanisms under consideration.

Cournot fashion in the integrated market. Because pairwise mergers between like banks are not profitable in this setup (as described above), we can focus on mergers between unlike banks in the integrated market. We solve the model by backward induction and characterize subgame perfect equilibria of the integrated market as the "no-merger IME" and the "merger IME".

3.1. The no-merger IME

A no-merger IME prevails if either the planner disallows mergers or banks find mergers unprofitable. In both cases, n low-cost and n high-cost banks compete in a Cournot fashion with deposit supply and loan demand schedules given in (6). In equilibrium, L = D, and bank i from market j solves

$$\max_{L_{ij}} \quad \frac{L}{2\lambda(b_1 + b_2)} \left(\lambda - \frac{L}{b_1 + b_2} - \frac{L}{a_1 + a_2} - c_j\right) L_{ij},\tag{14}$$

where L_{ij} denotes the amount lent by a bank *i* with marginal cost c_j . The following result characterizes the symmetric *interior* no-merger IME.

Lemma 4 If $c < \bar{c} \equiv \frac{\lambda}{n+2}$, all banks make strictly positive profits, so $\pi_j^* > 0$ for j = 1, 2, and the loan rate and risk-shifting in the no-merger IME are

$$r^*(c) = \lambda - Z(n, c) \cdot \frac{1}{1 + \xi^*}$$
 and $\theta_j(c_j) = \theta^*(c) = \lambda - \frac{1}{2} \cdot Z(n, c) \cdot \frac{1}{1 + \xi^*}$, (15)

respectively, where

$$Z(n, c) \equiv \frac{(3n+2)(2\lambda - c) + \sqrt{c^2(3n+2)^2 + 4n^2\lambda(\lambda - c)}}{8(n+1)}$$

is strictly decreasing in c.

However, if c is sufficiently large, so that $c \ge \bar{c}$, high-cost banks do not break even and $L_2^*(\bar{c}) = 0$. So, the no-merger IME comprises only n low-cost banks. We focus on the more interesting case, $c < \bar{c}$, where both high-cost and low-cost banks compete and make strictly positive profits.³³ We compare the SME and the no-merger IME as follows.

Proposition 3 When market 2 has a higher ratio of borrowers to depositors than market 1, that is $\xi_1 < \xi_2$, then for all $c \in (0, \bar{c})$, the no-merger IME loan rate and risk-taking

- (a) are always lower than their SME values in market 2, $r^*(c) < r_2(c)$ and $\theta^*(c) < \theta_2(c)$;
- (b-i) are lower than their SME values in market 1, $r^*(c) < r_1$ and $\theta^*(c) < \theta_1$, if the positive bankcustomer effect with respect to market 1 is sufficiently weak;
- (b-ii) are higher than their SME values in market 1, $r^*(c) > r_1$ and $\theta^*(c) > \theta_1$, if the positive bankcustomer effect with respect to market 1 is sufficiently strong.

³³However, if $c \ge \bar{c}$, the integrated market consists only of *n* identical (low-cost) banks, wherein the market structure is the same as that in the merger IME analyzed in Section 3.2 below. In both cases, high-cost banks exit the market and only the low-cost banks survive in the integrated market. We view the latter to be the more interesting case because exits through mergers have outnumbered exits through failures (Wheelock and Wilson, 2000).

Just as in equation (11), we can decompose the difference between loan rates in the no-merger IME and the SME of market j = 1, 2 into the bank-competitor and bank-customer effects as

$$r^{*}(c) - r_{j}(c_{j}) = \underbrace{-\frac{1}{1+\xi^{*}} \left(Z(n, c) - \lambda \cdot \frac{n+1}{n+2} \right)}_{\text{Bark-competitor effect}} + \underbrace{\frac{n+1}{n+2} \left(\frac{\lambda - c_{j}}{1+\xi_{j}} - \frac{\lambda}{1+\xi^{*}} \right)}_{\text{Bark-customer effect with respect to market } j}.$$
(16)

The first term in (16) denotes the negative bank-competitor effect and is the same for both markets. With Z(n, c) decreasing in c, higher cost-inefficiency weakens (reduces the magnitude of) the bank-competitor effect.³⁴ However, the second term in (16), the bank-customer effect, is now different between the two integrating markets. The bank-customer effect is negative for market 2, and with $c_2 = c > 0$, larger in magnitude than that in (11). Moreover, higher cost-inefficiency, c, strengthens the bank-customer effect. Because both bank-competitor and bank-customer effects are negative for market 2, no-merger IME loan rates will always be lower than their SME values in market 2, so $r^*(c) < r_2(c)$. The difference being that a higher cost-inefficiency in market 2 (i.e., higher c) implies a stronger (negative) bank-customer effect for market 2.

In contrast, with $c_1 = 0$, the bank-customer effect with respect to market 1 in the no-merger IME is positive and identical to that in (11). Following arguments similar to Proposition 2(b), we get Proposition 3(b) for market 1: Loan rates and risk-taking are higher or lower than their SME values depending on the relative strength of the negative bank-competitor and positive bank-customer effects. The difference between Propositions 2(b) and 3(b) come from the effect of cost-inefficiency. Because the bank-competitor effect weakens with c, all else equal, a higher c makes it more likely that IME loan rate and risk-taking are higher than their SME values in market 1. Intuitively, a higher c creates a wider gap between the SME loan rates and increases the likelihood that the IME loan rate lies between the SME values. We build on this intuition for empirical implications in Section 4.³⁵

3.2. The merger IME

Pairwise mergers between n high-cost and n low-cost banks in the integrated market yield n low-cost banks. Each bank faces deposit supply and loan demand schedules given by (6), and solves

$$\max_{L_i} \quad \frac{L}{2\lambda(b_1+b_2)} \left(\lambda - \frac{L}{b_1+b_2} - \frac{L}{a_1+a_2}\right) L_i.$$

The merger IME exists if each pair of a low-cost bank and a high-cost bank finds it profitable to merge, and the planner or the antitrust authority allows all such mergers. We assume for now that a merger IME exists, and in Section 3.3 below, we provide conditions for its existence.

Lemma 5 We obtain $\hat{c} \in (0, \bar{c})$ such that for large efficiency gains, that is $c > \hat{c}$, the merger between a pair of low- and high-cost banks is profitable. The merger IME loan rate and risk-shifting are

$$r_M = \lambda - \lambda \cdot \frac{n+1}{n+2} \cdot \frac{1}{1+\xi^*} \quad \text{and} \quad \theta_M = \lambda - \frac{\lambda}{2} \cdot \frac{n+1}{n+2} \cdot \frac{1}{1+\xi^*}, \tag{17}$$

³⁴Note that, for c = 0, the integrated market is same as the one described in Section 2.2, and the bank-competitor effect in (11) and (16) are the same. On the other hand, for $c = \overline{c}$, the integrated market consists only of *n* low-cost banks, so the bank-competitor effect is zero.

³⁵This result also stems from assuming $\xi_1 < \xi_2$ and $c_1 < c_2$ (see endnote 32). However, if $\xi_1 < \xi_2$ but $c_1 > c_2$, a stronger positive bank-customer effect may be needed to get $r^*(c) > r_1$.

respectively.

A merger is profitable when the sum of the no-merger IME profits of a low-cost bank and a high-cost bank is strictly less than the profits of the merged entity formed by the two banks in the merger IME. We find that this profitability condition holds when efficiency gains are sufficiently high, that is, $c > \hat{c}$. When efficiency gains are sufficiently high, "to merge" is a *strictly dominant strategy* for a pair of unlike banks. The following proposition compares the SME loan rates and risk-taking with those in the merger IME.

Proposition 4 When market 2 has a higher ratio of borrowers to depositors than market 1, that is $\xi_1 < \xi_2$, then for all $c < \overline{c}$, the merger IME loan rate and risk-taking

- (a) are lower than their SME values in market 2, $r_M < r_2(c)$ and $\theta_M < \theta_2(c)$;
- (b) are higher than their SME values in market 1, $r_1 < r_M$ and $\theta_1 < \theta_M$.

By construction, the merger IME comprises n low-cost banks, which is the same number in each segmented market, resulting in a zero bank-competitor effect.³⁶ Consequently, $r_M - r_j(c)$ comprises only the bankcustomer effect, which is positive with respect to market 1 but negative with respect to market 2. As a result, we get, $r_M < r_2(c)$ and $\theta_M < \theta_2(c)$ and and $r_M > r_1$ and $\theta_M > \theta_1$. The merger analysis emphasizes the importance of the bank-customer effect even after allowing for bank exits through mergers. Proposition 4 shows that loan rates and risk-shifting are lower than their SME values in the high-cost market (market 2) even when the number of competitor banks has not increased in the IME. This demonstrates that competition under market integration can yield pro-competitive outcomes without a concomitant increase in the number of banks. Such pro-competitive outcomes can originate from the bank-customer effect that alters price-taking behavior or from efficiency gains of bank mergers or both.

3.3. Welfare analysis and policy implications

Expected social welfare is the sum of the expected depositor surplus, the expected borrower surplus and the aggregate expected bank profits.³⁷ The planner permits mergers if the expected social welfare in the merger IME exceeds that in the no-merger IME. Let $W^*(c)$ and W_M denote social welfare in the no-merger and merger IME, respectively. Mergers are permitted if $\Delta W(c) \equiv W^*(c) - W_M < 0$ (see Appendix B for details). Using Example 1 below, we show that allowing mergers is the optimal choice for the planner when efficiency gains c are large, because social welfare in the merger IME is greater than that in the non-merger IME.

Example 1 Let $\lambda = 1.5$, $a_1 = a_2 = 4$, $b_1 = 1$ and $b_2 = 1.2$. Thus, $\xi_1 = 0.25$, $\xi_2 = 0.3$ and $\xi^* = 0.275$. Further, set n = 3 so that $\bar{c} = \lambda/(n+2) = 0.3$. Figure ?? depicts the function $\Delta W(c)$ for $c \in (0, 0.3)$. The function, $\Delta W(c)$, intersects the horizontal axis at $c^* \approx 0.035$. Welfare gains from mergers are low for small differences in cost between high- and low-cost banks, $c \leq c^*$. However, if $c > c^*$, then efficiency gains are sufficiently large so that social welfare in the merger IME exceeds that in the no-merger IME.

³⁶This simplification is easily modified if $n_1 \neq n_2$. If $n_1 > n_2$, there are n_1 low-cost banks and $n_1 - n_2$ more banks for market 2 customers in the merger IME. But if $n_1 < n_2$, n_1 low-cost and $n_2 - n_1$ high-cost banks compete in a Cournot fashion in the merger IME.

