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Abstract

A significant amount of evidence highlights the important role of financial intermediaries for economic development and growth. Despite all the benefits from financial intermediation, the level of participation in financial institutions varies significantly across countries. In particular, the usage of banks is much lower in less developed economies. Notably, less developed economies share many common characteristics including low-income per person, high average inflation rates, high degrees of exposure to liquidity risk, and high banking fees. I present a monetary growth model with important functions of fiat money and where financial intermediaries form endogenously to mitigate various market frictions such as liquidity risk and transactions costs. I demonstrate that all the unfavorable features of less developed economies listed above discourage people from intermediating their savings and hamper financial sector performance.

JEL Codes: G21, O42, E52, O16

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1 Introduction

A large body of evidence emphasizes the importance of financial intermediary development for economic growth. For instance, Levine, Loayza, and Beck (2000) find that countries that have a deeper banking sector grow faster.¹ Obviously, developments in the financial sector are an endogenous outcome in the economy. For example, as economies advance, financial markets and institutions emerge as the best choice made by the society to deal with various market frictions such as information asymmetries and transactions costs. In the same

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¹King and Levine (1993), Levine (1997), and Beck et al. (2000) reach a similar conclusion. More recent work by Beck et al. (2007a) finds that financial development raises income disproportionately favoring the poorest quintile, which lowers income inequality.

manner, individuals choose whether they want to institutionalize their savings or save directly in financial markets.

As bank deposits are essential for monetary policy and economic activity, it is important to understand the determinants of peoples' choice to institutionalize their savings. More importantly, what impact does monetary policy have on the choice of people to institutionalize their savings and financial sector developments? The objective of this paper is to develop a monetary model where financial institutions form endogenously and is capable of addressing these issues.

I proceed to provide details about my modeling framework. I examine a two-period overlapping generations economy. Following Townsend (1987), agents are born on one of two geographically separated locations. Further, each individual is endowed with some perishable goods when young and nothing when old. As agents only value their old age consumption, all income is saved. Further, private information and limited communication between locations generate a role for money in the economy. In particular, if an individual moves to another location, she has to use cash as she cannot establish and trade claims to assets due to limited communication. In addition to holding cash, agents can invest in a riskless but illiquid investment project. The investment project matures in two periods and generates no output if liquidated early. The final agent in this economy is a government that adopts a constant money growth rule.

After exchange occurs in the first period, a fraction of agents is randomly chosen to relocate. As money is the only asset that can cross locations, relocated agents must liquidate all their asset holdings into currency. Thus, random relocation is analogous to the liquidity preference shocks in Diamond and Dybvig (1983).

In this setting, agents can invest directly in financial markets by incurring a fixed cost or they can choose to intermediate their savings. Because the investment project is highly illiquid, agents must hold cash to consume in the event they relocate. Therefore, if agents self-insure against liquidity risk, they will end up holding idle cash balances if they do not relocate.

As in Townsend (1978), financial intermediaries are a coalition of people that arise to provide insurance. Following Greenwood and Jovanovic (1990), banks are costly to establish and therefore costly to access. In contrast to previous work such as Bencivenga and Smith (1998), banks serve two major functions in the economy. First, as banks can invest a large amount of resources in various assets, there are economies of scale from investment. That is, banks can economize on transactions costs by investing large amounts and spreading the fixed costs over a large number of depositors.

Additionally, banks provide risk pooling services. In particular, by attracting a large number of depositors, banks are able to completely diversify idiosyncratic shocks. Therefore, financial intermediaries prevent excess liquidity holdings (as long as money is dominated in rate of return) and provide insurance to their depositors.

Interestingly, the ability of banks to reduce transactions costs, agents' degree of exposure to liquidity risk, bank fees, monetary policy, and income are all

important factors influencing the choice of agents to institutionalize their savings. Specifically, if economies of scale are sufficiently strong to offset bank fees, financial intermediation would raise individuals' savings. Under this condition, agents always institutionalize their savings as in Berensten, Camera, and Waller (2007).

Furthermore, suppose agents incur a net resource cost from intermediating their savings. If the cost of banking services is relatively low, agents are only willing to institutionalize their savings when there is sufficient variability in their rates of return. This takes place in this setting when the nominal interest rate is above some threshold level.

By comparison, if bank fees are sufficiently large, the choice of agents to institutionalize their savings depends on their degree of exposure to liquidity risk. Specifically, agents choose not to intermediate their savings if they are highly exposed to liquidity risk. Intuitively, agents hold a lot of cash reserves in their portfolio when liquidity risk is significant. Therefore, the amount of self-insurance is large. As a result, agents are not willing to pay the high fees to get the extra insurance from financial intermediation.

In contrast, suppose agents' degree of exposure to liquidity risk is relatively low. Under this condition, agents choose not to institutionalize their savings when the inflation rate is significant. This happens because the ability of banks to provide insurance against relocation shocks significantly deteriorates at high inflation rates. Finally, agents completely opt out from using the banking sector if it is too costly due to high fees or if they are relatively poor.

The results described above are consistent with recent evidence by Beck et al. (2007b). In particular, Beck et al. (2007b) find that low income countries are associated with less bank outreach and have a less developed banking sector.² Furthermore, Ghossoub and Reed (2009) contend that agents are highly exposed to liquidity risk at low levels of income. As discussed above, high fees and high degrees of exposure to liquidity risk deter individuals from institutionalizing their savings and therefore hamper financial sector development.

Additionally, Beck et al. (2008) assert that significant market frictions or barriers like fees for banking services prevent many people from accessing banks. Moreover, Boyd, Levine, and Smith (2001) demonstrate that inflation impedes financial sector performance. In particular, the performance of the financial sector declines significantly at sufficiently high inflation rates (above 15%).

Related Literature

A number of papers study the endogenous formation of financial intermediaries. However, only very few examine its interaction with monetary policy.³

²Similar trends are found for the United States. For instance, Mulligan and Sala-i-Martin (2000) point out that the majority of U.S. households did not have interest-bearing assets in 1998. Notably, the lack of participation in financial markets is more apparent among the bottom quintile of the income distribution. They attribute the low participation in financial markets to high transactions costs.

