Bank competition and risk-taking under market integration

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Online appendix

1. The general model of market integration

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

1.1. 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 $v \geq 0$. 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 $R \geq v$. 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 $R(0) \geq 0$ and $R''(D/a) \geq 0$.

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 $[0, \bar{\theta}]$, and (ii) the probability of success, $p(\theta)$, is strictly decreasing and strictly concave on $[0, \bar{\theta}]$ with $p(0) = 1$ and $p(\bar{\theta}) = 0$. 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 $u \geq 0$. 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, $r \geq 1$, each borrower solves

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

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

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

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 $u(r) \geq u$. 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

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

We assume that $r(0) \geq R(0)$ and $r''(L/b) \leq 0$. 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 $P'(L/b) = p'(\theta(L/b))\theta'(L/b) > 0$.

1.2. The segmented market equilibrium

1.2.1. 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

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

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 1 *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*

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

where L_j denotes the aggregate loans in market j.

Proof. The proof is similar to that of Lemma 2 below. □

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.

1.2.2. 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 1 *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.

1.3. The integrated market equilibrium

1.3.1. 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 $J_m = \{1, 2, \ldots, m\}$ 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

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

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

$$R = R(D/a(m)) \quad \text{where} \quad R'(D/a(m)) > 0, \tag{C.7}$$

$$r = r(L/b(m)) \quad \text{where} \quad r'(L/b(m)) < 0, \tag{C.8}$$

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 $j = 1, \ldots, m$. 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 $j = 1, \ldots, m$. Being the horizontal sum of convex deposit supply (concave loan demand) schedules, aggregate deposit supply (loan demand) is also convex (concave), that is, $R''(D/a(m)) \geq 0$ ($r''(L/b(m)) \leq 0$). Figure 1 shows the inverse loan demand function for $m = 2$ and $b_1 < b_2$.

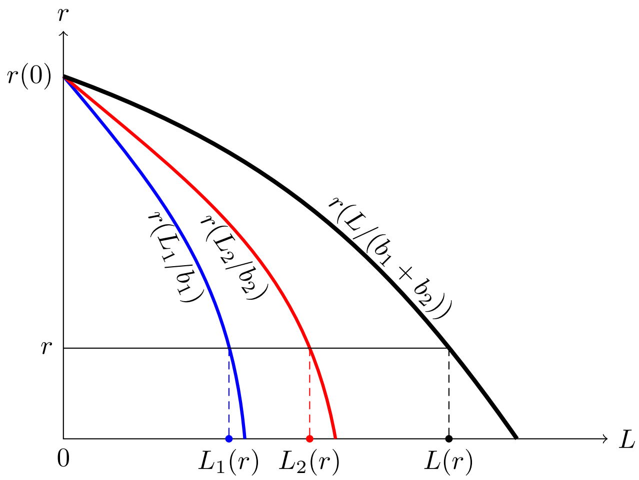

Figure 1: *Loan demand when two markets integrate. Loan demand in market $j = 1, 2$ is $L_j(r) = b_j H(u(r))$. If $b_1 < b_2$, $r_1(L_1)$ lies below $r_2(L_2)$. Loan demand in the integrated market, $L(r) = L_1(r) + L_2(r) = (b_1 + b_2)H(u(r))$, is more elastic than that in any of the segmented markets.*

1.3.2. 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 2 *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:

$$\begin{aligned}
&P(L/b)(r(L/b) - R(L/a)) + L_i(r(L/b) - R(L/a))P'(L/b) \cdot \frac{1}{b} \\
&= P(L/b)L_i \left(R'(L/a) \cdot \frac{1}{a} - r'(L/b) \cdot \frac{1}{b} \right) \\
\Longleftrightarrow L_i &= \frac{P(L/b)(r(L/b) - R(L/a))}{P(L/b)\left(R'(L/a) \cdot \frac{1}{a} - r'(L/b) \cdot \frac{1}{b}\right) - (r(L/b) - R(L/a))P'(L/b) \cdot \frac{1}{b}} \quad \text{for all } i.
\end{aligned}$$

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:

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

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

Evidently, the expressions for equilibrium loan rate and risk-taking for the IME in Lemma 2 are isomorphic to those obtained for the SME in Lemma 1. 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.

1.3.3. 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 2 to disentangle the effects of $a(m)$, $b(m)$, and $n(m)$ on loan rates.[1] Formally,

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

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.

Proposition 2 *In the IME, the effect on an increase in m on the loan rate r^* is given by*

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

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 $\Psi(L,\, b,\, n) \geq 0$ if $P'(L/b) < 0$. Note that

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

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

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

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

Note that $F_L - \mu_L > 0$ by (C.10). Moreover, and $F_a < 0$ because $R''(L/a) \geq 0$, 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

$$
\begin{aligned}
dr^* &= -\,r'(L/b)(L/b)\left(\frac{db}{b} - \frac{dL}{L}\right)\\
&= -\,r'(L/b)(L/b)\left\{\frac{nF_n}{L(F_L - \mu_L)} \cdot \frac{dn}{n} + \underbrace{\left(1 - \frac{b(\mu_b - F_b)}{L(F_L - \mu_L)}\right)}_{= \frac{a(\mu_a - F_a)}{L(F_L - \mu_L)}}\frac{db}{b} - \frac{a(\mu_a - F_a)}{L(F_L - \mu_L)} \cdot \frac{da}{a}\right\}.
\end{aligned}
\tag{C.13}
$$

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

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

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

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. □

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 $\hat{b}(m) \gtreqless \hat{a}(m)$ or $\hat{\xi}(m) \gtreqless 0$. 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 3 *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 3 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.

1.3.4. 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.[2]

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

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.

References

Boyd, J. and G. De Nicolò (2005). The theory of bank risk taking and competition revisited. *The Journal of Finance 60*, 1329–1343.

Corchón, L. and I. Fradera (2002). Comparative statics in cournot free entry equilibrium. *Mathematical Social Sciences 44*, 155–168.

Ghosh Dastidar, K. and S. Marjit (2022). Market size, entry costs and free entry cournot equilibrium. *Journal of Economics 136*, 97–114.

Martinez-Miera, D. and R. Repullo (2010). Does competition reduce the risk of bank failure? *The Review of Financial Studies 23*, 3638–3664.