THE UNIVERSITY OF TEXAS AT SAN ANTONIO, COLLEGE OF BUSINESS

Working Paper SERIES

Date November 30, 2016

WP # 0009ECO-566-2016

Commercial Banks, Credit Unions, and Monetary Policy

Edgar A. Ghossoub
The University of Texas at San Antonio

UTSA COLLEGE OF BUSINESS KNOWLEDGE FOR A NEW WORLD

ONE UTSA CIRCLE
SAN ANTONIO, TEXAS 78249-0631
210 458-4317 | BUSINESS.UTSA.EDU

Commercial Banks, Credit Unions, and Monetary Policy

Edgar A. Ghossoub[*][†]
The University of Texas at San Antonio

Abstract

The objective of this manuscript is to study the strategic interaction between different types of financial institutions and its implications for economic activity and monetary policy. While commercial banks and credit unions provide similar financial services, they have different ownership structure and therefore have different objectives. For instance, banks are often perceived as profit maximizers, while credit unions act like co-operative entities seeking value and aim to maximize the welfare of their depositors. Following the 2007-2008 financial crisis, credit unions gained more market share and their role in the process of financial intermediation became more pronounced. Such changes raise some important questions that I attempt to address in this manuscript. First, how does the strategic interaction between credit unions and commercial banks affect risk sharing, total welfare, and capital formation? Second, will the effects of monetary policy become stronger if credit unions gain more market share? Finally, what is the optimal size of each financial institution? In order to address these important questions, I study a dynamic general equilibrium model with an important role for money and where different types of financial intermediaries interact strategically in deposit and capital markets.

JEL Codes: E31, E41, E44, O42

Keywords: Credit Union, Banking Competition, Monetary Policy

1 Introduction

The objective of this manuscript is to study the strategic interaction between different types of financial institutions and its implications for economic activity and monetary policy. While commercial banks (banks thereafter) and credit unions provide similar financial services, they have different ownership structure and therefore have different objectives. For instance, banks are often

*Department of Economics, One UTSA Circle, University of Texas at San Antonio, San Antonio, TX 78249; Email: Edgar.Ghossoub@UTSA.edu; Phone: (210) 458-6322.

†This research benefited in part from a summer research grant from the College of Business at the University of Texas at San Antonio.

perceived as profit maximizers, while credit unions act like cooperative entities seeking value and aim to maximize the welfare of their depositors. As each type of financial intermediary has a different objective, their portfolio composition should also differ. This can be clearly seen from Figure 1 below that illustrates the loans/deposits ratio for credit unions and commercial banks over the last three decades. Until the recent financial crisis, it appears that commercial banks allocate on average a larger fraction of their deposits towards loans compared to credit unions.[1] This trend has recently reversed in recent years.

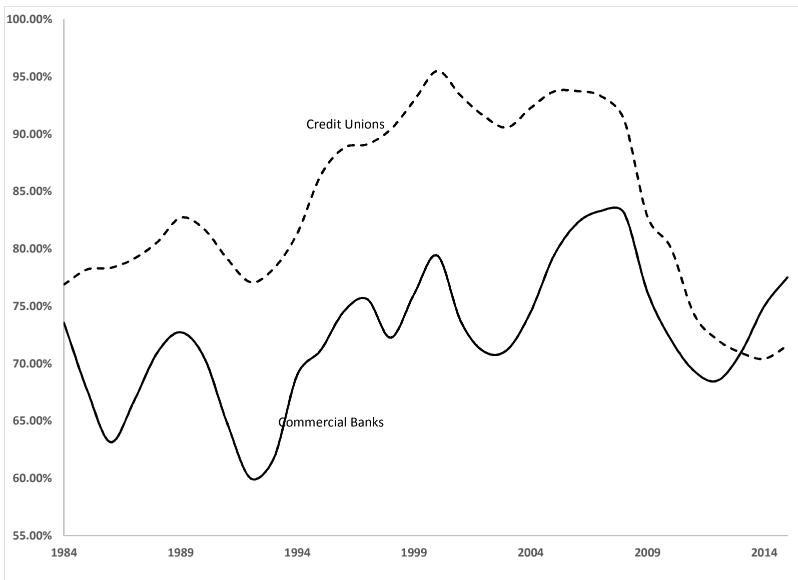

Figure 1. Loans to Deposits Ratio By Type of Financial Intermediary

Following the recent financial crisis, credit unions gained more popularity and market share as they were less exposed to problems in the credit market. For instance, data from the FDIC and the Credit Union National Association reveal that credit union loans grew by 8% during the financial crises while bank loans dropped by 10%. While banks continue to dominate the process of financial intermediation, these changes in the banking industry raise some important questions.[2] First, how does the strategic interaction between credit unions and commercial banks affect total welfare and capital formation? Second, given the important role financial intermediaries play in the transmission of monetary policy, financial institutions with different ownership structure should respond differently to monetary policy and different economic outcomes. Therefore, will

[1] Commercial banking data is obtained from the FDIC, whereas data on credit unions is obtained from the National Credit Union Administration (NCAU).

[2] Data from the World Council of Credit Union point out that while credit unions have around 20% market share of the deposit market in the United Sates, they play a much greater role in many European countries such as France and Spain.

the effects of monetary policy become stronger if credit unions gain more market share? Finally, should promoting commercial banking relative to credit unions be a regulatory objective?

This manuscript provides a first attempt at addressing these important questions. Notably, most previous studies that address the linkages between the industrial organization of the banking sector and monetary policy focus on the interaction between intermediaries of similar ownership structure.[3]

In order to examine how the strategic interaction between banks and credit unions affects different economic outcomes and monetary policy, I study a two-period overlapping generations production economy with an important role for financial intermediation and fiat money. As in Diamond and Dybvig (1983), financial intermediaries provide their depositors with risk sharing services. Following Schreft and Smith (1997), incomplete information and restriction on asset portability generate a role for money despite being dominated in rate of return by physical capital. In contrast to previous models like Schreft and Smith, there are two types of financial intermediaries that operate in different regions. In region 1, a credit union operates on behalf of its depositors and allocates its portfolio to maximize their welfare. In region 2, a commercial bank exerts its power in the deposit market and seeks to maximize its own profits. Deposit markets are assumed to be segregated as I abstract from deposit competition.[4,5] An exogenous change in the number of depositors in each region serves as a proxy for the relative importance of each type of type of financial intermediary. Further, financial intermediaries in each region compete in a Cournot fashion in a centralized capital market.

In this environment, the profit maximizing commercial bank holds a less liquid portfolio and allocates more resources towards capital formation compared to the credit union. In addition, due to its market power in the deposit market, the commercial bank offers its depositors with better insurance against idiosyncratic liquidity shocks. While the commercial bank provides its depositors with low variation in the return on their deposits, it also pays them a low return compared to the credit union. The disparity in the interest rates between credit unions and commercial bank is consistent with the data.[6]

Furthermore, when the amount of deposits in the credit union increases relative to the bank, the credit union unambiguously grabs market share in the capital market and gains more market power. However, the impact on aggregate capital formation depends on monetary policy (steady-state inflation).