³⁷The expected social welfare does not include the amount disbursed by the deposit insurer as it is a direct transfer to the depositors. See Appendix A for details.



Figure 1: Welfare effects of bank mergers.

Increased bank market power from mergers tends to raise loan rates and lower deposit rates, thereby reducing expected customer (borrower and depositor) surplus. In contrast, efficiency gains from mergers tend to lower loan rates and raise deposit rates increasing expected customer surplus. The net increase in social welfare from mergers depends on the relative magnitudes of these two opposing effects, reflecting the trade-off between market power and efficiency gains (Williamson, 1968). Example 1 shows mergers are welfare enhancing ($\Delta W(c) < 0$) if efficiency gains are sufficiently large ($c > c^*$).

In the sequential game, the planner moves first, either allowing or disallowing mergers. Because the merging pair of unlike banks (one low-cost bank and one high-cost bank) are homogenous, we assume that the antitrust authority cannot discriminate between mergers.³⁸ For $c \in (0, c^*]$, the planner disallows bank mergers, and we obtain the no merger IME described in Lemma 4. However, if $c \in (c^*, \bar{c})$, the planner permits bank mergers, and we obtain the merger IME described in Lemma 5. Moreover, loan rates and risk-taking are higher in the merger IME compared with the no-merger IME because there are fewer banks in the merger IME (negative bank-competitor effect).

Proposition 5 We obtain $c^* \in (0, \bar{c})$ such that for large efficiency gains, that is $c > c^*$, the planner permits n pairwise mergers, each consisting of a low-cost bank and a high-cost bank. Therefore, the merger IME exists for all $c > c_M \equiv \max\{\hat{c}, c^*\}$. Moreover, the loan rate and risk-taking in the merger IME are greater than their no-merger IME values: $r_M > r^*(c)$ and $\theta_M > \theta^*(c)$.

First, the values of c for which the merger IME exists is non-empty because $c_M < \bar{c}$. Second, even when they are privately optimal (i.e., if $c > \hat{c}$), bank mergers may not be socially optimal (i.e., if $c \le c^*$). In essence, our model presents a rationale for merger reviews. Lastly, higher social welfare in the merger IME relative to the no-merger IME is also accompanied by higher risk-taking. This has financial stability implications. The planner can lower risk-taking by disallowing mergers. But this comes at the cost of reducing social welfare. With the inclusion of the *financial stability factor* in merger reviews under the Dodd Frank Act of 2010, welfare considerations are no longer the sole factor in approving bank mergers. Our framework presents scenarios in which welfare and risk-taking implications yield conflicting recommendations for merger approvals.

³⁸In other words, the antitrust authority sets the rule that either allows or disallows *all* mergers. This is largely for simplicity and tractability. The planner's problem can be modified to determine the *socially optimal* number of $k \le n$ mergers. With k mergers permitted, the post-merger market structure is a Cournot oligopoly with n low-cost and n - k high-cost banks. Under certain parameter values of the model, we obtain that expected social welfare in the merger IME (with k pairwise mergers) is strictly concave in k and is maximized at $k = k^* < n$. However, our results (cf. Proposition 5) remain qualitatively the same under this modification. In practice, an interior number of mergers may be preferable if allowing all mergers increases market concentration significantly.

In sum, our model captures the efficiency enhancing role of across-market mergers (Berger et al., 1995, 1999; Sapienza, 2002). We show how efficient banks merge with relatively inefficient, less profitable banks when heterogenous markets integrate (cf. endnote 9). Furthermore, we find that market integration yields pro-competitive gains even without a concomitant increase in the number of banks (Proposition 4). As discussed above, the negative association between market integration and loan rates can originate from the bank-customer effect that alters price-taking behavior or from efficiency gains in bank mergers or both. While the empirical literature has attributed lower loan rates to efficiency gains, our model shows that this can happen, independent of efficiency gains, due to the bank-customer effect.

4. Empirical implications

The lack of consensus in empirical work on bank competition and risk-taking is pervasive and studies are often classified as belonging to either the competition-fragility view or the competition-stability view.³⁹ Even the influential line of research that exploits geographic deregulation in the United States to generate exogenous variations in bank competition remains inconclusive.⁴⁰

Our model helps reconcile these conflicting findings in the literature. Proposition 2 describes how the same deregulation episode can yield model predictions consistent with both views. Consistent with the competition-stability view, Proposition 2(a) states that deregulation reduces loan rates and risk-taking for borrowers in market 2, the relatively borrower-heavy market prior to integration. In contrast, Proposition 2(b) shows that loan rates and risk-taking in market 1 – initially, the depositor-heavy market – can increase or decrease. So, depending on underlying conditions, our model predictions for market 1 can be consistent with either view. In particular, when the bank-customer effect with respect to market 1 is sufficiently strong, borrowers in market 1 face higher loan rates and increased risk-taking [Proposition 2(b-ii)]. This result, consistent with the competition-fragility view, emerges even though deregulation increased the number of competitor banks.⁴¹ In essence, the bank-customer effect outweighs the traditional bank-competitor effect of an increase in the number of banks on risk-taking. Our results suggest that, in estimating the effects of increased competition from deregulation on risk-taking, it is important to account for differences in initial conditions of the integrating markets. Also, because model predictions depend on initial underlying conditions, no two deregulation episodes are necessarily alike, as evidenced in numerous empirical studies (Jayaratne and Strahan, 1996; Wall, 2004; Huang, 2008).

The model also helps generate testable predictions using the results above. For borrower-heavy market 2, model predictions are always consistent with the competition-stability view. Indeed, the difference in the competition-stability and competition-fragility predictions of the model is captured by predictions for

³⁹Berger, Klapper, and Turk-Ariss (2009); Beck, De Jonghe, and Schepens (2013); Berger, Klapper, and Turk-Ariss (2017); Akins, Li, Ng, and Rusticus (2016); Corbae and Levine (2018) use this classification. The competition-fragility view argues that an increase in competition increases risk-taking incentives by reducing bank profit margins and lowering franchise values (Keeley, 1990; Chong, 1991; Gan, 2004; Dick, 2006; Beck et al., 2006; Berger et al., 2009; Beck et al., 2013; Bushman et al., 2016; Corbae and Levine, 2018; Carlson et al., 2022). In contrast, the competition-stability view argues that competition is critical to financial stability and increased concentration has been shown to increase risk-taking (Jayaratne and Strahan, 1998; Schaeck and Cihák, 2014; Akins, Li, Ng, and Rusticus, 2016; Goetz, Laeven, and Levine, 2016; Goetz, 2018; Jiang, Levine, Lin, and Wei, 2020).

⁴⁰Keeley (1990) finds that increased competition following relaxation of state branching restrictions in the 1980s resulted in an increase in large banks' risk profiles. Meanwhile, Jayaratne and Strahan (1998) find that deregulation in the 1980s resulted in lower loan losses, but Dick (2006) finds higher loan loss provisions following deregulation in the 1990s. More recently, Jiang et al. (2020) find that increased bank competition reduced risk among corporate borrowers, but Bushman et al. (2016) and Jiang et al. (2023) find that deregulation increased bank risk.

⁴¹The bank-customer effect is also relevant for decreases in n (see Remark 2 at the end of Section 2).

depositor-heavy market 1 (Proposition 2(b)). Using (11), we show that increases $(r^* > r_1)$ or decreases $(r^* < r_1)$ in market 1 loan rates following deregulation depend on the *degree of market heterogeneity*, defined as the difference in customer composition of integrating markets, $\xi_2 - \xi_1$.

Proposition 6 The IME loan rates and risk-taking are

- (a) higher than their SME values in market 1 if the degree of market heterogeneity, $\xi_2 \xi_1$, or equivalently, difference in initial loan rates, $r_2 r_1$, is sufficiently high;
- (b) lower than their SME values in market 1 if the degree of market heterogeneity, $\xi_2 \xi_1$, or equivalently, difference in initial loan rates, $r_2 r_1$, is sufficiently low.

We show that there is a unique threshold $(\xi_2 - \xi_1)^0$ so that $r^* > (<) r_1$ according as $\xi_2 - \xi_1 > (<)(\xi_2 - \xi_1)^0$. Moreover, the one-to-one relation between customer composition and loan rates helps generate testable predictions in terms of both variables. All else equal, larger differences in initial customer composition or equivalently, pre-integration loan rates, reflect the strength of the bank-customer effect. Accordingly, either $\xi_2 - \xi_1$ or $r_2 - r_1$ can be used to predict the sign of $r^* - r_1$ with large differences in initial market conditions yielding higher loan rates and risk-taking in the IME (relative to their SME values).

We turn next to the measurement and identification challenges related to these testable predictions. Because customers in our model deposit or borrow a dollar, ξ translates to a local measure of demand for financing relative to supply. However, direct measures of ξ , such as bank loan-to-deposit ratios, suffer from severe endogeneity problems (Becker, 2007). Most indicators of local economic activity, such as income or population, are correlated with both supply of and demand for financing. Therefore, we need a source of exogenous variation in ξ . Becker (2007) provides evidence of banking market segmentation by exploiting demographic variation in the *fraction of seniors* of the local population. The fraction of seniors is a valid *instrument* for local capital supply because "seniors tend to hold higher levels of bank deposits" but "do not participate in the labor market or operate businesses ... and consume less than other groups ..." (Becker, 2007, p. 152). So, conditional on similar market characteristics, different shares of seniors in the population in the fraction of seniors can instrument for our measure of customer composition, with ξ decreasing in the share of seniors. While Becker (2007) uses this measure to explain geographical segmentation in terms of loan outcomes (i.e., the number of firms or startups in the market), our model predicts that ξ also has significant explanatory power for loan rates and risk-taking changes from deregulation.⁴²

On the other hand, measuring pre-integration loan rates is a question of data availability. Loan level data on r_1 and r_2 may not be readily available, especially around the start of the banking deregulation era. In a rare departure from pricing data limitations, Jayaratne and Strahan (1998, Figure 2) find that although loan prices (state level aggregates of average yield on bank loans) declined *on average*, they *increased* in seven U.S. states after branching deregulation. In essence, the distribution of loan rate changes following deregulation has positive and negative values, similar to the predicted $r^* - r_1$ in our model. While this result supports model predictions, a more detailed granular study is needed to uncover the mechanisms outlined

⁴²Although Becker (2007) does not explain the effect of deregulation on loan pricing because of data limitations, he finds that deregulation of intrastate branching "reduced the effects of geographical variation [of deregulation on loan outcomes (i.e., number of firms and startups in the market)] by approximately a third." In terms of the model, the change from ξ_1 and ξ_2 in the SME to ξ^* in the IME is in itself a reduction of variation in ξ . That this change would also result in reduced variation in loan outcomes, however, suggests that ξ is an important determinant of such outcomes. We extend the hypothesis on loan outcomes in Becker (2007) to loan characteristics such as loan pricing.

in our model.

