Dollarization as a signaling device

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Abstract

The objective of this paper is to point out that dollarization may be used as a signaling device. To this end, we introduce into a standard monetary policy model two types of governments: good and bad. Information is asymmetric, the government type is uncertain and the policy of the bad government is suboptimal. This uncertainty does not allow the good government to achieve the first best outcome even though it conducts optimal policy. Since, the bad government would never dollarize, the good government by dollarizing reduces uncertainty about the type of government and achieves the first best allocation. Here, unlike in models emphasizing the time inconsistency motive for dollarization, it does not change the actual policy. Thus, dollarization plays the role of a signaling device rather than a commitment device.

Keywords: dollarization, monetary policy, signaling

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1. Introduction

There are many countries, for example in Latin America, that have a long history of high inflation rates. In a number of these countries, governments conducted policies, that were not necessarily optimal for the societies they governed. As a result, in these countries, the public does not trust its government. Furthermore, many countries do not have long stable tradition of independent central bank. In some countries, even guaranteeing independence of the central bank in the constitution, does not ensure public belief in the low inflation policy. As the result of this heritage, a government that wants to implement optimal policy has low credibility. In such cases, establishing reputation is costly both in terms of welfare and GDP hence, dollarization may lead to savings on the costs of gaining credibility. We want to study this problem from the point of view of such a government, and see how dollarization can solve the problem of the lack of trust.

The standard argument for dollarization is that it brings credibility since it is a commitment device. We propose a new mechanism for building reputation through dollarization. We argue that dollarization may bring credibility since it provides the way to signal the intentions of the government. Therefore, we build a model with two types of the government: good and bad.¹ The good government wants to conduct optimal policy, and the bad government wants to use inflationary taxation in order to increase government expenditure above the socially optimal level.² The knowledge of the type of the government is private, the public knows only the probability distribution over the government types. The uncertainty about the government type distorts the equilibrium allocation away from optimal, therefore the good government cannot achieve optimal outcome, even if it conducts optimal policy. In the model there is a separating equilibrium: the good government dollarizes and the bad government does not dollarize. Hence, dollarization by eliminating the uncertainty about the government types, has real effects. Furthermore, in our model dollarization does not change the actual policy, as it would be the case if dollarization were a commitment device. Thus, in our model dollarization plays the role of a signaling device rather than a commitment device. It allows the good government to signal its type.

The model is a standard cash-credit goods model. We also assume that the government's budget is balanced in each period to avoid any complications with time inconsistency (coming from the fact that government may want to default on its debt). The only source of uncertainty in the model is the type of government.

The key force that drives the result is the fact that expected inflation is costly even if at the end the actual inflation is low. We assume that people decide how much labor to supply before they know monetary policy therefore, they base their decision on expectations. Dollarization brings down inflation expectations, so it improves welfare. In this view dollarization brings instantaneous reputation at no cost. The results are not driven by time inconsistency, since the only reason why the good government cannot achieve an optimal allocation is the fact that people are unsure whether they deal with the good or the bad government. Dollarization allows the good government to separate itself from the bad government.

There is an extensive literature on the pros and cons of dollarization (see Berg 2000). The two most important arguments in favor of dollarization are that it allows to import credibility which results in

¹ The idea of having two types of government is taken from Phelan (2006).
² Click (1998) documents that seigniorage accounted for a large share of government income in many Latin American countries in the 1970s and 1980s.
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lower inflation, and can increase trade by eliminating the exchange rate risk and the transaction costs associated with the currency exchange, for example see Alesina and Barro (2002). Similarly, Cooper and Kempf (2001) argue that dollarization may solve the time inconsistency problem, and Mendoza (2001) analyzes how dollarization can be beneficial by eliminating the distortions created by the exchange rate uncertainty and by weakening the informational and institutional frictions in the credit market. The main argument against dollarization is that it strips countries off the monetary independence. For example, Cooley and Quadrini (2001) analyze the effect of dollarization in the case of Mexico. They assume that the Mexican government conducts optimal policy and that the US policy is not optimal for Mexico. As the result in their model dollarization leads to non optimal policy, and does not improve the Mexican welfare. There are many more arguments for dollarization than presented above. To name just a few, Calvo (2001) argues that dollarization solves the “fear of floating” problem, and Arellano and Heathcote (2010) show that dollarization may broaden the access to financial markets. They show, that since dollarization increases the value of maintaining access to international financial markets, it makes it costlier for governments to default, thereby increasing the amount of debt that can be supported in equilibrium.

The crucial contribution of this paper to the literature is to point out that dollarization may improve credibility of government by signaling its intentions. We show that in the presence of uncertainty regarding the goals of government dollarization provides means to signal those goals. Hence, our work shows the mechanism of credibility building through dollarization that to the best of our knowledge has been absent from the debate. We want to stress that our argument complements the existing literature instead of rivaling it.

The structure of this paper is as follows. In Section 2 we show how governments behave in our framework. In Section 3 we present the model. In Section 4 we show the results. Section 5 concludes the paper.

2. Preliminaries

Our paper extends and modifies the Lucas and Stokey (1983) economy. First, we introduce the uncertainty about the type of government, second we allow each government to dollarize or not. Furthermore, following Svensson (1985) and Albenesi, Chari and Christiano (2003), we require households to use money accumulated in the previous period to purchase cash good in the current period. We use a version of a cash-credit good model with households, producers and government. Households buy consumption, supply labor and trade assets. Government collects taxes, issues money and finances the stream of government expenditure.

