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Abstract

Recent events in financial markets have led to a substantial decline in the number of financial institutions, which may affect the extent of financial competition. What are the implications of such outcome on the degree of risk sharing, asset markets, and monetary policy? In order to answer these questions, I develop a two-sector monetary growth in which money and financial institutions play important roles. Compared to a perfectly competitive financial sector, I demonstrate that imperfect competition in deposits and capital markets can have substantial adverse consequences on capital formation, assets prices, and the degree of risk sharing. More importantly, market power in financial markets may overturn the Tobin effect present under a perfectly competitive financial sector. This necessarily happens in economies with high degrees of liquidity risk and low levels of capital formation.

JEL Codes: O42, D42, E52, G21

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1 Introduction

The financial sector in general and the banking sector in particular around the globe have been subject to the a large wave of consolidations in the past three decades.¹ Recent events in financial markets have only served to speed up this process in the United States and Europe.² As the number of financial

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¹FDIC statistics point out that the number of commercial banks has declined by 50% between 1990 and 2009 in the United States. Berger et al. (1999) provide an overview of consolidations in the financial sector for the United States and Europe between 1984 and 1997. Recent work by Amel et al. (2004) points out to a similar trend in most industrial countries.

²For instance, FDIC data indicate that 168 banks failed between 2008 and 2009 in the United States. In addition, there were around 400 mergers over that same period.

institutions declines, the degree of competition may be altered, which raises concerns of policy makers. Specifically, this trend in financial markets raises two primary questions: How does financial sector competition (or lack of it) affect capital markets and the amount of insurance provided by the banking sector? More importantly, does imperfect financial competition have any implications for monetary policy? The second question is of significant importance because the effects of monetary policy hinge on the way the banking sector reacts to price changes.³ If banks are price setters in financial markets, they might behave differently relative to a competitive banking sector.

The objective of this manuscript is to develop a framework that is capable of addressing these issues. In particular, I examine a two-period overlapping generations economy that has two production sectors: a capital goods sector and a consumer goods sector. The economy is inhabited by three types of agents: capital producers, depositors, and bankers. Following Townsend (1987), agents are born on one of two geographically separated locations or islands. Private information and limited communication prevent credit from flowing across islands. Money overcomes these trade frictions and it is the only asset that can cross locations. Furthermore, there is a government that adopts a constant money growth rule and rebates its seigniorage income to young depositors in the form of lump-sum transfers.

After trade takes place, a fraction of young depositors is randomly chosen to relocate to the other location. Because money is the only asset that can cross locations, agents must liquidate all their belongings into currency.⁴ As in Schreft and Smith (1997), financial intermediaries or bankers completely diversify idiosyncratic shocks. Therefore, all savings are intermediated.⁵ In addition to holding cash reserves, banks purchase capital goods, which they rent to consumer goods firms in the subsequent period.

As a benchmark, I assume that banks enter competitively in deposits and capital markets. Thus, they make their portfolio choice to maximize the expected utility of their depositors. Under a technical condition, a steady state exists and is unique. Additionally, a higher rate of money creation promotes capital formation. Intuitively, inflation raises depositors' savings through higher transfers, which expands banks' ability to invest in asset markets. The higher demand for new equipment raises their price and lowers their yield.

I proceed to answer the questions raised above. In order to do so, I study the behavior of an economy in which the banking sector is fully concentrated.⁶ In contrast to previous work such as Williamson (1986), the bank has market power in both deposit and capital markets. In this manner, the banker extracts

³Concentration in the financial sector can also have important consequences on financial and economic stability. This issue has been extensively examined in the literature. Allen and Gale (2004) and Boyd and De Nicoló (2005) provide a nice overview of the literature.

⁴Random relocation shocks are analogous to liquidity preference shocks in Diamond and Dybvig (1983).

⁵This necessarily happens because banking services are costless to access.

⁶I follow Boyd, De Nicoló, and Smith (2004) by comparing two economies. The first economy has $N > 1$ bankers that engage in price competition in deposits and capital markets. The second economy has one banker that has market power in financial markets.

all surplus from deposit markets. Further, the bank is a monopsonist in the market for new equipment and a monopolist in the rental market for capital.

If banks have market power in financial markets, they have an incentive to restrict investment activity to lower asset prices and raise the return from capital. Therefore, an imperfectly competitive financial sector can have significant adverse consequences on capital markets. Additionally, market power in the market for deposits can lead to a low level of insurance against liquidity risk relative to a competitive banking sector. As I demonstrate in the text, this necessarily happens when the level of total factor productivity is below some threshold level.

Moreover, market power in banking is a source of indeterminacy of equilibria. In particular, there can be either a unique steady-state or two steady-states. Specifically, multiple steady-states arise when agents' degree of exposure to liquidity risk is significant. Because market power can lead to multiplicity of equilibria, the economy is subject to poverty traps. That is, the economy could end up with a significantly low level of investment and inefficiently low asset prices.

In contrast to the economy with a perfectly competitive banking sector, the effects of monetary policy depend on the degree of liquidity risk in the economy and the extent of economic development. When the banking sector is concentrated, inflation affects the economy through two primary channels. First, a higher rate of money creation raises deposits through higher transfers. This enables the bank to expand its portfolio and to increase capital investment.

Furthermore, inflation affects the amount of insurance the bank is willing to provide. In particular, a higher rate of money growth reduces the return to relocated agents. Because the banker extracts all the surplus from deposit markets, a higher inflation rate encourages him to hold a more liquid portfolio. Therefore, inflation hampers capital formation through this channel.

When the need for liquidity is not too significant, the steady-state is unique and the impact of inflation through government rebates dominates. Consequently, a higher rate of money creation raises investment activity as under a perfectly banking system. The higher amount of capital formation raises the price of capital and reduces its rental rate. Therefore, inflation adversely affects the return to capital.

By comparison, two steady-states may exist when the degree of liquidity risk is significant. In the steady-state with a high capital stock, the return to capital is relatively low and the bank is allocating a large fraction of its deposits into capital investment. More importantly, the banker is providing a good amount of insurance against relocation shocks. As the bank is holding a highly illiquid portfolio, it is able to avoid the inflation tax by receiving transfers from the government. Consequently, inflation raises the level of investment in physical capital.

Conversely, when the level of capital formation is small, the bank is holding a highly liquid portfolio to insure its depositors against liquidity risk. Despite that, the bank is providing its depositors with a very low level insurance. Consequently, a higher rate of money creation causes the bank to allocate more

resources towards cash reserves and less into capital. In this manner, inflation also causes asset prices to decline and the return to capital to increase.

Interestingly, the results in this manuscript are consistent with recent empirical evidence that finds an asymmetric relationship between inflation and economic activity. In particular, if a significant correlation between the level of output and inflation is found, it is positive in industrialized countries and negative in less developed economies.^{7,8} This work provides an interesting explanation to these correlations in the data. The effects of monetary policy vary across countries because of differences in the extent of financial competition, individuals' degree of exposure to liquidity risk, and the level of income.

Related Literature

A large literature examines the impact of banking competition on financial market activity.⁹ However, only very few papers study its implications for monetary policy. For example, using an overlapping-generations endowment economy, Williamson (1986) demonstrates that monetary policy is not superneutral when banks have market power. In particular, inflation promotes credit market activity. While banks have market power in credit markets, deposit markets are perfectly competitive in his setting.

By comparison, Boyd et al. (2004) consider an environment in which financial intermediaries provide risk sharing services to their depositors. Their primary focus is on the effects of the industrial organization of banks on liquidity crises. They demonstrate that banking crises are more likely to occur under a perfectly competitive financial system in high inflation environments. In contrast to Williamson (1986), banks have market power in deposit markets. However, banks face an exogenous rate of return to investment projects.

Furthermore, Paal et al. (2005) develop a one sector monetary growth model to study the impact of banking competition on economic growth. As in Boyd et al. (2004), banks have market power in deposit markets. However, capital markets are perfectly competitive. In such a setting, profit maximizing banks seek to economize on cash holdings because it is dominated in rate of return - a growth enhancing effect. In addition, market power in deposits market has adverse consequences on savings and growth. While the effects of market power on growth are ambiguous, their model always predicts the presence of a Tobin effect.

My work is also related to a recent study by Ghossoub, Laosuthi, and Reed (2010). Ghossoub et al. (2010) demonstrate that monetary policy can exhibit

⁷See for example the work by Bullard and Keating (1995), Ahmed and Rogers (2000), Bae and Ralti (2000), Crosby and Otto (2000), and Rapach (2003).

⁸In a recent study, Ghossoub and Reed (2009) demonstrate that the effects of monetary policy vary with the level of economic development. Specifically, they highlight the importance of liquidity risk in the formulation of monetary policy. However, their work does not examine the interaction between financial competition and monetary policy.

⁹Previous work includes Petersen and Rajan (1995), Deyoung et al. (1999), Cetorelli and Gambera (2001), Focarelli and Panetta (2003), Beck et al (2004), Berger et al (2004), Bonaccorsi and Dell'Araccia (2004), Demirguc-Kunt et al. (2004), and Deidda and Fattouh (2008).

a reverse-Tobin effect under a monopolist banking system. As in Williamson (1986), they consider an endowment economy and focus on credit market activity.

In contrast to the previous studies discussed above, I develop a two-sector production economy in which banks have market power in both deposits and capital markets. This renders the bank a multi-product monopolist, which has important consequences for economic activity and monetary policy. In particular, I demonstrate that simultaneous market power in deposit and capital markets can be a source of multiplicity of equilibria and may give rise to development traps. Furthermore, inflation can have significant adverse effects in economies with high degrees of liquidity risk and low levels of development.

