International Research Journal of Applied Finance ISSN 2229 – 6891
Vol. VII Issue – 10 October, 2016 www.irjaf.com
DOI: 10.0710/article-1

Loan Market Competition and Bank Stability - A Re-examination of Banking Competition and Risk Taking

Li-Hsuan Lee* Yeong-Yuh Chiang Hsing-Hua Chang

Abstract

The link between banking competition and stability is complex. In 2005, Boyd and De Nicóclo provide a competition-stability model by arguing that competition drives down loan rates and induces less risky investment. This paper introduces a deposit-cost-transmitting mechanism and argues that there is an inverse U-shaped relationship between banking competition and the borrowers' risk-taking behaviors. When banks are equipped with capital-cost transmitting power, great profit margins drive banks to raise loan rates and cause entrepreneurs to choose riskier projects. The environment with higher banking bargaining power tends to be in favor of the competition-fragility view. When banks' monopoly power is less robust, stiffer competition depresses demand for deposits and decreases both deposit rates and loan rates, inducing the choices of safer projects. Thus, the competition-stability view prevails over the concentration-stability view in a competitive banking system.

Keywords: Bank competition; Financial stability; Risk shifting; Market structure

I. Introduction

Since the deregulation and the financial crisis in 1980s, there is a common argument that bank competition stimulates risk-taking behaviors. By considering competition in deposit markets and funding costs, Allen and Gale (2000) provide a theoretical model to justify this competition-fragility viewpoint. They argue that competition increases banks' funding costs, erodes their charter value, and induces them to invest in riskier projects. Boyd and De Nicóclo (2005, henceforth BDN) add the role of entrepreneurs and argue that their choice of riskier investment in response to higher loan rates causes a trade-off between concentration and fragility in the banking sector. As the number of banks increases, competition lowers loan rates and induces less risky investment (referred to the risk-shifting effect or the BDN effect).

Recently, some studies revisit the discussion of competition-fragility and concentration-fragility view. Boyd, De Nicolo, and Jalal (2009, henceforth BDJ) extend the BDN model and assume that banks can invest in riskless assets. They discover an important role of the BDN effect in determining the relationship between competition and bank risk taking. The BDN effect is strong as long as the number of banks is greater than a threshold of N. If and only if the BDN effect is present and sufficiently strong, an increase in bank competition will not result in an increase of bank failure.

By adding loan correlation to the BDN framework, Martinez-Miera and Repullo (2010, henceforth MR) discover a margin effect in which banks' profits decrease and failure probabilities of banks increase as banking competition stiffens. They argue that, as competition increases, the margin effect eventually dominates the risk-shifting effect and leads to a U-shaped relationship between probability of bank failure and the number of banks.

Our study discovers a non-linear relation similar to what BDJ find but through a different mechanism. Banks compete with each other in both loan markets and deposit markets. BDN add loan market competition to the Allen and Gale model (2000) and find the risk-shifting effect of loan market competition. This study reconsiders deposit market competition by decomposing loan rates into two parts: risk premium and transmission of deposit costs and introduces a deposit-cost-transmitting mechanism. Banking competition affects loan rates through transmitting power and deposit rates.

We argue that equilibrium in deposit markets does matter for the discussion of the risk structure of the loan portfolio. When the number of banks increases, but is less than a threshold, total demand for deposits increases and the deposit rate increases. Through the cost-transmitting channel, loan rates rise and borrowers choose projects with higher risk (BDN effect). As the number of banks passes the threshold, an increase in the number of bank causes total demand for deposits to decrease, inducing lower loan rates and less risky chosen projects. Consequently, we have an inverse U-shaped relation between bank riskiness and the degree of banking competition. This deposit cost transmission mechanism distinguishes our paper from the above-mentioned literature.

Banking competition has often been constrained to ensure the stability of the banking system. There are many different arguments behind the competition-fragility view. Some argue that deregulation results in low levels of banks' profits and charter value, encouraging banks to take risks for high returns (Chan, Greenbaum, and Thakor (1986), Keeley (1990), Edwards and Mishkin (1995), and Allen and Gale (2000, 2004)). Keeley (1990) finds the empirical evidence that the deregulation of state branching in the 1980s led to an increase in bank failures. Allen and Gale (2000, 2004) theoretically argue that banks lose their charter value in competition and that a trade-off between competition and stability emerges.

Others argue that banks use costly screening or monitoring technology to relieve adverse selection and moral hazard problems in loan markets. A bank's profit level affects its use of costly information-acquiring technology (Boot and Greenbaum (1993), Allen and Gale (2004)). Banks with higher monopoly power make more profits and use information-acquiring technology more frequently. This leads to a more stable banking sector. In addition, banks have a relationship lending rents over their borrowers. These rents draw banks away from taking risk (Marquez (2002), Besanko and Thakor (1993)). Competition reduces the banks' revenues and erodes their buffers to balance the defaulting loan loss (MR (2010)).

The competition-fragility view is well received and significantly affects regulatory policies (BDN). However, the empirical evidence on bank competition and system stability is ambiguoun. [1] Contrary to the competition-fragility view, BDN provide a concentration-fragility (competition-stability) view. Most theoretical studies of banking competition and stability assume that banks choose their own project risk and ignore the fact that banks compete with one another in loan markets. BDN consider loan-market competition and show the existence of a negative relation between competition and the risk of fragility due to the BDN effect.

