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Equilibrium Features of Imperfect Competition in the Deposit Market of Banking Sector

Mohammad Feghhi Kashani*, Majid Omidi

Faculty of Economics, Allameh Tabataba'i University, Tehran, Iran

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Abstract

This paper endeavors to investigate the potential role of deposit market structure as a distinct channel for (monetary, fiscal, and regulatory) policy transmission mechanisms. In doing so, we have developed the core idea in a rational expectations partial equilibrium setup incorporating the possible contagion risks in the banking system. This has enabled us to achieve more sensible analytical findings within a tractable structure capable of making diverse equilibria observed in some empirical evidence. The setup/paper lays down conditions under which one could expect Nash equilibria, involving "limited price war," "deposit rates rat race," "bank run," and "systemic banking crisis" followed by incidents of "banking panic." The multiplicity of equilibria results from the interactions between the deposit market structural characteristics and policy commands due to externalities originating from strategic complementarity/substitution among the rival banks in the market. Further, the paper explores the allocation and stabilization efficiency implications in terms of conceivable equilibria for deposit rates, deposit market share, expected net returns, expected markup, and the expected level of effort of banks operating in the banking system with an emphasis on the role of equity capital in between.

Highlights

- The primary focus of analysis on the deposit market and its positive and normative implications.
- The emphasis on asymmetric Nash equilibria.
- This paper introduces a theoretical basis for policymakers intervening in the money market and monitoring bank performance to improve banking sector efficiency and stability.

* mir30kas@gmail.com

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1. Introduction

In the literature on financial intermediation, the effects of competition in the banking sector have been extensively studied. According to the studies, the competition allows for efficient resources allocation, increases the efficiency of financial service production, lowers credit risk, and improves economic growth (king & Levine, 1993; Rajan & Zingales, 1998, 2003; Cecchetti et al., 2014). One of the controversial issues in the literature is the role of competition in influencing bank stability (Carletti & Hartmann, 2003; Beck, 2008).

While there has been a growing emphasis on the role of financial frictions in financial stability since the global financial crisis, imperfect banking competition is frequently overlooked, as the majority of the existing literature focuses on agency problems between borrowers and lenders (Holmström & Tirole, 2011). Whether imperfect competition in the banking deposit market has any implications for banking sector stability and, if so, through what channels they would come into play makes up one of the main concerns of this paper.

Imperfect competition in the banking sector and the incidence of numerous frictions, including entry barriers that may create rents for incumbent banks, have been well documented in the literature (Vives, 2020). For instance, potential entrants are frequently confronted with difficulties resulting from economies of scope and scale, switching costs, branch, asynchronous transfer mode (ATM) telecommunication networks, brand reputation, regulatory settings, and financial advantages of too big to fail (TBTF) theory in banking, or the incumbents' strategic behavior. Historically, regulations and entry obstacles have amplified factors leading to enhance the possible collusion. Banking is a multiproduct industrial sector with different competition levels in different divisions (competition levels and entry obstacles). In retail banking, deposit markets are still mainly a local market (even though this is changing for consumer loans). In corporate banking, describing the reason for being local of the small and medium-sized businesses market, established relationships and asymmetric knowledge are significant frictions. Even though electronic banking and the rise of fintech competitors have increased competition and eroded relationship banking strategy, endogenous and exogenous switching costs still exist. Other banking divisions, including investment and wholesale banking, compete globally according to a more market-based order; thus, even if the market is concentrated owning to great endogenous fixed costs (IT technology, information collection, and human capital), the competition may be strong.

The widespread expansion of financial intermediaries with varying characteristics may result in some financial fragility, necessitating additional regulations to avoid distortions and facilitate the process of financing efficient investment projects. Despite the extensive literature on how to compete and stabilize in the banking sector, many issues in this area remain unresolved and need more thorough investigation. For instance, some challenges need to be addressed, such as What are non-price and price competitions in the deposit market? What factors influence it? What negative or positive effects do they have on the economy? What are the effects of bank homogeneity or heterogeneity and the level of development of banking system services on competition between banks? How do banks adjust depositors' expectations based on their perception of the future state of the economy? How is the loan market or the level of banking supervision affected by the intense competition between banks for deposits? What are the external effects of banks' behavior on each other or the contagion risk that can weaken or improve bank performance? Or how do the deposits and assets markets, in general, interact with the level of monitoring efforts?

The present study attempts to use a basic imperfect competition model in the banking sector to investigate a number of these challenges and describe its consequences for the real sector, banking stability, and the efficacy of policymaker choices. In short, the two distinguishing features of this paper are, first, the primary focus of analysis on the deposit market and its positive and normative implications, and second, the emphasis on asymmetric Nash equilibria. As a result, this paper introduces a theoretical basis for policymakers intervening in the money market and monitoring bank performance to improve banking sector efficiency and stability.

The rest of the paper has been structured as follows: Section 2 reviews the relevant literature. Section 3 outlines some stylized facts and discusses the implications of our analytical results, particularly for the Iranian economy. Section 4 presents the model and characterizes the model's (partial) equilibria. Section 5 examines the equilibrium deposit rate and monitoring efforts. Section 6 provides a brief assessment of the role of policy factors. Finally, Section 7 provides the concluding remarks.

2. Literature Review

This paper relates to the literature on financial stability and analysis of bank behavior in the context of imperfect competition. In particular, it contributes to the literature on the competitiveness of banks in the deposit market and the impact of contagion risk and macroeconomic risk on the banking system.

The existing theoretical literature has studied the relationship between banking competition and financial stability from two perspectives: the negative competition-stability relationship and, in contrast, the positive competition-stability relationship. In the negative relationship perspective, the literature focuses on the risk-taking channel and emphasize that although competition boosts market efficiency, it reduces banking sector stability by declining banks valuation and encouraging bankers to make riskier investments (e.g., Keeley, 1990; Hellmann et al., 2000; Corbae & Levine, 2018). In the negative relationship perspective, the literature, by focusing on borrowers' risk-taking rather than banks' risk-taking, emphasizes that competition lowers the loan rate and reduces firm bankruptcies, thus making banks stable (Boyd & De Nicolo, 2005). Therefore, it is found that the relationship between competition and stability in the banking sector is ambiguous and depends on the predominance of each of the above effects.

There has been a long-standing argument that unrestricted competition in the deposit market is sowing the seeds of instability in the banking system. Accordingly, the deposit market is the subject of the majority of the current research on the stability and welfare aspects of banking competition (e.g., Matutes & Vives, 1996, 2000; Allen & Gale, 2004; Repullo, 2004). The share feature across these studies is that strong competition for deposits can significantly increase the potential risk-taking of banks, making them more vulnerable. The chain of arguments usually goes as follows: the higher the interest rates on deposits, the higher the deposit repayment burden. Due to the limited liability of banks, this raises the moral hazard of a risk-shifting problem and encourages banks to take more risks. These studies suggest strategies, such as deposit insurance, the lender of last resort, and capital requirements to prevent excessive risk-taking by banks.

Further, in the literature, the reasons for systemic risk could be divided into three categories. The first category deals with systemic risk-taking or shows why many financial institutions are crucially interconnected (Acharya, 2009; Farhi & Tirole, 2012). The second category is the rich literature on contagion mechanisms or how losses can spill over from one financial sector to another (Allen & Gale, 2000; Freixas et al., 2000). The third category discusses amplification mechanisms or why small shocks may affect the economy significantly (Shleifer & Vishny, 1992; Brunnermeier & Pedersen, 2009; Martin et al., 2014).

This paper attempts to consider those key drivers and the heterogeneity of banks and, more critically, the banks' behavior in internalizing systemic risk and the role of policy factors in between.

Matutes and Vives (1996) are the closest to our setup in terms of approach. However, unlike their work, there is no self-fulfilling expectations mechanism and higher efficiency of portfolio diversification associated with incorporating economies of scale and standard network externalities in our setting. Thus, the endogeneity of banks' quality in our model does not come from those drivers, but it results from strategic complementarity/substitution among the rival banks and the market structure. Further, the multiplicity of equilibria within our setup is not due to coordination problems out of alternative self-fulfilling expectations originating from economies of scale. Likewise, our setting does not involve minimum required size for banks activity and viability entailing minimum deposit requirement for banks, which can be a source of shaping a coordination game among depositors in the market. Also, unlike theirs, in our model, depositors can observe the returns on the banks' investment portfolios. In addition, the non-pecuniary penalty associated with a bank's failure in our structure is in terms of market share loss and bank run as opposed to theirs, which is in the form of an ad hoc style. These departures should be an interesting feature of our setup because they can produce various types of equilibria without resorting to those restrictive characterizations.

