Distributional Role of Monetary Policy under Limited Credit Access

July 23, 2018

Abstract

The paper explores the redistributive effects of a monetary policy shock in a limited participation framework with limited credit access. Expansionary monetary policy redistributes consumption from traders to non-traders. This redistribution is the largest when only financial market participants have a choice between multiple means of payments while non-participants do not. Welfare analysis reveals that the effectiveness of monetary policy on the economy is the greatest when all agents (financial market participants and nonparticipants) can choose from alternative means of payment in a financially segmented model. The model is calibrated to the US economy for quantitative analysis.

Keywords: Cash-Credit Choice, Monetary Policy, Choice of payment methods, Limited Participation, Limited Credit.

JEL Classification: E5, E4

1 Introduction

This paper aims to study the distributional role of monetary policy in a segmented asset market model when there is an additional limitation for financial market non-participants in the form of lack of access to credit markets. Financial market segmentation has been well documented in the literature on monetary policy (Grossman and Weiss (1983); Mankiw and Zeldes (1991), Vissing-Jørgensen (2002)) and one of the implications of such segmentation is that monetary policy actions
have differential effects on those who are directly connected to financial markets to those who are not (Grossman and Weiss (1983), Lucas (1990), Alvarez et al. (2001), Fuerst (1992), Rotemberg (1984), Williamson (2006), Zervou (2013)). Mankiw and Zeldes (1991) found that the fraction of households owning stock increases with average labor income. This indicates that financial market participation is low among low income households. According to the Preliminary Findings from the 2015 Diary of Consumer Payment Choice\(^1\), income level of a household significantly influences choice of payment method. Households earning less than $25,000 annually have a particularly strong cash preference and use cash and check for majority of transactions. In a study by Bennett et al. (2014), it has been shown that the usage of cash is very high in low-income households. According to a report by the Federal Reserve Board of Governors based on the Survey of Household Economics and Decision-making in October 2016\(^2\), 20.7% of households, overall, in US did not have credit cards, and in particular, 40.5% of low income households did not own a credit card. Hence, low income households have, on one hand low financial market participation, and on the other hand high cash usage. This forms the basis of the study in this paper - whether the distributional role of monetary policy is affected when means of payment are considered to differ among financial market participants as well as non-participants.

Studies regarding cash and credit as alternative means of payment dates back to Lucas Jr and Stokey (1985), followed by Prescott (1987), Lacker and Schreft (1996) among others. In models with money and credit, consumers avoid inflation through credit, and face higher welfare costs of inflation compared to standard cash-in-advance economies [Gillman (1993)]. However, there is a relatively small literature on limited credit access. Dotsey and Guerron-Quintana (2016), using a segmented market model, find that the availability of credit allows agents to smooth consumption significantly and the effectiveness of monetary policy declines with a decrease in credit costs. Rojas Breu (2013) finds that the increase in access to credit in the U.S. from 1990 to the near present has had a slightly negative impact on welfare when there is limited participation in credit markets. However, in the above-mentioned papers, there is no inquiry into the effectiveness of monetary policy when there is no universal access to credit. In this current paper, there is limited participation in asset markets as well as the credit markets - the non-participants in the financial markets do not have access to credit. In the event of an expansionary monetary policy, I find that

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the non-participants in the financial market, with no access to alternative means of payments, face a more adverse outcome in the event of a monetary expansion than when they have access to credit. Therefore, connectedness to the financial markets as well as the choice between multiple methods of payment are crucial to the redistributional role of monetary policy. Choi (2011) finds that credit can dampen fluctuations in consumption arising from monetary policy when both traders and non-traders can choose from multiple means of payment. Further, monetary policy directly redistributes consumption goods between non-traders and traders, and, money injection may increase or decrease consumption for traders and non-traders. However, the direction of re-distribution after a monetary shock is ambiguous. In this paper, I find that monetary policy redistributes consumption in favor of traders in financial markets. Further in contrast to Choi (2011)’s paper, the current paper analyzes the effects of alternative monetary responses to an adverse income shock when fraction of agents are not only segmented financially, but also via the access to credit. The main contribution is that, the magnitude of the response to monetary policy in the face of a bad income shock is much larger when all agents have access to cash and credit, as opposed to only financial market participants having access to credit.

