“The Role of Financial Sector Competition for Monetary Policy”*

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January 2010

Abstract

In this paper, we examine the impact of competition in the banking industry on financial market activity. In particular, we explore this issue in a setting where banks simultaneously insure individuals against liquidity risk and offer loans to promote intertemporal consumption smoothing. In addition, spatial separation and private information generate a transactions role for money.

Interestingly, we demonstrate that the industrial organization of the financial system bears significant implications for the effects of monetary policy. Under perfect competition, higher rates of money growth lead to lower interest rates and a higher volume of lending activity. In contrast, in a monopoly banking sector, money growth restricts the availability of funds and raises the cost of borrowing.

JEL Classification: E43, E52, L11

Keywords: Monetary Policy, Financial Sector Concentration, Price Competition

1 Introduction

Available evidence indicates that the degree of financial sector competition varies markedly across countries. For example, within the European Monetary Union, the financial industry in Greece and Belgium is highly concentrated

*We thank Stacey Schreft for detailed feedback on an earlier version of the manuscript. Seminar participants at the University of Missouri, the Midwest Economic Theory Meetings at the University of Kansas, and the Federal Reserve Bank of Atlanta provided valuable comments.

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though France and Germany have been much less so. This is likely due to the fact that the United States, a number of studies have documented that there are large differences in the degree of concentration in local markets. While the degree of concentration differs across economies, there is also concern that the industry has generally been becoming less competitive over time. For example, there were around 19,000 different financial institutions in the United States in 1989. Nearly ten years later, only 10,000 were in operation. Furthermore, due to the recent financial crisis, the trend has obviously accelerated.

In light of these observations, this paper examines the likely impact of the competitive structure of the banking industry on financial market outcomes. In particular, we explore the impact of competition in a framework where banks simultaneously insure individuals against liquidity risk and offer loans to promote intertemporal consumption smoothing. Spatial separation and limited communication generate a transactions role for money. Interestingly, we demonstrate that the industrial organization of the banking system bears significant implications for the effects of monetary policy. Under perfect competition, higher rates of money growth lead to lower interest rates in credit markets and a higher amount of loans. In stark contrast, in a monopoly banking economy, money growth restricts the availability of funds and raises the cost of borrowing.

Consequently, our results imply that the industrial organization of the financial system should be an important factor in the determination of monetary policy. Notably, the findings for the monopolistic economy mirror recent empirical studies which emphasize that inflation generally inhibits financial sector performance. For example, Boyd, Levine, and Smith (2001) point out that the volume of lending to the private sector is lower in high inflation countries. This suggests that noncompetitive behavior is a significant aspect of financial market activity.

In order to provide deeper insight into the results, we proceed by outlining the details of our model. In particular, there are two types of agents who value different opportunities to smooth consumption. The first group of agents, depositors, experience liquidity risk and wish to smooth income fluctuations across states. As in Diamond and Dybvig (1983), financial institutions provide risk pooling services to help insure individuals against such risk. The second...
group of agents, borrowers, do not experience liquidity risk. However, loans from banks help them to smooth consumption over time. Thus, the economy is composed of two different financial markets: a deposit market and a credit market. As we demonstrate, there are important linkages between the two markets. Notably, pricing decisions in the deposit market affect the availability of funds in the credit market.

Following Schreft and Smith (1997), the economy consists of two geographically separated islands and communication across islands is not possible. This friction limits trading opportunities so that private liabilities do not circulate. In the economy, liquidity risk is motivated by relocation shocks which force individuals to move to the other island. Since money is the only asset that can be traded across locations, depositors who experience positive realizations of the relocation shock will seek to withdraw funds in the form of money balances. These individuals will consume less than depositors who do not move because money is dominated in rate of return. Nevertheless, banks must acquire money holdings in order to provide individuals with insurance against the liquidity risk that they encounter.

As a benchmark, we study the effects of money growth if the banking sector is perfectly competitive. Under perfect competition, banks provide depositors with an amount of insurance to maximize their expected utility. In terms of credit market activity, a type of Tobin effect occurs. At higher rates of money growth, the costs of holding money increase. As a result, banks choose to reduce the liquidity of their portfolios and supply more loans to the credit market. In turn, interest rates are lower.

Next, we study the behavior of a monopoly bank. Since the monopolist seeks to maximize profits, it only provides enough insurance to induce individuals to deposit their funds. Thus, market power imposes a pricing distortion in the deposit market. Consequently, the effects of monetary policy are significantly different than in a perfectly competitive financial system. At higher inflation rates, individuals who experience relocation shocks would receive a lower

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8 Antinolfi and Kawamura (2008) discuss the relative importance of banks versus other types of financial markets for monetary policy. While banks help insure individuals against liquidity risk, financial markets allow banks to insure themselves against risks from investment opportunities.

9 In the United States, both Berger and Hannan (1989) and Neumark and Sharpe (1992) find that monopolistic banks exercise their influence by distorting prices. To be specific, Berger and Hannan observe that banks in markets with higher concentration pay lower rates on deposits. In contrast, Neumark and Sharpe point out that concentration is associated with asymmetric price rigidities – banks generally pay higher rates of return when market rates increase, but monopolistic banks adjust them more slowly. In contrast, downward price adjustments are much more flexible.

10 In contrast to imperfections from market power, Bhattacharya, Haslag, and Martin (2005) study the implications of private information for optimal monetary policy. Due to the friction of moral hazard, the Friedman Rule may not be the optimal monetary policy.
rate of return. In order to provide depositors with sufficient insurance, banks acquire additional money balances. The increase in money holdings reduces the availability of funds to borrowers. Moreover, interest rates are higher. In this manner, the competitive structure of the financial system has important ramifications for the effects of monetary policy.