The paper is organized as follows. In Section 2, I describe the model and examine the outcome in each production sector and explain the behavior of depositors. Section 3 studies an economy with a perfectly competitive banking sector. By comparison, I analyze an economy with a fully concentrated banking sector in Section 4. I offer concluding remarks in Section 5. Most of the technical details are presented in the Appendix.

2 Environment

Consider a discrete-time economy with two geographically separated locations or islands. Each location is populated by an infinite sequence of two-period lived overlapping generations. Let $t = 1, 2, \dots, \infty$, index time. Within each generation, there are three types of agents: workers (potential depositors), capital goods producers, and bankers. At the beginning of each time period, a continuum of workers and capital goods producers is born on each island. The population of each group of agents is equal to one. By comparison, there are $N \geq 1$ bankers.

Workers and bankers are assumed to derive utility from consuming the economy's single consumption good when old, c_t . In contrast, capital goods producers only value young age consumption. The preferences of a typical worker and capital goods producer are expressed by $u(c_t) = \ln c_t$.¹⁰ Furthermore, bankers are assumed to be risk neutral.

Agents have no physical endowments. However, workers and capital goods producers are born with one unit of labor effort. Because there is no disutility from labor, workers supply their labor inelastically when young and are retired when old. In contrast, young capital goods producers do not trade their labor effort. Unlike other agents, bankers have no endowments.

The consumption good is produced by a representative firm using capital and labor as inputs. The production function is of the Cobb-Douglas form, with $Y_t = AK_t^\alpha L_t^{1-\alpha}$, where Y_t , K_t , and L_t are period t aggregate output, capital stock, and labor, respectively. In addition, A is a technology parameter and $\alpha \in (0, 1)$ reflects capital intensity. Equivalently, output per worker is expressed by $y_t = Ak_t^\alpha$, with $k_t = \frac{K_t}{L_t}$ is the capital labor ratio. Further, I assume that the capital stock depreciates completely in the production process.

¹⁰The results in this manuscript hold under general types of preferences.

Capital is produced in the following manner. In period t , each young capital goods producer uses her own labor, l_t and consumption goods to produce next period's capital stock, k_{t+1} . Following Abel (2003), $k_{t+1} = ai_t^\rho l_t^{1-\rho}$, where $a > 0$ denotes the level of productivity in the capital sector, i_t is investment per capital goods producer, and ρ is the investment share in capital production.¹¹ Clearly, if $a = \rho = 1$, the production of capital goods becomes identical to that in a one sector model with complete depreciation. Specifically, one unit of foregone consumption generates one unit of new capital.

There are two types of assets in this economy: money (fiat currency) and physical capital. Denote the per worker nominal monetary base by M_t . At the initial date 0, the generation of old workers at each location is endowed with the aggregate capital, K_0 and money supply, M_0 . Since the population of workers is equal to one, these variables also represent aggregate values. Assuming that the price level is common across locations, I refer to P_t as the number of units of currency per unit of goods at time t .

Moreover, workers in the economy are subject to relocation shocks. After exchange occurs in the first period, a fraction of agents is randomly chosen to relocate. The probability of relocation, π , is public information and the same in each location. Because the population of workers is unity, the probability of relocation also reflects the number of relocated agents (movers).

Limited communication and spatial separation make trade difficult between locations. For example agents cannot use checks or debit cards to consume if they move because they lose contact with their home island. As in standard random relocation models, fiat money alleviates these trade frictions. Further, it is the only asset that can be carried across islands.¹²

Since money is the only asset that can cross locations, workers 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). In addition, it provides a fundamental role for financial intermediation. In this manner, bankers serve two primary purposes in the economy. First, they insure workers against random relocation shocks. Additionally, they invest in asset markets. In contrast to workers, capital goods producers and bankers are not subject to relocation shocks.

The final agent in this economy is a government (or central bank) that adopts a constant money growth rule. The evolution of real money balances, m , between periods $t - 1$ and t is expressed as:

$$m_t = \sigma \frac{P_{t-1}}{P_t} m_{t-1} \quad (1)$$

where $\sigma > 1$ is the gross rate of money creation chosen at the beginning of time and $\frac{P_{t-1}}{P_t}$ is the gross rate of return on money balances between period $t - 1$ and

¹¹In Abel (2003), capital goods producers use capital and consumption goods as inputs. Incorporating capital into the production of capital does not change the primary results of the paper.

¹²Money is universally recognizable, durable and divisible object. Moreover, it is costless to carry across locations.

t . The government rebates back seigniorage income to young workers. Denote the amount of transfers at the beginning of period t by τ_t , where

$$\tau_t = \frac{\sigma - 1}{\sigma} m_t \quad (2)$$

2.1 Trade

2.2 Factors Markets

In period t , a representative firm rents capital and hires workers in perfectly competitive factor markets at rates r_t and w_t , respectively. The inverse demands for labor and capital by a typical firm are expressed by

$$w_t = (1 - \alpha) A k_t^\alpha = w(k_t) \quad (3)$$

and

$$r_t = \alpha A k_t^{\alpha-1} \quad (4)$$

2.3 A Capital Goods Producers' Problem

At the beginning of period t , each capital goods producer uses her own labor, l_t and chooses the amount of investment, i_t to maximize profits, Π_t^e . Each unit of capital produced is sold to banks in exchange for q_t units of goods in perfectly competitive markets.¹³ A typical capital goods producer's problem is summarized by:

$$\Pi_t^e = \underset{i_t}{\text{Max}} q_t k_{t+1} - i_t \quad (5)$$

subject to

$$k_{t+1} = a i_t^\rho \quad (6)$$

The profit maximizing choice of investment is such that:

$$q_t a \rho i_t^{\rho-1} = 1 \quad (7)$$

where $a \rho i_t^{\rho-1} q_t$ is the additional revenue from investing one unit of goods in capital production, which is equal to its marginal cost. The marginal cost is simply one unit of foregone consumption.

Using (6) and (7), the total amount of new equipment produced in period t is

¹³Note that a capital goods producer has no resources prior to the production of capital. That is, before trade takes place in period t . Therefore, she cannot buy inputs before selling the capital goods. Capital goods are delivered in the subsequent period. In this manner, a capital goods producer cannot produce and rent capital directly to firms because she does not have the resources to do so. Moreover, profits are earned in period t after which all markets close.

$$k_{t+1} = a^{\frac{1}{1-\rho}} (\rho q_t)^{\frac{\rho}{1-\rho}} \quad (8)$$

Clearly, capital goods producers supply more units of capital at a higher price. Equivalently, the inverse supply of new equipment can be expressed as:

$$q_t = \frac{1}{\rho a^{\frac{\rho}{1-\rho}}} k_{t+1}^{\frac{1-\rho}{\rho}} \quad (9)$$

Finally, by substituting the profit maximizing choice of inputs, (8) into the profit function, equilibrium profits are given by:

$$\Pi_t^e = (1 - \rho) \rho^{\frac{\rho}{1-\rho}} (a q_t)^{\frac{1}{1-\rho}} \quad (10)$$

Capital goods producers generate profits in equilibrium because they use their own labor effort. Equivalently, Π_t^e is the real wage a capital goods producer earns for working in the production of capital goods. All profits are consumed at the end of period t . Further, profits are strictly increasing in the price of new equipment or the stock of capital.¹⁴

2.4 Workers

Workers are identical ex-ante. In period t , a worker earns the real wage rate, w_t , which is entirely saved. In absence of financial intermediaries, agents do not have access to financial markets. For instance, one can assume that high transactions costs prevent agents from investing in capital and money markets.¹⁵ Denote the expected utility received in absence of banks (financial autarky) by \underline{u} .¹⁶ Thus, workers are willing to participate in financial markets only if they receive at least \underline{u} .¹⁷ Under this condition, they deposit all their savings at banks.

¹⁴Because labor effort of capital goods producers is not traded, one does not have to worry about them pretending to be workers. This is true because labor types are public information and perfectly verifiable.

¹⁵Mulligan 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.

¹⁶As workers do not have access to capital and money markets in autarky, these markets are closed. Thus, financial autarky is characterized by an endowment economy. One can easily modify the environment by endowing young workers with x units of goods. In such a primitive financial system, agents can transport their goods to the other location. However, a significant fraction of the goods perish along the way (transportation cost) 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. In this manner, modifying the environment to account for these issues is straightforward but has no implications on the results of the paper. Instead, I assume that financial autarky generates an exogenous expected utility \underline{u} . For a model of endogenous formation of financial institutions, please refer to Greenwood and Smith (1997).

¹⁷In this setting, financial intermediaries are costless to establish and to access. Therefore, it is easy to verify that financial intermediation always dominates direct investment in equilibrium.

3 Perfectly Competitive Bankers

In this section, I suppose that the banking sector behaves in a perfectly competitive manner. Because bankers are Bertrand competitors, perfect competition occurs when the number of banks exceeds unity, $N > 1$.

In this economy, banks play an important role in capital markets. First, banks are demanders of new equipment in primary capital markets. In addition, banks supply capital to firms in the secondary market or rental market.