The rest of the paper is organized as follows: section (2) describes the model economy, section (3) describes the equilibrium including the steady state, section (4) presents quantitative analysis and the conclusion is stated in section (6).

2 The model economy

2.1 The environment

Time is discrete. The economy comprises of a goods market, and two asset markets - bonds and money. There exists a unit mass of infintely-lived identical households in the continuum $[0,1]$. Each household comprises of a shopper-seller pair. The bonds market is segmented such that only $\lambda$ fraction can participate in the bonds market, where $\lambda \in (0,1)$. Each household’s objective is to choose a path of consumption and asset holdings to maximize:

$$U(\{c_{i,j}^k\}_{t=0}^\infty) = E_0 \sum_{t=0}^\infty \beta^t \{\ln c_{i,j}^k - x_{i,j}^k\}$$

(1)
where $0 < \beta < 1$ is the discount factor, $c^k_{t,j} = \frac{1}{0} \int c_{t,j}(i) \, di$ represents an array of consumption of goods purchased in period $t$ by household $j$, and $x^k_{t,j}$ is the transactions cost of using credit, which is further defined later in the paper. Price of each consumption good is $P_t$. The transactions cost of credit could include record-keeping costs and the effort exerted to keep such records affects utility. $c_{t,j}$ denotes consumption at time $t$ by consumer of type $k$, with $k \epsilon (T, N)$. The fraction $1 - \lambda$ of the population that does not participate in the bonds market - the non-traders ($k = N$) - receives a fixed real endowment $y^N = \frac{1}{0} \int y^N(i) \, di > 0$ of the non-storable consumption good in each period. The fraction $\lambda$ of the population that participates in the financial markets - the traders ($k = T$) - receives a fixed real endowment $y^T = \frac{1}{0} \int y^T(i) \, di > 0$ of the non-storable consumption good in each period. Since non-traders do not have access to credit, $x^N_{t,j} = 0$.

Figure 1: Timing

The timing of the model is depicted in figure (1). Each household enters period $t$ with $M^k_{t-1}$ units of currency. In each period $t$, the asset market opens first, the monetary authority makes a
nominal lump sum transfer, \( T_t \) to trader households. Hence, the growth rate of money, \( \theta_t \), which is a stochastic variable, is revealed to the households at the beginning of each period.

\[
M_t = M_{t-1} + \lambda T_t
\]

\[i.e. \quad M_t = (1 + \theta_t)M_{t-1}\] (2)

where the per capita transfer, \( T_t \) equals \( \theta_t M_{t-1} \). In real terms:

\[
m_t = \frac{(1 + \theta_t)}{(1 + \pi_t)} m_{t-1}
\] (3)

where \( 1 + \pi_t \) is the rate of inflation. Let \( u_t = \theta_t - \theta \) be the deviation of money growth rate from its steady-state average rate and assume:

\[
u_t = \rho u_{t-1} + \varphi_t
\] (4)

where \( \varphi_t \) is a white noise innovation with variance \( \sigma^2_\varphi \). Trader households buy \( B_{t,j} \) units of interest-bearing one period nominal bond. Each bond, purchased for one unit of money, is a claim to \( 1 + R_t \) units of money in period \( t + 1 \). After the asset market closes, the goods market opens. In order for money to have value we assume that no agent can consume their own endowment - this is a standard assumption in the literature. The shopper of each households receive the cash remaining after transactions in the asset market. The cash-in-advance constraint that a shopper, \( j \), in trader and non-trader households face in the goods market are, respectively, as follows:

\[
P_t \int_0^1 (1 - \xi_{t,j}(i))c_{t,j}(i) \, di \leq M_{t-1} + T_t - B_{t,j} + (1 + R_{t-1})B_{t-1,j}
\] (5)

\[
P_t \int_0^1 c_{t,j}(i) \, di \leq M_{t-1}
\] (6)