In this section we take a closer look at the behavior of government in a world with no uncertainty about the type of government and no possibility of dollarization. We examine the behavior of both types of government when agents know exactly the type of government they face. In the next section we introduce a fully specified model with the uncertainty about the type of government and the choice of whether to dollarize or not.

There are two types of government: good government, \( \theta_g \), and bad government, \( \theta_b \). Denote the type of government as, \( \theta \in \{ \theta_g, \theta_b \} \). Government decides on the level of government expenditure \( G \) and on the growth rate of money \( \mu \). Denote the government's policy as \( \pi \). Note, that in our model, optimal
policy should satisfy the Friedman rule. Usually, we say that the monetary policy satisfies the Friedman rule if the nominal interest is zero. In our model there is no nominal interest rate, but the analog of the zero nominal interest rate is $\mu = \beta$, where $\beta$ denotes the discount factor of households. We define this monetary policy as satisfying the Friedman rule.

2.1. Households

There is measure one of households, households take government’s policy, $\pi$, as given. Each household starts each period with nominal assets $a$. In the beginning of each period in the assets market, the households trade money, $m$, and one-period bonds, $b$. Each bond costs $q$ and pays one unit of nominal value in the next period. The asset market constraint has the following form:

$$m + qb \leq a$$

We also impose a no-Ponzi constraint of the form $b \geq -b$, where $b$ is a large enough finite number. Next the households split into two parties. One party goes to the goods market and buys cash goods, $c_1$, with money, credit goods, $c_2$, with credit, and next period assets, $a'$. The other party goes to the labor market and supplies labor, $l$. Since cash goods can only be bought with money each household faces the cash-in-advance constraint

$$Pc_1 \leq m$$

where $P$ denotes the price level.

The budget constraint in the goods market has the following form:

$$\mu a' + Pc_2 + Pc_1 \leq Wl + m - PT + b$$

where $T$ denotes lump sum taxes.\(^3\)

Denote aggregate values with capital letters, and individual values with small letters. We follow Albanesi, Chari and Christiano (2003) in normalizing all nominal variables by dividing each nominal variable (money, nominal assets, bonds, price and wage) in each period by the aggregate stock of nominal assets, so $A = 1$. Due to this normalization we have $\mu$ in the households budget constraint (3). The household have the following instantaneous utility function:

$$u(c_1, c_2, G, l) = \log c_1 + \log c_2 + \xi \log G + \log(1 - l)$$

\(^3\) The assumption that taxes are lump sum instead of distortionary is not crucial here, since as Chari and Kehoe (1999) show – given relatively weak assumptions – optimal monetary policy should still follow the Friedman rule even if income taxes are distortionary.
Denote the vector \((m, b, c_1, c_2, l, a')\) as \(x\). The problem of the household, given governments' policy \(\pi\), takes the following form:

\[
V(a; \pi) = \max_x \left\{ \log c_1 + \log c_2 + \xi \log G + \log(1 - l) + \beta V(a'; \pi) \right\}
\]

(subject to (1) – (3))

(5)

2.2. Government

We assume that a government runs a balanced budget:

\[
G = T + \frac{\mu - 1}{p} M
\]

(6)

where \(M\) denotes the money supply.

Furthermore, we assume that government has only limited ability to collect taxes. Let \(\bar{T}\) be an upper limit on taxes. The value of the limit is provided at the end of this section. This limit puts a constraint on a government and it cannot freely choose the level of government expenditure and the growth rate of money.

2.3. Producers and resource constraint

For simplicity we assume the following production function:

\[
y = l
\]

(7)

Furthermore, we assume that cash, credit and government goods are produced with the same technology, which implies that all goods have the same price \(P\). Zero profit condition implies:

\[
P = W
\]

(8)

Feasibility condition takes the following form:

\[
C_1 + C_2 + G = Y = L
\]

(9)

---

4 We assume that the budget is balanced to avoid the time inconsistency problems associated with incentives to deflate government debt, for details see Lucas and Stokey (1983).

5 We also impose a standard constraint that the interest rates are non-negative which translates into the following constraint \(\mu \geq \beta\).

6 There are many possible reasons for that. For example, it could be due to inefficient tax collection or due to political constraints.
In the assets market, since government cannot borrow or lend, the aggregate stock of bonds is equal to zero:

\[ B = 0 \]  

(10)

Furthermore, since the aggregate stock of nominal assets is normalized to one, we have the constraint in the nominal assets market:

\[ A = 1 \]  

(11)

Also, given that \( B = 0 \), we have the constraint for the money market:

\[ M = 1 \]  

(12)

2.4. Recursive competitive equilibrium

Next we use the standard concept of recursive competitive equilibrium to describe the behavior of the private economy. Agents in the economy take the government’s policy as given and optimize their decisions.

**Definition 1.** A recursive competitive equilibrium (RCE), given the government policy \( \pi \), is an individual policy function \( x(\alpha; \pi) \), a value function \( V(\alpha; \pi) \), an aggregate allocation \( X(\pi) \), and prices \((P(\pi), W(\pi), q(\pi))\) such that: \(^7\)

- \( x(\alpha; \pi) \) and \( V(\alpha; \pi) \), given \( \pi, X(\pi) \) and prices, solve the household’s problem (5),
- aggregate and individual choices coincide \( x(1; \pi) = X(\pi) \),
- producers satisfy (8),
- the government budget (6) is satisfied,
- all markets clear, (9)–(12), are satisfied.

