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ABSTRACT

Monetary Policies for Developing Countries: The Role of Institutional Quality*

Weak public institutions, including high levels of corruption, characterize many developing countries. With a simple model, we demonstrate that institutional quality has important implications for the design of monetary policies and can produce several departures from the conventional wisdom. We find that a pegged exchange rate or dollarization, while sometimes prescribed as a solution to the problem of a lack of credibility, is typically not appropriate in developing countries with poor institutions. Such an arrangement is inferior to an optimal inflation targeting, or a Rogoff-style central banker, whose optimal degree of conservatism is proportional to the quality of institutions. Furthermore, our results cast doubt on the notion that a low inflationary target or a currency board can be used as an instrument to induce governments to strengthen quality of public institutions.

JEL Classification: E52, E58, E61, E62 and H50
Keywords: conservative central banker, corruption, currency board, dollarization, inflation targeting, institutional quality and monetary policy

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I. INTRODUCTION

Textbook discussions of monetary policies do not usually separate developing from developed countries. Are there important features about developing countries that might suggest that the optimal design of monetary policies should be different systematically between them? In this paper, we study one particular feature that is prevalent in developing (and transition) economies, namely weak institutions. Obviously, developed countries are not immune to this problem, but it is far less prevalent than in many developing countries. Surprisingly, the consequence of weak public institutions on the design of monetary policy has not been systematically examined. The main objective of this paper is to fill this void, and to demonstrate that the effect is not trivial.

As many developing countries lack credibility in their monetary policy, a subject heavily studied in the literature, a conventional wisdom is that these developing countries should peg their currency to a major currency from a low-inflationary country, have a currency board, or dollarize. Our analysis in this paper, however, will show that when weak institutions are considered these policies are not necessarily appropriate.

Our theory combines useful ingredients from two different strands of the literature. The first strand is on the design of monetary policy, which is too voluminous to be referenced completely here, but includes, as seminal contributions, Kydland and Prescott (1977), Calvo (1978), Barro and Gordon (1983), Backus and Driffill (1985), Rogoff (1985), Barro (1986), Alesina and Tabellini (1987), Cukierman (1992), Walsh (1995), and Svensson (1997).[2] In this paper, we make use of a framework developed by Alesina and Tabellini (1987), where the government's objective function includes provision of public goods in addition to minimizing inflation and output fluctuations.[3] This strand of literature discusses the role of central bank independence. However, a particular feature that separates developing from developed countries is the quality of governance and public institutions generally. As far as we know, the literature on monetary policies has largely ignored this feature.

The second strand is the one that studies the causes and consequences of weak institutions, in particular, corruption. Important work on the effect of institutions on development includes Rose-Ackerman (1975), Shleifer and Vishny (1993), and Mauro (1995). Empirically, Rauch and Evans (2000), Van Rijckeghem and Weder (2001), and Acemoglu, Robinson and Johnson (2001 and 2002) examined the determinants of corruption. Wei (2000a, 2000b, 2001), Bai and Wei (2000), Fisman and Wei (2004)

[2] See Persson and Tabellini (1990) and Berger and others (2001) for surveys of the literature.

[3] For recent work on fiscal and monetary policy, see Benigno and Woodford (2003) and references cited there.

and Du and Wei (2004) investigated the consequences of corruption for international capital flows, tax evasion, and stock market volatility. Bardhan (1997) provided a survey. For the purpose of our paper, we model weak institutions as an erosion of a government's ability to collect revenue through formal tax channels. This may arise through outright theft by tax officials or practices whereby tax inspectors collude with taxpayers to reduce the latter's tax obligation in exchange for a bribe. As far as we know, these two strands of the literature have not been married before. In other words, none of the papers in the literature that we know of has examined the implications of weak institutions, including widespread corruption, for the design of monetary policies.

Under an inflation targeting framework, we study how the socially optimal level of the inflation target is affected by weak institutions. We further examine the implications of weak institutions for the design of several other monetary frameworks, including a currency board, dollarization, and a Rogoff-type conservative central banker, and rank these monetary frameworks in terms of their social welfare. We also examine the authorities' incentive in strengthening institutions and fighting corruption from a political economy perspective.

Several interesting results emerge from our analysis. First, generally speaking, the optimal inflation target is higher for a country with poorer institutional quality. Hence, an inflation target of 1-4 percent, that is common among advanced industrialized countries and might be called "international best practice," is generally not something to be emulated by developing countries in our framework.

Second, pegged exchange rate, currency boards, or dollarization are often prescribed as ways to solve the lack of credibility problem. However, we show that these monetary regimes are typically not very credible themselves and are likely to fail (often associated with a currency crisis) in countries with weak institutions.

Third, a Rogoff-type conservative central banker is generally preferable to a mechanical inflation target of 1-4 percent and to all exchange-rate-based monetary arrangements. In equilibrium, the optimal degree of central bank conservatism is proportional to institutional quality in the economy. Thus, developing countries with lower institutional quality should have less conservative central bankers, and in the limit, when weak institutions make collection of tax revenue infeasible, the optimal degree of conservatism is zero.

Fourth, we consider the political economy of strengthening institutional quality, e.g., corruption control. In particular, we ask whether forcing a government not to rely too much on the inflation tax through external pressure (e.g., conditionality in an IMF program) could induce it to improve institutional quality, e.g., to fight corruption. The

answer is probably not. One interesting result is that weak institutions can be a trap by themselves. That is, when the initial quality of institutions is sufficiently low, it would be difficult to induce the authorities to devote any effort to strengthen them.

