Banking Competition and Monetary Policy: The Role of Barriers to Entry*

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Abstract

In recent years, the competitive landscape of the banking system in many countries has changed in fundamental ways. The global financial crisis, in particular, has contributed towards an increasingly concentrated financial system. Moreover, barriers to entry are often blamed for the lack of competition in the sector. In order to address these issues, this paper studies the impact of strategic interactions among financial institutions in a model with money. We incorporate imperfectly competitive behavior by considering that banks compete in terms of the amount of loans they issue. Under fixed entry, by construction, monetary policy only affects the rate of return to money. This restriction serves as a superneutral benchmark for credit market activity and the role of entry barriers. In contrast, under endogenous entry, as inflation affects the ability of banks to insure depositors against liquidity risk, monetary growth discourages bank entry and leads to higher costs of loans. In this manner, we introduce an important transmission channel in which inflation obstructs financial market activity. Furthermore, the detrimental effects of inflation are exacerbated in economies with high barriers to entry in the banking sector.

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1 Introduction

In recent years, the competitive structure of the financial system in many countries has fundamentally changed. In nearly every country, the banking sector has become more concentrated. In the United States, for example, there were over 19,000 different

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financial institutions that were active in 1989. Just a decade later, the number was only equal to half of the size.[1] In the U.K., Logan (2004) reports that the largest nine U.K.-owned banks held approximately 85% of non-financial deposits. Moreover, the trend towards further consolidation continues. Therefore, policymakers must confront the consequences of a sector that continues to be challenged by increasing concentration. The largest institutions, receiving some criticism for their size, have become even bigger after the global financial crisis.[2] As a result, the concentration of activity has further intensified.

As stressed by Barth et al. (2013), barriers to entry are one of the most important factors in determining the number of firms and the degree of competition in the banking sector.[3] A key component of entry barriers stems from regulatory barriers imposed by the government.[4] Notably, Barth et al. find that there was some evidence of an increase in banking requirements across 136 different countries from 1999-2011. The largest increases in requirements in the European Union took place in Finland, Germany, and France. Entry requirements also increased in Ireland and Iceland. Ayadi et al. (2013) also determine that entry requirements increased in France around the same time, but they decreased in Greece. Entry requirements remained relatively high in Italy, Portugal, and Spain. Moreover, the additional regulatory burdens imposed on banks after the crisis imply that barriers to entry have risen further.[5]

In the U.K., in particular, major changes in banking requirements have been adopted this year to lower the costs of entry in order to promote access to credit and improve the competitive structure of the banking system. Such reforms in banking requirements suggest that policymakers have concluded that barriers to entry are too high and that the banking sector is too concentrated.[6] However, in Australia, it appears that many believe that the current level of entry barriers should continue: "Most of these barriers are entirely appropriate and reflect the important role that banking plays in society."[7]

[1] The Bank for International Settlements provides a comprehensive overview of consolidation patterns in the financial services services sector during the 1990s. In particular, they caution that "Consolidation could reduce competition in these markets, increasing the cost of liquidity for some firms and impeding the arbitrage of interest rates between markets. In addition, consolidation could affect the performance of the market if the resulting large financial firms behave differently from their smaller predecessors." Kwan (2004) describes the sources of change in the banking industry in the United States.

[2] See Gongloff et al. (2013). Also, Ganel (2013).

[3] Claessens and Laeven (2004) also point out that countries which promote foreign bank entry and have fewer restrictions on entry into the banking sector are more competitive.

[4] As explained in the Grupo Santander Retail Banking Sector Inquiry Preliminary Report (2005), "From Santander's experience, the main challenge for a Bank entering another market is precisely the entrance...."

[5] Down and Toeman (2010) describes how barriers to entry in the UK retail banking system increased after the crisis. Duke (2012) discusses the effects of additional regulatory costs on small banks in the United States.

[6] A detailed assessment of barriers to entry in the U.K. banking system is provided in the review by the Office of Fair Trading (2010) and Financial Services Authority (2013). Financial Services Authority (2013) provides a list of changes in banking requirements to be implemented.

[7] Statement by Leon Carter (2008), National Secretary of the Financial Sector Union of Australia in "Inquiry into Competition in the Banking and Non-Banking Sectors."

What is the optimal competitive structure of the banking system? What are the social benefits and costs of increasing competition? What are the welfare-maximizing costs of entry into the financial sector? Public policies to address the changing competitive landscape need to confront these questions.

