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Institutional Quality, Income Inequality, and Monetary Policy

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Abstract

In this manuscript, we study how the quality of public institutions interacts with income inequality and monetary policy in a general equilibrium setting. In particular, we show that weak institutions lead to higher inflation rates and more income inequality. While inflation and income inequality are negatively related in our setting, the marginal effects of inflation on income inequality are more pronounced when institutions are weak. Furthermore, it is optimal to raise the value of money when the quality of institutions is low.

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1 Introduction

A number of studies demonstrate that inflation adversely affects the distribution of income.[1] Other studies such as Chong and Calderón (2000) and Chong and Gradstein (2007) indicate that the quality of political institutions is negatively related to income inequality.[2] Furthermore, Blackburn and Powell (2011) and Bittencourt et al. (2014) among others, demonstrate that higher degrees of corruption put a toll on tax revenues which leads to more reliance on inflationary

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[1]See for example, Bhattacharya et al. (2005), Albanesi (2007), and Ghossoub and Reed (2017) among others.

[2]The quality of political institutions can be reflected by the degree of corruption, the extent of tax evasion, law enforcement, etc. For example, Alesina and Angeletos (2005) indicate that corruption is also an important impediment to more equitable distribution of income.

policies.[3] Taken together, it is hard to believe that the quality of institutions does not influence the redistributive effects of monetary policy. In this manner, inflation, institutional quality, and income inequality are interdependent and therefore should be examined together. This is especially important when studying monetary policy in developing economies where the quality of political institutions are low and the levels of corruption and tax evasion are high.

In this manuscript, we shed new lights on the interaction between monetary policy and income inequality by studying the role of corruption. Put it differently, we focuses on the quality of political institutions and its impact on the redistributive effects of monetary policy among other issues. This paper provides a first attempt to fill the gap in the literature and answer the following important questions: Do the effects of monetary policy on income inequality depend on the extent of corruption? How does the optimal monetary policy vary with the quality of institutions. Finally, if the monetary authority aims at targeting income inequality, how does monetary policy vary with the level of corruption?

In order to address these important issues, we develop a dynamic general equilibrium model where money alleviates informational frictions and banks arise endogenously to insure their depositors against idiosyncratic liquidity shocks. In a two-period overlapping generations production economy, there are two groups of agents born each period: Capitalists and Depositors. All agents are born with one unit of labor effort when young, which is supplied inelastically.

Each capitalist or entrepreneur is born with an investment idea that allows her to combine capital and labor to produce the economy's single consumption good when old. While capitalists are subjected to a tax on revenues, they can evade some of the tax without being detected. Therefore, the amount of taxes that entrepreneurs hide from the government reflects the extent of corruption or the quality of public institutions. That is, in economies where public institutions are efficient, tax evasion tends to be low.

As in Schreft and Smith (1997, 1998), depositors are exposed to liquidity shocks that can be completely diversified through financial intermediation (banks). Banks take deposits from workers and allocate them into cash reserve and loans to capitalists (to fund investment in capital). The final agent in this economy is the government that collects taxes from capitalists and receives seigniorage revenue from the central bank to fund its spending. As a benchmark we assume that the government adjusts the amount of liabilities to meet its obligations. We extend our analysis by assuming that the central bank targets the rate of money creation. As in Ghossoub and Reed (2017), the consumption of capitalists relative to depositors serves as a proxy for income inequality.

In this setting, corruption affects the economy through a number of channels. First, more corruption lowers the tax bill of capitalists which encourages them to invest in capital formation. This is similar to the "greasing the wheel effect" of corruption, which raises income and the tax base – a disinflationary

[3] Al-Marhubi (2000) and Smith-Hillman (2007) provide empirical support for a positive correlation between inflation and the extent of corruption.

effect. However, more corruption results in a loss of tax revenues to the government which will rely on inflation tax. Overall, we show that economies with public institutions of poor quality have higher inflation rates and more income inequality which is consistent with previous work.