As to the contagion risk and its implications for banks' equilibrium monitoring efforts, our setup builds mainly on the setups of Dell'Ariccia et al.

(2014) and Dell'Ariccia and Ratnovski (2019), which originally are extensions of Allen et al. (2011) setup. Our chief point of departure is augmenting their model with an imperfect deposit market characterized by risky deposit rates and differentiated bankers maximizing their expected profits by bidding their interest rates to achieve the maximum market share. This extends their setup by creating an additional strategic complementarity originating from the deposit market structure. We will illustrate how this extension implicates the deposit market structure as a new channel through which contagion risk and its associated contingent (bailout) policies would impact each bank equilibrium monitoring effort. That is why we have primarily focused on the asymmetric Nash equilibria.

3. Some stylized Facts: Iran

In recent years, the risk of economic activity in Iran has risen sharply, with large fluctuations in macroeconomic variables. The gross domestic product (GDP) data shows that this variable has been fluctuating between positive and negative growth rates for a short period of time. After a sharp increase in 2012 and 2013, the inflation rate reached 34.7%, had changed direction, and took a downward trend. Again in 2017, it began to rise (Fig. 1). These fluctuations in the growth rate of production or business cycles (economic boom and bust) and inflation rate have severely affected the activities of banks in the deposit and credit markets, resulting in a rise in their liquidity and credit risk. On the other hand, it can be observed that banks' capital has not increased in proportion to the growth of risky assets, and as a result, banks' capital adequacy ratio has decreased. The capital adequacy ratio of the banking system in both groups of state-owned banks (including commercial and specialized state-owned banks) and private banks (including Article 44 or privatized and non-state-owned banks) has been declining in most years and even lower than the regulatory limits (8%) (Fig. 2).

Changes in bank deposit interest rates in the 2010s have also been significant. Despite the decrease in the inflation rate from 2013 to 2016 and the improvement in the economic growth situation, the interest rate on deposits in the mentioned years in both banking groups has an upward trend and has risen sharply (Fig. 3). It is also observed that despite the price competition in the deposit market in recent years and changes in the share of banks in the deposit market, the share of state-owned banks and private banks in the deposit market has been almost constant and has not changed significantly (Fig. 4).

The non-performing loan ratio is one of the most important indicators of banking performance. In addition to showing the degree of efficiency and productivity of resource allocation and the banking system's profitability, it also affects the ability of banks to lend in the future. An investigation of the trend of non-performing loan ratio in the group of state-owned and private banks in recent years shows that this variable has a downward trend but is still at high levels (Fig. 5).

The expansion of banking and the gradual replacement of the new electronic payment system with traditional payment instruments, such as banknotes and coins, has drastically reduced the cost of transferring funds. As can be observed, the share of notes and coins in liquidity at the end of 2020 has fallen below 3%, and most of the liquidity in the economy is in the form of demand deposits and quasi-money in banks (Fig. 6).

In summary, the data indicate that banking risks in Iran were high in the 2010s and their risks intensified in the years when banks competed in the deposit market.

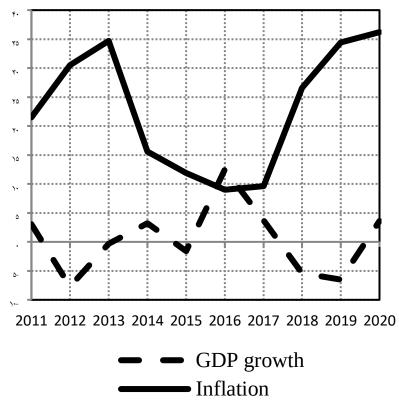

Figure 1. GDP Growth and Inflation

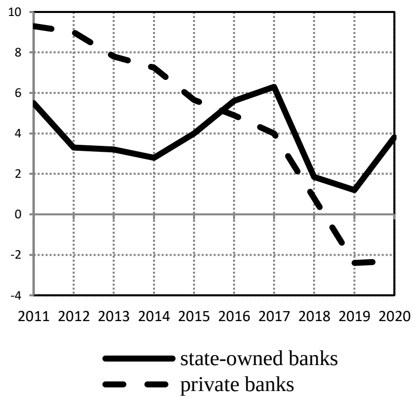

Figure 2. Capital Adequacy Ratio

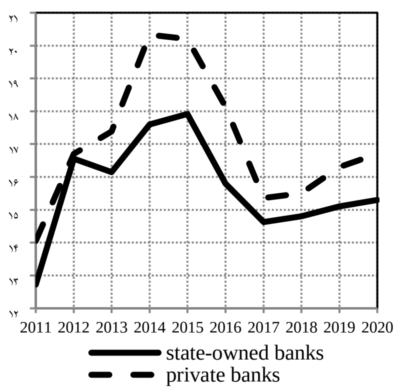

Figure 3. Deposit Intrest Rate

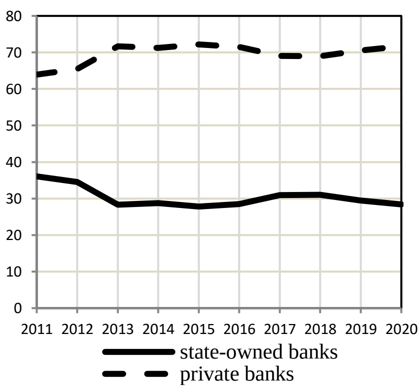

Figure 4. The banking groups share of deposit market*

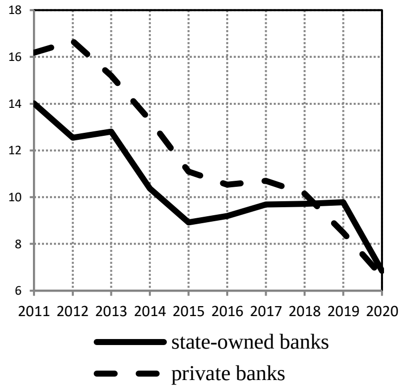

Figure 5. Non-Performing Loan Ratio

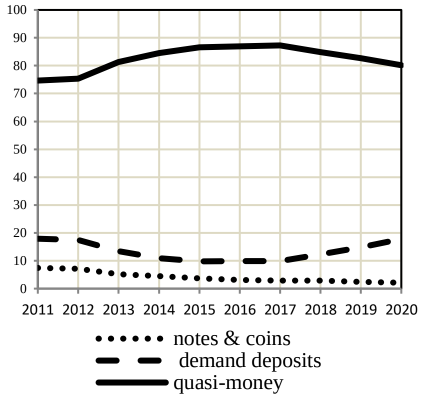

Figure 6. Liquidity Components share

***Source**: Central Bank of Iran (Fig.1, 5, 6), banks' financial statements (Fig. 2, 3), and the authors' calculations (Fig. 4, 6)*

***Note**: 1- In 2013, the central bank increased the coverage of monetary statistics by adding some banks and credit institutions included in the group of non-governmental banks, and resulted in the increased share of private banks and a decreased share of state-owned banks in the deposit market.*

4. Model

Following Matutes and Vives (1996), we consider the economy to include fund holders (depositors) with rational expectations, two banks i = A, B and the regulator (government or central bank) in two periods t = 0, 1. Each bank has a loan portfolio in the size of l_i, financed through capital k_i, and deposit d_i. Banks are risk-averse and receive deposits di from fundholders in a competitive market. In order to preserve the character of financial intermediation of the conventional banking type, it is assumed that $0 < d_i < 1$. As a standard hoteling model, we assume that two banks are located one unit apart, and depositors are uniformly and continuously distributed between the two banks.

Depositors will receive a return ϑ if they keep their money in cash, and a return $p_i r_{di} - mn_i$ if they deposit it in a bank, where p_i is depositors' beliefs about the probabilities of banks' success affected by assets and liabilities sides of the bankers' balance sheets, r_{di} is the deposit interest rate offered by bank i, m is the cost of each transfer unit, and n_i is the distance from the depositor to bank i. On the other hand, high m can be seen as a sign of underdevelopment of the banking system in general in providing financial services, especially in terms of technology, which can be reflected in the cost of transferring funds.