In contrast to BDN and BDJ, we consider the transmission of deposit costs to loan rates. Competition in the banking sector affects the extent to which the bank can transmit its deposit costs to loan rates. We assume that such a transmission power is decreasing in the number of banks to reflect that a bank's bargaining power in setting loan rates decreases as the banking market becomes more competitive. When the number of bank is small enough, stiffer competition (the number of banks is larger) enhances the demand for deposits and causes the

[1] See Uhde and Heimeshoff (2009), Jimenez, Lopez, and Saurina (2010), Perotti and Suarez (2002), and Hoggarth, Milne and Wood (1998).

deposit rate to rise and, thus, increases the loan rate until a threshold of *N*. After *N* touches the threshold, stiffer banking competition lowers the demand for deposits and the deposit rate decreases, causing banks to set lower loan rates. Consequently, the relationship between the risk of borrowers' projects and the number of banks (the competition of the banking sector) is inverse U-shaped.

This paper decomposes the loan rate into two different components: risk premium and the transfer of deposit costs. Ho and Saunders (1981) develop a model of interest margins and argue that pure margins can be separated into two different categories. The first category involves market competition and includes monopoly rent or bank surplus. The second category is related to banks' attitudes toward risks they face, and includes the degree of risk aversion, loan size, and project risk. Their arguments justify our decomposition of loan rates. The data from World Development Indicators available on the World Bank website are consistent with this decomposition. The data comprise time series of deposit rates, loan rates, and risk premiums of several countries. These countries have similar regular patterns over time in all three variables. Figure 1 illustrates the time series of lending rates, deposit rates, and risk primes of the UK between years 1973 and 2008, and Figure 2 illustrates the same time series of the Japanese economy. Using the same data set, we ran a regression of lending rates on deposit rates and risk premiums. The regression result supports our decomposition of loan rates into to risk premium and a mark-up of deposit rates. The results are illustrated in Table 1. Banks adjust their lending rates in response to the changes in deposit rates; that is, they transmit their fund costs to their loan customers. In addition, the risk premium represents banks' risk attitude and are part of interest spreads.

The remainder of this paper is organized as follows: Section II specifies the economic environment and discusses the borrower's and the bank's optimization problem; Section III discusses equilibrium and its economic implications; and lastly, Section IV summarizes the paper's findings and provides concluding remarks.

II. Model

We modify Allen and Gale's model (2000, Chapter 8) to allow banks to compete in both loan and deposit markets and to decompose the loan rate into two different components: risk premium and a transfer of loan costs. There are three types of agents: depositors, banks, and entrepreneurs. All agents are risk neutral. Both banks and entrepreneurs have no resources.

II.1. Model Set up

Depositors

There are a large number of depositors. Banks choose the amount of deposits to take and the deposit rate is determined by the supply function of deposits $r_D(Z)$, where Z is the total amount of deposits in the market. The deposit rate $r_D(Z)$ has the following properties: $r'_D(Z) > 0$ and $r''_D(Z) \geq 0$. All deposits are insured and banks pay a constant premium α.

Entrepreneurs

There are a sufficiently large number of entrepreneurs, and each of them has access to one project, though without endowment. Each project requires one dollar of investment and yields a return $S \in [0, \bar{S}]$ with probability $P(S)$, and 0 otherwise. The entrepreneur decides his own project's riskiness by choosing a target return *S*. We assume that the success probability $P(S)$ is decreasing in *S*, $P'(S) < 0$, and satisfies $P(0) = 1,\ P(\bar{S}) = 0$ and $P''(S) \leq 0$ for all $S \in [0, \bar{S}]$.

The choices of S and project outcomes are observed by banks with zero screening cost. Banks have no direct control over the riskiness of entrepreneurs' projects, though they consider entrepreneurs' choices when making decisions. With a loan rate r_L, the entrepreneur chooses S to maximize their expected returns $P(S)[S-r_L]$.

Banks

There are N identical banks competing for deposits and loan business in a Nash fashion. Let L denote a bank's total amount of loans and D denote a bank's total amount of deposits. Each bank has equal amounts of loans and deposits, and $L=D$. Each bank chooses loan rates and the size of business (and D) to maximize its profits. Let $Z=ND$. A loan rate comprises two parts: $r_L(S)=\beta(N)r_D(Z)+R(S)$. One can interpret $\beta(N)r_D(Z)$ as a transfer of funding costs to borrowers, and $R(S)$ as a risk premium. One advantage of this decomposition is that it reflects that banks consider both funding costs and the riskiness of loan contracts when setting a loan rate, thus enabling the model to trace the impact of deposit rates and risk premium on project choices separately. Assume that $R'(S)>0$ and $R''(S)\geq 0$. Risk premium increases as a firm chooses a higher return (and riskier) project, and the convexity of $R(S)$ is made to guarantee the concavity of project returns. To what extent a bank can transfer its funding cost to borrowers is subject to the market structure. This paper assumes that $\beta'(N)<0$ and $\beta''(N)\geq 0$ based on Cowling and Waterson (1976) and Clarke and Davies (1982). Both studies indicate that the price-cost margin is positively correlated with the level of concentration. Furthermore, Clarke and Davies argue that there exists an inverse relation between the number of firms and the concentration index since the inequalities between firms in cost are small. Thus, competition weakens the bank's ability to transmit deposit costs to its loan customers at increasing speed. Regarding entrepreneurs' best responses to the loan rate in its decision making process, a bank chooses the size of a business to maximize its profits. The bank utilizes screening technology to reveal the risk level of entrepreneurs' projects at no cost.