The paper proceeds as follows. In Section II, we set up the model and discuss the nature of the time inconsistency problem. In Section III, we analyze the nature of the monetary commitment and compare various popular frameworks that implement such a commitment, namely inflation targeting, a fixed exchange rate, a currency board, and dollarization. We find that the introduction of weak institutions helps clarify relative desirability of these frameworks. In Section IV, we analyze the discretionary monetary regime and examine how a Rogoff-type conservative central banker can improve upon the outcome of the discretionary regime. In this section, we also compare the social welfare in a Rogoff-type conservative central banker framework with those in three commitment frameworks and briefly discuss the issue of implementation. In Section V, we extend our basic model to the case in which a Laffer effect in seignorage revenue is present. In Section VI, we examine whether the authorities have incentive to strengthen institutions from a political economy perspective. Section VII concludes.

II. BASIC SETUP

Our model utilizes a framework developed in Alesina and Tabellini (1987), which we think has not been sufficiently appreciated in the literature. The government's objective function includes public goods provision in addition to stabilizing inflation and output:

$$V(\pi, \tau) = -\frac{1}{2}\left[\pi^2 + ky^2 + l(g - \overline{g})^2\right] , \tag{1}$$

where π denotes the inflation rate; y the log of real output; g the ratio of expenditure on public goods to output; and $l > 0$ and $k > 0$ are the weights on output stability and public expenditure stability, respectively. In this objective function, the target levels for inflation and output are normalized to zero. In addition, the government aims to minimize the deviation of public goods provision from a nonnegative target $\overline{g}$.

To generate an inflation bias under a discretionary regime in a Barro-Gordon (1983) model without public goods provision, one has to assume that a government's targeted output level is systematically above the long-run equilibrium. An interesting property of the Alesina-Tabellini reformulation is that the need to provide public goods ($\overline{g} > 0$) is enough to generate an inflation bias by itself. This is demonstrated below. For simplicity, we normalize the target output level to zero.[4]

[4] The government's objective function can be expressed even more generally as

$$V(\pi, \tau) = -\frac{1}{2}\left[\pi^2 + k(y - y^*)^2 + l(g - \overline{g})^2\right] ,$$

For simplicity, we consider a deterministic economy with no shocks to aggregate demand. A modified Lucas supply curve governs the relationship between aggregate output and government policies: unexpected monetary growth increases aggregate demand, and a distortionary tax rate reduces aggregate supply.[5] To be more precise, output is given by:

$$y = \alpha(\pi - \pi^e) - \beta\tau, \tag{2}$$

where π^e is the expected inflation rates, τ is the tax rate on total output, and coefficients $\alpha > 0$, $\beta > 0$.[6]

To finance the public goods provision, the government has two sources of revenue: an output tax τ, and an inflation tax π. There is ample evidence suggesting that seignorage is an important source of government revenue for developing countries. For example, Cukierman, Edwards and Tabellini (1992, Table 1) show that over 1971-1982, seignorage (defined as an increase in base money) as a share of total government revenue varies from a low level for developed countries (e.g., 3.0% for Canada, 1.7% for the U.K, and 2.3% for the U.S.) to over ten or even twenty percentage points for developing countries (e.g., 21.6% for Bolivia, 28.0% for Ghana, 13.1% for India, 23.9% for Mexico, and 24.8% for Uganda).

A crucial assumption that we make is on the connection between the government's fiscal capacity and the quality of institutions. More precisely, weak institutions (e.g., corruption) are assumed to cause a leakage of the tax revenue: the lower the institutional quality, the greater the leakage. If the private sector pays a tax in the amount of τ, only $\phi\tau$ accrues to the government, where $0 \leq \phi \leq 1$. ϕ can be thought of as an institution-quality index. If $\phi = 1$, then the quality is the best and there is no leakage of tax revenue. If $\phi = 0$, then the quality is the lowest and there is

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where $y^* > 0$ is the target level of output set above what is consistent with a natural rate of unemployment that is the source of the inflation bias in the Barro-Gordon framework. Because the public goods provision at the $\overline{g} > 0$ level already generates an inflation bias in our framework, without loss of generality we can focus our analysis on the simpler objective function given in equation (1), where $y^* = 0$. A more general formulation merely complicates the algebra without yielding additional insights.

[5] Our main result carries through to more complex settings including random supply shocks, which we will elaborate on when comparing the inflation targeting framework with the currency board arrangement. This is, however, the simplest model we can think of that captures the interactions between the monetary and fiscal authorities and allows us to address corruption. For further discussion of this model and, in particular, of its micro-foundations, see Alesina and Tabellini (1987).

[6] Equation (2) implicitly assumes that money demand is not affected by fiscal policy and, therefore, that fiscal policy is not subject to time inconsistencies. Otherwise, an independent central bank could not directly control inflation, since it would be jointly determined by the money supply and the tax rate.

complete leakage, and the government cannot collect any tax revenue. Modified from Alesina and Tabellini (1987), the government's budget constraint can be written as:[7]

$$g = \phi\tau + \pi. \tag{3}$$

Note that when $\phi = 1$, the quality of institutions, being the best, is not an issue, and our model boils down to the set up in Alesina and Tabellini. Also, as in Alesina and Tabellini, our model abstracts from public debt.[8]

III. COMMITMENT AND ITS IMPLEMENTATIONS

A. The Commitment Regime

We consider an institutional setup in which monetary and fiscal authorities each control a single policy instrument (an inflation rate, π, by the central bank, and a tax rate, τ, by the fiscal authority), but share a common objective function defined by Equation (1). The two branches of the government solve a noncooperative game. The equilibrium inflation and tax rates are given by the Nash equilibrium of the game.[9]

In this subsection, we focus on the case in which the central bank can credibly commit to a given inflation rate, i.e., $\pi = \pi^e$. It is easy to verify that, in this case, $y = -\alpha\tau$. The Nash equilibrium monetary and fiscal policies can be directly obtained from solving the two first-order conditions, i.e., the two reaction functions.[10] Doing so, we obtain the Nash equilibrium inflation and tax rates under commitment:

$$\pi^C = \frac{kl\beta^2\overline{g}}{(1+l)\,k\beta^2 + l\phi^2}, \tag{4}$$

$$\tau^C = \frac{l\phi\overline{g}}{(1+l)\,k\beta^2 + l\phi^2}. \tag{5}$$

A number of observations can be made. First, if there is no need to provide public goods ($\overline{g} = 0$), then the equilibrium inflation (and tax) rate(s) under a commitment regime would be zero, consistent with the result from Barro and Gordon.