Moreover, we assume that there are two types of projects in the economy. The type h projects are high return and risk projects (high-risk projects), and the type l projects are low return and risk projects (low-risk projects) whose amount is realized in period 1. Banks form their investment portfolio from the mentioned projects according to their expectations from the future state of the economy. Accordingly, the expected income of bank i will be as follows:

$$E(R_i) = \beta_{i,H} R_H + (1 - \beta_{i,H}) R_L$$

where R_H is the income of high-risk projects, R_L is the income of risk-free projects, $\beta_{i,H}$ is the share of high-risk projects, and $(1 - \beta_{i,H})$ is the share of risk-free projects is in the assets portfolio of bank i. Depositors calculate the probabilities of success of banks p_i, considering the share of high-risk projects in the bank's portfolio and the share of capital in the bank financing, $p_i = 1 - (1 - k_i)\beta_{i,H}$. Also, we assume that the total volume of the capital market equals unit $0 \leq k_i + k_j \leq 1$. Therefore, capital, in addition to being a source of financing for the bank, is a factor moderating depositors' expectations (perceptions) about the ability of bank i to repay depositors' funds (quality of balance sheet liabilities) in relation to the share of risky assets of banks. In addition, it is assumed that there are no "information processing frictions" in this analytical environment.

Thus, one of the distinguishing features of our paper is the analysis of the components of depositors' beliefs about the probabilities of success of banks and its effect on the competitiveness of banks in the deposit market.

The decision-making procedure of economic agents in this model is briefly shown in Figure 2.

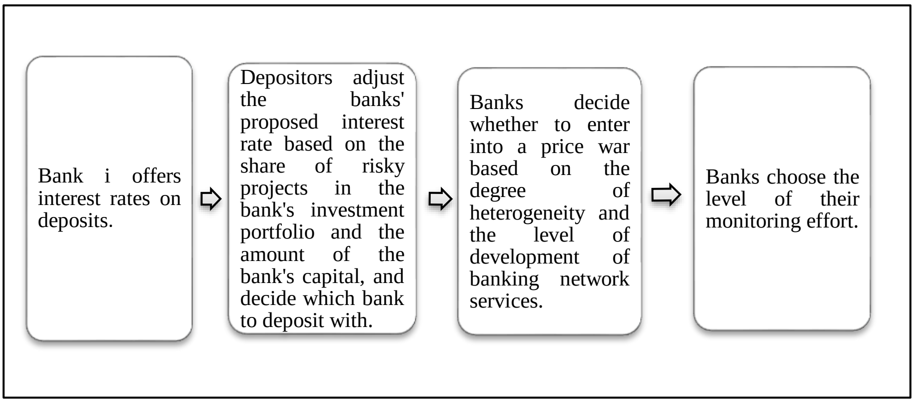

Figure 7. Decision-making procedure in the proposed model

The Nash equilibrium formed in this analytical framework can generally include various equilibrium states as described in the properties given in the following definitions.

Definition 1: In this structure, the necessary condition for the occurrence of "systemic crisis" in the banking system (banking system collapse) and the occurrence of "banking panic" in general require the possible "short selling" for banks and sufficient conditions include:

$$\beta_{i,H}(1 - k_i) \geq 1 \ \ and \ \ \beta_{j,H}(1 - k_j) \geq 1 \ , \qquad i = A, j = B \qquad (1)$$

$$\beta_{i,H}(1 - k_i) \geq 1 \ \ or \ \ \beta_{j,H}(1 - k_j) \geq 1 \ , \qquad i = A, j = B \qquad (2)$$

Indeed, the first condition indicates the situation in which, in this analytical environment, a "banking panic" by rational depositors in the banking system can succeed, and the second condition guarantees the success of their attack on a bank in the banking system, that is the success of a "bank run." It should be noted that these conditions if banks do not have any capital to build confidence ($k_i = 0$) requires the allocation of at least all of the bank's portfolio of projects to high-risk projects ($\beta_{i,H} = 1$), otherwise it requires the possible "short selling" for the bank. With such an approach, if the resulting equilibrium contains the values β and k that meet the above conditions, the banking system will be either in a state of systemic crisis or in a state of a successful attack on a bank. It is important to note that depending on the distance of the equilibrium values β and k from such a threshold and the severity of an adverse shock, a bank or even the entire banking system can be in such equilibrium states. To be more precise, the equilibria formed in the vicinity of the above-mentioned threshold will ensure the fragility of the entire banking system or at least some of the banks operating in the banking system. This, in particular, requires the awareness and readiness of the policymaker to be sensitive and act promptly.

Definition 2: The equilibrium of the deposit rates rat race ensures the alignment of banks' financing costs (deposit rates) and the allocation and stabilization inefficiencies that can benefit or detriment depositors.

Although the equilibrium of deposit rates rat race is conceptually similar to the equilibrium in the Akerlof (1976) and Brunnermeier and Oehmke (2013) setups, which include equilibria associated with inefficiencies in the relevant markets, the origin of the equilibrium of deposit rates rat race in our paper, rather than "adverse selection problem," is the structural feature of the deposit market in combination with asymmetric Nash equilibrium and more precisely the emergence of a "strategic complementarity" situation among actors in the banking system.

Definition 3: The equilibrium resulting from "limited price competition" is a situation in which the cost of financing financial intermediation (deposit rate) for each of the banks operating in the deposit market will be higher in equilibrium without eliminating any of the active banks.

Moreover, the theoretical framework of this paper can provide the possible tracking, identifying, and analyzing the following equilibrium situations in addition to the above.

Definition 4: The equilibrium resulting from "full price competition (price war) " is a situation in which the cost of financing financial intermediation (deposit rate) for each of the banks operating in the deposit market will be higher in equilibrium with the survival of only one active bank.

Thus, the only difference between the equilibrium involved in Definitions 3 and 4 will be the formation of a complete monopoly in the deposit market in the latter.

Definition 5: "Credible collusion" is a situation in which the formed equilibrium will guarantee the maximum common profit of all banks operating in the banking system.

In the following, we will analyze the banks' strategies in the deposit market. For simplicity, we assume $\vartheta = 0$. Therefore, the individual deposits his funds in the bank if:

$$p_i r_{di} - m n_i \geq 0 \tag{3}$$

By solving the hoteling model, the amount of deposit in bank i is given by:

$$d_i \equiv n_i = \frac{1}{2} + \frac{p_i r_{di} - p_j r_{dj}}{2m} \tag{4}$$

Thus, the following results can be raised in general.

Lemma 1: In a Cournot model, the relative market power of each bank in the deposit market to gain a share through the channel of change in the offered deposit interest rate of that bank depends on the relative position (risk of liabilities and assets) of each bank balance sheet and is independent of banking system services development level (transfer fee).

Proof of Lemma 1: By substituting $p_i = 1 - (1 - k_i)\beta_{i,H}$ in equation (4), we will have:

$$d_i = \frac{1}{2} + \frac{(1-(1-k_i)\beta_{i,H})r_{di} - (1-(1-k_j)\beta_{j,H})r_{dj}}{2m} \tag{5}$$

Therefore, the final effect of the offered deposit interest rate by banks on their share of the deposit market is given by:

$$\frac{\partial d_i}{\partial r_{di}} = \frac{1-(1-k_i)\beta_{i,H}}{2m} = MP_{ri} \ and \ \frac{\partial d_i}{\partial r_{dj}} = -\frac{1-(1-k_j)\beta_{j,H}}{2m} = -MP_{rj} \tag{6}$$

From equation (6), we will have:

$$MP_{ri} \gtrless MP_{rj} \ \ if \ \ \left\{\frac{(1-k_i)}{(1-k_j)}\right\} \lessgtr \left\{\frac{\beta_{j,H}}{\beta_{i,H}}\right\} \tag{7}$$

This lemma indicates that the weaker bank, in terms of the quality of the balance sheet risk to preserve its current market share, would inevitably offer higher deposit rates than the rival bank. In other words, the greater the quality difference that results, the greater the gap between the offered deposit rates in this area. Indeed, the above lemma can justify the formation and observation of such a phenomenon in the banking industry of some economies, including the Iranian economy.