where \( i \in [0, 1] \) and \( \xi_{t,j}(i) \) is an indicator variable: \( \xi_{t,j}(i) = 1 \) if shopper \( j \) uses credit to buy goods in market \( i \) in period \( t \) and \( \xi_{t,j}(i) = 0 \) if shopper \( j \) uses cash in that market. However, the non-traders do not have access to credit, and use only cash to pay for goods and services. Equations (5) and
are standard Clower-type cash-in-advance constraints where agents must allocate the amount of cash they are willing to spend in the goods market before the asset market opens. Shoppers of trader households choose cash and credit to pay for the array of goods and services in the goods market. There is a transactions cost associated with the use of credit, $\gamma(i) > 0$, where $\gamma(i)$ is increasing, differentiable on $i$, $\gamma(0) = 0$ and $\lim_{i \to 1} \gamma(i) = \infty$. The markets are ordered such that $\gamma(i)$ increases from lower numbered markets to higher numbered markets. The transactions cost of credit appear as effort in the household’s preferences.

$$x_{t,j} = \int_0^1 \xi_{t,j}(i) \gamma(i) \, di$$  \hspace{1cm} (7)

At the end of each period, the worker-shopper pair of each households meet again to pool resources and to consume. The household budget constraints are of traders and non-traders, respectively, as follows:

$$P_t \int_0^1 c_{t,j}^T(i) \, di + M_t^T = P_t \int_0^1 y_{t,j}^T(i) \, di + (M_{t-1}^T + T_t) - B_t + (1 + R_{t-1})B_{t-1,j}$$  \hspace{1cm} (8)

$$P_t \int_0^1 c_{t,j}^N(i) \, di + M_t^N = P_t \int_0^1 y_{t,j}^N(i) \, di + M_{t-1}^N$$  \hspace{1cm} (9)

The optimization problem of each trader and non-trader household is to maximize (1), subject to the following cash-in-advance constraints, in real terms, for traders and non traders, respectively:

$$\int_{1-i}^1 (1 - \xi_t(i)) c_{t,j}^T(i) \, di \leq \frac{m_{t-1}^T}{1 + \pi_t} + \tau_t - b_{t,j} + \frac{(1 + R_{t-1})}{(1 + \pi_t)} b_{t-1,j}$$  \hspace{1cm} (10)

$$\int_0^1 c_{t,j}^N(i) \, di \leq \frac{m_{t-1}^N}{1 + \pi_t}$$  \hspace{1cm} (11)

and the following budget constraints, in real terms, for traders and non-trader households respec-
tively:

\[
\int_0^i \xi_{t,j}(i)c_{t,j}^T di + \int_{1-i}^1 (1 - \xi_{t,j})c_{t,j}^T (i) di + m_t^T = \int_0^1 y_{t,j}(i) di + \frac{m_{t-1}^T}{1 + \pi_t} + \tau_t - b_{t,j} + \frac{(1 + R_{t-1})}{1 + \pi_t} b_{t-1,j}
\]

(12)

\[
\int_0^i c_{t,j}^N(i) di + m_t^N = \int_0^1 y_{t,j}(i) di + \frac{m_{t-1}^N}{1 + \pi_t}
\]

(13)

Dividing the nominal variables by the price level gives us: 

\[
m_k^T = M_k^T \frac{p_t}{p_t}, m_{k-1}^T = M_{k-1}^T \frac{p_t}{p_t}, b_{t,j} = B_{t,j} \frac{p_t}{p_t}, b_{t-1,j} = B_{t-1,j} \frac{p_t}{p_t}, m_t = M_t \frac{p_t}{p_t}, \tau_{t,j} = T_{t,j} \frac{p_t}{p_t}.
\]

Traders face an additional no-Ponzi scheme constraint:

\[
\lim_{t \to \infty} \beta^t b_{t,j} = 0
\]

### 3 Equilibrium

**Definition 1** A symmetric competitive equilibrium consists of the sequences \{c_{t,j}^k, m_t^k, b_{t,j}, \tau_t, R_{t-1}, y_t^k\}_{i=0}^\infty, where \( j \in [0, 1], k \in (T, N) \) such that:

1. \( \{c_{t,j}^k, m_t^k, b_{t,j}\}_{i=0}^\infty \) solves the household’s problem given \( \{\tau_t, R_{t-1}\}_{i=0}^\infty \).

