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During the past decade a number of countries imposed capital controls that had two distinguishing features: they were asymmetric, in that they were designed principally to discourage capital inflows, and they were temporary. This paper studies formally the consequences of these policies, calibrates their potential effectiveness, and assesses their welfare implications in an environment in which the level of capital inflows can be sub-optimal. In addition, motivated by the fact that these types of controls have often been left in place after the dissipation of the shock that lead to the controls being implemented, the paper evaluates the welfare cost of procrastination in removing these types of controls.

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1. Introduction

There have been various episodes in the past decade when capital inflows to countries were very large relative to the size of the economies (see Table 1). This can be a serious problem if the inflows are temporary. There are many historical examples of substantial reversals of capital inflows (see Figure 1). This paper studies a form of capital control that a group of countries used in the 1990s to manage this potential problem. These capital controls had two distinguishing characteristics: they were *asymmetric* and they were intended to be purely *temporary*.

The asymmetry of the capital controls stemmed from the fact that they were targeted at discouraging capital inflows but posed little barrier to capital outflows. In fact, in several countries--notably Brazil, Chile, and Colombia--the asymmetry of the controls was reinforced by simultaneously lifting some long-standing controls on capital outflows. The types of controls that were imposed on capital inflows varied across countries; they included both outright quantitative restrictions and various forms of taxes.[1] The Czech Republic (1995) utilized quantitative limits on short-term foreign borrowing. Brazil (1993-97) used an explicit tax in tandem with outright prohibition or minimum stay restrictions for certain types of inflows. Both types of controls in Brazil varied considerably over time in terms of which types of inflows they applied to and, for the explicit taxes on inflows, the tax rates also varied across time. Malaysia (1994) used outright prohibitions on certain types of inflows and, as in Thailand (1995-97), placed restrictions on domestic banks' offshore borrowing. Chile (1991-98) and Colombia (1993-98) relied mainly on a specific type of indirect tax—a non-remunerated deposit requirement at the central bank—that applied to various types of inflows, but mostly shorter-term inflows. Chile also utilized minimum stay requirements to mitigate reversals of inflows.

The reason for the temporariness of the capital controls varies across countries, although a common thread was the aim of stopping or slowing what was perceived as temporary inflows of capital—"short-term inflows". At one extreme, the Malaysian authorities explicitly stated in January 1994 that restrictions on capital inflows were to be implemented and that they would be temporary.[2] In most other cases the authorities were not as explicit about the duration of the policy, but it was apparent that the measures were a response to a temporary shock. This shock was reflected in a surge

[1]For further details on country experiences see Reinhart and Smith (1998) and Ariyoshi *et. al* (2000).
[2]Malaysia introduced the controls in January 1994 and removed them in August 1994.

in capital inflows, a significant increase in the current account deficit, and a surge in economic activity, particularly personal consumption expenditures (see Ariyoshi *et. al* (2000), Reinhart and Smith (1998)). Their temporariness was also reflected in the fact that the tax rates or quantitative restrictions were varied (or simply removed) in synch with cyclical developments—when inflows slowed the restrictions were eased. [3] [4]

Another noteworthy characteristic of these recent experiences with capital controls is that the controls were implemented in a very different economic environment than is usually the case when capital controls are implemented. This is potentially important because while empirical work often concludes that capital controls lose their effectiveness relatively quickly this literature does not usually differentiate between controls on inflows and controls on outflows.[5] There is reason to believe that the effectiveness of capital controls is not symmetric and, in particular, that controls on inflows may be more effective than controls on outflows. One reason is that controls on outflows are usually resorted to during balance-of-payments crises. In these circumstances, the imposition of controls, in and of itself, may send a signal that worse times are to come.[6] In contrast, the countries mentioned above that imposed controls on capital inflows did so under more normal economic circumstances. While rate-of-return differentials were often still an incentive to evade the controls, these differentials were generally much smaller than during crises. Finally, some recent empirical studies that focus specifically on controls on inflows find that they may have been effective in terms of altering the composition and/or the level of inflows (Ariyoshi *et. al* (2000), Reinhart and Smith (1998), Montiel and Reinhart (1999), De Gregorio *et al.* (2000)).

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[3]One might argue that controls that are intended as permanent can be categorized as temporary if they lose their effectiveness over time. Controls of this type are the focus of the literature on "leaky controls" (*e.g.* Gros (1987)). These types of controls probably create different incentives and thus may not fit well into the class of capital controls considered in this paper.