Related Literature

Our work contributes to a growing literature that investigates the economic impact of the industrial organization of the financial system. To begin, Boyd, DeNicolo, and Smith (2004) construct an overlapping generations model with aggregate liquidity risk to study how competition affects the probability of a banking crisis. If the inflation rate is sufficiently high, banking crises are more likely to occur in a monopolistic banking system. In addition, Paal, Smith, and Wang (2005) develop an endogenous growth model to study the impact of financial competition on economic growth. Interestingly, they point out that banking concentration may be growth-enhancing.11

While our research seeks to determine how banking competition affects financial market activity, there are important differences compared to previous work on the topic. For example, in Boyd, DeNicolo, and Smith, banks face an exogenous rate of return to investment projects. However, our framework incorporates a credit market in which the interest rate and volume of lending activity respond to the competitive structure of the financial system. Moreover, the impact of monetary policy depends on the degree of competition in significant ways.

Our work also contrasts with Paal, Smith, and Wang. Although their production economy generates an endogenous rate of return to investment, financial institutions provide different services compared to our model. Both papers consider the role of banks for providing insurance against liquidity risk, but Paal, Smith, and Wang view that financial institutions act as intermediaries which channel funds to promote capital accumulation and growth. By comparison, we emphasize that banks are important institutions which provide risk pooling services and intertemporal consumption smoothing. Notably, we show that pricing decisions in the deposit market can affect economic activity in the credit market. In doing so, we can further examine how monetary policy interacts with the competitive structure of the financial system. The results are qualitatively significant – frictions from monopoly power may be responsible for the detrimental impact of inflation on credit market activity observed in the empirical literature. In addition, we study the impact of monetary policy in economies where the government’s seigniorage revenues are redistributed to individuals in the private sector.

11Pagano (1993) shows that market concentration has an adverse effect on economic growth. As a result of the higher rate on loans, Guzman (2000) finds that default is more likely to occur in an economy with a monopolistic banking industry.
The paper is organized as follows. Section 2 describes the economic environment. Section 3 studies activity in a perfectly competitive banking system. Section 4 considers the impact of monetary policy in a monopolistic banking sector. Section 5 extends the model to examine the impact of monetary policy in economies where the government’s seigniorage revenues are redistributed to agents in the private sector. Section 6 provides concluding remarks. The proofs of major results are provided in the Appendix.

2 Environment

We consider a discrete-time economy populated by an infinite sequence of two-period lived overlapping generations, plus an initial old generation. In particular, the economy consists of two symmetric, geographically separated islands. On each island, there are three types of agents: depositors, borrowers, and bankers. While the population of both depositors and borrowers is equal to one, the population of bankers is given by \( N \). The competitive structure of the financial system depends on the population of bankers. If \( N = 1 \), there is only one bank available to individuals. In contrast, if \( N > 1 \), the banking industry behaves in a perfectly competitive manner. Although the population resides in two separate locations, there is a single consumption good available on both islands. The price of one unit of goods in units of currency is common across locations and is defined by \( \pi \).

Each depositor is born with \( x \) units of the consumption good but does not receive an endowment when old. In addition, depositors only derive utility from old-age consumption, \( c_2 \), with preferences \( u(c_2) = \frac{c_2^{1-\theta}}{1-\theta} \), where \( \theta \in (0,1) \) is the coefficient of risk aversion. In contrast to depositors, borrowers receive \( y \) units of the consumption good when old. Moreover, borrowers derive utility from consumption in both periods of their lives. The lifetime utility function of borrowers is expressed by:

\[
U(c_1, c_2) = c_1^{1-\eta} + \beta^{1-\eta} c_2^{1-\eta}
\]

Finally, bankers do not have any endowments. Like depositors, they only value second period consumption. However, bankers are risk neutral.\(^{12}\)

Private information serves as the primary trade friction in the economy. Although each island is characterized by complete information, communication across islands is not possible. Consequently, private liabilities do not circulate. Moreover, depositors in the economy are subject to relocation shocks. Each period, a fraction of young depositors must move to the other island. The probability of relocation, \( \pi \), is exogenous, publicly known, and the same in each island. Unlike depositors, borrowers are not subject to relocation.

As in standard random relocation models, money alleviates trade frictions made difficult by spatial separation. In particular, it is the only asset that can

\(^{12}\)If the banking system is fully concentrated, the monopoly bank earns positive profits. Since bankers derive utility in the second period, they retain their net revenues for consumption. This follows Boyd, De Nicolo, and Smith (2004) and Paal, Smith, and Wang (2005).
cross locations. Since money is the only asset that can cross locations, depositors who learn they will be relocated will liquidate all their asset holdings into currency. Random relocation thus plays the same role that liquidity preference shocks perform in Diamond and Dybvig (1983).

Banks provide two major services in the economy. First, they insure depositors against liquidity shocks. Since banks provide insurance against the shocks, each young depositor will put all of her income in the bank. Second, as borrowers value consumption in both periods of their lives, financial intermediaries provide them with an opportunity to smooth their consumption by issuing loans. In this manner, banks offer a schedule of rates of return for each unit of deposits and charge interest rates for each unit of loans. With deposits received, banks allocate funds to real money balances, \( m_t \), and loans, \( l_t \).

The final agent in the economy is a central bank that adopts a constant money growth rule. The total nominal amount of money in each location at time \( t \) is given by \( M_t \). The evolution of the money supply on each island follows \( M_t = \sigma M_{t-1} \), where \( \sigma \) is the gross rate of money creation. Money holdings by each old individual from the initial generation are equal to \( M_0 \).

Next, we describe the timing of events and actions. At the initial stage of date \( t \), young depositors receive their endowments and banks announce the schedule of interest rates (\( \rho^m_t \) if relocated and \( \rho^n_t \) if not relocated). Given interest rates in the deposit market, young depositors leave their \( d_t \) units of goods at local banks. With deposits received, banks choose portfolio allocations between money and loans. The amount of cash that banks acquire comes from two sources. First, money balances can be obtained by conducting trades with old movers. In particular, banks provide movers with \( \frac{M_{t-1}}{P_t} \) units of goods in exchange for their currency holdings. Furthermore, financial institutions receive additional currency through monetary injections from the government. With the remaining funds, banks issue loans to young borrowers.