At the beginning of period t , each banker announces deposit rates. A bank promises a gross real return on deposits, r_t^m if a young individual is relocated and a gross real return r_t^n if not. Rates of return are chosen such that depositors participate in the banking sector. That is, the following participation constraint must hold:

$$\pi \ln r_t^m (w(k_t) + \tau_t) + (1 - \pi) \ln r_t^n (w(k_t) + \tau_t) \geq \underline{u} \quad (11)$$

A bank's portfolio choice in period t , involves determining the amount of real money balances, m_t and the amount of capital to purchase, k_{t+1} . A typical bank's balance sheet is expressed by:

$$w(k_t) + \tau_t = m_t + q_t k_{t+1} \quad (12)$$

Because agents' types are publicly observable, banks are able to offer deposits contracts that are contingent on the realization of the shock. As relocated agents need cash to transact, total payments made to movers, satisfy:

$$\pi r_t^m (w(k_t) + \tau_t) = m_t \frac{P_t}{P_{t+1}} \quad (13)$$

Finally, I choose to study equilibria in which money is dominated in rate of return. Therefore, banks will not hold excess reserves. A bank's total payments to non-movers are therefore paid out of its revenue from renting capital to firms in $t + 1$. The constraint on payments to non-movers is such that:

$$(1 - \pi) r_t^n (w(k_t) + \tau_t) = r_{t+1} k_{t+1} \quad (14)$$

Due to perfect competition, banks make zero profits in equilibrium and make their portfolio choice to maximize the expected utility of their depositors. A typical bank's problem is summarized by

$$\underset{r_t^m, r_t^n, m_t, k_{t+1}}{Max} \quad \pi \ln r_t^m (w(k_t) + \tau_t) + (1 - \pi) \ln r_t^n (w(k_t) + \tau_t) \quad (15)$$

subject to (11)-(14).

The solution to the bank's problem generates the demand for real money balances:

$$m_t = \pi (w(k_t) + \tau_t) \quad (16)$$

Alternatively,

$$\gamma_t = \frac{m_t}{(w(k_t) + \tau_t)} = \pi \quad (17)$$

where γ_t is the reserves to deposits ratio.

Due to logarithmic preferences, banks allocate a constant fraction of their deposits into cash reserves. That is, the demand for cash reserves does not depend on the return to different assets. This occurs because the income and substitution effects from different rates of returns changes exactly offset each other.

Furthermore, using (12) and (16), the quantity of new equipment demanded by banks is inversely related to its price,

$$q_t k_{t+1} = (1 - \pi)(w(k_t) + \tau_t) \quad (18)$$

Finally, using (12) and (16) in (13) and (14), the equilibrium rates of return to different types of depositors are:

$$r_t^m = \frac{P_t}{P_{t+1}} \quad (19)$$

and

$$r_t^n = \frac{r_{t+1}}{q_t} = R_t \quad (20)$$

where R_t is the net gross real return on capital purchased in period t and rented in period $t + 1$. Equivalently, the relative return to depositors is:

$$\frac{r_t^n}{r_t^m} = R_t \frac{P_{t+1}}{P_t} \quad (21)$$

3.1 General Equilibrium

I proceed to characterize the equilibrium for the economy with perfectly competitive banks. Equilibrium is characterized by a set of non-negative quantities, (y_t, k_{t+1}, L_t, m_t) and prices, $\left(\frac{P_t}{P_{t+1}}, r_{t+1}, w_t, q_t\right)$ that clear output, capital, labor, and money markets.

In equilibrium labor receives its marginal product, (3), and the labor market clears, with $L_t = 1$. Substituting (2), (3), and (9) into (18) generates the equilibrium law of motion for capital:

$$k_{t+1} = \left(\frac{1}{1 + \frac{\pi}{\sigma(1-\pi)}} (1 - \alpha) \rho a^{\frac{1}{\rho}} A \right)^\rho k_t^{\alpha\rho} \equiv \Psi(k_t) \quad (22)$$

Furthermore, from (1), (3), and (16), equilibrium in the money market requires that prices evolve such that:

$$\frac{P_{t+1}}{P_t} = \sigma \left(\frac{k_t}{k_{t+1}} \right)^\alpha \quad (23)$$

Equations (22) and (23) characterize the behavior of the economy at a given point in time. The locus defined by (22) is illustrated in Figure 1 below.

I proceed to study the stationary behavior of the economy. Imposing steady-state on (22), the steady-state capital stock is given by

$$k^{PC} = \left(\frac{1}{1 + \frac{1}{\sigma} \frac{\pi}{1-\pi}} (1-\alpha) \rho a^{\frac{1}{\rho}} A \right)^{\frac{\rho}{1-\alpha\rho}} \quad (24)$$

where the superscript PC , designates the outcome under perfect competition. Incorporating the expression for transfers, (2) into (16), the steady-state amount of cash reserves held by the banking sector is:

$$m^{PC} = \frac{\pi \left(\rho a^{\frac{1}{\rho}} \right)^{\frac{\alpha\rho}{1-\alpha\rho}} \left(\frac{(1-\alpha)A}{1 + \frac{1}{\sigma} \frac{\pi}{1-\pi}} \right)^{\frac{1}{1-\alpha\rho}}}{(1-\pi)}$$

Moreover, using (4) and (9) in the steady-state, the gross real return to capital and the price of new equipment are respectively expressed by

$$R^{PC} = \frac{\left(1 + \frac{1}{\sigma} \frac{\pi}{1-\pi} \right) \alpha}{(1-\alpha)} \quad (25)$$

and

$$q^{PC} = \frac{1}{\left(\rho a^{\frac{1}{\rho}} \right)^{\frac{1-\alpha}{1-\alpha\rho}} \left(\frac{(1-\alpha)A}{1 + \frac{\pi}{\sigma(1-\pi)}} \right)^{\frac{1-\rho}{1-\alpha\rho}}} \quad (26)$$

Proposition 1. *Suppose \underline{u} is sufficiently small. Under this condition, a steady-state in an economy with perfectly competitive financial markets exists and is unique if $\sigma \geq \frac{(1-\alpha)-\pi}{(1-\pi)\alpha}$. Moreover, the steady-state is globally stable.*

A steady-state in an economy with perfectly competitive banks exists if two conditions are satisfied. First, workers must deposit their savings at the bank. This happens if workers' welfare (expected utility) under banks exceeds that in autarky. That is, if the reservation expected utility, \underline{u} is relatively small. Additionally, money must be dominated in rate of return in equilibrium. Using (25), the return to capital exceeds that to money if the inflation rate is sufficiently large.

Interestingly, monetary policy generates a Tobin effect when the banking sector is perfectly competitive. In particular, workers receive a higher amount of transfers from the government under a higher rate of money creation. This raises the amount of deposits and therefore the demand for different assets in the economy. The higher demand for new equipment raises their price. Moreover, as banks are suppliers in secondary capital markets, the rental income declines

under a higher supply of capital goods. From (25), the return to capital is lower under a higher inflation rate.

I proceed to study the stability of the steady-state. The dynamical properties of the economy can be derived from the law of motion of capital, (22). It is easily verified that $\Psi'(k_t) > 0$ and $\Psi''(k_t) < 0$, which implies that $\Psi(k_t)$ is concave in k_t as illustrated in Figure 1 below. Consequently, the steady-state equilibrium is locally stable.

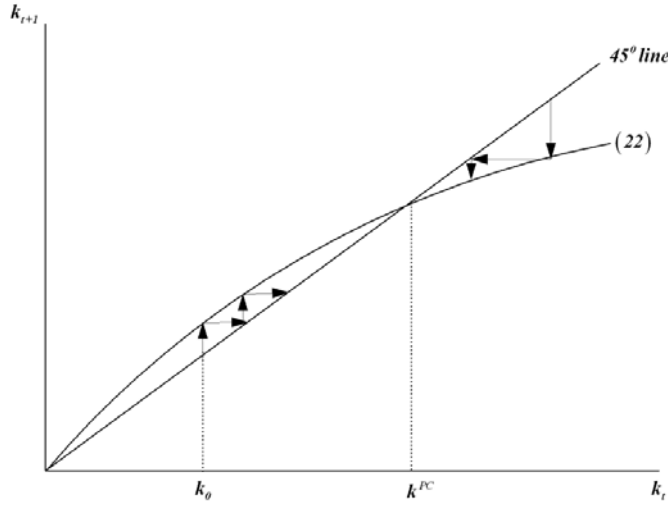


Figure 1: Dynamics Under a Perfectly Competitive Banking Sector

4 Imperfectly Competitive Banking Sector

In contrast to the previous section, I now examine an economy where the banking sector is fully concentrated. That is, the population of bankers is equal to unity, $N = 1$. At the beginning of period t , the banker announces deposit rates, r_t^m and r_t^n . The bank exerts its market power by extracting all surplus from deposit markets. Hence, the participation constraint, (11) holds with equality.

The banker makes his portfolio and pricing decisions, $(m_t, k_{t+1}, r_t^m, r_t^n, r_{t+1}, q_t)$ to maximize profits in $t + 1$, Π_{t+1}

$$\Pi_{t+1} = \underset{m_t, k_{t+1}, r_t^m, r_t^n, r_{t+1}, q_t}{Max} \quad r_{t+1}k_{t+1} + m_t \frac{P_t}{P_{t+1}} - \pi r_t^m (w(k_t) + \tau_t) - (1 - \pi) r_t^n (w(k_t) + \tau_t) \quad (27)$$

subject to (12) and (13).¹⁸ Further, payments made to non-relocated agents are made out of the return from renting capital. The banker is willing to provide

¹⁸Because the banker values old age consumption, all deposits are invested in asset markets.

financial services only if he makes positive profits. Thus, the constraint on payments to non-movers is such that:

$$(1 - \pi) r_t^n (w(k_t) + \tau_t) < r_{t+1} k_{t+1} \quad (28)$$

Because the bank is the sole buyer of capital in primary markets, it faces an upward sloping supply of new equipment. Therefore, the bank acknowledges that it must pay a higher price for capital goods to induce capital goods producers to supply more units. From (9), the price of new equipment is such that $q_t = q_t(k_{t+1}) = \frac{1}{\rho a^{\frac{1}{\rho}}} k_{t+1}^{\frac{1-\rho}{\rho}}$. Finally, the banker has monopoly power over capital in the rental market. Consequently, it accounts for the effects of a higher level of capital formation on the rental rate, (4).