[3] Boyd and De Nicolo (2005), Ghossoub et al. (2012), and Ghossoub (2012) compare two economies. In one economy the banking system is perfectly competitive, while in the other economy there is a monopoly bank. In a more recent work, Ghossoub and Reed (2014, 2015) examine a setting where the banks compete over prices in the deposit market. Competition over deposits render all banks in their setting similar to credit unions in this paper.

[4] High switching costs prevent depositors from moving from one region to another.

[5] Purroy and Salas (2000) study imperfect competition in the deposit market between two different types of financial intermediaries.

[6] The National Credit Union Administration provides an interesting comparison of average savings, deposits, and loan rates at credit unions and banks: https://www.ncua.gov/analysis/Pages/industry/credit-union-bank-rates.aspx

In particular, when inflation is sufficiently low, both financial institutions lose their ability to exert market power in capital markets. The level of aggregate capital investment falls when resources are diverted from the commercial bank to the credit union as the bank holds a less liquid portfolio. However, at higher levels of inflation, each financial institution is capable of exerting its market power in capital markets. While a relatively higher deposit base in the credit union allows it to grab market share in capital markets, the net impact on capital formation is not trivial as there are many factors influencing investment decisions. First, the positive impact from higher deposits in the credit union on capital formation is mitigated by the increased distortion as the credit union gets larger in size. On the other hand, as the commercial bank loses deposits, its market power in capital markets is hindered, which encourages the bank to hold a less liquid portfolio. Overall, real economic activity is improved as credit unions gain market share in the deposit market.

In regards to monetary policy, I demonstrate that a higher rate of money creation lowers the value of money, which promotes capital investment in all regions. This necessarily happens when inflation is above some threshold level. Interestingly, credit unions are able to grab market share from banks when inflation is sufficiently low. More importantly, the credit union's portfolio gets less liquid in a low inflationary environment compared to that of the bank. However, at high inflation rates, credit unions lose market share in capital markets when inflation increases.

Next, do the effects of monetary policy get stronger as the credit union gains market share? How about the regional effects? Notably, at low levels of inflation, the marginal effects of monetary policy increase in both regions when competition between the credit union and the commercial bank intensifies.[7] However, once inflation increases above a certain threshold, further gains in market share by the credit union hinder the marginal effects of monetary policy in the region where the bank operates and in the aggregate.

Finally, should promoting commercial banking relative to credit unions be a regulatory objective? The results in this manuscript suggest that there is no clear answer to this question as the optimal distribution of deposits between each financial institution depends on monetary policy and the degree of liquidity risk. Using the aggregate expected utility of depositors as the proxy for economic welfare, it is optimal to have more resources allocated by the commercial bank relative to the credit union when the degree of liquidity risk is high. This happens because the commercial bank provides better insurance against idiosyncratic liquidity shocks. Furthermore, when the degree of liquidity risk is low, credit unions should play a bigger role in allocating resources as inflation increases. By comparison, when agents are highly exposed to liquidity risk, it is optimal to give a bigger role for commercial banks under higher inflation rates. The Friedman rule, where both money and capital earn the same real return is optimal in this environment.

[7] Both Cechetti (1999) and Kashyap and Stein (1997) study how the effectiveness of monetary policy depends on competition in the banking system. However, they do not differentiate between different types of financial institutions.

The remainder of the paper is as follows. Section 2 outlines the physical description of the environment in the model. Section 3 looks at the problem of each economic agent. Section 4 studies the steady-state behavior of the economy and the effects of monetary policy and degree of competition. Section 5 studies welfare implications. Section 6 offers concluding remarks.

2 Environment

Consider a two period overlapping generations economy. There are two geographically separated yet symmetric locations or islands. At the beginning of each period, a unit mass of ex-ante identical workers (or depositors) are born in each location. Moreover, every island is divided into two regions, indexed by $i = 1, 2$. A fraction λ of the population resides in region 1 and the remaining $(1 - \lambda)$ are in region 2. In addition to workers, a financial intermediary or a banker is present in each region.

Each worker is endowed with one unit of labor effort when young and is retired when old. Workers do not value leisure, so labor is supplied inelastically. Moreover, workers only value consumption in their second life period. The lifetime utility of a worker born in period t in region i, is expressed by: $u(c_{i,t+1}) = \frac{c_{t+1}^{1-\theta}}{1-\theta}$, where $\theta < 1$ is the coefficient of risk aversion. Unlike depositors, financial intermediaries have no endowments and are risk neutral.

The consumption good is produced by representative firm using capital and labor. The production technology is of the Cobb-Douglas form and is expressed as $Y_t = F(K_t, L_t) = AK_t^{\alpha} L_t^{1-\alpha}$, where K_t and L_t denote the aggregate stocks of capital and labor on each island in period t. The parameter A represents total factor productivity and $\alpha \epsilon (0, 1)$ reflects capital intensity. The economy's factors of production are traded in a centralized market. From the perspective of the firm, capital and labor rented from both regions are identical. Moreover, the capital stock is assumed to completely depreciate during the production process.

There are two assets in the economy, physical capital and fiat money. One unit of goods allocated towards investment in physical capital in period t becomes one unit of capital in period $t+1$. In addition to physical capital, there is a stock of money (fiat currency) that circulates in the economy. We denote the per worker nominal monetary base as M_t. Money is a universally recognizable, durable, and divisible object. At the initial date 0, the generation of old workers at each location is endowed with the aggregate stock of 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, P_t is the number of units of currency per unit of goods at time t.

Following Schreft and Smith (1997, 1998), workers are exposed to idiosyncratic risk. To be specific, there is a positive probability that they will need to conduct transactions in the opposite location. As is standard in Schreft-Smith type models, the transaction location shock is viewed as a "random relocation" shock which occurs with probability π. In particular, the realization of the relocation shock will not occur until after financial portfolio allocations have been implemented. As the number of workers is unity, the probability of relocation also reflects the number of agents that will be relocated (movers) on each island. Though the total number of agents exposed to the relocation shock is public information, the individual's realization is privately observed.

Furthermore, there is limited communication between different locations. Therefore, agents cannot trade claims to assets they own in their original location. However, fiat money can be used to overcome these frictions. Moreover, it is the only asset that can be moved across islands. As a result, workers who learn they will be relocated will liquidate all their asset holdings into currency. In this manner, financial intermediaries (bankers) play an important role in terms of insuring workers against the idiosyncratic risk.[8] In contrast to workers, bankers are not subject to relocation shocks.

Deposit markets are assumed to be segregated. That is, depositors in region 1 can only trade with the financial intermediary in region 1.The bank in region 1 is assumed to act as cooperative entity or a credit union that seeks to maximize the expected utility of its depositors. By comparison, the banker in region 2 seeks to maximize its own expected profits. Furthermore, throughout this paper, I assume that $\lambda < \frac{1}{2}$, which translates into the commercial bank having a larger market share compared to the credit union.

