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Fiscal discipline and the choice of a nominal anchor in stabilization

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Abstract

The conventional wisdom is that exchange rate-based stabilizations induce more fiscal discipline than money-based programs. The Latin American experience does not support this view. Among the major stabilization programs implemented since 1960, the mean increase in the primary balance-to-GDP ratio was 3.2 percentage points under money-based programs, as opposed to only 0.2 percentage points under exchange rate-based programs. We present a model – where fiscal policy is set by an optimizing but non-benevolent government – that replicates this stylized fact. If the policy maker is impatient, a money-based stabilization provides more discipline, and higher welfare for the representative agent, than does an exchange rate-based stabilization.

Keywords: Exchange rate regimes; Fiscal discipline

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1. Introduction

A key issue in the design of stabilization programs is the choice of a nominal anchor, which is a choice between money-based and exchange rate-based

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stabilization. Evaluations typically focus on the very short-run issue of bringing down inflation quickly with minimal real costs.[1] But bringing down inflation is only part of the story: keeping it down is the more difficult part. While most economists would agree that sustaining low inflation requires reducing the fiscal deficit and the associated demand for seigniorage, there has been little analysis of the link between the choice of nominal anchor and incentives to undertake fiscal reform.

In the policy literature the conventional wisdom is that exchange rate-based stabilization programs induce more fiscal discipline than do money-based programs.[2] However, with a few exceptions, the experience of Latin America during the last 30 years does not support that view. Three startling facts stand out from the major stabilization programs carried out in Latin America since 1960. First, only under exchange rate-based programs did the primary fiscal balance deteriorate between the year in which the program was launched and the following year. Second, under all of the nine money-based programs the primary balance-to-GDP ratio increased by more than one percentage point. In contrast, this happened in only four of the 12 exchange rate-based programs. Third, during the first year the mean increase in the primary balance-to-GDP ratio was 3.2 percentage points under money-based programs, as opposed to only 0.2 percentage points under exchange rate-based programs (see Fig. 1). A similar pattern nominal-to-GDP ratio (see Fig. 2). Thus, contrary to the conventional wisdom, money-based programs seem to provide more fiscal discipline than do exchange rate-based programs.[3]

In this paper we provide a theoretical rationale for this stylized fact. As in Calvo (1987) and Helpman and Drazen (1987), our starting point is that stabilization typically involves two different stages. First the Central Bank pursues a tighter monetary policy, using either the money supply or the nominal exchange rate as an instrument. Second, politicians who control the budget decide whether or not to tighten fiscal policy to make it compatible with price stability.

In this context, the reason that money-based stabilizations provide stronger incentives for fiscal authorities to close the deficit is the following. Under exchange rate-based stabilization, inflation falls sharply at first, but ongoing money-financed deficits eventually lead to the collapse of the peg and the end of the stabilization program. The politicians who control the budget can therefore enjoy high spending and low inflation today at the cost of high inflation in the

[1] In the 1970s the debate was primarily about the size of the accompanying recession. More recently attention has turned to its timing, with some analysts claiming that money-based stabilizations induce an early recession, while exchange rate-based stabilizations induce an early boom and only later a recession. See Calvo and Vegh (1994).

[2] See, for instance, Aghevli et al. (1991), Frenkel et al. (1991), and Giavazzi and Pagano (1988).

[3] Perhaps a few well publicized exceptions, such as those of Mexico (1987) and Argentina (1991), are the source of the conventional wisdom.

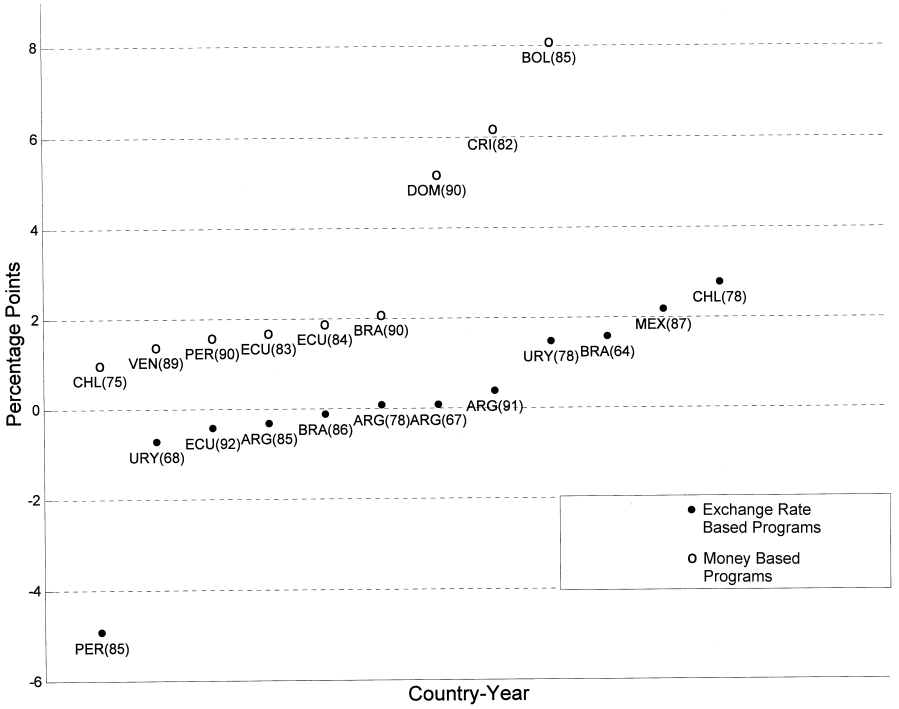

Fig. 1. Change in the Primary Balance-to-GDP Ratio.

future. On the other hand, under money-based stabilization, failure to close the deficit is translated into expectations of high monetization in the future. This implies that under a money-based plan the politicians have to endure high inflation not only in the future, but also today. Therefore, which type of plan will induce greater fiscal discipline depends on how much politicians discount the future. We show that if politicians are impatient, a stabilization under flexible rates induces greater fiscal adjustment by forcing the costs of unsound policies to be paid up front.[4]

We formalize this idea in a standard setup of optimizing agents with price flexibility, perfect foresight and perfect capital mobility. It is well known (Helpman, 1981) that in this benchmark model the choice between fixed and flexible exchange rates is immaterial for a given path of government spending and taxes. The contribution of our paper is to identify distortions that characterize real-world stabilization programs, and to embed them in a model within which a consistent comparison of fiscal policies under alternative exchange rate regimes can be carried out.

[4]One caveat is in order: this argument does not hold if reserves are near zero and the Central Bank cannot borrow abroad.

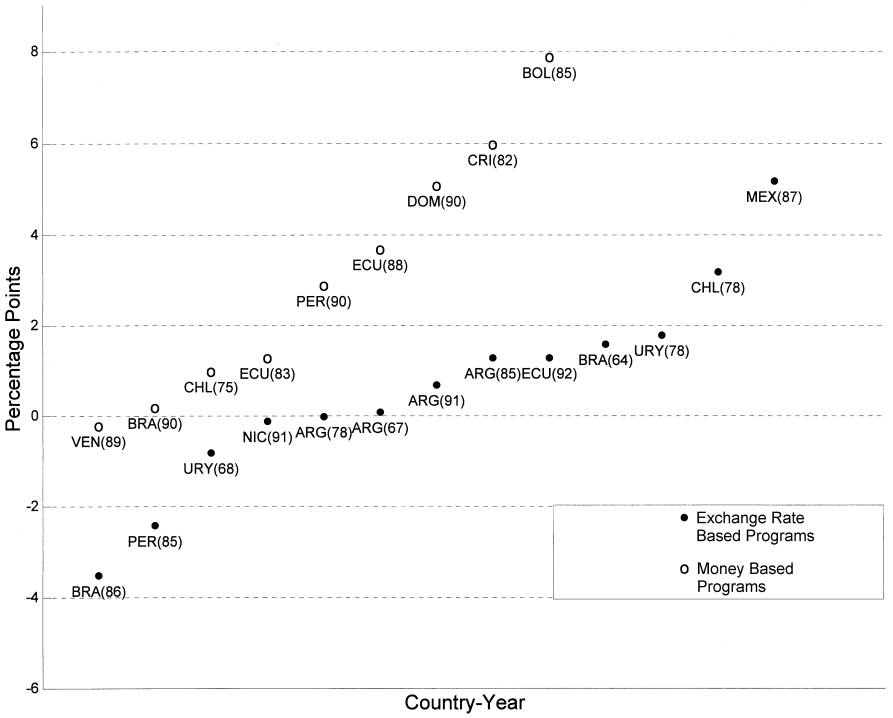

Fig. 2. Change in the Nominal-to-GDP ratio.

We depart from the standard model by endogenizing fiscal policy, and by introducing two distortions: (i) the fiscal authority (FA) has the proclivity to spend more than is socially desirable because it derives utility (political power, prestige, etc.) from public spending; and (ii) the FA discounts the future at a higher rate than society does (as a result, for instance, of uncertainty about being in office in the future).