In general, Lemma 1 indicates that a bank with a better risk quality in terms of assets and liabilities than its competitor has a comparative advantage in the event of a price war in the deposit market and therefore can confirm the stronger motivation of the bank to start a price war. It should be noted that in this analytical framework, the greater the quality difference, the lower the likelihood of a price war because the weak bank knows that in the event of such a war, it will have a much weaker position than its rival, and if it does, it will have to pay higher costs to increase or even preserve its existing share compared to the rival bank. On the contrary, the less heterogeneity between the two banks, the greater the likelihood of a price war because the necessary (balance sheet structure) adjustments for survival and superiority over the competitor can seem relatively more detailed and less costly and therefore more achievable for banks.

Accordingly, if we consider a situation in which the entire banking industry can be seen as a system consisting of two banking groups with a high degree of heterogeneity between the two groups and low heterogeneity within each group, then we can expect that price competition in the deposit market is mainly occurs within the group and among the banks in each group rather than among the banking groups. In other words, the share of banking groups in the deposit market is expected to change less over time, but the share of banks within each group will experience more changes.

Proposition 1: The marginal benefit of the improved level of development of banking system services (lower transaction costs) for a bank with a larger share of the deposit market, and other conditions being constant, will be greater.

Proof of proposition 1: From equation (5), we have:

$$\frac{\partial d_i}{\partial m} = \frac{-[(1-(1-k_i)\beta_{i,H})r_{di}-(1-(1-k_j)\beta_{j,H})r_{dj}]}{2m^2} \tag{8}$$

In other words, Proposition 1 indicates that the improved level of development of the banking system in providing financial services can lead to asymmetry in the share of the deposit market in favor of the bank with a higher share. This proposition, together with Lemma 1, shows that how the improved level of development of the banking system in providing financial services may lead to a lower share of the bank with better quality in the deposit market and encourage risky inefficiencies in the industry if the share of the lower quality bank in terms of higher balance sheet risk was higher in the initial equilibrium; and of course vice versa.

5. Partial Equilibria

5.1 Equilibrium Deposit Rates and the Factors Affecting It

The model presented in this section is based on the extension of the framework used in Dell Ariccia et al. (2014) and Dell Ariccia and Ratnovski (2019) setups in accordance with the objectives and analytical structure of this paper. As mentioned earlier, we have also assumed that the bank loan portfolios consist of two types of projects: high-risk and low-risk projects.

The loan portfolio of bank i obtains expected (gross) return $\mathrm{E(R_i)}$ with a probability $\mathrm{q_i}$ and otherwise has a zero return with probability $(1-\mathrm{q_i})$, where $\mathrm{q_i}$ is the level of monitoring efforts considered by the bank and associated with the cost $\frac{1}{2}\mathrm{cq_i^2}$ per unit of the loan. In addition, it is assumed that banks select the quantity of parameter q simultaneously and do not know the quantity of parameter q relating to each other when making decisions. We also assume $0 < (\mathrm{E(R_i)} - \mathrm{r}_{d\mathrm{i}} - \sigma) < \mathrm{c}$, where σ is leverage coefficient. This assumption ensures that the model has an interior solution. In addition, we assume that when one bank fails (in the absence of intervention and financial assistance from monetary and fiscal authorities), the value of the investment portfolio of another bank (regardless of that bank's level of monitoring) is affected by the contagion risk α.

Accordingly, the expected profit function of bank i at t = 0 is considered as follows:

$$E(\pi_i) = q_i\left(1-\alpha\left(1-q_j\right)\right)\left(E(R_i)l_i - r_{di}d_i - r_{ki}k_i\right) - \frac{c}{2}q_i^2 l_i \quad (9)$$

Where $l_i = d_i + k_i$ and also $r_{ki} = r_{di} + e_i$ is assumed to be the rate of return on capital, which e_i is the risk premium of capital owners and $e_i = \sigma\frac{l_i}{k_i}$ is directly related to the degree of bank leverage, where σ is leverage coefficient.

The resulting Nash equilibrium includes the deposit cost $\hat{r}_{di}$, net expected return $\tilde{R}_i$, the level of monitoring efforts $\hat{q}_i$, and the share of each bank in the deposit market $\hat{d}_i$ as follows:

$$\hat{r}_{di} = \frac{1}{5}\left(3E(R_i) + 2\frac{p_j}{p_i}E\left(R_j\right)\right) - \frac{1}{5}\sigma\left(3 + 2\frac{p_j}{p_i}\right) - \frac{1}{5}\frac{m}{p_i}\left(10 + 12k_i + 8k_j\right) \quad (10)$$

$$\tilde{R}_i \equiv E(R_i) - \hat{r}_{di} - \sigma = \frac{2}{5}E(R_i) - \frac{2}{5}\frac{p_j}{p_i}E\left(R_j\right) + \frac{2}{5}\sigma\left(\frac{p_j}{p_i} - 1\right) + \frac{1}{5}\frac{m}{p_i}\left(10 + 12k_i + 8k_j\right) \quad (11)$$

$$\hat{q}_i = \frac{\left(1-\alpha(1-\hat{q}_j)\right)\left(E(R_i) - \hat{r}_{di} - \sigma\right)}{c} = \frac{(1-\alpha)\left(c+\alpha\tilde{R}_j\right)\tilde{R}_i}{c^2 - \alpha^2\tilde{R}_j\tilde{R}_i} \quad (12)$$

$$\hat{d}_i = \frac{1}{2} + \frac{\frac{1}{5}(p_iE(R_i) - p_jE(R_j)) - \frac{1}{5}\sigma(p_i - p_j) - \frac{1}{5}m(4k_i - 4k_j)}{2m} \quad (13)$$

Also, by substituting the equilibrium values of the deposit rate and the level of monitoring efforts in the profit function of each bank, we end up with $E(\hat{\pi}_i) = \frac{c}{2}\hat{q}_i^2\hat{l}_i$. Moreover, using equation (11) in the entire banking sector, we have in equilibrium:

$$EMUP \equiv (p_i\tilde{R}_i + p_j\tilde{R}_j) = 4m\left(1 + k_i + k_j\right) \quad (14)$$

Where EMUP is the depositors' expected markup at equilibrium. A noteworthy point in all the above equilibrium values is the decisive role of the expected (gross) returns of the bank and its competitor from the view of depositors in interaction with the development of the banking sector. This can be considered one of the distinguishing features of the study structure. Based on this, the following results can be presented in a framework of static comparative analysis.

Theorem 1: In Nash equilibrium, the elasticity of the depositors' expected markup concerning funding transferring cost equals unite. If the development of banking system services is fixed, an increase (decrease) in (equilibrium) expected excess return in the entire banking system would include an increase (decrease) in the banking system default probability from the point of view of depositors (in equilibrium).

Proof of Theorem 1: Using equation (14), we have:

$$\varepsilon_{MUP,m} = \frac{\partial EMUP}{\partial m}\frac{m}{EMUP} = 1 \quad (15)$$

And the second part of the theorem is clear concerning equation (14).

The first part of this theorem confirms that in the equilibrium, for one percent change in the development of banking system services, the depositors' expected markup of the bank system would change at exactly one percent. In particular, the second part can play an important role in the inferences regarding the function of the banking system in equilibrium. More precisely, as can be seen from equation (14), the total depositors' expected excess return is a fixed amount in the equilibrium, directly related to the depositors' fund transferring cost. It is clear that with a constant m, the depositors' expected excess return on a bank in equilibrium increases only if the depositors' expected excess return or expected success (or both) on another bank decreases. Likewise, suppose that the expected return on investment in the entire banking system has increased in equilibrium. In that case, it can induce that, in general, the depositors' banking system default probability should have increased.

Conversely, if the expected return on equity in the entire banking system reduces in equilibrium, then it may indicate that the depositors' banking system default probability should be reduced. Therefore, in the first case, the function of the banking system, both in the field of allocation of resources and in the field of risks (stabilization) from the point of view of depositors, is generally distorted compared to the second case and will have lower efficiency. In the first case, the "risk premium" is a request from the banking system at a higher level, indicating a higher financing cost for the real sector of the economy to adopt and implement its investment projects in general and thus ignore some profitable projects in equilibrium. In addition, the higher default probability in the first case than in the second case can mean that the banking system is more fragile.