³For previous work on the endogenous formation of financial institutions that does not ex-

For instance, Williamson (1986a) examines an overlapping generations economy where establishing a bank is costly and provides information advantage. He demonstrates that all borrowing and lending is intermediated in equilibrium. In particular, banks will always form as long as bank deposits are sufficiently high to cover up the cost of banking. Furthermore, inflation unambiguously encourages financial intermediation.⁴ In contrast to Williamson (1986a), banks provide liquidity services and reduce transactions costs simultaneously in this manuscript. More importantly, agents may choose not to participate in banks even if they can afford to pay the fee. This necessarily happens when agents are highly exposed to liquidity risk or inflation is sufficiently large.

My work can also be contrasted with Berensten, Camera, and Waller (2007). In particular, Berensten et al. (2007) develop a search model such as in Lagos and Wright, where banks provide record keeping services and allocate resources. In contrast to Williamson (1986a), they assume that banks are costless to establish. Further, sufficiently high inflation rates lower the net gains from financial intermediation. However, banks always dominate direct investment. In contrast to their work, the formation of banks is costly in this paper. Therefore, a sufficiently high inflation tax can significantly depress the financial system causing people to avoid financial intermediation altogether.

Finally, the work by Bencivenga and Smith (2003) is the closest to my framework. In their setting, agents incur transactions costs from accessing a financial intermediary. They demonstrate that inflation may hinder banking formation when nominal interest rates are above some threshold. In contrast to their setting, financial intermediaries reduce transactions through economies of scale. Further, the formation of banks is costly to establish as in Greenwood and Jovanovic (1990). This allows us to study the interaction between the different roles that financial intermediaries serve and monetary policy. The result obtained in Bencivenga and Smith (2003) is obtained in this manuscript when bank fees are significant and agents' degree of exposure to risk is relatively small. I also demonstrate that if banks charge high fees and agents are highly exposed to liquidity risk, agents will choose not to intermediate their savings as they are holding highly liquid portfolios.

This paper is organized as follows. In Section 2, I describe the model and study the behavior of agents. I offer concluding remarks in Section 3. Most of the technical details are presented in the Appendix.

amine the interaction between monetary policy and the institutionalization of savings, see for example, Townsend (1978, 1983), Boyd and Prescott (1986), Williamson (1986b), Greenwood and Jovanovic (1990), Greenwood and Smith (1997), and Bencivenga and Smith (1998).

⁴In his setting, money does not play a major role in the economy. More importantly, money and demand deposits are perfect substitutes. Thus, both assets are held in equilibrium up to the point where they generate the same rate of return. In this manner, agents allocate more resources towards bank deposits when the return to money falls. The higher amount of deposits increases the number of banks that can be supported in the economy.

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. At the beginning of each time period, a continuum of young individuals is born on each island with measure N .

Each agent is endowed with x units of perishable goods during her young age and receives no endowments when old. Further, agents derive utility from consuming the economy's single consumption good, c when old. The preferences of a typical agent are expressed by $u(c) = \frac{c^{1-\theta}}{1-\theta}$, where $\theta \in (0, 1)$, is the coefficient of risk aversion.

While agents do not receive endowments in their old-age, they can save their young age income in financial markets. In particular, agents can invest in an irreversible and illiquid investment project (or technology) and hold cash reserves. For each unit of goods allocated to the technology in period t , agents receive $r > 1$ units of consumption in $t + 1$ and zero units if the investment is liquidated early. 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 . In this manner, one units of goods invested in cash in t generates $\frac{P_t}{P_{t+1}}$ units of goods in the subsequent period.

Following Townsend (1978), participation in financial markets is costly. In particular, agents incur a fixed cost, T , in units of goods from participating in capital and money markets. Since the cost is lump sum, agents wish they could pool their funds and invest all at once to lower trading costs. One may interpret these transactions costs as legal fees.

Denote the per capita nominal monetary base and investment in the project, by \tilde{m}_t and i_t respectively. At the initial date 0, the generation of old agents at each location is endowed with the aggregate money supply, M_0 . Finally, define $m_t = \tilde{m}_t/P_t$ to be the real supply of money per person in period t .

Moreover, individuals in the economy are subject to relocation shocks. Each period, a fraction of young agents must move to the other island. These agents are called "movers." Limited communication and spatial separation make trade difficult between different locations. As in standard random relocation models, fiat money is the only asset that can be carried across islands.⁵

Since money is the only asset that can cross locations, agents 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 absence of financial intermediation, agents self insure against liquidity risk by investing directly in financial markets. Each agent has the ability to form a financial intermediary. Establishing a bank is costly. In particular, it costs $F\epsilon(x, Nx)$. That is, one agent requires more than his income to start a bank.

⁵Currency is accepted in both locations because it is universally recognized and cannot be counterfeited.

This can only be achieved by attracting deposits. If a bank forms, it attracts deposits and provides a number of financial services. First, by attracting a large number of depositors, the bank can completely diversify idiosyncratic shocks. Thus, a financial intermediary provides liquidity services and prevents excessive cash holding.

Additionally, due to increasing returns to scale to investment, a financial intermediary lowers transactions costs in financial markets by spreading the costs over a large number of depositors. In particular, if funds are pooled through an intermediary and invested all at once in financial markets, the cost per investor will be, $\frac{T}{N}$.⁶ In this manner, financial intermediaries play an important role in reducing transactions costs - a role generally ignored in previous work with liquidity risk such as Bencivenga and Smith (1998). In exchange for these services and to cover the startup costs, a bank charges its depositors a fee, f units of goods per depositor.

In addition to depositors, there is a central bank that follows a constant money growth rule. The aggregate nominal stock of cash in period t is expressed by $M_t = \sigma M_{t-1}$, where $\sigma > 1$ is the gross rate of money creation. In real per capita terms:

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

where $\frac{P_{t-1}}{P_t}$ is the gross rate of return on money balances between period $t-1$ and t . The government uses seigniorage income to finance an endogenous sequence of spending. Denote government spending per capita by g_t , with:

$$g_t = \frac{\sigma - 1}{\sigma} m_t$$

Following Huybens and Smith (1999), government spending does not play any role in the economy.⁷

2.1 A typical agent's problem

At the beginning of period t , after receiving their endowments, agents choose whether to institutionalize their savings or invest directly in financial markets (financial autarky). Denote u^b and u^a to be the maximized expected utility under banking and financial autarky respectively. An agent chooses to intermedie her savings if doing so improves her welfare. That is,

$$u^b \geq u^a$$

I proceed to examine welfare under each method of saving.