II.2. Equilibrium

In this section, we first analyze and characterize both the entrepreneur's best choice and how the entrepreneur's best choice affects the bank's decision. Thereafter, we examine how the bank's decision affects the riskiness of invested projects and loan asset quality.

Given a loan rate $\beta(N)r_D(Z)+R(S)$, each entrepreneur chooses S to maximize their expected profits:

$$P(S)[S-r_L]=P(S)[S-\beta(N)r_D(Z)-R(S)]. \tag{1}$$

The first order condition is

$$P'(S)[S-\beta(N)r_D(Z)-R(S)]+P(S)[1-R'(S)]=0. \tag{2}$$

Rewrite the necessary condition as

$$S+\frac{P(S)}{P'(S)}-\frac{P(S)}{P'(S)}R'(S)-R(S)=\beta(N)r_D(Z). \tag{3}$$

This condition characterizes the entrepreneur's best choice of S. The left-hand side of (3) is the marginal benefit of S, and the right-hand side is the marginal "cost" of S. The left-hand side of (3) increases in S (due to the concavity of the objective function). When Z increases, the right-hand side of (3) increases, and the entrepreneur chooses a higher S in response. A higher demand for deposits (a greater Z) leads to a greater deposit rate. The cost-transmitting mechanism ($\beta(N)$> 0) causes loan rates to increase and entrepreneurs to choose a greater S in

International Research Journal of Applied Finance ISSN 2229 – 6891
Vol. VII Issue – 10 October, 2016 www.irjaf.com
DOI: 10.0710/article-1

response. The strict concavity of the objective function leads to a unique solution to the first order condition. Let $S^*(Z)$ be the solution of (3).

Lemma 1
Under the maintained assumptions, there is at most one symmetric equilibrium (denoted by $S(Z) > 0$), which is completely characterized by equation (3) and $S'(Z) > 0$.
Proof: See Appendix 1

As banks raise more funds from deposits, deposit rates increase and entrepreneurs choose riskier projects in response. Banks do not make a direct decision on project risk. They affect the choice of project risk through loan rates.

Given the entrepreneurs' best response, a bank chooses *D* to maximize

$$P(S)[R(S) + \beta(N)r_D(ND) - r_D(ND) - \alpha] \cdot D,$$

subject to

$$S + \frac{P(S)}{P'(S)} - \frac{P(S)}{P'(S)}R'(S) - R(S) = \beta(N)r_D(Z).$$

Using $S(Z)$ and $Z = ND$ the objected function can be rewritten as

$$P(S(ND))[R(S(ND)) + \beta(N)r_D(ND) - r_D(ND) - \alpha] \cdot D.$$

The analysis of the banking optimization leads to the following lemma.

Lemma 2
When the cost-transmitting power is strong enough (as N small enough), the probability of bank failure is increasing in the number of banks.
Proof: See Appendix 2

III. Simulation

III.1. A numerical example

In this example, we compute the equilibrium for a parameterized version of the model in which all functions except deposit-cost transmitting function are linear. The deposit supply function is linear in deposits, $r_D(Z) = rZ$. The success probability of a project is linear in its output (and risk) level: $P(S) = 1 - aS$, and $a > 0$. For $P(S)$ satisfying the properties of probability $0 \leq P(S) \leq 1$, there exists a lower bound of *S*, $\underline{S} = 0$ and a upper bound of *S*, $\bar{S} = 1/a$. The risk premium for the loan contract is $R(S) = cS$, and $0 < c < 1$. Assume that the deposit insurance is costless and $\alpha = 0$. The deposit-cost-transmitting function is $\beta(N) = 1/N^b$, where *b* is a constant.

From (1) one can derive $S(Z)$ as

$$S(Z) = \frac{\frac{a}{N^b}rZ + 1 - c}{2a(1-c)}, \text{ and } S'(Z) > 0. \tag{4}$$

Given the firm's choice rule, *S*(*Z*), a bank chooses a deposit level (*D*) to maximize its expected profits, and the optimal deposit level is

$$D = \frac{a(S-1)[cS + (1/N^b - 1)rZ]}{[ar/2N^b(1-c)][cS + (1/N^b - 1)rZ] + (1-aS)[cr/2N^b(1-c) + (1/N^b - 1)r]}. \tag{5}$$

Plugging (5) into (4) we can examine the relation between *S* and *N*. In Figure 3 we plot this

International Research Journal of Applied Finance ISSN 2229 – 6891
Vol. VII Issue – 10 October, 2016 www.irjaf.com
DOI: 10.0710/article-1

relation for the environment with parameters: $a = 0.1$, $b = 0.5$, $c = 0.2$ and $r = 0.1$. In this example, $\beta(N) < 1$ for $N > 1$, and the marginal revenue of choosing D $r_L'(Z) - r_D'(Z) = R'S'(Z) + (\beta(N) - 1)r_D'(Z)$ is negative for $N > 1$. Since the marginal revenue is negative, banks choice less deposit level in respond to a decreasing marginal revenues. Let $\tilde{N}$ denote the turning point of N at which $S(Z)$ reaches its highest level. Due to the fact that risk premium is positive, the turning point $\tilde{N}$ is greater than one. The relation between S and N is inverse U-shaped with a turning point $N > 1$. Before the turning point, stiffer competition causes higher demand for deposits and thus higher loan rates, inducing entrepreneurs to choose riskier projects. After the turning point, banks reduce their business sizes in response to stiffer competition and entrepreneurs choose less risky projects in response.