The objective of this paper is to develop a framework to assess the consequences of changes in the degree of competition in the banking sector. In order to address the social benefits and costs of the concentration of banking activity, a rigorous model of intermediation is required. Following Diamond and Dybvig (1983), we contend that banks provide valuable opportunities for risk sharing and insurance against liquidity risk. As policymakers have expressed concerns about increasing concentration on credit markets, banks in our framework also channel funds from depositors to borrowers. In this manner, banks in our model serve two different groups of market participants – depositors and borrowers. Moreover, banks perform two important social functions – they promote risk sharing and help individuals smooth consumption.

The degree of concentration has important implications for the provision of both services across groups of individuals in the model. Our analysis begins by considering a setting with a fixed number of firms in order to study the effects of concentration on the strategic choices of intermediaries along with the services they deliver to both groups. We show that an increase in concentration distorts the flow of credit but leads to better risk-sharing among depositors.[8] Consequently, the optimal competitive structure of the financial system seeks to balance the provision of financial services across both groups of market participants.

Given the strategic behavior among institutions in our framework, there are important experiments regarding monetary policy to consider. Notably, very little research investigates how the transmission channels of monetary policy depend on the degree of competition in financial markets. However, the design of policy should account for the type of strategic behavior and the ability of institutions to exploit their market power in the financial system. In order to make rigorous arguments about the effects of policy, we require that a model be based upon a rigorous transactions demand for money. Following Schreft and Smith (1997, 1998), incomplete information provides a foundation for money as a medium of exchange and store of value. By construction, inflation does not affect credit market activity under fixed entry but it does have effects on risk sharing. In this manner, the effects under fixed entry highlight the implications of monetary policy on the welfare of depositors.

The analysis proceeds by looking at activity under endogenous entry. Given that inflation distorts the ability of intermediaries to provide risk sharing among depositors, it also distorts the incentives of firms to enter the banking system. Consequently, under endogenous entry, inflation is associated with a higher degree of concentration. The feedback effect from inflation to concentration in equilibrium leads to a lower volume of credit. Moreover, inflation exacerbates the problem of entry costs. That is,

[8] Hannan (1991) and Corvoisier and Gropp (2002) argue that borrowers in markets with higher concentration ratios face higher costs for loans. Moreover, they may also experience more difficulty obtaining access to credit – Beck, Demirguc-Kunt and Maksimovic (2003) document that credit rationing occurs more often in concentrated banking systems.

the adverse effects of inflation on availability of credit funding are stronger as barriers to entry are higher. In this manner, the effects of inflation on credit market activity are highly non-linear depending on barriers to entry. In addition, though we find a negative relationship between credit market activity and inflation under endogenous entry, it is the interference in the ability of banks to provide risk-pooling services that ultimately is responsible. Therefore, the mechanism by which policy affects credit funding derives from the risk-pooling role of intermediaries under equilibrium entry.

Interestingly, most of the discussion about entry barriers among policymakers focuses on the implications for credit markets without addressing how barriers to entry interfere with standard monetary policy transmission channels. Yet, we show that failing to acknowledge this dimension is likely to lead to misguided public policy. Should such barriers be eased, the negative effects of inflation through incentives for firms to enter the sector would be lower. Therefore, the role of inflation to promote credit activity through standard Tobin-type asset substitution channels would be considerably more effective.

Finally, the analysis concludes by studying the optimal concentration of the banking sector. As previously established, banks in the model perform two important social functions – they promote risk pooling and consumption smoothing for two different groups of agents: depositors and borrowers. The welfare-maximizing degree of concentration optimally balances the provision of financial services across the two groups. In particular, the optimal degree of concentration is highly dependent on the incidence of liquidity risk.

Related Literature

Our paper contributes to an emerging literature which studies the implications of the industrial organization of the banking system for the effects of monetary policy. To begin, Ghossoub, Laosuthi, and Reed (2012) study how the effects of monetary policy vary between monopolistic and competitive banking systems. They show that in a perfectly competitive banking system, higher rates of money growth generate a Tobin-type effect in which inflation lowers interest rates and stimulates lending activity. However, in a price-distorted monopolistic banking system, inflation generates the opposite effect.

Building on the structure of Ghossoub, Laosuthi, and Reed, Matsuoka (2011) compares optimal monetary policy in a monopolistic banking sector to a competitive banking system. In contrast to the previous work which focuses on credit markets and consumption smoothing by borrowers, Ghossoub (2012) demonstrates how the industrial organization of the banking system affects prices in capital markets. In particular, the distortions from monopoly power in the banking system have adverse consequences for the standard transmission of monetary policy in promoting capital accumulation.[9]

[9] Ruckes (2004) applies Bertrand competition in the presence of asymmetric information to study the interactions between the level of screening by banks and prices in the credit market. However, it principally focuses on the financial contracts offered by banks. By comparison to our framework, it

In comparison to our framework, all of the previous papers study financial market activity under price competition in credit and deposit markets. As a result, they only compare economies with competitive banking systems to fully concentrated industries. Consequently, the ability to study the concentration of activity in the banking system is rather limited.[10]

In this manner, previous research does not address the conditions under which each type of competitive structure is likely to be observed in equilibrium. That is, they only study economic activity under fixed entry. Therefore, previous work cannot address the role of barriers to entry and the endogenous degree of concentration as in our setup.