2. Markets clear in every period:

   a. **Bond Market:** \( \int_0^1 b_{t,j} dj = 0 \),

   b. **Goods Market:**

      \[
      \int_0^1 (\int_0^1 y_{t,j}^T (i) di) dj + \int_{1-\lambda}^1 (\int_0^1 y_{t,j}^N (i) di) dj = \int_0^1 (\int_0^1 c_{t,j}^T (i) di) dj + \int_{1-\lambda}^1 (\int_0^1 c_{t,j}^N (i) di) dj
      \]

      where \( \int_0^1 y_{t,j}^T (i) di dj + \int_{1-\lambda}^1 y_{t,j}^N (i) di dj = Y_t, Y_t \) being the aggregate endowment,

   b. **Money Market:** \( m_t = \lambda m_t^T + (1 - \lambda) m_t^N \)

It can be said that no one will hold bonds in equilibrium, since all trader households are identical. Trading of government bonds allows the nominal interest rate to be determined. Since all goods are sold at the same price, \( p_t \), households are indifferent between sellers - each household
purchases the same amount of good across all sellers. In a symmetric equilibrium, every shopper in trader and non-trader household, respectively, holds the same amount of money balances in the goods market. The subscript $j$ is no longer used.

For the purpose of simplicity, without the loss of generality, I normalize the aggregate endowment to unity. Due to the symmetric nature of the equilibrium, it can be said that each trader receives $y^T = \frac{1}{\lambda}$ of the aggregate endowment and non-traders receive fraction $y^N = \frac{1}{1-\lambda}$ of the same. Hence, the equilibrium condition in the goods market can be re-written as follows:

$$1 = \frac{\lambda}{0} \int c^T_t \, di + \int_{1-\lambda}^{1} c^N_t \, di$$

(14)

The first order conditions obtained from the dynamic optimization of a representative agent’s decision problem must be satisfied in equilibrium. Let $\mu^k_t$ denote the Lagrangian multiplier for the cash-in-advance constraint and $\lambda^k_t$ denote the same for the budget constraint, where $k \in (T, N)$. The first-order condition for the household’s choice of money holdings, take the form:

$$\lambda^k_t = \beta \left( \lambda^k_{t+1} + \mu^k_{t+1} \right) \frac{1}{1 + \pi_{t+1}}$$

(15)

The loss in utility of wealth from holding one unit of wealth as money balance at time $t$ must be equal to the utility gain from an additional unit of consumption at time $t + 1$. Optimization by trader households also gives the following first order condition with respect to bond holdings:

$$\beta c^T_{t+1}(i)^{-1} \frac{(1 + R_t)}{(1 + \pi_{t+1})} = c^T_t(i)^{-1}$$

(16)

Equation (16) shows that the utility loss from giving up one unit of consumption for traders at time $t$ should be equal to the utility gain from an additional unit of consumption at time $t + 1$. Taking the first order condition of the optimization problem of the traders with respect to consumption:

$$(c^k_i(i))^{-1} = \mu^k_t + \lambda^k_t$$

(17)

where $c^k_i(i)$ represents consumption at market $i$ for household of type $k$. Here, $\lambda^k_t + \mu^k_t$ is the marginal utility of holding real balances, where $\mu^k_t$ is the liquidity component of the marginal
utility of real balances. Real balances are part of total household wealth and the component \( \mu^k \) represents the liquidity services provided by the real balances. It is important to note here that the presence of a binding liquidity constraint drives a wedge between the marginal utility of wealth and the marginal utility of consumption, the latter being higher, and the difference is given by the marginal utility of real balances. Let \( c_{iT}^{T,0}(i) \) and \( c_{iT}^{T,1}(i) \) represent consumption that a shopper in a trader household decides to purchase with cash and credit, respectively.

\[
(c_{iT}^{T,0}(i))^{-1} = \mu^T_t + \lambda^T_t \tag{18}
\]

\[
(c_{iT}^{T,1}(i))^{-1} = \lambda^T_t \tag{19}
\]

From the above two equations it can be said that the marginal utility of cash differs from that of credit. In particular the marginal utility from consumption with cash is higher than that of credit. The marginal utility from consumption with cash is higher due to the existence of liquidity services.