In sum, the bank maximizes (27) subject to (4), (9), (11), (12), (13), and (28). Substituting the binding constraints into the objective function, the problem is reduced into a choice of capital,

$$\Pi_{t+1} = \underset{k_{t+1}}{Max} \alpha A k_{t+1}^\alpha - \frac{(1 - \pi) \pi^{\frac{\pi}{1-\pi}} e^{\frac{u}{1-\pi}} \left(\frac{P_{t+1}}{P_t}\right)^{\frac{\pi}{1-\pi}}}{\left(w(k_t) + \tau_t - \frac{1}{\rho a^{\frac{1}{\rho}}} k_{t+1}^{\frac{1-\rho}{\rho}}\right)^{\frac{\pi}{1-\pi}}} \quad (29)$$

The profit maximizing choice of capital is such that

$$\Pi_1 \equiv \alpha^2 A k_{t+1}^{\alpha-1} - \frac{1}{\rho^2 a^{\frac{1}{\rho}}} \frac{\pi^{\frac{1}{1-\pi}} e^{\frac{u}{1-\pi}} \left(\frac{P_{t+1}}{P_t}\right)^{\frac{\pi}{1-\pi}}}{\left(w(k_t) + \tau_t - \frac{1}{\rho a^{\frac{1}{\rho}}} k_{t+1}^{\frac{1-\rho}{\rho}}\right)^{\frac{1}{1-\pi}}} k_{t+1}^{\frac{1-\rho}{\rho}} = 0 \quad (30)$$

Where the term, $\alpha^2 A k_{t+1}^{\alpha-1}$ reflects the marginal revenue from renting one unit of capital to firms and $\frac{1}{\rho^2 a^{\frac{1}{\rho}}} \frac{\pi^{\frac{1}{1-\pi}} e^{\frac{u}{1-\pi}} \left(\frac{P_{t+1}}{P_t}\right)^{\frac{\pi}{1-\pi}}}{\left(w(k_t) + \tau_t - \frac{1}{\rho a^{\frac{1}{\rho}}} k_{t+1}^{\frac{1-\rho}{\rho}}\right)^{\frac{1}{1-\pi}}} k_{t+1}^{\frac{1-\rho}{\rho}}$ is the marginal cost of a unit of capital. The marginal cost of capital to the bank is the additional return that must be paid to non-movers under a higher level of capital formation. Specifically, under a higher rate of capital formation, the bank must pay capital goods producers a higher price to stimulate production. The higher amount investment requires the bank to cut its money holdings and thus making lower payments to relocated agents. In order to induce agents to participate in financial markets, the bank must pay a higher return to agents (as a group) in the event they do not relocate.

Using (12) and (30), the equilibrium amount of cash holdings by the bank is:

$$m_t = \frac{\pi e^{\frac{u}{1-\pi}} \left(\frac{P_{t+1}}{P_t}\right)^{\frac{\pi}{1-\pi}}}{\left(\alpha^2 A \rho^2 a^{\frac{1}{\rho}}\right)^{\frac{1}{1-\pi}}} k_{t+1}^{\frac{1-\alpha\rho}{\rho}(1-\pi)} \quad (31)$$

In contrast to the perfectly competitive case, the equilibrium amount of cash reserves is strictly increasing with the level of investment. Intuitively, the banker generates a higher revenue under a higher level of capital formation. Because the bank has market power in deposit markets, it has an incentive to make lower payments to non-movers under a higher level of capital. This can only happen if the bank provides better risk sharing by offering a higher return in the bad state - thus holding more money balances.

Upon substituting (29) into (30), the bank's equilibrium profits can be expressed as

$$\Pi_{t+1} = \alpha A k_{t+1}^\alpha - (1 - \pi) \frac{e^{\frac{u}{P_t}} \left(\frac{P_{t+1}}{P_t} \right)^\pi \left(\alpha^2 A \rho^2 a^{\frac{1}{\rho}} \right)^\pi}{k_{t+1}^{\frac{1-\alpha\rho}{\rho} \pi}} \quad (32)$$

which are strictly increasing in k_{t+1} . Furthermore, using (11), (13), and (31), payments made to each type of depositor as well as the relative return to depositors are respectively:

$$r_t^m (w(k_t) + \tau_t) = \frac{e^{\frac{u}{P_t}} k_{t+1}^{\frac{1-\alpha\rho}{\rho} (1-\pi)}}{\left(\alpha^2 A \rho^2 a^{\frac{1}{\rho}} \frac{P_{t+1}}{P_t} \right)^{1-\pi}} \quad (33)$$

$$r_t^n (w(k_t) + \tau_t) = \frac{e^{\frac{u}{P_t}} \left(\frac{P_{t+1}}{P_t} \right)^\pi \left(\alpha^2 A \rho^2 a^{\frac{1}{\rho}} \right)^\pi}{k_{t+1}^{\frac{1-\alpha\rho}{\rho} \pi}} \quad (34)$$

$$\frac{r_t^n}{r_t^m} = \frac{\alpha^2 A \rho^2 a^{\frac{1}{\rho}} \frac{P_{t+1}}{P_t}}{k_{t+1}^{\frac{1-\alpha\rho}{\rho}}} \quad (35)$$

4.1 General Equilibrium

Using (2), (3), (9), and (31) into the bank's balance sheet, (12), capital markets clear when:

$$\frac{1}{\rho a^{\frac{1}{\rho}}} k_{t+1}^{\frac{1}{\rho}} = w(k_t) - \frac{1}{\sigma} \frac{\pi e^{\frac{u}{P_t}} \mu_t^\pi}{\left(\alpha^2 A \rho^2 a^{\frac{1}{\rho}} \right)^{1-\pi}} k_{t+1}^{\frac{1-\alpha\rho}{\rho} (1-\pi)} \quad (36)$$

where $\mu_t = \frac{P_{t+1}}{P_t}$ is the gross inflation rate between period t and $t + 1$. Additionally, by the substitution of (31) in (1), the money market clearing condition is such that prices evolve according to

$$\mu_{t+1}^\pi = \sigma \frac{1}{\mu_t^{1-\pi}} \left(\frac{k_{t+1}}{k_{t+2}} \right)^{\frac{1-\alpha\rho}{\rho} (1-\pi)} \quad (37)$$

The loci defined by (36) and (37) characterize the behavior of the economy under imperfect financial competition at each point in time.

I start by studying the long-run behavior of the economy. Imposing steady-state on (36), the stationary level of capital formation is generated by the solution to

$$\Gamma(k, \sigma) \equiv \Omega(k) + \lambda(k, \sigma) = 1 \quad (38)$$

where $\Omega(k) = \frac{q(k)k}{w(k)} = \frac{1}{(1-\alpha)A\rho a^{\frac{1}{\rho}}} k^{\frac{1-\alpha\rho}{\rho}}$ is the fraction of wages allocated towards

capital investment. In addition, $\lambda(k, \sigma) = \frac{m(k, \sigma) - \tau}{w(k)} = \frac{\pi e^{\frac{u}{k}} k^{\frac{(1-\alpha\rho)(1-\pi) - \alpha}{\rho}}}{(1-\alpha)A \left(\sigma A \alpha^2 \rho^2 a^{\frac{1}{\rho}} \right)^{1-\pi}}$

reflects the net reserves to wage ratio held by the bank and $\Gamma(k, \sigma)$ is the bank's total assets to deposits ratio.¹⁹

I proceed to characterize each term in (38). By definition of Ω , it is clear that the fraction of deposits allocated towards capital investment is higher under a higher level of capital formation. That is, $\Omega'(k) > 0$. Further, $\Omega(0) = 0$, $\lim_{k \rightarrow \infty} \lambda \rightarrow \infty$, and $\Omega^{-1}(1)$ is the upper bound on capital investment. The behavior of $\lambda(k, \sigma)$ is summarized in the following lemma:

Lemma 1. *The locus defined by $\lambda(k, \sigma)$ satisfies:*

- a. If $\pi \leq \frac{1-2\alpha\rho}{1-\alpha\rho}$, $\frac{d\lambda}{dk} \geq 0$, $\lambda(0, \sigma) = 0$, and $\lambda(\check{k}, \sigma) = 1$, where $\check{k} = \left(\frac{(1-\alpha)A^{2-\pi} \left(\alpha^2 \rho^2 a^{\frac{1}{\rho}} \right)^{1-\pi}}{\pi e^{\frac{u}{\sigma}} \sigma^\pi} \right)^{\frac{\rho}{(1-\alpha\rho)(1-\pi) - \alpha}}$.
- b. If $\pi > \frac{1-2\alpha\rho}{1-\alpha\rho}$, $\frac{d\lambda}{dk} < 0$, $\lim_{k \rightarrow 0} \lambda \rightarrow \infty$, $\lim_{k \rightarrow \infty} \lambda \rightarrow 0$, and $\lambda(\check{k}, \sigma) = 1$.