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[7] Equation (3) can be obtained from a two-step derivation as in Alesina and Tabellini (1987). First, the government budget constraint in nominal terms is: $G_t = \phi\tau_t P_t X_t + M_t - M_{t-1}$, where G denotes public spending, P price level, X real output, and M equilibrium money supply, respectively. Second, dividing both sides by nominal income $P_t X_t$, we have $g_t = \phi\tau_t + (M_t - M_{t-1})/P_t X_t = \phi\tau_t + \pi_t$.

[8] In our view, regular tax collection is more prone to leakage due to weak institutions than inflation tax collection, partly because the former involves many more layers of government bureaucracy. We focus on this case in this paper and note that it is quite straightforward to extend the analysis to allow also for a leakage in inflation tax collection.

[9] In this setting, a cooperative game would yield the same result.

[10] The second-order conditions associated with this problem (as well as those of the time-consistent problem below) are trivially satisfied since $V(\pi, \tau)$ is globally concave with respect to its arguments.

Second, it is straightforward to see that the equilibrium inflation under a commitment regime goes up as the quality of institutions becomes worse (ϕ goes down). The intuition is as follows: a decrease in institutional quality essentially raises the shadow cost of raising revenue through regular tax channels vis-à-vis inflation tax. Consequently, a higher inflation is needed.

Third, the effect of institution quality on taxes can be examined by taking the partial derivatives from (5),

$$\frac{\partial \tau^C}{\partial \phi} = \frac{\left[(1+l)\,k\beta^2 - l\phi^2\right] l\overline{g}}{\left[(1+l)\,k\beta^2 + l\phi^2\right]^2}. \tag{6}$$

The effect falls into two ranges. For moderate quality (or $1 \geq \phi \geq \beta\sqrt{(1+l)\,k/l}$), the optimal response to a decrease in institutional quality is to raise the tax rate. On the other hand, for poor quality, ($\phi \leq \beta\sqrt{(1+l)\,k/l}$), the optimal response to a decrease in quality is to reduce the tax rate. The nonmonotonicity of the effect can be understood as follows. When the quality of institutions is in the lower range, in response to a small increase in the rate of leakage in tax revenue, the government has to tax more to compensate for the lost revenue. If the quality of institutions is very poor, however, a given increment in tax revenue becomes too expensive to collect in terms of foregone output. As a result, for any increase in the rate of leakage, the optimal response is to shift the revenue collection from regular tax to inflation tax.

The equilibrium values of public expenditure, output and social loss under commitment are respectively:

$$g^C = \frac{(k\beta^2 + \phi^2) l\overline{g}}{(1+l)\,k\beta^2 + l\phi^2}, \tag{7}$$

$$y^C = -\frac{l\beta\phi\overline{g}}{(1+l)\,k\beta^2 + l\phi^2}. \tag{8}$$

$$V^C = -\frac{1}{2}\,\frac{kl\beta^2\overline{g}^2}{(1+l)\,k\beta^2 + l\phi^2} = -\frac{\overline{g}\pi^C}{2}\,. \tag{9}$$

It is straightforward to see from (9) that lower institutional quality leads to lower social welfare.

To summarize, we have:

Proposition 1 Under a commitment regime, (1) the equilibrium inflation rate goes up as the quality of institutions becomes poorer; (2) the tax rate goes up (or down) with the institutional quality if the quality is moderate (or severe); and (3) the social welfare declines as the quality of institutions worsens.

B. Implementations

Four popular frameworks have been developed to implement the commitment regime. They are an inflation target, a fixed exchange rate, a currency board, and dollarization. We will analyze and compare the desirability of these frameworks based on the insights from this model.

1. Inflation targeting

Inflation targeting is a monetary arrangement in which the central bank announces (or is asked to follow) a target level (or range) for the inflation rate.[11] In principle, inflation targeting can be viewed as an institutional commitment to achieve the desirable outcome (π^C, τ^C and g^C).

Several developed countries have adopted some version of inflation targeting, including Australia, Canada, New Zealand, Norway, Sweden, the United Kingdom, and Finland. In practice, these countries either target their inflation rates to a point (e.g., U.K.) or to a relatively narrow range, typically within 1-4 percent. It is often thought that a similar level of inflation target would benefit developing countries as well. For example, the IMF has advised several transition and emerging market economies to adopt inflation targeting.

The empirical evidence, however, by and large shows that inflation targeting has been less successful in developing economies than in developed countries. In fact, many developing countries are reluctant to adopt it, even though lack of credibility is a clear concern for them. We believe that the poorer quality of institutions in developing countries provides one important reason.[12]

It may be useful to make a distinction between a mechanical inflation target of 1-4 percent and an optimally chosen target. A mechanical inflation targeting is a framework that advocates developing countries to do what developed countries have been doing, namely to target a low inflation rate like 3 percent (or a narrow range in that neighborhood). Optimal inflation targeting is an arrangement that is consistent

[11] See Bernanke and others (1999) for recent international experience of inflation targeting.

[12] Masson, Savastano, and Sharma (1997) and Eichengreen, Masson, Savastano, and Sharma (1999) stated that a monetary authority "free of fiscal dominance" is a precondition for the success of an inflation targeting regime. Our model can be viewed as a formalization of this argument. Cukierman (1992, p. 445-452) suggested that limited access to capital market by developing country governments is another possible explanation for the apparent reluctance in adopting an inflation target framework.

with the optimal inflation level under commitment, with the target depending on a country's institutional quality:

$$\pi^{IT} = \frac{kl\beta^2\overline{g}}{(1+l)\,k\beta^2 + l\phi^2}. \tag{10}$$

An immediate implication is that the poorer the institutional quality (or the greater the slope of the Phillip's curve or the higher the target level of public goods provision), the higher the optimal level of the inflation target. A country with lower quality institutions (e.g. Russia) should target a higher inflation rate than a country with higher quality institutions (e.g., Sweden).