However, in contrast to previous studies like Blackburn and Forgues-Puccio (2010), the impact of corruption on capital formation is non-monotonic, where corruption adversely affects capital formation only when the level of corruption is high enough.[4] We proceed to answer the questions raised above by assuming that the central bank targets the rate of money growth (steady-state inflation). Do the effects of monetary policy on income inequality depend on the extent of corruption? The answer is simply yes. In our setting, a reverse Tobin effect prevails. In economies with poor institutions, banks hold highly liquid portfolios and inequality is high. Therefore, a higher inflation rate has more pronounced adverse effects on income inequality when the extent of corruption is high. Moreover, we find that a totally egalitarian central bank should raise the value of money when the quality of institutions falls. Finally, how does the optimal monetary policy vary with the quality of institutions. In our setting, changes in the rate of money growth involve a trade-off. While a higher inflation rate raises the welfare of entrepreneurs (due to a higher return on capital), depositors' welfare is adversely affected as they receive less insurance against liquidity risk. The optimal policy balances these trade-offs. In an economy where corruption is high, the capital stock is inefficiently low and income inequality is high. Thererefore, it welfare improving to lower inflation rates to promote capital formation and the wetotal welfare.

The rest of the paper is organized as follows. We describe the model in section 2. In section 3, we study the behavior of each group of agents. In section 4, we study the equilibrium behavior of the economy. Section 5 extends our baseline model by examining the effects of monetary policy. We conclude in section 6.

2 Environment

Consider a discrete-time economy where $t = 1, 2, ..\infty$, indexes time. In this economy there are two geographically separated, yet symmetric islands. At the beginning of each period, a unit mass of agents is born. A fraction ρ of agents are are entrepreneurs (or capitalists) and $(1 - \rho)$ are workers or potential depositors. All agents are born with one unit of labor effort when young, which is supplied inelastically and are retired when old. In addition, all agents are assumed to value their old age consumption only. The preferences of a typical agent born in period t are $u(c_{t+1}) = \frac{c_{t+1}^{1-\theta}}{1-\theta}$ where $\theta > 1$ is the coefficient of risk aversion and c_t is consumption per person. In contrast to workers, each entrepreneur is born

[4] A large litterature points out to the importance of the quality of public insitutions for econmic activity. See for example, Scully (1982), Knack and Keefer (1995), Hall and Jones (1999), and Rodrik et al. (2002). The theoretical work by Blackburn et al. (2005) and Blackburn and Forgues-Puccio (2010) find that corruption lowers capital formation.

with an investment idea that allows her to combine capital and labor to produce the economy's single consumption good when old. The production technology of a typical old capitalist in period t is: $y_t = f(k_t, l_t) = Ak_t^{\alpha} l_t^{1-\alpha}$,where k_t and l_t are the amounts of capital and labor used by a capitalist, respectively. Further, A is a technology parameter and $\alpha \in (0,1)$ reflects capital intensity. We also let Y_t, K_t, and L_t designate the aggregate amounts of output, capital, and labor, respectively. Moreover, one unit of goods invested in period t becomes one unit of capital in $t+1$.

There are two types of assets in this economy: money (fiat currency) and capital. Denote the aggregate nominal monetary base by M_t. At the initial date 0, the generation of old capitalists at each location is endowed with the aggregate capital, K_0 and old workers are endowed with the money supply, M_0. Assuming that the price level is common across locations, we refer to P_t as the number of units of currency per unit of goods at time t. Thus, in real terms, the supply of money is, $\tilde{m}_t = M_t/P_t$.

Following Schreft and Smith (1997, 1998), individuals in the economy are subject to relocation shocks. Each period, after portfolios are made, agents find out that they have to relocate to the other island with probability $\pi \in (0,1)$. Since the population size is one, π, also reflects the number of agents that must move. These agents are called "movers." The relocation probability is publicly known and its realization is private information. Random relocation thus plays the same role that liquidity preference shocks perform in Diamond and Dybvig (1983). 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. Furthermore, currency is universally recognized and cannot be counterfeited - therefore, it is accepted in both locations.