As explained above, a higher level of investment encourages the bank to hold more cash balances. However, from a stationary general equilibrium perspective, a higher level of capital formation also raises deposits through higher wages. Therefore, the impact of a change in capital investment on the reserves to deposits ratio is ambiguous. The result in Lemma 1 demonstrates that it depends on the probability of relocation.

Intuitively, if the probability of relocation is small, the bank is holding a small amount of cash reserves as the need for insurance is low. Therefore, the amount of cash in the economy is highly sensitive to changes in k . Consequently, the reserves to deposits ratio increases under a higher level of investment.

By comparison, the need for insurance is significant if agents are highly exposed to liquidity risk. Thus, the bank holds a highly liquid portfolio. This renders the amount of cash less sensitive to changes in investment. As a result, the fraction of deposits allocated towards money balances declines under a higher level of investment.

Using the result in Lemma 1, $\Gamma(k, \sigma)$ behaves in the following manner:

¹⁹It is easy to verify that $\Omega(k)$ and $\lambda(k, \sigma)$ behave in the same manner as investment to deposits ($w + \tau$) and money to deposits ratios, respectively.

Lemma 2. *The locus defined by $\Gamma(k, \sigma)$ satisfies:*

a. *If $\pi \leq \frac{1-2\alpha\rho}{1-\alpha\rho}$, $\frac{d\Gamma}{dk} > 0$, $\Gamma(0, \sigma) = 0$, and $\lim_{k \rightarrow \infty} \Gamma \rightarrow \infty$.*

b. *If $\pi > \frac{1-2\alpha\rho}{1-\alpha\rho}$, $\frac{d\Gamma(k, \sigma)}{dk} \geq (<) 0$ if $k \geq (<) \hat{k} = \left(\frac{\pi e^{\frac{\pi}{\rho}} \left(\pi - \frac{1-2\alpha\rho}{1-\alpha\rho} \right) \left(\rho \alpha^{\frac{1}{\rho}} \right)^{\pi}}{(\sigma \alpha^2 A \rho)^{1-\pi}} \right)^{\frac{\rho}{(1-\alpha\rho)\pi + \alpha\rho}}$,*

$\lim_{k \rightarrow \infty} \Gamma \rightarrow \infty$, and $\lim_{k \rightarrow 0} \Gamma \rightarrow \infty$.

As the behavior of Γ depends on the probability of relocation, the existence and uniqueness of steady-state equilibria also depend on π .

Proposition 2.

a. *Suppose $\pi \leq \frac{1-2\alpha\rho}{1-\alpha\rho}$. Under this condition, a steady-state exists and is unique if $\sigma \geq \sigma_0$ and $A > A_0$.*

b. *Suppose $\pi > \frac{1-2\alpha\rho}{1-\alpha\rho}$.*

i. *Under this condition, a steady-state exists and is unique if $a > a_0$, $\sigma \geq \max(\sigma_0, \sigma_1)$ and $A > A_0$.*

ii. *By comparison, two steady-states exist if $a > a_0$, $\sigma \geq \max(\sigma_0, \sigma_1)$, $A < A_0$, and $\rho > \rho_0$.*

The existence of steady-state equilibria requires that (38) has at least one solution. Furthermore, the contract between the banker and its depositors must be incentive compatible, $\frac{r^n}{r^m} \geq 1$. In addition, money must be dominated in rate of return and the bank has to make non-negative profits.

Using (4), (9), and (35), the steady-state relative return to depositors and the return to capital are respectively:

$$\frac{r^n}{r^m} = \frac{\alpha^2 A \rho^2 a^{\frac{1}{\rho}} \sigma}{k^{\frac{1-\alpha\rho}{\rho}}} \quad (39)$$

$$R = \frac{r}{q} = \frac{\alpha A \rho a^{\frac{1}{\rho}}}{k^{\frac{1-\alpha\rho}{\rho}}} \quad (40)$$

Further, imposing steady-state on (32), the banker's profits are:

$$\Pi = \alpha A k^\alpha - (1 - \pi) e^{\frac{\pi}{\rho}} \left(\frac{\alpha^2 A \rho^2 a^{\frac{1}{\rho}} \sigma}{k^{\frac{1-\alpha\rho}{\rho}}} \right)^\pi \quad (41)$$

From (39), the return to non relocated agents exceeds that to movers if $k \leq \tilde{k} = \left(\sigma \alpha^2 A \rho^2 a^{\frac{1}{\rho}} \right)^{\frac{\rho}{1-\alpha\rho}}$. Moreover, money is dominated in rate of return if $k < k\left(\frac{1}{\sigma}\right) = \left(\alpha A \rho a^{\frac{1}{\rho}} \sigma \right)^{\frac{\rho}{1-\alpha\rho}}$. It is easy to verify that $k\left(\frac{1}{\sigma}\right) > \tilde{k}$. Therefore, the return to capital exceeds that to money when the self-selection

constraint is satisfied.²⁰ Finally, from (41), profits are positive if $k > \underline{k} = \left(\frac{(1-\pi)e^{\frac{\rho}{\alpha}} (\alpha \rho^2 a^{\frac{1}{\rho}} \sigma)^\pi}{(\alpha A)^{1-\pi}} \right)^{\frac{1}{(1-\alpha\rho)\pi + \alpha\rho}}$.

When the degree of liquidity risk is low as in case *a* described above, $\frac{d\Gamma}{dk} > 0$ and (38) has a unique solution, k_A , as Γ is continuous and $\Gamma(0, \sigma) = 0$. This result is illustrated in Figure 2 below. Moreover, the self-selection constraint holds if $\Gamma(\tilde{k}, \sigma) \geq 1$. Upon substituting the expression for \tilde{k} in Γ , this condition is satisfied when the inflation rate is above some threshold level, σ_0 . Intuitively, payments made to relocated agents are strictly made out of cash reserves. Thus, the return to non-movers exceeds that to movers if the return to money is sufficiently low.

Furthermore, profits are positive at k_A if $\Gamma(\underline{k}) < 1$. As I show in the appendix, equilibrium profits are positive when the level of productivity in the final goods sector is sufficiently large, $A > A_0$. The high level of productivity translates into high levels of investment and positive profits. Under these conditions, a steady-state exists and is unique when the probability of relocation is small.

I proceed to examine case *b* in Proposition 2. As I demonstrate in Lemma 2, Γ is *U* shaped when depositors are highly exposed to liquidity risk as in case *b* in the Proposition. Γ is *U* shaped implies that there is a lower bound on the bank's portfolio (total assets to deposits ratio). A solution to (38) exists if the lower bound can be implemented. That is if the value of total assets to deposits at the inflection point is feasible, $\Gamma(\hat{k}, \sigma) < 1$. This occurs when the level of productivity in the capital goods sector is sufficiently large. Intuitively, for a given stock of capital, the supply of new equipment is significant when the capital sector is more productive. The higher supply of capital translates into a lower price of new equipment and a lower assets to deposits ratio at \hat{k} . Under this condition, (38) has two solutions, k_B and k_C , reflecting the capital stock for economies *B* and *C*, respectively. This result is illustrated in Figure 3 below.

I subsequently study the necessary conditions under which the high-capital economy, *C* exists and is unique. As in case *a* in Proposition 2, the incentive compatibility constraint holds if the equilibrium amount of capital formation exceeds \tilde{k} . This holds at economy *C*, if $\Gamma(\tilde{k}, \sigma) \geq 1$ and $\tilde{k} > \hat{k}$. The latter condition is satisfied when $\sigma > \sigma_1$. Furthermore, profits are positive at *C* if $\Gamma(\underline{k}) < 1$. This condition is satisfied if $A > A_0$ as in case *a* above. Under these conditions, economy *C* exists and is unique.

By comparison, two steady-states may exist if the following conditions hold. From (39), the amount of risk sharing provided by the monopolist is much higher in economy *C*. Therefore, for the return to non-movers to exceed that to movers at *B*, it is sufficient that it does so at *C*. This takes place when $\sigma \geq \max(\sigma_0, \sigma_1)$.

It remains to provide conditions under which profits are positive at the low-capital economy. As illustrated in Figure 4, this takes place when $\Gamma(\underline{k}) > 1$

²⁰The opposite does not hold.

and $\underline{k} < \hat{k}$. The last two conditions in the Proposition are necessary for profits to be positive in economy B . This also implies that profits are positive in the economy with high levels of capital formation. Consequently, two steady-states may exist when the probability of relocation is significant and the conditions in the Proposition are satisfied. Economy B has a low level of capital formation, a low price of new equipment, and a high cost of capital. By comparison, economy C is characterized by a relatively high level of investment activity, high asset prices, and a low return to capital. Moreover, the amount of insurance received by depositors is much higher in economy C - the economy with a high level of economic activity.