We conclude this discussion by emphasizing an important caveat. Our model uncovers the bankcustomer effect, but it is not the only mechanism at work in our model. Other mechanisms such as the bank-competitor effect (changes in n) and efficiency gains from bank mergers (changes in c) also contribute to changes in loan rates and risk-taking (Section 3). Empirical studies have found pro-competitive outcomes, such as declines in loan rates, despite consolidation in the banking industry (i.e., n decreasing with deregulation). These results have been explained in terms of the trade-off between market power and efficiency. In particular, lower loan rates have been attributed to large efficiency gains dominating the effect of increases in market power (Jayaratne and Strahan, 1998; Sapienza, 2002). This remains the consensus explanation behind pro-competitive outcomes, even though accurate measures or estimates of said efficiency gains are hard to come by (Farrell and Shapiro, 1990). Our results above show that such pro-competitive outcomes are also explained, independent of efficiency gains, in terms of the bank-customer effect (see Remark 2 at the end of Section 2). The relative contributions of each of the three mechanisms in determining the effect of competition from deregulation on loan rates and risk-taking is left to future empirical work.

5. Conclusion

This paper re-examines the established linkages between competition and financial stability. Traditional theories define increased competition as a within-market increase in the number of banks. It follows that increased within-market competition lowers loan rates and, consequently, reduces borrower risk-taking (Boyd and De Nicolò, 2005).⁴³ Using the same model as that in traditional theories, we determine how loan rates and risk-taking would change if, instead of a within-market increase, market integration (spatial deregulation) became the principal driver of increased competition. We find that loan rates and risk-taking can increase (as well as decrease) with an increase in the number of banks under market integration. In other words, across-market competition yields predictions different from within-market increases in competition.

The rationale behind our findings is explained by differences in the customer composition of integrating markets. Customer composition is the ratio of borrowers to depositors in a banking market. Because banks are entirely deposit-financed in our model, this translates to a local measure of demand for financing relative to supply. This measure could be instrumented, for example, by the fraction of seniors in the market (Becker, 2007). Our model uncovers the bank-customer effect, a novel mechanism unmodeled in previous research, whose magnitude increases with initial differences in the customer composition of the two integrating markets. For one of the two integrating markets, namely the one that is borrowerheavy prior to integration, loan rates and risk-taking will decrease, just as it would under within-market competition. With market integration, borrowers in this market transition to an integrated market with relatively more depositors (i.e., a relatively higher supply of loanable funds), which pushes loan rates down. The opposite happens for the other, relatively depositor-heavy, market. Borrowers in this market transition to an integrated market with relatively less depositors (i.e., a relatively lower supply of loanable funds), and this tends to raise rates. A sufficiently strong rate-increasing bank-customer effect can overwhelm the traditional rate-reducing effect of a rise in the number of competitor banks. As a result, rates can increase in the depositor-heavy market even though market integration has increased the number of banks. Because different loan rate and risk-taking outcomes depend on differences in initial conditions of the integrating

⁴³Throughout, we have used the result that borrower risk-taking increases with loan rates (Stiglitz and Weiss, 1981). The main results of the paper are robust to whether risk-taking increases or decreases with loan rates.

markets, accounting for these differences is critical to empirical work in this area.

We extend our model to show how market integration incentivizes bank mergers and analyze their implications for risk-taking. Efficiency gains drive merger profitability as well as increases in overall social welfare. While mergers may enhance social welfare, they are accompanied by higher loan rates and risk-shifting. Our framework presents scenarios in which welfare and risk-taking implications yield conflicting recommendations for merger approvals.

Our model reconciles the competition-fragility and the competition-stability views in empirical work on bank competition and risk-taking. In our model, the same deregulation episode can reduce risk-taking by borrowers from the relatively borrower-heavy market while simultaneously increasing risk-taking by borrowers from the relatively depositor-heavy market. Irrespective of whether the number of banks increases, decreases, or remains unchanged following deregulation, our model predictions under different initial conditions can be consistent with both the competition-fragility and the competition-stability view. We derive the precise conditions under which increased competition yields different risk-taking outcomes.

To the best of our knowledge, our paper is the first to directly examine the effect of market integration on loan rates and risk-taking. While future modeling efforts can include richer settings that improve our understanding about the linkages between competition and stability in banking, we have opted for a tractable approach. Our results underscore the need for re-examining the traditional approach that focuses on competition within a single banking market.

Appendices

Appendix A presents the base model of bank competition, and describes the market equilibrium and associated social welfare. Appendix B contains all the proofs. The online appendix analyzes a general model.

Appendix A The base model of bank competition

Microfoundations for linear deposit supply and loan demand schedules shown below are similar to Martinez-Miera and Repullo (2010). We analyze a baseline model of competition for a given banking market comprising a > 0 risk-neutral depositors, b > 0 risk-neutral borrowers, and $n \ge 2$ risk-neutral banks.

Depositors. Depositors are heterogenous in that their reservation utility, v, which is distributed uniformly over the support [0, 1]. Let G(v) denote the fraction of depositors with reservation utility less than or equal to v, where G'(v) > 0 for all v. Because deposits are insured, depositors get their reservation utility when the project fails. Each depositor deposits \$10nly if the deposit rate, R, is no less than their reservation utility, so $R \ge v$. Thus, the fraction of depositors who participate in the deposit market is G(R) = R. With a depositors, market deposit supply is D(R) = aG(R) = aR, and the inverse deposit supply function is

$$R \equiv R(D/a) = \frac{D}{a}.$$
 (A.1)

Entrepreneurs. Entrepreneurs (borrowers) are also heterogeneous in their reservation utility $u \in [0, 1/4\lambda]$. Let H(u) denote the fraction of borrowers that have reservation utility less than or equal to u with H'(u) > 0 for all u. We assume that $H(u) = 2\sqrt{\lambda u}$. Given a loan rate, $r \ge 1$, each borrower solves

$$u(r) = \max_{\theta} \left\{ (1 - \theta/\lambda)(\theta - r) \right\}.$$

From the first-order condition of the maximization problem, we obtain

$$\theta \equiv \theta(r) = \frac{1}{2}(\lambda + r)$$
 and $p(\theta) \equiv p(\theta(r)) = \frac{1}{2}(1 - r/\lambda)$.

An entrepreneur's maximum value function is

$$u(r) = p(\theta(r))(\theta(r) - r) = \frac{(\lambda - r)^2}{4\lambda}$$

An entrepreneur with reservation utility u would participate in the loan market only if $u(r) \ge u$. Thus, the fraction of entrepreneurs who participate in the loan market is $H(u(r)) = \lambda - r$. With b entrepreneurs, the market loan demand is $L(r) = bH(u(r)) = b(\lambda - r)$ and the inverse loan demand function is

$$r \equiv r(L/b) = \lambda - \frac{L}{b}.$$
 (A.2)

Given (A.2), risk-shifting and the probability of success respectively are

$$\theta(L/b) = \frac{1}{2} \left(\lambda + \lambda - \frac{L}{b} \right) = \lambda - \frac{L}{2b} \quad \text{and} \quad P(L/b) = \frac{1}{2} \left(1 - \frac{\lambda - (L/b)}{\lambda} \right) = \frac{L}{2\lambda b} \,. \tag{A.3}$$

The Cournot equilibrium. Because each bank *i* is deposit financed, $D_i = L_i$, and we get $D = \sum_i^n D_i = \sum_i^n L_i = L$. All banks face the same cost of lending, cL_i , where $c \ge 0$ is the constant marginal cost (which includes the deposit insurance premium). Each bank *i* chooses L_i to maximize the following expected profits solves

$$P(L/b)(r(L/b) - R(L/a) - c)L_i = \frac{L}{2\lambda b} \left(\lambda - \frac{L}{b} - \frac{L}{a} - c\right)L_i.$$

Lemma 6 There is a unique symmetric Cournot equilibrium wherein $L = nL_i$ for all banks *i*.

(a) The equilibrium deposit rate, loan rate, and risk-shifting are given by

$$R = (\lambda - c) \cdot \frac{n+1}{n+2} \cdot \frac{\xi}{1+\xi}, \qquad (A.4)$$

$$r = \lambda - (\lambda - c) \cdot \frac{n+1}{n+2} \cdot \frac{1}{1+\xi}, \qquad (A.5)$$

$$\theta = \lambda - \frac{\lambda - c}{2} \cdot \frac{n+1}{n+2} \cdot \frac{1}{1+\xi}, \qquad (A.6)$$

respectively, where $\xi \equiv b/a$ is the ratio of borrowers to depositors in the market.

(b) The equilibrium deposit rate is increasing, and the equilibrium loan rate and risk-shifting are decreasing in the number of banks, n. On the other hand, R, r and θ are all increasing in the ratio of borrowers to depositors, ξ. *Proof.* The first-order condition of bank *i*'s maximization problem is given by

$$L_i\left(\lambda - c - \frac{2L}{b} - \frac{2L}{a}\right) + L\left(\lambda - c - \frac{L}{b} - \frac{L}{a}\right) = 0.$$
(A.7)

Consider any two banks *i* and *i'* with $i \neq i'$. Both L_i and $L_{i'}$ must solve (A.7), and hence, in equilibrium, we cannot have $L_i \neq L_{i'}$. Thus, there is a symmetric Cournot equilibrium in which $L_i = L_{i'}$ for any $i \neq i'$. Therefore, all banks lend the same amount, $L_i = L/n$. Substituting $L_i = L/n$ into (A.7), we get

$$\frac{L}{n}\left(\lambda - c - \frac{2L}{b} - \frac{2L}{a}\right) + L\left(\lambda - c - \frac{L}{b} - \frac{L}{a}\right) = 0,$$

which has a unique solution in L, the aggregate loan volume which is given by

$$L = (\lambda - c) \cdot \frac{n+1}{n+2} \cdot \frac{ab}{a+b}.$$

Thus, the symmetric equilibrium is unique. Setting $\xi \equiv b/a$, the ratio of borrowers to depositors in the market, we get (A.4), (A.5) and (A.6).