The final agent in this economy is a government (or central bank) that adopts a constant money growth rule. Denote the real aggregate money stock in period t by $\tilde{m}_t$. The evolution of real money balances between periods $t-1$ and t is expressed as:

$$\tilde{m}_t = \sigma \frac{P_{t-1}}{P_t} \tilde{m}_{t-1} \tag{1}$$

where $\sigma > 0$ is the constant gross rate of money creation (or destruction when $\sigma < 1$) imposed at the beginning of time. In addition, $\frac{P_{t-1}}{P_t}$ is the gross real return on money balances between period $t-1$ and t. The government uses its seigniorage income to purchase goods. Denote the total amount of goods acquired by the government at the beginning of period t by τ_t where:

$$\tau_t = \frac{\sigma - 1}{\sigma} \tilde{m}_t \tag{2}$$

As a benchmark, I follow Huybens and Smith (1999) by assuming that government purchases are not redistributed back to agents and thus do not influence their decisions.

[8]While financial intermediaries play a similar role as in Diamond and Dybvig (1983), I study the interaction between financial intermediaries with different ownership structure.

3 Trade

3.1 Factor Markets

In period t, a representative firm rents capital and hires workers from both regions in a centralized market at rates r_t and w_t, respectively. As the firm is indifferent between factors from each region, in equilibrium the return on each factor is the same in each region. Furthermore, the firm behaves competitively and the inverse demands for labor and capital by a typical firm are:

$$w_{i,t} = w_t = (1-\alpha) AK_t^{\alpha} L_t^{-\alpha} \tag{3}$$

and

$$r_{i,t} = r_t = \alpha AK_t^{\alpha-1} L_t^{1-\alpha} \tag{4}$$

where $L_t = 1$ in equilibrium.

3.2 A Typical Worker

A young worker born in period t in region i, works and earns the wage rate, w_t, which is entirely saved. A worker cannot invest her savings directly in capital markets unless she uses a financial intermediary. Therefore, if an agent decides not to intermediate her savings (financial autarky), her only outside option is to hold cash reserves. Under financial autarky, the old age consumption of a typical worker in either region, denoted by c_{t+1}^a is:

$$c_{t+1}^a = w_t \frac{P_t}{P_{t+1}}$$

and the expected utility is:

$$\underline{u}_t = \frac{\left[w_t \frac{P_t}{P_{t+1}}\right]^{1-\theta}}{1-\theta}$$

3.3 The Credit Union in Region 1

The bank in region 1 acts like a cooperative entity that is owned by its depositors who combine their resources to hedge against liquidity risk. This financial institution is basically a credit union who receives λw_t in deposits. Its objective is to maximize the expected utility of its owners / depositors. The portfolio choice consists of real money balances, $m_{1,t}$ and capital investment, $i_{1,t}$. The banker's balance sheet is therefore:

$$\lambda w_t = m_{1,t} + i_{1,t} \tag{5}$$

Due to the large number of depositors, the credit union can completely diversify idiosyncratic shocks and consumption levels of each member will be contingent on the realization of the shock. Define $c^m_{1,t+1}$ and $c^n_{1,t+1}$ to be the consumption levels of a depositor if she relocates (a mover) an if she does not relocate (a non-mover) respectively. The total payments made to workers in the event they relocate are made of cash with:

$$\lambda \pi c^m_{1,t+1} = m_{1,t} \frac{P_t}{P_{t+1}} \tag{6}$$

The credit union's payments to non-movers are paid out of its revenue from renting capital to firms in $t+1$. The credit union competes with the commercial bank over capital goods in a Nash Cournot fashion. That is, the credit union takes into account the impact of its investing decision on the return to capital but it takes the actions of the banker in region 2 as given.

$$r\left(K_{1,t+1} + K_{2,t+1}\right) = \alpha A \left(K_{1,t+1} + K_{2,t+1}\right)^{\alpha-1} \tag{7}$$

where $K_{t+1} = K_{1,t+1} + K_{2,t+1}$. The constraint on payments to non-movers is such that:

$$(1-\pi)\lambda c^n_{1,t+1} = r\left(K_{1,t+1}, K_{2,t+1}\right) K_{1,t+1} \tag{8}$$

where $i_{1,t} = K_{1,t+1}$.

Furthermore, the contract between the bank and its depositors has to be incentive compatible. Therefore, the following self-selection constraint has to hold:

$$\frac{c^n_{1,t+1}}{c^m_{1,t+1}} \geq 1 \tag{9}$$

In order to induce workers to participate in the banking sector, the expected utility of a typical agent when their savings are intermediated, u^{CU}_t must be at least as high as that under direct investment. That is, the following participation constraint must hold:

$$u_{1,t} \geq \underline{u}_t \tag{10}$$

In sum, the credit union solves the following problem:

$$\underset{c^m_{1,t+1}, c^n_{1,t+1}, m_{1,t}, K_{1,t+1}}{Max} \pi \frac{\left(c^m_{1,t+1}\right)^{1-\theta}}{1-\theta} + (1-\pi) \frac{\left(c^n_{1,t+1}\right)^{1-\theta}}{1-\theta} \tag{11}$$

subject to (5)-(10) and $i_{1,t} = K_{1,t+1}$.

The solution to the problem yields the money demand equation in region 1:

$$m_{1,t} = \begin{cases} \dfrac{\lambda w_t}{1+\frac{1-\pi}{\pi}\left[1-(1-\alpha)\mu_{1,t+1}\right]^{\frac{1}{\theta}} \left(I_t\left(K_{t+1}, \frac{P_{t+1}}{P_t}\right)\right)^{\frac{1-\theta}{\theta}}} & \text{if } \frac{P_{t+1}}{P_t} > \frac{1}{\left[1-(1-\alpha)\mu_{1,t+1}\right] r(K_{1,t+1}, K_{2,t+1})} \\ \dfrac{\lambda w_t}{1+\frac{1-\pi}{\pi}\left(I_t\left(K_{t+1}, \frac{P_{t+1}}{P_t}\right)\right)^{-\frac{1-\theta}{\theta}}} & \text{if } \frac{P_{t+1}}{P_t} \in \left[\frac{1}{r(K_{1,t+1}, K_{2,t+1})}, \frac{1}{\left[1-(1-\alpha)\mu_{1,t+1}\right] r(K_{1,t+1}, K_{2,t+1})}\right] \end{cases} \tag{12}$$

where $I_t = \frac{P_{t+1}}{P_t} r\left(K_{1,t+1} + K_{2,t+1}\right) \equiv I_t\left(K_{t+1}, \frac{P_{t+1}}{P_t}\right)$ is the nominal return to capital and $\mu_{1,t+1} = \frac{K_{1,t+1}}{K_{t+1}}$ is the credit union's share in the capital market.

Equivalently, the bank in region 1 allocates a fraction, $\gamma_{1,t}$ of its deposits towards cash reserves:

$$\gamma_{1,t} = \begin{cases} \frac{1}{1+\frac{1-\pi}{\pi}\left[1-(1-\alpha)\mu_{1,t+1}\right]^{\frac{1}{\theta}}\left(I_t\left(K_{t+1},\frac{P_{t+1}}{P_t}\right)\right)^{\frac{1-\theta}{\theta}}} & \text{if } \frac{P_{t+1}}{P_t} > \frac{1}{\left[1-(1-\alpha)\mu_{1,t+1}\right]r(K_{1,t+1},K_{2,t+1})} \\ \frac{1}{1+\frac{1-\pi}{\pi}\left(I_t\left(K_{t+1},\frac{P_{t+1}}{P_t}\right)\right)^{-1}} & \text{if } \frac{P_{t+1}}{P_t} \in \left[\frac{1}{r(K_{1,t+1},K_{2,t+1})}, \frac{1}{\left[1-(1-\alpha)\mu_{1,t+1}\right]r(K_{1,t+1},K_{2,t+1})}\right] \end{cases} \tag{13}$$

and from (5), the supply of capital by the bank in region 1 is:

$$K_{1,t} = \left(1 - \gamma_{1,t}\right)\lambda w_t \tag{14}$$

where $\gamma_{1,t}$ is given by (13).