The choice of credit or cash, \( \xi_t(i) \), is determined by a trade-off between the transactions cost of credit and the opportunity cost of holding money.

\[
\xi_t(i) = \begin{cases} 
1 & \text{if } \ln c_{iT}^{T,1}(i) - \gamma(i) > \ln c_{iT}^{T,0}(i); \\
0 & \text{if } \ln c_{iT}^{T,1}(i) - \gamma(i) < \ln c_{iT}^{T,0}(i). 
\end{cases} 
\]

In a market, if the marginal benefit of cash (credit) is greater than the marginal benefit of credit (cash) then the shopper chooses to use cash (credit) in the market. A cut-off between cash and credit, \( i^* \), is determined by:

\[
\gamma(i^*) = \ln \frac{c_{iT}^{T,1}(i^*)}{c_{iT}^{T,0}(i^*)} = \ln \left\{ \frac{\mu^T_t + \lambda^T_t}{\lambda^T_t} \right\} \tag{20}
\]

If the marginal rate of substitution of \( c_{iT}^{T,0}(i) \) for \( c_{iT}^{T,1}(i) \) increases, then the number of markets where a shopper uses credit increases and a shopper purchases a larger variety of goods with credit. The shopper spends on credit to acquire goods if \( i < i^* \), and uses cash to acquire goods \( i \) if \( i > i^* \). It is assumed that \( \gamma(i) \) takes the following functional form:

\[
\gamma(i^*) = \ln \frac{1}{1 - i^*} \tag{21}
\]
3.1 Steady State Analysis

In steady state, from equation (3), the rate of inflation is given by the growth rate of money. The time subscripts are dropped from here on to denote steady state values. From equation (16), the steady state nominal interest rate is given by:

$$1 + R = \frac{1 + \pi}{\beta}$$  \hspace{1cm} (22)

An increase in the steady state growth rate of inflation increases the steady state nominal interest rate.

From the budget constraint of the non-traders in equation (13), and equilibrium conditions in the goods and assets market:

$$m_N^N = \frac{1}{1 - \lambda}$$  \hspace{1cm} (23)

Money holdings of the non-traders depend on endowment. An increase in the steady state growth rate of inflation has no effect on the money holdings allocated of the non traders. From the cash-in-advance constraint of non traders in equation (11), equation (23) and imposing the equilibrium condition in the goods and assets market:

$$c_N^N = \frac{1}{(1 - \lambda)(1 + \pi)}$$  \hspace{1cm} (24)

The consumption of non-traders depends on their endowment and the rate of inflation. An increase in the growth rate of inflation lowers the consumption of non-traders. An increase in the growth rate of money that leads to an increase in the growth rate of inflation, corrodes the value of money balances held by non-traders. Since non-traders do not have a choice between cash and credit, their consumption depends only on money balances held. Hence, a decrease in the value of real money balances held, reduces consumption of traders.

From equations (15), (20) and (21), the steady state solution for the cash-credit choice of traders is given as follows:

$$i = 1 - \frac{\beta}{1 + \pi}$$  \hspace{1cm} (25)

From the cash-in-advance constraint of the traders in equation (10), the budget constraint of the traders in equation (12), equation (25), and imposing the equilibrium condition in the goods and
assets market, we have the solution for consumption with cash in each market for traders:

\[ c^{T,0} = \frac{1}{\lambda} \left[ 1 + \frac{1}{\beta + 1 + \pi} - \frac{1 + \pi}{\beta} \right] \]  

(26)

In order to find the solution for consumption of traders with credit in each market, \( c^{T,1} \), we can use equations (25) and (26):

\[ c^{T,1} = \frac{1}{\lambda \beta} \left[ 1 + \frac{1 + \pi}{\beta + 1 + \pi} - \frac{1 + \pi}{\beta} \right] \]  

(27)