The final agent in the economy is a government that seeks to finance an endogenous sequence of aggregate spending, g_t. We assume that aggregate public spending is a fraction λ of total output. That is, $g_t = \lambda Y_t$. As a benchmark we assume that government spending does not have any productive uses. In order to fund its expenditures, the government taxes the output of entrepreneurs at an exogenous rate τ.[5] As discussed below, entrepreneurs are able to evade taxes and only pay a fraction $\delta \in [0,1]$ of their tax bill.[6] Therefore, the total government's revenues from taxes in period t, are $\delta\tau Y_t$. We further assume that the government incurs a perpetual primary deficit, where $\lambda > \delta\tau$ is assumed to hold for all δ. The government relies on seigniorage income to fund tis deficit. In this manner, the government's budget constraint in period t is:

$$\frac{M_t - M_{t-1}}{P_t} + \delta\tau Y_t = g_t \tag{1}$$

or equivalently:

[5] A tax on revenues follows previous work by Alesina and Tabellini (1987) and Blackburn and Powell (2011).

[6] This approach is similar to Huang and Wei (2006)

$$\frac{M_t - M_{t-1}}{P_t} = (\lambda - \delta\tau)\, Y_t \tag{2}$$

Using the fact that $\tilde{m}_t = M_t / P_t$, the government's budget constraint can be written as:

$$\tilde{m}_t - \tilde{m}_{t-1} \frac{P_{t-1}}{P_t} = (\lambda - \delta\tau)\, Y_t \tag{3}$$

which yields the gross inflation rate:

$$\frac{P_t}{P_{t-1}} = \frac{\tilde{m}_{t-1}}{\tilde{m}_t - (\lambda - \delta\tau)\, Y_t} \tag{4}$$

which suggests that a higher tax evasion leads to a loss in government revenues and a monetization of the deficit, thus higher inflation rates.

3 Trade

3.1 A Typical Entrepreneur's Problem:

Capitalists work and invest when young and produce and pay taxes when old. We assume that the system is exogenously corrupt, where entrepreneurs are able to evade paying some of their taxes without getting detected by the government.

At the beginning of period t, a young entrepreneur works and earns the market wage rate, w_t. As entrepreneurs only value old age consumption, all income is invested in capital formation, i_t. However, we assume that capital investment needs to take place in a large scale and internal funds are not sufficient to fund the investment project. That is, we focus on cases where $w_t < i_t$. In order to complete the project, agents seek external financing from banks. In particular, each young entrepreneur will apply for a one period loan, b_t^d from a bank at a gross real interest rate, R_t. Therefore, the following resource constraint must be satisfied:

$$i_t = w_t + b_t^d \tag{5}$$

where

$$i_t = k_{t+1} \tag{6}$$

At the beginning of period $t+1$, an old entrepreneur uses her capital stock, k_{t+1} and hires workers, l_{t+1} to produce consumption goods. Each old entrepreneur is assumed to pay an exogenous fraction, $\delta\tau$ of its revenues to the government, where $\tau \in [0, 1)$ is the tax rate and $\delta \in [0, 1]$ represents the degree of corruption. Clearly, $\delta = 0$ is the case of total corruption as none of the tax revenues reach the government's treasury. The opposite is obviously true when $\delta = 1$.

The amount of old-age consumption is such that:

$$c^e_{t+1} = (1 - \delta\tau) f(k_{t+1}, l_{t+1}) - w_{t+1} l_{t+1} - R_t b^d_t \tag{7}$$

with $f(k_{t+1}, l_{t+1}) = A k^{\alpha}_{t+1} l^{1-\alpha}_{t+1}$. All entrepreneurs behave competitively and an entrepreneur's problem in period t is summarized as follows.

$$\underset{i_t, l_{t+1}}{Max} \frac{\left(c^e_{t+1}\right)^{1-\theta}}{1-\theta} \tag{8}$$

subject to (5) – (7).