[4]There are earlier instances where countries have sought to restrict capital inflows temporarily, but these instances are considerably more isolated than the experience in the 1990s. One of the better known instances involved Switzerland in the late 1970s in which substantial capital inflows--partly because of German residents' desire to escape a new withholding tax in Germany--prompted the Swiss National Bank to impose a 100 percent reserve requirement on non-residents' bank deposits in Switzerland. The consequence was a negative nominal interest rate on foreign deposits in Swiss banks because these banks demanded a fee to accept foreign deposits.

[5]Dooley (1996) surveys the literature on capital controls. Mathieson and Rojas-Suarez (1993) review the empirical evidence on the effectiveness of capital controls (see also Ariyoshi *et. al* (2000)).

[6]See Bartolini and Drazen (1997) for a related analysis.

There are several possible reasons why policymakers might want to impose controls on capital inflows (*e.g.,* Dooley (1996)). The reason considered in this paper underlies many of the country experiences discussed above. Namely, taxing capital inflows can be helpful in curbing an excessive temporary increase in economic activity, and particularly private consumption, that is being financed to a large extent by capital inflows. This possibility has been widely discussed in the context of exchange rate crises. For instance, Feldstein (p.6,1999) notes that "[w]hile access to more foreign debt could raise domestic investment, experience shows that countries that seek substantially more foreign debt frequently invest those funds in relatively unproductive ways…." The approach taken in the paper is to study capital inflow restrictions in a dynamic general equilibrium model in which certain shocks can result in temporarily excessive domestic consumption financed by capital inflows. By "excessive" it is meant that private consumption and foreign debt are, at least temporarily, higher than the Pareto efficient allocation. Capital inflow restrictions in the model are therefore a natural application of the Theory of Second Best.

The shocks that can lead to excessive capital inflows in the model are temporary changes in the foreign interest rate and, secondly, temporary changes in domestic monetary policy. These shocks have previously been identified as being important for explaining surges in capital inflows to developing countries (*e.g.*, Calvo *et al.* (1993), Eichengreen and Rose (1998), and Frankel and Rose (1996)). The paper considers two underlying "distortions" that are responsible for why these shocks can have these consequences. First, the paper considers a monetary distortion as in the literature on "temporary stabilizations" (Calvo (1986), Calvo and Vegh (1993), Calvo *et al.* (1995), and Rebelo and Vegh (1995)). Second, the paper considers an environment in which the social cost of foreign debt exceeds the private cost. Several authors have discussed this type of externality. For instance, Harberger (1986) argues that the risk premium on foreign debt is increasing in the *level* of foreign debt, Chang and Velasco (1999) emphasize that the social and private costs of *short-term* foreign debt might be different, and Furman and Stiglitz (1998) discuss various reasons why private accumulation of foreign debt might have negative external effects on others in the economy.

There is a large literature on capital controls. Nonetheless, as Dooley (1996) emphasizes, while there is a well-developed literature dealing with the economic effects of capital controls, there is little work that studies the possible merits of capital controls in an environment with well-defined

motives for capital controls. This paper studies such an environment that is motivated by recent experiences in developing countries. There is also an existing literature (beginning with Calvo (1986)) that is concerned with the economic effects of temporary reductions in inflation rates. This type of policy change is one of the "shocks" considered in the paper, but the focus below is very different from these other studies. Most importantly, the focus below is on the positive and normative consequences of taxing capital inflows in an environment in which some domestic and foreign shocks can produce an inefficient level of capital inflows. In contrast, the literature on temporary policy changes is an inherently positive analysis--the aim is to explain the behavior of macroeconomic aggregates during actual domestic stabilization policies.[7]

A main finding of the paper is that the tax rate on capital inflows must be very high in order to have much effect on the capital account balance. For instance, a reduction in the capital account balance by five percent of GDP would require a tax rate on net interest payments on foreign-held debt on the order of 85 percent for one year or 60 percent for two years.[8] These tax rates are high, but so are the tax rates that have been imposed in countries that have been successful in curbing capital inflows.