2. Fixed exchange rate and currency board

A fixed exchange rate regime, by definition, fixes the rate of exchange between the domestic currency and an anchor currency. A currency board arrangement is a monetary framework whereby the domestic money is rigidly pegged to a foreign currency and the domestic high-powered money is backed up completely by foreign exchange reserves.[13] By construction, under a fixed exchange rate or currency board arrangement, there is an implied inflation target which is the inflation rate in the anchor country's inflation rate. Generally speaking, the anchor currency is that of a country with high quality institutions. If we denote the inflation under a fixed exchange rate or a currency board by π^{CB}, we expect $\pi^{CB} < \pi^{C}$. Under this condition, the tax rate is

$$\tau^{CB} = \frac{l\phi\left(\overline{g} - \pi^{CB}\right)}{k\beta^2 + l\phi^2} > \frac{l\phi\left(\overline{g} - \pi^{C}\right)}{k\beta^2 + l\phi^2} = \tau^{C}. \tag{11}$$

Therefore, a developing or transition economy with lower institutional quality under a fixed exchange rate or a currency board will have an inflation rate that is lower than optimal, and a tax rate higher than optimal.[14] Its welfare is thus lower than optimal.

It is sometimes thought that developing countries can "import credibility" through a fixed exchange rate or currency board. Our results suggest that weak institutions may limit or even destroy the imported credibility. A fixed rate regime or a currency board is more difficult to sustain in a country with poor institutions because the inflation rate implied by the exchange rate regime is too low from the viewpoint of the importing country.

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[13] See Ghosh, Gulde, and Wolf (2000, 2003) for insightful discussions on currency board and its problems.

[14] In the context of this model, a crawling peg of the type used in Chile and Israel in the past is better than a conventional currency board for a high-corruption country, as it allows for more seignorage revenue.

We have so far assumed away stochastic shocks to the aggregate Phillips curve. Without these shocks, a fixed exchange rate, a currency board arrangement, and a mechanical inflation target are equivalent. However, we note parenthetically that if shocks are introduced, an inflation targeting framework can dominate a fixed-rate or currency board arrangement as it allows for the flexibility to respond to shocks that are specific to the domestic economy.

3. Dollarization

Dollarization, or more generally, the adoption of a foreign currency, is a monetary arrangement that involves an even stronger commitment to low inflation –assuming that the anchor country has low inflation– than a currency board arrangement. Unlike a currency board arrangement, the national currency disappears under dollarization.[15] The commitment is stronger because the cost to the government of reversing such an arrangement is higher. If the anchor country is the same for a currency board and for dollarization (e.g., the United States), the inflation rates of the two regimes are the same. However, the government in a dollarization regime has to forgo a significant amount of seignorage revenue associated with the issue of domestic money, which according to Cukierman, Edwards and Tabellini (1992, Table 1) can be over 20% of total government revenue for many developing countries. Hence, the tax rate under a dollarization regime is higher, but social welfare is lower, than under a pegged exchange rate or currency board.

At this point, we can rank the various monetary frameworks.

Proposition 2 The optimal commitment regime dominates a mechanical inflation targeting regime, which (weakly) dominates a fixed rate or currency board arrangement, which in turn dominates a dollarization regime.

IV. DISCRETION AND CONSERVATIVE CENTRAL BANKER

A. Conventional Discretionary Regime

If a central bank cannot precommit, the inflation rate (and correspondingly the tax rate) derived for a commitment regime would not be time consistent. As is well known in the literature, if the expected inflation were at the commitment level ($\pi^e = \pi^C$), the central bank would always find it optimal to raise inflation unexpectedly. Hence, such inflation expectations would not be rational. The time-consistent policy

[15] See Fischer (1982), among others, for an analysis of seigniorage as a rationale for a national money.

mix, (π^D, τ^D), is the Nash equilibrium solution to the noncoordinated game played by the central bank and fiscal authority, who take the expected inflation rate as given.

The solution is characterized by the two first-order conditions associated with (1), where, in addition, we require that the expected inflation rate equals its equilibrium value. Solving the two first-order conditions for π^D and τ^D, we have the Nash equilibrium policy mix:

$$\pi^D = \frac{kl\beta(\alpha\phi+\beta)\overline{g}}{kl\beta(\alpha\phi+\beta)+k\beta^2+l\phi^2}, \tag{12}$$

$$\tau^D = \frac{l\phi\overline{g}}{kl\beta(\alpha\phi+\beta)+k\beta^2+l\phi^2}. \tag{13}$$

It is easy to see that $\pi^D \geq \pi^C$, and $\tau^D \leq \tau^C$. Equality holds for both π and τ only when $\phi = 0$. Thus generally speaking, the inflation under discretion is higher than under commitment, and the tax rate is lower.