Perfect competition in the factor markets implies that wages earn their marginal product:

$$w_{t+1} = (1 - \delta\tau)(1 - \alpha) A k^{\alpha}_{t+1} l^{-\alpha}_{t+1} \tag{9}$$

Moreover, in equilibrium, an entrepreneur will not make profit from its investment funded through bank loans:

$$(1 - \delta\tau) f_{k_{t+1}} = R_t \tag{10}$$

where $f_{k_{t+1}} = \partial f(k_{t+1}, l_{t+1}) / \partial k_{t+1} = \alpha A k^{\alpha-1}_{t+1} l^{1-\alpha}_{t+1}$. Using this information, an entrepreneur's consumption in $t+1$ is such that:

$$c^e_{t+1} = R_t w_t \tag{11}$$

Using (5), (6), and (10), the inverse demand for bank loans by a single entrepreneur is:

$$R_t = (1 - \delta\tau) \alpha A \left(b^d_t + w_t\right)^{\alpha-1} l^{1-\alpha}_{t+1} \tag{12}$$

where $b^d_t + w_t = k_{t+1}$. In addition, it is clear that as loans become more costly, entrepreneurs rely less on external financing.

Finally, in equilibrium labor market clearing requires that $L_t = \rho l_t = 1$ for all t. Using this information into the individual loan demand equation, (12) to get:

$$R_t = (1 - \delta\tau) \alpha A \left[\rho \left(b^d_t + w_t\right)\right]^{\alpha-1} \tag{13}$$

which is the aggregate inverse demand for loans, as $\rho\left(b^d_t + w_t\right) = \rho k_{t+1} = K_{t+1}$ in equilibrium. Analogously, it directly follows that the expression for wages in period t can be written as:

$$w_t = (1 - \delta\tau)(1 - \alpha) A K^{\alpha}_t \tag{14}$$

3.2 A Typical Depositor's Problem

At the beginning of period t each lender earns the market wage rate, w_t which is entirely saved. Workers do not pay taxes in any period of their lifetime. Since banks are able to insure lenders against relocation shocks, all their savings are intermediated.

3.3 A Typical Bank's Problem

At the beginning of period t, each bank announces deposit rates by promising a gross real return r_t^m if a depositor is relocated (mover) and r_t^n if the depositor is not relocated (non-mover). Banks receive a total amount of deposits of $(1-\rho)\,w_t$ which is allocated between cash reserves, m_t and loans to entrepreneurs, b_t^s. Therefore, the bank's balance sheet condition is expressed as:

$$(1-\rho)\,w_t = m_t + b_t^s \tag{15}$$

In addition, announced deposit returns must satisfy the following constraints. First,due to the large number of depositors, banks are able to completely diversity liquidity risk and predict the number of movers. As we focus on cases where money is dominated in rate of return, banks hold enough currency to meet the liquidity needs of depositors where payments to movers are such that:

$$(1-\rho)\,\pi r_t^m w_t = m_t \frac{P_t}{P_{t+1}} \tag{16}$$

Further, payments to non-movers are made from the revenues generated on loans to entrepreneurs, with:

$$(1-\rho)\,(1-\pi)\,r_t^n w_t = R_t b_t^s \tag{17}$$

Finally, the bank's contract must incentivize depositors to truthfully reveal their type ex-post. Therefore, the following self-selection constraint must also hold:

$$\frac{r_t^n}{r_t^m} \geq 1 \tag{18}$$

Due to perfect competition in the deposit market, banks choose portfolios to maximize the expected utility of each depositor. A typical bank's problem is summarized by:

$$\underset{r_t^m, r_t^n, m_t, b_t^s}{Max}\; \pi \frac{\left(r_t^m w_t\right)^{1-\theta}}{1-\theta} + (1-\pi)\,\frac{\left(r_t^n w_t\right)^{1-\theta}}{1-\theta} \tag{19}$$

subject to $(15)-(18)$.

When the incentive compatibility constraint is nonbinding, the solution to the bank's problem yields the demand for cash reserves, where:

$$m_t = \frac{(1-\rho)\,w_t}{1+\frac{1-\pi}{\pi} I_t^{\frac{1-\theta}{\theta}}} \tag{20}$$

and $I_t = R_t \frac{P_{t+1}}{P_t}$. Equivalently, banks allocate a fraction $\gamma_t \equiv m_t/\,(1-\rho)\,w_t$ of their deposits into cash reserves, with:

$$\gamma_t = \frac{1}{1+\frac{1-\pi}{\pi} I_t^{\frac{1-\theta}{\theta}}} \tag{21}$$