The closest paper to our research is Williamson (1986) who also constructs a model of imperfect competition in credit markets and allows for equilibrium entry. However, in his framework, money is only a store of value. In addition, the economic functions of banks are quite different – while Williamson discusses the role of banks to alleviate costs of private information, we emphasize the risk pooling role of financial institutions. Notably, it is the ability of institutions to provide risk pooling to depositors which plays a key role in affecting entry incentives and the transmission of monetary policy.

The remainder of the paper is organized as follows. Section 2 studies a benchmark model in which banks engage in non-cooperative behavior. Next, equilibrium entry in the banking system is determined. Section 4 extends the model to look at the welfare-maximizing degree of concentration in the banking system. Finally, Section 5 offers some concluding remarks. The proofs of major results are provided in the Appendix.

2 The Benchmark Model

We begin by considering an economy in the presence of non-cooperative behavior and limited banking entry. Following Schreft and Smith (1997) and Ghossoub, Laosuthi, and Reed (2012), banks compete by posting a schedule of prices in the deposit market. In contrast, competition in the credit market is characterized by quantity competition.

does not consider the effects of monetary policy. In contrast, Bagliano, Dalmazzo, and Marini (2000) propose that monetary policy can affect the ability of banks to collude in financial markets. While they demonstrate that the design of policy should account for strategic interactions among banks, depository institutions perform limited financial functions. In their framework, banks accept deposits and issue loans. That is, the primary function of banks is to promote intertemporal consumption smoothing. In contrast, following Diamond and Dybvig (1983), we incorporate that banks provide important risk pooling services to participants in financial markets.

[10] There are two recent exceptions. One of them is Ghossoub and Reed (2013) who study the effects of the size distribution of the banking system for the efficacy of monetary policy in a model of imperfectly competitive banks. However, they do not address the concentration of activity through the number of intermediaries. Instead, their primary focus is to study how the impact of monetary policy on credit markets depends on the relative size distribution of banks in the financial system. Another exception is Laosuthi and Reed (2013) but they look at the implications of imperfectly competitive behavior through the market for transactions-demand services.

In this manner, the degree of competition has a significant impact on the strategic behavior of banks.

2.1 Environment

The economy consists of an initial old generation and an infinite sequence of two-period-lived overlapping generations. At each date $t = 0, 1, ...$, young agents are born to one of two separate islands. Each island contains a continuum of young depositors and borrowers with unit mass of each type. Although the two locations are separated, there is a single consumption good available on both sites. The price level for one unit of goods is common across islands and is defined as p_t at time t. For simplicity, the two islands are symmetric.

There are two types of ex-ante identical agents: depositors (which we also refer to as lenders) and borrowers. Young depositors are born with $x > 0$ units of the consumption good but do not receive endowments when old. They value consumption only in the last period (c_2) with preferences given by: $U(c_2) = \ln(c_2)$. In contrast, young borrowers are born without endowments but receive $y > 0$ units of the consumption good in their old-age. However, they derive utility from consumption in both periods of their lives. The discounted lifetime utility function of borrowers is expressed by: $U(c_1, c_2) = \ln(c_1) + \beta \ln(c_2)$.

In this economy, there are N identical financial intermediaries on each island with linear preferences. Each bank's objective is to maximize profits in units of consumption goods. Banks have access to the financial system and can generate income by providing financial services to individuals in the economy. Specifically, banks offer a schedule of rates of return for each unit of deposits and charge prices for each unit of loans. With deposits received, banks can trade funds for two primary assets: fiat money and one-period, default-free loans. The return to fiat money depends on the total amount of currency in the economy. M_t denotes the amount of the monetary base per depositor on each island and σ denotes the net growth rate of money. Therefore, the money supply for $t > 0$ evolves according to:

$$M_{t+1} = (1 + \sigma)M_t \tag{1}$$

Spatial separation and private information generate trade frictions in the economy. To be specific, there is no communication across islands. Consequently, private liabilities do not circulate between the two locations. Moreover, a relocation shock occurs on each island. In particular, a fraction of young depositors (π) must move to the other island. The probability of the relocation shock is exogenous, publicly known and the same in each site. Furthermore, fiat money is the only asset that agents can carry to the other location and exchange for goods. Therefore, the relocation shock plays the role of a liquidity preference shock in the Diamond-Dybvig model and fiat currency helps individuals avoid trading frictions. As a result, currency has an advantage over other assets in terms of liquidity. This allows fiat money to be dominated in rate of return.