In this paper, net government transfers (outlays minus taxes) to the public must be financed through seigniorage, the inflation tax or borrowing.[5] The costs to the FA of higher net transfers derive from the fact that private agents' utility is a function of consumption and real money balances, and individual welfare is assumed to have some weight in the FA's objective function. Since higher anticipated inflation reduces demand for real balances, it reduces private agents' welfare, and is therefore costly to the FA. Hence, fiscal authorities must trade off their desire to make higher net transfers against the costly inflationary consequences of such behavior.

[5]Or by drawing down international reserves, which is the same as borrowing.

In keeping with our earlier characterization, we assume that a stabilization program consists of two stages. First, monetary policy is tightened by the Central Bank (CB). Second, the FA determines fiscal policy. It is not necessary for this characterization that the CB be independent, but simply that monetary authorities temporarily have some policy leeway. In the absence of formal independence, this leeway could be gained through exceptional political circumstances that give central bank technocrats room to maneuver, or by the presence of an international organization such as the IMF. Moreover, even if the CB is dependent on the executive, monetary policy can be changed immediately and without the approval of the legislature, while changes in fiscal policy are subject to delays and legislative approval. This fact alone almost inevitably makes fiscal consolidation a follow-up to monetary tightening.

We analyze two alternative stabilization schemes. In one the CB temporarily fixes the rate of change of the nominal exchange rate, and the money supply is endogenous. We label this scheme *Temporary Exchange Rate-Based Stabilization* (TEBS). In the other, the CB temporarily fixes the growth rate of nominal money and the exchange rate is endogenous. This is the case of *Temporary Money-Based Stabilization* (TMBS). Confronted with each monetary regime, the FA chooses its preferred level of the primary fiscal deficit, understanding that there is an intertemporal fiscal budget constraint.

In both cases we focus on ''temporary'' policies, in the sense that the CB can only precommit its monetary or exchange rate policy for a finite length of time. We do this for two reasons, one empirical and one theoretical. The empirical reason is that most monetary policy regimes – and especially fixed exchange rate experiments – are of limited duration.[6] As Calvo (1986a), (1991) stresses, most attempted pegs face credibility problems, and are commonly regarded as temporary by investors and the public. The theoretical reason for our focus on temporary policies is that in a deterministic model such as the one we consider below, if the CB can precommit to an exchange rate or money rule for the entire future, the present value of monetary revenues is fixed. This in turn fixes the present value of fiscal deficits, and leaves no room for the FA to make any interesting decisions.

With fully flexible prices and purchasing power parity, the rates of inflation and devaluation are the same regardless of the exchange rate regime.[7] Therefore, under an exchange rate-based stabilization, the rate of inflation is whatever the CB chooses, regardless of what the FA does with the level of spending. If there is a deficit (after including the revenue from money creation), the shortfall will be made up by borrowing. This in turn means that inflation will have to rise (relative

[6]Klein and Marion (1994) study a sample of 61 pegged exchange rate episodes in Latin America since the 1950s, and find that the episodes have a mean duration of 32 months, a median of 10 and a standard deviation of 49.

[7]If non-traded goods are present, so that CPI inflation and devaluation are no longer the same, all theoretical arguments in the paper still apply, but quantitative effects may be altered.

to its initial level) in the future in order to service the additional debt. Thus, by not reducing spending today the FA pays no cost in the short run – while inflation is low – but simply incurs the cost of high inflation in the future.[8]

Now consider the case in which the CB fixes the rate of nominal money growth. If the FA does not eliminate the fiscal deficit, private agents will anticipate higher inflation in the future. As a result, inflation today will be higher than it would have been under predetermined rates. Therefore, the cost of high spending is spread over time: there is high inflation tomorrow (though lower than under predetermined rates), but there is also inflation today.

Focus next on the options faced by a FA that understands the trade-offs outlined above. Does it have a greater incentive to set a lower level of spending under predetermined exchange rates or under flexible rates? Our first result is that if the FA's discount rate is equal to the interest rate, both stabilization schemes are equivalent. However, if the FA discounts the future heavily (i.e., if its discount rate is larger than the world real interest rate), spending and the deficit are lower under a money-based stabilization. Conversely, if the FA has a relatively low discount rate, there is more fiscal discipline under an exchange rate-based program.

The intuition for this result is as follows. The choice of a nominal anchor under temporary stabilization is a decision about allocating the burden of the inflation tax across time. Under fixed rates, the bulk of the tax burden is pushed to the future, when the peg is abandoned. In contrast, under flexible rates the inflation tax burden is spread over time. Given the FA's dislike for inflation, if its discount factor is small relative to the interest rate on debt, it prefers to finance any deficit with debt and to raise higher inflation tax revenues in the future. An exchange rate-based stabilization comes closer to implementing this preferred intertemporal allocation than does a money based program. This implies that the marginal cost of spending is higher under flexible rates, and therefore equilibrium spending is lower. Conversely, when the FA's discount factor is low, stabilization under flexible rates implements the FA's preferred mix of present and future inflation more closely. Therefore, spending is lower under exchange rate-based stabilization.

What are the implications of this for the welfare of the representative private agent? Our second result is that the stabilization scheme that induces more fiscal discipline also provides higher individual welfare. In the model we consider, government spending does not enter the individual's utility function. But since such spending must be financed (at the margin) by distortionary inflation taxes,

[8]Calvo (1987) writes: ''These remarks show how tempting it may be for a politician – especially one who knows that his tenure will be over in the not-too-distant future – to resort to anti-inflationary policy of this sort since (a) no tough decision has to be taken in the short run; (b) the policy immediately appears to be successful, and (c) if well calibrated, the ''bomb'' will explode in the hands of his successor.''

individual welfare is indirectly a decreasing function of the level of government spending, and statements about spending are easily translated into statements about welfare. In particular, if the FA's discount rate is relatively high, so that spending is lower under floating than under fixing, individual welfare is higher under floating. The opposite is true when the FA's discount rate is relatively low.

In the empirical section we analyze the 22 serious stabilization episodes in Latin American since 1960. These include the major stabilization programs widely studied in the literature. We test the hypothesis that the mean improvement in the fiscal balance is greater under money-based than under exchange rate-based stabilizations by regressing the change in the fiscal balance-to-GDP ratio on a dummy that takes the value of one for money-based programs, and on some control variables. We consider four concepts of fiscal balance: nominal, primary and the cyclically adjusted nominal and primary balances. We also consider different measures of change in the fiscal balance. In all cases the coefficient of the money-based dummy is positive and significant at the standard levels. We are not alone in finding such a link between exchange rate regimes and fiscal policy. Gavin and Perotti (1997) have recently tested our hypothesis using a new fiscal policy data set that includes 13 Latin American countries covering the period 1968–1995. They also find that fiscal deficits tended to be larger under fixed exchange rates. Moreover, this worse fiscal performance cannot be explained by worse macroeconomic conditions under fixed rates.

To the best of our knowledge, the approach taken in this paper is novel. A number of papers, such as Calvo (1987), Helpman and Drazen (1987), and Talvi (1996), construct models in which the government budget constraint links fiscal and exchange rate policies. However, all these papers make fiscal policy endogenous only in the sense that expenditures must satisfy a solvency condition. In none of them is fiscal policy the explicit choice of an optimizing policy maker – much less one who faces politically-distorted incentives.

In comparing the performance of fixed and flexible exchange rates during stabilizations, our paper is similar to Helpman and Razin (1987). The aim of the theoretical exercise, however, is different. They present a model that rationalizes the consumption booms associated with exchange rate-based stabilization programs. In their model the distortion is that consumers have finite horizons. Since an exchange rate freeze represents a reduction in present taxes, and since present consumers do not expect to pay in full the future fiscal liability, there is a consumption boom and a deterioration of the trade balance. Helpman and Razin show that an appropriate sequence of monetary injections and taxes can induce the efficient allocation that obtains under flexible rates. In their model, the distortion is in the private economy, and a benevolent government attempts to neutralize it by choosing an appropriate monetary–fiscal policy mix. In our model, the distortion is in the fiscal authority's preferences, and the question is whether the harmful effect of this distortion on individual welfare can be ameliorated by the appropriate choice of exchange rate regime.

The plan of the paper is as follows. In Section 2 we present the model, and in Section 3 we solve for the endogenous fiscal deficit. The two types of stabilization programs are compared in Section 4. Section 5 contains our empirical investigation. Section 6 concludes.

2. The model

We consider a standard model of a small open economy with price flexibility and perfect capital mobility.[9] The economy is populated by a private sector and a government.

2.1. The private sector

The representative private agent consumes the single tradable good, which serves as the numeraire. She receives an endowment y of this good in each period. She can store her wealth in an internationally traded bond, whose real value is denoted by f_t, or in domestic money, whose nominal outstanding stock is denoted by M_t. We will adopt the convention that asset stocks are chosen at the end of each time period. Hence, M_t is the stock nominal balances chosen at the end of period t and carried over to period $t+1$. Assuming purchasing power parity and letting the foreign price level be constant and equal to one we have that the nominal exchange rate is equal to the domestic price level: $E_t = P_t$.