The deposit rate, R is increasing in n, but r and θ are decreasing in n because (n + 1)/(n + 2) is increasing in n. However, R is increasing in ξ because $\xi/(1 + \xi)$ is increasing in ξ . Also, r and θ are increasing in ξ because $1/(1 + \xi)$ is decreasing in ξ . \Box

Social welfare. In the banking market described above, the expected social welfare, W(L), is the sum of the expected depositor surplus, DS(L), the expected borrower surplus, BS(L), and aggregate expected bank profits, $\Pi(L)$. Using (A.1), (A.2), and (A.3), deposits are insured against project failure, and that L = D in the Cournot equilibrium, the expected depositor surplus, expected borrower surplus, and aggregate expected profits of n banks are respectively given by

$$DS(L) = LP(L/b)R(L/a) - a \int_0^{R(L/a)} v dG(v),$$
(A.8)

$$BS(L) = Lu(r(L/b)) - b \int_0^{u(r(L/b))} u dH(u),$$
(A.9)

$$\Pi(L) = P(L/b)(r(L/b) - R(L/a))L - P(L/b)C(L),$$
(A.10)

where C(L) is the aggregate cost of lending of all banks. The deposit insurer disburses $a \int_0^{R(L/a)} v dG(v)$ in the event of bank failure which happens with probability 1 - P(L/b). However, we exclude this term from the calculation of the expected social welfare as it is a transfer from the insurer to the depositors, and hence, the net transfer is zero. For simplicity, we also ignore any social costs associated with bank failure. The (expected) social welfare is the sum of (A.8), (A.9) and (A.10), so

$$W(L) = Lu(r(L/b)) + P(L/b)r(L/b)L - a \int_{0}^{R(L/a)} v dG(v) - b \int_{0}^{u(r(L/b))} u dH(u) - P(L/b)C(L)$$

= $L \cdot \frac{1}{4\lambda} \left(\lambda - \left(\lambda - \frac{L}{b}\right)\right)^{2} + \left(\frac{L}{2\lambda b}\right) \left(\lambda - \frac{L}{b}\right)L - a \cdot \frac{(L/a)^{2}}{2} - b \cdot \frac{(L/b)^{3}}{12\lambda} - \left(\frac{L}{2\lambda b}\right)C(L)$
= $\frac{(a - b)L^{2}}{2ab} - \frac{L^{3}}{3\lambda b^{2}} - \left(\frac{L}{2\lambda b}\right)C(L).$ (A.11)

We assume b < a, that is, $\xi < 1$ so that social welfare is not always negative.

Appendix B Proofs and additional results

This appendix contains the proofs of the main results, and some additional results. We omit some of the cumbersome mathematical expressions. The *Mathematica* codes are available upon request.

B.1 Proof of Lemma 1

The lemma obtains by setting $n = n_j$, $\xi = \xi_j$ and c = 0 in Lemma 6(a).

B.2 Proof of Proposition 1

The proposition follows directly from Lemma 6(b).

B.3 Proof of Lemma 2

The lemma obtains by setting n = 2n, $\xi = \xi^*$ and c = 0 in Lemma 6(a).

B.4 Proof of Proposition 2

From Lemmas 1 and 2, it follows that

$$r^{*} - r_{j} = -\lambda \cdot \frac{2n+1}{2n+2} \cdot \frac{1}{1+\xi^{*}} + \lambda \cdot \frac{n+1}{n+2} \cdot \frac{1}{1+\xi_{j}}$$

$$= -\lambda \cdot \frac{2n+1}{2n+2} \cdot \frac{1}{1+\xi^{*}} + \left(\lambda \cdot \frac{n+1}{n+2} \cdot \frac{1}{1+\xi^{*}}\right) + \lambda \cdot \frac{n+1}{n+2} \cdot \frac{1}{1+\xi_{j}} - \left(\lambda \cdot \frac{n+1}{n+2} \cdot \frac{1}{1+\xi^{*}}\right)$$

$$= \underbrace{-\lambda \cdot \frac{1}{1+\xi^{*}} \left(\frac{2n+1}{2n+2} - \frac{n+1}{n+2}\right)}_{\text{Bank-competitor effect}} + \underbrace{\lambda \cdot \frac{n+1}{n+2} \left(\frac{1}{1+\xi_{j}} - \frac{1}{1+\xi^{*}}\right)}_{\text{Bank-customer effect with respect to market } j}.$$
(B.1)

Note that the bank-competitor effect is always negative, but the bank-customer effect can be of either sign. First, consider region 2. Given the assumption that $\xi_1 < \xi_2$, we have $\xi_1 < \xi^* < \xi_2$. Therefore, For $\xi_j = \xi_2$, the bank-customer effect with respect to market 2 is negative. Therefore, $r^* < r_2$. Because $\theta(r)$ is strictly increasing in r, we have $\theta^* < \theta_2$. Next, consider market 1. Because $\xi_1 < \xi^*$, the bank-customer effect with respect to market 1. Because $\xi_1 < \xi^*$, the bank-customer effect with respect to market 1 is positive, while the bank-competitor effect is negative. Therefore, $r^* > r_1$ and $\theta^* > \theta_1$ if and only if the positive bank-competitor effect is sufficiently strong to outweigh the negative bank-competitor effect.

B.5 Proof of Corollary 1

Following similar steps as in the proof of Proposition 2, we obtain (12) which is

$$R^* - R_j = \underbrace{\lambda \cdot \frac{\xi^*}{1 + \xi^*} \left(\frac{2n+1}{2n+2} - \frac{n+1}{n+2}\right)}_{-\xi^* \times \text{ Bank-competitor effect}} + \underbrace{\lambda \cdot \frac{n+1}{n+2} \left(\frac{1}{1 + \xi_j} - \frac{1}{1 + \xi^*}\right)}_{\text{Bank-customer effect with respect to market }j}.$$

The first term is the "bank-competitor effect on deposit rates" which is positive for both markets, while the bank-customer effect is positive (negative) with respect to market 1 (market 2). Hence, $R^* > R_1$. On the other hand, $R^* < (>) R_2$ according as the negative bank-customer effect with respect to market 2 is sufficiently strong (weak).

B.6 Perfectly elastic deposit supply function

We assume that the deposit supply function is upward-sloping. To understand why, let us assume instead that deposit supply is perfectly elastic, so that $R(D) = \overline{R} \ge 0$. Banks collect any amount of deposits at the flat rate to meet loan demand. Each bank solves a maximization problem similar to that in Section 2.1 with $R_i(L_i/a_i)$ replaced by \overline{R} . The symmetric SME loan rate in market j = 1, 2 is

$$r_j = \bar{R} + \frac{\lambda - \bar{R}}{n+2} \,.$$

In contrast to (4), $r_1 = r_2$ even if $\xi_1 \neq \xi_2$. Assuming a perfectly elastic deposit supply implies that loan rates are identical across segmented markets even when these markets have different loan demand. Moreover, the equilibrium loan rate r_j is a constant mark-up over marginal cost, \bar{R} , which is decreasing in the number of banks. Upon integration, the loan rate in the integrated market becomes

$$r^* = \bar{R} + \frac{\lambda - \bar{R}}{2n+2} \,.$$

Clearly, $r^* < r_j$ for each j = 1, 2 because there are more banks in the integrated market. Even with market heterogeneity, the effect of integration on loan rates is comprised entirely of the negative bank-competitor effect. Therefore, with perfectly elastic deposit supply, the composition of bank customers does not affect loan rates and risk-taking under market integration.

B.7 Proof of Lemma 3

The lemma obtains by setting $n = n_j$, $\xi = \xi_j$ and $c = c_j$ in Lemma 6(a).

B.8 Pairwise mergers between like banks.

We analyze the profitability of mergers between pairs of like banks (with the same operating costs) in any segmented market and in the integrated market.

Lemma 7 Suppose that a merger between two banks with the same operating costs yields no efficiency gains.

- (a) In each segmented market j = 1, 2 with a_j depositors, b_j borrowers, and $n \ge 2$ homogeneous banks with same operating costs $c_j \in \{0, c\}$, a merger between a pair of banks is profitable only if the pre-merger market structure is a duopoly;
- (b) In the integrated market with $a_1 + a_2$ depositors, $b_1 + b_2$ borrowers, and n low-cost and n high-cost banks, any merger between a pair of banks with same operating costs is never profitable.

Proof. To prove part (a), we first show that there are merger incentives only if the segmented market is a duopoly (n = 2). The symmetric equilibrium aggregate loan volume in market j = 1, 2 is given by

$$L_j \equiv L(n, c_j) = (\lambda - c_j) \cdot \frac{a_j b_j}{a_j + b_j} \cdot \frac{n+1}{n+2},$$

which yields per bank expected profits

$$\pi_j \equiv \pi(n, c_j) = \frac{L_j}{2\lambda b_j} \cdot \left(\lambda - \frac{L_j}{b_j} - \frac{L_j}{a_j} - c_j\right) \cdot \frac{L_j}{n} = \frac{(\lambda - c_j)^3}{2\lambda} \cdot \frac{a_j^2 b_j}{(a_j + b_j)^2} \cdot \frac{(n+1)^2}{n(n+2)^3} \cdot \frac{(n+1)^2}{n(n+2)^$$

The above is the common equilibrium profit level of all banks when there are n banks, each with marginal cost c_j . A merger between a pair of banks with marginal operating cost c_j implies that there are n - 1 symmetric banks after the merger had taken place, and hence, the merged entity earns $\pi(n - 1, c_j)$. On the other hand, before the merger has taken place, each bank consumes $\pi(n, c_j)$. Thus, such merger is profitable if

$$\pi(n-1, c_j) > \pi(n, c_j) + \pi(n, c_j) = 2\pi(n, c_j) \quad \Longleftrightarrow \quad \frac{n^2}{(n-1)(n+1)^3} > \frac{2(n+1)^2}{n(n+2)^3}.$$

The above inequality has a solution for n = 2, and does not hold for any $n \ge 3$. In other words, there are incentives to merge if the post-merger market becomes a monopoly.