A recursive competitive equilibrium is fully characterized by the following equations:

\[ C_1 = \beta \frac{1 - G}{\beta + 2\mu} \]  

(13)

\[ C_2 = \mu \frac{1 - G}{\beta + 2\mu} \]  

(14)

\[ 1 - L = \mu \frac{1 - G}{\beta + 2\mu} \]  

(15)

\[ G = (\mu - 1) \beta \frac{1 - G}{\beta + 2\mu} + T, \quad T \leq \bar{T} \]  

(16)

\(^7\) Note, here RCE is defined for given policy \( \pi \), therefore inside the RCE \( V(\alpha; \pi) \) and \( x(\alpha; \pi) \) are functions of \( \alpha \) for given \( \pi \). Only when the government chooses the policy \( \pi \) allocations and prices become functions of \( \pi \).
Note that social optimality requires $C_i = C_2$, and in our case we have $\mu C_i = \beta C_2$. Thus, if growth rate of money is higher than the one implied by the Friedman rule, $\mu > \beta$, it creates a wedge in cash good-credit good choice, that distorts economy away from social optimum. Also the higher $\mu$ the farther away is the economy from optimum.

2.5. Markov problem

In this subsection we describe the behavior of both types of government. We specify their objectives and later we describe the choices that both governments make in a Markov equilibrium. Since we focus on the case when governments have no ability to commit, we are going to use the concept of Markov problem rather than the Ramsey problem. Governments here choose the policy today and take the future policy as given. The precise definition of Markov equilibrium is presented at the end of this subsection. Both types of government solve the following problem:

$$\max_{(G,\mu)} \left\{ u^0(c_1, c_2, G, l) + \beta V^0(1; \pi) \right\}$$

(subject to (13)–(16))

(17)

where $V^0(1; \pi)$ is defined on the equilibrium path of $(c_1, c_2, G, l)$ given government policy $\pi$ according to the following formula:

$$V^0(1; \pi) = u^0(c_1, c_2, G, l) + \beta V^0(1; \pi)$$

(18)

where:

$$u^0(b)(c_1, c_2, G, l) = \log c_1 + \log c_2 + \xi \log G + \log(1 - l)$$

$$u^0(b)(c_1, c_2, G, l) = \log c_1 + \log c_2 + \xi b \log G + \log(1 - l)$$

where $\xi_b > \xi$.

We assume that the good government maximizes the utility of the representative agent, but the bad government maximizes the utility that assigns higher value to the government expenditure than the representative agent’s utility.

The limit on lump sum taxes, $T$, is such that it is enough to finance the socially optimal level of government expenditure, but not the level that is preferred by the bad government. Thus, if the bad government wants to increase the government expenditure it has to print money. We set $T = (1 + \xi - \beta)/(3 + \xi)$ where $\xi < \xi < \xi$. We would like to stress that there is more than one way of modeling why governments do bad things. Our way of modeling bad government captures simple intuition, that there are situations that governments print too much money. Next we define a Markov equilibrium.
**Definition 2**. A Markov equilibrium is: (i) a policy \( \pi(\theta) \); and (ii) a recursive competitive equilibrium, s.t. the policy of type \( \theta \) government solves the Markov problem (17) given RCE.

It is straightforward to find a Markov equilibrium. We find that in a Markov equilibrium the good government chooses:

\[
G = \frac{\xi}{3 + \xi}, \quad \mu = \beta
\]

and the bad government chooses:

\[
G = \frac{\xi \beta (1 + \xi)}{(1 + \xi_b)(3 + \xi)} > \frac{\xi}{3 + \xi}, \quad \mu = \beta \frac{1 + \xi}{1 + \xi_b} > \beta
\]

Define:

\[
G_L = \frac{\xi}{3 + \xi} \quad \text{and} \quad G_H = \frac{\xi \beta (1 + \xi)}{(1 + \xi_b)(3 + \xi)}
\]

Note that without the limit on taxes the bad government would have chosen government expenditure at an even higher level. In our situation the bad government faces a trade off. When it increases the government expenditure, it enjoys higher level of government expenditure, but pays for it with creating more distortions in the economy.

## 3. Model

In this section we introduce uncertainty about the type of government, which creates uncertainty about the government’s policy. To simplify analysis we restrict the set of possible values of \( G \) to \( \{G_L, G_H\} \). From the previous section we can see that this is not a very restrictive assumption, because this is what these governments want to do anyway. Furthermore, each government faces the decision whether to dollarize or not.

### 3.1. Dollarization

Here by dollarization we mean loss of the independent monetary policy and adoption of the foreign monetary policy (for example US monetary policy). Since for simplicity we use a closed economy model we assume that by dollarizing a country adopts the Friedman rule (which, for convenience, we also call US monetary policy). This is not a key assumption here, but it makes the argument clear. As it will be shown later, the main message of the paper is that a government by dollarizing can affect the real side of the economy even though there is no actual change in policy. Thus the only force generating this change is the signaling role of dollarization. The result would still go through if this assumption was weakened, i.e. the US monetary policy was not far from the Friedman rule. But then dollarization would not only play the role of signaling device but also – well recognized in the literature – role of
commitment device. Since, we emphasize the signaling role of dollarization, for clarity, we assume that by dollarizing a country adopts optimal monetary policy.