The world lasts for two periods: 1 and 2.[10] The timing of transactions is as follows. The agent enters period 1 with a stock of real bonds f_0 and a stock of nominal money M_0. During period 1 the agent receives production income y, interest payments rf_0 and a lump-sum transfer from the government τ_1 (we should think of these as net transfers: gross outlays minus taxes).[11] She then consumes an amount c_1, and chooses the holdings of real money $m_1 \equiv M_1/E_1$ and of the bond f_1 that she wishes to carry over into period 2. During period 2 the private agent receives income y again and a second government transfer τ_2 and uses all her accumulated wealth (including the real value of outstanding money balances) to pay the inflation tax and consume an amount c_2. It follows that the representative agent's budget constraint for period 1 is

$$(1+r)f_0 + m_0 + y + \tau_1 = c_1 + \pi_1 m_0 + m_1 + f_1 \tag{1}$$

and for period 2

[9] We will adhere to the standard model in order to show that our results are not dependent on complicated assumptions.

[10] We will refer to the time before the world starts as period 0. Policy announcements will be made at this time.

[11] Hence, nothing prevents τ_t from being negative.

$$(1+r)f_1 + m_1 + y + \tau_2 = c_2 + \pi_2 m_1 \tag{2}$$

where r is the exogenous world real rate of interest, and π_t is the rate of inflation and nominal devaluation, defined as:[12]

$$\pi_t \equiv \frac{E_t - E_{t-1}}{E_t} \tag{3}$$

Consolidating Eqs. (1) and (2), and defining the domestic nominal interest rate as $i_t \equiv r + \pi_t$, we have

$$(1+r)(f_0 + m_0) + y\left(\frac{2+r}{1+r}\right) + \tau_1 + \frac{\tau_2}{1+r} = c_1 + i_1 m_0 + \frac{c_2 + i_2 m_1}{1+r} \tag{4}$$

which has the usual interpretation that the present value of expenditures must be equal to the present value of income. The representative agent's objective function is

$$v(c_1) + \left(\frac{\epsilon}{\epsilon - 1}\right) m_0^{(\epsilon-1)/\epsilon} + \left[v(c_2) + \left(\frac{\epsilon}{\epsilon - 1}\right) m_1^{(\epsilon-1)/\epsilon}\right]\left(\frac{1}{1+r}\right), \ \epsilon \in (0,1) \tag{5}$$

where $v(c_t)$ has the usual properties. Notice three things about this function. First, it contains m_0 and m_1 rather than m_1 and m_2 because m_{t-1} is the level of real money balances prevalent during t. Second, the individual's discount rate is the same as the rate of interest. Third, we have assumed $\epsilon \in (0,1)$ to ensure that total monetary revenue is increasing in i_t, so that the economy is always on the sensible side of the inflation Laffer curve. The need for this assumption will become clear later in the paper.

2.2. The government

The government consists of a Fiscal Authority (FA) and a Central Bank (CB). We present the consolidated accounts of both authorities. The government enters period 1 with a stock of net external debt b_0 and with nominal monetary liabilities M_0. During period 1 it transfers a net amount τ_1 to the private agent and pays interest rb_0 on its net debt. It finances any remaining gap with monetary revenue $(M_1 - M_0)/E_1 = (m_1 - m_0) - \pi_1 m_0$ – which includes both seigniorage and the inflation tax – and by changing its net debt position. At time 2 the government makes a transfer τ_2 and must repay its outstanding debt (both real and monetary), its only source of income being the inflation tax. Hence, for any given net transfer τ_2, the exchange rate must adjust to insure that the inflation tax is sufficient to

[12] Notice that we have defined the rate of inflation as $(E_t - E_{t-1})/E_t$, rather than the conventional $(E_t - E_{t-1})/E_{t-1}$. Under our definition, the rate of inflation is bounded above by one, and can therefore be interpreted readily as a tax rate.

balance the government accounts. It follows that the government budget constraints at times 1 and 2 are

$$(1+r)b_0 + m_0 + \tau_1 = \pi_1 m_0 + b_1 + m_1 \tag{6}$$

$$(1+r)b_1 + m_1 + \tau_2 = \pi_2 m_1 \tag{7}$$

Consolidating Eqs. (6) and (7) and again using the definition of i_t we can write

$$(1+r)(b_0 + m_0) + \tau_1 + \frac{\tau_2}{1+r} = i_1 m_0 + \frac{i_2 m_1}{1+r} \tag{8}$$

We can now combine Eqs. (4) and (8) to obtain the economy-wide resource constraint:

$$c_1 + \frac{c_2}{1+r} = (1+r)(f_0 - b_0) + y + \frac{y}{1+r} \tag{9}$$

Given that the government consumes nothing, the present value of consumption simply equals the present value of national income, including income from initial net foreign assets.

2.3. Solution to the private sector's problem

Next we solve the private sector's problem. Acting atomistically, the representative agent takes as given the expected τ_1 and τ_2 and chooses c_1, c_2, m_0 and m_1 in order to maximize Eq. (5) subject to Eq. (4). Letting an asterisk denote an equilibrium level, the first order conditions are

$$v'(c_1^*) = v'(c_2^*) \tag{10}$$

$$(m_{t-1}^*)^{-1/\epsilon} = i_t v'(c_t^*), \ t = 1,2 \tag{11}$$

Condition (10) indicates that consumption is constant across both periods: $c_1^* = c_2^* = \bar{c}$. Substituting this in Eq. (9) we have that

$$\bar{c} = \left(\frac{1+r}{2+r}\right)\left[(1+r)(f_0 - b_0) + \left(\frac{2+r}{1+r}\right)y\right] \tag{12}$$

so that consumption equals permanent income.[13]

[13]The result that consumption is constant and independent of monetary policy follows from the assumption of separability of consumption and money in the utility function. We adopt the separability assumption for simplicity, but jettisoning it would only strengthen our results: as Calvo (1986a) has shown, if money and consumption are complements (as in the case of cash-in-advance) then a temporary stabilization creates a temporary consumption boom. Under fixed rates the boom would be larger, further weakening the incentives for fiscal consolidation.

Condition (11) shows that money demand depends on the nominal rate of interest and the level of consumption. If we normalize the level of $\bar{c}$ in Eq. (12) so that $v'(\bar{c}) = 1$, expression (11) can be written as

$$m^*_{t-1} = i_t^{-\epsilon},\ t = 1,2 \tag{13}$$

which is the money demand function we will use repeatedly throughout the paper. Notice from budget constraint (8) that total monetary revenue in each period equals $i_t m_{t-1} = i_t^{1-\epsilon}$, $t = 1,2$.[14]

2.4. Stabilization schemes

In our setup, a stabilization has two stages. In the first stage there is an exogenous temporary contraction (relative to what agents had been expecting) either of the devaluation rate or of the nominal money growth rate. In the second stage the FA chooses the level of the fiscal balance. Two comments are in order. First, this modeling assumption should not be interpreted as implying that the CB is independent, which is not true in many Latin American countries. Rather, this assumption is meant to capture the fact that during some periods monetary authorities enjoy some leeway because of exceptional political or economic circumstances, or because of the presence of an international organization. Second, the timing captures the fact that even if the CB is dependent on the executive, monetary policy can be changed immediately and without the approval of the legislature, while changes in fiscal policy are subject to delays and legislative approval.

In a *Temporary Money-Based Stabilization* (TMBS) the CB sets period 1's growth rate of nominal money $\mu_1 \equiv (M_1 - M_0)/M_1$ equal to some constant, and the exchange rate becomes endogenous. In a *Temporary Exchange Rate-Based Stabilization* (TEBS) the CB sets period 1's nominal devaluation rate π_1 equal to some constant, and the money supply becomes endogenous.[15] In both cases, and as

[14]Notice that total monetary revenues include both inflation tax and seigniorage. This is why the expression is $i_t m_{t-1}$ rather than $\pi_t m_{t-1}$.

[15]Notice that if the CB were able to set the rate of devaluation for periods 1 and 2 (π_1 and π_2) exogenously, then (by Eq. (13)) the CB would fully determine m_0 and m_1. In that case, budget constraint (8) would leave the FA without freedom: the present value of net transfers can only be the residual of total exogenous monetary revenue minus the period 1 value of the government's initial liabilities (both monetary and non-monetary):

$$\tau_1 + \frac{\tau_2}{1+r} = i_1^{1-\epsilon} + \frac{i_2^{1-\epsilon}}{1+r} - (1+r)(b_0 + m_0).$$

In this case the FA does not make any interesting decision but simply decides upon the intertemporal allocation of transfers as in any elementary consumption problem.

in Sargent and Wallace (1981) and Drazen (1985), inflation in period 2 must adjust to ensure the government's budget constraint is met.[16]

The timing of actions is as follows. At the end of period 0, the CB announces its monetary policy (μ_1 or π_1). Once monetary policy is announced, the FA announces τ_1 and τ_2, the level of fiscal transfers that will take place. Given these announcements, the private agent chooses m_0, her desired time 1 real balances. Lastly, the CB transfers to the private agent the gains (or losses) it made as a result of movements in the exchange rate during period 0. During period 1 the private agent selects c_1 and m_1, her desired real balances for time 2. The FA does not make any decision. When time 2 arrives the government repays its outstanding debt, the CB redeems the real value of outstanding money balances, and the private agent consumes all her remaining wealth.[17]

3. Endogenous determination of fiscal policy

The FA's optimization problem under the alternative stabilization schemes is the focus of this section. The FA has control over government transfers τ_t, $t = 1,2$, which it sets in order to maximize the following objective function:

$$\alpha[u(\tau_1) + \beta u(\tau_2)] + (1-\alpha)\left[v(c_1) + \frac{\epsilon}{\epsilon - 1} m_0^{(\epsilon-1)/\epsilon} + \beta\left\{v(c_2) + \frac{\epsilon}{\epsilon - 1} m_1^{(\epsilon-1)/\epsilon}\right\}\right] \tag{14}$$

where $u(\tau)$ and $v(c)$ have the usual properties,[18] β is the FA's subjective discount factor, $\beta \in (0,1)$, and $\alpha \in (0,1)$. The key feature of this function is that government transfers yield utility – political power, prestige, greater chances of reelection – to those who control fiscal policy, and this element carries weight α in the FA's objective function. This is the first ''political'' distortion that can lead the FA to set τ at a positive level in equilibrium, even though since all transfers are to be financed (at the margin) through distortionary taxation, the public's preferred level of τ need not be positive. At the same time, the FA also

[16] It makes no difference what the exchange rate regime is after stabilization ends. We simply assume that regimes are maintained into the second period. The common feature under both regimes is that the period 2 devaluation rate is such that the inflation tax provides enough revenue to repay all government liabilities.

