Monetary policies for developing countries: The role of institutional quality

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Abstract

Weak public institutions, including high levels of corruption, characterize many developing countries. We demonstrate that this feature has important implications for the design of monetary policymaking institutions. We find that a pegged exchange rate or dollarization, while sometimes prescribed as a solution to the credibility problem, is typically not appropriate for countries with poor institutions. Such an arrangement is inferior to a Rogoff-style conservative central banker, whose optimal degree of conservatism is proportional to the quality of institutions. Finally, we cast doubt on the notion that a low inflationary framework can induce governments to improve public institutions.
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1. 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? In this paper, we study one particular feature that is prevalent in developing (and transition) economies, namely weak public

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governance. Obviously, developed countries are not immune to this problem, but it is far less prevalent than in many developing countries. Surprisingly, the consequence of this feature on the design of monetary policy has not been systematically examined. This paper aims 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 countries should peg their currency to a major currency from a low-inflationary country, adopt 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 and other important contributions, Kydland and Prescott (1977), Calvo (1978), Barro and Gordon (1983), Rogoff (1985), Barro (1986), Alesina and Tabellini (1987), Cukierman (1992), Svensson (1997), Walsh (1995), and Benigno and Woodford (2003).[1] 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. The second strand studies the causes and consequences of weak institutions, in particular, corruption. This literature includes work on the effects of institutions on development (Rose-Ackerman, 1975; Shleifer and Vishny, 1993; Mauro, 1995). Wei (2000, 2001), Bai and Wei (2000), Fisman and Wei (2004) and Du and Wei (2004) investigated the consequences of corruption for international capital flows, tax evasion, and stock market volatility. 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.

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. 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 for the design of several other monetary frameworks, including a currency board, dollarization, and a Rogoff-type conservative central banker, and rank them in terms of social welfare. We also examine the authorities' incentive in strengthening institutions from a political economy perspective.

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

Second, pegged exchange rate, currency boards, or dollarization are often prescribed as ways to solve the lack of credibility problem. However, 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% and to most exchange-rate-based monetary arrangements. In equilibrium, the optimal degree of central bank conservatism is proportional to institutional quality. Thus, developing countries with lower institutional quality should have less conservative central

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[1] See Persson and Tabellini (1990) and Berger et al. (2001) for surveys of the literature.

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 institutions. 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 a poor-institution trap. 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. Section 2 sets up the model. Section 3 compares various popular frameworks that implement a commitment regime, namely inflation targeting, fixed exchange rates, currency boards, and dollarization. It is shown that the relative desirability of these frameworks depends on the institutional quality. Section 4 analyzes the discretionary regime and examines a conservative central banker framework. Section 5 extends the basic model to allow for a Laffer curve effect in seigniorage revenue. Section 6 endogenizes the institutional quality from a political economy perspective. Section 7 concludes.

2. Basic setup

Our model utilizes a framework developed in Alesina and Tabellini (1987), which we think has been insufficiently appreciated in the literature. The government's objective function includes public goods provision in addition to stabilizing inflation and output:

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

where π denotes the inflation rate, y the log of real output, and g the ratio of expenditure on public goods to output. $k>0$ and $l>0$ are the weights on output and public expenditure stabilities, 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 $\bar{g}$.

To generate an inflation bias under a discretionary regime, the original Barro-Gordon (1983) model 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 ($\bar{g}>0$) is enough to generate an inflation bias. This is demonstrated below.

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, but a distortionary tax rate reduces aggregate supply. To be more precise, output is given by:

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

where π^e is the expected inflation rate, and τ is the tax rate on total output. $\alpha>0$ and $\beta>0$ are coefficients.[2]

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 seigniorage is an important source of government revenue for developing countries. For example, Cukierman et al. (1992,

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[2] Eq. (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.