⁶The ability of banks to reduce transactions costs depends on the number of banks and the degree of competition in the banking sector. As I discuss below, banks engage in price competition in this economy. In addition, I assume that all contracts are enforced. It is easy to verify that agents have an incentive to collectively form only one financial institution to minimize transactions costs.

⁷This assumption is not essential to the primary results of the paper. I elaborate on this issue in the last section of the paper.

2.1.1 Welfare Under Direct Investment

Suppose agents participate directly in financial markets (or financial autarky) by incurring a transactions cost, T . As agents do not value young age consumption, all income is saved in cash reserves and the long term project:

$$x - T = m_t^a + i_t^a \quad (2)$$

where m_t^a and i_t^a denote respectively the amount of cash balances and investment per person under financial autarky.

If an agent is forced to relocate, he will lose his investment in the long term project and thus his consumption in $t + 1$, c_{t+1}^m will stem from cash balances on hand:

$$c_{t+1}^m = m_t^a \frac{P_t}{P_{t+1}} \quad (3)$$

Despite that money is dominated in rate of return, agents will end up holding excess cash reserves in the event they do not relocate. This happens because money is the only form of insurance in absence of financial intermediation. Thus, if an agent does not relocate, his consumption, c_{t+1}^n comes from cash reserves and the return on the investment project:

$$c_{t+1}^n = m_t^a \frac{P_t}{P_{t+1}} + r i_t^a \quad (4)$$

Agents make their portfolio choice to maximize their expected utility. The problem facing a typical agent under financial autarky is summarized by:

$$u^a = \underset{c_{t+1}^m, c_{t+1}^n, m_t^a, i_t^a}{Max} \frac{1}{1-\theta} \left(\pi (c_{t+1}^m)^{1-\theta} + (1-\pi) (c_{t+1}^n)^{1-\theta} \right) \quad (5)$$

subject to (2) – (4).

Define $I_t = r \frac{P_{t+1}}{P_t}$ to be the gross nominal return to the investment project between t and $t+1$. The portfolio choice of typical agent under direct investment is such that:

$$m_t^a = \gamma^a(I_t) (x - T) \quad (6)$$

where $\gamma^a(I_t) = \frac{m_t^a}{(x-T)} \in (0, 1]$ is the fraction of deposits allocated towards money balances, with

$$\gamma^a(I_t) = \begin{cases} \frac{1}{\left(1 - \frac{1}{I_t}\right) \left(1 + \left(\frac{1-\pi}{\pi}\right)^{\frac{1}{\theta}} (I_t - 1)^{\frac{1-\theta}{\theta}}\right)} & \text{if } I_t > 1 \\ 1 & \text{if } I_t = 1 \end{cases} \quad (7)$$

While agents hold cash reserves to insure themselves against relocation shocks, they also value income. Therefore, agents hold less cash if its return falls relative to that of the investment project (higher I). Furthermore, agents invest all their savings into cash reserves if money is costless to hold, $I_t \leq 1$.

Using (2) and (6), the amount invested in the project by an agent before the realization of the shock is:

$$i_t = (1 - \gamma^a(I_t))(x - T) \quad (8)$$

I proceed to examine the amount of insurance received by a typical agent in the steady-state. Imposing steady-state on (1), the steady-state rate of money creation is equal to the inflation rate. That is, $\sigma = \frac{P_{t+1}}{P_t}$. Furthermore, it can be easily verified that the relative consumption of different types of agents in the steady-state is:

$$\begin{aligned} \frac{c^n}{c^m} &= \left(\frac{1-\pi}{\pi}(I-1)\right)^{\frac{1}{\theta}} \text{ if } I > 1 \\ \frac{c^n}{c^m} &= 1 \text{ if } I = 1 \end{aligned} \quad (9)$$

Clearly, the ability of agents to self insurance against relocation shocks depends on their degree exposure to liquidity risk and the inflation rate. Specifically, for a given nominal interest rate agents hold more cash reserves if they are more likely to relocate. While agents are more insured against risk, they earn a relatively low rate of return. In contrast, agents hold less cash reserves under a higher return to investment. Therefore, the variability in consumption in different states of nature increases with I . Additionally, agents completely insure themselves against relocation shocks at the Friedman rule level of interest - zero nominal interest rate. As agents hold idle cash balances when they self-insure, money becomes too good of an asset at the Friedman rule. Therefore, they allocate all their savings into money balances, with $c^n = c^m = (x - T) \frac{1}{\sigma}$.

Finally, using (6)–(8) into (5), the stationary maximized welfare of a typical agent under direct investment is:

$$\begin{aligned} u^a &= \frac{\pi}{1-\theta} \frac{I}{I-1} \left(\frac{1}{\gamma^a(I)}\right)^{\theta} \left((x - T) \frac{1}{\sigma}\right)^{1-\theta} \text{ if } I > 1 \\ u^a &= \frac{1}{1-\theta} \left[(x - T) \frac{1}{\sigma}\right]^{1-\theta} \text{ if } I = 1 \end{aligned} \quad (10)$$

Upon substituting (7) into (10), it is easy to verify that:

$$u^a = \frac{\pi}{1-\theta} \left(\frac{1}{(I-1)^{\frac{1-\theta}{\theta}}} + \left(\frac{1-\pi}{\pi}\right)^{\frac{1}{\theta}} \right)^{\theta} [(x - T)r]^{1-\theta} \text{ if } I > 1$$

Consequently, the welfare of an agent under direct investment is strictly decreasing in the rate of money growth (nominal interest rate) and transactions costs for all $I \geq 1$.

2.1.2 Welfare Under Financial Intermediation

In this section, I examine the expected utility of a typical agent if she decides to intermediate her savings. In particular, I assume that there is free entry in the banking business. Therefore, any agent may form a bank. Under a perfectly competitive banking sector, banks choose portfolios to maximize the expected

utility of each depositor. A bank promises a gross real return r_t^m if the young individual will be relocated and a gross real return r_t^n if not. Since the market for deposits is perfectly competitive, financial intermediaries take the return on deposits as given. Finally, as financial intermediation is costly, the bank charges a fee for its service. Perfect competition implies that the bank will make zero profits in equilibrium, thus $Nf = F$.