The timing of actions is as follows. In each period, there are two stages of transactions. As shown in Figure 1, banks accept deposits and make portfolio choices in the first stage:

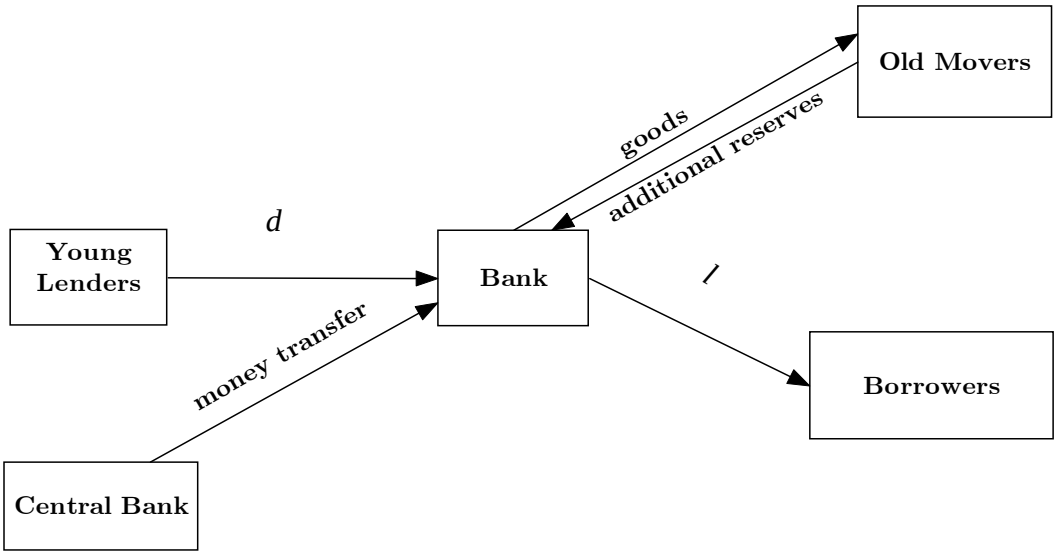

Figure 1: Banks' Portfolios Choices

At the initial stage of date t, banks post the schedule of interest rates (r_t^m for movers and r_t^n for nonmovers) to be offered in the deposit market. In turn, young lenders deposit d_t units of goods. Furthermore, banks receive currency reserves through money transfers from the monetary authority at the rate σM_{t-1}. Given funds received, banks choose the amount of currency reserves (m_t). Additional money balances can be obtained by trading deposits for fiat money with relocated old agents. Banks use the remaining amount of deposits to issue loans (l_t^s) to young borrowers in the credit market.

In the second-stage, financial intermediaries pay non-movers with the income generated from the credit market. These transactions are illustrated in Figure 2:

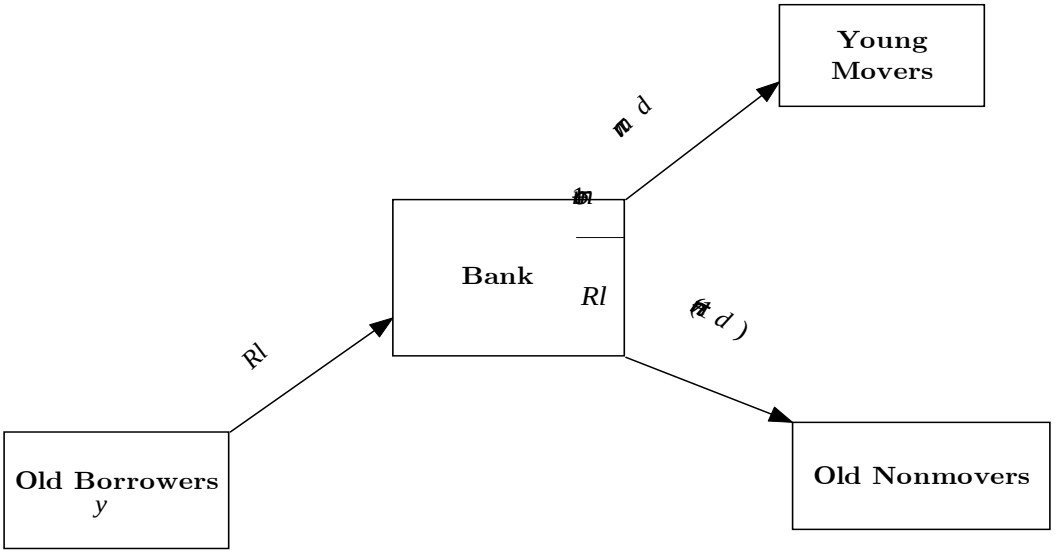

Figure 2: Repayment of Loans

After banks allocate deposits between money and loans, old borrowers receive their endowments. Due to their obligations in the credit market, borrowers must pay back their loans along with interest to the bank. Banks use these funds to finance payments to old non-movers. At the end of period t, the relocation shock occurs. Young relocated agents will go to the bank and withdraw currency. All old agents from the previous generation consume and die.

Next, we explain the behavior of each group of agents. We proceed by studying the impact of competition and the effect of monetary policy on credit market activity.

2.2 Depositors

Depositors are born with endowments but derive utility from consumption only in their old-age. Due to the relocation shock and limited communication across locations, these young individuals deposit all of their endowments in banks. The economy consists of young agents with unit mass and N identical financial intermediaries. Therefore, the amount of deposits for each bank is given by:

$$d = \frac{x}{N}$$

2.3 Borrowers

Borrowers receive endowments when old and do not experience liquidity shocks. Furthermore, they value consumption during their youth and old-age. In order to smooth

consumption, they seek to obtain loans (l_t^d) from the credit market. Given R_t as the real interest rate for each unit of loans, a borrower's objective is:

$$\underset{l_t^d}{Max} \ln(l_t^d) + \beta \ln(y - R_t l_t^d) \tag{2}$$

Therefore, individual loan demand is given by:

$$l_t^d = \frac{y}{(1+\beta)R_t} \tag{3}$$

Obviously, individual loan demand is inversely related to the price. When the endowment increases or the rate of time preference decreases, borrowers want to obtain more loans in order to smooth consumption. Furthermore, the total population of borrowers is equal to one in each location. Thus, the market loan demand (L_t) is the same as the individual loan demand.

2.4 Banks

Banks compete by offering rates of return to deposits. Since banks post prices to be paid according to withdrawal dates, they act as Bertrand competitors in the deposit market. In contrast, banks compete in the credit market by offering quantities of loans. That is, each bank recognizes that its own decisions about the amount of loans will affect the market interest rate, but that its choices do not affect those of any other bank. Moreover, from the perspective of each borrower, the loans offered by each bank are the same. In this manner, the price for each unit of loans will be the same across banks and the credit market is characterized by Cournot competition.

Due to price competition in the deposit market, intermediaries are Nash competitors; that is, banks announce rates of return, taking the announced rates of return of other banks as given. In equilibrium, price competition among banks for depositors will force banks to choose return schedules and portfolio allocations to maximize the expected utility of a representative depositor. As a result, a bank's objective is given by:

$$\underset{r_t^m, r_t^n, m_t, l_t^s}{Max} \pi \ln(r_t^m \frac{x}{N}) + (1-\pi) \ln(r_t^n \frac{x}{N}) \tag{4}$$

Banks use deposits to trade for currency reserves in the money market and issue loans in the credit market. Therefore, the bank's balance sheet constraint requires that:

$$m_t + l_t^s \leq \frac{x}{N} \tag{5}$$

Relocated agents cannot access their account in the other location due to limited communication. As a result, they must use fiat money to trade for goods. Thus, the payment to relocated individuals is given by the amount of reserves:

$$\pi r_t^m \frac{x}{N} \leq m_t \frac{p_t}{p_{t+1}} \tag{6}$$

Since movers receive payments at the end of their youth, it is also convenient to refer to r_t^m as the short-term interest rate in the economy.

Fiat money is dominated in rate of return. Therefore, intermediaries will never choose to carry excess balances between periods. As a result, the return to nonrelocated agents is obtained by loan payments in the credit market:

$$(1-\pi)r_t^n \frac{x}{N} \leq R_t \; l_t^s \tag{7}$$

Following the discussion for r_t^m, r_t^n represents the long-term interest rate on deposits.

In addition, if the return of relocated agents is more than the return of nonrelocated agents, all depositors would seek to withdraw their funds at the end of the current period. In order to prevent a liquidity crisis, the following self-selection constraint must also hold:

$$r_t^m \leq r_t^n \tag{8}$$

This constraint also reflects the requirement that money is dominated in rate of return.