Table 1) show that over 1971–1982, seigniorage (defined as an increase in base money) as a share of total government revenue could account for more than ten percentage points (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 a 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 $0 \le \phi \le 1$. 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.[3] If $\phi=0$, then there is complete leakage, and the government collects no tax revenue.[4] The government's budget constraint can be written as[5]:

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

Note that when $\phi=1$, our specification becomes that in Alesina and Tabellini (1987). Our model abstracts from public debt and leakage in the collection of inflation tax.

3. Commitment and its implementations

3.1. 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 Eq. (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.[6]

This subsection focuses on the case in which the central bank sets an inflation rate and can credibly commit to it. In this case, $y=-\beta\tau$. The Nash equilibrium monetary and fiscal policies can be directly obtained from solving two first-order conditions, i.e., the two reaction functions.[7] This yields the equilibrium inflation and tax rates:

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

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

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[3] Here, the normal administrative cost for tax collection is not considered a leakage.

[4] Although we focus on corruption as the main reason for tax leakage, weak institution and its associated low fiscal capacity can be attributed to other factors, such as a large informal sector in many developing countries, a tradition of flouting government regulations, little experience with voluntary compliance, and constantly changing procedures in transition economies.

[5] Eq. (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 $P_t X_t$ and approximating $(M_t - M_{t-1})/P_t X_t$ as π_t, we have $g_t = \phi\tau_t + \pi_t$.

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

[7] The second-order conditions associated with this problem (as well as with the discretionary case later) are trivially satisfied since $V(\pi, \tau)$ is globally concave.

A number of observations can be made. First, if there is no need to provide public goods ($\bar{g}=0$), then the equilibrium inflation and tax rates under the commitment regime would be zero. Second, it is straightforward to see that the inflation rate goes up as the quality of institutions becomes worse (ϕ goes down). As the shadow cost of raising revenue through regular tax channels rises vis-à-vis the inflation tax, a higher inflation becomes optimal. Third, as institutional quality worsens, the tax rate τ^C can go either up or down, depending on the combination of other parameters.[8]

The equilibrium levels of public expenditure and social welfare are $g^C = \frac{(k\beta^2 + \phi^2)l\bar{g}}{(1+l)k\beta^2 + l\phi^2}$ and $V^C = -\frac{1}{2}\frac{kl\beta^2\bar{g}^2}{(1+l)k\beta^2 + l\phi^2}$, respectively. Therefore, lower institutional quality unambiguously reduces social welfare.

Proposition 1. *Under a commitment regime, as the institutional quality becomes poorer, (1) the equilibrium inflation rate goes up; (2) the tax rate can go either direction, but (3) the social welfare declines unambiguously.*

3.2. Comparing inflation targeting, exchange rate fixing, currency board, and dollarization

Four popular frameworks have been developed to implement the commitment regime: inflation targeting, exchange rate fixing, currency board, and dollarization. It is easy to compare their relative desirability based on the insights from this model.

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.[9] In principle, this system can be used to achieve the desirable outcome (π^C, τ^C and g^C).

A number of countries, including Australia, Brazil, Canada, Finland, New Zealand, Norway, Poland, Sweden, and the United Kingdom, have adopted inflation targeting. In practice, they either target their inflation rates to a point (e.g., U.K.) or to a relatively narrow range, typically within 1–4%. It is often thought that a similar level of inflation target would benefit developing and transition economies as well. The empirical evidence, however, shows that inflation targeting has been less successful in developing and transition economies. In fact, many of them are reluctant to adopt it, even though a lack of credibility is a clear concern for them. We believe that the poorer quality of institutions provides one important reason.[10]

It is useful to make a distinction between a mechanical inflation target and an optimally chosen target. A mechanical inflation targeting is a framework that advocates developing countries to do what developed countries are doing, namely to target a low inflation rate such as 4% (or a narrow range around that). An optimal inflation targeting is an arrangement that is consistent with the optimal inflation level discussed earlier. An immediate implication is that the poorer the institutional quality, the higher the optimal level of the inflation target. A mechanical inflation target could reduce the welfare of countries with lower quality institutions.