Furthermore, using (5), (6), (8), and (12), the relative consumption or depositors in region 1 is:

$$\frac{c^n_{1,t+1}}{c^m_{1,t+1}} = \begin{cases} \left[\left[1-(1-\alpha)\mu_{1,t+1}\right] * I_t\left(K_{t+1},\frac{P_{t+1}}{P_t}\right)\right]^{\frac{1}{\theta}} & \text{if } \frac{P_{t+1}}{P_t} > \frac{1}{\left[1-(1-\alpha)\mu_{1,t+1}\right]r(K_{1,t+1},K_{2,t+1})} \\ 1 & \text{if } \frac{P_{t+1}}{P_t} \in \left[\frac{1}{r(K_{1,t+1},K_{2,t+1})}, \frac{1}{\left[1-(1-\alpha)\mu_{1,t+1}\right]r(K_{1,t+1},K_{2,t+1})}\right] \end{cases} \tag{15}$$

Discussion:

In this setting, the portfolio of the credit union in region 1 depends on the inflation rate. In particular, when the inflation rate is above a threshold level, $\left[1-(1-\alpha)\mu_{1,t+1}\right]^{-1}\left(r\left(K_{1,t+1}, K_{2,t+1}\right)\right)^{-1}$, the incentive compatibility constraint facing the bank does not bind. Moreover, the banker allocates a smaller fraction of its deposits towards cash reserves when the inflation rate is higher. Therefore, the credit union provides less insurance against liquidity risk at higher inflation rates if inflation is sufficiently high. The term $\left[1-(1-\alpha)\mu_{1,t+1}\right] \in [0,1]$ represents the extent of market power and distortions that stem from imperfect competition in the capital market. In particular, the credit union holds a more liquid portfolio when it gains market share (market power) in capital markets. The higher amount of cash reserves enables it to provide its depositors with better insurance against liquidity shocks for a given return to capital.

3.4 Bank in Region 2: Commercial Bank

At the beginning of period t, the banker in region 2 announces deposit rates, $r^m_{2,t}$ and $r^n_{2,t}$. The bank exerts its market power by extracting all surplus from deposit markets. Hence, the participation constraint, (10) holds with equality. Total deposits in region 2 amount to $(1-\lambda)\,w_t$. In contrast to the credit union, the banker seeks to maximize its own profits. Given that the banker only values old age consumption, all deposits are invested in asset markets. Therefore, the banker makes her portfolio and pricing decisions, $\left(m_{2.t}, K_{2,t+1}, r_{2,t}^m, r_{2,t}^n\right)$ to maximize profits in $t+1$, Π_{t+1} :

$$\Pi_{t+1} = \underset{m_{2,t},K_{2,t+1},r_{2,t}^m,r_{2,t}^n}{Max} r_{t+1}K_{2,t+1} + m_{2,t}\frac{P_t}{P_{t+1}} - \pi\,(1-\lambda)\,r_{2,t}^m w_t - (1-\pi)\,(1-\lambda)\,r_{2,t}^n w_t \tag{16}$$

subject to:

$$(1-\lambda)\,w_t = m_{2,t} + i_{2,t} \tag{17}$$

where $i_{2,t} = K_{2,t+1}$.

Payments to movers of whom there are $\pi\,(1-\lambda)$ are made of cash balances:

$$\pi\,(1-\lambda)\,r_{2,t}^m w_t = m_{2,t}\frac{P_t}{P_{t+1}} \tag{18}$$

Further, payments made to non-relocated agents are made out of the return from renting capital. The banker is willing to provide financial services only if she makes non-negative profits. Thus, the constraint on payments to non-movers is such that:

$$(1-\pi)\,(1-\lambda)\,r_{2,t}^n w_t < r\,(K_{1,t+1} + K_{2,t+1})\,K_{2,t+1} \tag{19}$$

As for the bank in region 1, Cournot competition in the rental market for capital implies that the bank faces a downward sloping demand for capital, (7). Consequently, it takes into account that it must earn a lower return from capital under a higher level of investment taking the actions of the credit union as given. Finally, the following incentive compatibility constraint must hold:

$$\frac{r_{2,t}^n}{r_{2,t}^m} \geq 1 \tag{20}$$

In sum, the bank maximizes (16) subject to (4), (10), (5), (6), and (20). To begin, suppose the self-selection constraint, (20) is non-binding. Substituting the binding constraints into the objective function, the problem is reduced into a choice of capital:

$$\Pi_{t+1} = \underset{K_{2,t+1}}{Max}\; \alpha A\,(K_{1,t+1} + K_{2,t+1})^{\alpha-1} K_{2,t+1} - \frac{(1-\lambda)\,\frac{P_t}{P_{t+1}}}{(1-\pi)^{\frac{\theta}{1-\theta}}}\left(w_t^{1-\theta} - \frac{\pi^\theta}{(1-\lambda)^{1-\theta}}\left[(1-\lambda)\,w_t - K_{2,t+1}\right]^{1-\theta}\right)^{\frac{1}{1-\theta}} \tag{21}$$

The profit maximizing choice of capital is such that

$$\left[1-(1-\alpha)\frac{K_{2,t+1}}{K_{t+1}}\right]r\left(K_{1,t+1}+K_{2,t+1}\right)=\frac{(1-\lambda)\frac{P_t}{P_{t+1}}}{(1-\pi)^{\frac{\theta}{1-\theta}}}\frac{\pi^{\theta}m_{2,t}^{-\theta}}{(1-\lambda)^{1-\theta}}\left(w_t^{1-\theta}-\frac{\pi^{\theta}}{(1-\lambda)^{1-\theta}}\frac{m_{2,t}^{1-\theta}}{(1-\pi)}\right)^{\frac{\theta}{1-\theta}} \tag{22}$$

where the term on the left-hand-side is the marginal revenue from investing a unit in capital. The term on the right-hand-side of (22) reflects the additional payments the bank has to make to non-movers upon holding an extra unit of capital. Given that the bank extracts all the surplus from the deposit market, relocated depositors receive a lower return when capital investment is higher. In order to retain their deposits, the bank has to offer its depositors a higher return if they do not relocate. Upon re-writing (22), the demand for money balances by the bank in region 2 is given by:

$$m_{2,t}=\frac{1}{\pi^{\frac{\theta}{1-\theta}}}\frac{(1-\lambda)\,w_t}{\left[1+\frac{1-\pi}{\pi}\left[1-(1-\alpha)\,\mu_{2,t+1}\right]^{\frac{1-\theta}{\theta}}\left(I_t\left(K_{t+1},\frac{P_{t+1}}{P_t}\right)\right)^{\frac{1-\theta}{\theta}}\right]^{\frac{1}{1-\theta}}} \tag{23}$$