Finally, the solution for money balances held by traders is given obtain by using the budget constraint of traders from equation (12), equations (25) and (27):

\[ m^T = \frac{1}{\lambda} \left[ 1 - \left( \frac{1 + \pi}{\beta} - 1 \right) \left( \frac{1}{\beta + 1 + \pi} - \frac{1 + \pi}{\beta} \right) \right] \]  

(28)

An increase in the growth rate of inflation increases the number of markets where the traders choose to use credit. When the monetary authority raises the growth rate of money, and that leads to an increase in the growth rate of inflation, the expected nominal interest rate increases, and hence the opportunity cost of holding cash. Thereby, households substitute cash for credit, and choose to increase the number of markets where they use credit. Traders increase the volume of transactions with credit in each market. These two effects together cause total consumption with credit to increase. An increase in the growth rate of money has two opposing effects on the money balances held by traders. One the one hand, an increase in the growth rate of inflation corrodes the value of money balances held by traders and as well as increases the opportunity cost of holding money - putting a downward pressure on money balances. On the other hand, traders receive the monetary transfers which tend to raise the amount of real balances held. However, the first effect dominates. Overall, there is a decrease in the amount of real balances held by traders. A lower money balances pushes the consumption with cash in each market downwards, however, a decrease in the number of markets where cash is used is lower, implying an upward pressure on cash transactions per market. The latter effect dominates, leading to an increase in the consumption with cash per market. Further, there are two opposing effects on the total consumption with cash: a decrease in amount of real balances tends to lower it, an increase in the transfers from monetary authority tend to increase it - the second effect is stronger which leads to increase in total consumption with cash for traders. Thus, the total consumption of traders - with credit and cash - is higher after
an increase in the growth rate of money. Therefore, it can be said that an expansionary monetary policy redistributes consumption from financial market non-participants to participants who also have access to credit as a means of payment.

4 Dynamics around the steady state

In order to assess the dynamic effects of increase in money growth rate on the model, values must be assigned to the parameters in the model. Alvarez et al. (2001)’s value for $\beta$, the subjective rate of time discount in the utility function, is adopted. I use the stock market participation rate for 1997, as is standard in the literature, from the study by Walentin (2010), which sets to $\lambda = 0.273$, excluding retirement accounts. For the period from 1984 to 2007\(^3\), the average annual growth rate of M1 in the United States was 4.1 percent. An annual rate of 4 percent would imply a quarterly value of 1.01 for $(1 + \theta^{ss})$, so set $(1 + \theta^{ss}) = 1.01$ to match M1. Estimating an AR(1) process for M1 growth yields the value of autoregression coefficient for money growth $\rho_u = 0.75$ with a value of 0.1 percent for $\sigma_u$, the standard deviation of innovations to the nominal money growth rate. The parameter values are summarized in table (1).

<table>
<thead>
<tr>
<th>Table 1: Baseline Parameter Values I</th>
</tr>
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<tbody>
<tr>
<td>$\beta$</td>
</tr>
<tr>
<td>0.989</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 2: Steady State Values at Baseline Parameter Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y^T$</td>
</tr>
<tr>
<td>3.67</td>
</tr>
</tbody>
</table>

4.1 Effect of Monetary Policy Shock

The focus of this section will be on the short-run redistributive effects of monetary policy shocks. The effects of an expansionary monetary policy is demonstrated in Figure (2)\(^4\).

\(^3\)https://fred.stlouisfed.org

\(^4\)The model is solved with first-order approximation using Dynare
A one standard deviation shock to the growth rate of money raises the growth rate of money, which increases the growth rate of inflation. A higher inflation rate increases the expected nominal interest rate, which increases the opportunity cost of holding money for traders who substitute credit for cash and also increase consumption with credit per market. Given money balances from the previous period, a higher inflation rate reduces the value of money balances held for both traders as well as non-traders. Since the decrease in the number of markets where cash is used...
is greater than the decrease in the money value of real balances, consumption with cash in each market increases. Overall, there is an increase in total consumption of traders. For non-traders, an increase in the inflation rate lowers the value of real balances from the previous period, which further lowers their consumption. Hence, expansionary monetary shock redistributes consumption from non-traders to traders. The choice that traders have between using cash and credit allows them to lessen the impact of higher inflation rate arising from increased money growth rate.