For part (b), we just provide the sketch of the proof as the calculations are cumbersome. Let $\pi_j(n_l, n_h)$ denote the equilibrium profit of each bank with marginal cost c_j when there are n_l low-cost and n_h high-cost banks in the integrated market. If there are no mergers, each bank with marginal cost c_j has profits $\pi_j(n, n)$. If two low-cost banks merge, the merged entity (as well as each of the n - 2 rivals with the same marginal cost) obtains $\pi_1(n - 1, n)$. On the other hand, if two high-cost banks merge, the merged entity (as well as each of the n - 2 same type rivals) obtains $\pi_2(n, n - 1)$. So, for the merger of two low-cost banks to be profitable, we require $\pi_1(n - 1, n) > 2\pi_1(n, n)$, and for the merger of two high-cost banks to be profitable, we require $\pi_2(n, n - 1) > 2\pi_2(n, n)$. It turns out that none of the last two inequalities holds if we have $n \ge 2$, that is, there are at least two banks of each cost type (the requirement to form a merger between two banks with the same marginal cost). \Box

B.9 Proof of Lemma 4

Let L_j be the aggregate loan volume of banks, each with marginal operating $\cot c_j$, j = 1, 2. Because there are asymmetric banks in the integrated market (*n* low-cost and *n* high-cost banks), the Cournot equilibrium is an asymmetric equilibrium. However, the IME is characterized by within-group symmetry, that is, $L_{ij} = L_j/n$. Moreover, the equilibrium must respect $L = L_1 + L_2 = D$. To save on notations, let $a \equiv a_1 + a_2$ and $b \equiv b_1 + b_2$, and hence, $\xi^* \equiv (b_1 + b_2)/(a_1 + a_2) = b/a$. Letting $c_1 = 0$ and $c_2 = c$, the first-order condition of each bank with marginal $\cot c_j$ yields

$$(L_1 + L_2) \left(\lambda - \left(\frac{1}{a} + \frac{1}{b}\right) (L_1 + L_2)\right) + \frac{L_1}{n} \left(\lambda - 2\left(\frac{1}{a} + \frac{1}{b}\right) (L_1 + L_2)\right) = 0,$$

$$(L_1 + L_2) \left(\lambda - c - \left(\frac{1}{a} + \frac{1}{b}\right) (L_1 + L_2)\right) + \frac{L_2}{n} \left(\lambda - c - 2\left(\frac{1}{a} + \frac{1}{b}\right) (L_1 + L_2)\right) = 0.$$

The above system of non-linear equations have three sets of solutions in (L_1, L_2) . The first set is discarded because it consists $L_1 = L_2 = 0$. The second set is also discarded because $L_1 < 0$ for $\lambda > 1$, a, b > 0, $n \ge 2$ and $0 < c \le \lambda$. The final expressions for L_1 and L_2 in the third set of the solutions are cumbersome, so we omit them. The third set of solutions $(L_1^*(c), L_2^*(c))$ yields

$$L^*(c) = L_1^*(c) + L_2^*(c) = \frac{ab\left\{(2\lambda - c)(3n + 2) + \sqrt{c^2(3n + 2)^2 + 4\lambda(\lambda - c)n^2}\right\}}{8(a + b)(n + 1)} = Z(n, c) \cdot \frac{ab}{a + b}$$

In the interior equilibrium, we have $L_1^*(c) > L_2^*(c) > 0$ whenever $c < \lambda/(n+2) \equiv \overline{c}$. Because $\xi^* \equiv b/a$, the equilibrium loan rate and risk-shifting are given by

$$r^{*}(c) = \lambda - \frac{L^{*}(c)}{b} = \lambda - Z(n, c) \cdot \frac{1}{1 + \xi^{*}},$$

$$\theta^{*}(c) = \lambda - \frac{L^{*}(c)}{2b} = \lambda - \frac{1}{2} \cdot Z(n, c) \cdot \frac{1}{1 + \xi^{*}}$$

Finally,

$$Z_c(n, c) = \frac{1}{8(n+1)} \left(\frac{c(2+3n)^2 - 2\lambda n^2}{\sqrt{c^2(3n+2)^2 + 4\lambda(\lambda-c)n^2}} - (3n+2) \right) < 0$$

because

$$\frac{c(2+3n)^2 - 2\lambda n^2}{\sqrt{c^2(3n+2)^2 + 4\lambda(\lambda-c)n^2}} - (3n+2) < 0 \quad \Longleftrightarrow \quad 16\lambda^2 n^2(n+1)(2n+1) > 0.$$

B.10 Proof of Proposition 3

Following similar steps as in the proof of Proposition 2, we obtain (16) which is

$$r^{*}(c) - r_{j}(c_{j}) = \underbrace{-\frac{1}{1 + \xi^{*}} \left(Z(n, c) - \lambda \cdot \frac{n+1}{n+2} \right)}_{\text{Bank-competitor effect}} + \underbrace{\frac{n+1}{n+2} \left(\frac{\lambda - c_{j}}{1 + \xi_{j}} - \frac{\lambda}{1 + \xi^{*}} \right)}_{\text{Bank-customer effect with respect to market } j}.$$

To prove part (a), consider market 2, in which the SME loan rate is $r_2(c)$. Because both the bank-competitor effect and the bank-customer effect with respect to this market are negative, we have $r^*(c) < r_2(c)$. To show part (b), note that $c_1 = 0$, and hence, the bank-customer effect with respect to market 1 is the same as in (B.1) and is positive. Thus, $r^*(c) > r_1$ if and only if the bank-customer effect with respect to market 1 is sufficiently strong to outweigh the negative bank-competitor effect.

B.11 Proof of Lemma 5

Let $\pi_j(n_l, n_h, c)$ be the Cournot equilibrium expected profit of a bank with marginal operating cost $c_j \in \{0, c\}$ when there are n_l low-cost, n_h high-cost banks in the integrated market, and the efficiency gain is c. Clearly, $\pi_j(n, n, c)$, which is the equilibrium profit of a bank with marginal cost c_j in the no-merger IME. Consider a merger between a low-cost bank and a high-cost bank which creates a low-cost bank. Following this merger, the market would consists of n low-cost and n - 1 high-cost banks. Thus, the expected profit of the merged entity would be $\pi_1(n, n - 1, c)$. Such merger is profitable if $\Delta \pi(c) \equiv \pi_1(n, n - 1, c) - (\pi_1(n, n, c) + \pi_2(n, n, c)) > 0$, the second term on the left-hand-side of the inequality representing the aggregate profits of the low-cost bank and the high-cost bank in the no-merger IME. Note that, in a merger between a low-cost bank and a high-cost bank, the gain to the merged entity is $\Delta \pi(c) \equiv$

 $\pi_1(n, n-1, c) - (\pi_1(n, n, c) + \pi_2(n, n, c))$. Under the surplus division rule, $(\tilde{\pi}_1, \tilde{\pi}_2)$, given by

$$\tilde{\pi}_1 = \pi_1(n, n, c) + \frac{1}{2} \cdot \Delta \pi(c)$$
 and $\tilde{\pi}_2 = \pi_2(n, n, c) + \frac{1}{2} \cdot \Delta \pi(c)$

so that $\tilde{\pi}_1 + \tilde{\pi}_2 = \pi_1(n, n-1, c)$, both banks gain relative to the no-merger IME, and hence, such a merger is profitable. We now show that there is $\hat{c} \in (0, \bar{c})$ such that $\Delta \pi(c) > 0$ for all $c > \hat{c}$, that is a merger between a pair of unlike banks profitable if efficiency gains are sufficiently high. Note that $\Delta \pi(0) < 0$, which follows from Lemma 7(a) because at c = 0, the integrated market consists only of $2n \geq 4$ lowcost banks. On the other hand, $\Delta \pi(\bar{c}) = \pi_1(n, 0, \bar{c}) - (\pi_1(n, 0, \bar{c}) + 0) = 0$. It can be shown that $\lim_{c\to\bar{c}} d\Delta \pi(\bar{c})/dc < 0$. Therefore, there must be values of c, close to \bar{c} , such that $\Delta \pi(\bar{c}) > 0$. Then, the existence of $\hat{c} \in (0, \bar{c})$ follows from the Intermediate Value Theorem. The second part of the lemma obtains by setting $\xi = \xi^*$ and c = 0 in Lemma 6(a).

B.12 Proof of Proposition 4

The merger IME is equivalent to no-merger IME where high-cost banks do not lend (i.e., $c = \bar{c}$). Thus, $r_M = r^*(\bar{c})$, and the bank-competitor effect in the merger IME is zero because $Z(n, c) = Z(n, \bar{c})$. Hence, expression (16) becomes

$$r_M - r_j(c_j) = \underbrace{\frac{n+1}{n+2} \left(\frac{\lambda - c_j}{1+\xi_j} - \frac{\lambda}{1+\xi^*} \right)}_{\text{for equation of the set of the set$$

Bank-customer effect with respect to market j

Because $c_1 = 0$, $r_M - r_1$ consists only the positive bank-customer effect, and hence, $r_1 < r_M$. In contrast, for market 2 with $c_2 = c$ and negative bank-customer effect, both terms of the above expression are negative, and thus, $r_M < r_2(c)$. Because optimal risk-shifting is increasing in the loan rate, we have $\theta_1 < \theta_M < \theta_2(c)$.

B.13 Bank mergers and social welfare in the integrated market

We compute social welfare functions associated with the no-merger IME and the merger IME by using the expression of social welfare in (A.11) in Appendix A. In the no-merger IME, the low-cost banks do not incur any costs of lending, and hence, the aggregate cost consists only of the costs of lending by the high-cost banks. In other words, C(L) in (A.11) becomes $cL_2^*(c)$. Therefore, social welfare in the no-merger IME is given by

$$W^*(c) = \frac{((a_1 + a_2) - (b_1 + b_2))(L^*(c))^2}{2(a_1 + a_2)(b_1 + b_2)} - \frac{(L^*(c))^3}{3\lambda(b_1 + b_2)^2} - \left(\frac{(L^*(c))}{2\lambda(b_1 + b_2)}\right) \cdot c(L_2^*(c)).$$

In contrast, in the merger IME, the aggregate cost of lending is zero because the integrated market consists only low-cost banks. Therefore, social welfare in the merger IME is given by

$$W_M = \frac{((a_1 + a_2) - (b_1 + b_2))(L_M)^2}{2(a_1 + a_2)(b_1 + b_2)} - \frac{(L_M)^3}{3\lambda(b_1 + b_2)^2}$$

Thus, the welfare difference is $\Delta W(c) \equiv W^*(c) - W_M$.

B.14 Proof of Proposition 5

To show the first part, we prove the existence of $c^* \in [0, \bar{c})$. Note that, at $c = \bar{c}$, the merger IME is equivalent to the no-merger IME, and hence, $\Delta W(\bar{c}) = 0$. It can be shown that $\lim_{c \to \bar{c}} d\Delta W(c)/dc > 0$. Because $\Delta W(c)$ is continuous on $[0, \bar{c}]$, there must be $\hat{c} < \bar{c}$ such that $\Delta W(\hat{c}) < 0$. Let $\mathbb{C} = \{c \mid \Delta W(c) > 0\}$. There are two possibilities. First, if $\mathbb{C} = \emptyset$ (i.e., $\Delta W(c) \le 0$ for all c), set $c^* = 0$. The other possibility is \mathbb{C} is non-empty. Note that $\mathbb{C} \subset \mathbb{R}$, and is bounded above because \hat{c} is an upper-bound of \mathbb{C} . Then, by the Completeness Axiom, $c^* = \sup\{\mathbb{C}\}$ exists with $c^* \le \hat{c} < \bar{c}$. Note that c^* has the desired property that $\Delta W(c^*) = 0$. If $\Delta W(c^*) \ne 0$, then either c^* is not an upper-bound of \mathbb{C} (when $\Delta W(c^*) > 0$) or c^* cannot be the *least* upper-bound of \mathbb{C} (when $\Delta W(c^*) < 0$).