The inverse U-shaped relationship between S and N compromises both views of competition-fragility and competition-stability in a unified framework. The market structure of the banking sector determines how competition affects the banking fragility. Both opposing views are correct in different ranges of N. When the market is not competitive enough ($N < \tilde{N}$), the competition-fragility view holds true. When the market is competitive enough ($N > \tilde{N}$), the competition-stability view holds true.

III.2 Welfare

To analyze the social welfare of this economy, we assume that the society incurs a welfare cost $C(n)$ increasing in the number of failed banks (n). Due to the homogeneous choices of S, $n = N$. Following the convention, we assume the government run deposit insurance and, thus, the government budget can be written as $P \cdot \alpha - (1-P)Z - (1-P)C(N)$, subtracting deposit indemnity $(1-P)Z$ and the expected social cost $(1-P)C(N)$ from deposit insurance premium revenue $P \cdot \alpha \cdot Z$. There are four types of agents in our economy, investors, firms, banks and the government. The social welfare function is defined by the sum of all agents' expected returns; namely

$$W(Z) = Pr_DZ + (1-P)Z - Z + P(S - R(S) - \beta r_D)Z + P[R(S) + (\beta - 1)r_D - \alpha]Z$$
$$+ [P\alpha - (1-P)]Z - (1-P)C(N)$$

The four terms of the right hand side are the expected returns of investors, firms and banks and the government budget respectively. W(Z) can be rewritten as

$$W(Z) = (PS-1)Z - (1-P)C(N)$$

Using the set-up in previous example and assume that $C(n)=2n$, the relationship between social welfare and the number of banks is depicted in Figure 4. Both inverse U-shaped relationships of social welfare and N, and the inverse U-shaped relationship of S and N indicates that banking competition and stability does not necessarily guarantee welfare gains. When the banking industry is sufficiently competitive, bank profits and depositor' expect returns decrease with the number of banks N.[2] There is a trade-off between stability and efficiency. Note that the social welfare will be negative when $N > 18$. It is because that when the number of banks goes up, the social cost increases rapidly.

III.3. Fixed Deposit Rate

In some countries, interest rates ceilings are legally imposed on saving accounts, for example, the Regulation Q restricted the interest rate banks could pay on demand deposits. Recently, China and Spain still have remained an interest rate ceilings on bank deposits (Feyzioğlu,

[2] We plot both relations of competition-bank profits and competition-depositor' expect returns to the number of banks (N) in Figure 5 and Figure 6.

Porter and Takáts (2009), Reinhart, Kirkegaard and Sbrancia (2011)). Interest rates ceilings limit banks' funding costs and neutralize price competition in deposit markets. Consequently, the inverse U-shape relationship between S and N disappears.

Replacing the deposit rate by a fixed risk free rate, r^*, we analyze the effect of banking competition when the deposit rate is fixed. When the deposit rate is fixed, competition for deposits will not affect the deposit rate. Firms' optimization problem becomes

$$\max_S \quad P(S)(S-R(S)-\beta(N)r*) .$$

The first order condition is

$$P'(S)(S-R(S)-\beta(N)r*)+P(S)(1-R'(S))=0 .$$

The optimal choice rule of S is decreasing in N. and satisfies the following equation

$$S^{**}=R(S^{**})+\beta r^*+\frac{P(S^{**})}{P'(S^{**})}(R'(S^{**})-P(S^{**})) .$$

Notice that the optimal choice of S depends on N, but not on D. The effect of banking competition on the choice of S is independent of the bank's optimization behavior. Moreover, the bank's profit function, $P(S)[R(S)+(\beta(N)-1)\ r^*-\alpha]D$, indicates that the banking market structure determines the level of profits. In contrast to the inverse U-shaped relation in cases with market-determined deposit rates, S^{**} is downward slopping in N when the deposit rate is fixed. Changes in N affect the choice of S through two channels: direct effect ($\beta(N)$) and indirect effect $r_D(ND)$. When the deposit rate is fixed, the indirect channel disappears. Competition among banks drives down the deposit cost-transmission factor (because $\beta'(N)<0$) and the firm chooses less risky projects in response. The view of concentration-fragility prevails.

However, unlike the previous section, when deposit rates are fixed, both relations of S and welfare to N become monotone. Banking competition is negatively related to choice of S and positively related to welfare. The outcome is in favor of the view of competition-stability.[1]

IV. Conclusion

Banking literature has a long discussion on how competition in the banking sector affects banks' risk-taking behaviors. Some early studies tend to support the concentration-stability view by the arguments of charter value and monitoring cost (Keely (1990), Chan, Greenbaum, and Thakor (1986), Besanko and Thakor (1993), Boot and Greenbaum (1993), Edwards and Mishkin (1995), Allen and Gale (2004), Marquez (2002), and Wagner (2010)). Recent literature challenges the view of concentration-stability and some of them suggests that high loan rates induces moral hazard behaviors and result in higher risks in the banking sector (Caminal and Matutes (2002), BDN, BDJ, and MR (2010)).

This paper provides a different interpretation for the relation between banking competition and banking fragility. We consider a model in which banks compete in both deposit and loan markets, and the loan rate is decomposed into two components: risk premium and deposit-cost-transmission. We find out that an inverse U-shaped relationship exists between banking fragility and the number of banks.

Both views of competition-fragility and competition-stability are correct for different ranges

[1] Also, we examine the relations between S and N and the relation between social welfare W and N under fixed deposit rate with parameters: $a = 0.1$, $b = 0.5$, $c = 0.2$ and $r^* = 1.1$ in Figure 7 and Figure 8.