4.2 Comparing with credit-less economy

In this section, we compare the redistributive effects of a monetary policy shock in an economy where there is no credit with one in which only financial market participants have access to credit.

Figure 3: Impact of a shock to money growth rate: Comparing with only-cash-for-all economy

Figure (3) shows a comparison of the effects of a positive one standard deviation monetary shock
when there is no credit in the economy with the case where only financial market participants can use credit. The redistributive effect of monetary policy is higher when the financial market participants are able to access credit. A choice between alternative means of payment allows traders to reduce the effect of the monetary shock.

4.3 Comparing with an economy where all individuals have access to credit

Figure 4: Impact of a shock to money growth rate: Comparing with an economy where all individuals have access to credit
This section compares the redistributive effects of a monetary policy shock in an economy where there is no credit with one in which only financial market participants have access to credit, as well as, one where all individuals have access to credit. Figure (4) shows a comparison of the effects of a positive one standard deviation monetary shock when there is no credit in the economy with the case where only financial market participants can use credit and with the case where both financial market participants and non-participants can access credit. In each case, monetary policy redistributes welfare from traders to non-traders. However, the non-traders have the most adverse outcome when only traders have access to credit. If non-traders also have the choice between alternative means of payment, then they are able to use the composition of cash and credit as a tool to lower the impact of an expansionary monetary shock. Hence, it can be concluded that increasing availability of credit to non-participants in the financial market, may contribute towards cushioning them from the negative impact of a higher inflation rate due to a monetary expansion.

4.4 Monetary Policy Response to Adverse Endowment Shock

In this section, following Walsh (2010), I use a negative shock to technology which lowers endowment in order to induce a crisis scenario. and then assess the scope of monetary policy in counteracting it. Let \( y_T = \bar{y}_T - \epsilon_t \) and \( y_N = \bar{y}_N - \epsilon_t \) be the deviation of the endowment of traders and non-traders from their steady states, respectively, and assume that:

\[
\epsilon_t = \rho_e \epsilon_{t-1} + \epsilon_{\phi_t}
\]  

(29)

where \( \epsilon_t \) is a white noise with variance \( \sigma_{\epsilon}^2 \). The value of \( \sigma_{\epsilon} \), the standard deviation of endowment shock, is set to match the standard deviation of quarterly HP-filtered log U.S. GDP for the 1985:1 - 2014:4 period of 1.10 percent, and \( \rho_e \) is the autoregressive co-efficient in the productivity process, whose value is set to 0.34.

<table>
<thead>
<tr>
<th>( \rho_e )</th>
<th>( \sigma_{\epsilon} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.95</td>
<td>0.34</td>
</tr>
</tbody>
</table>

An endowment parameter, \( \phi \), is added to the shock to growth rate of money supply such that

\( \frac{5}{5} \)Chapter 3
the monetary authority reacts to it as follows:

\[ u_t = \rho u_{t-1} + \phi z_{t-1} + \varphi_t \]  

(30)

Table (4) enlists the possible values of \( \phi \):

<table>
<thead>
<tr>
<th>No Response</th>
<th>( \phi = 0 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Counter Cyclical (Increase in growth rate of money)</td>
<td>( \phi = -0.15 )</td>
</tr>
<tr>
<td>Pro Cyclical (Decrease in growth rate of money)</td>
<td>( \phi = 0.15 )</td>
</tr>
</tbody>
</table>

Figures (5) and (6) compares three possible monetary reactions to an adverse income shock when only financial market participants have access to credit and when all agents have access to credit, respectively. While the total consumption of non-traders worsen further as a consequence of a monetary expansion and that of traders improve, the impact is less severe when non-traders can also use credit to mitigate the negative impacts of the adverse income shock.
Figure 5: Monetary Response to Adverse Endowment Shock: Only Traders Use Credit
Figure 6: Monetary Response to Adverse Endowment Shock: All Agents Use Credit
**Symmetric Effects:** The redistributive effects of monetary policy is symmetric, that is, in case of monetary tightening, redistribution of consumption occurs in favor of non-traders as demonstrated in Figure (7).