We now show the last part. From the expressions of loan rate and risk-shifting in the no-merger IME [cf. (15)] and those in the merger IME [cf. (17)], we obtain

$$r_M - r^*(c) = \frac{1}{1 + \xi^*} \left(Z(n, c) - \lambda \cdot \frac{n+1}{n+2} \right) = \frac{1}{1 + \xi^*} \left(Z(n, c) - Z(n, \bar{c}) \right),$$

$$\theta_M - \theta^*(c) = \frac{1}{2} \cdot \frac{1}{1 + \xi^*} \left(Z(n, c) - Z(n, \bar{c}) \right).$$

Because Z(n, c) is strictly decreasing in $c, Z(n, c) > Z(n, \bar{c})$ for all $c < \bar{c}$. Therefore, both of the above expressions are strictly positive.

B.15 Proof of Proposition 6

Recall that

$$r^* = \lambda - \lambda \cdot \frac{2n+1}{2n+2} \cdot \frac{1}{1+\xi^*}$$
 and $r_1 = \lambda - \lambda \cdot \frac{n+1}{n+2} \cdot \frac{1}{1+\xi_1}$.

Therefore,

$$r^* - r_1 > 0 \iff \frac{1 + \xi^*}{1 + \xi_1} > \frac{(2n+1)(n+2)}{(2n+2)(n+1)} \equiv F(n).$$
 (B.2)

It is easy to see that F(n) is a strictly decreasing function with $\min\{F(n)\} = \lim_{n\to\infty} F(n) = 1$ and $\max\{F(n)\} = F(2) = 10/9 \approx 1.11$. Thus, F(n) > 1 as long as n is finite. Note that the relative strength of the bank-customer effect is separable as functions of ξ and n in (B.2). Also, F(n) = 1 implies that the bank-competitor effect is zero [cf. (B.1)], and $r^* > r_1$ as long as $\xi_1 < \xi_2$: If there are infinitely many banks in each segmented market, after market integration, the impact of changes in the number of banks on loan rates is negligible.

For simplicity, let $a_1 = a$, $a_2 = x_a \cdot a$ with $a, x_a > 0$, $b_1 = b$, $b_2 = x_b \cdot b$ with $b, x_b > 0$. Then, $\xi_1 = b/a$ and $\xi_2 = (x_b \cdot b)/(x_a \cdot a)$. Also,

$$\xi^* = \frac{b_1 + b_2}{a_1 + a_2} = \frac{(1 + x_b)b}{(1 + x_a)a}.$$

We first establish that the left-hand-side of (B.2) is an increasing function of the difference in the degree of market heterogeneity, $\xi_2 - \xi_1$. First, $(1 + \xi^*)/(1 + \xi_1)$ is an increasing function of

$$\frac{\xi^*}{\xi_1} = \frac{1+x_b}{1+x_a} \,.$$

Next, $(1 + x_b)/(1 + x_a)$ is an increasing function of

$$\frac{x_b}{x_a} = \frac{\xi_2}{\xi_1}$$

Finally, there is a one-to-one correspondence between ξ_2/ξ_1 and $\xi_2 - \xi_1$. Therefore, the left-hand-side of (B.2) is an increasing function of $\xi_2 - \xi_1$. Thus, (B.2) can be written as

$$r^* - r_1 > 0 \iff f(\xi_2 - \xi_1) > F(n),$$
 (B.3)

where $f'(\cdot) > 0$ and f(0) = 1. Note that $\lim_{(\xi_2 - \xi_1) \to \infty} f(\xi_2 - \xi_1) = \infty$, and we can always choose a finite $\xi_2 - \xi_1$ such that $f(\xi_2 - \xi_1) > F(2) = 10/9$. Then, by the intermediate value theorem, there is a unique $(\xi_2 - \xi_1)^0 > 0$ such that $f((\xi_2 - \xi_1)^0) = F(n)$ (as shown in Figure 2). In other words, $r^* < (>) r_1$ according as $\xi_2 - \xi_1 < (>) (\xi_2 - \xi_1)^0$.



Figure 2: $r^* < (>) r_1$ according as the degree of market heterogeneity is low (high).

Next, note that

$$r_j = \lambda - \lambda \cdot \frac{n+1}{n+1} \cdot \frac{1}{1+\xi_j} \implies \frac{\lambda - r_1}{\lambda - r_2} = \frac{1+\xi_2}{1+\xi_1}.$$

The left-hand-side of the above condition is increasing in $r_2 - r_1$, while the right-hand-side is increasing in $\xi_2 - \xi_1$. Therefore, $\xi_2 - \xi_1 = g(r_2 - r_1)$ where g is a real-valued function with $g'(\cdot) > 0$ and g(0) = 0. Condition (B.3) is alternatively written as

$$r^* - r_1 > 0 \iff h(r_2 - r_1) \equiv f(g(r_2 - r_1)) > F(n).$$

Because f, g are increasing functions, we have $h'(\cdot) > 0$ with h(0) = f(g(0)) = f(0) = 1. Following the same argument as above, we show that there is a unique $(r_2 - r_1)^0 > 0$ such that $r^* < (>) r_1$ according as $r_2 - r_1 < (>) (r_2 - r_1)^0$.

6. The general model of market integration

This appendix analyzes the effect of market integration on loan rates and risk-shifting when $m \ge 2$ erstwhile segmented markets integrate to form a single banking market.

6.1. Micro-foundations

We first derive general inverse deposit supply and loan demand which are functions of supply-of-funds per depositor and aggregate loan volume per borrower, respectively from the optimization behavior of the customers of banks. We further show that our results above hold broadly under such generalizations.

Depositors. Depositors are heterogeneous in their reservation utility $v \ge 0$. Let G(v) denote the fraction of depositors with reservation utility less than or equal to v with G'(v) > 0 for all v. A depositor deposits \$1 only if $R \ge v$. Thus, the fraction of depositors who participate in the deposit market is G(R). With a depositors, market deposit supply is D(R) = aG(R) with D'(R) = aG'(R) > 0: The deposit supply function is upward-sloping. The inverse deposit supply function is

$$R = G^{-1}(D/a) \equiv R(D/a) \quad \text{with } R'(\cdot) > 0.$$

The inverse supply of deposits is a function of supply-of-funds per depositor. We assume $R(0) \ge 0$ and $R''(D/a) \ge 0$.

Entrepreneurs. Loan demand in any market is obtained from a simple model of lending under borrower moral hazard (as in Martinez-Miera and Repullo, 2010). We assume a contractual environment where entrepreneurs have access to a set of risky projects of size 1 indexed by θ whose returns are random and perfectly correlated. Entrepreneurs with zero net worth must borrow to invest in the project. If a dollar is invested in a given project, it yields

$$\tilde{y} = \begin{cases} y(\theta) & \text{with probability } p(\theta), \\ 0 & \text{otherwise} \end{cases}$$

We assume that (i) the return, $y(\theta)$, is strictly increasing and strictly concave on $[0, \overline{\theta}]$, and (ii) the probability of success, $p(\theta)$, is strictly decreasing and strictly concave on $[0, \overline{\theta}]$ with p(0) = 1 and $p(\overline{\theta}) = 0$. The variable θ represents the "riskiness" of the project—the higher the θ , the higher is the return $y(\theta)$, but the lower is the probability of success, $p(\theta)$. Borrowers' choice of risk is not publicly verifiable, and therefore, not contractible.

Entrepreneurs (borrowers), who are of total measure b > 0, are heterogeneous in their reservation utility $u \ge 0$. Let H(u) denote the fraction of borrowers that have reservation utility less than or equal to u with H'(u) > 0 for all u. Given a loan rate, $r \ge 1$, each borrower solves

$$u(r) = \max_{\theta} \{ p(\theta)(y(\theta) - r) \}.$$
 (C.1)

The first-order condition associated with (C.1) is

$$h(\theta) \equiv y(\theta) + y'(\theta)(p(\theta)/p'(\theta)) = r.$$
(C.2)

Given the assumptions on $p(\theta)$ and $y(\theta)$, $h(\theta)$ is strictly increasing in θ . The above condition is the equality between the expected marginal revenue of risk-shifting and its expected marginal cost. Condition (C.2) defines optimal risk-taking as a function of the loan rate, $\theta = \theta(r)$. Given that $h'(\theta) > 0$, $\theta'(r) > 0$, that is, optimal risk-shifting of each borrower is increasing in loan rates (borrower incentive compatibility). From the Envelope theorem it follows that $u'(r) = -p(\theta(r)) < 0$.

An entrepreneur would participate in the loan market only if $u(r) \ge u$. Thus, the fraction of entrepreneurs who participate in the loan market is H(u(r)). With b entrepreneurs, the market loan demand is L(r) = bH(u(r)). Note that L'(r) = H'(u(r))u'(r) < 0, that is, the loan demand function is downward-sloping. The inverse loan demand function is given by

$$r = u^{-1} (H^{-1}(L/b)) \equiv r(L/b)$$
 with $r'(\cdot) < 0$.

We assume that $r(0) \ge R(0)$ and $r''(L/b) \le 0$. Given the above inverse demand function, risk-shifting and the probability of success respectively are $\theta(L/b) \equiv \theta(r(L/b))$ with $\theta'(L/b) = \theta'(r(L/b))r'(L/b) < 0$, and $P(L/b) \equiv p(\theta(L/b))$ with $P'(L/b) = p'(\theta(L/b))\theta'(L/b) > 0$.

6.2. The segmented market equilibrium

6.2.1. The equilibrium

With no equity and no interbank market, the balance sheet identity of bank *i* in market *j* implies $L_{ij} = D_{ij}$. Consequently, aggregate loan demand equals aggregate deposit supply in market *j* so that $L_j = \sum_{i=1}^{n_j} L_{ij} = \sum_{i=1}^{n_j} D_{ij} = D_j$. Bank *i* in market *j* chooses the volume of loans, L_{ij} , to maximize expected profits, taking into account choices made by its competitors and the entrepreneurs' choice of risk. In the segmented market, each bank *i* in market *j* solves

$$\max_{L_{ij}} P(L_j/b_j)(r(L_j/b_j) - R(L_j/a_j))L_{ij}.$$
(C.3)

Given that all banks are identical, and that they face the same aggregate deposit supply and loan demand schedules, in the segmented market, there are no asymmetric equilibria. Moreover, the symmetric equilibrium is unique. In the symmetric Cournot equilibrium, we have $L_{ij} = L_j/n_j$ for all *i*. The following lemma characterizes the (symmetric) SME in market *j*.