Under either a fixed exchange rate or a currency board arrangement, there is an implied inflation target which is the anchor country's inflation rate. Generally speaking, the anchor country tends to have higher quality institutions than most developing countries. Therefore, a developing economy

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[8] See Huang and Wei (2005) for more discussion.

[9] See Bernanke et al. (1999) for recent international experience of inflation targeting.

[10] Masson et al. (1997) and Eichengreen et al. (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 the system.

with lower institutional quality tends to have a lower inflation rate than is optimal, and a higher tax rate than is optimal.[11] Its welfare is thus lower than it could be.

It is sometimes thought that developing countries can "import credibility" through a fixed exchange rate or currency board. Our discussion suggests that weak institutions may limit or even destroy the imported credibility as the implied inflation rate is too low and the incentive to deviate from it is too strong.

We have so far assumed away stochastic shocks to the aggregate Phillips curve. Without these shocks, a fixed exchange rate, a currency board, and a mechanical inflation target are qualitatively equivalent. However, if shocks are introduced, an inflation targeting framework can dominate the other two arrangements as it allows for the flexibility to respond to shocks that are specific to the domestic economy. As noted in Cukierman et al. (2004), an exchange rate band also permits an optimal tradeoff between flexibility and commitment.

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, the national currency disappears. The commitment is stronger because the cost to the government of reversing such an arrangement is higher. While the underlying inflation rates of the two regimes are the same, the government in a dollarization regime has to forgo seigniorage revenue associated with the issuance of domestic money. Hence, the tax rate under dollarization is higher, but the social welfare is lower, than under a pegged exchange rate or currency board.

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

4. Discretion and conservative central banker

4.1. 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 was at the commitment level ($\pi^e = \pi^C$), the central bank would always find it optimal to raise inflation unexpectedly. Hence, such inflation expectation would not be rational. The time-consistent policy mix, (π^D, τ^D), is the Nash equilibrium solution to the noncooperative game played by the central bank and the fiscal authority, who take the expected inflation rate as given.

The solution is characterized by the two first-order conditions associated with (1), with the requirement that the expected inflation rate equals its equilibrium value. Solving the two first-order conditions, we have a Nash equilibrium policy mix:

$$\pi^D = \frac{\bar{g}\pi^C}{(1-\mu)\pi^C + \mu\bar{g}}, \tag{6}$$

$$\tau^D = \frac{\bar{g}\tau^C}{\alpha\beta k\tau^C + \bar{g}}, \tag{7}$$

where $\mu \equiv \beta/(\alpha\phi + \beta) \leq 1$.

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[11] 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 seigniorage revenue. See Ghosh et al. (2003) for more discussions on currency board and its problems.

It is easy to verify that $\pi^D \geq \pi^C$, and $\tau^D \leq \tau^C$, with the equality holding if and only if $\phi = 0$. Thus, the inflation under discretion is higher than under commitment, and the tax rate is lower. It is straightforward to work out the level of the social welfare, $V^D = -\frac{1}{2} \frac{[kl(\alpha\phi+\beta)^2+k^2\beta^2+l^2\phi^2]kl\beta^2\bar{g}^2}{[kl\beta(\alpha\phi+\beta)+k\beta^2+l\phi^2]^2}$, as well as the public goods provision and the output.

From (7), it is clear that the derivative of the discretionary tax with respect to ϕ has the same sign as the derivative of the commitment tax with respect to ϕ. For moderate institutional quality $(\phi/\beta \geq \sqrt{(1+l)k/l})$, 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.