It is also important to notice that dollarization, contrary to the currency board or fixed exchange rate (as we could witness during the crisis in Argentina in 2002), is not easily revertible. To capture this important feature of dollarization, that distinguishes it from the currency board or the fixed exchange rate regimes, we allow governments to dollarize or undollarize only at certain points in time. Furthermore, it implies that the same results may not be achievable with other exchange rate regimes.

Once a government dollarizes, it loses control over monetary policy and has to follow US monetary policy. Furthermore, dollarization decision strips a government of seigniorage income thus constraining fiscal policy as well. If a government does not dollarize, it can control both fiscal and monetary policy. The difference between governments is that the good government maximizes welfare of the representative agent; and the bad government would like to have higher than optimal level of government expenditure. The prior probability that the government’s type is good is equal to $\rho$, and the prior probability that the government’s type is bad is equal to $(1-\rho)$.

3.2. Timing

The prior probability that the type of government is good, $\rho$, is publicly known. Each period $t$ is divided into two subperiods. The timing is illustrated in Figure 1.

**Subperiod 1.** In the first subperiod the government decides whether to dollarize or not, $d \in \{D, N\}$ (where $D$ denotes dollarization and $N$ no dollarization). While making this decision the government takes into account the state of the economy which is $(\rho, \theta)$. Agents do not make any move in this subperiod.

![Timing of the model](image)
Subperiod 2. In the second subperiod households first observe the decision of the government \( d \) and update their belief \( \rho_d \). Each household starts each period with nominal assets holding \( a \). This assets at the beginning of the second subperiod are used to buy money, \( m \), and state contingent bonds (bonds are contingent on the government’s policy,\(^8\) which is the only source of uncertainty in this economy), \( b(G) \). Then each household splits into two parties and one party goes to the labor market where it has to sign a contract on hours worked, \( t \), for an expected competitive wage. This decision is made before \( G \) is observed and cannot be contingent on \( G \). Note also that it is a key assumption for our result. The other party goes to the goods market, learns government policy \( G \) and uses money to buy cash goods \( c_i(G) \) and credit to buy credit goods \( c_j(G) \). Since the party that goes to the goods market observes \( G \), these decisions are contingent on \( G \) (they are made by households before splitting).

In the second subperiod, if the economy is dollarized then a government does nothing in the second subperiod, otherwise it has to choose its monetary and fiscal policy.

The public state of the world for agents is \((\rho, d)\). The state of the world for an individual agent is \((\rho, d, a)\). The state of the world for a government is \((\rho, \theta)\).

3.3. Government

A government moves in two stages, in the first stage a government decides whether to dollarize or not \( d \in \{D, N\} \). If the government in the first stage decides not to dollarize, then in the second stage it has to pick government expenditure, \( G \in \{G_1, G_2\} \), and monetary policy, \( \mu \in [\beta, \infty) \). To finance government expenditure government can use lump sum taxes:

\[
T \leq \bar{T} = \frac{1 + \xi - \beta}{3 + \xi}
\]

where \( \bar{T} \) is a limit on taxes and \( \xi < \bar{\xi} < \xi_0 \).

The introduction of the limit on taxes plays a very important role here. The limit is such that it allows to the government to finance:

\[
G_L = \frac{\xi}{3 + \xi}
\]

but does not allow to finance:

\[
G_H = \frac{\xi_b (1 + \bar{\xi})}{(1 + \xi_b)(3 + \bar{\xi})}
\]

If the government chooses \( G_H \), it has to print money. The relation between monetary policy and fiscal policy is given by the balanced government budget:

\(^8\) This is to show that the result does not follow from asset markets incompleteness.
Thus, the choice of $G$ completely describes the behavior of the government. Denote the strategy of government as $\gamma(\rho, d, \theta)$, where $\gamma(\rho, d, \theta)$ probability that type $\theta$ government chooses $G_L$ given its decision on dollarization $d \in \{D, L\}$.

If the government in the first stage decides to dollarize, then monetary policy is fixed by this decision, we assume that then $\mu = \mu^{US} = \beta$. Given that the government runs a balanced budget, the government cannot afford $G_H$, thus $G$ has to be equal to $G_L$.

The dynamics of the types of government is given by the following rule:

$$
\Pr(\theta' = \theta_g | \theta = \theta_g) = 1 - \varepsilon_g, \Pr(\theta' = \theta_b | \theta = \theta_g) = \varepsilon_g
$$

$$
\Pr(\theta' = \theta_b | \theta = \theta_b) = 1 - \varepsilon_b, \Pr(\theta' = \theta_g | \theta = \theta_b) = \varepsilon_b
$$

(20)

where $\theta$ denotes current government type, $\theta'$ future government type.

We assume some persistence of the government type, $\varepsilon_g, \varepsilon_b \leq 0.5$. If the inverse were true, i.e. the bad rather then good government would be more likely to follow the good government then our result would not go through. In our case if the good government reveals its type today it affects positively both current and future utility (see the proofs in Appendix for details).

### 3.4. Households

First, households observe whether government dollarizes or not $d \in \{D, N\}$. The state of the world for agents at the time of their decision making is $(\rho, d, a)$. For convenience we suppressed notation by dropping $(\rho, d)$ whenever possible. Once the government's decision is made, households update their belief\(^9\) about the probability of facing the good government, $\rho_d, d \in \{D, N\}$.