DOI: 10.0710/article-1

of the market structure of the banking sector (indexed by the number of banks *N*). When banks are equipped with large transmitting power, great profit margins drive banks to raise deposit levels and cause entrepreneurs to choose riskier projects. The environment with higher banking bargaining power tends to be in favor of the competition-fragility view. When banks' monopoly power is less robust (*N* is big enough), stiffer competition (larger *N*) depresses demand for deposits and decreases the deposit rates and, then, loan rates, inducing the choices of safer projects. The competition-stability view prevails over the concentration-stability view.

Recent theoretical studies demonstrate a similar nonlinear relationship between bank competition and stability but for a different reason. MR (2010) modifies the BDN model to accommodate correlated risks among projects. They conclude that the BDNs' risk-shifting effect dominates in monopolistic markets. However, the lower revenues from performing loans and the lower spread margin in competitive markets will not provide enough buffers against loan losses, which consequently lead to riskier banks. The buffer factor suggests a U-shaped relationship between competition and the probability of bank failure.

BDJ conclude that competition can either increase or decrease the probability of bank failure. The moral hazard problem on the firms initiates the BDN effect which plays a dominant role in determining whether competition and bank-risk-taking is positively or negatively related. The BDN effect is more and more important as competition increases and the negative relation between banking competition and the probability of bank failures exists only in the BDN effect is strongly strong..

Empirical literature provided supports for the nonlinear relationship. Beck et al. (2006) show complex evidence between concentration and bank crises. Although the main finding supports the concentration-stability view, they also indicate that the traditional theory that concentration enhances stability by boosting the market power is inconsistent with their empirical findings. Also, Berger et al. (2009) argue that the two strands of "competition-stability" and "competition-fragility" need not to be in conflict with each other. Their empirical evidences are consistent with the traditional "competition-fragility" view. However, they also show that market power will increase loan risk, which will lead to a riskier banking sector.

Appendix A

Proof of Lemma 1：

The entrepreneur chooses S to maximize their expected return

$$P(S)[S-r_L]=P(S)[S-\beta(N)r_D(ND)-R(S)]$$

The necessary condition can be rewritten as

$$\beta(N)r_D(ND)=S-R(S)+\frac{P(S)-P(S)R'(S)}{P'(S)}.$$

Let $H(S)\equiv S-R(S)+\dfrac{P(S)-P(S)R'(S)}{P'(S)}$. Totally differentiating the above equation with respect to S and Z, one can obtain

$$H'(S)dS=\beta(N)r'_D(Z)dZ, \text{ and}$$

$$dS/dZ=\frac{\beta(N)r'_D(Z)}{H'(S)}>0,$$

where $H'(S)>0$, the sufficient condition for the maximization problem.

Appendix B

Proof of Lemma2：

For a given best response function of entrepreneurs, bank i chooses D_i to maximize

$$P(S)[R(S)+\beta(N)r_D(ND)-r_D(ND)-\alpha]D$$

subject to

$$S-R(S)+\frac{P(S)-P(S)R'(S)}{P'(S)}=\beta(N)r_D(Z).$$

From the constraint S can be solved as a function of Z ($S(Z)$). Thus, the maximization problem becomes

$$\max_D \quad P(S(Z))[R(S(Z))+\beta(N)r_D(Z)-r_D(Z)-\alpha]D \quad .$$

Using $Z=ND$, the necessary condition is

$$\begin{aligned}\Delta \quad &\equiv P'(S(Z))S'(Z)[R(S(Z))-(1-\beta(N))r_D(Z)-\alpha]D\\ &+P(S(Z))[R'(S(Z))S'(Z)-(1-\beta(N))r'_D(Z)]D\\ &+P(S(Z))[R(S(Z))-(1-\beta(N))r_D(Z)-\alpha]\\ &=0.\end{aligned}$$

Similar to BDN, the necessary condition can be rewritten as

$$[R(S(Z))-(1-\beta(N))r_D(Z)-\alpha]-F(Z,N)=0,$$

where

$$F(Z,N)=\frac{P(S(Z))[r'_D(Z)-R'(S)S'(Z)-\beta(N)r'_D(Z)]Z}{[P'(S)S'(Z)Z+P(S(Z))N]}>0.$$

The term $F(Z,N)$ incorporates BDN's monopoly rent. As N approaches infinity, the monopoly rent converges to zero and the Nash equilibrium converges to the competitive outcome $[R(S(Z))-(1-\beta(N))r_D(Z)-\alpha]=0$.

Totally differentiating the necessary condition, we have

$$\Delta_Z dZ+\Delta_N dN=0 \quad ,$$

where $\Delta_Z<0$ is the sufficient condition for the maximization, and

$$\begin{aligned}\Delta_N=&\frac{-Z}{N^2}\{P(S)[R'(S)S'(Z)-(1-\beta(N))r'_D(Z)]+P'(S)S'(Z)[R(S(Z))-(1-\beta(N))r_D(Z)-\alpha]\}\\ &+\frac{Z}{N}[P'(S)S'(Z)\beta'(N)r_D(Z)+P(S(Z))\beta'(N)r'_D(Z)]+P(S(Z))\beta'(N)r_D(Z)(0)\\ &=\frac{1}{N}\{P(S(Z))[R(S(Z))-(1-\beta(N))r_D(Z)-\alpha]\}\end{aligned}$$

$$+\beta'(N)[P'(S)S'(Z)r_D(Z)\frac{Z}{N}+P(S(Z))r'_D(Z)\frac{Z}{N}+P(S(Z))r_D(Z)] \quad .$$

When $\beta(N)>1$, $F(Z, N)>0$ and the term $[P'(S(Z))S'(Z)Z+P(S(Z))N]$ is negative; then $\Delta_N>0$ if and only if $\beta(N)$ is sufficient strong. Thus, $dZ/dN=-\Delta_N/\Delta_Z>0$ and $dS/dN=(dZ/dN)(dS/dZ)>0$. With an increase in N, both $\beta(N)$ and profit margin decrease, and there exists a threshold value of N such that $[P'(S(Z))S'(Z)Z+P(S(Z))N]>0$ and $\Delta_N<0$. Furthermore, $dZ/dN=-\Delta_N/\Delta_Z<0$ and $dS/dN=(dZ/dN)(dS/dZ)<0$.