Moreover, we have

$$g^D = \frac{[k(\alpha\phi+\beta)\beta+\phi^2]l\overline{g}}{kl\beta(\alpha\phi+\beta)+k\beta^2+l\phi^2}, \tag{14}$$

$$y^D = -\frac{l\beta\phi\overline{g}}{kl\beta(\alpha\phi+\beta)+k\beta^2+l\phi^2}, \tag{15}$$

$$V^D = -\frac{1}{2}\frac{\left[kl(\alpha\phi+\beta)^2+k^2\beta^2+l^2\phi^2\right]kl\beta^2\overline{g}^2}{\left[kl\beta(\alpha\phi+\beta)+k\beta^2+l\phi^2\right]^2}. \tag{16}$$

We can examine how monetary and fiscal policies would optimally respond to a decrease in institutional quality and compare it with the case when the central bank is able to commit. In contrast to the commitment regime, the optimal responses of both monetary and fiscal policies to a decrease in institutional quality are nonlinear. More precisely, from (12) and (13), we can show that

$$\frac{\partial\pi^D}{\partial\phi} = \frac{[k\alpha\beta^2 - l(\alpha\phi^2+2\beta\phi)]kl\beta\overline{g}}{[kl\beta(\alpha\phi+\beta)+k\beta^2+l\phi^2]^2}, \tag{17}$$

$$\frac{\partial\tau^D}{\partial\phi} = \frac{\left[(1+l)\,k\beta^2 - l\phi^2\right]l\overline{g}}{[kl\beta(\alpha\phi+\beta)+k\beta^2+l\phi^2]^2}. \tag{18}$$

If the quality of institutions is relatively modest (e.g., $\phi \geq \beta(\sqrt{1+k\alpha^2/l}-1)/\alpha$), then the optimal response to a decrease in quality is to raise the inflation rate ($\partial\pi^D/\partial\phi < 0$). On the other hand, if the quality of institutions is already poor ($\phi < \beta(\sqrt{1+k\alpha^2/l}-1)/\alpha$), then the opposite response (lowering the inflation tax) would be optimal. The optimal response of the fiscal policy, τ^D, has a similar

nonmonotonicity. For moderate institutional quality ($\phi \geq \beta\sqrt{(1+l)\,k/l}$), an optimal response to a decrease in quality is to raise the tax rate. But at a poor quality level ($\phi < \beta\sqrt{(1+l)\,k/l}$), the optimal response would be to lower the tax rate.

This makes an interesting comparison with the commitment case. For example, starting at a poor quality of institutions (e.g., $\phi < \beta(\sqrt{1+k\alpha^2/l}-1)/\alpha$), the optimal monetary policy response to a decrease in quality is to lower the inflation rate under a discretionary regime, but to raise the inflation rate under a commitment regime. Despite this non-linear response pattern, it is easy to see that $V^D \leq V^C$, where the equality sign holds when $\phi = 0$, consistent with the conventional result in the literature on rule vs. discretion.

Proposition 3 The optimal commitment regime generates a lower inflation, higher tax rate, and higher social welfare than the discretionary regime.

B. Rogoff-type Conservative Central Banker

The discussion in the above subsection suggests that the optimal commitment regime strictly dominates the discretionary regime for any institutional quality except for the extreme case in which the poorest quality of institutions renders regular tax collection completely infeasible. If, for whatever reason, a commitment regime of any sort is not available, then, as proved by Rogoff (1985), delegating the monetary policy to a more conservative central banker (still with discretion) can improve upon the social welfare relative to a straightforward discretionary regime. Here, "more conservative" means that the weight in the loss function on inflation placed by the central banker is greater than that by the social planner.

In this section, we examine whether and how the optimal degree of central banker conservatism is affected by the presence of weak institutions. As a by-product, we also examine how the inclusion of public goods provision in the social welfare function may modify our understanding of the role of a conservative central banker.

Consider a modified central banker's problem. Let S denote the weight on the inflation rate placed by the central banker. The central banker's objective function is given by

$$V^{CC}(\pi,\tau) = -\frac{1}{2}\left[S\pi^2 + ky^2 + l(g-\overline{g})^2\right]. \tag{19}$$

If the central banker cares about inflation as much as the social planner, then $S = 1$. If the central banker is more conservative than the social planner, then $S \geq 1$.

The central banker and the fiscal authority still play a noncooperative Nash game. The time-consistent policy mix in this case, labeled as (π^{CC}, τ^{CC}), is characterized by the first-order conditions associated with (19), where, in addition, we require that the expected inflation rate equals its equilibrium value. Solving the pair of the first order conditions for (π^{CC}, τ^{CC}), we have:

$$\pi^{CC} = \frac{kl\beta(\alpha\phi + \beta)\overline{g}}{kl\beta(\alpha\phi + \beta) + S\left(k\beta^2 + l\phi^2\right)}, \tag{20}$$

$$\tau^{CC} = \frac{Sl\phi\overline{g}}{kl\beta(\alpha\phi + \beta) + S\left(k\beta^2 + l\phi^2\right)}. \tag{21}$$

Obviously, at $S = 1$, the regime of a conservative central banker coincides with the discretionary regime without a conservative central banker. Since $\partial\pi^{CC}/\partial S < 0$ and $\partial\tau^{CC}/\partial S > 0$, the more conservative is the central banker, the lower the equilibrium inflation rate is, but the higher the tax rate becomes.

Moreover, we can easily derive the corresponding levels of public goods provision, output and social loss:

$$g^{CC} = \frac{[kl\beta(\alpha\phi + \beta) + S\phi^2]\overline{g}}{kl\beta(\alpha\phi + \beta) + S\left(k\beta^2 + l\phi^2\right)}, \tag{22}$$

$$y^{CC} = -\frac{Sl\beta\phi\overline{g}}{kl\beta(\alpha\phi + \beta) + S\left(k\beta^2 + l\phi^2\right)}, \tag{23}$$

$$V(\pi^{CC}, \tau^{CC}) = -\frac{1}{2}\frac{\left[kl(\alpha\phi + \beta)^2 + S\left(k\beta^2 + l\phi^2\right)\right] kl\beta^2\overline{g}^2}{\left[kl\beta(\alpha\phi + \beta) + S\left(k\beta^2 + l\phi^2\right)\right]^2}. \tag{24}$$

Suppose the social planner can choose any value of S, then what is the optimal degree of conservatism of the central banker that would maximize the social welfare? To answer this, we minimize the social loss function described by (24) with respect to S. The first-order condition leads to[16]

Proposition 4 $S^* = 1 + \frac{\alpha}{\beta}\phi$.