The bank's portfolio choice in period t , involves determining the amounts of real money balances, m_t^b and investment in the project, i_t^b . Due to economies of scale in investment, the cost of participating in financial markets to the bank is $\frac{T}{N}$ per depositor. The bank's balance sheet is expressed by:

$$x - \frac{T}{N} - f = m_t^b + i_t^b \quad (11)$$

Announced deposit returns must satisfy the following constraints. First, due to the large number of depositors, a bank is able to perfectly predict the total need for liquidity. Therefore, the demand for liquidity per depositor is:

$$\pi r_t^m \left(x - \frac{T}{N} - f \right) = m_t^b \frac{P_t}{P_{t+1}} \quad (12)$$

Furthermore, in contrast to the self-insurance problem, the bank will not hold excess reserves as long as money is dominated in rate of return. Total payments to non-movers are therefore paid out of its return on the long term project in $t + 1$:

$$(1 - \pi) r_t^n \left(x - \frac{T}{N} - f \right) = r i_t^b \quad (13)$$

The bank's problem is summarized by:

$$u^b = \underset{r_t^m, r_t^n, m_t^b, i_t^b}{Max} \frac{1}{1 - \theta} \left(\pi \left(r_t^m \left(x - \frac{T}{N} - f \right) \right)^{1 - \theta} + (1 - \pi) \left(r_t^n \left(x - \frac{T}{N} - f \right) \right)^{1 - \theta} \right) \quad (14)$$

subject to (11) – (13).

Using (11) – (13) into (14), the problem is reduced into a choice of m :

$$u^b = \underset{m_t^b}{Max} \frac{1}{1 - \theta} \left(\pi^\theta \left(m_t^b \frac{P_t}{P_{t+1}} \right)^{1 - \theta} + (1 - \pi)^\theta \left(r \left(x - \frac{T}{N} - f - m_t^b \right) \right)^{1 - \theta} \right) \quad (15)$$

The optimal choice of money holdings by the bank is such that:

$$m_t^b = \gamma^b(I_t) \left(x - \frac{T}{N} - f \right) \quad (16)$$

where $\gamma^b(I_t) = \frac{m_t^b}{x - \frac{T}{N} - f} \in (0, 1]$ is the bank's cash to deposits ratio, with:

$$\begin{aligned}\gamma^b(I_t) &= \frac{1}{1 + \frac{1-\pi}{\pi} I_t^{\frac{1-\theta}{\theta}}} \text{ if } I_t > 1 \\ \gamma^b(I_t) &= \pi \text{ if } I_t = 1\end{aligned}\quad (17)$$

Next, using the balance sheet condition, the bank's investment in the long term project is such that:

$$i_t^b = (1 - \gamma^b(I_t)) \left(x - \frac{T}{N} - f \right) \quad (18)$$

As in standard models with money demand, banks allocate a smaller fraction of their deposits into cash reserves if the cost of holding money is higher. Equivalently, a higher return to the investment project encourages bank to raise their investment in the long term project.

Further, the ex-post relative return to different types of depositors is:

$$\begin{aligned}\frac{r^n}{r^m} &= I^{\frac{1}{\theta}} \text{ if } I > 1 \\ \frac{r^n}{r^m} &= 1 \text{ if } I = 1\end{aligned}\quad (19)$$

In contrast to financial autarky, the wedge between the return to different types of agents is independent of the realization of the shock. This happens because financial intermediation completely diversifies idiosyncratic risk due to the large number of depositors. However, the ability of banks to insure their depositors deteriorates under higher inflation rates. In addition, as in financial autarky, banks provide full insurance against relocation shocks at the Friedman rule rate of money growth. In particular, each depositor receives, $c^n = c^m = (x - \frac{T}{N} - f) \frac{1}{\sigma}$.

Finally, upon substituting (16) and (18) into (15) and by imposing steady-state, the equilibrium expected utility of an individual under financial intermediation is:

$$\begin{aligned}u^b &= \frac{1}{\sigma^{1-\theta}} \frac{(x - \frac{T}{N} - f)^{1-\theta}}{1-\theta} \frac{\pi^\theta}{(\gamma^b(I))^\theta} \text{ if } I > 1 \\ u^b &= \frac{1}{1-\theta} \left[(x - \frac{T}{N} - f) \frac{1}{\sigma} \right]^{1-\theta} \text{ if } I = 1\end{aligned}\quad (20)$$

Using the expression for $\gamma^b(I)$, it is easy to verify that u^b can be expressed as:

$$u^b = \frac{(x - \frac{T}{N} - f)^{1-\theta}}{1-\theta} r^{1-\theta} \left[1 - \pi \left(1 - \frac{1}{I^{\frac{1-\theta}{\theta}}} \right) \right]^\theta$$

Therefore, u^b is strictly decreasing in $\sigma(I)$, T , and f .

2.1.3 The Institutionalization of Savings

From the work above, agents choose to institutionalize their savings if $u^b \geq u^a$. Using (10) and (20), this condition can be expressed as:

$$\Psi(I) = \frac{1}{\pi} \frac{x - \frac{T}{N} - f}{x - T} \left(\frac{\frac{1}{I^{\frac{1-\theta}{\theta}}} + \frac{1-\pi}{\pi}}{\frac{1}{(I-1)^{\frac{1-\theta}{\theta}}} + \left(\frac{1-\pi}{\pi}\right)^{\frac{1}{\theta}}} \right)^{\frac{\theta}{1-\theta}} - 1 \geq 0 \quad (21)$$

I proceed by characterizing $\Psi(I)$ in the following lemma.