![Figure 7: Impact of a negative shock to money growth rate (Only traders have access to credit)](image)

Further, when there is a positive endowment shock, total consumption improves relatively more for non-traders than that of traders as a consequence of monetary tightening after a positive endow-

20
ment shock (figure 8).

Figure 8: Monetary policy response to good endowment shock when only traders have access to credit
5 Welfare

This section analyzes the impact of a positive money growth shock on the welfare of the economy. Suppose that monetary authority chooses the money growth rate to maximize the household’s welfare in equilibrium. Then the policy maker solves for the following problem, in the steady state:

\[
\ln W = \max_\theta \int_0^\lambda \left\{ i^{T^*} \ln c^{T,1}(i^{T^*}) + (1 - i^{T^*}) \ln c^{T,0}(i^{T^*}) - \int_0^{i^{T^*}} \gamma(i^{T^*}) d\lambda \int di^T d\lambda \right\}
\]

\[
+ \int_0^\lambda \left\{ i^{N^*} \ln c^{N,1}(i^{N^*}) + (1 - i^{N^*}) \ln c^{N,0}(i^{N^*}) - \int_0^{i^{N^*}} \gamma(i^{N^*}) d\lambda \right\} \int d(1 - \lambda)
\]

Figure (9) shows the impact of a monetary expansion on per period welfare of households. The increase in welfare of households is relatively higher if all agents have access to credit. When only traders can use credit, the consumption of traders improve while that of non-traders worsen more than when all agents can use credit, in a financially segmented market. Hence, overall welfare for the economy does not improve as much.

Figure 9: Impact of a shock to money growth rate: Comparing with an economy where all individuals have access to credit
Comparing across credit costs: In order to be able to compare the welfare effects of a positive monetary policy shock for alternative cost of credit, I add another parameter to the cost of using credit, $\kappa > 0$, such that as $\kappa$ increase, credit becomes costlier:

$$\gamma(i^*) = \ln\left(\frac{1}{1 - i^*}\right)^\kappa$$

(32)

Figure (10) shows that as the cost of credit decreases, the positive impact of a monetary expansion increases. As credit becomes less expensive, agents can switch between cash and credit with greater ease. This allows them to cushion themselves from the inflationary effects of an increase in growth rate of money supply.

![Figure 10: Impact of a shock to money growth rate: Comparing with an economy where all individuals have access to credit](image)

Comparing the welfare effects of monetary policy response to adverse income shock: Figure (11) demonstrates a comparison of the welfare effects of monetary response in the face of adverse income shock when financial market participants have access to credit versus when all agents can use credit. It is evident from figure (11) that the effects of monetary policy is magnified when access to credit is universal. As previously mentioned, when all agents, financial market participants as well as non participants can choose from alternative means of payment, monetary policy exhibits greater effectiveness.

Figure (12) demonstrates that the welfare effects are symmetric. When there is a favorable income shock, a monetary tightening worsens welfare most, when all agents have access to credit.
Figure 11: Impact of a shock to money growth rate: Comparing with an economy where all individuals have access to credit

Figure 12: Impact of a negative shock to money growth rate: Comparing with an economy where all individuals have access to credit
6 Conclusion

This paper explores the distributional role of monetary policy when there is financial market segmentation as well as limited credit access. A fraction of the population participate in financial markets and are also able to choose from alternative means of payment (cash and credit). The remaining fraction of households do not participate in financial markets and have no access to credit. In this paper, as in the existing literature, a positive monetary expansion redistributes consumption in favor of traders. In addition, this paper also concludes that the non-participants in financial markets are worse off when they do not have access to credit. Further, when monetary policy is counter-cyclical to adverse income shock, total consumption of non-participants worsen while that of participants improve. A welfare analysis reveals that the magnitude of the impact of monetary policy is greater when there is universal access to credit as opposed to limited access. In addition, as credit becomes less costly, the positive welfare impacts of monetary expansion improve. Hence, increasing availability of credit to financial market non-participants may help alleviate the impact of higher inflation rate from a positive monetary expansion for them. Additionally, improvements in credit market that lead to lower credit cost for all agents lead to a greater improvement in welfare.

References