References

Allen, F. and D. Gale. (2000) Comparing financial systems. Cambridge, MA: MIT Press.

Allen, F. and D. Gale. (2004) Competition and financial stability. Journal of Money, Credit, and Banking 36:3 Pt.2, 433-80.

Beck, T., A. Demirgüç-Kunt, and R. Levine. (2006) Bank concentration, competition, and crises: First results. Journal of Banking and Finance 30, 1581-603.

Berger, A.N., L.F. Klapper, and R. Turk-Ariss. (2009) Bank competition and financial stability. Journal of Financial Services Research, 35, 99-118.

Besanko, D., and A.V. Thakor. (1993) Relationship banking, deposit insurance and bank portfolio choice. In: Mayer, C. and Vives, X. (eds), Capital Markets and Financial Intermediation. Cambridge, UK: Cambridge University Press, 292-318.

Boot, A., and S. Greenbaum. (1993) Bank regulation, reputation and rents theory and policy implications. In: Mayer, C. and Vives, X. (eds), Capital Markets and Financial Intermediation. Cambridge, UK: Cambridge University Press, 262~285.

Boyd, J.H., and G. De Nicoló. (2005) The theory of bank risk-taking and competition revisited. Journal of Finance 60, 1329-343.

Boyd, J.H., G. De Nicoló. and A. Jalal. (2009) Bank risk taking and competition: New theory, new empirics. IMF Working Paper 09/143.

Caminal, R., and C. Matutes. (2002) Market power and banking failures. International Journal of Industrial Organization 20, 1341-61.

Carletti , E. (2008) Competition and Regulation in Banking, in A. Boot and A. Thakor (eds.), Handbook in Financial Intermediation, Elsevier, North Holland.

Chan, Y.-S., S. Greenbaum, and A. V. Thakor. (1986) Information reusability, competition and bank asset quality.Journal of Banking and Finance, 10, 243-53.

Clarke, R. and S. Davies. (1982) Market structure and price-cost margins, Economica, 49: 277-287.

Crowling, K. and M. Waterson. (1976) Price cost margins and market structure. Economica, 43, 267-274.

Feyzioğlu, T., N. Porter, and E.Takáts. (2009) Interest Rate Liberalization in China, IMF Working Paper 09/171.

Ho, T. S. Y. and A, Saunders. (1981) The determinants of bank interest margins: theory and empirical evidence, Journal of Financial and Quantitative Analysis, 16, 581-600.

Hoggarth, G., A. Milnem, and G. Wood, (1998) Alternative routes to banking stability: A comparison of UK and German banking systems, Financial Stability Review, October, Bank of England.

Jimenez, G., J. Lopez, and J. Saurina. (2010) How does competition impact bank risk taking, Banco de Espana Working Paper, No. 1005.

Keeley, M.C. (1990) Deposit insurance, risk and market power in banking, American Economic Review 80, 1183-200.

Koskela,E and R. Stenbacka. (2000) Is there a tradeoff between bank competition and financial fragility?, Journal of Banking and Finance, 24, 1853-1873.

Marquez, R. (2002) Competition, adverse selection, and information dispersion in the banking industry, Review of Financial Studies, 15, 901-926.

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

Perotti, E. C. and J. Suarez. (2002) Last bank standing: What do I gain if you fail? European Economic Review, 46, 1599 - 1622.

Reinhart, C., J. Kirkegaard and M. Sbrancia. (2011) Financial repression redux, Finance and Development, 48, 22-26.

Schaeck, Klaus, M. Cihak and S. Wolfe. (2009) Are More Competitive Banking Systems More stable, Journal of Money, Credit and Banking, 41, 711-734.

Uhde, A. and Heimeshoff, U. (2009) Consolidation in banking and financial stability in Europe: Empirical evidence, Journal of Banking and Finance, 33, 1299-1311.

Figure 1 Interest rates in U.K. over the period 1973-1998

This figure shows the trends of bank interest rates and risk premium in United Kingdom from 1973 to 1998. We plus the deposit rate and risk premium rate to inquire the co-movement between deposit rates and loan rates. All data come from World Development Index.