or equivalently, money to deposits ration is:

$$\gamma_{2,t}=\frac{1}{\pi^{\frac{\theta}{1-\theta}}}\frac{1}{\left[1+\frac{1-\pi}{\pi}\left[1-(1-\alpha)\,\mu_{2,t+1}\right]^{\frac{1-\theta}{\theta}}\left(I_t\left(K_{t+1},\frac{P_{t+1}}{P_t}\right)\right)^{\frac{1-\theta}{\theta}}\right]^{\frac{1}{1-\theta}}} \tag{24}$$

where $\mu_{2,t+1}=\frac{K_{2,t+1}}{K_{t+1}}$ is region 2's bank market share in capital markets. Analogous to the credit union, the bank in region 2 holds a less liquid portfolio when inflation is higher. Furthermore, $\left[1-(1-\alpha)\frac{K_{2,t+1}}{K_{t+1}}\right]$ represents the extent of market power by the commercial bank. If the bank has a large market share in capital markets, it holds a more liquid portfolio. In addition, using (10), (17), (18), and (23), the relative return to depositors in region 2 is:

$$\frac{r_{2,t}^{n}}{r_{2,t}^{m}}=\left[1-(1-\alpha)\,\mu_{2,t+1}\right]^{\frac{1}{\theta}}\left(I_t\left(K_{t+1},\frac{P_{t+1}}{P_t}\right)\right)^{\frac{1}{\theta}} \tag{25}$$

By definition of $I_t=r\left(K_{1,t+1},K_{2,t+1}\right)\frac{P_{t+1}}{P_t}$, the incentive compatibility constraint is non binding if $\frac{P_{t+1}}{P_t}>\left[1-(1-\alpha)\,\mu_{2,t+1}\right]^{-1}\left(r\left(K_{1,t+1},K_{2,t+1}\right)\right)^{-1}$ or equivalently $I_t\geq\left[1-(1-\alpha)\,\mu_{2,t+1}\right]^{-1}=\underline{I}_{2,t}$.

As I focus on cases where money is dominated in rate of return, the incentive compatibility constraint binds for all $\frac{P_{t+1}}{P_t}\in\left[\frac{1}{r(K_{1,t+1},K_{2,t+1})},\frac{1}{\left[1-(1-\alpha)\mu_{2,t+1}\right]r(K_{1,t+1},K_{2,t+1})}\right]$. When the incentive compatibility constraint binds, the bank's portfolio decision is pinned down by its resource constraints. Upon using (10), (17), and (18), the bank's cash holdings at low inflation rates is:

$$m_{2,t} = \pi (1-\lambda) w_t \tag{26}$$

Using this information, the amount of cash held by the bank in region 2 is:

$$m_{2,t} = \begin{cases} \frac{1}{\pi^{\frac{\theta}{1-\theta}}} \frac{(1-\lambda)w_t}{\left[1+\frac{1-\pi}{\pi}\left[1-(1-\alpha)\frac{K_{2,t+1}}{K_{t+1}}\right]^{\frac{1-\theta}{\theta}} I_t^{\frac{1-\theta}{\theta}}\right]^{\frac{1}{1-\theta}}} & \text{if } \frac{P_{t+1}}{P_t} > \frac{1}{\left[1-(1-\alpha)\mu_{2,t+1}\right] r(K_{1,t+1},K_{2,t+1})} \\ \pi (1-\lambda) w_t & \text{if } \frac{P_{t+1}}{P_t} \in \left[\frac{1}{r(K_{1,t+1},K_{2,t+1})}, \frac{1}{\left[1-(1-\alpha)\mu_{2,t+1}\right] r(K_{1,t+1},K_{2,t+1})}\right] \end{cases} \tag{27}$$

Equivalently, the bank allocates a fraction, $\gamma_{2,t}$ of its deposits towards cash reserves:

$$\gamma_{2,t} = \begin{cases} \frac{1}{\pi^{\frac{\theta}{1-\theta}}} \frac{1}{\left[1+\frac{1-\pi}{\pi}\left[1-(1-\alpha)\frac{K_{2,t+1}}{K_{t+1}}\right]^{\frac{1-\theta}{\theta}} I_t^{\frac{1-\theta}{\theta}}\right]^{\frac{1}{1-\theta}}} & \text{if } \frac{P_{t+1}}{P_t} > \frac{1}{\left[1-(1-\alpha)\mu_{2,t+1}\right] r(K_{1,t+1},K_{2,t+1})} \\ \pi & \text{if } \frac{P_{t+1}}{P_t} \in \left[\frac{1}{r(K_{1,t+1},K_{2,t+1})}, \frac{1}{\left[1-(1-\alpha)\mu_{2,t+1}\right] r(K_{1,t+1},K_{2,t+1})}\right] \end{cases} \tag{28}$$

with the supply of capital from region 2 is:

$$K_{2,t+1} = \left(1-\gamma_{2,t}\right)(1-\lambda) w_t \tag{29}$$

where $\gamma_{2,t}$ is given by (28).

Furthermore, from the work above, the relative return to depositors in region 2 is:

$$\frac{r^n_{2,t}}{r^m_{2,t}} = \begin{cases} \left[1-(1-\alpha)\frac{K_{2,t+1}}{K_{t+1}}\right]^{\frac{1}{\theta}} I_t^{\frac{1}{\theta}} & \text{if } \frac{P_{t+1}}{P_t} > \frac{1}{\left[1-(1-\alpha)\mu_{2,t+1}\right] r(K_{1,t+1},K_{2,t+1})} \\ 1 & \text{if } \frac{P_{t+1}}{P_t} \in \left[\frac{1}{r(K_{1,t+1},K_{2,t+1})}, \frac{1}{\left[1-(1-\alpha)\mu_{2,t+1}\right] r(K_{1,t+1},K_{2,t+1})}\right] \end{cases} \tag{30}$$

Finally, using (16), (17), (18), (28), and (30), the bank's equilibrium profits are:

$$\Pi_{t+1} = \begin{cases} \left[I_t\left(1-\gamma_{2,t}\right) - \frac{\left[1-\pi^{\theta}\gamma_{2,t}^{1-\theta}\right]^{\frac{1}{1-\theta}}}{(1-\pi)^{\frac{\theta}{1-\theta}}}\right] \frac{P_t}{P_{t+1}} (1-\lambda) w_t & \text{if } \frac{P_{t+1}}{P_t} > \frac{1}{\left[1-(1-\alpha)\mu_{2,t+1}\right] r(K_{1,t+1},K_{2,t+1})} \\ \left[I_t - 1\right] \frac{P_t}{P_{t+1}} (1-\pi)(1-\lambda) w_t & \text{if } \frac{P_{t+1}}{P_t} \in \left[\frac{1}{r(K_{1,t+1},K_{2,t+1})}, \frac{1}{\left[1-(1-\alpha)\mu_{2,t+1}\right] r(K_{1,t+1},K_{2,}} \right. \end{cases} \tag{31}$$

which clearly suggests that the bank's profits are positive above the Friedman rule, i.e. $r\left(K_{1,t+1}, K_{2,t+1}\right) > \frac{P_t}{P_{t+1}}$. Moreover, as money is dominated in rate of return, the credit union in region 1 holds a more liquid porftolio compared to the profit maximzing bank in region 2. This can be easily observed when the incentive compatibility constraint is binding in both regions, where $\gamma_{1,t} > \pi$.