[17] We have required that government decisions be taken as having been made prior to the private agent's decisions in order to avoid time inconsistency issues, which are not essential to our argument. We have also assumed away the kinds of monetary indeterminacy which may be present under flexible rates.

[18] Notice that $u(\tau)$ is defined for both positive and negative values of τ, and is increasing across the whole real line.

internalizes the objectives of the representative individual, but discounts the future at a rate β that need not coincide with the individual's discount rate $(1+r)^{-1}$.

In setting transfers the FA must trade off benefits against costs. The benefits of increasing net transfers derive from the increased utility of transfers. The costs derive from the fact that higher net transfers have to be financed with a higher inflation tax, which reduces equilibrium real balances in at least one, and maybe both, periods. To determine which stabilization provides more fiscal discipline we need to find the effects of changes in τ_t on inflation rates, and thus on m_0 and m_1.

Maximizing Eq. (14) with respect to the τ's, we obtain

$$u'(\tau_1) = -\left(\frac{1-\alpha}{\alpha}\right)\left[m_0^{-1/\epsilon}\left(\frac{\partial m_0}{\partial \tau_1}\right) + \beta m_1^{-1/\epsilon}\left(\frac{\partial m_1}{\partial \tau_1}\right)\right] \tag{15}$$

$$u'(\tau_2) = -\left(\frac{1-\alpha}{\alpha}\right)\left(\frac{1}{\beta(1+r)}\right)\left[m_0^{-1/\epsilon}\left(\frac{\partial m_0}{\partial \tau_2}\right) + \beta m_1^{-1/\epsilon}\left(\frac{\partial m_1}{\partial \tau_2}\right)\right] \tag{16}$$

Notice two things about Eqs. (15) and (16). First, if we divide one expression by the other and rearrange we have

$$u'(\tau_2)\beta(1+r) = u'(\tau_1) \tag{17}$$

The time profile of transfers is independent of exchange rate and monetary policy and depends only (as in a standard consumption problem) on the rates of discount and interest.

Second, the effect of changes in τ_t on money holdings and inflation in each period is different under each of the two stabilization schemes. Under TEBS, π_1 is predetermined by the CB. Thus m_0 remains unchanged, and any change in one τ_t (holding the other period's transfers constant) just affects m_1. Under TMBS, on the other hand, the CB only fixes μ_1, while inflation rates – and thus m_0 and m_1 – are endogenous and dependent on the choice of τ_1 and τ_2.

Before we proceed we must impose an upper bound on initial government debt to ensure government solvency. Notice that since the upper bound for the inflation rate is $\pi = 1$, the money demand function (13) implies that the maximum attainable monetary revenue is $(1+r)^{1-\epsilon}$ per period. Substituting this upper bound in Eq. (8) it follows that initial government debt must satisfy the following inequality:

$$(1+r)[b_0 + (1+r)^{-\epsilon}] + \bar{\tau}_1 + \frac{\bar{\tau}_2}{1+r} \leq \frac{2+r}{(1+r)^{\epsilon}} \tag{18}$$

where $\bar{\tau}_t = \max[\tau^*_{t,\mathrm{TEBS}}, \tau^*_{t,\mathrm{TMBS}}]$

3.1. Fiscal policy under exchange rate-based stabilization

Once the CB announces π_1 and the FA announces the τ's at the end of period 0, private agents rearrange their portfolios by buying or selling domestic money from

the CB. The nominal exchange rate E_0 is given by history and cannot jump under TEBS. Let $M_{0^-}/E_{0^-} \equiv m_{0^-}$ and b_{0^-} be the levels of real balances and net foreign assets outstanding before the policy announcements are made. Portfolio rebalancing is accomplished through the following asset swap: $(M_0 - M_{0^-})/E_0 \equiv m_0 - m_{0^-} = -(b_0 - b_{0^-})$. Substituting this into budget constraint (8) and using Eq. (13) to eliminate the i_t's, we have

$$(1+r)(b_{0^-} + m_{0^-}) + \tau_1 + \frac{\tau_2}{1+r} = m_0^{(\epsilon-1)/\epsilon} + \frac{m_1^{(\epsilon-1)/\epsilon}}{1+r} \tag{19}$$

An equilibrium under TEBS is a quintuple $(\tau_1^*, \tau_2^*, m_0^*, m_1^*, \pi_2^*)$ that satisfies the FA's first order conditions (15) and (16), the government's budget constraint (19), the money demand Eq. (13) and the devaluation rate π_1 set by the CB.

In order to obtain the equilibrium level of transfers, note that under TEBS, given that π_1 and therefore m_0 are exogenous, $\partial m_0/\partial \tau_t = 0$, $t = 1,2$. To obtain $\partial m_1/\partial \tau_t$ we differentiate budget constraint (19) and obtain

$$\frac{\partial m_1}{\partial \tau_1}\left(\frac{1}{1+r}\right) = \frac{\partial m_1}{\partial \tau_2} = -m_1^{1/\epsilon}\left(\frac{\epsilon}{1-\epsilon}\right) \tag{20}$$

Combining Eqs. (15), (16), (20) we have

$$u'(\tau_{1,\mathrm{TEBS}}^*) = u'(\tau_{2,\mathrm{TEBS}}^*)\beta(1+r) = \left(\frac{1-\alpha}{\alpha}\right)\left(\frac{\epsilon}{1-\epsilon}\right)\beta(1+r) \tag{21}$$

Since $u''(\tau_t) < 0$, Eq. (21) uniquely determines the level of $\tau_{t,\mathrm{TEBS}}^*$, $t = 1,2$. Substituting these values of τ_t and the value of $m_0(\pi_1)$ implied by Eq. (13) into budget constraint (19) yields a unique level of m_1. Lastly, the money demand (13) uniquely determines π_2. This completes the characterization of equilibrium under TEBS.

Note that $\tau_{t,\mathrm{TEBS}}^*$, $t = 1,2$, is not a function of π_1. This is because in the case of C.E.S. utility the difference between (a) the marginal cost of lower money balances m_1 and (b) the marginal benefit of higher inflationary revenue, is independent of the actual level of m_1.[19]

3.2. Fiscal policy under money-based stabilization

Under TMBS, at the end of period 0 the CB announces μ_1 and the FA announces τ_1 and τ_2. Once again, and using their expectations of π_1 that correspond to these announcements, agents attempt to rearrange their portfolios. The situation is slightly more complex than under TEBS, for under TMBS the CB does not intervene in the foreign exchange market, so the market can only clear as a result of an exchange rate movement at time zero. Let m_0^* be the stock of real

[19] Mechanically, both the marginal utility cost and the marginal revenue benefit are of the form $m_1^{-1/\epsilon}$.

balances agents want to hold given the announcements. It must be the case that $m_0^* = (1-\pi_0)m_{0^-}$, with $\pi_0 \equiv (E_0 - E_{0^-})/E_0$. Hence, in this case private agents experience a capital loss (gain) of magnitude $\pi_0 m_{0^-}$ that has a counterpart in an equal gain (loss) for the government. There was no such effect on the government budget constraint in the TEBS case. In order to carry out a consistent comparison of stabilization schemes under alternative nominal anchors it is necessary to offset this additional revenue-raising capacity of the government under TMBS. We assume that at the end of period 0 the government gives a rebate to agents equal to

$$s_0 = \pi_0 m_{0^-} \tag{22}$$

Private agents, of course, acting atomistically, do not internalize the effect their demand for real balances has on the size of the rebate. Since m_0^* is all the real domestic balances they wish to hold, agents use the government transfer to buy bonds. Thus, the stock of interest-yielding assets they carry into period 1 is $b_0 = b_{0^-} + s_0$. By substituting this and Eq. (22) into budget constraint (8) it follows that the government budget constraint is given by Eq. (19). Hence, under TMBS the FA faces the same intertemporal budget constraint as under TEBS.