In each period each household decides how much to work, and how much of cash good and credit good to consume. They form their belief about the probability distribution over the government types, which together with the strategy of both governments $\gamma$ allows households to compute the probability of each $G$, $\Pr(G)$, according to the following formula $\Pr(G_L) = \rho_d \gamma(\theta_g) + (1 - \rho_d) \gamma(\theta_b)$ and $\Pr(G_H) = \rho_d (1 - \gamma(\theta_g)) + (1 - \rho_d) (1 - \gamma(\theta_b))$. Furthermore, we assume that households are cautious, and they form their plans for all possible values of $G$, even if their probabilities are zero (i.e. even for $G$ such that $\Pr(G) = 0$). The instantaneous utility function is given by:

$$
\lim_{\varepsilon \to 0} \sum_{G \in \{G_L, G_H\}} \Pr(G) \left[ \log c_1(G) + \log c_2(G) + \xi \log G + \log(1 - l) \right]
$$

(21)

\(^9\) All the updating rules are presented in the Appendix.
where:

\[
\Pr_x(G) = \begin{cases} 
\Pr(G), & \text{if } \Pr(G) \in [\varepsilon, 1 - \varepsilon] \\
\varepsilon, & \text{if } \Pr(G) \leq \varepsilon \\
1 - \varepsilon, & \text{if } \Pr(G) \geq 1 - \varepsilon 
\end{cases}
\]

Notice that without this modification, for \( G \) s.t. \( \Pr(G) = 0 \) households would not care about the choice of \( c_1(G), c_2(G) \) and the strategies for the government (defined later) would not be well defined.

Denote the nominal household’s asset holdings, carried over from the previous period, as \( a \). Households use this assets to buy money \( m \), and state contingent bonds \( b(G) \), where \( G \in \{G_L, G_H\} \) and \( \Pr_x(G)q(G) \) is a price of bond \( b(G) \) that pays one if government expenditure are equal to \( G \) and zero otherwise. Thus households face the following budget constraint:

\[
m + \sum_{G \in \{G_L, G_H\}} \Pr_x(G)q(G)b(G) \leq a
\]

Again we normalize all nominal variables, so that \( A = 1 \). Money is used to purchase cash goods subject to the cash in advance constraint.

\[
P(G)c_1(G) \leq m
\]

where \( P \) denotes the price of goods. Nominal assets have to satisfy the following constraint for \( G \in \{G_L, G_H\} \):

\[
\mu(G)a'(G) + P(G)c_2(G) + P(G)c_1(G) \leq W(G)l + m - P(G)T(G) + b(G)
\]

where \( a'(G) \) is multiplied by \( \mu(G) \), because of normalization. Additionally, they face a no-Ponzi game condition, which is analogous to the one in the previous section.

Denote the variables describing choice of households by \( x = (m, b(G_L), b(G_H), c_1(G_L), c_1(G_H), c_2(G_L), c_2(G_H), l, a'(G_L), a'(G_H)) \), and the aggregate policy rules by \( X \). The aggregate policy rules are given by:

\[
X = X(\rho, d)
\]

Recall, that before the next period starts, agents observe the value of the government expenditure and update their believes about the type of government, the new belief is denoted by \( \rho' \). Afterwards, given the transition probabilities from (20), they form the next period belief \( \rho' \). Agents take the governments' strategy \( \delta(\rho, \theta) \), \( \gamma(\rho, d, \theta) \) and the believes \( \rho, \rho_{d}, \rho_{G} \) as given and solve the following problem:
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\[ V(a, \rho, d) = \lim_{\epsilon \to 0} \max_{x} \sum_{G \in \{G_1, G_2\}} \Pr_{\epsilon}(G) \{u(c_1(G), c_2(G), G, l) + \] 
\[ + \beta \mathbb{E}_{\rho \theta} \left[ \mathbb{E}_{\delta} [V(a'(G), \rho', d') | \theta] \right] \} \] 
\[ \text{(subject to (22) – (25))} \]

Note that \( E_\theta [V(a', \rho', d') | \theta] = \delta(\rho', \theta)V(a', \rho', D) + (1 - \delta(\rho', \theta))V(a', \rho', N) \) and \( E_{\rho \theta} E_\delta [V(a'(G), \rho', d') | \theta] = \sum_\rho \Pr(\theta; \rho \theta) E_\delta [V(a'(G), \rho', d') | \theta] \).

Denote the policy functions for individuals (which solve the problem above) as:

\[ x = x(\rho, d, a) \] (27)

3.5. Firms and resource constraint

For simplicity we assume the following production function:

\[ y = l \] (28)

Cash, credit and government goods are produced with the same technology by the same firm, which implies that the nominal price of the three goods is the same \( P \). Firms are competitive which, together with the production function, implies that:

\[ P(G) = W(G) \] (29)

Profits are zero.

Feasibility condition is:

\[ C_1(G) + C_2(G) + G = L \] (30)

where \( C_1, C_2, L \) are aggregate values of, respectively, cash good, credit good, and labor supply.