From (6), one sees that a decrease in ϕ has two offsetting effects on discretionary inflation: it increases the commitment inflation level π^C but decreases the inflationary bias captured by μ. Thus in contrast to the commitment case, the optimal response of monetary policy in discretion to a decrease in institutional quality is nonlinear. If the quality of institutions is relatively modest $(\alpha\phi/\beta \geq \sqrt{1+k\alpha^2/l}-1)$, then the optimal response to a decrease in quality is to raise the inflation rate. On the other hand, if the quality of institutions is already poor $(\alpha\phi/\beta < \sqrt{1+k\alpha^2/l}-1)$, then the opposite response would be optimal.

This makes an interesting comparison with the commitment case. For example, starting from a poor quality of institutions $(\alpha\phi/\beta < \sqrt{1+k\alpha^2/l}-1)$, the optimal monetary policy response to a decrease in the institutional quality is to lower the inflation rate under a discretionary regime, but to raise it under a commitment regime. For the intuition behind this difference, one first recalls that a decrease in the institutional quality implies a rise in the shadow price of collecting regular taxes relative to collecting the inflation tax. This explains why the inflation rate under commitment KHe, while this force still operates, there is an additional, opposing force at work. The equilibrium inflation rate under discretion is already higher than that under commitment, especially when the initial level of the institutional quality is low, resulting in a lower social welfare. When the marginal cost of raising regular taxes increases yet again, in order not to further reduce the social welfare by raising the inflation rate from an already high level, cutting public goods provision and cutting both the regular and inflation taxes now become more attractive. Despite this nonlinear response pattern, it is easy to see that $V^D \leq V^C$, where the equality sign holds when $\phi = 0$. Therefore, consistent with the literature, an ability to commit (to the optimal level of inflation) raises welfare.

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

4.2. Rogoff-type conservative central banker

If, for whatever reason, a commitment regime is not available, Rogoff (1985) suggested that delegating the monetary policy to a more conservative central banker (still with discretion) can improve upon the social welfare relative to the conventional 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

$$V^{CC}(\pi, \tau) = -\frac{1}{2}[S\pi^2 + ky^2 + l(g-\bar{g})^2] \tag{8}$$

If the central banker cares about inflation as much as the social planner, then $S=1$. We can 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 $= S-1$.

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 (8), with the requirement that the expected inflation rate equals its equilibrium value. This yields:

$$\pi^{CC} = \frac{\bar{g}\pi^C}{(1-S\mu)\pi^C + S\mu\bar{g}}, \tag{9}$$

$$\tau^{CC} = \frac{\bar{g}\tau^C}{\left(\frac{1}{S(1-\mu)} - \frac{\mu}{1-\mu}\right)\alpha\beta k\tau^C + \bar{g}}, \tag{10}$$

where $\mu=\beta/(\alpha\phi+\beta) \le 1$ as defined earlier. It is clear that with a more conservative central banker, the inflation rate comes down, but the tax rate goes up. One can work out the level of social welfare as $V(\pi^{CC}, \tau^{CC}) = -\frac{1}{2}\frac{[kl(\alpha\phi+\beta)^2+S^2(k\beta^2+l\phi^2)]kl\beta^2\bar{g}^2}{[kl\beta(\alpha\phi+\beta)+S(k\beta^2+l\phi^2)]^2}$.

Suppose the social planner can choose any value of S, then what degree of conservatism would maximize the social welfare? To answer this, we maximize $V(\pi^{CC}, \tau^{CC})$ with respect to S. The first order condition leads to[12]

Proposition 4. *The optimal degree of central bank conservatism is given by* $S^* = 1 + \frac{\alpha}{\beta}\phi$.