An equilibrium under TMBS is a sextuple $(\tau_1^*, \tau_2^*, m_0^*, m_1^*, \pi_1^*, \pi_2^*)$ that satisfies the FA's first order condition (15) and (16), the government budget constraint (19), and the two money demand equations, one of which is Eq. (13). Since π_1 is now an endogenous variable, we need another equation to determine the system. From the definition of real balances we get the identity

$$m_1(1-\mu_1) \equiv m_0(1-\pi_1) \tag{23}$$

where μ_1 is exogenously set by the CB. Using Eqs. (13) and (23) we obtain

$$\frac{\partial m_0}{\partial m_1} = \frac{1-\mu_1}{(1+r) + [(1-\epsilon)/\epsilon]i_1} \tag{24}$$

Differentiating Eq. (19) we have that

$$\frac{\partial m_1}{\partial \tau_1} = \frac{\partial m_1}{\partial \tau_2}(1+r) = -\left(\frac{\epsilon}{1-\epsilon}\right)\left[m_0^{-1/\epsilon}\left(\frac{\partial m_0}{\partial m_1}\right) + \frac{m_1^{-1/\epsilon}}{1+r}\right] \tag{25}$$

Finally, combining Eqs. (13), (15), (16), (24), (25) we have

$$\begin{aligned} u'(\tau_{1,\mathrm{TMBS}}^*) &= u'(\tau_{2,\mathrm{TEBS}}^*)\beta(1+r) \\ &= \left(\frac{1-\alpha}{\alpha}\right)\beta(1+r)\left(\frac{\epsilon}{1-\epsilon}\right)\left[\frac{1+x}{1+x\,\beta(1+r)}\right] \end{aligned} \tag{26}$$

where

$$x \equiv \left(\frac{1}{\beta}\right)\left(\frac{i_1^*}{i_2^*}\right)\left[\frac{(1-\mu_1)}{(1+r) + [(1-\epsilon)/\epsilon]i_1^*}\right]$$

The equilibrium $(\tau^*_{1,\mathrm{TMBS}}, \tau^*_{2,\mathrm{TMBS}}, m^*_0, m^*_1, \pi^*_1, \pi^*_2)$ is the solution to the two money demand Eq. (13) and to (19), (23), and (26).

4. Comparing alternative stabilization schemes

In this section we compare the fiscal discipline exerted by TEBS and TMBS, and the welfare levels attained by the representative agent under each program.

4.1. Fiscal discipline

We define fiscal discipline in terms of the present value of net fiscal transfers made by the FA. Of course, changes in transfers are reflected one-to-one in changes in the fiscal deficit. Thus, the stabilization scheme that induces more fiscal discipline is the one that induces a lower value for $\tau_1 + \tau_2(1+r)^{-1}$.

A comparison of Eqs. (26) and (21) provides an unambiguous ranking of the levels of fiscal discipline under the two stabilization schemes. To see this, note that the R.H.S. of Eq. (26) is equal to the R.H.S. of Eq. (21) multiplied by the term in square brackets. The term in square brackets in Eq. (26) is equal to one if $\beta = (1+r)^{-1}$, greater than one when $\beta(1+r) < 1$, and smaller than one when $\beta(1+r) > 1$. Since $u''(\tau_t) < 0$ by assumption, it follows that the ranking of $\tau^*_{t,\mathrm{TEBS}}$ and $\tau^*_{t,\mathrm{TMBS}}$ depends only on the value of $\beta(1+r)$. Moreover, since the time profile of transfers is the same under both stabilization schemes, if $\tau^*_{1,\mathrm{TEBS}} > \tau^*_{1,\mathrm{TMBS}}$ then $\tau^*_{2,\mathrm{TEBS}} > \tau^*_{2,\mathrm{TMBS}}$, and vice versa. We state this result in the following proposition:

Proposition 1. *The ranking of fiscal discipline induced by alternative stabilization schemes is only a function of the ratio of the fiscal authority's discount factor β to the gross interest rate $1+r$.*

- *Both schemes induce the same degree of fiscal discipline if $\beta = (1+r)^{-1}$*
- *Money-based programs induce more discipline if fiscal authorities are impatient: $\beta < (1+r)^{-1}$*
- *Exchange rate-based programs induce more discipline if fiscal authorities are patient: $\beta > (1+r)^{-1}$.*

To clarify the intuition behind this proposition, one can think of the choice of a nominal anchor as a specific rule to distribute the burden of the inflation tax intertemporally. Consider the experiment of increasing the level of fiscal transfers. Under TEBS, the entire increase in the inflation tax necessary to finance the fiscal expansion is shifted to the future. Under TMBS, this necessary increase in inflationary finance is spread between the present and the future. This spreading

occurs because under rational expectations and floating rates, higher money creation tomorrow means higher inflation today as well as tomorrow. If fiscal authorities strongly discount the future ($\beta(1+r)<1$), TEBS implements an intertemporal distribution of the inflation tax burden which is closer to the FA's preferred one. This implies that the marginal cost of financing an increase in transfers using money financing is lower under TEBS than under TMBS. As a result, $\tau^*_{t,\mathrm{TMBS}} < \tau^*_{t,\mathrm{TEBS}}$ for both t.

To sum up, the source of the discipline effect in our model is the intertemporal allocation of the inflation tax burden induced by the alternative stabilization schemes. The less attractive this intertemporal allocation is to the FA, the stronger the fiscal discipline under the scheme. In particular, when the FA discounts the future at a rate higher than the world rate of interest, TMBS provides more discipline.

Notice that, interestingly, Proposition 1 holds for any level of π_1 and μ_1, regardless of how tight or ambitious the temporary stabilization program is. Moreover, the connection between the ''tightness'' of each program and the degree of fiscal discipline it induces is revealing. We see immediately from Eq. (21) that $\tau^*_{t,\mathrm{TEBS}}$ does not depend on π_1, so that tightening up the temporary stabilization program by slowing down the rate of nominal devaluation does not affect fiscal discipline. By contrast, we show in Appendix A that $\partial\tau^*_{t,\mathrm{TMBS}}/\partial\mu_1 > 0$, for $t = 1,2$. Mechanically, this comes simply from using money demand function (13) to express Eqs. (19), (17), (23), (26) in terms of τ_1 and i_1, with μ_1 as an exogenous parameter. Total differentiation then yields the desired result. The following proposition summarizes this result:

Proposition 2. *A tighter TEBS does not affect the degree of fiscal discipline. A tighter TMBS increases fiscal discipline.*

The result presented here is somewhat extreme, because $\tau^*_{t,\mathrm{TEBS}}$, $t = 1,2$, does not adjust at all. The general principle, however, should still hold in more general formulations: because a FA that discounts the future heavily would prefer to defer the inflationary costs until the second period, and because it can do so more readily under TEBS than under TMBS, the latter prompts the FA to carry out greater adjustment.

4.2. Welfare comparisons

Next we address the issue of which stabilization scheme generates higher welfare for private agents. Using Eq. (19) to eliminate the term

$$\left[m_0^{(\epsilon-1)/\epsilon} + \left(\frac{1}{1+r}\right) m_1^{(\epsilon-1)/\epsilon}\right]$$

from the private agent's payoff function, it follows that the indirect utility function of the representative agent is

$$V^{\mathrm{PA}} = v(\bar{c}) + \frac{v(\bar{c})}{1+r} + \left(\frac{\epsilon}{\epsilon - 1}\right)\left[(1+r)(b_{0^-} + m_{0^-}) + \tau_1 + \frac{\tau_2}{1+r}\right] \tag{27}$$

Since $\epsilon < 1$ by assumption, and all variables other than the τ_t's in Eq. (27) are exogenous, it follows that V^{PA} is decreasing in τ_t, $t = 1,2$. Thus, using the ranking of the τ_t's for different parameter values provided by Proposition 1, we can derive the following result:

Proposition 3. *The welfare attained by private agents under alternative stabilization schemes is only a function of the ratio of the fiscal authority's discount factor β and the gross interest rate $1 + r$.*

- *Both schemes induce the same welfare if $\beta = (1+r)^{-1}$*
- *Money-based programs generate more welfare if fiscal authorities are impatient: $\beta < (1+r)^{-1}$*
- *Exchange rate-based programs generate more welfare if fiscal authorities are patient: $\beta > (1+r)^{-1}$*

The intuition for this result is very simple. Given that the individual's discount rate is always the same as the world rate of interest, and given that the revenue from money creation in each period $m_t^{(\epsilon-1)/\epsilon}$ is of the same form as the instantaneous utility function, the private agent is indifferent about the intertemporal allocation of the inflation tax. She only cares about the present value of this tax. Since this present value is strictly increasing in the level of transfers, it follows that the higher the level of transfers in any given stabilization scheme, the lower the welfare of the private agent. In particular, when TMBS leads the FA to set a lower level of transfers than it would under TEBS, welfare is higher under TMBS.