Lemma 2: In Nash equilibrium, the elasticity of a bank's deposit rate concerning depositors' beliefs about the probabilities of success of banks is determined by the elasticities of the banking sector development and depositors' expected gross return on the rival bank, and its direction will depend on the relative size of the absolute value of the two elasticity (existence of a threshold feature).

Proof of Lemma 2: Using equation (10), we can show:

$$\varepsilon_{\hat{r}_{di},P_i} = -\left[(1-\frac{\sigma}{E(R_j)})\varepsilon_{\hat{r}_{di},(P_jE(R_j))} + \varepsilon_{\hat{r}_{di},m} \right] \quad (16)$$

$$Where: \varepsilon_{\hat{r}_{di},P_i} = \frac{\partial \hat{r}_i}{\partial P_i}\frac{P_i}{\hat{r}_{di}},\ \varepsilon_{\hat{r}_{di},(P_jE(R_j))} = \frac{\partial \hat{r}_i}{\partial (P_jE(R_j))}\frac{(P_jE(R_j))}{\hat{r}_{di}} > 0, \quad (17)$$

$$\varepsilon_{\hat{r}_{di},m} = \frac{\partial \hat{r}_{\mathrm{di}}}{\partial \mathrm{m}}\frac{\mathrm{m}}{\hat{r}_{di}} < 0\ , and\ i = A, B\ \ j = B, A$$

If $\frac{\sigma}{\mathrm{E}(\mathrm{R}_j)} < 1$, then

$$\varepsilon_{\hat{r}_{di},P_i}\begin{cases} \leq 0 \quad if \quad \left|\varepsilon_{\hat{r}_{di},m}\right| \leq \left(1-\frac{\sigma}{E(R_j)}\right)\varepsilon_{\hat{r}_{di},(P_jE(R_j))}\ (State\ \ 1-i) \\ > 0 \quad if \quad \left|\varepsilon_{\hat{r}_{di},m}\right| > (1-\frac{\sigma}{E(R_j)})\varepsilon_{\hat{r}_{di},(P_jE(R_j))}\ (State\ \ 2-i) \end{cases}$$

In fact, the characteristic of the thresholds hidden in Lemma 2 indicates that in Nash equilibrium, any change in the depositors' prior beliefs about the probabilities of success of banks has two interactions from two channels on the relative competitive position of that bank through fund transferring cost in Nash equilibrium. First, a direct change in the fund transferring cost channel, and then an inverse change in the channel of the depositors' expected gross return on the rival bank. The outcome of these two interactions, reflected in the banking system development and the depositors' expected gross return on the rival bank elasticities, will determine how the final result affects the cost of bank deposit rates in the Nash equilibrium.

Also, in bank i, an increase in the share of high-risk projects through two major channels can affect the expected return on that bank, first, through the expected gross return on the bank, which increases it, and then through its effect on the depositors' expected success (default probability) in any bank that can reduce or increase it. The outcome from these two channels determines how the increase will affect the expected return on the bank I in equilibrium. Specifically, we have:

$$\frac{\partial \tilde{R}_i}{\partial \beta_{i,H}} = \left(1 - \frac{\partial \hat{r}_{di}}{\partial E(R_i)}\right)\frac{\partial E(R_i)}{\partial \beta_{i,H}} - \frac{\partial \hat{r}_{di}}{\partial P_i}\frac{\partial P_i}{\partial \beta_{i,H}} = \left(1 - \frac{\partial \hat{r}_{di}}{\partial E(R_i)}\right)(R_H - R_L) + \frac{\partial \hat{r}_{di}}{\partial P_i}(1 - k_i) \quad (18)$$

The right-hand side of equation (18) is always positive, and for the second expression, according to Lemma 2, it is clear that if bank i is in the state (i-2), an increase in the share of high-risk projects will increase the expected excess returns. However, if bank i is in the state (i-1), depending on whether the absolute value of the effect of changed $\beta_{i,H}$ from the depositors' expected success channel is greater than its effect from the expected gross return channel, expected excess return of bank i is in the inverse change in equilibrium, and otherwise will change directly. In this case, an increase in k_i can reduce the effect through expected success, and also, a high rate $(R_H - R_L)$ can also enhance the effect through the expected gross return channel. In addition, high $p_j E(R_j)$ can reduce, and low development of banking system services (large m) can increase the effect of changed $\beta_{i,H}$ on $\tilde{R}_i$. The initial status of the share of high-risk projects in the investment portfolio of bank i can also be influential.

Proposition 2: If the adjusted expected gross return with the default probability of bank i is greater than the final profit per unit of final loss due to the increased share of high-risk projects, the expected excess returns of the rival bank in equilibrium will be increased and vice versa.

Proof of Proposition 2: Using equations (11) and (12), we have:

$$\frac{\partial \tilde{R}_j}{\partial \beta_{i,H}} = -\frac{\partial \hat{r}_{dj}}{\partial \beta_{i,H}} = -\frac{\partial \hat{r}_{dj}}{\partial (P_i E(R_i))}\left[P_i(R_H - R_L) - (E(R_i) - \sigma)(1 - k_i)\right] \quad (19)$$

Hence, according to Proposition 2, we have:

$$\frac{\partial \tilde{R}_j}{\partial \beta_{i,H}} \begin{cases} \leq 0 & if \quad \frac{E(R_i)-\sigma}{P_i} \leq \frac{(R_H - R_L)}{(1-k_i)} \quad (State\ 1-j) \\ > 0 & if \quad \frac{E(R_i)-\sigma}{P_i} > \frac{(R_H - R_L)}{(1-k_i)} \quad (State\ 2-j) \end{cases} \quad (20)$$

In fact, under state (j-1) (state (j-2)) in Proposition 2, the result of two interactions is an increase in the effect of $\beta_{i,H}$ on P_i and $E(R_i)$ implies an increase (decrease) in the depositors' expected gross return on bank i, $P_i E(R_i)$ ؛ In a way, in the equilibrium, the rival bank has increased (decreased) its deposit rate to minimize the implications of action of bank i for its market share, which will ultimately reduce the excess of the expected return on bank i in the equilibrium.

Collorary 1: As a result of the increased share of high-risk projects of bank i, if the increased cost of deposits of both banks (A and B) from the expected gross return channel is greater than the changed cost of deposit rates of both banks from the channel of depositors' expected success of bank i, the excess of expected return in market equilibrium increases (and vice versa). Establishing states (i-2) and (j-2) in Lemma 2 and Proposition 2, respectively, will be a sufficient condition for this.

Proof of Collorary 1: Using the proof of Lemma 2 and Proposition 2 and equation (18), we have:

$$\frac{\partial \tilde{R}_i}{\partial \beta_{i,H}} + \frac{\partial \tilde{R}_j}{\partial \beta_{i,H}} = \left[\left(1 - \frac{\partial \hat{r}_{di}}{\partial E(R_i)}\right) - \frac{\partial \hat{r}_{dj}}{\partial (P_i E(R_i))} P_i\right](R_H - R_L) + \left[\frac{\partial \hat{r}_{di}}{\partial P_i} + \frac{\partial \hat{r}_{dj}}{\partial (P_i E(R_i))}(E(R_i) - \sigma)\right](1 - k_i) \tag{21}$$

Collorary 1 indicates that the expected excess return in market equilibrium would increase following an increase in the share of high-risk projects in one of the banks (A or B) if the final benefit per unit of final loss from the increased share of high-risk projects is greater than the changed cost of deposit rates of both banks due to its effect on the depositors' expected success of bank i per unit. The increased cost of deposit rates of both banks is due to the increased gross expected return on bank i.