Let us measure the degree of conservatism of the central banker by the excess weight she places on the inflation term relative to the social planner, i.e., conservatism $= S - 1$. A number of observations can be made. First, generally speaking for $0 < \phi \leq 1$, $S^* > 1$, thus a central banker that is more conservative than the social planner should be appointed to improve upon the social welfare. Second, the optimal degree of conservatism is proportional to the quality of institutions in the economy. The poorer the quality of institutions (i.e., a lower value of ϕ), the stronger is the effect of distortionary tax on output (i.e., a higher β), or the weaker is the effect of surprising

[16] It can be verified that (24) is indeed convex in S.

inflation on output (i.e., a lower α), the less conservative the central banker should be. Third, in the extreme case in which weak institutions prevent the working of the tax system completely (i.e., when $\phi = 0$), the optimal degree of conservatism is zero.

When the central banker is optimally chosen (i.e., $S^* = 1 + \frac{\alpha}{\beta}\phi$), we can compute the level of inflation, taxes, and social welfare. It can easily be verified that $\pi^{CC} = \pi^C$, $\tau^{CC} = \tau^C$, and $V^{CC} = V^C$.

Proposition 5 When the conservative central banker is optimally chosen, this (modified) discretionary regime restores the first-best solution under commitment.

This proposition is somewhat surprising and worth some further elaboration. There are a number of differences between our framework and that of the original Rogoff framework. First, in Rogoff (1985), the social planner is only concerned with inflation and output stabilization. In contrast, we have added public goods provision as part of the objective function. Although a more conservative central banker can lower inflation further, it would not be optimal to do that given the increasing costs of collecting taxes. Second, we do not have stochastic shocks to the aggregate supply/demand. Third, we do not have the equivalent of the labor market distortion that causes the social planner to attempt to stabilize output at a level above its natural rate.

In our setting, the welfare under a Rogoff-style conservative central banker dominates that of a currency board or dollarization. One may think that installing a conservative central banker requires fewer technical preconditions than implementing an inflation targeting framework due to the principle of contract implementation (Moore (1992), Maskin and Moore (1999)). If that is true, the conservative central banker may also be better than an inflation targeting framework, though it is beyond the scope of this paper to have a full discussion on this issue.

In the absence of public goods provision (and hence fiscal policy), the Walsh (1995) contract implements the commitment solution under a discretionary regime. However, once fiscal policy is introduced, strategic manipulation by the fiscal authority could make the Walsh contract suboptimal (Huang and Padilla (2002)). As a result, the discretionary tax may be too high while the inflation rate may be too low. By this logic, the Rogoff-type conservative central banker arrangement may outperform the Walsh-type incentive contract.

V. A LAFFER CURVE EFFECT IN SEIGNORAGE

The discussion so far has ignored a possible nonlinear, Laffer curve effect of a rise in the inflation rate on seignorage revenue. As Cagan (1956) has shown, the semi-elasticity of the demand for money affects the ability of government to extract seignorage: when inflation rate exceeds a threshold, the seignorage starts to decline. In other words, seignorage revenue and inflation rate are not proportional to each other. In this section, we extend our analysis to feature such an effect.

A simple way to capture the Laffer curve effect is to replace π in (3) by $\pi \exp(-\gamma\pi)$, where the parameter $\gamma \geq 0$ defines the strength of the Laffer curve effect. When $\pi \leq 1/\gamma$, an increase in inflation leads to an increase in the total seignorage. When inflation exceeds a threshold, or $\pi > 1/\gamma$, however, any further increase in inflation rate leads to a decline in the total seignorage. Indeed, in the limit, when inflation approaches infinity, everyone avoids using the domestic currency, and the government collects no seignorage revenue. This is represented by $\lim_{\pi\to\infty} \pi \exp(-\gamma\pi) = 0$.

With the introduction of this possibility, the government budget constraint becomes:

$$g = \phi\tau + \pi \exp(-\gamma\pi). \tag{25}$$

The basic setup in the earlier sections is a special case in which $\gamma = 0$.[17]

Under the commitment regime, the two first-order conditions are:[18]

$$\pi = l\left[\overline{g} - \phi\tau - \pi \exp(-\gamma\pi)\right](1 - \gamma\pi)\exp(-\gamma\pi), \tag{26}$$

$$k\beta^2\tau = l\phi\left[\overline{g} - \phi\tau - \pi \exp(-\gamma\pi)\right]. \tag{27}$$

We denote the Nash equilibrium inflation and tax rates by $(\pi^C(\gamma), \tau^C(\gamma))$.

Although a closed form solution for $(\pi^C(\gamma), \tau^C(\gamma))$ is not possible, we can still obtain several interesting results concerning the equilibrium. Note first that with $\tau > 0$, condition (26) implies that to have $\pi > 0$, it has to be the case $1 - \gamma\pi > 0$. That is, the Nash equilibrium inflation $\pi^C(\gamma)$ has an upper bound, $1/\gamma$, which is a decreasing function of γ. This suggests that the optimal inflation under commitment never goes beyond the threshold, to the "wrong" side of the Laffer curve.

Second, it is easy to show that $\frac{\partial \pi^C(\gamma)}{\partial \phi} < 0$ for all $\gamma \geq 0$. That is the inflation rate goes down as the quality of institutions improves (ϕ goes up) regardless of the strength of the Laffer curve effect.

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[17] It is possible that tax revenue collection also has a Laffer curve effect. It can be analyzed by replacing $\phi\tau$ in (3) with $\phi\tau \exp(-\rho\tau)$, where $\rho > 0$. We leave this for future research.

[18] The second-order conditions associated with this problem (as well as those in the discretionary problem below) are satisfied.