Proposition 1. *Suppose the borrower's endowment is sufficiently high such that* $y \geq \frac{N(1-\pi)(1+\beta)x}{[N-(1-\pi)](1+\sigma)}$. *Under this condition, a steady-state equilibrium exists and is unique. Each bank competes by allocating funds to portfolios such that* $m = \left(\frac{N}{N-(1-\pi)}\right)\pi\frac{x}{N}$ and $l^s = \left(\frac{N-1}{N-(1-\pi)}\right)(1-\pi)\frac{x}{N}$.

As in the standard model with log preferences, the amount of money balances depends on the probability of the relocation shock and endowments, but is independent of the return to all types of assets. This occurs because the income and substitution effects associated with the return to money offset eachother. Consequently, the supply of loans offered by each bank is also independent of monetary policy and the interest rate in the loan market.

When depositors are born with larger endowments, the total amount of deposits in the economy will be higher. Thus, each bank has more funds to allocate to cash reserves and loans. Furthermore, depositors are risk averse. If the fraction of movers is higher, individuals want to receive more insurance against liquidity risk. In order to maximize the expected utility of depositors, banks will hold more money balances and issue less loans.

Notably, each bank's portfolio allocation depends on the degree of financial competition (N). The terms $\left(\frac{N}{N-(1-\pi)}\right)$ and $\left(\frac{N-1}{N-(1-\pi)}\right)$ reflect the *fractions* of deposits that are allocated to reserves and loans respectively. When the banking sector is more competitive, the level of distortions decreases. As a result, given deposits received, each bank is willing to increase the amount of loans but decrease the amount of currency reserves.

However, an increase in competition leads to a lower amount of deposits per bank ($\frac{x}{N}$). Thus, less funds are allocated to currency reserves and loans. Moreover, the effect of financial competition on the amount of deposits dominates the effect of competition from less market power. In this manner, a higher degree of competition

causes the amount of money balances and loans on each bank's balance sheet to decrease.

At this point, we show that imperfectly competitive banks use deposits received to acquire more reserves and issue less loans compared to perfectly competitive banks. Therefore, a lower degree of competition leads to more insurance in the deposit market, but less consumption smoothing in the credit market. In a perfectly competitive banking economy, currency reserves and loans only depend on the probability of the relocation shock and deposits that each bank receives. The amount of consumption insurance is equal to the fraction π of deposits while the amount of loans is equal to the fraction $1-\pi$ of deposits.

Based upon banks' portfolio allocations and the assumption that all intermediaries are identical, the market price and the aggregate quantity of loans in the credit market are:

$$R = \left(\frac{N-(1-\pi)}{N-1}\right)\frac{y}{(1-\pi)(1+\beta)x} \tag{9}$$

$$L = \left(\frac{N-1}{N-(1-\pi)}\right)(1-\pi)x \tag{10}$$

Interest rates and the amount of loans are independent of monetary policy. This occurs because each bank's portfolio allocations do not depend upon the rate of return to money and borrowers are not subject to the relocation shock. However, the degree of tractability in the benchmark model yields clear insights about the impact of financial competition.

Lemma 1. *An increase in competition leads to a higher aggregate volume of loans and lower interest rate in the credit market.*

The effect of banking competition on the credit market can be seen by considering the terms $\left(\frac{N-(1-\pi)}{N-1}\right)$ and $\left(\frac{N-1}{N-(1-\pi)}\right)$ on the expressions of price and quantity respectively. As in the standard Cournot model, market supply is higher when there are more firms. Similarly, as there are more banks in operation, the amount of loans will increase. This results in a lower interest rate in the credit market.

The following corollary characterizes the interest rate and amount of lending in a perfectly competitive economy.

Corollary 1. *In a perfectly competitive economy, the price and quantity of loans are given by* $R_{pc} = \frac{y}{(1-\pi)(1+\beta)x}$ *and* $L_{pc} = (1-\pi)x$ *respectively.*

Banks in an imperfectly competitive economy can exploit their market power by issuing less loans and holding more reserves. In contrast, when the economy is characterized by perfect competition, banks take the interest rate on loans as given. As a result, the amount of loans is high and the interest rate is low compared to an economy under imperfect competition in the financial sector.

Next, consider rates of return in the deposit market. Payments to movers are limited by the return to money, the probability of relocation shock, and the degree

of distortion of banks' reserves. In steady-state equilibrium, it is easy to show that the short-term interest rate can be expressed as:

$$r^m = \left(\frac{N}{N-(1-\pi)}\right)\frac{1}{(1+\sigma)} \tag{11}$$

Money is dominated in rate of return but it is the only medium of exchange at the other location. Therefore, currency reserves are only used to pay movers. When the growth rate of money increases, the value of fiat money decreases. Consequently, the short-term deposit rate is lower. Furthermore, if the banking sector is more competitive, each bank issues more loans. This implies that banks hold less money balances. As a result, the return to relocated agents is lower when there is more financial competition.