A second main finding is that for reasonable parameterizations the welfare benefits of taxing capital inflows are usually small. In particular, when "overborrowing" is due to just the monetary distortion discussed above, the welfare benefits (expressed in terms of a discounted stream of private consumption) of even very large shocks are typically within one percent of GDP. When there is an externality associated with foreign borrowing, the welfare benefits of taxing capital inflows are substantially larger, but they are generally still within two percent or so of GDP for even very large shocks. It is shown that these modest potential benefits of taxing capital inflows can easily be lost, or even reversed (*i.e.*, welfare losses), if the tax rate is not sufficiently close to the optimal tax rate.

A third component of the analysis builds on the fact that many of the countries implementing the types of capital controls that are considered in the paper leave them in place longer than the

[7]In the context of domestic stabilizations, Calvo (1986) notes that capital controls could raise welfare because they restrict access to foreign capital and thus limit the response of consumption to the shock. Related, Calvo *et al.* (1995) compares the behavior of some macroeconomic variables with perfect capital mobility and no capital mobility.

[8]A reduction in the capital account balance of five percentage points of GDP, while substantial, is not an unrealistic target given the magnitudes of the capital inflows; the ratio of capital inflows to GDP reached 10, 16.7, and 17.2 percent in Chile, the Czech Republic, and Malaysia, respectively, on the eve of the introduction of capital controls in these countries.

period of time that the offending shock lasts. This procrastination in the removal of controls may be due to a concern that capital inflows will surge if controls are removed too soon. It may also be because "…a control system, once established, is likely to take on a life of its own…Thus, controls designed to mitigate a temporary distortion might outlive the economic rationale on which they were established" (Dooley (p.642, 1996)). Whatever the reason, the calculations in the paper suggest that the welfare benefits of capital inflow taxes generally vanish after roughly twice the length of time that the initial shock lasts. This finding may therefore be helpful in gauging the costs associated with delaying the removal of capital inflow restrictions.

The format of the paper is as follows. Section 2 describes the model and illustrates the qualitative consequences of taxing capital inflows. Section 3 measures the magnitudes of tax rates that are required to engineer significant reductions in capital inflows and measures the welfare consequences of capital inflow taxes. Section 4 studies externalities from foreign borrowing. Finally, section 5 contains concluding comments.

2. A Model with Taxes on Capital Inflows

2.1. Model

The home country is a small open economy facing a foreign instantaneous real interest rate of $r^* > 0$. The representative agent in the home country has preferences:

$$\int_0^\infty e^{-\beta t} U(C_t, C_t^*)\, dt, \tag{1}$$

where C_t and C_t^* denote consumption of the non-traded and traded goods respectively, $\beta > 0$ is the subjective discount rate, and $U(C_t, C_t^*)$ is twice differentiable, strictly concave, and increasing in each of its arguments. As usual, it is assumed that $\beta = r^*$ which implies that steady-state consumption (in the absence of capital controls) is constant.

There is free trade in goods, and the world price of the traded good in units of foreign currency is P_t^*. The foreign rate of inflation is π^*, and thus the foreign nominal interest rate is $i^* = r^* + \pi^*$. The home-country currency price of the non-traded good is denoted P_t, and the home-

country currency price of a unit of foreign currency is denoted E_t. The real exchange rate is therefore $e_t = E_t P_t^* / P_t$. The nominal exchange rate depreciates at rate ε and we assume $\varepsilon + \pi^* \geq 0$.

The representative agent's consumption purchases must satisfy a cash-in-advance constraint:

$$m_t \geq \alpha (C_t^* + C_t / e_t), \tag{2}$$

where m_t is real cash balances and α is a positive constant. This constraint binds if the nominal interest rate on domestic bonds, i_t, is positive; the assumptions $\varepsilon + \pi^* \geq 0$ and $r^* > 0$ will ensure this is the case.

There are three assets available to home-country residents: the domestic currency (which is not held by foreigners); foreign bonds that yield r^* (in units of the traded good); and one-period domestic bonds that yield r_t (in units of the traded good). The real and nominal interest rates on home-country bonds will depend on whether there are restrictions on capital inflows.

Each period the representative agent in the home country receives an endowment of y units of the non-traded good and y^* units of the traded good. The agent's real net wealth at time t is $a_t \equiv m_t - b_t$, where b_t is net foreign debt. Thus, the budget constraint is:

$$\dot{a}_t = \frac{y}{e_t} + y^* - \frac{C_t}{e_t} - C_t^* - r_t b_t - (\pi^* + \varepsilon) m_t + \tau_t, \tag{3}$$

where τ_t is lump-sum transfers from the government. The appropriate interest rate in formulating (3) is the domestic rate because the paper only considers restrictions on capital *inflows*, and thus $r_t \geq r^*$.