We assume that the government budget is balanced so the aggregate bonds holdings are zero:

\[ B(G) = 0 \] (31)

All nominal variables are normalized by the beginning of period aggregate nominal assets holdings which, since the aggregate bond holdings add up to zero, is equal to the stock of money. Given this normalization in each period the aggregate stock of money is:

\[ M = 1 \] (32)
and the aggregate nominal assets holdings is:

\[ A = 1 \]  \quad (33)

### 3.6. Recursive competitive equilibrium

Next we define a recursive competitive equilibrium given the decision of the government \( d \in \{D, N\} \), the governments’ policy rules and the updating rules (see Appendix for the updating rules).

**Definition 3.** A recursive competitive equilibrium (RCE) given: (i) the governments’ policy \( \delta(\rho, \theta), \gamma(\rho, d, \theta) \) (ii) the event \( d \in \{D, N\} \); and (iii) the updating rules for \( \rho_d, \rho_G \) and \( \rho \); is a collection of functions: \( \{P(G), W(G), q(G), x(a, \rho, d), X_{G}(\rho, d)\} \) and a value function \( V(a, \rho, d) \) such that:

- \( x(a, \rho, d) \) and \( V(a, \rho, d) \) solve the household’s problem (26),
- the aggregate and the individual policy rules coincide \( x(1, \rho, d) = X(\rho, d) \),
- producers satisfy (29),
- the government budget (19) is satisfied,
- all markets clear, (30–33) are satisfied.

Equilibrium is fully described by:

\[ q(G)c_1(G) = c_2(G) \]  \quad (34)

\[ \frac{1}{1-l} = \sum_{a \in \{a_1, a_u\}} \Pr(G) \frac{1}{c_2(G)} \]  \quad (35)

\[ P(G)c_1(G) = M = 1 \]  \quad (36)

\[ q(G)\mu(G) = \beta \]  \quad (37)

plus the government budget constraint (19) and the feasibility constraint (30). Notice that \( q(G) \) (if different from 1) distorts the economy away from optimum. The optimal allocation requires \( c_1 = c_2 = 1-l \).

### 3.7. Markov problem

Next we define the problems solved by governments. Once the dollarization decision is made governments solve the following problems. If \( d = N \), the good government solves:

\[ \max_\gamma \gamma \{u(c_1(G_L), c_2(G_L), G_L, l) + bE_{\rho_G} [E_\theta [V(1, \rho', d') | \theta]] \} \]

\[ + (1-\gamma) \{u(c_1(G_H), c_2(G_H), G_H, l) + bE_{\rho_G} [E_\theta [V(1, \rho', d') | \theta]] \} \]

(subject to RCE)
If \( d = N \), the bad government solves:

\[
\max_{\gamma} \gamma[u^b(c_1(G_L), c_2(G_L), G_L, l)] + \beta E_{\rho_G}[E_\delta[V^b(1, \rho^*, d^*)] | \theta] \\
+ (1 - \gamma)\{u^b(c_1(G_H), c_2(G_H), G_H, l) + \beta E_{\rho_G}[E_\delta[V^b(1, \rho^*, d^*)] | \theta]\}
\]

(subject to RCE)

\[ (39) \]

where \( u^b(c_1, c_2, G, l) = \log c_1 + \log c_2 + \zeta_h \log G + \log(1 - l) \), and \( \zeta_h > \zeta \). \( V^b \) and \( V \) are defined given the future government strategies \( \gamma(\cdot) \), \( \delta(\cdot) \), the households’ policy function \( X(\cdot) \), and the updating rules for \( \rho, \rho_d, \rho_G \) as:

\[
V(1, \rho, d) = \sum_{G \in \{c_1, c_2\}} \Pr(G)\{u(c_1(\cdot), c_2(\cdot), G, l(\cdot)) + \beta E_{\rho_G}[E_\delta[V(1, \rho^*, d^*)] | \theta]\}
\]

\[ (40) \]

\[
V^b(1, \rho, d) = \sum_{G \in \{c_1, c_2\}} \Pr(G)\{u^b(c_1(\cdot), c_2(\cdot), G, l(\cdot)) + \beta E_{\rho_G}[E_\delta[V^b(1, \rho^*, d^*)] | \theta]\}
\]

\[ (41) \]

Let’s define government’s problem in the first subperiod. The good government wants to conduct optimal policy (it maximizes utility of the representative agent). Let \( \delta(\rho, \theta_g) \) be a policy of the good government, and let it denote the probability of dollarization by the good government. This policy solves:

\[
\max_{\delta} \delta V(1, \rho, D) + (1 - \delta) V(1, \rho, N)
\]

\[ (42) \]

The bad government maximizes its own utility function. Let \( \delta(S, \theta_b) \) be a policy of the bad government, and let it denote the probability of dollarization by the bad government. This policy solves:

\[
\max_{\delta} \delta V^b(1, \rho, D) + (1 - \delta) V^b(1, \rho, N)
\]

\[ (43) \]

Notice that, in equilibrium agents, take the policy of future governments as given, hence, by solving (43) and (44), the governments also implicitly do. Next we define a Markov equilibrium.