Lemma 1. *The locus defined by $\Psi(I)$ satisfies:*

i. *If $\pi \geq \frac{1}{2}$, $\Psi' > 0$.*

ii. *If $\pi < \frac{1}{2}$, $\Psi' \geq (<) 0$ for $I \leq (>) \hat{I}$, where $\hat{I}: \frac{(\frac{1-\pi}{\pi})^{\frac{1}{\theta}} (\hat{I}-1)^{\frac{1}{\theta}}}{1 + \frac{1-\pi}{\pi} \hat{I}^{\frac{1}{\theta}}} = 1$.*

iii. *$\Psi(1) = \frac{((x - \frac{T}{N} - f)^{1-\theta} - (x-T)^{1-\theta})}{1-\theta} \frac{1}{\sigma^{1-\theta}} \geq (<) 0$ if $f \leq (>) f_0 = \frac{N-1}{N}T$.*

iv. *$\lim_{I \rightarrow \infty} \Psi \rightarrow \frac{1}{1-\pi} \frac{x - \frac{T}{N} - f}{x-T} - 1 \geq (<) 0$ if $f \leq (>) f_1 = \frac{N-1}{N}T + \pi(x-T) > f_0$.*

Lemma 1 demonstrates that the effects of inflation (nominal rate of return) on the net gains from financial intermediation depend on the degree of liquidity risk and the level of inflation. First, if agents are highly exposed to liquidity risk, $\pi \geq \frac{1}{2}$, inflation raises the net gains from institutionalizing savings. This clearly happens because the need for insurance is significant.

In contrast, if the degree of liquidity risk is relatively low, the effects of inflation depend on the level of inflation. Specifically, if the inflation rate is below some threshold level, a higher rate of money creation raises the gains from institutionalizing savings. In contrast, at sufficiently high levels of interest rates, the ability of banks to provide insurance deteriorates. Consequently, inflation erodes the gains from banking for all $I > \hat{I}$.

Furthermore, as I demonstrate in the previous section, agents fully insure themselves against random relocation shocks when money is costless to hold. The same outcome holds under banks. In this manner, when $I = 1$, the net gains from banking strictly depend on the level of income under each method of savings. In particular, if bank fees are sufficiently small, $f \leq f_0$, economies of scale in banking permit agents to save at least as much as under direct investment. In contrast, if bank fees are significant, access to financial markets through financial intermediaries becomes more costly. Therefore, banking lowers welfare a the Friedman rule level.

Finally, when inflation is infinitely large, money will not be held in equilibrium and all savings are invested in the illiquid project. As a result, an agent will not receive consumption if she relocates. Thus, the net gains from banking depend on an agent's consumption level in the good state (if she does not relocate). In the limit, the consumption per person under financial autarky and banking are respectively, $r(x-T)$ and $r\left(\frac{x - \frac{T}{N} - f}{1-\pi}\right)$. Banking dominates financial autarky when $\sigma(I) \rightarrow \infty$, if the fee charged by the bank is below some level, $f_1 > f_0$.

I proceed to examine conditions under which agents choose to intermediate their savings in Proposition 1 below.

Proposition 1.

a. *If $f \leq f_0$, $u^b \geq u^a$ for all $I \geq 1$.*

b. *If $f \in (f_0, f_1)$, $u^b \geq (<) u^a$ for all $I \geq (<) \tilde{I}$.*

- c. If $f \in (f_1, f_2)$, where $f_2 > f_1 > f_0$, is such that $\Psi(\hat{I}) = 0$.
- i. For all $\pi \geq \frac{1}{2}$, $u^b < u^a$.
- ii. For all $\pi < \frac{1}{2}$, $u^b \geq u^a$ if $I \in [\underline{I}, \bar{I}]$, where \underline{I} and \bar{I} are the roots of $\Psi(I) = 0$ and $u^b < u^a$ otherwise.
- d. If $f \geq f_2$, $u^b < u^a$ for all $I \geq 1$.

In order to understand the results in Proposition 1, it is important to point out to the trade-offs that could possibly arise in this economy. Banks provide two types of services in this setting. First, financial intermediaries completely diversify idiosyncratic shocks and provide liquidity services. As banks do not hold excess cash reserves, they are able to pay higher expected rates of returns on savings while insuring their depositors.

Furthermore, through economies of scale, financial intermediaries reduce transactions costs and therefore, the cost of participating in financial markets. In contrast to Bencivenga and Smith (1991, 1998), if economies of scale are strong enough to offset bank fees, financial intermediation would raise individuals' savings. This takes place when $\frac{T}{N} + f < T$, or equivalently, when the fee banks charge is sufficiently low, $f \leq f_0$. Under this condition, agents always institutionalize their savings as in Berensten, Camera, and Waller (2007).⁸ Case *a* in Proposition 1 is illustrated in Figures 1 and 2, for $\pi \geq \frac{1}{2}$ and $\pi < \frac{1}{2}$, respectively.

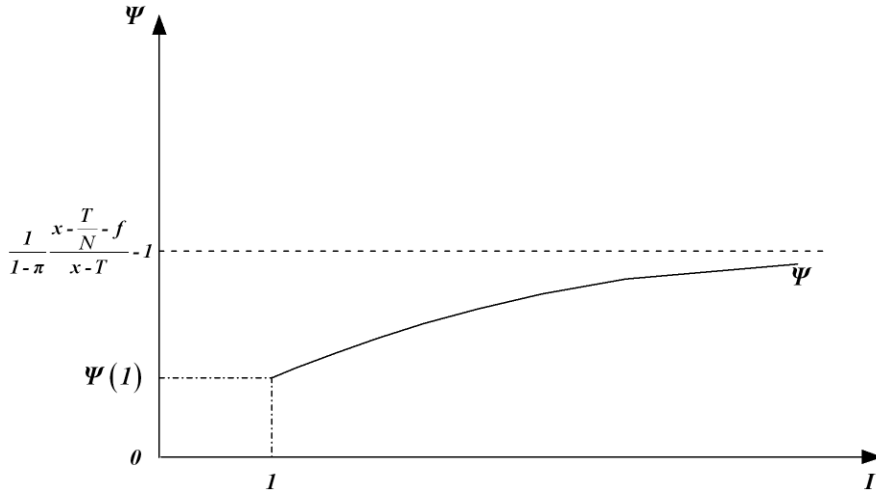


Figure 1: Case *a*, $\pi \geq \frac{1}{2}$: Banks are Always Open

⁸Berensten, Camera, and Waller (2007) examine the special case where banks do not provide a cost advantage to investors, $f = f_0$ in this setting.