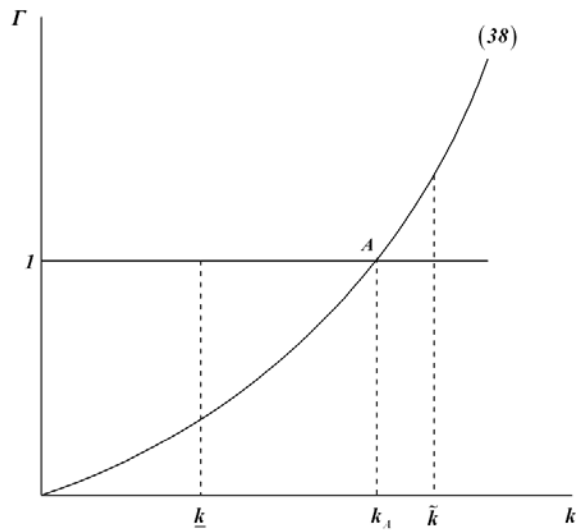


Figure 2: Unique Steady-State Under Low Levels of Liquidity Risk

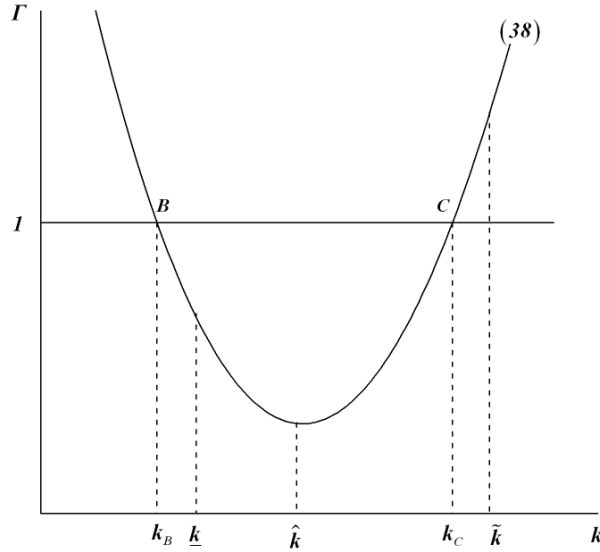


Figure 3: Unique Steady-State Under High Levels of Liquidity Risk

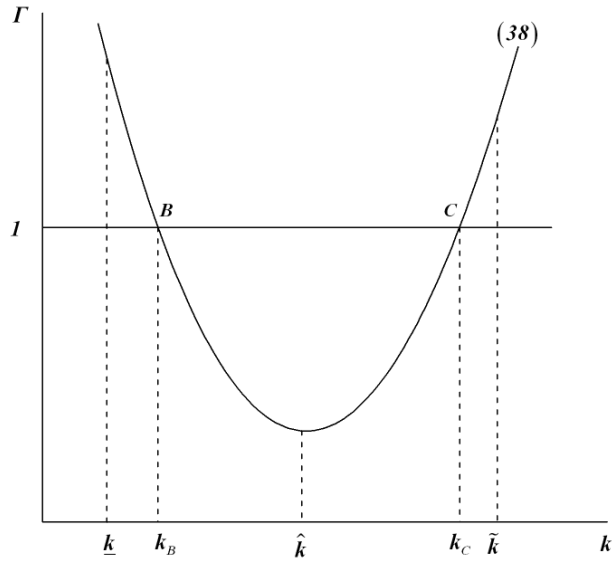


Figure 4: Multiple Steady-States Under High Levels of Liquidity Risk

I proceed to answer the following two questions: How does the degree of financial competition affect the extent of capital formation and asset prices? Moreover, how does financial competition influence the amount of risk sharing

in the economy? In order to make the analysis more tractable, I focus on cases where the steady-state under imperfect financial competition is unique. Let the outcome under perfect and imperfect financial competition be symbolized by the superscripts, IC and PC respectively.

Proposition 3. *Suppose the level of productivity in the consumer goods sector is such that:*

- a. *If $A > A_2$, $k^{IC} > k^{PC}$, $q^{IC} > q^{PC}$, and $\left(\frac{r^n}{r^m}\right)^{IC} < \left(\frac{r^n}{r^m}\right)^{PC}$*
- b. *If $A < A_1 < A_2$, $k^{IC} < k^{PC}$, $q^{IC} < q^{PC}$, and $\left(\frac{r^n}{r^m}\right)^{IC} > \left(\frac{r^n}{r^m}\right)^{PC}$*
- c. *If $A \in (A_1, A_2)$, $k^{IC} < k^{PC}$, $q^{IC} < q^{PC}$, and $\left(\frac{r^n}{r^m}\right)^{IC} < \left(\frac{r^n}{r^m}\right)^{PC}$*

Proposition 3 provides an interesting result. Compared to perfect competition, market power in financial intermediation can promote capital formation, raise asset prices, and lead to more insurance to depositors. This happens at high levels of technological change and economic development. The intuition is as follows.

When the level of productivity in the consumer goods sector is high, the demand for capital by firms is significant. Therefore, the rental rate and wages are high as well. However, when the banking sector is perfectly competitive, banks' portfolios are independent of prices. Therefore, the only effect the level of productivity has on banks occurs through wages (deposits). The high level of deposits translates into a higher demand for capital by banks, which raises the price of new equipment proportionately with r . Therefore, as in Greenwood et al. (1997), the return to capital does not vary with the level of productivity when banks are perfectly competitive as it can be seen from (25).²¹ Consequently, from (21), the amount of insurance provided by banks does not vary with the level of productivity.

Interestingly, this is not the case when the banking sector is concentrated. In particular, due to market power in capital markets, the high level of productivity encourages the banker to increase its investment in physical capital and make more profits. High productivity also expands the size of the bank's portfolio through high wages and deposits as in the perfectly competitive case.

Furthermore, as the bank extracts all surplus from deposit markets, it has an incentive to make lower payments to its depositors in the good state (if they do not relocate). This can only be achieved by compensating depositors in the event they relocate. In this manner, at high levels of productivity, the banker is holding a lot of capital and is providing a significant amount of insurance to its depositors. Interestingly, if the level of productivity is high enough, the levels of investment and insurance provided by the monopolist can exceed those under perfect competition as in case *a* in Proposition 3. The high demand for capital also implies higher asset prices.

Conversely, if firms' level of productivity is sufficiently low as in case *b*, imperfect competition in capital markets depresses capital formation and asset

²¹Greenwood et al (1997) examine a non-monetary economy in which banks are absent. Moreover, this result is independent of depositors' tolerance to the risk.

prices. Additionally, market power in the market for deposits leads to a low level of insurance against liquidity risk. Finally, over an intermediate range of the total factor productivity, monopolistic competition hinders capital markets and lowers asset prices. However, because the level of productivity is relatively high, the banker is able to provide its depositors with better insurance compared to a perfectly competitive banking sector.

Notably, this result is consistent with recent work by Beck et al (2004). In particular, Beck et al (2004) find that bank concentration and the availability of credit are negatively correlated only in less developed countries. Martinez Peria and Mody (2004) find a positive correlation between banking concentration and interest rates spread in Latin American countries. Moreover, Deyoung et al. (1999) also find an asymmetric relationship between banking concentration and credit market activity. In particular, they provide evidence that banking concentration has positive (negative) effects on small business lending in urban (rural) markets for the United States.²² In a more recent work on the Italian economy, Focarelli and Panetta (2003) demonstrate that consolidation may have adverse short run consequences for depositors. However, in the long-run, mergers benefit depositors through higher interest rates on deposits.

Finally, Proposition 3 also indicates that financial consolidation could raise total welfare if the economy is at high stages of economic development. However, this unambiguously comes at the expense of depositors' welfare. Conversely, imperfect competition significantly reduces the welfare of all agents in the economy when the level technological change in the consumer goods sector is sufficiently low.

I proceed to examine the effects of monetary policy when the banking sector is fully concentrated.

Proposition 4.

a. Suppose $\pi \leq \frac{1-2\alpha\rho}{1-\alpha\rho}$. Under this condition, inflation promotes capital formation.

b. Suppose $\pi > \frac{1-2\alpha\rho}{1-\alpha\rho}$. Further, suppose two steady-states exist. Under these conditions, inflation adversely affects capital formation in the low-capital steady-state. In contrast, inflation generates a Tobin-effect in the economy with a high level of capital formation.

From the equilibrium condition, (38), a higher rate of money creation shifts Γ downwards for a given k . In contrast to the economy with a perfectly competitive banking sector, the result in Proposition 4 demonstrates that the effects of monetary policy depend on the degree of liquidity risk in the economy and the extent of economic development.

²²Other work by Bonaccorsi di Patti and Dell'Ariccia (2004) finds a bell shaped relationship between market power and firm creation. In addition, Cetorelli and Gambera (2001) obtain a negative relationship between banking concentration and economic growth using a sample of 41 countries. Furthermore, Demirgüç-Kunt et al. (2004) find a positive correlation between banking concentration and interest rates spread in a sample of 72 countries.

When the banking sector is fully concentrated, inflation affects the economy through two primary channels. First, a higher rate of money creation raises deposits through higher transfers. This enables the bank to expand its portfolio and to increase capital investment. Notably, this is the only channel in operation when the banking sector is competitive.

Additionally, unlike an economy with a perfectly banking sector, the bank responds to a change in the return to different assets. In particular, a higher rate of money growth reduces the return to money and that to relocated agents. Because the banker extracts all the surplus from deposit markets, a higher inflation rate provokes the banker to hold more cash reserves to compensate its depositors in the bad state. This comes at the expense of capital formation.

When the need for liquidity is not too significant as in case a in Proposition 4, the steady-state is unique and the impact of inflation through government rebates dominates. Consequently, a higher rate of money creation raises investment activity. The higher amount of capital formation raises the price of capital and reduces its rental rate. Therefore, inflation adversely affects the return to capital.

Furthermore, suppose the degree of liquidity risk is significant. As I demonstrate in Lemma 2, two steady-states may exist. In the steady-state with a high capital stock, the return to capital is relatively low and the bank is investing a large fraction of its deposits into capital investment. More importantly, from (39), the banker is providing a good amount of insurance against relocation shocks. Because the bank is holding a highly illiquid portfolio, it is able to avoid the inflation tax by receiving transfers from the government. Consequently, inflation raises the level of investment in physical capital.