Lemma 8 The symmetric SME is characterized by loan rate, $r_j = r(L_j/b_j)$, deposit rate, $R_j = R(L_j/a_j)$, risk-shifting, $\theta_j = \theta(L_j/b_j)$, and intermediation margin

$$r(L_j/b_j) - R(L_j/a_j) = \frac{(b_j R'(L_j/a_j) - a_j r'(L_j/b_j)) P(L_j/b_j) L_j}{a_j (n_j b_j P(L_j/b_j) + P'(L_j/b_j) L_j)},$$
(C.4)

where L_j denotes the aggregate loans in market j.

Proof. The proof is similar to that of Lemma 9 below. \Box

Equation (C.4) determines bank loan volumes in the symmetric Cournot equilibrium. We obtain the loan rate in the SME from the inverse loan demand function, $r(L_j/b_j)$. Likewise, we obtain aggregate deposits and the deposit rate in the SME from $D_j = L_j$, and the inverse deposit supply function, $R(D_j/a_j)$, respectively.

6.2.2. Competition and risk-taking in the SME

Increased competition in the SME is defined as an increase in the number of banks. Competition can increase in any of the segmented markets if local banking authorities lower fixed set-up costs.

Proposition 7 In the SME of each market j, loan rate r_j and risk-shifting θ_j are strictly decreasing in the number of banks, n_j .

Proof. Follows from Boyd and De Nicolò (2005, Proposition 2).

As the number of banks increases in the Cournot market, total loan volume increases. Because the SME loan rate is decreasing in the aggregate loan volume, it decreases with n_j . Moreover, the optimal risk-shifting is increasing in the loan rate, and hence, decreasing as competition grows.

6.3. The integrated market equilibrium

6.3.1. Deposit supply and loan demand in the integrated market

Now, suppose that a subset of segmented markets, $J_m \subset J$, are integrated to form a single banking market, where $J_m = \{1, 2, ..., m\}$ and $|J_m| = m < |J|$. Given the assumption that there is no entry or exit of banks, the number of banks in the integrated market is equal to the total number of banks across the *m* markets combined, so that

$$n(m) = \sum_{j=1}^{m} n_j \tag{C.5}$$

Although the aggregate number of banks remains unaltered after market integration, each bank faces new rivals in the integrated market. In a similar vein, the measure of depositors and borrowers in the integrated market equals the aggregate of the measures of depositors and borrowers in each of the m individual markets, respectively. Therefore

$$a(m) \equiv \sum_{j=1}^{m} a_j$$
 and $b(m) \equiv \sum_{j=1}^{m} b_j$. (C.6)

The feature that the integrated market (by construction) is the sum of the individual segmented markets in terms of banks, borrowers, and depositors is conventional and largely for simplicity of exposition. As we show below, the key underlying mechanisms of the model remain robust to different outcomes. For example, the bank-competitor effect is negative irrespective of whether (C.5) holds or whether n(m) is greater than, equal to, or less than n_j for each j. The inverse deposit supply and loan demand functions in the integrated market are

$$R = R(D/a(m))$$
 where $R'(D/a(m)) > 0$, (C.7)

$$r = r(L/b(m))$$
 where $r'(L/b(m)) < 0,$ (C.8)

respectively. The inverse deposit supply of the integrated market, R(D/a(m)), is the horizontal sum of the *m* individual inverse deposit supply schedules, and consequently, more elastic than $R(D_j)$ for any j = 1, ..., m. Likewise, the inverse loan demand function, r(L/b(m)), which is the horizontal sum of the *m* individual inverse loan demand schedules, is more elastic than $r(L_j/b_j)$ for each j = 1, ..., m. Being the horizontal sum of convex deposit supply (concave loan demand) schedules, aggregate deposit supply (loan demand) is also convex (concave), that is, $R''(D/a(m)) \ge 0$ ($r''(L/b(m)) \le 0$). Figure 3 shows the inverse loan demand function for m = 2 and $b_1 < b_2$.



Figure 3: Loan demand when two markets integrate. Loan demand in market j = 1, 2 is $L_j(r) = b_j H(u(r))$. If $b_1 < b_2$, $r_1(L_1)$ lies below $r_2(L_2)$. Loan demand in the integrated market, $L(r) = L_1(r) + L_2(r) = (b_1 + b_2)H(u(r))$, is more elastic than that in any of the segmented markets.

6.3.2. The equilibrium

In the integrated market, J_m , all n(m) banks are identical and they face the same inverse deposit supply (C.7) and inverse loan demand (C.8). Given that banks are exclusively deposit-financed, $L_i = D_i$ holds for all *i*. This yields the market clearing condition, L = D. Bank *i* solves

$$\max_{L_i} P(L/b(m))(r(L/b(m)) - R(L/a(m)))L_i$$

It follows that $L_i = L/n(m)$ for all *i*, and the symmetric IME is described by the following proposition.

Lemma 9 The symmetric IME is characterized by loan rate, $r^* = r(L/b(m))$, deposit rate, $R^* = R(L/a(m))$, optimal risk-shifting $\theta^* = \theta(L/b(m))$, and the intermediation margin

$$r(L/b(m)) - R(L/a(m)) = \frac{(b(m)R'(L/a(m)) - a(m)r'(L/b(m)))P(L/b(m))L}{a(m)(n(m)b(m)P(L/b(m)) + P'(L/b(m))L)}$$

where L denotes the aggregate loans in the integrated market and a(m) and b(m) are given by (C.6).

Proof. We suppress for the time being the argument m from a(m), b(m) and n(m). With $L = \sum_{i=1}^{n} D_i = D$, the first-order condition of the maximization problem of bank i in the integrated market J_m is given by:

$$P(L/b)(r(L/b) - R(L/a)) + L_i(r(L/b) - R(L/a))P'(L/b) \cdot \frac{1}{b}$$

= $P(L/b)L_i\left(R'(L/a) \cdot \frac{1}{a} - r'(L/b) \cdot \frac{1}{b}\right)$
 $\iff L_i = \frac{P(L/b)(r(L/b) - R(L/a))}{P(L/b)\left(R'(L/a) \cdot \frac{1}{a} - r'(L/b) \cdot \frac{1}{b}\right) - (r(L/b) - R(L/a))P'(L/b) \cdot \frac{1}{b}}$ for all *i*.

Because the right-hand side of the above condition depends only on the aggregate loans, L, it immediately follows that $L_i = L_{i'}$ for any $i \neq i'$. Therefore, there are no asymmetric equilibria. In the (symmetric)

IME, $L_i = L/n$ for all *i*. Thus, the above optimality condition boils down to:

$$\mu(L, a, b) - F(L, a, b, n) = 0, \tag{C.9}$$

where $\mu(L, a, b) \equiv r(L/b) - R(L/a)$ is the equilibrium intermediation margin, and

$$F(L, a, b, n) \equiv \frac{(bR'(L/a) - ar'(L/b))P(L/b)L}{a(nbP(L/b) + P'(L/b)L)}$$

The second order necessary condition is given by:

$$\mu_L(L, a, b) - F_L(L, a, b, n) < 0.$$
(C.10)

The equilibrium loan rate is given by r(L/b), and the equilibrium risk-shifting is given by $\theta(L/b)$.

Evidently, the expressions for equilibrium loan rate and risk-taking for the IME in Lemma 9 are isomorphic to those obtained for the SME in Lemma 8. In spite of this similarity, we show below how the integration of heterogenous markets can alter the relation between competition and loan rates, and consequently, competition and risk-taking in the SME.

6.3.3. Effect of increased competition on loan rates and risk-taking

Increased competition in the IME is defined as an increase in the number of integrating markets. Given that integrating markets are heterogenous in our setting, we take an increase in m to imply that additional markets are integrated. Formally, if the set of integrated markets expands from J_m to $J_{m'}$, where $|J_m| = m$, $|J_{m'}| = m'$, then $J_m \subseteq J_{m'} \subset J$. In other words, we compare loan rates and risk-shifting between the IME in market J_m (shorthand for the smaller integrated set of m markets) and that in market $J_{m'}$ (shorthand for the larger integrated set of m' markets). Agents (banks and customers) are homogenous across the two sets of markets. But, their measures are different in each market, and with integration, deposit supply and loan demand schedules are more elastic in the larger (integrated) market.

The bank-competitor and the bank-customer effects. We explore the comparative static properties of the IME described in Lemma 9 to disentangle the effects of a(m), b(m), and n(m) on loan rates.⁴⁴ Formally,

$$\frac{dr^*}{dm} = \underbrace{\frac{\partial r}{\partial n} \cdot n'(m)}_{\text{bank-competitor effect}} + \underbrace{\frac{\partial r}{\partial a} \cdot a'(m) + \frac{\partial r}{\partial b} \cdot b'(m)}_{\text{bank-customer effect}}.$$
(C.11)

Increasing *m* increases the number of competitor banks in the integrated market n(m) and so, the first term on the right-hand-side of (C.11) denotes the *bank-competitor effect*. The second and third terms together constitute the *bank-customer effect*—the effect of an increase in the measure of customers (depositors and borrowers) under market integration. Because n(m), a(m), and b(m) are all strictly increasing in *m*, the sign of each term on the right-hand side of (C.11) is determined by the sign of the partial derivative in each term. We summarize our findings in terms of the following proposition.

⁴⁴We treat m as a continuous variable. Clearly, n(m), a(m), and b(m) are all strictly increasing functions of m.

Proposition 8 In the IME, the effect on an increase in m on the loan rate r^* is given by

$$\frac{dr^*}{dm} = \underbrace{Z_0(m) \cdot \hat{n}(m)}_{\text{bank-competitor effect}} + \underbrace{Z_1(m) \cdot (\hat{b}(m) - \hat{a}(m))}_{\text{bank-customer effect}} \equiv Z_0(m) \cdot \hat{n}(m) + Z_1(m) \cdot \hat{\xi}(m), \quad (C.12)$$

where $Z_0(m) < 0$ and $Z_1(m) > 0$ for all m, $\xi(m) \equiv b(m)/a(m)$ denotes the ratio of borrowers to depositors in market m, and $\hat{x}(m) \equiv x'(m)/x(m)$ denotes the rate of expansion of any arbitrary function x(m).