**Definition 4.** A Markov equilibrium is: (i) policy rules \( \delta(\cdot), \gamma(\cdot, N) \); and (ii) a recursive competitive equilibrium, s.t.:

- policy of the good government, \( \gamma(\cdot; N, \theta_g) \), solves (38), given \( \delta(\cdot); \gamma(\cdot, N, \theta_h) \) and RCE,
- policy of the bad government, \( \gamma(\cdot; N, \theta_b) \), solves (39), given \( \delta(\cdot); \gamma(\cdot, N, \theta_g) \) and RCE,
- policy of the good government, \( \delta(\cdot; \theta_g) \), solves (42), given \( \delta(\cdot; \theta_g), \gamma(\cdot) \) and RCE,
- policy of the bad government, \( \delta(\cdot; \theta_b) \), solves (43), given \( \delta(\cdot; \theta_g), \gamma(\cdot) \) and RCE,
- updating rules for \( \rho, \rho_d, \rho_G \) are consistent with strategies and dynamics of government.
4. Results

In this section we describe the behavior of governments in equilibrium.

Proposition 5. In a pure strategies Markov equilibrium:
- in case of no dollarization, the good government chooses \( G = G_L \) (i.e. \( \gamma(N, \theta_g) = 1 \)),
- in case of no dollarization, the bad government chooses \( G = G_H \) (i.e. \( \gamma(N, \theta_b) = 0 \)),
- the good government dollarizes, \( \delta(\theta_g) = 1 \) (unless \( \rho = 1 \), then it is indifferent),
- the bad government does not dollarize, \( \delta(\theta_b) = 0 \).

Proof. See Appendix.

In equilibrium if the bad government does not dollarize, then in order to finance high government expenditure it has to print money. Thus the bad government creates distortions in the economy. Furthermore, since dollarization makes it impossible to finance the high level of government expenditure, the bad government will not choose dollarization. Given this strategy of the bad government, the good government decides to dollarize. The main reason for dollarization is to distinguish itself from the bad government.

Notice, that after dollarization the good government has to choose, \( G = G_L \), but without dollarization it would have chosen the same. If there is no dollarization we have the following strategies, the good government chooses the low level of government expenditure, and the bad government chooses the high level of government expenditure. Thus, government does not dollarize in order to commit and escape the time inconsistency problem. The only reason for dollarization is the fact that it allows the good government to distinguish itself from the bad government, and thus signal its type. Dollarization allows the good government to signal its type before the choice of labor supply is made, so that \( l \) is not distorted, and even though it does not change the policy (by policy we mean the choice of \( G \)) it has real effects. Since dollarization does not change the policy, real effects come from the fact that dollarization plays the role of a signaling device rather than a commitment device.

Let us stress here that the result does not rely on the fact that dollarization is not costly for the good government. The result still goes through if the costs of dollarization are smaller than gains. Precisely, it can be shown that dollarization is an optimal solution, even if dollarization means implementing the US policy, that is not optimal from the point of view of the dollarizing country (i.e. \( \mu^{US} > \beta \)), but is not far from optimal (i.e. \( \mu^{US} \) is not too big).

5. Conclusion

In this paper, we find that governments faced with the lack of public trust may find it optimal to dollarize. We find a very specific motivation for how dollarization can help credibility issues. It allows the good government to separate itself from the bad government. Thus dollarization works as a signal. This view on dollarization differs from the standard one, which views dollarization as a commitment device. In our framework, by dollarizing the government is not trying to escape the time inconsistency problem, because, even without dollarization, it would have chosen the same policy (here the low value of government expenditure). Thus dollarization plays the role of signaling device. Dollarization has real effects as it allows to bring down the inflation expectations.
In order to emphasize the signaling role of dollarization, we show that dollarization has real effects even though it does not change the actual policy (growth rates of money and government expenditure are the same with and without dollarization for the good government). Thus, for clarity of the presentation, we assume that by dollarizing a country adopts optimal monetary policy. But, this is not a key assumption here. The result would still go through as long as policy after dollarization would not have been far from optimal. But then dollarization would play both the role of signaling and commitment devices. Hence, our focus on the signaling role of dollarization explains the assumption we made.

References


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Appendix

Updating rules

In order to obtain consistent with strategies beliefs $\rho_d$, use the following formulas:

$$\rho_d = \begin{cases} \frac{\delta(\rho, \theta_g)\rho}{\delta(\rho, \theta_g)\rho + \delta(\rho, \theta_b)(1 - \rho)}, & \text{if possible} \\ 0, & \text{if } \rho = 0 \\ 1, & \text{otherwise} \end{cases} \quad (44)$$

$$\rho_N = \begin{cases} \frac{(1 - \delta(\rho, \theta_g))\rho}{(1 - \delta(\rho, \theta_g))\rho + (1 - \delta(\rho, \theta_b))(1 - \rho)}, & \text{if possible} \\ 1, & \text{if } \rho = 1 \\ 0, & \text{otherwise} \end{cases} \quad (45)$$

In order to obtain consistent with strategies beliefs $\rho_G$, use the following formulas:

$$\rho_{G_L} = \begin{cases} \frac{\gamma(\theta_g)\rho_d}{\gamma(\theta_g)\rho_d + \gamma(\theta_b)\rho_d}, & \text{if possible} \\ 0, & \text{if } \rho = 0 \\ 1, & \text{otherwise} \end{cases} \quad (46)$$

$$\rho_{G_H} = \begin{cases} \frac{(1 - \gamma(\theta_g))\rho_d}{(1 - \gamma(\theta_g))\rho_d + (1 - \gamma(\theta_b))\rho_d}, & \text{if possible} \\ 1, & \text{if } \rho = 1 \\ 0, & \text{otherwise} \end{cases} \quad (47)$$