Notably, the effect of monetary policy on the short-term interest rate depends upon the degree of financial competition. When the economy consists of more banks, each bank issues more loans and holds less currency reserves. Monetary policy only affects the rate of return to fiat money. *Moreover, the effect of monetary policy on the short-term deposit rate is weaker in more competitive banking sectors.* This takes place banks in a system that is highly concentrated provide a large amount of insurance against liquidity risk.

In contrast to the return to movers, payments to nonmovers depend on the fraction of relocated agents, the amount of endowments, and the rate of time preference. The rate of return to nonrelocated agents in the steady-state is:

$$r^n = \frac{y}{(1-\pi)(1+\beta)x} = R_{pc} \tag{12}$$

Interestingly, the long-term interest rate is the same as the price of loans in a perfectly competitive economy. This occurs since the distortion in the credit market affects the market price and the amount of loans in banks' portfolios in different ways. When the level of competition increases, the level of distortions decreases. As a result, the interest rate in the credit market is lower while the amount of loans is higher. However, the impact of competition on the market price of loans is offset by the the effect of competition on quantity. In this manner, the long-term interest rate on deposits is independent of the degree of financial competition.

Since monetary policy only affects the short-term interest rate on deposits in this setting, the primary role of the central bank is to encourage risk sharing. That is, monetary policy can affect deposit market performance, but it cannot influence credit market outcomes. Moreover, as mentioned above, central banks will have less influence on deposit market activity in highly competitive financial systems. *Optimal* monetary policy is the money growth rate in which movers and non-movers receive the same rate of return. As monetary policy has less impact in competitive banking systems, the money growth rate that achieves complete risk sharing must be lower in economies with a larger number of banks.

Under equilibrium entry, there is greater scope for monetary policy to affect financial market activity. We turn to this possibility immediately below.

2.5 Non-Cooperative Behavior and the Endogenous Degree of Banking Competition

To understand how the degree of banking competition can be endogenized, it is useful to continue to recognize that there are two different financial markets – a deposit market and a credit market. Depositors are born with endowments while borrowers do not have any income in their youth. As described by Bencivenga and Smith (1991), we allow for depositors to act as cooperative entities that are able to coalesce and pool their funds to form a risk-pooling financial intermediary. However, following Williamson (1986), there are fixed costs in the amount F that are required to set-up a bank. Alternatively, F could represent the income they would earn from a fixed storage technology rather than establishing an intermediary. In this sense, F reflects the opportunity cost of bank entry.

Based upon this interpretation, one can determine the number of banks that are active in the credit market through an equilibrium entry condition. That is, under endogenous entry, depositors have incentives to establish more banks if they can obtain more surplus from establishing an intermediary. Each intermediary acts as a Cournot-competitor in the credit market. If the depositors were risk-neutral, they would establish intermediaries until their incomes raised from participating in financial markets were exhausted by the costs of entry, F. However, depositors in our model are risk-averse and make decisions based upon expected utility. Thus, the free entry condition depends on depositors' logarithmic preferences as follows:

$$\pi \ln(r^m \frac{x}{N}) + (1-\pi)\ln(r^n \frac{x}{N}) = \ln(F) \tag{13}$$

In equilibrium, the number of financial institutions will be such that depositors' expected utility from establishing banks will be equal to the lost utility from establishing a bank, $ln(F)$.

As an example, we consider the equilibrium number of banks as provided by the following lemma:

Lemma 2. *Suppose the probability of a liquidity shock is equal to 1/2. As a result, the equilibrium number of firms is given by:*

$$N = \frac{1 + \sqrt{1 + \frac{32xy}{F^2(1+\beta)(1+\sigma)}}}{4} \tag{14}$$

Interestingly, the relative population of depositors is equal to 1/2 of the population. However, the equilibrium number of firms will be higher than the relative population of depositors. This reflects the additional income to be earned from issuing loans to borrowers. For example, if borrowers will have higher levels of income, they will choose to borrow more. This drives the income from lending higher and

encourages more firm entry into the banking system. By comparison, higher entry costs (or barriers to entry) drive down the number of firms and lead to increased concentration.