4 General Equilibrium:

In equilibrium, all markets clear. The labor market clears, with $L_t = 1$ and wages are given by (3). Next, the money market clears with: $m_{1,t} + m_{2,t} = \tilde{m}_t$, where $m_{1,t}$ and $m_{2,t}$ are given by (12) and (27), respectively. Furthermore, the aggregate supply of capital is given by $K_{1,t+1} + K_{2,t+1} = K_{t+1}$, where the expressions for $K_{1,t+1}$ and $K_{2,t+1}$ are given by (14) and (29), respectively. The demand for capital is expressed by (7). From the solution to the bank's problem in each region, the incentive compatibility constraint binds at a different inflation rate as long as banks in each region have different market share in the capital market. More specifically, define $\underline{I}_{1,t}$, to be the gross return on capital below which depositors in region 1 receive complete insurance, where $\underline{I}_{1,t} = \left[1 - (1-\alpha)\,\mu_{2,t+1}\right]^{-1}$. By comparison, complete risk sharing is achieved in region 2 if $1 \leq I_t \leq \left[1 - (1-\alpha)\,\mu_{1,t+1}\right]^{-1}$. In this manner, $\underline{I}_{2,t} \geq \underline{I}_{1,t}$ if $\mu_{1,t+1} \leq \mu_{2,t+1}$ (or equivalently, $\mu_{1,t+1} \leq \frac{1}{2}$), which is assumed to hold throughout the analysis as the bank in region 2 has a much larger deposit base compared to the credit union ($\lambda < \frac{1}{2}$).

In this manuscript, I choose to study the behavior of the economy in the steady-state. From the evolution of real money balances, (1), the gross steady-state inflation rate is pinned down by the rate of money creation, with $\frac{P_{t+1}}{P_t} = \sigma$. Given that $\underline{I}_{2,t} \geq \underline{I}_{1,t}$, three cases arise in this setting which are presented in the following Corollary:

Corollary 1.

Case 1. $I_t \in [1, \underline{I}_1]$ *under which the incentive compatibility constraint binds in both regions.*

Case 2. $I_t \in (\underline{I}_1, \underline{I}_2]$ *under which the incentive compatibility constraint binds in region 2 but not in region 1.*

Case 3. $I_t > \underline{I}_2$ *under which the incentive compatibility is not binding in either region.*

Proposition 1. *Suppose* $\sigma \geq \underline{\sigma}_0$, *where* $\underline{\sigma}_0 = (1-\pi)\,\frac{1-\alpha}{\alpha}$. *Under this condition, a steady-state equilibrium where banks are operating in both regions exists and is unique.*

In this manuscript, I focus on equilibria where money is dominated in rate of return, $I \geq 1$. As I demonstrate in the appendix, this requires the rate of money growth to exceed $\underline{\sigma}_0$. Furthermore, I demonstrate that the incentive compatibility constraint binds in both regions as under Case 1, if $\sigma \in [\underline{\sigma}_0, \underline{\sigma}_1)$, whereas we obtain Case 2 above if $\sigma \in [\underline{\sigma}_1, \underline{\sigma}_2)$. Both $\underline{\sigma}_1$ and $\underline{\sigma}_2$ are defined in the appendix. Finally, the incentive compatibility constraint is relaxed in both regions if $\sigma > \underline{\sigma}_2$.

I proceed to study the effects of monetary policy.

Proposition 2.

i. Suppose $\sigma \in (\underline{\sigma}_0, \underline{\sigma}_1)$. *Under this condition,* $\frac{dK}{d\sigma} < 0$, $\frac{dI}{d\sigma} > 0$, $\frac{d\mu_1}{d\sigma} < 0$, *and* $\frac{d\mu_2}{d\sigma} > 0$.

ii. Suppose $\sigma \in [\underline{\sigma}_1, \underline{\sigma}_2)$. *Under this condition,* $\frac{dK}{d\sigma} > 0$, $\frac{dI}{d\sigma} > 0$, $\frac{d\mu_1}{d\sigma} > 0$, *and* $\frac{d\mu_2}{d\sigma} < 0$.

iii. Suppose $\sigma \geq \underline{\sigma}_2$. *Under this condition,* $\frac{dK}{d\sigma} > 0$, $\frac{dI}{d\sigma} > 0$, $\frac{d\mu_1}{d\sigma} >< 0$, *and* $\frac{d\mu_2}{d\sigma} >< 0$.

Proposition 2 indicates that the effects of monetary policy are highly non-monotonic. In particular, when inflation is sufficiently low as under case i, the incentive compatibility constraints bind in both regions. Under a higher rate of money growth, movers would receive a lower return on their deposits. The credit union in region 1 responds by holding more cash reserves and less capital in order to satisfy the complete insurance contract. However, this is not the case in region 2. When $\sigma \in (\underline{\sigma}_0, \underline{\sigma}_1]$, the bank in region 2 is allocating a constant fraction of its deposits towards cash reserves and therefore it does not adjust its portfolio to changes in the rate of money growth. Instead of holding more cash reserves to offset the lower payments made to movers, the profit maximizing bank also lowers the return to non-movers. Overall, the credit union loses market share in the capital market and the capital stock falls under a higher rate of money creation when inflation is initially low.

Over an intermediate range of the rate of money growth, the incentive compatibility constraint is relaxed region 1 but still binds in region 2.[9] Therefore, the credit union holds a less liquid portfolio under a higher rate of money growth. As the commercial bank in region 2 offers complete risk sharing, the credit union grabs market share in the capital market. In this manner, inflation promotes capital formation.

Finally, when inflation is sufficiently large as under case iii, the incentive compatibility constraint is relaxed in both regions. Banks in both regions hold a less liquid portfolio under lower value of money. Therefore, inflation exhibits a Tobin effects. However, given that the bank in region 2 allocates a larger fraction of its deposits towards capital formation, it invests more aggressively in the capital market to grab market share and make more profits. While its hard to prove the last result analytically, i present a numerical example in Table 1 below. The parameters used in this example are: $A = 10$, $\lambda = 0.2$, $\pi = 0.75$, $\alpha = 1/3$, and $\theta = 0.9$.[10]

[9] Ahmed and Rogers (2000) finds a positive relationship between inflation and capital formation for the United States. Bullard and Keating (1995) find a non-montonic relationship between real output and inflation across countries.

[10] The result holds under a broad range of parameters.