Conversely, when the level of capital formation is small ($k < \hat{k}$), the bank is holding a highly liquid portfolio to insure its depositors against liquidity risk. Despite that, the bank is providing its depositors with a very low level insurance. Consequently, a higher rate of money creation provokes the bank to allocate more resources towards cash reserves and less into capital. In this manner, inflation also causes asset prices to decline and the return to capital to increase.

Notably, the result in Proposition 4 is reinforced if the reservation utility, \underline{u} is adversely affected by inflation. In particular, monetary policy would have a stronger quantitative effects on the economy as it would operate through a third channel. From the capital market clearing condition, (38), a decline in \underline{u} causes the Γ locus to further shift downwards. Intuitively, suppose the expected utility under autarky falls under a higher inflation rate. Because the banker is extracting all the surplus from deposit markets, it responds by reducing its payments made to its depositors. Specifically, profit maximizing requires the bank to reduce its payments made to non-relocated agents. This enables the bank to further avoid the inflation tax when the degree of liquidity risk is low.

4.2 Dynamical Equilibria

In section 3.5, I demonstrate that two steady states may exist when the banking sector is fully concentrated. This raises the following questions: Are both steady-state approachable? Furthermore, how does financial structure affect the stability of the economy? In order to answer these questions, I conduct stability analysis of dynamical equilibria. In contrast to the economy with perfectly competitive banks, it is very hard to derive a phase diagram. Therefore, I focus my attention on the local stability properties of the system in the neighborhood of the steady-states.

4.2.1 Local Dynamics

The dynamic behavior of the economy is summarized by (36) and (37). Using the implicit function theorem and the evolution of capital, (36), $k_{t+2} \equiv k_{t+2}(k_{t+1}, \mu_{t+1})$ and

$$\mu_{t+1} = \sigma^{\frac{1}{\pi}} \frac{1}{\mu_t^{\frac{1-\pi}{\pi}}} \left(\frac{k_{t+1}(k_t, \mu_t)}{k_{t+2}(k_{t+1}(k_t, \mu_t), \mu_{t+1})} \right)^{\frac{1-\alpha\rho}{\rho} \frac{1-\pi}{\pi}}$$

The stability properties of a steady state are generated from the eigenvalues of the Jacobian matrix:

$$J = \begin{bmatrix} \frac{\partial k_{t+1}}{\partial k_t} & \frac{\partial k_{t+1}}{\partial \mu_t} \\ \frac{\partial \mu_{t+1}}{\partial k_t} & \frac{\partial \mu_{t+1}}{\partial \mu_t} \end{bmatrix}_{ss}$$

I denote the determinant and trace of J by D and T respectively. The discriminant, Δ , is $\Delta = T^2 - 4D$. The elements of the Jacobian are given by:

$$\frac{\partial k_{t+1}}{\partial k_t} \Big|_{SS} = \frac{\alpha(1-\alpha)Ak^\alpha}{\frac{1}{\rho^3 a^{\frac{1}{\rho}}} k^{\frac{1}{\rho}} + \frac{\frac{1-\alpha\rho}{\rho}(1-\pi)\pi e^{\frac{\mu}{\sigma}}}{\left(\alpha^2 A \rho^2 a^{\frac{1}{\rho}} \sigma\right)^{1-\pi}} k^{\frac{1-\alpha\rho}{\rho}(1-\pi)}} > 0 \quad (42)$$

$$\frac{\partial k_{t+1}}{\partial \mu_t} \Big|_{SS} = -\frac{\frac{\pi^2 e^{\frac{\mu}{\sigma}}}{\sigma^2 - \pi} k^{\frac{1-\alpha\rho}{\rho}(1-\pi)+1}}{\frac{(\alpha^2 A)^{1-\pi}}{\rho^{1+2\pi} a^{\frac{1}{\rho}}} k^{\frac{1}{\rho}} + \frac{(1-\alpha\rho)(1-\pi)\pi e^{\frac{\mu}{\sigma}}}{\rho \sigma^{1-\pi}} k^{\frac{1-\alpha\rho}{\rho}(1-\pi)}} < 0 \quad (43)$$

$$\frac{\partial \mu_{t+1}}{\partial k_t} \Big|_{SS} = \frac{\left(1 - \frac{\partial k_{t+1}}{\partial k_t} \Big|_{SS}\right) \frac{\partial k_{t+1}}{\partial k_t} \Big|_{SS}}{\frac{\rho}{1-\alpha\rho} \frac{\pi}{1-\pi} \frac{1}{\sigma} k + \frac{\partial k_{t+1}}{\partial \mu_t} \Big|_{SS}} \leq 0 \quad (44)$$

$$\frac{\partial \mu_{t+1}}{\partial \mu_t} \Big|_{SS} = \frac{-1 + \left(1 - \frac{\partial k_{t+2}}{\partial k_{t+1}} \Big|_{SS}\right) \sigma \frac{1-\alpha\rho}{\rho} \frac{1}{k} \frac{\partial k_{t+1}}{\partial \mu_t} \Big|_{SS}}{\frac{\pi}{1-\pi} + \sigma \frac{1-\alpha\rho}{\rho} \frac{1}{k} \frac{\partial k_{t+2}}{\partial \mu_{t+1}} \Big|_{SS}} \leq 0 \quad (45)$$

Moreover, the eigenvalues of J may be obtained by solving the following equation:

$$p(\lambda) = |J - \lambda I| = 0$$

$$|J - \lambda I| = \begin{vmatrix} \frac{\partial k_{t+1}}{\partial k_t}|_{SS} - \lambda & \frac{\partial k_{t+1}}{\partial \mu_t}|_{SS} \\ \frac{\partial \mu_{t+1}}{\partial k_t}|_{SS} & \frac{\partial \mu_{t+1}}{\partial \mu_t}|_{SS} - \lambda \end{vmatrix}$$

When the steady-state is unique, it is either saddle-path stable or a sink. By comparison, when multiple steady-state are present, both steady states can be approached. In particular, the steady-state with a low level of economic activity is always a saddle, while the steady-state with a high level of capital formation is either a saddle or a sink. Compared to an economy with a perfectly competitive financial sector, market power can generate an indeterminacy of equilibria. Since the unique steady-state can be a sink, there can be a continuum of trajectories converging to the steady-state from any initial level of capital stock in the neighborhood of the steady-state.

The possibility that the steady-state is a saddle when it is unique is illustrated in the following example. Suppose $A = 2$, $\alpha = \rho = \pi = .5$, $a = 3$, $\underline{u} = .1$, and $\sigma = 1.05$. Under these parameters, $k_A = 1.56$, $\lambda_1 = .33$, and $\lambda_2 = -1.74$. The subsequent example illustrates the case when two steady-states exist and where the low and high capital economies are saddle and sink respectively. Suppose $A = 1.85$, $\alpha = .3$, $\rho = .5$, $\pi = .9$, $a = 3$, $\underline{u} = .1$, and $\sigma = 1.05$. Under these parameters, two steady-states exist, with $k_B = .33$ and $k_C = .91$. The eigenvalues of the Jacobian matrix corresponding to the low capital economy are $\lambda_1 = 2.38$ and $\lambda_2 = -.27$. By comparison, $\lambda_1 = .564$ and $\lambda_2 = -.201$ for economy C .

5 Conclusion

The number of financial institutions around the world has significantly declined in the past two decades. For instance, the number of commercial banks has declined by one half between 1990 and 2009 in the United States alone. If this trend continues, it could have significant adverse consequences on the degree of competition in the financial system. This raises two primary questions: How does the lack of financial sector competition affect capital markets and the amount of insurance provided by the banking sector? More importantly, does market power have any implications for monetary policy? In order to address these issues, I develop a two-sector overlapping generations model in which a group of agents is exposed to liquidity shocks. Bankers insure depositors against such risk and invest in the economy's assets. Following Boyd, De Nicoló, and Smith (2004), I compare an economy with a perfectly competitive banking sector to an economy with a fully concentrated financial sector. Specifically, unlike previous work such as Williamson (1986), banks have market power in deposits and capital markets.

I demonstrate that imperfect financial competition can generate a number of unfavorable outcomes. First, it could hamper capital formation and lower asset prices. Second, market power in deposit markets can lead to an inefficiently low amount of insurance. Third, the economy becomes subject to poverty traps.

Moreover, if market power significantly reduces capital formation, it may overturn the Tobin effect present under a perfectly competitive financial sector. This necessarily happens when agents are highly exposed to liquidity risk. Finally, an imperfectly competitive financial system can be a source of indeterminacy of equilibria.