After bank portfolios for the current period are established, 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 depositors or consume them directly as profits. At the end of period \( t \), young depositors learn their location status. Those who must move will go to the bank and withdraw currency. At the end of the period, relocation occurs and all old agents consume and die.\(^{13}\)

We continue by explaining the behavior of each group of individuals.\(^{13}\)

\(^{13}\)In our benchmark framework, we assume that the government retains its seigniorage revenues. In this manner, inflation tax revenues do not affect asset allocation decisions. This follows Paal, Smith, and Wang (2005). However, in Section 5 below, we extend the model to include inflation-financed government debt. Consequently, seigniorage revenues will be redistributed from old movers to old non-movers. That is, inflation taxes redistribute income across different groups of depositors.
2.1 Depositors

Depositors are born with endowments but derive utility from consumption only in their old-age. In absence of financial intermediation, agents do not have access to financial markets. For instance, one can assume that high transactions costs prevent agents from investing in credit and money markets. Denote the expected utility received in absence of banks (financial autarky) by $u$. Clearly, depositors are willing to intermediate their savings if they receive at least $u$.

2.2 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 financial institutions. As $R_t$ represents the real interest rate for each unit of loans, a borrower’s objective is:

$$\max_{l_t^d} \left( \frac{l_t^d}{1-\theta} \right)^{1-\theta} + \beta \frac{(y-R_t l_t^d)^{1-\theta}}{1-\theta}$$

Therefore, individual loan demand is given by:

$$l_t^d = \frac{y}{(\beta R_t)^{\theta} + R_t}$$

Borrowers’ loan demand functions have standard properties. For example, an individual’s demand for funds is inversely related to the cost of borrowing. If agents obtain higher levels of income in old-age, they will borrow more. In contrast, if borrowers place more weight on old-age utility, the demand for loans will fall.

Depending on the degree of competition, banks will provide different levels of insurance against liquidity risk. As a result, the demand for money balances in the economy will be influenced by the industrial organization of the financial system. In turn, financial sector competition will determine the availability of funds to the credit market. Furthermore, through these features of financial market activity, we are able to demonstrate that market power leads to different effects of monetary policy.

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14 Mulligan and Sala-i-Martin (2000) point out that around 60 percent of households in the United States did not hold interest-bearing financial assets in 1989. Additionally, Beck et. al (2008) contend that high transactions costs such as bank fees even prevent people from using banks in many countries.

15 As agents do not have access to credit and money markets in autarky, these markets are closed. Thus, financial autarky is characterized by a primitive financial system. Since goods are perishable, we can easily modify the model to allow agents to transport their goods to the other location. However, a significant fraction of the goods perish along the way (transportation costs) leading to a very low return. In this manner, the expected utility in autarky is a function of parameters in the economy. Further, when financial markets open in the presence of financial intermediaries, the transportation technology becomes obsolete as it is dominated in rate of return. Modifying the environment to account for these issues is straightforward but has no implications on the results of the paper. Instead, we assume that financial autarky generates an exogenous expected utility $u$. 

3  Perfectly Competitive Banks

In a perfectly competitive banking industry, banks compete against each other for deposits. Intermediaries are Nash competitors; that is, banks announce rates of return \( r_i^m, r_i^n \), taking the announced rates of return of other banks as given. Then, each bank chooses a schedule \( (r_i^m, r_i^n, m_t, l_t) \) to maximize the expected utility of a representative depositor. A representative bank’s objective is:

\[
\max_{r_i^m, r_i^n, m_t, l_t} \pi \frac{(r_i^m x)^{1-\theta}}{1-\theta} + (1 - \pi) \frac{(r_i^n x)^{1-\theta}}{1-\theta}
\]

subject to a balance sheet constraint:

\[
x \geq m_t + l_t
\]

Relocated agents cannot access their account in the other location due to limited communication. As a result, they must use money to trade for goods. Therefore, the return to relocated individuals depends on the amount of reserves and inflation:

\[
\pi r_i^m x \leq m_t \frac{P_t}{P_{t+1}}
\]

In contrast, agents who do not move can keep their funds in the bank. The rate of return will be determined by the bank’s revenue from the credit market:

\[
(1 - \pi) r_i^n x \leq R_t l_t
\]

In addition, if the return of relocated agents is more than the return of nonrelocated agents, individuals will lie about their types. Consequently, they would all seek to withdraw deposits at the end of the period. For these reasons, the following self-selection constraint must also hold:

\[
r_i^m \leq r_i^n
\]

Finally, in order to induce individuals to deposit their funds, the expected utility of each depositor must satisfy a participation constraint. In particular, young depositors may choose not to participate in the financial system. Consequently, the expected utility from depositing funds must be higher than the autarky level \( u \):

\[
\frac{\pi (r_i^m x)^{1-\theta} + (1 - \pi) (r_i^n x)^{1-\theta}}{(1-\theta)} \geq u
\]

To maximize an individual’s expected utility, banks allocate funds to currency reserves such that:

\[
m_t = \frac{x}{1 + \frac{1 - \pi}{\pi} \left( R_t \frac{P_{t+1}}{P_t} \right)^{1-\theta}}
\]
As $\theta < 1$, the bank’s money demand function is decreasing in its return to investment opportunities. This occurs for the standard reasons in monetary models – higher rates of return to interest-bearing assets raise the opportunity cost of holding money. Similar arguments apply to the effects of inflation. At higher inflation rates, the value of real money balances will be lower. Consequently, each bank chooses to allocate less deposits to money holdings.

**Equilibrium** We proceed to examine economic outcomes in the steady-state. Given the monetary authority’s fixed money growth rule, the gross inflation rate, $\pi^{t+1}$, is equal to $\sigma$.

**Definition 1.** A steady-state equilibrium in a perfectly competitive banking industry is an economy such that:
1. depositors put all of their endowments in banks, (8);
2. each bank’s objective is to maximize the expected utility of a representative depositor, (3), and
3. the self-selection condition for depositors holds (7).