A number of observations can be made. First, generally speaking for $0<\phi\le 1$, $S^*>1$, thus a central banker more conservative than the social planner should be appointed. 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 inflation on output (i.e., a lower α), the less conservative the central banker should be.[13] 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, it can be verified that $\pi^{CC}=\pi^C$, $\tau^{CC}=\tau^C$, and $V^{CC}=V^C$. That is, this (modified) discretionary regime restores the first-best solution under commitment. This result is somewhat surprising and worth some further elaboration. There are a number of differences between our model and Rogoff's framework. First, we have added public

[12] It can be verified that $V(\pi^{CC}, \tau^{CC})$ is indeed convex in S.
[13] As a possible extension, one might endogenize β and make it a decreasing function in ϕ. That is, when the leakage in tax collection increases, the tax distortions could become smaller. In this case, the effect of surprising inflation on output (α) becomes relatively more important in determining S^*.

goods provision as part of the objective function. Although a more conservative central banker can reduce 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 conservative central banker dominates that of a currency board or dollarization. If installing a conservative central banker requires fewer technical preconditions than implementing an inflation target (e.g., due to the principle of contract implementation a la Moore, 1992; Maskin and Moore, 1999), then a conservative central banker framework would also be better than an inflation target. Without a fiscal policy or with only a passive fiscal policy, the Walsh (1995) contract can implement the commitment solution under a discretionary regime. However, once strategic manipulation by the fiscal authority is introduced, the Walsh contract could be 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 conservative central banker arrangement may outperform the Walsh-type incentive contract.

5. A Laffer curve effect in seigniorage

The discussion so far has ignored a possible nonlinear, Laffer curve effect of a rise in the inflation rate on seigniorage revenue. As Cagan (1956) has shown, the semi-elasticity of the demand for money affects the ability of government to extract seigniorage: when inflation rate exceeds a threshold, the seigniorage starts to decline. In other words, seigniorage 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 Eq. (3) by $\pi \exp(-\gamma\pi)$, where the parameter $\gamma \geq 0$ can be thought of as the semi-elasticity of the demand for real money balances and captures the strength of the Laffer curve effect. When $\pi \leq 1/\gamma$, an increase in inflation leads to an increase in the total seigniorage. When inflation exceeds a threshold, or $\pi > 1/\gamma$, however, any further increase in inflation rate leads to a decline in the total seigniorage. Indeed, in the limit, when inflation approaches infinity, everyone avoids using the domestic currency, and the government collects no seigniorage 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:

$$g = \phi\tau + \pi\exp(-\gamma\pi). \tag{11}$$

The basic setup in the earlier sections is a special case in which $\gamma=0$.[14]

Under the commitment regime, the two first-order conditions are[15]:

$$\pi = l[\bar{g}-\phi\tau-\pi\exp(-\gamma\pi)](1-\gamma\pi)\exp(-\gamma\pi), \tag{12}$$

$$k\beta^2\tau = l\phi[\bar{g}-\phi\tau-\pi\exp(-\gamma\pi)]. \tag{13}$$

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

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[14] It is possible that tax revenue collection also has a Laffer curve effect. It can be analyzed by replacing $\phi\tau$ in Eq. (3) with $\phi\tau \exp(-\rho\tau)$, where $\rho>0$. Other things equal, this complication tends to tilt the choice between inflation and tax towards the former, especially when the need for public goods provision is high. We leave this for future research.

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

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 (12) 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.

Third, it can be verified that $\frac{\partial \pi^C(\gamma)}{\partial \gamma} < 0$ if $(k\beta^2 + l\phi^2)\frac{(2-\gamma\pi^C(\gamma))\exp(2\gamma\pi^C(\gamma))}{[1-\gamma\pi^C(\gamma)]^2} > kl\beta^2$. 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 $\gamma \geq 0$,

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

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

We have also analyzed the discretionary regime. We find that in the discretionary case, we cannot say unconditionally that the Laffer curve effect would lead to a lower inflation. What we do know for sure is that the Laffer curve effect tilts revenue collection away from inflation toward tax. Interested readers can find the analysis in the working paper version (Huang and Wei, 2005) for detail.

6. 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 reforms to strengthen institutions. Our modeling strategy is similar to the case of tax reform in Cukierman et al. (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 the institutional quality and the authorities' effort go hand in hand and their relationship can be captured in a multiplicative form:

$$\phi = \phi_0\sqrt{f}, \tag{14}$$

where $f \in [1, 1/\phi_0^2]$ denotes the level of effort by the authorities, ϕ_0 is the initial value of ϕ.