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6 Technical Appendix

Proof of Lemma 2. Differentiating (38) with respect to k and simplifying, to get:

$$\frac{d\Gamma(k, \sigma)}{dk} = \frac{(1 - \alpha\rho) k^{\frac{1-2\alpha\rho}{\rho}}}{(1 - \alpha) A\rho} \left(\frac{1}{\rho a^{\frac{1}{\rho}}} + \frac{\left[\frac{1-2\alpha\rho}{1-\alpha\rho} - \pi \right] \pi e^{\frac{u}{\rho}}}{\left(\sigma \alpha^2 A \rho^2 a^{\frac{1}{\rho}} \right)^{1-\pi}} k^{-\frac{\pi(1-\alpha\rho)-\rho}{\rho}} \right) \quad (46)$$

It is clear that $\frac{d\Gamma(k, \sigma)}{dk} > 0$ if $\pi < \frac{1-2\alpha\rho}{1-\alpha\rho}$. In addition, $\Gamma(0, \sigma) = 0$ and $\lim_{k \rightarrow \infty} \Gamma \rightarrow \infty$. In contrast, suppose $\pi > \frac{1-2\alpha\rho}{1-\alpha\rho}$. Under this condition, $\frac{d\Gamma(k, \sigma)}{dk} \geq 0$ if

$$k > \left(\frac{\pi e^{\frac{u}{\rho}} \left(\frac{\alpha\rho}{(1-\alpha\rho)} - (1-\pi) \right) \left(\rho a^{\frac{1}{\rho}} \right)^{\pi}}{\left(\sigma \alpha^2 A \rho \right)^{1-\pi}} \right)^{\frac{\rho}{(1-\alpha\rho)\pi + \alpha\rho}} = \hat{k}$$

Therefore, $\frac{d\Gamma(k, \sigma)}{dk} \geq (<) 0$ if $k \geq (<) \hat{k} = \left(\frac{\pi e^{\frac{u}{\rho}} \left(\frac{\alpha\rho}{(1-\alpha\rho)} - (1-\pi) \right) \left(\rho a^{\frac{1}{\rho}} \right)^{\pi}}{\left(\sigma \alpha^2 A \rho \right)^{1-\pi}} \right)^{\frac{\rho}{(1-\alpha\rho)\pi + \alpha\rho}}$,

which implies that the curve is U shaped. Finally, it is trivial to show that $\lim_{k \rightarrow \infty} \Gamma \rightarrow \infty$, and $\lim_{k \rightarrow 0} \Gamma \rightarrow \infty$. This completes the proof of Lemma 2.

Proof of Proposition 2. Suppose $\pi < \frac{1-2\alpha\rho}{1-\alpha\rho}$ as in case a in the Proposition. Under this condition, $\frac{d\Gamma(k, \sigma)}{dk} > 0$. From (39), the return to non-movers exceeds that to movers if the equilibrium amount of capital, k_A is such that such that $k_A \leq \tilde{k} = \left[\sigma \alpha^2 A \rho^2 a^{\frac{1}{\rho}} \right]^{\frac{\rho}{1-\alpha\rho}}$. This outcome is generated if $\Gamma(\tilde{k}, \sigma) \geq 1$. Upon substituting \tilde{k} in Γ and some simplifying algebra, this condition can be written as:

$$\left(\sigma \alpha^2 \rho^2 a^{\frac{1}{\rho}} \right)^{\frac{\alpha\rho}{1-\alpha\rho}} A^{\frac{1}{1-\alpha\rho}} (\sigma \alpha^2 \rho - (1 - \alpha)) + \pi e^{\frac{u}{\rho}} \geq 0$$

Clearly the term on the LHS is strictly increase in σ . Therefore, there exists a $\sigma = \sigma_0$, such that for all $\sigma \geq \sigma_0$, $\frac{\sigma^n}{r^m} \geq 1$.

Furthermore, as described in the text, equilibrium profits are positive if $k_A > \left(\frac{(1-\pi)e^{\frac{u}{\rho}} \left(\alpha \rho^2 a^{\frac{1}{\rho}} \sigma \right)^{\pi}}{(\alpha A)^{1-\pi}} \right)^{\frac{\rho}{(1-\alpha\rho)\pi + \alpha\rho}} = \underline{k}$. This takes place under case a if

$\Gamma(\underline{k}) < 1$. Upon substituting the expression for \underline{k} in Γ , the condition can be written as:

$$A \geq \frac{\left(\alpha \rho \sigma + \frac{\pi}{1-\pi} \right)^{\frac{(1-\alpha\rho)\pi + \alpha\rho}{(1-\pi)}}}{(1 - \alpha)^{\frac{(1-\alpha\rho)\pi + \alpha\rho}{(1-\pi)}} \left(\rho^2 a^{\frac{1}{\rho}} \sigma \right)^{\frac{\alpha\rho}{(1-\pi)}} \alpha^{\frac{1-(1-\alpha\rho)\pi}{(1-\pi)}}} \left((1 - \pi) e^{\frac{u}{\rho}} \right)^{\frac{1-\alpha\rho}{(1-\pi)}} = A_0$$

Consequently, if the conditions under case a in Proposition 2 hold, a steady-state exists and is unique.

I proceed to prove case *b* in the proposition. Under Case *b*, Γ intersects the one line if: $\Gamma(\hat{k}, \sigma) < 1$. Under this condition, they intersect twice. Using the expression of \hat{k} in (46), this condition can be written as:

$$a > \frac{(\pi e^{\frac{u}{\alpha}})^{\frac{(1-\alpha\rho)}{\alpha}} \left(\frac{\alpha\rho(1-\pi)+\pi}{(1-\alpha)(1-\alpha\rho)} \right)^{\frac{\pi+\alpha\rho(1-\pi)}{\alpha}}}{A^{\frac{1}{\alpha}} (\alpha^2 \sigma)^{\frac{(1-\alpha\rho)(1-\pi)}{\alpha}}} \left(\left(\pi - \frac{1-2\alpha\rho}{(1-\alpha\rho)} \right) \frac{1}{\rho} \right)^{\frac{1-\pi(1-\alpha\rho)}{\alpha}} = a_0$$

In this manner, Γ intersects the one line twice at B and C .

Because $\frac{d\Gamma(k, \sigma)}{dk} > 0$ when $k > \hat{k}$, the contract between the bank and its depositors in economy C is incentive compatible if $\Gamma(\tilde{k}, \sigma) \geq 1$. That is, $\sigma \geq \sigma_0$. As Γ is U shaped, we also need to make sure that $\tilde{k} > \hat{k}$. Using the expressions for \tilde{k} and \hat{k} , this condition holds if:

$$\sigma > \frac{\left(\pi e^{\frac{u}{\alpha}} \left(\pi - \frac{1-2\alpha\rho}{1-\alpha\rho} \right) \right)^{(1-\alpha\rho)}}{\alpha^2 A \rho^{1+\alpha\rho} \alpha} = \underline{\sigma_1}$$

Consequently, if $\sigma > \max(\sigma_0, \underline{\sigma_1})$, $\frac{r^n}{r^m} > 1$ in economy C . Moreover, as in Case *a*, profits are positive when $A > A_0$. In this manner, when the conditions under case *b.i* are satisfied, economy C exists and is unique.

From (39), the relative return to non-movers is strictly decreasing in the level of investment. Therefore, $\sigma > \max(\sigma_0, \underline{\sigma_1})$, also implies that the self-selection constraint also holds in economy B . Furthermore, profits are positive in economy B if $k_B > \underline{k}$. This takes place if $\Gamma(\underline{k}) > 1$ and $\underline{k} < \hat{k}$. The latter condition can be written as:

$$\rho > \frac{(1-\pi) \left(1 + \frac{1}{\pi} \sigma \right)}{\left[2 - \pi + \frac{1-\pi}{\pi} \sigma \right] \alpha} = \rho_0$$

Consequently, when the conditions under case *b.ii* hold, economies B and C both exist. This completes the proof of Proposition 2.

Proof of Proposition 3. An imperfectly competitive financial sector generates better risk sharing if:

$$\left(\frac{r^n}{r^m} \right)^{IC} \leq \left(\frac{r^n}{r^m} \right)^{PC}$$

Using (21) and (39), this condition becomes:

$$(\alpha\rho)^{\frac{\rho}{1-\alpha\rho}} k^{PC} \leq k^{IC}$$

Upon substituting for the expression of k^{PC} , the banker provides better risk sharing if:

$$k^{IC} \geq \left(\frac{(1-\alpha)\alpha\rho^2 a^{\frac{1}{\rho}} A}{1 + \frac{\pi}{\sigma(1-\pi)}} \right)^{\frac{\rho}{1-\alpha\rho}} = \check{k}$$

When the steady-state is unique, a necessary condition for the condition above to hold is to show that $\Gamma(\check{k}) \leq 1$. From (46), this condition can be written as:

$$A \geq A_1 = \left(\frac{\pi e^{\frac{u}{\sigma}}}{\left((1-\alpha\rho) + \frac{1}{\sigma} \frac{\pi}{1-\pi} \right) (\sigma\alpha)^{1-\pi}} \right)^{(1-\alpha\rho)} \frac{\left(\frac{\sigma(1-\pi)+\pi}{\sigma(1-\pi)(1-\alpha)} \right)^{\pi(1-\alpha\rho)+\alpha\rho}}{\left(\alpha\rho^2 a^{\frac{1}{\rho}} \right)^{\alpha\rho}}$$

Additionally, imperfect financial competition leads to lower capital formation if $\Gamma(k^{PC}) > 1$. Substituting k^{PC} into Γ , this condition becomes:

$$A < \frac{(\sigma(1-\pi) + \pi)^{1-(1-\alpha\rho)(1-\pi)} ((1-\pi)(1-\alpha)\rho)^{(1-\alpha\rho)(1-\pi)-\alpha\rho} e^{\frac{u}{\sigma}(1-\alpha\rho)}}{\left[(1-\alpha)(\alpha\rho)^{2(1-\pi)} \right]^{(1-\alpha\rho)} (a\sigma\rho)^\alpha} = A_2$$

I proceed to show that $A_1 < A_2$. Using some algebra, $A_1 < A_2$ if:

$$(\alpha\rho)^{\frac{(1-\pi)(1-\alpha\rho)-\alpha\rho}{(1-\alpha\rho)}} < \frac{(1-\pi)(1-\alpha\rho)}{\pi} \sigma^{\frac{1}{(1-\alpha\rho)}} + \sigma$$

which always holds under case *a* because $(1-\pi)(1-\alpha\rho) > \alpha\rho$ and $\sigma > 1$. This completes the proof Proposition 3.