Competition between Customer- and Investor-Owned Banks with Differentiated Deposit Supply and Loan Demand

Richard Meade*

Auckland University of Technology & Cognitus Economic Insight

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Abstract

This paper models duopolistic competition between an investor-owned ("stock") bank and customer-owned ("mutual") bank using the Hotelling framework. The standard model of household inter-temporal utility maximisation is adapted to allow households to have preferences over both price (i.e. deposit and loan rates) and non-price bank characteristics (i.e. non-rate bank attributes). The stock and mutual banks are assumed to maximise profits and total surplus (i.e. profits plus depositor and borrowers surpluses) respectively. We show that while the mutual bank formally maximises customer welfare, it can offer a lower deposit rate and higher lending rate than the investor-owned bank, provided it has sufficient mass-market appeal in terms of non-rate attributes. This provides an explanation for apparently unattractive mutual bank performance, relative to investor-owned banks, that does not rely on assuming inferior governance (i.e. greater incentive problems) in mutual banks.

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1 Introduction

How do banks compete when their customers care about both prices (i.e. deposit and loan rates) and non-price bank attributes? How does that competition change when banks have different corporate forms, with some owned by investors, and others by their customers?

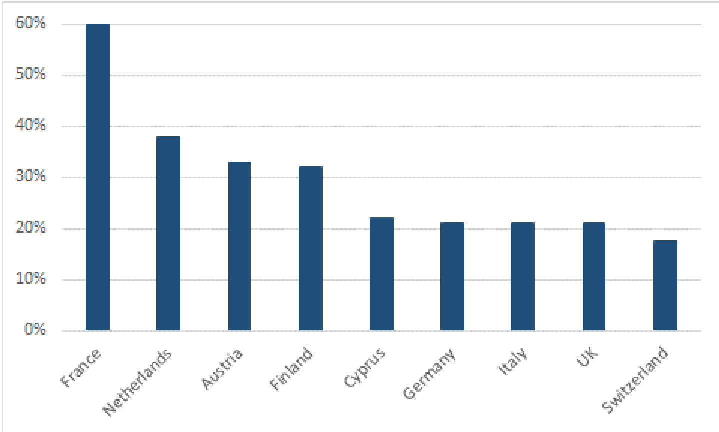
Little is known about such "mixed" competition between investor-owned ("stock") banks and customer-owned ("mutual", or "cooperative") banks. Yet, as illustrated in Figure 1, mutual banks account for sufficient deposit shares in many countries that they can be expected to be systemically relevant, and important contributors to the welfare of both their own customers and their rivals' customers. Mutual bank behaviour, and how that behaviour interacts with the behaviour of stock banks, thus remains relevant for policymakers and regulators concerned about issues such as bank sector riskiness, and customer welfare in imperfectly-competitive banking sectors.

Research into the relative behaviours and performance of stock and mutual financial organisations (banks and insurance companies) has progressed in waves. Mainly empirical contributions on stock and mutual banks from the 1960s are summarised in O'Hara (1981). That later study, and subsequent empirical studies on stock and mutual insurance companies, drew on the agency theory literature popular in the 1980s and 1990s (e.g. see the studies cited in Smith and Stutzer (1995)). Hansmann (1996) provides a thorough treatment of the theoretical considerations, and applies them to his survey of the relative roles and importance of stock and mutual banks in the US.

Mutual bank performance received renewed attention following prominent financial crises, notably the global financial crisis, and before then, the US savings and loan crisis. Evidence relating to periods before, during and after the global financial crisis of 2007–2008 indicates that customer-owned banks tended to be more financially stable than their investor-owned rivals (Iannotta et al. (2007), Hesse and Cihak (2007), Fonteyne (2007), Beck et al. (2009), Liu and Wilson (2013)). These findings echo those of studies of both during and before the US savings and loans crisis of 1986–1995 (Ayadi et al. (2010), Fonteyne (2007)).