According to the above results, it is possible to identify cases corresponding to some of the aforementioned definitions among different equilibrium situations. Specifically, if the competitors of banks A and B are in the states (j-1) and (i-2), respectively, so that the absolute value of the effect of the changed share of high-risk projects in the bank portfolio $\beta_{i,H}$ on the expected excess return on bank i from depositors' expected success channel is less than the effect of the expected gross return channel, then the sufficient condition to achieve equilibrium to be consistent with Definition 2 in the equilibrium of deposit rates rat race is $P_i < P_j$. Similarly, if the competitors of bank A and B are in the states (j-1) and (i-1), respectively, so that the absolute value of the effect of the changed share of high-risk projects in the bank portfolio on the deposit rate of bank i from the depositors' expected success channel is less than the effect of the expected gross return channel, so that $P_i < P_j$. Then a sufficient condition to achieve the equilibrium of deposit rates rat race requires fewer depositors' gross expected return on the rival bank with the default probability of bank i, which will be the same as for bank i with the default probability of the rival bank ($\frac{P_j \mathrm{E}(\mathrm{R}_j)}{P_i} < \frac{P_i \mathrm{E}(\mathrm{R}_i)}{P_j}$). It can also be shown that if the competitor of bank i is in the state (j-2), bank i is in the state (i-2) so that the effect of the changed share of high-risk projects in the portfolio of bank i on the deposit of bank i rate from the depositors' expected success channel is more than the effect of the expected gross return channel. Then the necessary condition to achieve equilibrium to be consistent with Definition 2 in the equilibrium of the deposit rates rat race against depositors is $\left[\frac{\partial \hat{r}_{di}}{\partial \beta_{i,H}} + \frac{\partial \hat{r}_{dj}}{\partial (P_{i,0}E(R_i))}\frac{\partial P_i}{\partial \beta_{i,H}} > \frac{\partial E(R_i)}{\partial \beta_{i,H}}\left(1 - \frac{P_i}{P_j}\right)\right]$.

Suppose a bank is a competitor in the state (j-1) and bank i is in the state (i-1) so that the absolute value of the effect of the changed share of high-risk projects in the portfolio of bank i on the expected excess return of bank i from the depositors expect success channel is more than its effect from the gross return channel. In that case, the resulting equilibrium in accordance with Definition 3 will guarantee a limited price war situation. It can be easily deduced that policy factors can play an important role in forming each of the different equilibrium situations.

A change in the capital of any bank will also affect the share, deposit cost, and the equilibrium expected excess return on that bank only through the depositors' expected success channel in relation to that bank. This is, in fact, one of the distinguishing features of the consequences of change in $\beta_{i,H}$. Thus from equations (10), (11), and (13), we will have:

$$\frac{\partial \hat{r}_{di}}{\partial k_i} = \frac{\partial \hat{r}_{di}}{\partial P_i}\frac{\partial P_i}{\partial k_i} = \frac{\partial \hat{r}_{di}}{\partial P_i}\beta_{i,H} - \frac{12}{5}\frac{m}{P_i} \tag{22}$$

$$\frac{\partial \tilde{R}_i}{\partial k_i} = -\frac{\partial \hat{r}_{di}}{\partial P_i}\frac{\partial P_i}{\partial k_i} + \frac{12}{5}\frac{m}{P_i} = -\frac{\partial \hat{r}_{di}}{\partial P_i}\beta_{i,H} + \frac{12}{5}\frac{m}{P_i} \tag{23}$$

$$\frac{\partial \hat{d}_i}{\partial k_i} = \frac{\partial \hat{d}_i}{\partial P_i}\frac{\partial P_i}{\partial k_i} - \frac{4}{10} = \frac{\partial \hat{d}_i}{\partial P_i}\beta_{i,H} = \frac{\beta_{i,H}(E(R_i)-\sigma)-4m}{10m} \tag{24}$$

Based on equations (22)-(24), if $\beta_{i,H}(E(R_i)-\sigma) > 4m$, it is clear that although the improvement in the confidence-building factor of bank i can increase the equilibrium share of that bank in the deposit market, its effect on the deposit rate cost and the expected excess return. In this framework, the results will be determined as Lemma 2 and its inverse, respectively. More specifically, if bank i is in the state (i-1), the increased k_i means an increase in the market share of bank i, a decrease in the cost of deposit rates, and an increase in the expected excess return. But if bank i is in the state (i-2), the increased k_i means an increase in the market share of bank i, an increase in the cost of deposit rates, and a decrease in its expected excess return. These results from the better or worse relative competitive position of bank i following the increased or decreased k_i. Regarding the effect of k_i on the deposit cost of bank i, we also have:

$$\frac{\partial \hat{r}_{dj}}{\partial k_i} = \frac{\partial \hat{r}_{dj}}{\partial P_i}\frac{\partial P_i}{\partial \delta k_i} - \frac{8}{5}\frac{m}{P_i} = \frac{\partial \hat{r}_{dj}}{\partial (P_i E(R_i))}\beta_{i,H}E(R_i) - \frac{8}{5}\frac{m}{P_i} \tag{25}$$

$$\frac{\partial \tilde{R}_{dj}}{\partial k_i} = -\frac{\partial \hat{r}_{dj}}{\partial P_i}\frac{\partial P_i}{\partial k_i} = -\frac{\partial \hat{r}_{dj}}{\partial (P_i E(R_i))}\beta_{i,H}E(R_i) + \frac{8}{5}\frac{m}{P_i} \tag{26}$$

Corollary 2: The necessary condition for reducing the expected excess return in the equilibrium market as a result of the improvement in the confidence-building factor of bank i is that the effect of improvement in the relative competitive position of bank i on the deposit rate of the rival bank is greater than the effect of improvement on the depositors' expected success of bank i on the deposit rate of that bank and a sufficient condition ensures that bank i is in the state (i-2).

Proof of Corollary 2:

$$\frac{\partial \tilde{R}_i}{\partial k_i} + \frac{\partial \tilde{R}_i}{\partial k_i} = -\left[\frac{\partial \hat{r}_{di}}{\partial P_i} + \frac{\partial \hat{r}_{dj}}{\partial (P_i E(R_i))} E(R_i)\right] \beta_{i,H} + \frac{m}{5}\left(\frac{8}{P_i} + \frac{12}{P_i}\right) \tag{27}$$

Based on Lemma 2, it is clear that in the state (i-2), equation (27) is always negative.

Comparison of the resulting equations shows that the changes in $\beta_{i,H}$ and k_i have different effects on the deposit cost and the equilibrium expected excess return of bank i, respectively, and a sufficient condition for to be more effective the high-risk projects $\beta_{i,H}$ than k_i in relation to the deposit cost is $\frac{\partial \hat{r}_{di}}{\partial P_i} < 0$ (state (i-1) in Lemma 2) and in relation to the expected excess return is $\frac{\partial \hat{r}_{di}}{\partial P_i} > 0$ (state (i-2) in Lemma 2). Also, among the various conceivable equilibrium states, it appears that if bank i is in the state (i-2), the above equilibrium is consistent with Definition 3, which would indicate a limited price war situation.

5.2 Equilibrium Deposit Rates and the Factors Affecting It

The model presented in this section is based on the extension of the framework used in Dell Ariccia et al. (2014) and Dell Ariccia and Ratnovski (2019) setups in accordance with the objectives and analytical structure of this paper. As mentioned earlier, we have also assumed that the bank loan portfolios consist of two types of projects: high-risk and low-risk projects.

$$\begin{cases} if\ \tilde{R}_i \geq \tilde{R}_j \ \Rightarrow \ \hat{q}_i \geq \hat{q}_j \\ if\ \tilde{R}_i < \tilde{R}_j \ \Rightarrow \ \hat{q}_i < \hat{q}_j \end{cases} \tag{28}$$

The reason for this is the higher final benefit from each unit increase in the monitoring efforts for the bank with a higher expected excess return. In general, based on equation (29), there will be an inverse relationship between the contagion risk and the level of equilibrium monitoring efforts of bank i, taking into account the assumption that the model has an internal answer.

$$\frac{\partial \hat{q}_i}{\partial \alpha} = \frac{\tilde{R}_i \tilde{R}_j \left[\alpha^2 \tilde{R}_i (\tilde{R}_j - c) + 2\alpha (c \tilde{R}_i - c^2) + c^2 (1 - \frac{c}{\tilde{R}_j})\right]}{(c^2 - \alpha^2 \tilde{R}_i \tilde{R}_j)^2} < 0 \tag{29}$$