Of course, the extreme simplicity of this result is due to the specification of preferences, but the thrust of the result would hold more generally. Under other types of preferences, the agent would care about the intertemporal allocation of the inflation tax as well as its present value. As long as the instantaneous utility function was concave, the regime that provided more fiscal discipline would also yield higher private welfare if the time path of real money balances that it induced were ''smoother''. But if we think that TMBS is likely to provide more fiscal discipline, this qualification should not create much of a problem. Since under TMBS the exchange rate can move in anticipation of future events, the time path of real balances will be smoother under TMBS than under TEBS for any degree of fiscal discipline. Therefore, if individual preferences are for smoothing the path of

money holdings, this fact provides an additional channel through which TMBS can provide higher welfare than TEBS.[20]

The next result is a straightforward implication of Proposition 2 and the fact that welfare is a strictly decreasing function of the degree of fiscal discipline:

Proposition 4. *A tighter TEBS does not affect individual welfare. By contrast, a tighter TMBS increases individual welfare.*

Notice that these results stand in sharp opposition to those of Calvo (1986a), (1991), who argued that the best temporary stabilization is no temporary stabilization at all. In our context that is not true for either exchange rate regime. Under fixing, a temporary stabilization has no effect on welfare, while under a floating exchange rate regime and in the realistic case of impatient policy makers, reducing money growth causes individual welfare to increase relative to the pre-stabilization level. The difference is that Calvo took fiscal policy as exogenous and focused on the welfare costs of intertemporal distortions in consumption and money-holdings, while our model focuses on the beneficial effects of fiscal discipline and skirts the issue of costly intertemporal distortions. Of course, the full truth lies in a model that incorporates both effects (and many other relevant ones, such as the endogeneity of output). However, we regard it as important to highlight a previously neglected channel through which temporary stabilizations can affect individual welfare.

5. Fiscal adjustment in Latin America

In this section we test the hypothesis that in Latin America the mean improvement in the fiscal balance has been greater under money-based stabilization programs than under exchange rate-based programs. We study the 22 serious stabilization episodes in Latin America. The list includes all the widely-studied high-inflation stabilization experiences in the region from 1960 to 1994,[21] and it covers all the Latin American episodes which are classified as stabilizations by Easterly (1996).[22]

[20]Calvo (1991) makes the same point in a slightly different context (one in which fiscal policy is exogenous), arguing that the welfare losses from ''temporary stabilization'' are likely to be lower under TEBS than under TMBS.

[21]See, for example, the wide-ranging and well known volumes edited by Bruno et al. (1988), (1991), and the influential papers by Helpman and Leiderman (1988), Kiguel and Liviatan (1988), (1992a), (1992b), Vegh (1992) and Calvo and Vegh (1994). A brief description of each of the 22 stabilizations was included in the working paper version of this article, and is available from the authors upon request.

[22]Easterly (1996) classifies an episode as a stabilization if it involved a shift from a situation of over 40% inflation for at least 2 years to a situation of under 40% inflation for at least 2 years.

All of the included episodes are reasonably comprehensive and serious stabilization attempts. Isolated measures widely perceived as stop-gaps cannot influence fiscal decisions, which are typically made before such measures are taken, and remain in place after they are abandoned. This is why we have excluded the sequence of mini-plans implemented in Argentina after the collapse of the 1985 *Plan Austral*, and in Brazil after the collapse of the 1986 *Plan Cruzado*.[23] We also leave out populist expansionary policies that have appropriated the label of ''stabilization,'' such as those enacted in Argentina under Perón and Isabelita, in Chile under Allende, and in Nicaragua under the Sandinistas.

As indicators of the fiscal situation, we present in Table 1 the nominal and primary balances of the consolidated Public Sector for each episode. The primary deficit is equal to the nominal deficit minus interest payments. Standard sources such as the Government Finance Statistics of the IMF generally provide data only for the nominal balance of the Central Government, and do not include information about public enterprises, decentralized agencies, etc. Therefore, we have used as the main source of data a comprehensive study by the United Nations Economic Commission for Latin America and the Caribbean, summarized in ECLAC (1992), (1993), (1995), whose coverage is broader and more comprehensive. For each episode we provide data for five years: year t, the year in which the stabilization took place, and years $t-2$, $t-1$, $t+1$, and $t+2$.

Note that these data overstate the relative degree of fiscal discipline induced by exchange rate-based stabilizations for two reasons. First, it is clear that exchange rate-based stabilizations reduce inflation more swiftly than money-based stabilizations, since the stable exchange rate immediately anchors down the price of tradeables. If the tax system is not indexed, this anchoring substantially increases the real value of tax revenue, implying that under exchange rate-based programs the fiscal adjustment is smaller than what the data suggest. Second, exchange rate-based programs are associated with early booms and later recessions, while money-based programs are associated with early recessions.[24] As a result, exchange rate-based programs have an additional channel through which to improve the fiscal balance in period $t+1$.

These effects increase the difficulty of finding evidence to support our hypothesis that money-based stabilization programs improve the fiscal balance more than exchange rate-based stabilizations. Nonetheless, Table 1(a) and Fig. 1 reveal three striking facts which provide such evidence. First, between the year in

[23]In the second half of the 1980s under the stewardship of the Radical Party, Argentina implemented the February Plan, the Primavera I and Primavera II Plans, and the Austral II Plan. After the advent of the Peronist Administration, the short-lived Bunge-Born and Bonex plans were put into effect. Brazil in the same period tried the Cruzado II, the Bresser Plan and the Summer Plan. As this proliferation of plans and labels suggests, these were not comprehensive attempts at bringing down inflation. These experiences are discussed in papers by Heymann, Cardoso and Kiguel-N. Liviatan, all in the volume edited by Bruno et al. (1991).

[24]See Calvo and Vegh (1994).

Table 1
(a) Fiscal balance in exchange rate-based programs[a]; (b) fiscal balance in money-based programs[a]

Episode	$t-2$	$t-1$	t	$t+1$	$t+2$
(a) Fiscal balance in exchange rate-based programs					
Argentina (67)					
Primary balance	−2.8	−3.6	−1.8	−1.7	−1.2
Nominal balance	−2.9	−3.7	−1.8	−1.7	−1.3
Argentina (78)					
Primary balance		−2.7	−3.5	−3.4	−4.0
Nominal balance		−4.7	−6.5	−6.5	−7.5
Argentina (85)					
Primary balance	−9.2	−7.0	−0.6	−0.9	−3.6
Nominal balance	−15.2	−11.9	−6.0	−4.7	−7.2
Argentina (91)					
Primary balance	−1.3	−0.5	1	1.4	1
Nominal balance	−2.8	−1.7	−0.8	−0.1	−0.1
Brazil (64)					
Primary balance	−4.3	−4.2	−3.2	−1.6	−1.1
Nominal balance	−4.3	−4.2	−3.2	−1.6	−1.1
Brazil (86)					
Primary balance	3.3	2.6	1.8	1.7	1.3
Nominal balance	−5.0	−5.8	−2.5	−6.0	−4.8
Chile (78)					
Primary balance	2.8	1.0	3.0	5.8	6.2
Nominal balance	1.2	0.0	1.4	4.6	5.4
Ecuador (92)					
Primary balance	1.8	1.5	2.4	2.0	2.0
Nominal balance	0.6	−1.0	−1.7	−0.4	−0.2
Israel (85)					
Primary balance	−3.4	−11.1	9.0	12.2	7.4
Nominal balance	−8.1	−18.9	−2.6	1.9	−1.3
Mexico (87)					
Primary balance	3.5	2.1	5.3	7.5	7.6
Nominal balance	−8.0	−14.5	−14.4	−9.2	−5.4
Nicaragua (91)					
Primary balance					
Nominal balance	−6.7	−17.1	−7.5	−7.6	−7.3
Peru (85)					
Primary balance	−4.3	−0.7	3.1	−1.8	−4.0
Nominal balance	−10.2	−6.6	−2.7	−5.1	−6.6
Uruguay (68)					
Primary balance	0.2	−2.3	−0.5	−1.2	0.0
Nominal balance	−0.7	−3.0	−1.7	−2.5	−1.3
Uruguay (78)					
Primary balance	−1.7	0.0	−0.5	1.0	0.5
Nominal balance	−3.0	−1.4	−1.5	0.3	0.1

Table 1. Continued

Episode	$t-2$	$t-1$	t	$t+1$	$t+2$
(b) Fiscal balance in money-based programs					
Bolivia (85)					
Primary balance	−16.1	−20.8	−9.3	−1.2	−6.2
Nominal balance	−18.0	−23.6	−10.9	−3.0	−8.2
Brazil (90)					
Primary balance	1.3	−1.1	2.1	4.2	1.3
Operational balance[b]	−5.0	−6.9	1.2	1.4	−2.1
Chile (75)					
Primary balance	−9.8	−5.6	1.8	2.8	1.0
Nominal balance	−10.5	−6.5	0.2	1.2	0.0
Costa Rica (82)					
Primary balance	−6.5	−1.8	−0.3	5.9	5.7
Nominal balance	12.7	−4.6	−6.9	−0.9	−0.2
Dominican Republic (90)					
Primary balance	−4.3	−1.9	−1.0	4.2	4.6
Nominal balance	−6.9	−5.9	−5.0	0.1	1.6
Ecuador (83)					
Primary balance	−4.8	−4.3	−2.5	−0.8	2.0
Nominal balance	−0.1	−2.5	−1.3	0.0	0.2
Ecuador (88)					
Primary balance	−2.3	−2.3	0.0	1.9	1.8
Nominal balance	−5.0	−9.6	−5.3	−1.6	0.6
Peru (90)					
Primary balance	−3.7	−3.6	0.1	1.7	0.9
Nominal balance	−7.5	−7.1	−4.5	−1.6	−1.8
Venezuela (89)					
Primary balance	2.5	−5.7	5.5	6.9	4.3
Nominal balance	−4.2	−8.4	1.1	0.9	0.6

[a]As a percentage of GDP.
[b]For Brazil (90) we include the operational deficit because the nominal is distorted due to extremely high inflation. The numbers for the nominal deficit are −53.0, −83.1, −26.9, −23.7 and −41.6.

which the plan was launched (year t) and the following year (year $t+1$) the primary fiscal balance deteriorated *only* under exchange rate-based programs (five cases). Second, the episodes in which the fiscal balance improved by more than two percentage points of GDP include four out of nine money-based programs and only two out of 12 exchange rate-based programs. Third, the mean change in the fiscal balance-to-GDP ratio between t and $t+1$ is 3.2 percentage points for money-based programs, as opposed to only 0.2 percentage points for exchange rate-based programs. A similar pattern arises when considering the nominal balance (which includes interest payments). In this case the mean change in the fiscal balance-to-GDP ratio between t and $t+1$ is 3.1 percentage points for money-based programs, and 0.6 percentage points for exchange rate-based programs.