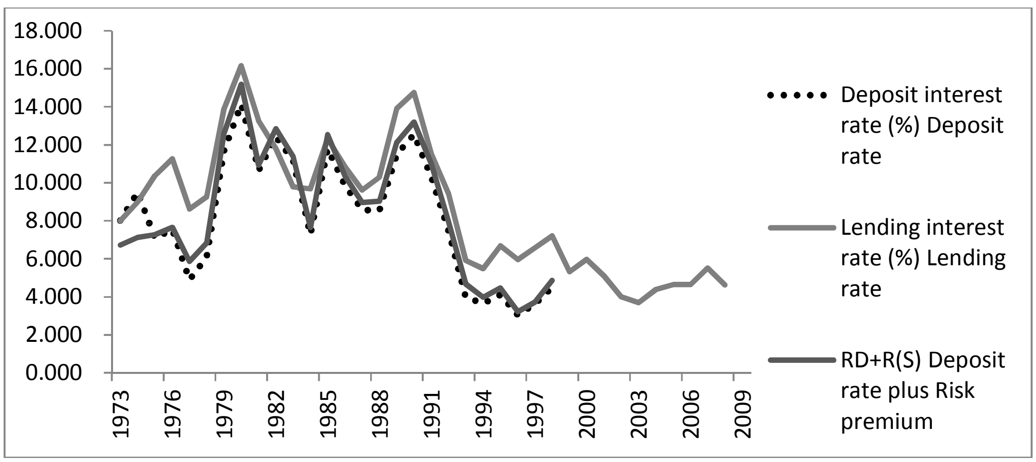


Figure 2 Interest rate in Japan over the period 1973-2008

This figure shows the trends of bank interest rates and risk premium in Japan from 1973 to 2008. We plus the deposit rate and risk premium to inquire the co-movement between deposit rates and loan rates. All data come from World Development Index.

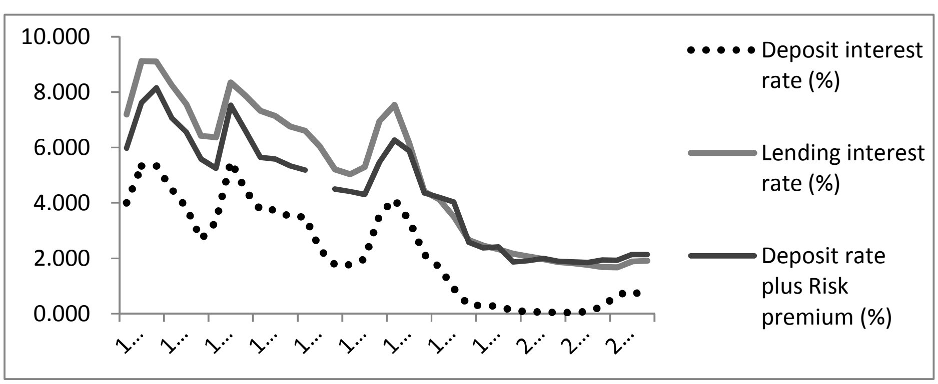


Figure 3 Competition and the risk of banks loan with cost-transmission effect

International Research Journal of Applied Finance ISSN 2229 – 6891
Vol. VII Issue – 10 October, 2016 www.irjaf.com
DOI: 10.0710/article-1

This figure shows the relationship between the number of banks *N* and the project risk of loans *S* with the cost-transmission effect. Since banks can transmit deposit costs to entrepreneurs, the deposit level raise up with sufficient strong transmitting power, and then lower level with increasing sharing costs. Entrepreneurs choose their project risk in respond to the changing of interest rates, result in an inverse U-shape relationship between competition and the risk of banks.

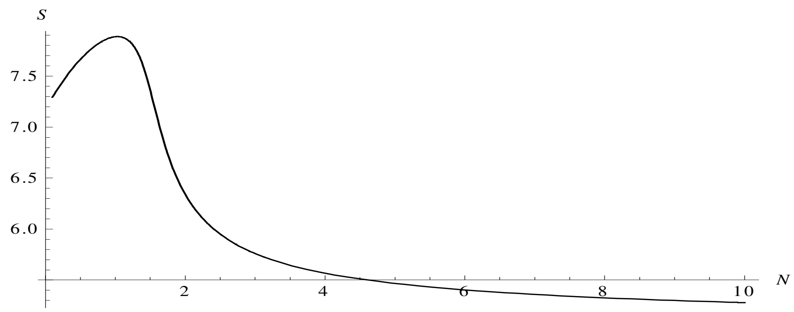
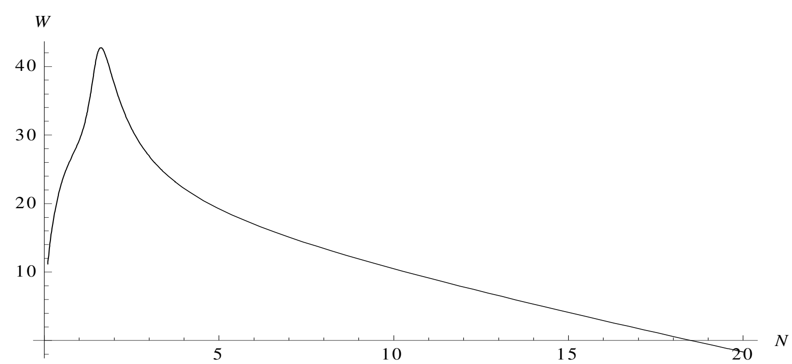


Figure 4 Competition and the social welfare with cost-transmission effect

This figure shows the relationship between the number of banks *N* and the social welfare *W* with the cost-transmission effect. The social welfare includes the expected returns of investors, entrepreneurs and banks and the insurance incomes and the social costs of government. The social welfare goes down under a competitive structure or even to a negative level.



International Research Journal of Applied Finance ISSN 2229 – 6891
Vol. VII Issue – 10 October, 2016 www.irjaf.com
DOI: 10.0710/article-1

Figure 5 Competition and bank profits with cost-transmission effect

This figure shows the relationship between the number of banks *N* and the expected return of banks with the cost-transmission effect. The banks profits are decreasing with the number of banks.