Such analyses highlight that customer-owned banks maximise customer welfare as well as profits, and have access to inter-generational capital reserves that cannot be distributed. These combine to mean that they face less pressure than investor-owned banks to maximise profits by pursuing higher returns through assuming higher investment (i.e. lending) risks and/or diversifying into non-traditional business areas. Furthermore, their non-distributable reserves also enable customer-owned banks to better smooth

Figure 1: Deposit Shares of European Mutual Banks



Source: UK data from www.bsa.org.uk (2014), otherwise data from International Cooperative Banking Association (2005).

inter-temporal risks, with benefits for the wider financial system (Ayadi et al. (2010), Chaddad and Cook (2004), Allen and Gale (1997)). Customer-owned banks have also been found to reduce the impacts of financial crises due to adopting less pro-cyclical lending policies than investor-owned banks (Ferri et al. (2014)).

Despite these waves of research interest in mutual banks, formal modelling of mixed interbank competition remains extremely sparse. Smith et al. (1981) develop a theoretical model of mutual bank behaviour, but do not consider the relative behaviours of mutual and stock banks. Girotti and Meade (2014, 2017) present theoretical models of mixed bank competition, but they treat deposit supply and loan demand as being undifferentiated, and hence do not formally model customers' bank type choices.

In this paper we fill a gap in the theoretical literature on mixed bank competition. We formally model households' loan demand and deposit supply choices, allowing for both price (i.e. loan and deposit rate) and non-price (e.g. branch size and location, etc) differentiation between bank types. By integrating loan and deposit choices within a Hotelling-type framework for differentiated demand, customers' choices over bank type are endogenised. Taking banks' non-price attributes as being exogenous, the resulting loan demands and deposit supplies are then applied in a model of mixed duopoly bank competition. Facing these loan demands and deposit supplies, the stock bank is assumed to choose loan and deposit rates to maximise profits, while the mutual bank is assumed to do so to maximise profits – which accrue to customers – plus customer (i.e. depositor and borrower) surplus.

Despite the mutual bank formally seeking to maximise both profits and customer surplus – i.e. customer welfare – we show that in equilibrium it can set higher loan rates and lower deposit rates than its stock rival. This arises if the mutual bank is more aligned with customers' distribution of preferences over non-price bank attributes – i.e. if it is sufficiently more "mass market" in appeal than the stock bank on non-price dimensions.

Notably, this result arises in a model without informational asymmetries or other agency costs. It provides an explanation for why mutual banks might offer apparently unattractive loan and deposit rates relative to profit-maximising stock banks, despite maximising customer welfare. This view of mutual bank relative performance is relevant to policymakers or regulators who might otherwise attribute such performance differences to supposed or assumed mutual bank governance (i.e. internal incentive) problems.

The next section sets out our model, starting with households' deposit and loan choices when confronted with mixed bank types. We then describe our model of duopolistic competition between a single stock bank and single mutual bank. Section 3 presents our results, while Section 4 discusses and concludes.

2 Model

2.1 Setup

We consider a one-period bank duopoly in which mutual/customer-owned bank CO competes with stock/investor-owned bank IO in choices of deposit rates (r^D_{CO} and r^D_{IO} respectively) and loan rates (r^L_{CO} and r^L_{IO} respectively). Timing is as follows. First, the banks' non-price attributes are fixed exogenously. Second, the banks compete simultaneously in prices (i.e. in both deposit and loan rates) to attract deposits and write loans, anticipating how households will choose at which bank they will make deposits and take loans. Finally, households choose at which bank they will make deposits and take loans, given the banks' exogenous non-price attributes, and endogenous deposit and loan rates choices.

Formally, each bank is assumed to face a given deposit supply from depositors, denoted $q^D_{CO}\left(r^D_{CO}, r^D_{IO}\right)$ and $q^D_{IO}\left(r^D_{CO}, r^D_{IO}\right)$ respectively, with banks assumed to be riskless (i.e. depositors face no default risk). Deposit supply for each bank is assumed to be increasing in its own deposit rate, but decreasing in its rival's deposit rate. A specific derivation of deposit supplies is given below.

Likewise, each bank is assumed to face a given loan demand from customers, denoted $q^L_{CO}\left(r^L_{CO}, r^L_{IO}\right)$ and $q^L_{IO}\left(r^L_{CO}, r^L_{IO}\right)$ respectively, with borrowers assumed to be riskless (i.e. banks face no default risk). Loan demand for each bank is assumed to be decreasing in its own loan rate, but increasing in its rival's loan rate. A specific derivation of loan demands is also given below.