We assume further that the authorities share the preference of the social planner except that they also bear the cost (disutility) of the effort, which is proportional to their effort,

$$C = \theta(f-1), \tag{15}$$

where $\theta > 0$ is the cost per unit of the effort.

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 focuses on the commitment case, but it is straightforward to extend it to the discretionary case. The policy game is the same as before, except that the authorities need to choose their level of effort first.

Since the authorities share the preference of the social planner, their utility net of the effort cost is

$$V_A^C(f) = V^C - C = -\frac{1}{2} \frac{kl\beta^2 \bar{g}^2}{(1+l)k\beta^2 + l\phi_0^2 f} - \theta(f-1). \tag{16}$$

Taking the first derivative of (16) with respect to f, one gets[16]

$$\frac{kl^2\beta^2\bar{g}^2\phi_0^2}{2[(1+l)k\beta^2 + l\phi_0^2 f]^2} - \theta = 0. \tag{17}$$

Examining this first-order condition (17), we have the following proposition.

Proposition 5. *For $\underline{\theta} < \theta < \bar{\theta}$, where*

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

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

an interior optimal solution $1 < f^* < 1/\phi_0^2$ exists, and

$$f^* = \sqrt{\frac{k}{2\theta}} \frac{\beta\bar{g}}{\phi_0} - \frac{1+l}{l} \frac{k\beta^2}{\phi_0^2}.$$

The equilibrium level of effort (f^*) goes up, if the marginal cost of effort is lower (smaller θ), or more importance is placed on public goods provision (higher l or $\bar{g}$).

The equilibrium inflation and tax rates are

$$\pi^C(f^*) = \frac{kl\beta^2\bar{g}}{(1+l)k\beta^2 + l\phi_0^2 f^*} = \frac{\beta\sqrt{2k\theta}}{\phi_0}, \tag{18}$$

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[16] It is easy to verify that the second-order condition holds.

$$\tau^C(f) = \frac{l\phi_0\sqrt{f^*}\bar{g}}{(1+l)k\beta^2 + l\phi_0^2 f^*} = \sqrt{\sqrt{\frac{2\theta}{k}}\frac{\bar{g}}{\beta\phi_0} - \frac{1+l}{l}\frac{2\theta}{\phi_0^2}}. \tag{19}$$

It is easy to see that

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

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

Further examining the first-order condition (17), we have the following corollary, which suggests that the cost coefficient, θ, is a key parameter that affects the authorities' incentive to strengthen institutions.

Corollary 6. *If $\theta \geq \bar{\theta}$, 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 that $\lim_{\phi_0 \to 0} \bar{\theta} = 0$. In other words, when the initial quality of institutions is very poor, such that ϕ_0 has a very low value, most values of θ would be greater than $\bar{\theta}$. In this case, the authorities would have no incentive to devote any effort to strengthen the institutions.[17] 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 by no means a decisive tool to strengthen the institutions.

7. Concluding remarks

In this paper, we examine the effects of institutional quality on the desirability of several popular monetary regimes, including inflation targeting, exchange rate fixing, currency board, and a 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.

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[17] It is possible that changing the assumed relationship between institutional quality and effort could modify this result.

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% and to most 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 seigniorage revenue likely lowers inflation and raises 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. First, 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. Second, the effect of a Laffer curve in tax revenue as well as in seigniorage on inflation and tax rates is also interesting. Third, a systematic empirical examination can be illuminating. For example, is there support for Proposition 4 in the paper that the optimal degree of central bank conservatism depends positively on the institutional quality, and the elasticity of the aggregate demand with respect to the inflation surprise, but negatively on the elasticity of the aggregate supply to the distortionary tax rate? Does the dispersion in the experiences of developing and transition economies with inflation targeting reflect the insights of this model? These can be interesting and important topics for future research.

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