Notably, monetary policy also has a significant impact on the degree of competition. Thus, we offer the following observation:

Corollary 2. *Higher inflation discourages bank entry. Consequently, monetary growth leads to a lower amount of loans and a higher interest rate in the credit market. The effects of inflation on credit market activity will be more severe as barriers to entry are higher.*

Interestingly, higher inflation not only decreases the return to money but exacerbates the degree of distortions in the credit market. This occurs because an increase in the growth rate of money results in a lower short-term interest rate in the deposit market. Since inflation interferes with the ability of banks to provide risk pooling services, a smaller number of banks will be established. Consequently, interest rates in the credit market will be higher and there will be a lower volume of lending activity.

At this point, we have established two different channels for monetary policy to affect financial market activity. In the model with fixed entry, inflation lowers the return to money. In addition, under equilibrium entry, inflation leads to less credit market activity as it will be more difficult to provide risk-sharing and there will be less banks in operation. That is, the mechanism by which policy affects credit funding dervies from the risk-pooling role of intermediaries under equilibrium entry. If the barriers to entry were lower, the negative effects of inflation through incentives for firms to enter the sector would be mitigated.

3 Conclusions

In recent years, the competitive landscape of the banking system in many countries has changed in fundamental ways. The global financial crisis, in particular, has contributed towards an increasingly concentrated financial system. Moreover, barriers to entry are often blamed for the lack of competition in the sector. In order to address these issues, this paper studies the impact of strategic interactions among financial institutions in a model with money. We incorporate imperfectly competitive behavior by considering that banks compete in terms of the amount of loans they issue. Under fixed entry, by construction, monetary policy only affects the rate of return to money. However, the social benefits and costs of the degree of concentration are easily understood in terms of trade-offs between risk sharing and consumption smoothing over time by borrowers. By comparison, under endogenous entry, as inflation affects the ability of banks to insure depositors against liquidity risk, monetary growth discourages bank entry and leads to higher costs of loans.

In this manner, we introduce an important transmission channel in which inflation obstructs financial market activity. Furthermore, the detrimental effects of inflation

are exacerbated in economies with high barriers to entry in the banking sector. Interestingly, most of the discussion about entry barriers among policymakers focuses on the implications for credit markets without addressing how barriers to entry interfere with standard monetary policy transmission channels. Failing to acknowledge this dimension is likely to lead to misguided public policy. Should such barriers be eased, the negative effects of inflation through incentives for firms to enter the sector would be lower. Therefore, the role of inflation to promote credit activity through standard Tobin-type asset substitution channels would be considerably more effective.

4 Appendix

1. The profit-maximization choices of banks in the presence of non-cooperative behavior.

Due to price competition in the deposit market, banks allocate funds and set interest rates to maximize the expected utility of a representative depositor. The objective problem is:

$$\underset{r_t^m, r_t^n, m_t, l_t^s}{Max} \pi \ln(r_t^m \frac{x}{N}) + (1-\pi)\ln(r_t^n \frac{x}{N})$$

subject to:

$$m_t + l_t^s \leq \frac{x}{N}$$

$$\pi r_t^m \frac{x}{N} \leq m_t \frac{p_t}{p_{t+1}}$$

$$(1-\pi) r_t^n \frac{x}{N} \leq R_t l_t^s$$

Money is dominated in the rate of return. Furthermore, all constraints are binding. Therefore, we can solve for r_t^m and r_t^n as a function of money balances (m_t) and the amount of loans (l_t^s) respectively. As a result, the objective problem becomes:

$$\underset{m_t, l_t^s}{Max} \pi \ln(\frac{m_t}{\pi}\frac{p_t}{p_{t+1}}) + (1-\pi)\ln(\frac{R_t l_t^s}{(1-\pi)})$$

By using the balance sheet constraint, $m_t = \frac{x}{N} - l_t^s$. Thus, we can write the profit function as:

$$\underset{l_t^s}{Max} \pi \ln(\left[\frac{(\frac{x}{N} - l_t^s)}{\pi}.\frac{p_t}{p_{t+1}}\right] + (1-\pi)\ln(\frac{R_t l_t^s}{(1-\pi)})$$

Upon using the loan demand function and substituting the price of loans into the objective function of the bank:

$$\underset{l_t^s}{Max} \pi \ln(\left[\frac{(\frac{x}{N} - l_t^s)}{\pi}.\frac{p_t}{p_{t+1}}\right] + (1-\pi)\ln(\frac{y l_t^s}{(1-\pi)(1+\beta)L})$$

We take the first derivative with respect to l_t^s and assume that all banks are symmetric. Therefore, each bank issues loans such that:

$$l_t^s = \left[\frac{(N-1)}{N-(1-\pi)}\right](1-\pi)\frac{x}{N}$$

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