If either bank attracts greater (fewer) deposit funds than it needs to finance the loans it writes, it is assumed to be able to risklessly invest (borrow) those funds on a wholesale money market at exogenous rate r^W. We assume that each bank $i \in \{CO, IO\}$ has fixed costs F_i and quadratic variable costs for each of raising deposits and writing loans (parameterised by γ^D and γ^L respectively).

Simplifying notation by writing $r^j \equiv \left(r^j_{CO}, r^j_{IO}\right)$ for $j \in \{D, L\}$, profits for bank i are the difference between its loan revenues and deposit costs, plus any wholesale balancing revenues (or less any balancing costs), net of variable and fixed costs:

$$\begin{aligned}\Pi_i\left(r^D, r^L\right) &= r^L_i q^L_i\left(r^L\right) - r^D_i q^D_i\left(r^D\right) + r^W\left(q^D_i\left(r^D\right) - q^L_i\left(r^L\right)\right)\\ &\quad -\tfrac{\gamma^L}{2} q^L_i\left(r^L\right)^2 - \tfrac{\gamma^D}{2} q^D_i\left(r^D\right)^2 - F_i\end{aligned} \tag{1}$$

2.2 Deposit Supplies

The deposit supply facing each bank type is derived from a household two-period utility maximisation problem. Each household has exogenous income y_t in periods $t \in \{1, 2\}$, and consumes c_t each period. We assume that a given household makes a fixed deposit $D > 0$ in period 1, earning deposit rate r^D_i for $i \in \{CO, IO\}$, taking deposit rates as given. The household's inter-temporal budget constraints write as:

$$\begin{aligned}c_1 &= y_1 - D\\ c_2 &= y_2 + D\left(1 + r^D_i\right)\end{aligned} \tag{2}$$

The household must reduce its period 1 consumption below exogenous first period income y_1 by deposit amount D, but doing so means it can consume more in period 2 due to having the deposit repaid with interest (taking r^D_i as given). Assuming time-invariant preferences, and discount factor β, the household's *gross* utility thus writes as:

$$U\left(c_1\right) + \beta U\left(c_2\right) \quad \text{s.t. } (2)$$

$$\Leftrightarrow \quad U_i \equiv U\left(y_1 - D\right) + \beta U\left(y_2 + D\left(1 + r_i^D\right)\right) \tag{3}$$

To motivate a household choosing to deposit at either bank type, we suppose that bank i offers households a differentiated bundle of non-deposit rate characteristics, and that households have preferences over those characteristics.

Specifically, we assume that households are uniformly distributed over the Hotelling unit line, with CO exogenously located at a and IO exogenously located at $1-b$. Consumers incur a quadratic "misalignment cost" (proportional to $c > 0$) from being located at x rather than where their preferred bank type is located. We impose that $a + b < 1$ to ensure that deposit supplies are upward sloping (and that loan demands, as derived below, are downward sloping).

In this framework, the household's utility maximisation problem amounts to choosing at which bank to make their deposit, based on the *net* utility they derive from doing so. Formally, a household located at x faces the following *net* utility maximisation problem:

$$\max_{\{CO, IO\}} \left\{U_{CO} - c\left(x-a\right)^2, U_{IO} - c\left(x - \left(1-b\right)\right)^2\right\} \tag{4}$$

where:

$$U_i \equiv U\left(y_1 - D\right) + \beta U\left(y_2 + D\left(1 + r_i^D\right)\right), \quad i \in \{CO, IO\} \tag{5}$$

Since $U\left(y_1 - D\right)$ and β are common to the household's utility from each bank type, it will choose to deposit at CO if:

$$\begin{aligned} &U\left(y_2 + D\left(1 + r_{CO}^D\right)\right) - c\left(x-a\right)^2 \\ &> U\left(y_2 + D\left(1 + r_{IO}^D\right)\right) - c\left(x-\left(1-b\right)\right)^2 \end{aligned} \tag{6}$$

To ensure tractable deposit demand functions, we simplify by further assuming that preferences are logarithmic, and quasi-linear in income. With these simplifications, the household's utility from depositing with bank i is:

$$U_i\left(r_i^D\right) = y_2 + ln\left(D\right) + ln\left(1 + r_i^D\right) \approx y_2 + ln\left(D\right) + r_i^D \tag{7}$$