In order to test the null hypothesis that the mean improvement in the fiscal

balance is greater under money-based than under exchange rate-based stabilizations, we ran several OLS regressions of the following form:

$$\Delta FB = \alpha + \beta DU_m + \gamma Controls, \tag{28}$$

where ΔFB is the change in the fiscal balance-to-GDP ratio and DU_m is a dummy that takes the value of one for money-based programs. We consider two concepts of fiscal balance: the ratios of nominal and primary balances to GDP.

For each concept we consider three measures of ΔFB. First, we consider the change between years $t+1$ and t (recall that t is the year in which the stabilization was launched). Second, to control for the fact that in some cases the fiscal balance during year t might reflect the measures of fiscal restraint undertaken (for instance, because the program was introduced very late in the year), we also consider the change in FB between $t-1$ and $t+1$. Finally, we also consider the change between FB's average for $t-1$ and t, and its average for $t+1$ and $t+2$.

We use three controls in the regressions: the log change in the terms of trade, the change in the US three month T-bill interest rate, and the lagged level of the fiscal balance-to-GDP ratio. The first variable controls for the fact that changes in the terms of trade might affect the fiscal balance in cases where governments' fiscal revenues are heavily dependent on the export of primary commodities such as oil or copper. Second, the change in the US interest rate controls for changes in debt service. We use this control only in the nominal fiscal balance equations. We include the third control variable because some researchers argue that if the initial fiscal deficit is large, it is relatively easy to reduce because it contains substantial fat. On the other hand, one could argue against this that high fiscal deficits might reflect a structural weakness in the fiscal process of the country, thus rendering deficit reduction unlikely regardless of the exchange rate regime.

The regression results are shown in Tables 2 and 3. For future reference we reproduce here the regression equation that corresponds to the primary fiscal balance that we will use as our benchmark:

$$\begin{array}{ccccccc} \Delta PFB_{t+1,t} & = & 0.07 & + & 3.18DU_m & - & 2.08\Delta TT_{t+1,t} \\ & & (0.50) & & (1.03)^{**} & & (7.30) \\ & & R^2 = 0.34 & & \bar{R}^2 = 0.27 & & N = 21 \end{array} \tag{29}$$

According to this equation, the improvement in the fiscal balance-to-GDP ratio averages 3.18 percentage points higher under money-based programs than under exchange rate-based programs. Moreover, this difference is different from zero at the 1% level of significance.

The estimated coefficient of the dummy turns out to be positive and significant at the 5% level for all the fiscal balance concepts used and for all the time periods considered. We also ran the battery of regressions shown in Tables 2 and 3 using the ratios of nominal and primary balances to trend GDP in order to partially eliminate cyclicality. Again, in all cases the dummy enters positively and

Table 2
Regression results

	Dependent variable: Change in the primary fiscal balance between:								
	t and $t+1$			$t-1$ and $t+1$			Ave. $(t-1,t)$ and ave. $(t+1,t+2)$		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Money-based dummy	3.05**	3.18**	2.27**	6.19**	6.22**	4.02**	4.23**	4.25**	2.88**
	(0.84)	(1.03)	(0.96)	(1.83)	(1.85)	(1.60)	(0.93)	(0.99)	(0.88)
Δ% terms of trade for		−2.08	1.29		−3.46	7.35		−1.64	7.64
the respective period		(7.30)	(5.96)		(9.60)	(7.26)		(7.22)	(4.80)
Deficit in $t-1$			−0.17						
			(0.13)						
Deficit in $t-2$						−0.51*			−0.30*
						(0.24)			(0.15)
Constant	0.19	0.07	0.07	1.88**	1.67**	1.98*	0.87*	0.78	1.06
	(0.44)	(0.50)	(0.50)	(0.50)	(0.65)	(0.94)	(0.44)	(0.53)	(0.64)
R^2	0.34	0.34	0.41	0.42	0.43	0.54	0.45	0.45	0.51
Adjusted R^2	0.30	0.27	0.30	0.39	0.36	0.45	0.42	0.39	0.42
N	21	21	21	21	21	20	21	21	20[a]

Newey–West heteroskedasticity-consistent standard errors in parentheses.
*,**Different from zero at the 10% and 5% levels of significance, respectively.
[a]The observation $t-2$ for Argentina (1978) is not available.

Table 3
Regression results

	Dependent variable: Change in the nominal fiscal balance between:								
	t and $t+1$			$t-1$ and $t+1$			Ave. $(t-1/t)$ and ave. $(t+1/t+2)$		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Money-based dummy	2.45**	3.18**	2.69**	5.26**	4.92**	3.63**	3.41**	3.52**	3.02**
	(0.98)	(0.85)	(0.87)	(2.02)	(1.92)	(1.44)	(1.09)	(1.28)	(1.12)
Δ% terms of trade for		−6.05	−2.26		−6.06	1.37		−4.10	7.93
the respective period		(5.31)	(7.34)		(10.17)	(7.17)		(6.83)	(5.83)
U.S. T-bill rate		0.29	0.37		−0.18	0.42		0.05	0.59*
		(0.29)	(0.35)		(0.31)	(0.37)		(0.26)	(0.31)
Deficit in $t-1$			−0.15						
			(0.13)						
Deficit in $t-2$						−0.63**			−0.51**
						(0.20)			(0.18)
Constant	0.65	0.20	−0.50	2.70**	2.34**	0.34	1.80**	1.63*	−0.27
	(0.48)	(0.54)	(0.91)	(0.73)	(1.08)	(1.43)	(0.56)	(0.82)	(1.16)
R^2	0.21	0.26	0.33	0.30	0.36	0.56	0.30	0.30	0.55
Adjusted R^2	0.17	0.14	0.17	0.27	0.25	0.45	0.26	0.18	0.43
N	22	22	22	22	22	21	22	21	20[a]

Newey–West heteroskedasticity-consistent standard errors in parentheses.
*,**Different from zero at the 10 and 5% levels of significance, respectively.
[a]The observation $t-2$ for Argentina (1978) is not available.

significantly at the 5% level.[25] Therefore, we can conclude that the hypothesis that the improvement in the fiscal balance is greater under money-based programs cannot be rejected.

To check whether this result is robust to changes in the sample we run the benchmark regression (29) for eight different samples (Table 4 presents the results). In the first sample we add the Israeli stabilization of 1985, an important example of a successful exchange rate-based program that improved the fiscal balance. As Column (2) of Table 4 shows, the dummy enters positively and significantly.

Second, although in the 1985 Bolivia episode the Central Bank held daily auctions at which agents could buy and sell foreign exchange freely, the exchange rate remained stable after an initial depreciation. This observation has led some researchers to argue that the exchange rate acted as a de facto anchor. Column (3) of Table 4 shows the regression results when the money-based dummy is assumed to take the value of zero for Bolivia, and thus Bolivia is considered as having undergone an exchange rate-based stabilization. Still, the dummy enters positively and significantly.

Third, it may be argued that the 1985 Bolivia episode should not be part of the

Table 4
Robustness

	Dependent variable: Change in the primary fiscal balance between t and $t+1$							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Money-based dummy	3.18**	2.87**	2.09**	1.83**	2.91**	2.94**	2.82**	3.62**
	(1.03)	(1.09)	(0.84)	(0.81)	(0.94)	(1.09)	(1.14)	(0.94)
Δ% terms of trade	−2.08	−0.80	−2.42	6.77	−6.53	−2.19	−2.17	−4.46
	(7.30)	(7.71)	(9.19)	(5.58)	(4.97)	(7.42)	(7.50)	(6.64)
Constant	0.07	0.38	0.63	0.58	0.36	0.07	0.07	−0.35
	(0.50)	(0.50)	(0.42)	(0.37)	(0.50)	(0.51)	(0.51)	(0.33)
R^2	0.34	0.29	0.12	0.36	0.41	0.30	0.30	0.40
N	21	22	21	20	20	20	20	20[a]

(1) Benchmark regression, column (2) of Table 4.
(2) Adding Israel (1985) to the sample as an exchange rate-based program.
(3) Considering Bolivia (1985) as an exchange rate-based program.
(4) Eliminating Bolivia (1985) from the sample.
(5) Eliminating Peru (1985) from the sample.
(6) Eliminating the Dominican Rebublic (1990) from the sample.
(7) Eliminating Costa Rica (1982) from the sample.
(8) Eliminating Chile (1978) from the sample.[a]The observation $t-2$ for Argentina (1978) is not available.