σ	1.01	1.02	1.03	1.04	1.05	1.06	1.07	1.08	1.09	1.1
K	2.11736	2.117815	2.118266	2.118713	2.119156	2.119594	2.120029	2.127958	2.139136	2.150245
K_1	0.405229	0.405562	0.405891	0.406217	0.406541	0.406861	0.407179	0.408008	0.409055	0.410092
K_2	1.712131	1.712254	1.712375	1.712496	1.712615	1.712733	1.71285	1.71995	1.730081	1.740152
γ_1	0.763319	0.763142	0.762966	0.762792	0.76262	0.762449	0.76228	0.762092	0.761898	0.761706
γ_2	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.749276	0.748239	0.74721
μ_1	0.191384	0.1915	0.191615	0.191728	0.191841	0.191952	0.192063	0.191737	0.191224	0.190719
μ_2	0.808616	0.8085	0.808385	0.808272	0.808159	0.808048	0.807937	0.808263	0.808776	0.809281
w	8.560655	8.561268	8.561876	8.562478	8.563074	8.563665	8.56425	8.574913	8.589902	8.604746
$(r^n/r^m)_1$	1.05943	1.06045	1.061461	1.062463	1.063456	1.064441	1.065417	2.037899	2.051794	2.065668
$(r^n/r^m)_2$	1	1	1	1	1	1	1	1.003871	1.009444	1.015009
$c_{1,m}$	8.626414	8.54047	8.456208	8.373578	8.292533	8.213029	8.135022	8.067747	8.005663	7.944587
$c_{1,n}$	16.38374	16.39483	16.40582	16.4167	16.42748	16.43817	16.44875	16.44126	16.42597	16.41088
$c_{2,m}$	8.475896	8.3934	8.312501	8.233151	8.155308	8.078929	8.003972	7.932069	7.862141	7.7934
$c_{2,n}$	8.475896	8.3934	8.312501	8.233151	8.155308	8.078929	8.003972	7.962772	7.936389	7.910371
u_1	12.61005	12.60097	12.59198	12.58308	12.57428	12.56558	12.55696	12.54913	12.54169	12.53431
u_2	12.38279	12.37069	12.35871	12.34686	12.33514	12.32354	12.31206	12.30214	12.29295	12.28385
Π	1.765961	1.782213	1.798147	1.813773	1.829101	1.844138	1.858893	1.872839	1.886375	1.899755
U	12.42824	12.41674	12.40536	12.39411	12.38297	12.37194	12.36104	12.35154	12.3427	12.33394

Table1. The Effects of Monetary Policy

I proceed to study the implications of credit unions gaining market share in the deposit market for various economic outcomes.

Proposition 3.

i. Suppose $\sigma \in [\underline{\sigma}_0, \underline{\sigma}_1]$. *Under this condition,* $\frac{d\mu_1}{d\lambda} > 0$, $\frac{d\mu_2}{d\lambda} < 0$, $\frac{dI}{d\lambda} > 0$, *and* $\frac{dK}{d\lambda} < 0$.

ii. Suppose $\sigma \in (\underline{\sigma}_1, \underline{\sigma}_2]$. *Under this condition,* $\frac{d\mu_1}{d\lambda} > 0$, $\frac{d\mu_2}{d\lambda} < 0$, $\frac{dI}{d\lambda} < 0$, *and* $\frac{dK}{d\lambda} > 0$.

iii. Suppose $\sigma > \underline{\sigma}_2$. *Under this condition,* $\frac{d\mu_1}{d\lambda} > 0$, $\frac{d\mu_2}{d\lambda} < 0$, $\frac{dI}{d\lambda} >< 0$, *and* $\frac{dK}{d\lambda} >< 0$.

The result in Proposition 3 indicates that the credit union unambiguously grabs market share from banks in the capital market as their deposit base gets relatively larger. However, the net impact on capital formation is ambiguous and depends on several factors.

First, when inflation is sufficiently low, the incentive compatibility constraint binds in both region. In this manner, the desire of banks to use their marker power is not present. A larger deposit base enables the credit union to increase its capital investment. However, given that the credit union allocates a larger fraction of its deposits towards cash reserves relative to the commercial bank, the increase in capital investment from region 1 is offset by the drop in investment from the commercial bank in region 2. Overall at low inflation rates, aggregate capital formation is lower as credit unions gain market share in the deposit market.

Secondly, over an intermediate range of the money growth, the nominal return to capital is high enough to relax the self-selection constraint in region 1 but not in region 2. A change in the deposit base of the credit union relative to the bank affects capital formation through a number of channels. First, as under case i, the credit union is able to hold more assets when its deposit base increases. However, as the credit union gets larger, it also gains market power in the capital market which induces it to allocate a smaller fraction of its deposits towards capital investment. The final impact occurs through the nominal return to capital. As the credit union increases its capital investment (taking the investment by the commercial bank as given), it lowers the cost of holding money, which stimulates its investment in capital formation further. Overall, aggregate capital formation is improved.

Under case iii, each financial institution is capable of exerting its market power in capital markets. While a relatively higher deposit base in the credit union allows it to grab market share in capital markets, the net impact on capital formation is not trivial as there are many factors influencing investment decisions. First, the positive impact from higher deposits in the credit union on capital formation is mitigated by the increased distortion as the credit union gets larger in size. That is, for a given nominal return to capital, the credit union holds a more liquid portfolio. On the other hand, as the commercial bank loses deposits, its market power in capital markets is hindered, which encourages the bank to hold a less liquid portfolio. The net impact depends on which effects deominate. Numerical work presented in Table 2 below, suggests that aggregate capital formation increases as the credit union gains deposit market share when inflation is relatively high.[11] The Table uses the same parameter values as in Table 1, with $\sigma = 1.08$:

[11] The result holds over a large set of parameter values.

λ	0.2	0.25	0.3	0.35	0.4
K	2.127959	2.17698	2.209173	2.225676	2.227122
K_1	0.408008	0.500478	0.588191	0.670709	0.747547
K_2	1.719951	1.676502	1.620982	1.554967	1.479576
γ_1	0.762092	0.768305	0.774189	0.779841	0.785338
γ_2	0.749276	0.741288	0.733297	0.725161	0.716755
μ_1	0.191737	0.229896	0.266249	0.301351	0.335656
μ_2	0.808263	0.770104	0.733751	0.698649	0.664344
w	8.574915	8.640262	8.682644	8.704211	8.706096
R	2.014822	1.98446	1.965134	1.955408	1.954562
I	2.176007	2.143217	2.122345	2.111841	2.110926
Ω_1	0.237908	0.231696	0.225811	0.220159	0.214662
Ω_2	0.250724	0.258712	0.266703	0.274839	0.283245
$(r^n/r^m)_1$	2.037898	1.938976	1.857101	1.788601	1.730982
$(r^n/r^m)_2$	1.003872	1.047757	1.093942	1.143442	1.197381
$c_{1,m}$	8.067749	8.195497	8.298774	8.380121	8.441024
$c_{1,n}$	16.44125	15.89087	15.41166	14.98869	14.61126
$c_{2,m}$	7.932069	7.907316	7.860439	7.792536	7.703872
$c_{2,n}$	7.962778	8.284948	8.598865	8.91031	9.224473
u_1	12.54913	12.55242	12.55394	12.55385	12.55222
u_2	12.30214	12.31148	12.31751	12.32056	12.32083
Π	1.87284	1.773523	1.680646	1.592669	1.508251
U	12.35154	12.37172	12.38844	12.40221	12.41339

Table 2. Credit Union Market Share and Economic Outcomes

The results in Proposition 3 do not tells how the marginal effects of monetary policy depend on the extent of market share of each financial institution. That is, do the effects of monetary policy get stronger as the credit union gains market share? How about the regional effects? In order to address this important issue, I construct the following examples in Tables 3-5 using the same parameter values from the previous tables. Interestingly, at low levels of inflation, the marginal effects of monetary policy increase in both regions when the competition between the credit union and the commercial bank intensifies. However, once inflation increases above a certain threshold, further gains in market share by the credit union hinder the marginal effects of monetary policy in region 2 and in the aggregate.