As above, since y_2 and $ln(D)$ are independent of bank type i, the utility maximisation problem (4) of a household located at x simplifies to:

$$\max_{\{CO, IO\}} \left\{r_{CO}^D - c\left(x-a\right)^2, r_{IO}^D - c\left(x-\left(1-b\right)\right)^2\right\} \tag{8}$$

Solving in the usual way for the location $\hat{x}\left(r^D_{CO}, r^D_{IO}\right)$ of the household indifferent between depositing at CO or IO, we have:

$$\hat{x}\left(r^D_{CO}, r^D_{IO}\right) = \frac{r^D_{CO} - r^D_{IO}}{2c\left(1-a-b\right)} + \frac{1}{2}\left(1+a-b\right) \tag{9}$$

Finally, assuming a unit mass of households, the deposit supply for each bank is:

$$q^D_{CO}\left(r^D_{CO}, r^D_{IO}\right) = \hat{x}\left(r^D_{CO}, r^D_{IO}\right) \tag{10}$$

$$q^D_{IO}\left(r^D_{CO}, r^D_{IO}\right) = 1 - \hat{x}\left(r^D_{CO}, r^D_{IO}\right) \tag{11}$$

where (10) writes as in (9), and (11) writes as:

$$q^D_{IO}\left(r^D_{CO}, r^D_{IO}\right) = \frac{r^D_{IO} - r^D_{CO}}{2c\left(1-a-b\right)} + \frac{1}{2}\left(1-a+b\right) \tag{12}$$

Notice that since $a + b < 1$ has been imposed, deposit supplies are increasing in each bank's own deposit rate, and decreasing in its rival's deposit rate.

2.3 Loan Demands

A given household's choice of which bank to take a loan from, and hence the loan demands facing each bank, are derived analogously to above. A given household takes out a loan of exogenous amount $L > 0$. Using other notation as above, this implies the following inter-temporal budget constraints:

$$\begin{aligned} c_1 &= y_1 + L \\ c_2 &= y_2 - L\left(1 + r^L_i\right) \end{aligned} \tag{13}$$

The household can increase period 1 consumption by borrowing L, but must reduce its period 2 consumption below its exogenous second period income y_2 due to repayment of the loan and interest thereon (taking loan rate r^L_i as given).

The household's *gross* utility from borrowing can be written analogously as in (3):

$$U^L_i \equiv U\left(y_1 + L\right) + \beta U\left(y_2 - L\left(1 + r^L_i\right)\right) \tag{14}$$

Introducing exogenous non-price bank differentiation as above, CO is located in terms of non-price attributes exogenously at a on the Hotelling unit line, while IO is exogenously located at $1-b$. A household located at y, and facing "misalignment cost" $c_L > 0$, chooses to borrow from CO if:

$$\begin{aligned} &U\left(y_2 - L\left(1 + r^L_{CO}\right)\right) - c_L\left(y-a\right)^2 \\ &> U\left(y_2 - L\left(1 + r^L_{IO}\right)\right) - c_L\left(y-(1-b)\right)^2 \end{aligned} \tag{15}$$

Making the simplifying assumptions above, that preferences are logarithmic and quasi-linear in income, the household's utility maximisation problem in respect of loan choice becomes:

$$\max_{\{CO, IO\}} \left\{-r^L_{CO} - c_L\left(y-a\right)^2, -r^L_{IO} - c_L\left(y-(1-b)\right)^2\right\} \tag{16}$$

Solving as above for the location $\hat{y}\left(r^L_{CO}, r^L_{IO}\right)$ of the household indifferent between borrowing from CO or IO, and noting that this location represents total loan demand facing CO assuming a unit mass of borrowers (with $1-\hat{y}$ representing total loan demand facing IO), we have:

$$q^L_{CO}\left(r^L_{CO}, r^L_{IO}\right) = \frac{r^L_{IO} - r^L_{CO}}{2c_L(1-a-b)} + \frac{1}{2}\left(1+a-b\right) \tag{17}$$

$$q^L_{IO}\left(r^L_{CO}, r^L_{IO}\right) = \frac{r^L_{CO} - r^L_{IO}}{2c_L(1-a-b)} + \frac{1}{2}\left(1-a+b\right) \tag{18}$$

In contrast to deposit supplies above, with $a+b<1$ imposed, each bank's loan demand is decreasing in its own loan rate, but increasing in its rival's loan rate.