Similarly, to obtain $\rho'$ use $\rho_G$ and (20):

$$\rho' = \rho_G (1 - \varepsilon_g) + (1 - \rho_G)\varepsilon_b \quad (48)$$
Proof of proposition 5

First notice that for any \( \rho \) after dollarization, \( d = D \), we have: \((C_1(D), C_2(D), G, l(D)) = (1/(3+\xi), 1/(3+\xi), (2+\xi)(3+\xi))\) and for any \( \rho \neq 1 \) after no dollarization, \( d = N \), we have \( \rho_N = 0 \) and \((C_1(N, G_{ij}), C_2(N, G_{ij}), G, l(N)) = ((1+\xi)[(1+\xi_s)(3+\xi)], 1/(3+\xi), [\xi_s(1+\xi_s)]/[1+\xi_s](3+\xi), (2+\xi)(3+\xi))\). Denote the equilibrium value of current period utility after dollarization, \(\lim_{\epsilon \to 0} \sum_{G \in \{G_L, G_M\}} \Pr(G)u(C_1(G), C_2(G), G, L)\), as \(u(D)\) and after no dollarization as \(u(N)\). It is easy to show that \(u(D) > u(N)\), thus, as the good government dollarizes and the bad government does not dollarize. This implies that the future value \(\beta E_{\nu_G} [E_{\nu}[V(a'(G), \rho', d') | \theta]]\) is increasing in \(\rho_G\). Denote the equilibrium value of current period utility for the bad government after dollarization, \(\sum_{G \in \{G_L, G_M\}} \Pr(G)u_b(C_1(G), C_2(G), G, L)\), as \(u'(D)\) and after no dollarization as \(u'(N)\). Furthermore, it is easy to show that \(u'(D) < u'(N)\), thus the future value \(\beta E_{\nu_G} [E_{\nu}[V^{b'}(a'(G), \rho', d') | \theta]]\) does not change either. Thus, in problem (43) the current utility decreases while the future value does not change. So, this deviation is not profitable.

Consider deviation from \(D\) to \(N\). As we showed earlier \(u(D) > u(N)\), thus the current period utility falls. Furthermore, since the future value \(\beta E_{\nu_G} [E_{\nu}[V(a'(G), \rho', d') | \theta]]\) is increasing in \(\rho_G\) and this deviation changes \(\rho^d\) from 1 to 0, the future value also falls. Thus in problem (43) both the current utility and the future value decrease. Hence this deviation is not profitable.

A case of good government. Consider deviation from \(G_L\) to \(G_{ij}\). First notice that in equilibrium: \((C_1(G_{ij}), C_2(G_{ij}), G_{ij}, l) = (1/(3+\xi), 1/(3+\xi), (2+\xi)(3+\xi))\) which is efficient (the current utility is the highest possible). Denote the equilibrium value of \(u(C_1(G_{ij}), C_2(G_{ij}), G_{ij}, L)\) after no dollarization as \(u(G_{ij})\) and the equilibrium value of \(u(C_1(G_{ij}), C_2(G_{ij}), G_{ij}, L)\) after no dollarization as \(u(G_{ij})\). Next, notice that from the government budget \(\mu(G_{ij}) > \beta\), so \(q(G_{ij}) < 1\) and \(C_1(G_{ij}) \neq C_2(G_{ij})\) which, together with the feasibility and the fact that \(G_{ij} > G_L\), implies \(u(G_{ij}) > u(G_{ij})\). Also, since \(\rho_G\) does not change, the future value \(\beta E_{\nu_G} [E_{\nu}[V(a'(G), \rho', d') | \theta]]\) does not change either. Thus, in problem (48) the current utility decreases while the future value does not change. So, this deviation is not profitable.

A case of bad government. Consider deviation from \(G_{ij}\) to \(G_L\). First notice that in equilibrium: \((C_1(G_{ij}), C_2(G_{ij}), G_{ij}, l) = ((1+\xi)[(1+\xi_s)(3+\xi)], 1/(3+\xi), [\xi_s(1+\xi_s)]/[1+\xi_s](3+\xi), (2+\xi)(3+\xi))\) and \((C_1(G_L), C_2(G_L), G_L, l) = ((1+\xi)[(1+\xi_s)(3+\xi)], 1/(3+\xi), (2+\xi)(3+\xi))\). Denote the equilibrium value of \(u^b(C_1(G_{ij}), C_2(G_{ij}), G_{ij}, L)\) after no dollarization as \(u^b(G_{ij})\) and the equilibrium value of \(u^b(C_1(G_{ij}), C_2(G_{ij}), G_{ij}, L)\) after no dollarization as \(u^b(G_{ij})\). It is easy to show that \(u^b(G_{ij}) < u^b(G_{ij})\). Also since \(\rho_G\) does not change, the future value \(\beta E_{\nu_G} [E_{\nu}[V^b(a'(G), \rho', d') | \theta]]\) does not change either. Thus, in problem (40) the current utility decreases while the future value does not change. Therefore, this deviation is not profitable.

Consider deviation from \(N\) to \(D\). As we showed earlier \(u(D) < u(N)\), thus the current period utility falls. Furthermore, since the future value \(\beta E_{\nu_G} [E_{\nu}[V^b(a'(G), \rho', d') | \theta]]\) is decreasing in \(\rho_G\) and this deviation changes \(\rho^d\) from 0 to 1, the future value also falls. Thus, in problem (40) both the current utility and the future value decrease. Hence, this deviation is not profitable.