Proof. The first-order condition (C.9) can be written as

$$\mu(L, a, b) = F(L, a, b, n) \equiv \frac{\Phi(L, a, b)}{\Psi(L, b, n)}$$

where $\Phi(L, a, b) \equiv (b/a)R'(L/a) - r'(L/b) > 0$, and $\Psi(L, b, n) \equiv \frac{bn}{L} + \epsilon(L/b)$ with $\epsilon(L/b) \equiv P'(L/b)/P(L/b)$. Because the optimal risk-shifting of the entrepreneurs may be increasing or decreasing in the loan rate, the sign of P'(L/b) is indeterminate. If P'(L/b) > 0, then $\Psi(L, b, n)$ is also positive. Therefore, we would assume that $\Psi(L, b, n) \ge 0$ if P'(L/b) < 0. Note that

$$\mu_L = r'(L/b) \cdot \frac{1}{b} - R'(L/a) \cdot \frac{1}{a} < 0, \ \mu_a = R'(L/a) \cdot \frac{L}{a^2} > 0, \ \text{and} \ \mu_b = -r'(L/a) \cdot \frac{L}{b^2} > 0.$$

On the other hand, from the expression of F(L, a, b, n), we obtain

$$\begin{split} F_L &= \frac{1}{\Psi} \left[\frac{bR''(L/a)}{a^2} - \frac{r''(L/b)}{b} + F(L, a, b, n) \left(\frac{bn}{L^2} - \frac{\epsilon'(L/b)}{b} \right) \right], \\ F_a &= -\frac{b}{\Psi a^2} \left(R''(L/a)(L/a) + R'(L/a) \right), \\ F_b &= \frac{1}{\Psi} \left[\frac{R'(L/a)}{a} + \frac{Lr''(L/b)}{b^2} + F(L, a, b, n) \left(\frac{L\eta'(L/b)}{b^2} - \frac{n}{L} \right) \right], \\ F_n &= -\frac{\Phi b}{\Psi^2 L} < 0. \end{split}$$

Note that $F_L - \mu_L > 0$ by (C.10). Moreover, and $F_a < 0$ because $R''(L/a) \ge 0$, and hence, $\mu_a - F_a > 0$. Lastly, it is immediate to verify that

$$1 - \frac{b(\mu_b - F_b)}{L(F_L - \mu_L)} = \frac{a(\mu_a - F_a)}{L(F_L - \mu_L)}.$$

Totally differentiating the first-order condition (C.9), we obtain

$$\frac{dL}{L} = -\frac{nF_n}{L(F_L - \mu_L)} \cdot \frac{dn}{n} + \frac{a(\mu_a - F_a)}{L(F_L - \mu_L)} \cdot \frac{da}{a} + \frac{b(\mu_b - F_b)}{L(F_L - \mu_L)} \cdot \frac{db}{b}$$

Because $r^* = r(L/b)$, we have

$$dr^{*} = -r'(L/b)(L/b) \left\{ \frac{db}{b} - \frac{dL}{L} \right\}$$
$$= -r'(L/b)(L/b) \left\{ \frac{nF_{n}}{L(F_{L} - \mu_{L})} \cdot \frac{dn}{n} + \underbrace{\left(1 - \frac{b(\mu_{b} - F_{b})}{L(F_{L} - \mu_{L})}\right)}_{=\frac{a(\mu_{a} - F_{a})}{L(F_{L} - \mu_{L})}} \frac{db}{b} - \frac{a(\mu_{a} - F_{a})}{L(F_{L} - \mu_{L})} \cdot \frac{da}{a} \right\}.$$
(C.13)

Because $\hat{n}(m) \equiv n'(m)/n(m)$, $\hat{a}(m) \equiv a'(m)/a(m)$, $\hat{b}(m) \equiv b'(m)/b(m)$, and $\hat{\xi}(m) = \hat{b}(m) - \hat{a}(m)$ it follows from (C.13) that

$$\frac{dr^*}{dm} = -r'(L/b)(L/b) \left[\frac{nF_n}{L(F_L - \mu_L)} \cdot \hat{n}(m) + \frac{a(\mu_a - F_a)}{L(F_L - \mu_L)} \cdot \hat{\xi}(m) \right].$$

Define $Z_0 \equiv -r'(L/b)(L/b) \cdot \frac{nF_n}{L(F_L - \mu_L)}$ and $Z_1 \equiv -r'(L/b)(L/b) \cdot \frac{a(\mu_a - F_a)}{L(F_L - \mu_L)}.$

Because $r'(\cdot) < 0$, $F_n < 0$ and $F_L - \mu_L > 0$, we have $Z_0 < 0$. On the other hand, $Z_1 > 0$ as $r'(\cdot) < 0$, $F_L - \mu_L > 0$ and $\mu_a - F_a > 0$. This completes the proof of the Proposition. \Box

Equation (C.12) is isomorphic to (C.11). Just as in (C.11), the first term on the right-hand-side of (C.12) captures the bank-competitor effect. Moreover, just as in the SME, the bank-competitor effect is negative (because $Z_0(m) < 0$ for all m) in the IME. All else equal, an increase in the number of competitor banks with more integration reduces the market power of the banks in the loan market by reducing their market share, which in turn lowers the loan rate.

We also find that $Z_1(m) > 0$ for all m in (C.12). Consequently, the bank-customer effect is positive, zero, or negative according as $\hat{b}(m) \ge \hat{a}(m)$ or $\hat{\xi}(m) \ge 0$. When $\hat{b}(m) < \hat{a}(m)$, increasing m expands the deposit supply more than the loan demand. This implies a transition to a lower ratio of borrowers to depositors. As a result, the bank-customer effect is negative, which tends to lower loan rates. Conversely, when $\hat{b}(m) > \hat{a}(m)$, increasing m expands the loan demand more than deposit supply. Therefore, market integration implies transitioning to a higher ratio of borrowers to depositors. In this case, the bank-customer effect is positive, which tends to raise loan rates.

The overall effect of market integration on the equilibrium loan rate comprises the bank-competitor and bank-customer effects. A negative bank-customer effect reinforces the negative bank-competitor effect and the final outcome is a lower equilibrium loan rate in the integrated market. Accordingly, a negative bank-customer effect is a *sufficient condition* for a negative association between competition and loan rates. In contrast, a positive bank-customer effect can increase loan rates in the integrated market but only if it is sufficiently strong to outweigh the negative bank-competitor effect (i.e., $\hat{b}(m) - \hat{a}(m) >$ $(-Z_0(m)/Z_1(m)) \cdot \hat{n}(m))$. Therefore, a positive bank-customer effect is a *necessary condition* for a positive association between competition and loan rates.

We turn now to analyze the effect of competition on risk-taking incentives. The effect of increased competition on risk-taking in the IME comprises two effects: first, the effect of increased competition on the loan rate as shown above and second, the effect of the loan rate on risk-taking incentives of borrower. Taken together, the effect on increased competition on risk-taking in the IME is non-trivial.

Proposition 9 The negative relationship between competition and risk-taking in the SME can be reversed by a positive and sufficiently strong bank-customer effect in the IME.

Proposition 9 summarizes the impact of the bank-customer effect on risk-taking. As the general model here shows, the bank-customer effect exists even if bank customers (borrowers and depositors) are homogenous across all markets. As long as markets vary in terms of their composition of customers (ratio of borrowers to depositors), the bank-customer effect has the potential to alter the relationship between competition and risk-taking as more markets integrate.

6.3.4. Free entry

A final consideration is to allow free entry and endogenize the number of banks in the model. In doing so, we assume that there is a fixed setup cost, f_j , in market j. Set-up costs are market specific because they are largely determined by the local authorities and the cost of doing business within the market. Let $\pi(n_j, a_j, b_j)$ denote the maximized value of individual banks' expected profits in market j obtained from the maximization problem (C.3). The equilibrium number of banks in a free-entry Cournot equilibrium is derived from the *zero-profit* condition $\pi(n_j, a_j, b_j) = f_j$, and given by $n_j^* \equiv n(a_j, b_j, f_j)$. For a segmented market in our setting, the measures of entrepreneurs, a_j , and depositors, b_j are given. Therefore, the free-entry equilibrium number of banks, n_j^* is determined largely by the entry cost, f_j . Because expected equilibrium profits per bank decline in the number of banks, an increase fixed cost lowers the equilibrium number of banks in market j.⁴⁵

As shown above, n, a, b, are all functions of m in the IME. Expected profits and consequently, the free-entry equilibrium number of banks, n^* , are no longer just a function of set-up costs, f, but also a(m) and b(m) (e.g. Corchón and Fradera, 2002; Ghosh Dastidar and Marjit, 2022). Market integration affects the equilibrium interest rate, r, directly through measures of the customer base, a and b, but also indirectly through the number of banks, $n^* = n(a, b, f)$. It follows that

$$\frac{dr^*}{dm} = \underbrace{\frac{\partial r}{\partial n} \cdot \frac{\partial n^*}{\partial f} \cdot f'(m)}_{\text{bank-competitor effect}} + \underbrace{\left(\frac{\partial r}{\partial n} \cdot \frac{\partial n^*}{\partial a} + \frac{\partial r}{\partial a}\right) a'(m) + \left(\frac{\partial r}{\partial n} \cdot \frac{\partial n^*}{\partial b} + \frac{\partial r}{\partial b}\right) b'(m)}_{\text{bank-customer effect}}$$

The above equation is similar to (C.12), with the additional assumption that set-up costs, f, are now a function of the number of integrating markets, f(m). The sign of the first term, the bank-competitor effect, depends on how the fixed cost of entry changes with m. We could assume that f'(m) < 0 because market integration can prompt different regions to competitively lower set-up costs in a bid to host banks locally. Under this assumption, the bank-competitor effect would be negative. The latter two terms of the equation above comprise the bank-customer effect. When the number of banks are exogenous, we know that $\partial r/\partial a < 0$ and $\partial r/\partial b > 0$. However, integration also affects n^* through a and b, or equivalently, the ratio of borrowers to depositors, ξ . Without additional assumptions, the sign of the overall effect is not unambiguous. Nevertheless, even when the number of banks are endogenous in the model, the role of the bank-customer effect in determining how competition from market integration affects the loan rate, and consequently, risk-shifting remains robust.

⁴⁵From
$$\pi(n_j, a_j, b_j) = f_j$$
, we get $\frac{\partial \pi}{\partial n_j} dn_j = df_j$ so that with $\frac{\partial \pi}{\partial n_j} < 0$, we get $\frac{dn_j}{df_j} = 1/\frac{\partial \pi}{\partial n_j} < 0$.

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