**Proposition 1.** Assume that $\nu$ is sufficiently small. In addition, suppose that the money growth rate and borrowers’ endowments are such that $\frac{\nu^t}{\nu} > \left((\beta\frac{1}{\tau})^{\hat{b}} + \frac{1}{\tau}\right)(1 - \pi)$. Under this condition, a steady-state equilibrium in a perfectly competitive banking sector exists and is unique.

To provide interpretation for the conditions in the Proposition, it is useful to recognize that we seek to study economies in which money is dominated in rate of return. Moreover, the economy should have an active banking sector. In this manner, the first condition guarantees that individuals deposit their savings at banks. In addition, the interest rate on loans will be higher if there is more demand by borrowers. This occurs if borrowers receive a large amount of income in old-age. As a result, the condition in Proposition 1 establishes that money is dominated by the rate of return in the credit market.

We continue by investigating the effect of monetary policy on credit market outcomes.

**Proposition 2.** Suppose that a steady-state under perfect competition exists. If this occurs, higher inflation leads to an increase in the amount of loans. Furthermore, there is a negative relationship between the growth rate of money and the interest rate in the credit market.

When inflation rates are higher, the cost of holding money increases. In order to maximize the expected utility of a representative depositor, perfectly competitive banks devote less funds to money balances. As a result, the amount of loans increases and interest rates in the credit market fall.
4 A Monopoly Bank

We now examine an economy in which the banking sector is fully concentrated. In our framework, monopoly power leads to two important considerations for financial market activity. First, because there is only one bank available to depositors, the monopolist is the only financial institution that provides insurance against liquidity risk in the economy. Second, as the monopolist is also the only supplier of credit, it takes into account that the amount of loans it offers will affect the interest rate in the credit market. Notably, money holdings and loans are the only two investment opportunities available to the bank. Consequently, the pricing distortions across financial markets are linked together. These distortions bear significant ramifications for the impact of monetary policy on credit market activity.

In the economy with a perfectly competitive financial system, each bank chooses its loan supply and interest rates in the deposit market to maximize the expected utility of depositors. That is, taking the price of loans in the credit market as given, perfectly competitive banks design portfolio allocations to appropriately insure depositors against liquidity risk. In contrast to perfectly competitive banks, the monopolist exploits market power by choosing loan supply and deposit rates in order to maximize profits. In particular, it sets a schedule \((r^m_t, r^n_t, m_t, l_t)\) to maximize profits:

\[
\max_{r^m_t, r^n_t, m_t, l_t} R_t(l_t) l_t + m_t \frac{P_t}{P_{t+1}} - \pi r^n_x - (1 - \pi) r^m_x
\]

where \(R_t(l_t)\) is in the inverse demand curve for loans from (2).

As in the economy with perfectly competitive banks, depositors must receive sufficient incentives to deposit funds in the bank. Since there is only one bank available, the monopolist can extract all of the gains from depositors who participate in the financial system. Therefore, it offers rates of return such that the expected utility from depositing funds is equal to the autarky level. As a result, the participation constraint in equation (8) is binding.

Because money is dominated in rate of return, the monopolist will only devote funds to money balances in order to make payments to depositors who experience relocation shocks. Consequently, monopoly profits come from excess credit market revenues after payments to nonrelocated depositors. Furthermore, substituting from the binding participation constraint (8), the bank’s problem reduces to choosing the amount of loans supply, \(l_t\), to maximize profits:

\[
\max_{l_t} R_t(l_t) l_t - (1 - \pi) r^n_x(l_t) x
\]

recognizing that the return to be offered to non-movers will depend on the amount of loans in the credit market.

In order to determine the impact of monetary policy under a fully concentrated banking sector, we proceed to study the economy’s steady-state:
Definition 2. A steady-state equilibrium in a fully concentrated banking sector is an economy such that:

1. depositors put all of their funds in an account at the bank, (8);
2. the bank chooses a schedule \((r^m, r^n, m, l)\) to maximize profits, (10);
3. the self-selection condition for depositors holds, (7), and
4. the bank earns positive profits.

Lemma 1. Define \(\hat{l} = x - \sigma \pi [(1 - \theta) \frac{1}{\omega}]^{\frac{1}{1-\sigma}}\). If \(l \geq \hat{l}\), then the participation and self-selection constraints for depositors will be satisfied.

The participation constraint requires that depositors must receive at least the autarkic level of expected utility in order for the monopolist to attract funds. Interestingly, the participation constraint can be written as a function of the interest rate "spread" between non-movers and movers:

\[
\frac{r^n}{r^m} = \left(\frac{(\sigma \pi)^{1-\theta}}{1 - \pi} \cdot \frac{(1 - \theta) \omega}{(x-l)^{1-\theta}} - \frac{\pi}{1 - \pi}\right)^{\frac{1}{1-\sigma}}
\]

From equation (12), it is easily observed that the interest rate spread consistent with participation by depositors depends on the amount of loans offered by banks. If the bank offers more loans, its money holdings would be lower. Therefore, the banks’ risk averse depositors would need to be guaranteed a higher rate of return if relocation does not occur in order to deposit their funds. Moreover, the monopoly bank would choose to issue more loans so that the self-selection constraint among depositors holds. Lemma 1 provides conditions in which both constraints are satisfied.

The profit-maximizing loan supply by the monopolist is such that the marginal revenue from issuing loans is equal to its marginal cost, denoted \(MR(l)\) and \(MC(l, \sigma)\) respectively:

\[
MR(l) \equiv \frac{\partial R}{\partial l} + R(l)
\]

\[
MC(l, \sigma) \equiv \frac{\pi^\theta}{(1 - \pi)^{\frac{\omega}{\sigma} \cdot \sigma^{1-\theta}}} \left(\frac{(1 - \theta) \omega}{(x-l)^{1-\theta}} - \frac{\pi^\theta}{\sigma^{1-\theta}}\right)^{\frac{\omega}{\sigma}}
\]