This result is, in fact, a reflection of the inefficiency involved in the effects of exogenous news along with the contagion risk at the level of the equilibrium monitoring efforts of each bank. This is because even though the contagion risk equivalent in equilibrium to bank i is considered exogenous for each bank, this risk can be considered endogenous for the macro-level financial system. Therefore, it is conceivable that in equilibrium, the banking system will suffer from inefficiency in the idiosyncratic risk of each bank. This is due to ignoring the positive effect of each bank monitoring efforts on its rival bank. The level of equilibrium monitoring efforts with respect to equations (30) and (31) directly relates to the expected excess return of each bank and the expected excess return of the rival bank.

$$\frac{\partial \hat{q}_i}{\partial \tilde{R}_i} = \frac{(1-\alpha)(c+\alpha\tilde{R}_j)(c^2-\alpha^2\tilde{R}_i\tilde{R}_j)+\alpha^2\tilde{R}_i\tilde{R}_j(1-\alpha)(c+\alpha\tilde{R}_j)}{(c^2-\alpha^2\tilde{R}_i\tilde{R}_j)^2} > 0 \quad (30)$$

$$\frac{\partial \hat{q}_i}{\partial \tilde{R}_j} = \frac{(1-\alpha)\alpha\tilde{R}_i(c^2-\alpha^2\tilde{R}_i\tilde{R}_j)+\alpha^2\tilde{R}_i^{\,2}(1-\alpha)(c+\alpha\tilde{R}_j)}{(c^2-\alpha^2\tilde{R}_i\tilde{R}_j)^2} > 0 \quad (31)$$

The positive correlation between the level of equilibrium monitoring efforts and the expected excess return of each bank is followed by an increase in the final benefit of each unit of monitoring efforts, which is obvious. However, it is worth noting that there is a positive correlation for the expected excess return of the rival bank, which has occurred as a result of the contagion risk and positive externalization created by this channel due to increased monitoring efforts of the rival bank to improve its expected excess return. This has resulted in positive feedback from that bank and can help improve the efficiency of the banking system in the field of more effective idiosyncratic risk management. Therefore, its level can be expected to increase with increasing the contagion risk α.

Proposition 3: The share of high-risk projects in each bank's portfolio of the two expected excess return channels on that bank and its rival bank will affect the level of equilibrium monitoring efforts, and the result will be "state-dependent." A sufficient condition for the direct (inverse) effect is the establishment of state (i -2) for that bank and state (j -2) for the rival bank, and (state (i -1) for that bank and state (j -1) for the rival bank. Otherwise, if that bank is in the state (i -2) (state (i -1)) and the rival bank is in the state (j -1) (state (j -2)), the condition of co-change requires the absolute value of the final effect of the changed share of high-risk projects on the level of equilibrium monitoring efforts of that bank from the excess return channel of the rival bank be less (more) than from the excess return channel of that bank, and vice versa for reverse change.

Proof of Proposition 3*:* Using equation (12), we will have:

$$\frac{\partial \hat{q}_i}{\partial \beta_{i,H}} = \frac{\partial \hat{q}_i}{\partial \tilde{R}_i}\frac{\partial \tilde{R}_i}{\partial \beta_{i,H}} + \frac{\partial \hat{q}_i}{\partial \tilde{R}_j}\frac{\partial \tilde{R}_j}{\partial \beta_{i,H}} \quad (32)$$

We also showed that $\frac{\partial \hat{q}_i}{\partial \tilde{R}_i} > 0$ and $\frac{\partial \hat{q}_i}{\partial \tilde{R}_i} > 0$. According to Proposition 2, we have:

$$\frac{\partial \tilde{R}_j}{\partial \beta_{i,H}} \begin{cases} \leq 0 & if \quad (State\ 1-j) \\ > 0 & if \quad (State\ 2-j) \end{cases} \quad (33)$$

Also, according to equation (18) and Lemma 2, we clearly have:

$$\frac{\partial \tilde{R}_i}{\partial \beta_{i,H}} \begin{cases} \leq 0 & if \quad (State\ 1-i) \\ > 0 & if \quad (State\ 2-i) \end{cases} \quad (34)$$

One of the significant implications of Proposition 3 is that the status involves an inverse relationship between the level of equilibrium monitoring efforts and the increased share of high-risk projects in the banks' portfolios. Such status can indicate situations in which, on the one hand, the share of high-risk projects in the balance sheet assets of banks has expanded. On the other hand, inefficiency in monitoring efforts by banks has increased significantly. In such a situation, the banking system can become very fragile and make it significantly prone to forming a systemic crisis following an adverse shock, even if not very strong. This is especially important when, following monetary, fiscal, and regulatory policies commanded by policymakers, the liquidity and financial regime formed encourages the promotion of high-risk projects in the banking system and financial system or periods in which business cycles leads to an increase of high-risk projects share in the real sector and consequently the banking and financial sector. If the mentioned conditions and policies are specific and limited to one bank, the consequences can affect the banking system. This proposition is particularly important because it specifically identifies situations in which such policies and business cycles may not necessarily have such consequences and distinguishes them by explaining the salient features of each.

Proposition 4: The capital of each bank through the two channels, the expected excess return on that bank and its rival bank will affect the level of equilibrium monitoring efforts, and the final result will be "state-dependent." A sufficient condition for the inverse effect is establishing the state (i -2) for that bank. In the state (i -1), the condition of inverse change requires a more (less) absolute value of the final effect of the change in the confidence-building factor on the level of equilibrium monitoring efforts of that bank from the expected excess return channel of the rival bank compared to the expected excess return channel.

Proof of Proposition 4: Using equation (12), we will have:

$$\frac{\partial \hat{q}_i}{\partial k_i} = \frac{\partial \hat{q}_i}{\partial \tilde{R}_i}\frac{\partial \tilde{R}_i}{\partial k_i} + \frac{\partial \hat{q}_i}{\partial \tilde{R}_j}\frac{\partial \tilde{R}_j}{\partial k_i} \tag{35}$$

According to $\frac{\partial \hat{q}_i}{\partial \tilde{R}_i} > 0$, $\frac{\partial \hat{q}_i}{\partial \tilde{R}_j} > 0$ and $\frac{\partial \tilde{R}_j}{\partial k_i} < 0$, and also according to Lemma 2, we have:

$$\frac{\partial \tilde{R}_i}{\partial k_i}\begin{cases} \geq 0 & if \quad (State\ \ 1-i) \\ < 0 & if \quad (State\ \ 2-i) \end{cases} \tag{36}$$

Accordingly, it can be expected that in situations involving the inverse relation, if the capital improvements have been made externally even for a bank, for example, by policies implemented by monetary, fiscal, or regulatory policymakers, it has contributed inefficiency to the banking system. Thus sow the seeds of systemic instability in the financial system. In other words, policies can work in the opposite direction to their original purpose. Identifying the conditions involving these situations and their differential characteristics from the opposite situations is one of the advantages of this proposition and this analytical structure in general.

Proposition 5: The improved level of development of the banking system in a way that ensures a reduction in the cost of transferring funds will always reduce the level of monitoring efforts by each bank and vice versa.

Proof of Proposition 5: Using equation (12), we will have:

$$\frac{\partial \hat{q}_i}{\partial m} = \frac{2(1-\alpha)\left(\tilde{R}_j\frac{\alpha}{p_j}+(c+\alpha\tilde{R}_i)\frac{1}{p_j}\right)(c^2-\alpha^2\tilde{R}_j\tilde{R}_i)+\frac{4}{5}\alpha^2\left(\frac{\tilde{R}_i}{p_j}+\frac{\tilde{R}_j}{p_i}\right)(1-\alpha)(c+\alpha\tilde{R}_i)\tilde{R}_j}{\left[c^2-\alpha^2\tilde{R}_j\tilde{R}_i\right]^2} > 0 \tag{37}$$

This proposition emphasizes the possible destabilizing the role of any technological development by improving the efficiency of funds transfer and thus reducing its cost for the entire banking system and can be a reminder of the concept of "the curse of over-efficiency" in the study area.

5.3 Full Price Competition (Price War) and Credible Collusion Episodes

According to Definition 4, in full price competition, the highest deposit cost that any bank can pay is the rate at which the bank's profit becomes zero. Accordingly, the final equilibrium of the banking system can be expressed by Proposition 6.

Proposition 6: In the event of full price competition, the final equilibrium will ensure the formation of a monopoly structure with a zero expected excess return for the bank with the higher depositors' expected success probability and with a minimum level of monitoring efforts.