Third, it can be verified that $\frac{\partial \pi^C(\gamma)}{\partial \gamma} < 0$ if $\left(k\beta^2 + l\phi^2\right) \frac{\left(2-\gamma\pi^C(\gamma)\right)\exp\left(2\gamma\pi^C(\gamma)\right)}{\left[1-\gamma\pi^C(\gamma)\right]^2} > kl\beta^2$. Two sufficient condition for this to hold are $l \leq 2$ and $2\phi^2 > k\beta^2$. The first sufficient condition corresponds to the case of a government that is not overly concerned with public goods provision. The second sufficient condition corresponds to the case when the quality of public institutions exceeds a minimum threshold. Under either of the these conditions, the stronger is the Laffer curve effect, the lower is $\pi^C(\gamma)$. In these circumstances, a mechanical inflation targeting, fixed exchange rate, and currency board would be more acceptable than without considering the Laffer curve effect.

And fourth, for $\gamma \geq 0$,

$$\frac{\tau^C(\gamma)}{\pi^C(\gamma)} = \frac{\exp\left(\gamma\pi^C(\gamma)\right)}{1-\gamma\pi^C(\gamma)} \frac{\tau^C}{\pi^C} \geq \frac{\tau^C}{\pi^C}.$$

The last result can be understood intuitively. As the Laffer effect raises the marginal cost of seignorage, the mix of the revenue collection shifts toward greater reliance on tax. This leads to a higher ratio of tax to inflation rates.

We now turn to discussing the discretionary regime. The two first-order conditions are:

$$\pi = k\alpha\beta\tau + l\left[\overline{g} - \phi\tau - \pi\exp(-\gamma\pi)\right](1-\gamma\pi)\exp(-\gamma\pi) \tag{28}$$

$$k\beta^2\tau = l\phi\left[\overline{g} - \phi\tau - \pi\exp(-\gamma\pi)\right] \tag{29}$$

We denote the Nash equilibrium inflation and tax rates by $(\pi^D(\gamma),\ \tau^D(\gamma))$.

As it is difficult to obtain closed form solutions, we resort to finding ways to characterize the equilibrium. Manipulating the two first order conditions leads to

$$\pi^D(\gamma) = \frac{kl\beta\overline{g}}{kl\beta\exp\left(-\gamma\pi^D(\gamma)\right) + \frac{k\beta^2+l\phi^2}{\alpha\phi+\beta(1-\gamma\pi^D(\gamma))\exp(-\gamma\pi^D(\gamma))}}. \tag{30}$$

(30) implies that $1-\gamma\pi^D(\gamma) = 0$, or $\pi^D(\gamma) = 1/\gamma$, holds if

$$\gamma = \frac{1}{\overline{g}}\left(\frac{1}{e} + \frac{\beta}{l\alpha\phi} + \frac{\phi}{k\alpha\beta}\right). \tag{31}$$

It is useful to know whether the Laffer curve effect would necessarily lead to a lower inflation in the discretionary regime. It turns out that the answer is no. To state this more formally, one can verify from (30) that $\pi^D(\gamma) < \pi^D$ if and only if

$$kl < \frac{\left(k\beta^2 + l\phi^2\right)\left[1 - \left(1-\gamma\pi^D(\gamma)\right)\exp\left(-\gamma\pi^D(\gamma)\right)\right]}{(\alpha\phi+\beta)\left[\alpha\phi + \beta\left(1-\gamma\pi^D(\gamma)\right)\exp\left(-\gamma\pi^D(\gamma)\right)\right]\left[1-\exp\left(-\gamma\pi^D(\gamma)\right)\right]}. \tag{32}$$

As this condition is not directly intuitive, it may be helpful to look at the expression for values of γ in different ranges. Starting with small values of γ, say γ being close to zero, the above condition becomes $l < l_0$, where

$$l_0 \equiv \frac{k\beta^2}{k(\alpha\phi+\beta)^2 - \phi^2}. \tag{33}$$

At $\gamma\pi^D(\gamma) = 1$, where the seignorage is maximized, the condition becomes $l < l_1$, where

$$l_1 \equiv \frac{k\beta^2}{k\alpha\phi(\alpha\phi+\beta)\frac{e-1}{e} - \phi^2} > l_0. \tag{34}$$

For $\gamma\pi^D(\gamma) > 1$, where $\pi^D(\gamma) > 1/\gamma$ but the seignorage is less than the maximum, the condition becomes $l < l_2$, where $l_2 > l_1 > l_0$. Loosely speaking, as the Laffer curve gets stronger (i.e., as γ increases), the condition for a lower inflation ($\pi^D(\gamma) < \pi^D$) is more likely to be satisfied.

Finally, as in the commitment case, the Laffer curve effect shifts the mix of a given revenue collection toward tax. This can be expressed more formally by

$$\frac{\tau^D(\gamma)}{\pi^D(\gamma)} = \frac{1}{k\alpha\beta + \frac{k\beta^2}{\phi}\frac{1-\gamma\pi^D(\gamma)}{\exp(\gamma\pi^D(\gamma))}} \geq \frac{1}{k\alpha\beta + \frac{k\beta^2}{\phi}} = \frac{\tau^D}{\pi^D}.$$

Therefore, in the discretionary case, we cannot say unconditionally that the Laffer curve effect would lead to a lower inflation. This occurs if condition (32) holds. What we do know for sure is that the Laffer curve effect tilts revenue collection away from inflation toward tax.

VI. STRENGTHENING INSTITUTIONAL QUALITY

So far we have treated institutional quality, ϕ, as exogenously given. Efforts in strengthening institutional quality, e.g., through fighting corruption and improving fiscal capacity, should increase the value of ϕ. In this section we endogenize the quality of institutions and ask when a government would be willing to undertake efforts to strengthen institutions. Our modeling strategy is similar to the case of tax reform in Cukierman, Edwards and Tabellini (1992).

To start with, we observe that a government's effort to improve institutional quality is likely to come with a cost. The cost could be in the form of a loss of economic rents that officials enjoy, or a stiffened resistance from powerful special interest groups that have been benefiting from corruption and lost tax revenue. To capture this observation, we assume that

$$\phi \quad = \quad \phi_0\sqrt{f}, \tag{35}$$

where $f - 1 \in \left[0, 1/\phi_0^2 - 1\right]$ denotes the level of effort by authorities, ϕ_0 is the initial value of ϕ before any efforts have been devoted.