Since borrowers have diminishing marginal utility from consumption in their youth, the banks’ marginal revenue curve has the standard, downward-sloping behavior as a typical demand curve in a monopoly problem. From (14), higher amounts of loans raise the banks’ marginal cost of lending since the banks’ risk averse depositors would require a higher expected return when banks offer less insurance against liquidity risk. Further, it is easy to verify that the cost function is convex in \(l\). Because the revenue function is concave and the cost function is convex, the profit function must be concave in \(l\). Obviously, the total amount of deposits, \(x\) is the upper bound on the amount of loans that can be
issued, thus, \( \lim_{L \to x} MC = \infty \) and \( MC\left(\hat{i}, \sigma\right) = \frac{1}{\sigma} \). Please see Figure 1 below for a graph illustrating the profit-maximizing choice of the monopoly bank.\(^{16}\)

![Figure 1: Profit-Maximizing Lending by the Monopoly Bank](image)

Proposition 3 below establishes existence and uniqueness of a monetary steady-state in the monopoly banking economy:

**Proposition 3.** Suppose \( y \geq y \). Also let \( x > \bar{x} \), where \( y \) and \( \bar{x} \) are defined in the appendix. Under these conditions, a steady-state in the monopoly banking economy exists and is unique.

The first condition in Proposition 3 guarantees that the contract between depositors and the bank is incentive compatible and that money is dominated in rate of return. As discussed in Lemma 1, the relative return to non-movers is increasing with the level of lending. Furthermore, lending activity and interest rates are higher under a higher demand for loans (higher \( y \)). Consequently, when the demand for loans is relatively high, money is dominated in rate of return and the return to non-movers is at least as high as movers'.

The second condition in the proposition ensures that profits are positive in equilibrium. As discussed above, the profit function is concave in \( L \). Moreover, it can easily verified that profits are positive at \( \hat{l} \). Therefore, It is sufficient that the monopolist earns positive profits at \( L = x \). This happens if the bank’s portfolio is relatively large, \( x > \bar{x} \). Under this condition, profits are positive for all \( L \in [\hat{l}, x] \).

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\(^{16}\)In Figure 1, \( \hat{l} \) denotes the amount of loans where the marginal cost of lending is equal to zero.
**Proposition 4.** In a fully concentrated banking economy, monetary policy generates a reverse-Tobin effect. That is, an increase in the rate of money growth is associated with a lower amount of loans and higher interest rates in the credit market.

In contrast to perfectly competitive banks, a monopolist seeks to acquire additional cash reserves under higher inflation rates. For a given level of money holdings, an increase in the inflation rate reduces the return to movers. Since non-movers would earn a higher rate of return than depositors who experience liquidity shocks, higher rates of money growth provide the bank with an opportunity to further distort the credit market. That is, at higher rates of money growth, the bank can issue even less loans. Because the bank acquires more cash, movers will not experience a consumption loss from inflation.

Interestingly, our results demonstrate that the competitive structure of the financial system should be an important factor in the determination of monetary policy. If the financial sector is perfectly competitive, higher rates of money growth raise the cost of holding money and increase the supply of funds to the credit market. In contrast, in a monopoly system, money growth reduces the availability of credit.

5 An Economy with Government Debt

The preceding sections examine how the impact of monetary policy depends upon the industrial organization of the financial system. In economies where financial institutions have market power, pricing distortions can occur. As a result, the effects of monetary policy can be substantially different in economies where banks engage in non-competitive behavior.

In this section, we extend our analysis to consider the possibility of government debt. Following Schreft and Smith (1997), the government finances interest payments on previously issued debt through seigniorage revenues and new bonds. Accordingly, banks can acquire three different types of financial assets: money, loans to the private sector, and government bonds. In this manner, seigniorage revenues transfer income between depositors who experience different realizations of the relocation (i.e., liquidity) shock.

The primary purpose of this section is to illustrate that our previous insights are robust to the possibility of inflation-financed government debt. As a starting point, we focus on the case of a perfectly competitive financial system. The section concludes with some remarks about the effects of money growth in the presence of a monopoly bank.

Government bonds mature after one period and are default-free. In particular, one unit of goods held in bonds at \( t \) constitutes a sure claim to \( R_t^s \) units of
goods at $t + 1$.\footnote{Alternatively, one unit of bonds held in period $t$ yields $I_t$ units of currency in period $t + 1$. Thus, we can express the real return to bonds as $R^b_t = I_t \frac{P^*}{P_{t+1}}$.} In this setting, the government’s budget constraint becomes:

$$R^b_{t-1}b_{t-1} = \frac{M_t - M_{t-1}}{P_t} + b_t$$  \hspace{1cm} (15)$$

Since banks can allocate funds to an additional financial asset, a perfectly competitive bank’s balance sheet constraint is given by:

$$m_t + l_t + b_t \leq x$$  \hspace{1cm} (16)$$

Furthermore, payments made to non-movers are made out of the return on loans and government debt. Thus,

$$(1 - \pi) r^p_t x \leq R_t l_t + R^b_t b_t$$  \hspace{1cm} (17)$$

Banks issue loans and acquire government bonds until both types of investments yield the same rate of return. That is, a no-arbitrage condition must hold:

$$R_t = R^b_t$$  \hspace{1cm} (18)$$

Finally, the demand for cash reserves is the same as Section 3.

The following Lemma considers the steady-state impact of monetary policy in the economy with government debt:

**Proposition 5.** Suppose $\theta = \frac{1}{2}$ and $\sigma > 1 + \left(\frac{1}{1-\sigma}\right)^{\frac{1}{2}}$. Under these conditions, a steady-state in a perfectly competitive banking economy exists in the presence of government debt. Furthermore, lending activity increases and interest rates in the credit market decrease at higher rates of money growth.

Notably, Proposition 5 provides sufficient conditions under which the effects of money growth from Section 3 extend to the possibility of government debt. In Section 3, inflation raises the cost of holding money and leads banks to issue more loans to borrowers. If the government issues bonds, seigniorage revenues provide the government with the ability to borrow funds and crowd out loans to the private sector. However, if the government imposes a higher inflation tax, the seigniorage tax base falls because banks reduce their money holdings. Consequently, this restricts the ability to issue more bonds at higher inflation rates. As a result, the impact of monetary policy is qualitatively the same as Section 3.