2.4 Bank Objective Functions

The profits of bank i from (1) can now be computed explicitly using (9) and (12) for deposit supplies, and (17) and (18) for loan demands. Since IO is investor-owned, we assume that its owners require it to maximise profits (setting aside incentive issues within investor-owed banks). Hence IO is assumed to choose r^D_{IO} and r^L_{IO} to maximise $\Pi_{IO}\left(r^D, r^L\right)$ where r^D and r^L are defined as above.

Conversely, since CO is owned by its customers, we assume that it seeks to maximise overall customer welfare (again, setting aside incentive problems within the bank, and also between depositors and lenders). That is, CO is assumed to choose r^D_{CO} and r^L_{CO} to maximise:

$$\Pi_{CO}\left(r^D, r^L\right) + S^D_{CO}\left(r^D\right) + S^L_{CO}\left(r^L\right) \tag{19}$$

where depositor and borrower surpluses are, respectively:[1]

$$S^D_{CO}\left(r^D\right)=\int_0^{r^D_{CO}} q^D_{CO}\left(x,r^D_{IO}\right)dx \tag{20}$$

$$S^L_{CO}\left(r^L\right)=\int_0^{q^L_{CO}\left(r^L\right)} r^L_{CO}\left(x,r^L_{IO}\right)dx-r^L_{CO}\left(q^L_{CO}\left(r^L\right)\right)q^L_{CO}\left(r^L\right) \tag{21}$$

Since these expressions will be differentiated when taking first order conditions for CO's optimal deposit and loan rate choices, they need not be derived in full, and first order conditions can instead be applied using Leibniz's Rule. However, since our expressions for deposit supply and loan demand as derived above are relatively simple linear expressions, (20) and (21) were derived in full for the purposes of the results presented in Section 3.[2]

3 Results

In Section 2 we set out a model of mixed competition between duopolistic CO and IO banks, where the deposit supplies and loan demands facing each bank reflect differentiation between the banks in terms of non-price attributes (e.g. branch size and location). In general, due to such non-price differentiation, we should expect equilibrium deposit and loan rates to each differ for each bank type. In other words, CO and IO will in general be able to offer different deposit rates, and charge different loan rates, since they each cater to a particular segment of households. This would be true if each bank type had the same objective function (i.e. if they both simply maximised profits). However, it will also arise as a consequence of each bank type being assumed to maximise different objective functions – profits (1) for IO, versus profits plus depositor and borrower surpluses (19) for CO.

[1] Formally, the lower limit of the integral in (20) is the greater of 0 and any positive vertical intercept of the deposit supply function (i.e. allowing for the fact that it may take a positive deposit rate to elicit any deposit supply). The latter was used for the results presented in Section 3.

[2] Full details are available from the author on request.

3.1 Best Response Functions

First considering IO, taking first order conditions for (1) with respect to r_{IO}^{D} and r_{IO}^{L} produces best response functions:[3]

$$\begin{aligned} &\tilde{r}_{IO}^{D}\left(r_{CO}^{D}\right) \\ &\tilde{r}_{IO}^{L}\left(r_{CO}^{L}\right) \end{aligned} \tag{22}$$

Likewise, for CO, taking first order conditions for (19) with respect to r_{CO}^{D} and r_{CO}^{L} produces best response functions:

$$\begin{aligned} &\tilde{r}_{CO}^{D}\left(r_{IO}^{D}\right) \\ &\tilde{r}_{CO}^{L}\left(r_{IO}^{L}\right) \end{aligned} \tag{23}$$

3.2 Equilibrium Deposit and Loan Rates

Best response systems of equations (22) and (23) represent two sets of two linear equations, each in two unknowns (respectively, deposit and loan rates for each of $IO$and CO).