Define the domestic market discount factor, D_t, as:

$$D_t = \exp\left(- \int_0^t r_s \, ds\right). \tag{4}$$

Multiply (3) by D_t, integrate, and impose the transversality condition to yield:

$$\int_0^\infty D_t \left(\frac{C_t}{e_t} + C_t^* + i_t m_t \right) dt = \int_0^\infty D_t \left(\frac{y}{e_t} + y^* + \tau_t \right) dt + a_0, \tag{5}$$

where $i = r + \pi^* + \varepsilon$. To motivate taxes on capital inflows, assume that the representative agent has an initial stock of debt: $b_0 > 0$. Without loss of generality, let $b_0 = m_0$ so that $a_0 = 0$. Using this and (2) in (5) gives:

$$\int_0^{\infty} D_t \left(\frac{C_t}{e_t} + C_t^* \right) (1 + \alpha i_t)\, dt = \int_0^{\infty} D_t \left(\frac{y}{e_t} + y^* + \tau_t \right) dt . \tag{6}$$

The representative agent maximizes (1) subject to (6).

The consolidated budget constraint of the government/central bank in the home country is:

$$\dot{f}_t = r^* f_t + (\pi^* + \varepsilon) m_t + \dot{m}_t - \tau_t + \gamma_t r_t b_t . \tag{7}$$

Here, f_t is foreign exchange reserves (foreign bonds), and the final term on the right side is revenue from taxing capital inflows. This tax, at rate $\gamma_t \in [0,1)$, applies to net interest payments on foreign debt. Alternatively, if the tax applied to a broader base (*e.g.*, the stock of foreign debt) the main consequence would be that the tax rate that is necessary to generate a real interest rate of a given magnitude is lower. Note also that the paper is concerned with *temporary* controls on capital inflows so $\gamma_t > 0$ only for an interval of time $t \in [0,T)$, where $T < \infty$. It is assumed that $f_t = 0 \; \forall \; t$, and thus net revenue from seigniorage and from taxing capital inflows is rebated (lump-sum) to home-country residents.

Equilibrium in the non-traded goods market and the money market require:

$$C_t = y , \tag{8}$$

$$m_t = m_t^s . \tag{9}$$

To derive the equilibrium condition for the traded-goods sector, substitute (7) into (3), impose (8)-(9), integrate the resulting equation forward, and impose the transversality condition. This yields:

$$\int_0^{\infty} e^{-r^* t} C_t^* \, dt = \frac{y^*}{r^*} - b_0 . \tag{10}$$

2.2. Qualitative Effects of Taxing Capital Inflows

The obvious benchmark for comparing the effects of restrictions on capital inflows is the case in which there are no restrictions. When there are no taxes on inflows, arbitrage ensures $r_t = r^*$, for all t. Letting φ denote the Lagrange multiplier on (6), the first-order conditions are:

$$U_{C_t^*}(C_t, C_t^*) = \varphi(1 + \alpha i_t) , \tag{11}$$

$$U_{C_t}(C_t, C_t^*) = \frac{\varphi(1 + \alpha i_t)}{e_t} . \tag{12}$$

Equilibrium consumption is therefore $C_t = y$ and $C_t^* = y^* - r^* b_0$, and the (constant) equilibrium real exchange rate is $e = U_{C^*}(y, y^* - r^* b_0) / U_C(y, y^* - r^* b_0)$.

When there are taxes on capital inflows, the first-order conditions are:

$$U_{C_t^*}(C_t, C_t^*) = \exp\left(-\int_0^t (r_s - \beta)ds\right)\varphi(1 + \alpha i_t), \tag{13}$$

$$U_{C_t}(C_t, C_t^*) = \exp\left(-\int_0^t (r_s - \beta)ds\right)\varphi(1 + \alpha i_t) / e_t. \tag{14}$$

For illustration purposes suppose that $\gamma_t = \gamma$ for all $t \in [0,T)$, and let $\hat{t} < T$ denote a future date for which foreign debt is strictly positive for all $t < \hat{t}$. Then, for all $t \in [0, \hat{t})$, one can write:

$$U_{C_t^*}(y, C_t^*) = \varphi(1 + \alpha i_t)\, e^{-\gamma r^* t/(1-\gamma)}. \tag{15}$$