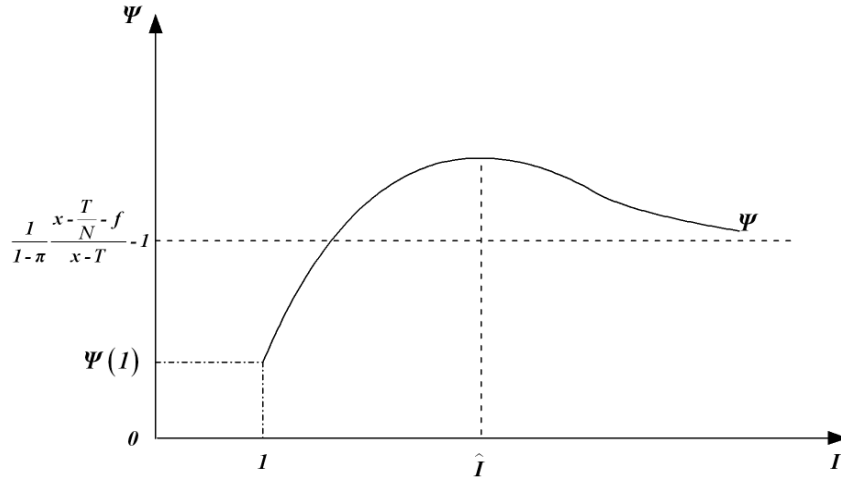


Figure 2: Case $a, \pi < \frac{1}{2}$: Banks are Always Open

In contrast, if economies of scale are not strong enough, accessing financial markets indirectly through banks becomes more costly relative to autarky. That is, agents have to incur a net cost to intermediate their savings, which becomes an important factor in choosing the method of saving.

If $f \in (f_0, f_1)$, the net cost of accessing a bank is relatively low. Therefore, the cost of risk sharing services is low. However, agents are only willing to institutionalize their savings when there is sufficient variability in their rates of return. That is, when the nominal interest rate is above some threshold, \tilde{I} . This result is illustrated in Figure 3 and 4 for different degrees of liquidity risk.

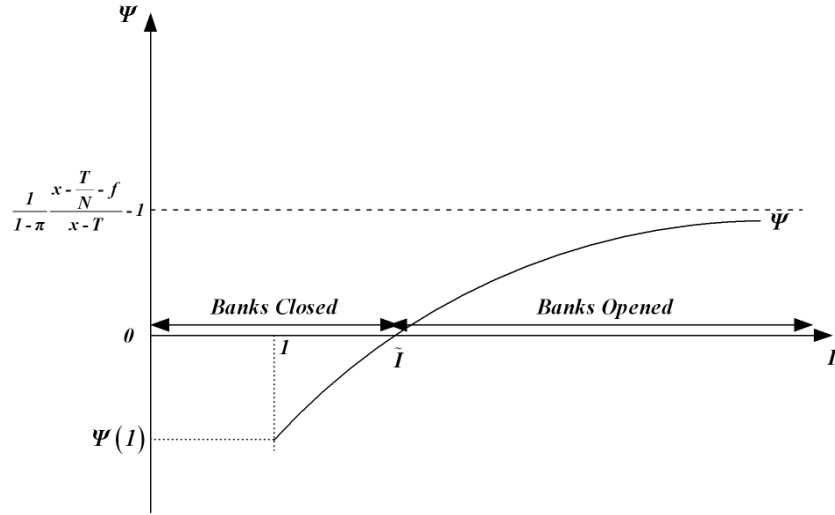


Figure 3: Case $b, \pi \geq \frac{1}{2}$: Agents Use Banks at High I .

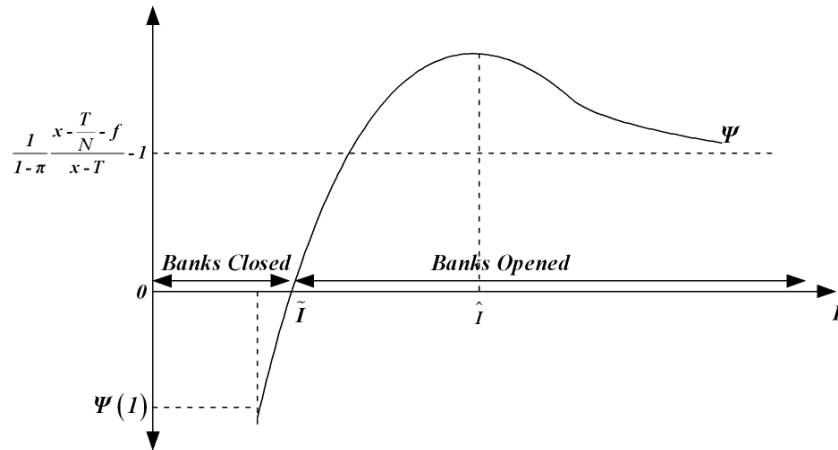


Figure 4: Case $b, \pi < \frac{1}{2}$: Agents Use Banks at High I .

By comparison, if bank fees are sufficiently large, $f \in (f_1, f_2)$, the choice of agents to institutionalize their savings depends on the degree of exposure to liquidity risk. Interestingly, if agents are sufficiently exposed to liquidity risk,

they will choose not to intermediate their savings. Intuitively, agents hold a lot of cash in their portfolio when they are highly exposed to liquidity risk. Therefore, the amount of self insurance is large for a given rate of money creation as can be seen from (9). Consequently, agents are not willing to pay the high fees to get the extra insurance from financial intermediation as illustrated in Figure 5.

In contrast, suppose the degree of exposure to liquidity risk is relatively low, $\pi < \frac{1}{2}$ as in case *c.iii*. Under this condition, banks will operate if inflation is within an intermediate range. Specifically, at low levels of inflation, the wedge between agents' consumption in each state of nature is relatively low. Therefore, agents are not willing to pay the high fees to get insured. Furthermore, when inflation rates are sufficiently high, the need for insurance is significant. However, banks' ability to provide insurance is significantly poor under high nominal interest rates. Hence, agents choose not to institutionalize their savings when the inflation rate is above some threshold level. This result is illustrated in Figure 6 below. Finally, if bank fees are substantial, $f \geq f_2$, agents cannot afford to use a bank.