σ	$dK_1/d\sigma$	$dK_2/d\sigma$	$dK/d\sigma$
1.02	0.025580	0.010169	0.035749
1.03	0.025345	0.010074	0.035419
1.04	0.025115	0.009981	0.035096
1.05	0.024889	0.009889	0.034778
1.06	0.024667	0.009800	0.034466
1.07	0.024449	0.009712	0.034160
1.08	0.024235	0.009625	0.033860
1.09	0.024025	0.009540	0.033565
1.1	0.023818	0.009457	0.033275

Table 3. Marginal Effects of Monetary Policy, $\lambda = .15$

σ	$dK_1/d\sigma$	$dK_2/d\sigma$	$dK/d\sigma$
1.02	0.033239	0.012264	0.045503
1.03	0.032935	0.012149	0.045084
1.04	0.032636	0.012037	0.044673
1.05	0.032343	0.011926	0.044269
1.06	0.032055	0.011818	0.043873
1.07	0.031773	0.011712	0.043484
1.08	0.082846	0.710000	0.792845
1.09	0.104693	1.013143	1.117837
1.1	0.103785	1.007087	1.110872

Table 4. Marginal Effects of Monetary Policy, $\lambda = .20$

σ	$dK_1/d\sigma$	$dK_2/d\sigma$	$dK/d\sigma$
1.02	0.136106	1.008677	1.144784
1.03	0.134878	1.002064	1.136942
1.04	0.133633	0.99561	1.129243
1.05	0.132412	0.989241	1.121652
1.06	0.131212	0.982955	1.114168
1.07	0.130034	0.976752	1.106787
1.08	0.128878	0.970629	1.099507
1.09	0.127741	0.964585	1.092326
1.1	0.126624	0.958618	1.085243

Table 5. Marginal Effects of Monetary Policy, $\lambda = .25$

5 Welfare Analysis

In this section, I study how monetary policy and the extent of competition between the credit union and the commercial bank affects economic welfare. As in previous studies like Williamson (1986) and Ghossoub and Reed (2010), the steady-state aggregate expected utility of depositors is used as a proxy for economic welfare. In particular, the aggregate utility function is such that:

$$U = \lambda u_1 + (1 - \lambda) u_2 \tag{32}$$

where u_i is the expected utility of a depositor in region i, with $i = 1, 2$.

Given the complexity the exercise, it is impossible to proceed analytically and therefore I resort to numerical simulation. Unless indicated, the parameters used are identical to those in previous examples. What is the optimal size of each type of financial institution? Does it depend on Monetary policy? Table 6. provides an answer to these important questions. First, the optimal size of each financial institution depends on monetary policy and the degree of liquidity risk. For a given inflation rate, it is optimal to have more resources allocated by the commercial bank relative to the credit union as the degree of liquidity risk increases. Furthermore, when the degree of liquidity risk is low, credit unions should play a bigger role as inflation increases. By comparison, when agents are highly exposed to liquidity risk, it is optimal to give a bigger role for commercial banks under higher inflation rates.

σ	λ^* (π=.75)	λ^* (π=.9)
1	0.60294	0.44721
1.05	0.60983	0.44656
1.1	0.61653	0.44603
1.15	0.62303	0.4456

Table 6. Optimal Distribution of Deposits

6 Conclusion

While commercial banks and credit unions provide similar financial services, they have different ownership structure and therefore have different objectives. For instance, banks are often perceived as profit maximizers, while credit unions act like cooperative entities seeking value and aim to maximize the welfare of their depositors. Since the great recession of 2007-2009, credit unions have gained market share in the deposit market from banks. In this manuscript I demonstrate that if credit unions play a bigger role in the economy relative to commercial bank, capital formation could be fostered if inflation is above some level. In a low inflationary environment, capital formation could fall. Moreover, the marginal effects of monetary policy on aggregate capital formation could increase as credit unions play a bigger role. However, this hinges on inflation rates being relative low. Finally, I demonstrate that when agents are highly exposed to liquidity risk, it is optimal to give a bigger role for commercial banks under higher inflation rates.

References

Ahmed, S. and J.H. Rogers, 2000. Inflation and the Great Ratios: Long Term Evidence from the U.S. Journal of Monetary Economics 45, 3-35.

Boyd, J., G. De Nicolo, and B.D. Smith, 2004. Crises in Competitive versus Monopolistic Banking Systems. Journal of Money, Credit and Banking 36, 487-506.

Boyd, J. and G. De Nicolo, 2005. The Theory of Bank Risk Taking and Competition Revisited. Journal of Finance 60, 1329-1343.

Bullard, J. and J. Keating, 1995. The Long-Run Relationship Between Inflation and Output in Postwar Economies. Journal of Monetary Economics 36, 477-496.

Cechetti, S., 1999. Legal Structure, Financial Structure, and the Monetary Policy Transmission Mechanism. Federal Reserve Bank of New York Economic Policy Review, 9-28.

Diamond, D. and P. Dybvig, 1983. Bank Runs, Deposit Insurance, and Liquidity. Journal of Political Economy 91, 191-206.

Ghossoub, E., T. Laosuthi, and R. Reed, 2012. The Role of Financial Sector Competition for Monetary Policy. Canadian Journal of Economics 45, 270-287.

_ _ _ _ and _ _ _ _ _, 2014. Banking Competition, Monetary Policy, and Capital Accumulation. Mimeo, University of Alabama.

_ _ _ _ and _ _ _ _ _, 2015. The Size Distribution of the Banking Sector and the Effects of Monetary Policy. European Economic Review 75, 156-176.

Kashyap, A. and J. Stein, 1997. The Role of Banks in Monetary Policy: A Survey with Implications for the European Monetary Union. Federal Reserve Bank of Chicago Economic Perspectives September - October, 2-18.

Purroy, P. and V. Salas, 2000. Strategic competition in retail banking under expense preference behavior. Journal of Banking and Finance 24, 809-824.

Schreft, S. and B.D. Smith, 1997. Money, Banking, and Capital Formation. Journal of Economic Theory 73, 157-182.

Schreft, S. and B.D. Smith, 1998. The Effects of Open Market Operations in a Model of Intermediation and Growth. Review of Economic Studies 65, 519-50.

Townsend, R., 1987. Economic Organization with Limited Communication. American Economic Review 77, 954-971.

Williamson, S.D., 1986. Increasing Returns to Scale in Financial Intermediation and the Non-Neutrality of Government Policy. Review of Economic Studies 53, 863-875.