A quick inspection of (21) indicates that banks hold a more liquid portfolio when the nominal return on loans is higher. In this setting, banks hold cash reserves to insure their depositors against idiosyncratic liquidity shocks. Therefore, a higher nominal return on loans implies that agents are receiving a relatively higher return on their deposits if they are in the good state (happen to be non-movers). As agents are highly risk averse, banks need to hold more cash reserves to compensate them in the bad sate. This channel dominates any substitution effects that arise from a higher return on loans relative to cash. Further, using (15) and (21) the supply of credit by banks is:

$$b_t^s = (1-\rho)\, w_t \left[1 - \frac{1}{1 + \frac{1-\pi}{\pi} I_t^{\frac{1-\theta}{\theta}}}\right] \tag{22}$$

Finally, using (15) – (17) and (20), the relative return to depositors is such that:

$$\frac{r_t^n}{r_t^m} = I_t^{\frac{1}{\theta}} \tag{23}$$

and the expected consumption to depositors is:

$$Ec_{t+1}^d = \left(\pi + (1-\pi)\frac{r_t^n}{r_t^m}\right) r_t^m w_t \tag{24}$$

4 General Equilibrium

We proceed to characterize the equilibrium behavior of the economy. In equilibrium, all markets will clear. In particular, the labor market clears where $L_t = 1$ and wages are given by (14). Furthermore, credit market clearing requires that:

$$b_t^s = b_t^D = K_{t+1} - \rho w_t \tag{25}$$

where the supply of loans, b_t^s, is given by (22). In addition, using (12), the nominal return on loans satisfies:

$$I_t = (1-\delta\tau)\, \alpha A K_{t+1}^{\alpha-1} \frac{P_{t+1}}{P_t} \tag{26}$$

where from (4) and by imposing equilibrium on the money market, with $m_t = \tilde{m}_t$ where the amount of real money balances is given by (20), the inflation rate is:

$$\frac{P_{t+1}}{P_t} = \frac{(1-\rho)\, w_t \gamma_t}{(1-\rho)\, w_{t+1}\gamma_{t+1} - (\lambda - \delta\tau)\, Y_{t+1}} \tag{27}$$

In sum, equations (25) – (27), characterize the behavior of the economy at a particular point in time.

4.1 Steady-State Analysis

In this manuscript, we focus on the steady-state behavior of the economy. Using (25), (22) in the steady-state, the credit market clearing condition is such that:

$$\frac{K^{1-\alpha}}{(1-\delta\tau)(1-\alpha)A} = (1-\rho)\left[1 - \frac{1}{1+\frac{1-\pi}{\pi}I^{\frac{1-\theta}{\theta}}}\right] + \rho \tag{28}$$

In addition, from (27) and (26), the nominal interest on loans is such that:

$$I = (1-\delta\tau)\frac{\alpha A}{K^{1-\alpha}}\frac{1}{1-\frac{(\lambda-\delta\tau)}{(1-\rho)(1-\delta\tau)(1-\alpha)\gamma(I)}} \tag{29}$$

where from (27), the inflation rate in the steady-state is:

$$\frac{P_{t+1}}{P_t} = \frac{1}{1-\frac{(\lambda-\delta\tau)}{(1-\rho)(1-\delta\tau)(1-\alpha)\gamma(I)}} \tag{30}$$

with, $\frac{d\frac{P_{t+1}}{P_t}}{dI} < 0$ and $\frac{P_{t+1}}{P_t} = \frac{1}{1-\frac{(\lambda-\delta\tau)}{(1-\rho)(1-\delta\tau)(1-\alpha)\pi}}$ as $\gamma(1) = \pi$. We further assume that $\frac{P_{t+1}}{P_t} > 0 \ \forall \ I \geq 1$ which occurs if $\gamma(1) > \frac{(\lambda-\delta\tau)}{(1-\rho)(1-\delta\tau)(1-\alpha)}$. In words, as banks hold a more liquid portfolio when the nominal interest on loans is higher, seigniorage revenues increase and there is less need to inflate the economy.

In this manner, (28) and (29) characterize the behavior of the economy in the steady-state. Upon combining both loci, the following polynomial yields the equilibrium value of I:

$$\Gamma(I) \equiv [1-(1-\rho)\gamma(I)]\left(1-\frac{(\lambda-\delta\tau)}{(1-\rho)(1-\delta\tau)(1-\alpha)\gamma(I)}\right)I = \frac{\alpha}{(1-\alpha)} \tag{31}$$

The characterization of Γ is summarized in the following Lemma.