There are two main consequences of the capital inflow tax. First, the tax causes the home-country real and nominal interest rates to immediately jump upward. The reason is that arbitrage results in $r_t = r^* / (1 - \gamma_t)$, because only then do both foreign and home-country bonds offer the same net-of-tax real return to foreign investors. As a result, the level of consumption jumps down because of a higher effective price of consumption today (*i.e.*, $1 + \alpha i_t$) relative to after the tax is removed. Second, so long as foreign debt is positive, the home-country real and nominal interest rates remain higher than foreign rates because the home country must still attract foreign capital. This encourages the representative agent in the home country to substitute consumption intertemporally, which is reflected in increased saving and an upward-sloping consumption path. If at some date $\hat{t}$ domestic savings are high enough that foreign debt has been reduced to zero, then since foreign capital is no longer required the real interest rate falls to $r_t = r^*$.[9] Similarly, if the tax on inflows is removed when there exists positive foreign debt then the real interest rate falls to r^* at the moment the tax is lifted. In this case, foreign capital will finance the remaining foreign debt, $b_T > 0$, at an interest rate of r^*. In both cases the level of consumption after $\hat{t}$ or T, whichever comes first, is

[9] One can rule out the possibility that the increase in savings is so large that the home country becomes a net creditor to the rest of the world (*i.e.*, one can rule out $b_t < 0$ for any $t < T$). The reason is that this circumstance would imply home-country investors have been accumulating foreign bonds; that is inconsistent with the assumption $r^* = \beta$. Thus, a tax on capital inflows will increase domestic interest rates and reduce or possibly eliminate foreign debt, but it could not result in the home country becoming a net creditor to the rest of the world..

permanently higher than before the capital controls were imposed because debt servicing costs are permanently lower. Consequently, the imposition of a tax on capital inflows initially causes a real exchange rate depreciation, and then subsequently a real exchange rate appreciation beyond the level that would have prevailed had capital inflow taxes never been imposed.

3. Effectiveness of capital controls and their welfare consequences

3.1. Why are temporary taxes on inflows so high?

In practice, taxes on inflows are often levied at very high rates.[10] For instance, consider a three-month investment in Chile during 1995 earning 20 percent per annum. The unremunerated deposit requirement in that year was equivalent to a 50 percent tax rate on net interest payments (see Ariyoshi *et. al* (2000)).

To provide insight into why tax rates tend to be high, we parameterize the model and consider some numerical exercises. Specifically, let preferences be:

$$U(C_t, C_t^*) = \frac{(C_t)^{(1-q)(1-1/\eta)} (C_t^*)^{q(1-1/\eta)}}{1-1/\eta}, \quad \eta > 0, \quad 0 \leq q \leq 1. \tag{16}$$

The parameter η measures the elasticity of intertemporal substitution, and q measures the share of traded goods in total consumption. For these preferences, optimal consumption satisfies:

$$C_t^* = \left(\frac{e^{(r-\beta)t} q \; y^{(1-q)(1-1/\eta)}}{\varphi \; [1+\alpha(r+\pi^*+\varepsilon)]} \right)^{\frac{1}{1-q(1-1/\eta)}}, \quad t < T, \tag{17}$$

$$C_t^* = \left(\frac{e^{(r-\beta)T} q \; y^{(1-q)(1-1/\eta)}}{\varphi \; [1+\alpha(r^*+\pi^*+\varepsilon)]} \right)^{\frac{1}{1-q(1-1/\eta)}}, \quad t \geq T, \tag{18}$$

where we define $r = r^*/(1-\gamma)$. In writing these expressions it has been assumed (innocuously) that the country has strictly positive foreign debt throughout the period that controls are in place. Finally, substituting (17) and (18) into (11) and integrating yields:

$$\varphi = \left(\frac{c_1 + c_2}{(y^*/r^*) - b_0} \right)^{1-a}, \tag{19}$$

[10]For discussion of the magnitudes of tax rates see Reinhart and Smith (1998).

where:

$$c_1 = \left(\frac{q\, y^{(1-q)(1-1/\eta)}}{1+\alpha(r+\pi^*+\varepsilon)} \right)^{\frac{1}{1-a}} \left(\frac{e^{-r^*T + (r-\beta)T/(1-a)} - 1}{-r^* + (r-\beta)/(1-a)} \right), \tag{20}$$

$$c_2 = \left(\frac{q\, y^{(1-q)(1-1/\eta)}}{1+\alpha(r^*+\pi^*+\varepsilon)} \right)^{\frac{1}{1-a}} \left(\frac{e^{-r^*T + (r-\beta)T/(1-a)}}{r^*} \right), \tag{21}$$

and $a = q(1-1/\eta)$.