We proceed to examine an economy with a monopoly bank. Specifically, we focus on steady-state equilibria. The bank’s problem is identical to that in the previous section except that it makes additional revenue from holding government bonds. Substituting from the binding constraints, the monopolist solves the following problem:
subject to (7), (8), and (15). For tractability, we assume that the bank takes the actions by the government in the bond market as given. Thus, the monopolist lends funds to the private and public sectors to the point where both investments yield the same return at the margin. That is:

\[ MR(l) = R^b \] (19)

In the following Lemma, we establish existence and uniqueness of a steady-state monetary equilibrium in a monopolistic banking sector:

**Proposition 6.** Suppose the conditions in Proposition 3 hold. Under these conditions, a steady-state equilibrium in an economy with a monopoly bank and inflation-financed government debt exists and is unique.

For a given amount of lending, the cost of issuing more loans is higher in the presence of government debt. This occurs because the bank holds less cash reserves in order to acquire government bonds. From this perspective, government debt crowds out private credit market activity. Due to the lower amount of loans, interest rates are higher than the case where \( b = 0 \). It easily follows that money is dominated in rate of return when the first condition in Proposition 3 holds. In the Appendix, it is also evident that the self selection constraint holds if the conditions in Proposition 3 are satisfied.

As in the previous section, the monopolist’s profit function is concave in \( l \). Therefore, it is sufficient for profits to be positive at \( l = x \) as profits are positive at \( l \). This occurs if the second condition in Proposition 3 holds.

Finally, we proceed to examine the effects of monetary policy. Using analogous reasoning, introducing government debt reinforces the effects of monetary policy on credit market activity in a concentrated financial system. Due to the pricing distortions in the deposit market, a monopoly bank acquires more money balances and issues less loans if money growth is higher. Since money holdings increase, the seigniorage tax base is also higher, allowing the government to supply more bonds. Therefore, at higher rates of money growth, the crowding out effect becomes more significant. In this manner, our results are robust to the possibility of inflation-financed government debt. Moreover, inflation-financed government debt exacerbates distortions in the financial sector from monopoly power.

6 Conclusions

Recent evidence indicates that the competitive structure of the financial system varies both within and across countries. In order to explore the impact of competition in the financial sector, we compare financial market outcomes from a perfectly competitive banking system to a monopolistic banking sector. In
our framework, banks provide two different types of financial services. In the deposit market, banks insure individuals against liquidity risk. Alternatively, in the credit market, financial institutions offer loans so that agents can smooth consumption over time. Notably, pricing decisions across markets affect overall financial market outcomes. For example, under perfect competition, higher rates of money growth generate an increase in lending along with lower costs of borrowing. However, in a monopoly banking sector, money growth reduces the amount of loans and raises interest rates. Interestingly, the latter prediction echoes recent empirical studies which emphasize that inflation adversely affects financial sector performance. In this manner, our results suggest that noncompetitive behavior is a significant aspect of activity in the financial system. These insights are important to consider in light of recent consolidation activity in the financial sector across the world.
References


7 Technical Appendix

1. Proof of Proposition 1. Using a typical bank’s balance sheet, (4) and the demand for cash reserves, (9), the supply of loans in the steady-state is expressed by:

\[ l^* = (1 - \gamma (R, \sigma)) x \]  

(20)

where \( \gamma \) is the fraction of deposits allocated to real money balances, with \( \gamma (R, \sigma) = \frac{\omega}{\eta} \). The steady-state behavior of the economy is characterized by the equilibrium in the loan market. That is, the intersection of the demand and supply of loans, (2) and (20), respectively.

First, it is clear that \( \frac{\partial l^*}{\partial x} > 0 \) while \( \frac{\partial l^*}{\partial \sigma} < 0 \). Furthermore, \( \lim_{R \to \infty} l^* \to \infty \) and \( \lim_{R \to \infty} l^d \to 0 \). Consequently, a steady-state where money is dominated in rate of return exists and is unique if at \( R = \frac{1}{\eta} \), the loan market is in excess demand. Evaluating the credit market at \( R = \frac{1}{\eta} \), an excess demand occurs when the condition in Proposition 1 is satisfied. This completes the proof of Proposition 1.

2. Proof of Proposition 2. From the loan market clearing condition we have:

\[ \frac{y}{(\beta R)^{\frac{1}{2}} + R} = (1 - \gamma (R, \sigma)) x \]

Taking the derivative with respect to \( \sigma \):

\[ \frac{\partial R}{\partial \sigma} = \frac{\frac{\partial l^*}{\partial \sigma}}{\frac{y}{x} R^{\frac{1}{2}} + R} \left[ (\beta R)^{\frac{1}{2}} + R \right] - \frac{\partial l^*}{\partial \sigma} < 0 \]

Furthermore, it is easy to verify that banks supply more loans under higher rates of money growth, for a given \( R \). Consequently, lending activity rises and real interest rates fall under higher \( \sigma \). This completes the proof of Proposition 2.

3. Proof of Lemma 1. The proof follows directly from (12). Specifically, the self-selection constraint holds if \( \frac{\sigma}{\eta} \geq 1 \). This happens if \( l \geq x - \sigma \pi [(1 - \theta) x^{\frac{1}{2}} - \frac{1}{x}] = \bar{l} \). This completes the proof of Lemma 1.

4. Proof of Proposition 3. The equilibrium amount of loans, \( l^* \) must satisfy \( l^* \geq \bar{l} \) for the self-selection constraint to hold. This requires that \( MC \left( \bar{l}, \sigma \right) \leq MR \left( \bar{l} \right) \) where \( \bar{l} \) is defined in the text. Using the expression for \( \bar{l} \), \( MC \left( \bar{l}, \sigma \right) = \frac{1}{x} \). By comparison, using (2), \( MR \left( \bar{l} \right) \) is given by:
\[ MR(\hat{i}) = -\frac{y}{1 + \frac{1}{\sigma} \beta \hat{\pi} R(\hat{i})^{\frac{1}{1-\pi}}} + R(\hat{i}) \]

Consequently, \( l^* \geq \hat{i} \) if:

\[ -\frac{y}{1 + \frac{1}{\sigma} \beta \hat{\pi} R(\hat{i})^{\frac{1}{1-\pi}}} + R(\hat{i}) \geq \frac{1}{\sigma} \tag{21} \]

Interestingly, this condition also guarantees that \( R^* \geq \frac{1}{\sigma} \) because \( MC(\hat{i}, \sigma) = \frac{y}{\sigma} \) and \( l^* \geq \hat{i} \). Condition (21) can be written in terms of \( \pi \).