Lemma 1. *The locus defined by* (31) *is such that:* $\Gamma'(I) > 0$, $\lim_{I\to\infty}\Gamma \to \infty$ *and* $\Gamma(1) = [1-(1-\rho)\pi]\left(1-\frac{(\lambda-\delta\tau)}{(1-\rho)(1-\delta\tau)(1-\alpha)\pi}\right)$.

We establish existence and uniqueness in the following Proposition.

Proposition 1. *Suppose* $\lambda \geq \tilde{\lambda}$, *where* $\tilde{\lambda} = \left(1-\frac{1}{[1-(1-\rho)\pi]}\right)(1-\rho)(1-\delta\tau)(1-\alpha)\pi + \delta\tau$. *Under this condition, an equilibrium where* $I > 1$ *exists and is unique.*

Given the characterization of (31), a unique nominal interest rate clears the market. More specifically, $I > 1$ in equilibrium if $\Gamma(1) < 1$. This occurs if the size of the primary deficit is above some level. Intuitively, given tax revenues, the government relies more on seigniorage income to fund a higher primary deficit. The higher reliance on seigniorage revenues stimulates inflation which raises the nominal return on loans. In Proposition 1, $I = 1$ at $\lambda = \tilde{\lambda}$. Therefore, $I > 1$ if $\lambda > \tilde{\lambda}$.

We proceed to examine the effects of corruption on different economic outcomes.

Proposition 2. *Suppose* $\lambda \geq \tilde{\lambda}$. *Under this condition,* $\frac{dR}{d\delta} < 0$, $\frac{dI}{d\delta} < 0$, $\frac{d\frac{c^e}{E(c^d)}}{d\delta} < 0$, $\frac{d\frac{P_{t+1}}{P_t}}{d\delta} < 0$, *and* $\frac{d\frac{r^n}{r^m}}{d\delta} < 0$. *Moreover,* $\frac{dK}{d\delta} \leq (>)\, 0$ *if* $\delta \leq (>)\, \hat{\delta}$, *where* $\hat{\delta} : \frac{P_{t+1}}{P_t} = \frac{\left(\frac{1}{\theta}\frac{1-\pi}{\pi} + \frac{\rho}{I^{\frac{1-\theta}{\theta}}}\right)}{\frac{\theta-1}{\theta}\frac{1-\pi}{\pi}\left\{\frac{[1-\lambda]}{(1-\alpha)(1-\delta\tau)} - [1-(1-\rho)\gamma(I)]\right\}}$.

In this setting, the extent of corruption affects the economy through two primary channels. First, entrepreneurs generate a higher (after tax) return on capital under higher level of corruption (lower value of δ) which stimulates investment. Entrepreneurs also pass-through some of their gains to workers through higher wages. Higher wages imply higher deposits and a higher supply of loans.

Secondly, higher levels of corruption lead to lower tax revenues which forces the monetary authority to inflate the economy in order to meet its obligations. From the work above, higher inflation rates drive banks to hold more liquidity to insure their depositors against liquidity risk. This in turn leads to a lower supply of loans to entrepreneurs and lower capital formation. Overall, higher levels of corruption increase the real and nominal cost of borrowing. A higher nominal interest rate also implies that depositors receive less insurance against liquidity shocks. Furthermore, corruption unambiguously increases income inequality between depositors and entrepreneurs due in part to an erosion of the value of money as inflation increases under higher levels of corruption.

Interestingly, the relationship between corruption on capital formation is non-monotonic. When the level of corruption is low, inflation is also low, therefore some corruption promotes capital formation. However, when inflation is high, corruption becomes detrimental for capital formation. Simply put, when inflation is initially high, depositors are receiving very low levels of insurance against liquidity shocks. Given that depositors are highly risk averse, further increases in the inflation rates requires significant increases in the real money holdings to insure depositors against idiosyncratic shocks.