Chosen as a baseline parameterization is $r^* = \beta = 0.03$, $\pi^* + \varepsilon = 0.10$, $q = 0.4$, $\alpha = 0.15$, $\eta = 0.5$, and $T = 1$ (*i.e.*, one year). This baseline parameterization is reasonable in light of empirical estimates of these parameters.[11] The experiments considered are as follows. For a given parameterization, varying the tax rate γ will affect the interest rate and thus net foreign debt. One can therefore calculate what the value of the tax rate (or equivalently the real interest rate) must be in order to generate a specific level of foreign debt after the tax has been in place for T years.

For the baseline parameterization the tax rate required to reduce foreign debt by five percent of GDP is 88.9 percent and the associated real interest rate is 2.6 percent per month (in excess of 31 percent per annum).[12] These magnitudes for the required tax rate and real interest rate are only significantly different if T is several years or if some of the preference parameters are implausible (see Figure 2). Thus, one can conclude that the magnitudes of the tax rate and the interest rate required to reduce the capital account balance by a significant amount over a few years are very high. If the tax base were broadened so that the tax applied to (say) total capital inflows, b_t, then the required tax rate would be lower but the required real interest rate would be the same. The reason that such a high interest rate is required is simply that intertemporal substitution in consumption is low for reasonable parameter values.

[11]The ratio of M1 to private consumption (in percent) was 11.4 in Brazil in 1991, 10.7 for Chile in 1991, and 16.7 for Columbia in 1988 (data from IFS). The average share of traded goods in total consumption during 1978-1986 was 0.47 in Brazil and 0.32 in Columbia (see Ostry and Reinhart (1992)). Empirical studies for developing countries find that the degree of intertemporal substitution in consumption is generally below unity (Ostry and Reinhart (1992), Reinhart and Vègh (1995)).

[12]Unless otherwise noted, all references to the real interest rate are expressed as the monthly effective rate.

The parameter analysis shown in Figure 2 provides insight into the link between required tax rates and the values of the various parameters. The required tax rate is decreasing in T simply because there is a longer period of time available to reduce foreign debt by any given amount. Greater intertemporal substitution reduces the required tax rate because this makes consumption (and thus foreign borrowing) more sensitive to interest rates. The ratio of the effective price of consumption (*i.e.*, $1+\alpha i_t$) when the tax is in place to this price after the tax is removed is a measure of how big the distortion is that is caused by the tax. Thus, since this ratio is increasing in α but decreasing in the domestic inflation rate, the required tax rate tends to be lower when α is larger or when the domestic inflation rate is lower. Finally, the required tax rate is increasing in the traded goods share because when this share is large, equilibrium consumption of traded goods is less sensitive to variations in their price.

3.2. Welfare effects of temporary capital controls

The above numerical experiments show that the magnitude of taxes on capital inflows must be large to generate modest adjustments in the capital account. But the motivation for engineering these adjustments with public policy is not apparent. As discussed above, countries that have implemented such measures have done so largely to deal with temporarily lower foreign interest rates and an associated increase in capital inflows and domestic consumption. This motive for restricting capital inflows is present in the model because a temporary decrease in the foreign interest rate (for example) causes domestic consumption to rise by more than is Pareto efficient. The reason is that the effective price of current consumption is $1+\alpha i_t$, rather than simply 1 in the social planner's problem. Thus, since $i_t = i_t^* + \varepsilon$, a temporary decrease in the foreign nominal interest rate (for a given exchange-rate policy) causes consumption to increase by more than is Pareto efficient.[13] Note that the parameter α may be a potentially important determinant of the welfare benefits of capital controls.

[13] If the shock is permanent then the equilibrium path of consumption will be Pareto efficient because the distortion under discussion arises only when there is temporal variation in the effective price of consumption.