We assume further that the authorities otherwise share the preference of the social planner except that they also have to bear the cost of strengthening institutions, which is proportional to their effort,

$$C = \theta (f - 1), \tag{36}$$

where $\theta > 0$ is the unit cost coefficient.

With this simple setup, the equilibrium effort level, and thus the equilibrium value of ϕ can be solved in two steps in a principal-agent framework. Our analysis will focus on the commitment case. The policy game is the same as before, except that the authorities need to choose their level of effort first.

Recall that under the commitment regime, the value of the loss function is (9). Since the authorities share the preference of the social planner, their loss inclusive of the costs of efforts devoted to strengthening institutions is

$$V_A^C (f) = -\frac{1}{2} \frac{kl\beta^2 \overline{g}^2}{(1+l) k\beta^2 + l\phi_0^2 f} - \theta (f - 1). \tag{37}$$

Taking first derivative of (37) with respect to f, one gets[19]

$$\frac{kl^2\beta^2 \overline{g}^2 \phi_0^2}{2\left[(1+l) k\beta^2 + l\phi_0^2 f\right]^2} - \theta = 0. \tag{38}$$

Examining this first-order condition (38), we have the following proposition.

Proposition 6 For $\underline{\theta} < \theta < \overline{\theta}$, where

$$\underline{\theta} \equiv \frac{kl^2\beta^2 \overline{g}^2}{2\left[(1+l) k\beta^2 + l\right]^2},$$

$$\overline{\theta} \equiv \frac{kl^2\beta^2 \overline{g}^2 \phi_0^2}{2\left[(1+l) k\beta^2 + l\phi_0^2\right]^2},$$

an interior optimal solution $0 < f^* < 1 - \phi_0$ exists.

The equilibrium inflation and tax rates are

$$\pi^C (f) = \frac{kl\beta^2 \overline{g}}{(1+l) k\beta^2 + l\phi_0^2 f}, \tag{39}$$

$$\tau^C (f) = \frac{l\phi \overline{g}}{(1+l) k\beta^2 + l\phi_0^2 f}. \tag{40}$$

It is easy to see that

$$\pi^C (f) = \frac{kl\beta^2 \overline{g}}{(1+l) k\beta^2 + l\phi_0^2 f^*} < \pi^C,$$

[19] It is easy to see the second-order condition holds.

$$\tau^C(f) = \frac{l\phi_0\sqrt{f^*\overline{g}}}{(1+l)k\beta^2 + l\phi_0^2 f^*} = \begin{cases} \leq \tau^C, \text{ if } (1+l)k\beta^2 \leq l\phi_0^2 f^*; \\ > \tau^C, \text{ if } (1+l)k\beta^2 > l\phi_0^2 f^*. \end{cases}$$

Further examining the first-order condition (38), we have the following corollary, which suggests that the cost coefficient, θ, is a key parameter that affects the authorities' incentive to strengthen institutions, including fighting corruptions and improving fiscal capacity.

Corollary 1 If $\theta \geq \overline{\theta}$, then the authorities would have no incentive to devote any efforts to strengthen institutions; If $\theta < \underline{\theta}$, however, the authorities would have incentive to devote sufficient efforts to strengthen institutions so that $\phi = 1$.

We note $\lim_{\phi_0 \to 0} \overline{\theta} = 0$. In other words, when the initial quality of institutions is very poor, such that ϕ_0 has a very low value, most values of $\theta \geq \overline{\theta}$. In this case, the authorities would have no incentive to devote any effort to strengthen institutions. This is because a very low initial level of institutional quality (e.g., a very high initial level of corruption) means a massive leakage of tax revenue. Under such circumstances even with a lot of costly effort, the authorities would not be able to raise enough revenue to make the effort worthwhile. Thus they would choose not to invest in any effort any all.

In this case, setting a low inflation level through inflation targeting or appointing a Rogoff-type conservative central banker would not by themselves induce the government to devote more effort to strengthen institutions. Perhaps reforms to improve institutional quality should be taken before adopting a monetary regime aiming for a low level of inflation.

If the initial quality of institutions is moderate, such that $\theta < \underline{\theta}$ holds, then the authorities would have incentive on their own to devote efforts to strengthen institutions. Setting a low inflation level through inflation targeting (to induce corruption fighting) would not hurt, though it is probably not a strengthening-institutions tool by itself.

VII. CONCLUDING REMARKS

In this paper, we examine the effects of institutional quality on the desirability of several popular monetary regimes, including inflation targeting, a fixed exchange rate, a currency board arrangement, and a Rogoff-type conservative central banker. The simple model of a monetary policy game, whereby institutional quality adversely affects the taxable revenue, has generated a number of interesting results.

First, we cast doubt on the conventional wisdom that prescribes pegged exchange rate regimes, currency boards and dollarization as means to increase the credibility of a government's resolve to maintain low inflation. Our analysis suggests that these monetary regimes may not be very credible themselves and can fail in countries where institutions are seriously weak. Second, an optimally chosen conservative central banker is generally preferable to a mechanical inflation target of 1-4 percent and to all exchange-rate-based monetary arrangements. The optimal degree of conservatism is proportional to the quality of institutions in the economy. Third, the presence of a Laffer curve effect on seignorage revenue likely lowers inflation and raise tax rate, although in some cases it may raise both inflation and tax rates. Fourth, the notion that a low inflation target or a currency board can be used as an instrument to induce governments to strengthen institutions is questionable. These findings are important in the design of monetary policies for developing countries.

A number of further extensions can be made. For example, the government can be allowed to borrow in domestic bond market or international capital market. The interactions among institutional quality, debt, and monetary policies can be explored. The effect of a Laffer curve in tax revenue as well as in seignorage on inflation and tax rate is also interesting. These would be important issues for future research.

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