5 The Effects of Monetary Policy

We proceed to study how the extent of corruption interacts with monetary policy. In order to do so, we assume that the central authority targets the rate of money creation. In particular, let the gross rate of money growth be denoted by σ, with $M_t = \sigma M_{t-1}$. From (1), the government's budget constraint is such that:

$$\frac{\sigma - 1}{\sigma} m_t + \delta\tau Y_t = g_t \tag{32}$$

and in real terms, the constant money growth rule is: $m_{t+1} = \sigma \frac{P_t}{P_{t+1}} m_t$. We further assume that the government plays an intergenerational redistributive role by channeling resources from entrepreneurs to depositors. In particular, suppose that a fraction ψ of government purchases is rebated to young depositors in the form of lump sum transfers. The parameter ψ can reflect the government's spending efficiency, where $\psi = 0$ is analogous to our baseline case where government spending is totally wasted.

Entrepreneurs' problem is identical to that in the baseline model. However, the amount of deposits in the banking system is: $(1 - \rho) w_t + \psi g_t$. Therefore, the bank's balance sheet condition becomes:

$$(1 - \rho)(w_t + \psi g_t) = m_t + b_t \tag{33}$$

Using this information, the solution to the bank's problem yields:

$$\gamma_t = \frac{m_t}{(1 - \rho)(w_t + \psi g_t)} = \frac{1}{1 + \frac{1-\pi}{\pi} I_t^{\frac{1-\theta}{\theta}}} \tag{34}$$

Moreover, from (32)-(34), the equilibrium amount of cash holdings is such that:

$$m_t = \frac{\left[(1 - \rho) + \psi \frac{\delta\tau}{(1-\delta\tau)(1-\alpha)}\right] w_t}{\frac{1}{\gamma_t} - \psi \frac{\sigma - 1}{\sigma}} \tag{35}$$

and the supply of loans is:

$$b_t^s = (1 - \rho) w_t - \left(1 - \psi \frac{\sigma - 1}{\sigma}\right) m_t + \psi \delta\tau Y_t \tag{36}$$

Upon using (5) and (36), the credit market clearing condition is:

$$K_{t+1} = w_t - \left(1 - \psi \frac{\sigma - 1}{\sigma}\right) m_t + \psi \delta\tau Y_t \tag{37}$$

with $w_t = (1 - \delta\tau)(1 - \alpha) A K_t^{\alpha}$ and the nominal interest rate is such that:

$$I_t = (1 - \delta\tau) \alpha A K_{t+1}^{\alpha - 1} \frac{P_{t+1}}{P_t} \tag{38}$$

Therefore equations (32), (35), (37), and (38) characterize the behavior of the economy at a particular point in time.

In the steady-state, the inflation rate is pinned down by the rate of money creation. That is, $\frac{P_{t+1}}{P_t} = \sigma$. We proceed by answering the following questions. Do the effects of monetary policy on income inequality depend on the extent of corruption? What is the optimal monetary policy and how does it depend on the level of corruption. Finally, if the monetary authority aims at targeting income inequality, how does inflation vary with the level of corruption? In order to answer these questions, we simulate our model using the following baseline parameter values: $\alpha = 0.4, A = 1$. $\pi = .5$, $\theta = 4$, $\tau = .3$, $\rho = .1$, $\lambda = .3$, and $\psi = .8$.[7]

Do the effects of monetary policy on income inequality depend on the extent of corruption? As it can be seen in Table 1 below, the marginal effects of inflation on income inequality are much higher when the level of corruption is high ($\delta = .1$). Intuitively, the level of credit market activity is low and banks hold highly liquid portfolios when the level of corruption is high. In this manner, changes in the value of money have a more pronounced effect on the welfare of depositors when corruption is high.

Further, as income inequality is increasing with the extent of corruption, a totally egalitarian central bank needs to set very low inflation targets to achieve complete income equality, i.e. $c^e = E\left(c^d\right)$ when the level of corruption is high as it is evident in Table 2. This occurs despite the more pronounced effects of inflation on income inequality when corruption is high.