Finally, we need to make sure that in equilibrium, the monopolist makes positive profits. As demonstrated in the text, the profit function is concave in \( l \). It is easily verified that profits are positive at \( l = \bar{l} = x - \alpha \pi \left( \frac{(1-\theta)}{\pi} \right)^{\frac{1}{1-\pi}} \cdot y \).

Under this condition, profits are always positive for all \( l \in \left[ \bar{l}, x \right] \). Equivalently, we can re-write this condition in terms of \( x \). As \( R \) is strictly decreasing in \( x \), we can define \( \bar{x} \) such that (22) holds with equality. Thus, when the second condition in Proposition 3 holds, equilibrium profits are positive. This completes the proof of Proposition 3.

5. Proof of Proposition 4. It is clear from (13) and (14) that inflation only enters the cost function. Taking the partial derivative of (14) with respect to \( \sigma \) and some simplifying algebra yields

\[ \frac{(1-\pi)^{\frac{1}{1-\pi}}}{\pi^{\frac{1}{1-\pi}} \alpha^{1-\theta - \pi^\theta}} \frac{\partial MC(l, \sigma)}{\partial \sigma} = -\frac{(1-\theta)^2}{\pi \cdot \sigma^{1-\theta} + \pi^\theta} \]

The marginal cost curve increases if \( \left( \frac{(1-\theta)^2}{\pi \cdot \sigma^{1-\theta} + \pi^\theta} \right)^{\frac{1}{1-\theta}} \cdot \pi < x - l \). Define \( \bar{l} = x - \left( \frac{(1-\theta)^2}{\pi \cdot \sigma^{1-\theta} + \pi^\theta} \right)^{\frac{1}{1-\theta}} \cdot \pi \) at which \( \frac{\partial MC(l, \sigma)}{\partial \sigma} = 0 \). It is clear that for all \( l \leq \bar{l} \), \( \frac{\partial MC(l, \sigma)}{\partial \sigma} \geq 0 \).
and for all \( l > \bar{l} \), \( \frac{\partial MC(l, \sigma)}{\partial \sigma} < 0 \). Thus, the marginal cost curve rotates clockwise around \( \bar{l} \).

Monetary policy impedes credit markets if \( l^* < \bar{l} \). This happens if \( MC(\bar{l}, \sigma) > MR(\bar{l}) \). Under this condition, equilibrium lending is less than \( \bar{l} \). Upon substituting for the expression of \( \bar{l} \) in (13) and (14). This condition can be written as:

\[
\frac{1}{\sigma} \left( \frac{1-\pi}{(1-\pi)(1-\sigma)} \right) \frac{\partial l}{\partial \sigma} > -\frac{\pi}{(1+\frac{\theta}{R(l)(1-\sigma)})} + R(\bar{l}) = MR(\bar{l})
\]

by previous work, \( MR \) is strictly decreasing in \( l \). Further, \( \frac{d\bar{l}}{dx} = 1 \). Therefore, define \( x_1 \) such that \( MC(\bar{l}, \sigma) = MR(\bar{l}) \). Then for all \( x > x_1 \), \( MC(\bar{l}, \sigma) > MR(\bar{l}) \). The result can be summarized as follows. For all \( x > \max(x_1, x_2) \), marginal cost increases with \( \sigma \) and therefore, the monopolist reduces the amount of lending.

This completes the proof of Proposition 4.

6. Proof of Proposition 5. Using the government budget constraint, (15), and a typical bank’s balance sheet, (16), the total supply of loans by banks can be expressed by:

\[
l^* = \left( 1 - \frac{\sigma - 1}{\sigma} \frac{1}{(R - 1)} \right) x
\]

Moreover, taking the derivative with respect to \( R \):

\[
(R - 1) \frac{1}{x} \frac{\partial l^*}{\partial R} = \left[ \frac{\sigma - 1}{\sigma (R - 1)} \right] \gamma (R, \sigma) - \frac{\partial \gamma}{\partial R} \left[ R - 1 \right] > 0
\]

In this manner, the supply of loans is strictly increasing in \( R \) for \( \sigma > 1 \).

Next we differentiate the supply of loans with respect to \( \sigma \), at a given \( R \), to obtain:

\[
\sigma^2 \frac{R - 1}{\gamma} \frac{1}{x} \frac{\partial l^*}{\partial \sigma} = -1 + [R \sigma - 1] \frac{1 - \theta}{\theta} (1 - \gamma)
\]

The sign of \( \frac{\partial l^*}{\partial \sigma} \) depends on the sign of the term on the right hand side of the equation. In particular, banks supply more loans under higher rates of money growth if:

\[
[R \sigma - 1] (1 - \gamma) > \frac{\theta}{1 - \theta}
\]

Substituting the expression for \( \gamma \) and letting \( \theta = 0.5 \), this condition can be written as:

\[
I^2 - 2I - \frac{\pi}{1 - \pi} > 0
\]

where \( I = R \sigma \).

Clearly, if \( I > 1 + \sqrt{\frac{1}{1-\pi}} \), banks supply more loans under higher rates of money growth. However, since we are interested in cases where \( I > \sigma > 1 \)
(equivalently, \( R > 1 \)), a sufficient condition for a Tobin effect is that \( \sigma > 1 + \sqrt{\frac{1}{1-\rho}} \). This completes the proof of Proposition 5.