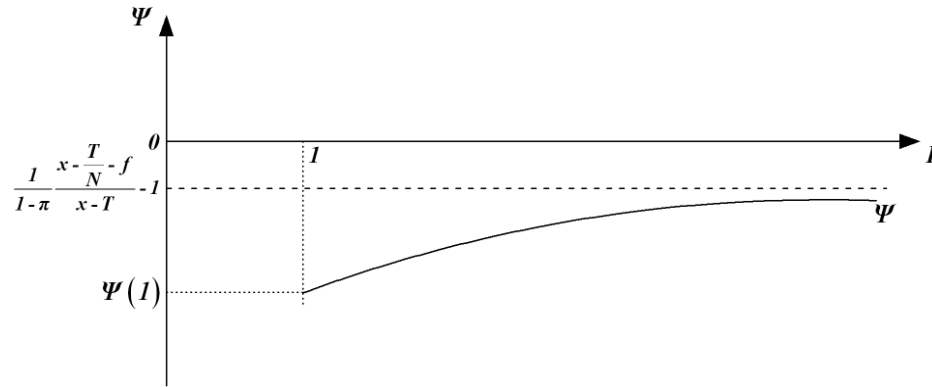


Figure 5: Case *c*, $\pi \geq \frac{1}{2}$: Banks are Always Closed

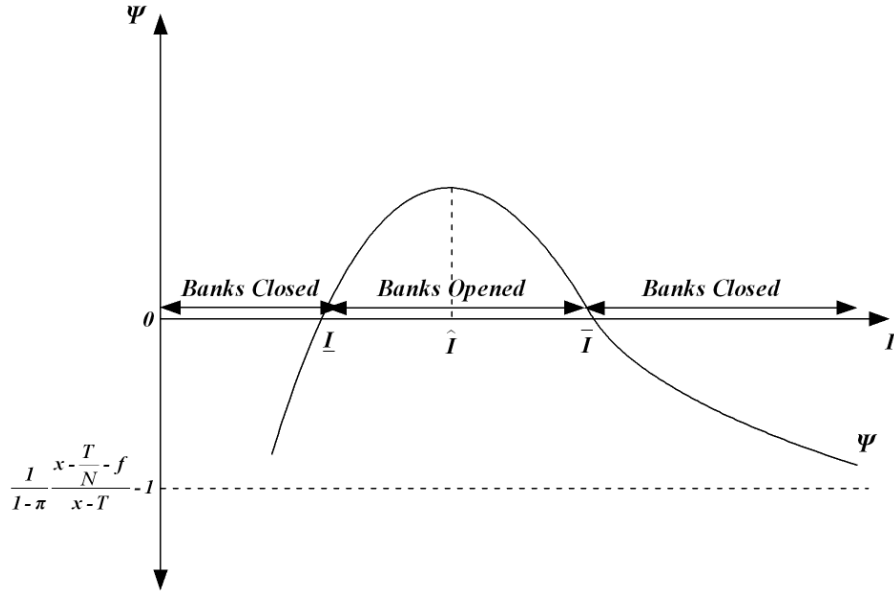


Figure 6: Case $c, \pi < \frac{1}{2}$.

While inflation may encourage financial sector development under certain conditions, it unambiguously lowers welfare as discussed in the previous section.⁹ Therefore, the Friedman rule rate of money creation is the optimal monetary policy. At the Friedman rule, liquidity risk is not an issue as agents are completely insured against it under both methods of saving. Therefore, agents choose to institutionalize their savings if banks provides a cost advantage over direct investment as in case a in the proposition.

Furthermore, in the spirit of Roubini and Sala-i-Martin (1995), one can assume that the cost of establishing a financial institution, F , is at the discretion of the government.¹⁰ For instance, the cost of establishing a bank may incorporate bribery, taxes, and infrastructure, all of which can be controlled by the

⁹The fact that higher inflation rates may encourage financial intermediation does not contradict with the work by Boyd et al. (2001). Despite that agents choose to institutionalize their savings at high inflation rates, banks' performance is adversely affected by inflation. That is, banks' ability to insure agents against liquidity risk worsen. Thus, inflation unambiguously hampers financial sector efficiency. However, when the cost of accessing the bank is low, banking still dominates self-insurance.

¹⁰Roubini and Sala-i-Martin (1995) treat financial intermediation as exogenous. However, they assume that the marginal utility of money is lower in a more developed financial sector. Further, the government perfectly controls the level of financial development in their model.

government.¹¹ In such a setting, monetary and fiscal policies are both essential for financial development. In particular, a policy that minimizes the cost of banking and the cost of holding money simultaneously, is the one that maximizes welfare and promotes financial development.

Finally, suppose the government's revenue from money creation is rebated back to young agents through lump sum transfers, τ . It is easily verified that (21) becomes:

$$\Psi = \frac{1}{\pi^{1-\theta}} \left(\frac{x + \tau^b - \frac{T}{N} - f}{x + \tau^a - T} \right)^{1-\theta} \frac{\left(\frac{1}{I^{\frac{1-\theta}{\theta}}} + \frac{1-\pi}{\pi} \right)^\theta}{\left(\frac{1}{(I-1)^{\frac{1-\theta}{\theta}}} + \left(\frac{1-\pi}{\pi} \right)^{\frac{1}{\theta}} \right)^\theta} - 1 > 0$$

where τ^b and τ^a are the amount of real transfers per person under banking and direct investment, respectively.

If seigniorage revenue is rebated back to young people, a higher rate of money growth raises the amount of transfers and thereby agents' income. Clearly, for a given rate of money growth, the amount of cash in the economy is much higher under financial autarky. Additionally, the demand for money is more sensitive to price changes. Therefore, inflation affects agents' choice to intermeditate their savings through an additional channel. Specifically, a higher rate of money creation hampers the formation of financial institution through this channel as income under autarky increases relative to that under banking. In this manner, rebating government transfers into the economy has an additional adverse effect on the welfare gains from banking. More importantly, the results derived in Proposition 1 can also be generated in this setting with some additional algebra.

3 Conclusion

Previous studies such as Levine et al. (2000) highlight the importance of financial intermediation for economic growth and development. Despite all the gains from financial intermediation, the level of participation in financial institutions varies significantly across countries. In particular, the usage of banks is much lower in less developed economies. Notably, less developed economies share many common characteristics including low-income per person, high average inflation rates, high degrees of exposure to liquidity risk, and high banking fees.