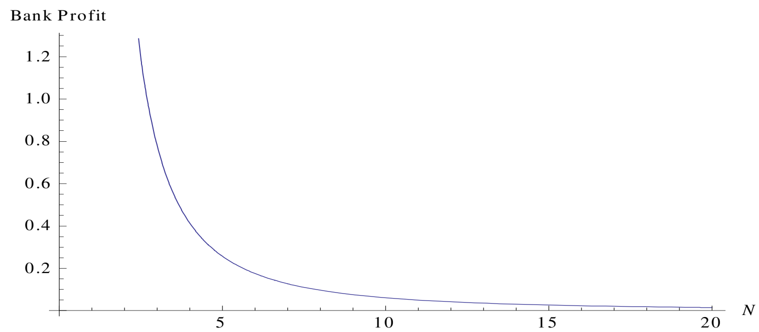


Figure 6 Competition and depositor's expect return with cost-transmission effect

This figure shows the relationship between the number of banks *N* and the expected return of depositor with the cost-transmission effect. Banks rise up deposit level and deposit rate with less competitive structure, and then turn down the deposit rate with powerless transmitting effect.

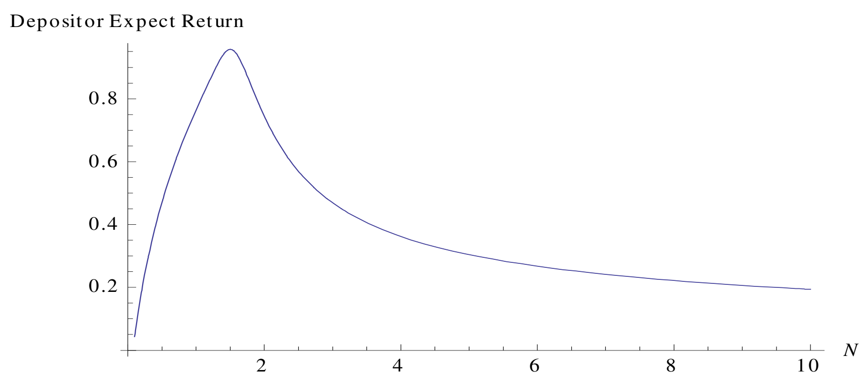
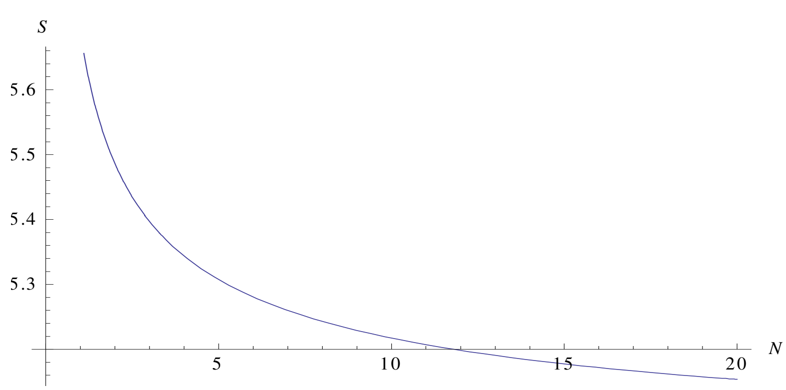


Figure 7 Competition and the risk of bank loan with fixed deposit rate

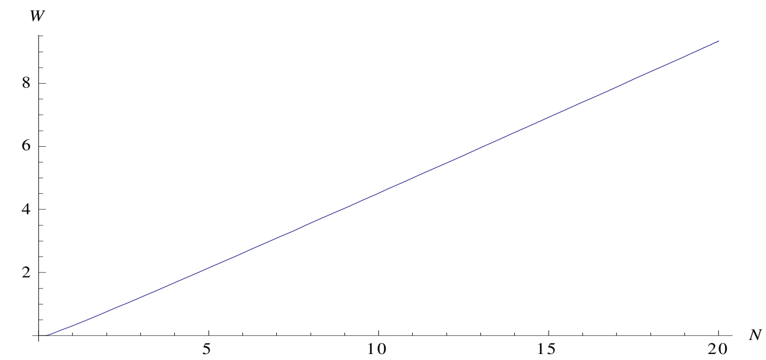
This figure shows the relationship between the number of banks *N* and the project risk of loans *S* with fixed deposit rate. Under the constant funding costs, the optimal deposits level is independent from loan rate setting. Lending rates decrease along with the increasing competition, and entrepreneurs choose safer project in respond to the decreasing loan rates.



International Research Journal of Applied Finance ISSN 2229 – 6891
Vol. VII Issue – 10 October, 2016 www.irjaf.com
DOI: 10.0710/article-1

Figure 8 Competition and the social welfare with fixed deposit rate

This figure shows the relationship between the number of banks *N* and the social welfare *W* with fixed deposit rate. The lower probability of failure decreases the social costs and increases the expected returns of depositors with fixed deposit rate. Therefore, competition results in an increasing social welfare with fixed deposit rate.



Authors

Li-Hsuan Lee*
Department of Money and Banking, National Cheng Chi University, Taipei, ROC, 95352501@nccu.edu.tw

Yeong-Yuh Chiang
Department of Economics, Chinese Culture University, Taipei, ROC, jyy@faculty.pccu.edu.tw

Hsing-Hua Chang
Department of Money and Banking, National Cheng Chi University, Taipei, ROC, achang@nccu.edu.tw

* Corresponding Author