7. Proof of Proposition 6. As in the previous section, using (5) and (8), the return to non-movers exceeds that of movers if \( m \leq \sigma \pi [(1-\theta)u + b] \). Equivalently, \( l^* \geq \hat{l}_1 = x - \sigma \pi [(1-\theta)u + b] \). Clearly \( \hat{l}_1 < \hat{l} \) because \( b > 0 \) in equilibrium. The bank’s problem is:

\[
M_{ax} R(l) l + R^b b - (1-\pi) \frac{\pi^\theta}{(1-\pi)^{\pi \sigma^{1-\theta}}} (1-\theta)u - \frac{\pi^\theta}{\sigma^{1-\theta}} (x-l-b)^{1-\theta}
\]

The first order condition with respect to \( l \):

\[
MR(l) = \frac{\pi^\theta}{(1-\pi)^{\pi \sigma^{1-\theta}}} \left( \frac{(1-\theta)u}{(x-l-b)^{1-\theta}} - \frac{\pi^\theta}{\sigma^{1-\theta}} \right)^{\theta} \equiv MC^b(l, \sigma)
\]  

(23)

Similarly, the first order condition with respect to \( b \):

\[
R^b = \frac{\pi^\theta}{(1-\pi)^{\pi \sigma^{1-\theta}}} \left( \frac{(1-\theta)u}{(x-l-b)^{1-\theta}} - \frac{\pi^\theta}{\sigma^{1-\theta}} \right)^{\theta}
\]  

(24)

where \( MR(l) \) is the marginal revenue function of issuing loans in the presence of government debt, which is identical to that in the previous section, (13).

Combining (23) and (24), we get the no-arbitrage condition in (19). Moreover, using (15) in the steady-state and (19) into (23), the profit maximizing choice of loans becomes:

\[
MR(l) = \frac{\pi^\theta}{(1-\pi)^{\pi \sigma^{1-\theta}}} \left( \frac{(1-\theta)u}{ \left( 1 + \frac{1}{R^b} \right)^{1-\theta}} - \frac{\pi^\theta}{\sigma^{1-\theta}} \right)^{\theta} \equiv MC^b(l, \sigma)
\]  

(25)

where \( MC^b(l, \sigma) \) is the marginal cost of issuing loans in the presence of government debt.

It is easily verified that \( MC^b \left( \hat{l}_1, \sigma \right) = \frac{1}{\sigma} \) and \( \frac{\partial MC^b (l, \sigma)}{\partial l} > 0 \) because \( R^b = MR(l) \), with \( MR'(l) < 0 \). In addition, for a given amount of loans, \( MC^b(l, \sigma) > MC(l, \sigma) \). This is true because the term \( \left( 1 + \frac{1}{R^b} \right)^{1-\theta} \) is positive when \( R^b > 1 \). Therefore, equilibrium lending is lower since government debt crowds out private credit.

The incentive compatibility constraint holds in equilibrium if \( MR \left( \hat{l}_1 \right) > MC \left( \hat{l}_1, \sigma \right) \). It is clear that \( MC^b \left( \hat{l}_1, \sigma \right) = MC \left( \hat{l}_1, \sigma \right) = \frac{1}{\sigma} \). Further, \( MR \left( \hat{l}_1 \right) > \)
MR(\hat{l})$ because $\hat{l}_1 < \hat{l}$. Consequently, if the incentive compatibility constraint is satisfied in an economy without public debt, it must hold when $b > 0$. That is, $MR(\hat{l}_1) > MC^b(\hat{l}_1, \sigma)$ if $MR(\hat{l}) > MC(\hat{l}, \sigma)$. In this manner, money is also dominated in rate of return.

It is easily verified that profits are positive at $\hat{l}_1$. Thus, because the profit function is concave, it is sufficient to examine profits at $l = x$. The profit function is identical to that in the previous section because $\beta = 0$ when $\lambda = \lambda_0$. Thus, the same condition for positive profits derived in the proof of proposition 3 holds in this section as well. This completes the proof of Proposition 6.

8. Effects of Monetary Policy in an Economy with Government Debt and a Monopoly Bank. As in the previous section, the rate of money creation has a direct impact only on the cost of issuing loans. Partially differentiating the marginal cost curve from (25) to obtain:

$$\frac{(1 - \pi) \theta}{\pi^2} \frac{\partial MC^b(l, \sigma)}{\partial \sigma} \sigma^2 = \left(1 + \frac{\theta R^b \sigma}{R^b - 1}\right) \frac{1 - \theta}{(x - l)^{1 - \theta}} - \frac{\theta R^b \sigma - 1}{R^b - 1} \frac{1 - \theta}{(x - l)^{1 - \theta}} - \frac{\theta}{(x - l)^{1 - \theta}}$$

The marginal cost of issuing loans increases under a higher rate of money growth if:

$$\left(1 - \frac{\theta}{\pi R^b}\right) \frac{1 - \theta}{(x - l)^{1 - \theta}} < \frac{\theta}{(x - l)^{1 - \theta}}$$

It is easy to verify that the term on the left-hand side of (27) is strictly increasing in $l$. Consequently, define $x_2$ such that the above holds with equality. In this manner, as in the previous section without government debt, the marginal cost curve rotates clockwise around $x_2$. A higher rate of money creation adversely affects lending activity if $MC^b(\hat{l}_1, \sigma) > MR(\hat{l}_1)$. This guarantees that $l^* < \hat{l}_1$, and thus is in the range where $MC^b$ increases with $\sigma$. We know that $MR' (l) < 0$ and $\frac{\partial MC^b(l, \sigma)}{\partial l} > 0$. Moreover, from (27) it is clear that $\frac{d\theta}{dx} > 0$ because the term on the left-hand side of (27) is strictly decreasing (increasing) in $x$ ($l$). From this standpoint, define $x_2$ such that $MC(\hat{l}_1, \sigma) = MR(\hat{l}_1)$, with $MC(\hat{l}_1, \sigma) > MR(\hat{l}_1)$ for all $x > x_2$. Suppose $x > max(x_0, x_2)$. Under this condition, monetary policy generates a reverse-Tobin effect in an economy with a monopoly bank and government debt. This completes the proof.