Simultaneously solving deposit rate best response functions for CO and IO produces the following equilibrium deposit rates:

$$r_{CO}^{D*} = \tfrac{(1-a-b)\left[\delta_D(a-b+3)-4r^W\right]c}{4(a+b-1)c-2\delta_D} + \tfrac{\delta_D\left(\delta_D-2r^W\right)}{4(a+b-1)c-2\delta_D} \tag{24}$$

$$r_{IO}^{D*} = r^W - \frac{\delta_D}{2} + \left(a - \frac{1}{2}\left(1+a^2-b^2\right)\right)c \tag{25}$$

Likewise, simultaneously solving loan rate best response functions for each bank produces the following equilibrium loan rates:

$$r_{CO}^{L*} = \tfrac{(a+b-1)\left[\delta_L(a-b+3)+4r^W\right]c_L}{4(a+b-1)c_L-2\delta_L} - \tfrac{\delta_L\left(\delta_L+2r^W\right)}{4(a+b-1)c_L-2\delta_L} \tag{26}$$

$$r_{IO}^{L*} = r^W + \frac{\delta_L}{2} - \left(a - \frac{1}{2}\left(1+a^2-b^2\right)\right)c_L \tag{27}$$

[3]Full expressions for these best response functions are tractable, given our linear forms for deposit supplies and loan demands, though non-trivial. Full details are available from the author on request.

3.3 Relative Deposit and Loan Rates for Each Bank Type

Recall that CO formally chooses deposit and loan rates to maximise total customer surplus (19), while IO does so to maximise profits. It might therefore be expected that CO should produce a higher deposit rate and lower loan rate than IO in equilibrium. However, closer inspection indicates that this is not assured.

Specifically, computing $r_{CO}^{D*} - r_{IO}^{D*}$ using (24) and (25), it can be shown that this difference is negative – i.e. CO offers a lower equilibrium deposit rate than IO – if:[4]

$$\frac{c}{\delta_D} < \frac{a-b}{(a-b-1)(a+b-1)} \tag{28}$$

Since we have imposed $a+b<1$, the denominator in the right-hand side of this condition is positive, as is the left-hand side. Hence this condition is satisfied if a is sufficiently greater than b. In other words, CO can afford to offer depositors a lower equilibrium deposit rate than IO, even though it is formally maximising customer welfare, if it has sufficient "mass market" appeal relative to IO (i.e. if it is sufficiently attractively located relative to depositor preferences, as compared with IO).

Likewise, computing $r_{CO}^{L*} - r_{IO}^{L*}$ using (26) and (27), it can be shown that this difference is positive – i.e. CO charges a higher equilibrium loan rate than IO – if:[5]

$$\frac{c_L}{\delta_L} < \frac{a-b}{(a-b-1)(a+b-1)} \tag{29}$$

As above, this condition is satisfied if a is sufficiently greater than b. In other words, CO can afford to charge borrowers a higher equilibrium loan rate than IO, even though it is formally maximising customer welfare, if it has sufficient "mass market" appeal relative to IO. For both deposit and loan rates, customer welfare reflects the combined impacts of both price attributes (i.e. deposit and loan rates) as well as non-price bank attributes (here, represented by their location on the Hotelling line). As a consequence, superficial comparisons of relative deposit rates and relative loan rates between the two bank types could lead to faulty inferences by regulators or policymakers about whether CO banks are actually maximising customer welfare (and indeed, whether IO banks are actually maximising profits).

[4] The same condition is produced if CO is assumed to maximise just $\Pi_{CO} + S_D$ instead of $\Pi_{CO} + S_D + S_L$.

[5] This condition reduces to $a > b$ if CO is assumed to maximise just $\Pi_{CO} + S_D$ instead of $\Pi_{CO} + S_D + S_L$.

4 Conclusions

The strategic behaviours of CO and IO banks when engaging in imperfect (here, differentiated) price competition have been relatively unexplored. Given the sometimes considerable deposit shares of CO banks, and evidence that they behave differently to IO banks in periods of financial crisis, they are both potentially systemic and policy relevant. This paper fills a gap in the literature by providing a simple and tractable framework for analysing such strategic behaviours.

Aside from providing this framework, our main contribution has been to show that despite CO banks formally maximising customer welfare (actually, due to them doing so), they can nonetheless offer lower deposit rates, and charge higher loan rates, than profit-maximising IO banks in equilibrium. This complicates assessments by financial regulators and policymakers of each bank type's contribution to bank sector performance, such as when concerned with bank sector competitiveness and pricing, or with possible governance deficiencies in one bank type or the other.

A strength of our analysis is that it lays bare each bank type's strategic considerations. However, obvious extensions would be to incorporate risk and incentive considerations, as have traditionally been the focus of previous research on CO and IO banks. This paper provides a firmer strategic foundation for further research on these equally policy-relevant considerations.

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