Proof of proposition 6: According to the profit function of each bank, it is clear that the highest deposit interest rate that each bank can offer equals:

$$\bar{r}_{di} = E(R_i) - \frac{c}{2} q_i \frac{1}{\left(1-\alpha(1-q_j)\right)} \tag{38}$$

Therefore, the maximum interest rate on deposits that each bank can pay has a negative relationship with the level of monitoring efforts of that bank q_i and a positive relationship with the level of monitoring efforts of the rival bank q_j. Therefore, if both banks move towards price competition, each bank must choose the lowest level of monitoring efforts. Then, according to equation (11) and Lemma 1, we will have in the final equilibrium:

$$\bar{r}_{di} = E(R_i) - \sigma = \frac{m}{P_i - P_j} \tag{39}$$

Therefore, according to corollaries 1 and 2, it is clear that a bank with higher capital k will eventually take over the entire market.

Under such conditions, the banking system as a whole can be expected to be more fragile because the share of high-risk projects in the bank's portfolio and the cost of its deposit will be high, and the level of monitoring efforts will be low.

If banks can establish a credible agreement and collusion, rather than each bank attempting to maximize its own profits, according to Definition 5, the maximized total profit will be $E(\pi_T) = E(\pi_i) + E(\pi_j)$.

Proposition 7: In case of credible collusion of banks, the cost of banks' deposits will decrease in the equilibrium, and the level of their monitoring efforts will increase compared to non-collusion.

Proof of proposition 7: In these conditions, the level of equilibrium monitoring efforts of each bank will be as follows:

$$q_i^c = \frac{\left(1-\alpha(1-q_j)\right)\left(E(R_i)-r_{di}^c-\sigma\right)}{c} + \frac{\alpha q_j\left(E(R_j)-r_{dj}^c-\sigma\right)\frac{d_j^c}{d_i^c}}{c} > \hat{q}_i \tag{40}$$

Where superscript c indicates the equilibrium values in the case of cooperation. The first expression on the right-hand side of equation (40) is equivalent to the same $\hat{q}_i$, and since the second expression is always positive, we will have: $q_i^c > \hat{q}_i$. Also, the equilibrium deposit cost of each bank is obtained by solving equation (41) for r_{di}^c:

$$-q_i\left(1-\alpha\left(1-q_j\right)\right)d_i^c+\frac{p_i}{2m}\left[q_i\left(1-\alpha\left(1-q_j\right)\right)\left(E(R_i)-r_{di}^c-\sigma\right)-\frac{c}{2}q_i^2\right]-\frac{p_j}{2m}\left[q_j\left(1-\alpha(1-q_i)\right)\left(E\left(R_j\right)-r_{dj}^c-\sigma\right)-\frac{c}{2}q_j^2\right]=0 \quad (41)$$

Since solving equation (41) for the deposit cost of each bank using only the first two expressions on the left-hand side of the equation gives the same equilibrium deposit cost for the non-collusion case, so equation (41) can also be written as follows:

$$r_{di}^c=\hat{r}_i-\frac{p_j}{2m}\left[q_j\left(1-\alpha(1-q_i)\right)\left(E\left(R_j\right)-r_{dj}^c-\sigma\right)-\frac{c}{2}q_j^2\right] \quad (42)$$

Considering that the equilibrium profit of each bank is greater than zero, the second expression on the left-hand side of equation (42) is always negative, and as a result, we will have $r_{di}^c \leq \hat{r}_{di}$.

The increased level of equilibrium monitoring efforts in these conditions is due to the internalization of the positive effects of monitoring efforts of each bank to reduce the contagion risk by both banks. Also, the reduction in the cost of bank deposit rates has been realized due to taking into account the common profit of the two banks in the deposit market. Therefore, it can be said that collusion between banks can improve the stability of the banking system as a whole.

6. Role of Policy Factors

As mentioned in different parts of this paper, monetary, fiscal, and regulatory authorities can effectively shape equilibrium states by implementing various policies. This, especially in many "state-dependent" cases, involves a change in size or makes a change in direction, quality, and even a kind of behavioral regime and consequently resource allocation in the banking system. Particularly, these authorities can design and implement policies focused on the various components of the liabilities and assets of banks reflected in the parameters k and β, as well as the rate of return on risk-free assets R_L and, therefore, the difference between the rate of return on high-risk and low-risk projects (risk-free), costs of funds transfer, and the contagion risk on the equilibrium deposit rate costs, expected excess return (net expected return), banks' share of the deposit market, the level of monitoring efforts, contagion risk to each bank, the banking system as a whole, the efficiency of the allocation of banking system resources and its stability, and the financial system, in general, are all effective.

For example, monetary authority change the banks' portfolio in equilibrium market by adopting expansionary or contractionary monetary policies in the context of risk-free bond rate changes, especially when they persist for a reasonable period of time, reaping the ultimate benefit of each unit of the changed share of high-risk projects, influencing the expectations of banks by changing their general and macro perspective on the trend of growth or stagnation of activities, setting a ceiling for high-risk projects or a floor for low-risk projects, and regulating. Also, by adopting explicit and implicit protection policies to rescue banks in the event of an emergency for banks, the expectations of depositors and banks will be affected, thereby predisposing banks to adjust their balance sheet liabilities and assets conservatively or opportunistically. Moreover, the fiscal authority can, by imposing discriminatory taxes against returns on high-risk projects, or by considering concessions or penalties in the form of tax exemptions or increases tax rates, increase the quality of banks' liabilities and assets in proportion to stated mechanisms in the theoretical part of the model.[1]

7. Concluding Remarks

This study addressed a theoretical explanation of banks' decision-making in an imperfect competitive deposit market and the consequences of contagion risk. In fact, according to the incidence of issues in the Iranian banking sector in recent years and some similar anecdotal episodes in advanced and emerging economies, challenges for policymakers have been raised in how to deal with them. These issues led us to address the standpoint concerns by extending extant theoretical paradigms to explore the factors affecting rival banks' strategies in the deposit market. Accordingly, the study has featured diverse equilibria concerning deposit rates and the level of banks' monitoring efforts due to interaction between deposit market structure and some policy conduct.

The findings generally indicate that in an imperfect competitive deposit market exposed to contagion risk, several variables, such as the cost of transferring funds, the difference between the high-risk and low-risk projects returns, each bank's expectation regarding the future state of the economy, and the level of banks' equity capital could play a role in shaping the equilibrium deposit rates, deposit market share, expected net returns, expected markup, and level of monitoring efforts for each bank. However, the effect of strength and direction of the variables on each bank may vary due to externalities originating from strategic complementarity/substitution among the rival banks in the market, making the resulting equilibria state-dependent. Further, the study explores the allocation and stabilization efficiency implications associated with the equilibrium.

In particular, it is shown why banks do not necessarily enter into a full-blown price war with each other and in economies where the banking sector consists of heterogeneous banking groups (such as public and private banking groups), this is why price competition in the deposit market may occur mostly within each banking group rather than between banking groups. Also, the analysis entailed the capital of each bank through the expected excess return of that bank, and its rival bank would affect the level of equilibrium monitoring efforts. The final result would be "state-dependent" (Proposition 4).

The striking contribution of this study is revisiting the deposit market structure as a new transmission channel for (monetary, fiscal, and prudential) policies targeted at the banking sector's stability and performance efficiency. This

[1] In this section, this general level of analysis in this area is sufficient and a comprehensive and more detailed analysis of the follow-ups of these policy implications, in order to observe brevity of the present paper, will be presented separately in another paper by the authors.

opens new opportunities for extensions and interpretations in this field. To name just a few, one could look into the discretionary and ruled-based macro- and micro-prudential policy implications in the form of banks' equity capital requirements for banking sector stability and efficiency. Also, one could investigate how the banks' risk-taking incentives in the context of their assets portfolio construction and investing in their monitoring efforts would dynamically interact with the deposit market structure and what would be its repercussions for policy design, evaluation, and conduct especially based on the idea of policies impacts on banks' rent-seeking incentives. Another interesting line for extension could be rewriting the model to scrutinize the implications of deposit market structure for banks' optimal disclosure policies. The authors have already taken some of the above-suggested lines of research.

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