	δ=.1		δ=.6	
σ	$d(c^e/E(c^d))/d\sigma$	$dK/d\sigma$	$d(c^e/E(c^d))/d\sigma$	$dK/d\sigma$
1.01	0.05815	-0.02991	0.04101	-0.02934
1.02	0.05906	-0.03019	0.04152	-0.02968
1.03	0.05996	-0.03047	0.04203	-0.03002
1.04	0.06086	-0.03074	0.04253	-0.03035
1.05	0.06175	-0.03101	0.04305	-0.03069
1.06	0.06264	-0.03128	0.04354	-0.03101
1.07	0.06352	-0.03154	0.04404	-0.03133
1.08	0.06440	-0.03180	0.04453	-0.03165
1.09	0.06528	-0.03206	0.04503	-0.03196
1.10	0.06614	-0.03231	0.04552	-0.03227

Table 1. Marginal Effects of Monetary Policy and the extent of Corruption

[7] The fraction of amount

δ	σ^*	$c^e / E(c^d)$
0.2	1.11620	1
0.3	1.92424	1
0.4	2.35139	1
0.5	2.57643	1
0.6	2.67192	1
0.7	2.68220	1
0.8	2.63635	1
0.9	2.55383	1

Table 2. Monetary Policy, Redistribution, and the Extent of Corruption

Next, what is the welfare maximizing (optimal) rate of money creation. In this economy, aggregate welfare is given by:

$$W = \rho u^e + (1 - \rho) E\left(u^d\right) \tag{39}$$

Under the parameter values examined, inflation generates a reverse Tobin effect. Combined with the fact that risk sharing deteriorates with inflation, inflation adversely affects the welfare of depositors. In contrast, the welfare of entrepreneurs is strictly increasing with inflation as the real return to capital is higher due to the reverse Tobin effect. In this manner, the welfare maximizing policy balances these trade-offs. When the level of corruption is high enough, $\delta \leq .8$, the capital stock is inefficiently low and depositors receive a very low amount of insurance against liquidity risk. In this manner, the adverse effects of inflation on the welfare of entrepreneurs dominates. Therefore, the Friedman rule is optimal. Moreover, as capital investment (real interest rate) is lower (higher) under higher levels of corruption, it is optimal to lower the rate of money growth. If the level of corruption is pretty low, $\delta > .8$, the amount of resources transferred from entrepreneurs to depositors is significant. Therefore, it is welfare improving to deviate form the Friedman rule in order to improve the wellbeing of entrepreneurs. In addition, as observed in Table 3 below, it is optimal to raise the value of money when corruption increases in order to increase the welfare of depositors.

δ	σ*
0.1	0.80163
0.2	0.83110
0.3	0.86430
0.4	0.90080
0.5	0.94103
0.6	0.98546
0.7	1.03466
0.8	1.08927
0.9	1.19184

Table 3. Welfare Maximizing Monetary Policy and the Extent of Corruption

Finally, what is the optimal degree of tax evasion and how does it vary with monetary policy. As we showed in Proposition 2, higher levels of corruption adversely affect capital formation. This in turn leads to a higher real return to capital and a higher consumption of entrepreneurs. However, more corruption implies less risk sharing to depositors which renders depositors worse off. The optimal degree of corruption balances these trade-offs. As we show in Table 4 below, an interior optimal value of δ exists. Moreover, the optimal level of corruption is increasing with inflation. That is, it is optimal to have high levels of tax evasions when inflation is low. Intuitively, depositors' well being is high when inflation is lower. Therefore, the marginal gains in the welfare of entrepreneurs from higher corruption are significant.

σ	δ*
1.00	0.31193
1.05	0.31646
1.10	0.32133
1.15	0.32652
1.20	0.33202
1.25	0.33782
1.30	0.34393

Table 4. Optimal Corruption and Inflation

6 Conclusions

It is well established in the literature that monetary policy has redistributive consequences. However, the impact of political institutions' quality on this relationship is not explored. In a general equilibrium model with money, we demonstrate that the quality of public institutions bears significant implications for the economy and for monetary policy. In particular, the adverse effects of inflation on income inequality are more significant in economies with low quality political institutions. Therefore, improving the quality of institutions can mitigate the impact of inflation on inequality. Moreover, central banks should stimulate capital formation in the long run by lowering inflation when institutions are weak.

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