I develop a monetary growth model where money overcomes incomplete information and provides liquidity. Further, agents are exposed to stochastic liquidity shocks. With some probability, they are forced to liquidate all their asset holdings into cash reserves. In absence of financial intermediation, fiat money is the only form of insurance against liquidity risk.

¹¹The model can be easily modified to permit the government to impose lump sum taxes on the formation of banks.

Agents can establish a financial intermediary by incurring a one time fixed cost. In contrast to previous work such as Bencivenga and Smith (1998), financial intermediaries reduce transactions costs through economies of scale and provide risk pooling services. In this setting I demonstrate that all the characteristics of developing countries listed above can explain the low participation in financial intermediation in these countries. Further, lowering inflation unambiguously raises welfare. Therefore, the Friedman rule is the optimal monetary policy. However, I show that the Friedman rule must be supported by fiscal policy to stimulate financial development.

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4 Technical Appendix

1. Proof of Lemma 1. Differentiating (21) with respect to I yields:

$$\Psi' = \frac{\frac{1}{(I-1)^{\frac{1-\theta}{\theta}} + \left(\frac{1-\pi}{\pi}\right)^{\frac{1}{\theta}}} + \frac{\frac{1}{I^{\frac{1-\theta}{\theta}} + \frac{1-\pi}{\pi}}}{(I-1)^{\frac{1}{\theta}}}}{\left(\pi \frac{x-T}{x-\frac{T}{N}-f}\right)^{\frac{1-\theta}{\theta}} \Psi^{\frac{1-2\theta}{\theta}} \left(\frac{1}{(I-1)^{\frac{1-\theta}{\theta}}} + \left(\frac{1-\pi}{\pi}\right)^{\frac{1}{\theta}}\right)^2} \quad (22)$$

As the term in the denominator in (22) is positive, $\Psi' > 0$ if the numerator is positive. That is,

$$\frac{1}{I^{\frac{1}{\theta}}} + \frac{1-\pi}{\pi} > \left(\frac{1-\pi}{\pi}\right)^{\frac{1}{\theta}} \left(1 - \frac{1}{I}\right)^{\frac{1}{\theta}} \quad (23)$$

Define $\mu(I) = \frac{1}{I^{\frac{1}{\theta}}} + \frac{1-\pi}{\pi}$ and $\lambda(I) = \left(\frac{1-\pi}{\pi}\right)^{\frac{1}{\theta}} \left(1 - \frac{1}{I}\right)^{\frac{1}{\theta}}$. The condition in (23) can be written as $\mu(I) > \lambda(I)$. It is clear that $\mu'(I) < 0$ and $\lambda'(I) > 0$. Further, $\mu(1) = \frac{1}{\pi}$, $\lim_{I \rightarrow \infty} \mu \rightarrow \frac{1-\pi}{\pi}$, $\lambda(1) = 0$, and $\lim_{I \rightarrow \infty} \lambda \rightarrow \left(\frac{1-\pi}{\pi}\right)^{\frac{1}{\theta}}$.

Two cases emerge here. First, suppose $\pi \geq \frac{1}{2}$. Under this condition, $\left(\frac{1-\pi}{\pi}\right)^{\frac{1}{\theta}} < \frac{1-\pi}{\pi}$. Therefore, $\mu(I) > \lambda(I)$ and $\Psi' > 0$, which is case *i* in Lemma 1. In contrast, suppose $\pi < \frac{1}{2}$. Under this condition, the polynomial defined by $\mu(I) = \lambda(I)$ has a unique positive root, \hat{I} . That is, $\mu(I)$ and $\lambda(I)$ intersect once. For all $I \geq \hat{I}$, $\Psi' < 0$ and for all $I < \hat{I}$, $\Psi' > 0$. The proof of points *iii* and *iv* is provided in the text. This completes the proof of Lemma 1.

2. Proof of Proposition 1. From the characterization of Ψ in Lemma 1, f_0 is such that $\Psi(1) = 0$ and for all $f < (>) f_0$, $\Psi(1) > (<) 0$. Further, for all $f \leq (>) f_1$, $\lim_{I \rightarrow \infty} \Psi \rightarrow \frac{1}{1-\pi} \frac{x-\frac{T}{N}-f}{x-T} - 1 \geq (<) 0$, where $f_1 > f_0$. Therefore, suppose $f \leq f_0$ as in case *a* in the Proposition. Under this condition, $\Psi(1) > 0$ and $\lim_{I \rightarrow \infty} \Psi \rightarrow \frac{1}{1-\pi} \frac{x-\frac{T}{N}-f}{x-T} - 1 > 0$. Consequently, for all $\pi \geq 0$, Ψ lies in the positive orthant and $u^b - u^a \geq 0$ if $I \geq 1$.

Next, consider case *b*, where $f \in (f_0, f_1)$. Under this condition, $\Psi(1) < 0$. However, $\lim_{I \rightarrow \infty} \Psi \rightarrow \frac{1}{1-\pi} \frac{x-\frac{T}{N}-f}{x-T} - 1 > 0$. Thus, for all $\pi \geq 0$, there exists an I , $\tilde{I} > 1$, such that $\Psi(\tilde{I}) = 0$ as illustrated in Figures 3 and 4 in the text.

By comparison, suppose $f > f_1$. Under this condition, $\lim_{I \rightarrow \infty} \Psi \rightarrow \frac{1}{1-\pi} \frac{x-\frac{T}{N}-f}{x-T} - 1 < 0$. Hence, when $\pi \geq \frac{1}{2}$, Ψ lies in the negative orthant for all $I \geq 1$ and $u^b - u^a < 0$.

In contrast, suppose $\pi < \frac{1}{2}$. Define f_2 such that $\Psi(\hat{I}) = 0$. Clearly, for all $f < f_2$, $\Psi(\hat{I}) > 0$ and therefore, the polynomial $\Psi(I) = 0$ has two positive roots. This implies the result in case *cii* in the Proposition holds. Finally, if

$f > f_2$, $\Psi(\hat{I}) < 0$, and $\Psi(I) < 0$ for $\pi < \frac{1}{2}$ as well. This completes the proof of Proposition 1.