[25]The results are available from the authors. We computed trend GDP by regressing GDP on a constant and a linear time trend with a break in 1975. We did not cyclically adjust the fiscal deficit because we could not find sufficiently long series for fiscal expenditures and revenues.

sample at all because it was a full blown hyperinflation. Column (4) of Table 4 shows regression results when Bolivia is eliminated from the sample. The dummy still enters positively and significantly.

Lastly, we address the objection that any one episode in which there was an extreme change in the fiscal balance could be driving the result. Columns (4) through (8) show the regression results when each of the five episodes in which the change in the primary fiscal balance between t and $t+1$ was greater than one standard deviation is eliminated. These episodes are Bolivia (1985), Peru (1985), Dominican Republic (1990), Costa Rica (1982) and Chile (1978). In each case, when these episodes are eliminated one by one, the dummy still enters positively and significantly.

6. Conclusions

In Latin America in the last 30 years, it is hard to find a country that undertook an exchange rate-based stabilization, while still suffering from a fiscal problem, and managed to correct this problem in the course of the program. The same is not true of countries that undertook money-based stabilization programs. This stylized fact stands in contrast to the conventional wisdom that exchange rate-based stabilizations provide more fiscal discipline than money-based stabilizations.

In this paper we offer a theoretical rationale for the fact that money-based programs induce more fiscal discipline. We argue that under temporary stabilization the choice of nominal anchor is essentially a choice of when to collect the inflation tax necessary to cover the fiscal deficits. Under an exchange rate-based program the increase in inflation necessary to cover an increase in the fiscal deficit is pushed to the future. In contrast, under a money-based program the increase in inflation is spread out between the present and the future. In turn, this choice determines the costs fiscal authorities must pay if they want to increase the deficit. If fiscal authorities are impatient, flexible rates provide more fiscal discipline; the opposite is true if fiscal authorities are relatively patient.

Our claim is not that fiscal discipline can be achieved only under floating exchange rate regimes. Fiscal discipline depends on both economic fundamentals – preferences, government access to capital markets – and on political fundamentals – underlying institutions, budget-making rules and degree of distributive tensions. Our claim is simply that in situations where there is no fiscal discipline to begin with, fixed rates per se do not guarantee it; conversely, flexible rates may tilt the balance in favor of greater discipline because of the immediacy of the punishment associated with imprudent fiscal policies under flexible rates.

A more general policy implication of this paper is that, if lack of fiscal discipline is a more acute problem than lack of monetary discipline, then money-based stabilizations are more appropriate; conversely, if lack of discipline by the monetary authorities is the more acute problem, then exchange rate-based

programs – which under capital mobility renders the money supply endogenous and therefore beyond the control of policy makers – may be more appropriate.

7. Sources

Brazil (64) *Source:* Kiguel and Liviatan (1989). *Note:* Figures are for the consolidated public sector.

Argentina (67) *Source:* Dornbusch and de Pablo (1988). *Note:* Figures are for the central government.

Uruguay (68) *Source:* Viana (1990). *Note:* Figures are for the central government.

Chile (75) *Source:* Ministerio de Hacienda (1990). *Note:* Figures are for the central government. Data on interest payments obtained from the Interamerican Development Bank ''State of Development in Latin America'' (various issues).

Argentina (78) *Source:* ECLAC Electronic Fiscal Database. *Note:* Figures are for the non-financial public sector.

Chile (78) *Source:* ECLAC Electronic Fiscal Database. *Note:* Figures are for the non-financial public sector.

Uruguay (78) *Source:* Banco Central del Uruguay, Boletin Estadistico (various issues). *Note:* Figures are for the central government.

Costa Rica (82) *Source:* ECLAC (1992). *Note:* Figures are for the non-financial public sector.

Ecuador (83) *Source:* For the nominal Balance ECLAC (1992) and for the primary balance CEPLAES-ILDIS (1993), (1994). *Note:* Figures are for the non-financial public sector.

Argentina (85) *Source:* ECLAC Electronic Fiscal Database. *Note:* Figures are for the non-financial public sector.

Bolivia (85) *Source:* ECLAC (1992). *Note:* Figures are for the non-financial public sector.

Israel (85) *Source:* Bank of Israel, Annual Report (various issues). *Note:* Figures are for the consolidated public sector.

Peru (85) *Source:* ECLAC (1992). *Note:* Figures are for the non-financial public sector.

Brazil (86) *Source:* ECLAC Electronic Fiscal Database. *Note:* Figures are for the consolidated public sector. The operational balance excludes the inflationary component of interest payments.

Mexico (87) *Source:* ECLAC (1992). *Note:* Figures correspond to the non-financial public sector.

Ecuador (88) *Source:* For the nominal balance ECLAC (1995) and for the primary balance CEPLAES-ILDIS (1993), (1994). *Note:* Figures are for the non-financial public sector.

Venezuela (89) *Source:* Veneconomy (1992). *Note:* Figures are for the consolidated public sector.

Brazil (90) *Source:* ECLAC (1995). *Note:* Figures are for the consolidated public sector. Both the operational and primary balance exclude the inflationary component of interest payments. Data on interest payment obtained from Barbosa and Giambiagi (1994).

Dominican Republic (90) *Source:* Medeiros (1993). *Note:* Figures are for the consolidated public sector.

Peru (90) *Source:* ECLAC Electronic Fiscal Database. *Note:* Figures are for the non-financial public sector.

Argentina (91) *Source:* ECLAC (1995). *Note:* Figures are for the non-financial public sector. Implicit interest expenses (primary balance) estimated on the basis of data from the Ministry of the Economy and the Central Bank of Argentina.

Nicaragua (91) *Source:* ECLAC (1995). *Note:* Figures are for the central government.

Ecuador (92) *Source:* For the nominal balance ECLAC (1995) and for the primary balance CEPLAES-ILDIS (1993), (1994). *Note:* Figures are for the non-financial public sector.

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Appendix A

Proof of Proposition 4. Using Eq. (17) we can write $\tau_2 = \psi(\tau_1)$ where $\psi'(\tau_1) > 0$. We can therefore define

$$\tau_1 + \frac{\tau_2}{1+r} = \tau_1 + \frac{\psi(\tau_1)}{1+r} \equiv \Psi(\tau_1) \tag{A.1}$$

where $\Psi'(\tau_1) > 0$ as well. It follows that the system of Eq. (19), (23) and (26) in the text can be written compactly as

$$B(\tau_1^*, i_1^*, \mu_1) \equiv (1+r)(b_{0^-} + m_{0^-}) + \Psi(\tau_1^*) - (i_1^*)^{1-\epsilon}[1 + (1+r)^{-1}\sigma h(i_1^*, \mu_1)] = 0 \tag{A.2}$$

$$F(\tau_1^*, i_1^*, \mu_1) \equiv u'(\tau_1^*) - \left(\frac{1-\alpha}{\alpha}\right)\left(\frac{\epsilon}{1-\epsilon}\right)\left[\frac{1 + \beta\sigma h(i_1^*, \mu_1)}{1 + (1+r)^{-1}\sigma h(i_1^*, \mu_1)}\right] = 0 \tag{A.3}$$

where

$$h(i_1^*, \mu_1) \equiv \left[\frac{1 + r - i_1^*}{1 - \mu_1}\right]^{(\epsilon-1)/\epsilon} > 0 \tag{A.4}$$

and where $\sigma > 0$ is the elasticity of $(i_2^*)^{1-\epsilon}$ with respect to $(i_1^*)^{1-\epsilon}$ at the initial equilibrium.

Totally differentiating Eqs. (A.2) and (A.3) we see that

$$\frac{\mathrm{d}\tau_1^*}{\mathrm{d}\mu_1} = \frac{(B_{\mu_1}/B_{i_1^*}) - (F_{\mu_1}/F_{i_1^*})}{(F_{\tau_1^*}/F_{i_1^*}) - (B_{\tau_1^*}/B_{i_1^*})} \tag{A.5}$$

where the subscripts represent partial derivatives. Second order conditions of the FA's problem can easily be shown to guarantee that the denominator of the R.H.S. of Eq. (A.5) is positive. The numerator, on the other hand, is equal to

$$h(i_1^*, \mu_1)^{\epsilon/(\epsilon-1)}\left\{\frac{\epsilon[1 + r + h(i_1^*, \mu_1)][1 + r - i_1^*]}{\epsilon[1 + r + h(i_1^*, \mu_1)][1 + r - i_1^*] + h(i_1^*, \mu_1)}\right\} > 0 \tag{A.6}$$

We conclude that $\mathrm{d}\tau_1^*/\mathrm{d}\mu_1 > 0$. Since $\tau_2 = \psi(\tau_1)$, we have $\mathrm{d}\tau_2^*/\mathrm{d}\mu_1 = \psi'(\tau_1)\mathrm{d}\tau_1^*/\mathrm{d}\mu_1 > 0$ as well.

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