3.2.1. Foreign Shocks

The first experiment considered therefore involves a temporary decrease in the foreign nominal interest rate. This could arise either because of a temporary decrease in the foreign real interest rate or the foreign inflation rate. The case of a decrease in the foreign real interest rate produces a somewhat more complicated optimal tax problem because the Pareto efficient consumption path in the home country is upward sloping. In comparison, the Pareto efficient consumption path is flat when there is instead a temporary decline in the foreign inflation rate. In this case the optimal tax problem therefore is to minimize the reaction of consumption to the shock. This tax problem is still a fairly complicated problem because the tax affects the domestic real interest rate and thus it will alter the slope of the consumption path. The discussion below focuses mainly on this problem rather than the case of a temporary decrease in the foreign real interest rate, but the main differences in the conclusions from the two problems will be discussed.

Suppose therefore that the foreign inflation rate temporarily decreases from π^* to $\tilde{\pi}^*$ during $[0,T)$. For now we limit attention to the case of a constant tax rate. The marginal utility of wealth with tax rate γ over $[0,T)$ is:

$$\varphi = qy^{(1-q)(1-1/\eta)}\left(\frac{c_1 + c_2}{(y^*/r^*) - b_0}\right)^{1-a}, \tag{22}$$

where:

$$c_1 = \left(\frac{e^{-r^*T+(r-\beta)T/(1-a)} - 1}{[1+\alpha(r+\tilde{\pi}^*+\varepsilon)]^{1/(1-a)}[-r^* + (r-\beta)/(1-a)]}\right), \tag{23}$$

$$c_2 = \left(\frac{e^{-r^*T+(r-\beta)T/(1-a)}}{r^*[1+\alpha(r+\pi^*+\varepsilon)]^{1/(1-a)}}\right). \tag{24}$$

One can therefore write social welfare as:

$$W_0 = \left(\frac{y^{(1-q)(1-1/\eta)}}{1-1/\eta}\right)\left(\frac{q\,y^{(1-q)(1-1/\eta)}}{\varphi}\right)^{\frac{a}{1-a}}\left[\left(\frac{e^{-\beta T + a(r-\beta)T/(1-a)} - 1}{(-\beta + a(r-\beta)/(1-a))[1+\alpha(r+\tilde{\pi}^*+\varepsilon)]^{a/(1-a)}}\right) + \left(\frac{e^{-\beta T + a(r-\beta)T/(1-a)}}{\beta[1+\alpha(r^*+\pi^*+\varepsilon)]^{a/(1-a)}}\right)\right]. \tag{25}$$

There is no closed-form solution for the optimal (constant) tax rate associated with maximizing this welfare function. We therefore use a numerical optimization algorithm to determine the optimal tax rate. The welfare benefit under the optimal tax is computed as the amount of

additional traded-goods income that would be required for the agent to be just as well off were the tax rate equal to zero. This stream of traded goods is discounted and expressed as a percentage of current annual GDP.

For the baseline parameterization and a fall in the foreign nominal interest rate of nine percentage points the welfare benefit of taxing capital inflows is 0.0024 percent of GDP. Thus, for even a large foreign shock there are small welfare benefits of taxing capital inflows. Moreover, this conclusion is not sensitive to the parameterization: for a wide range of parameterizations the welfare benefits peak at about 0.1 percent of GDP (see Figure 3). Note that the welfare benefits are exactly zero when $\alpha = 0$, because in this case the distortion in consumption decisions caused by the temporary fall in the foreign nominal interest rate disappears. For similar reasons, the welfare benefits are even smaller than in the baseline when intertemporal substitution in consumption is lower, T is smaller, or the share of traded goods q is larger.[14] Finally, the welfare benefits associated with a shock to the foreign *real* interest rate are (slightly) *lower* than those associated with a purely nominal interest rate shock.

An important implication of this welfare finding is that if the actual tax rate is different from the optimal tax rate, then the policy could produce welfare losses. Indeed, if the tax rate is significantly higher than the optimal tax rate the magnitude of the welfare loss will be large. Specifically, when the tax rate is increased above the optimal level the welfare benefits fall continuously reaching a maximum loss amounting to well over 50 percent of current GDP for the baseline parameterization.

Qualitatively, the welfare losses from not taxing capital inflows occur because both the *intratemporal* and *intertemporal* marginal rates of substitution in consumption are distorted by the shock to the foreign nominal interest rate. To see this, note that the socially optimal allocation of consumption is $C_t = y$ and $C_t^* = y^* - r^* b_0$. In the decentralized economy, however, consumption of traded goods rises for the duration of the shock because the effective price of consumption falls. This is the intertemporal distortion. The magnitude of this intertemporal distortion can be significantly

[14] A higher domestic inflation rate (than the baseline) would also reduce the welfare benefits. As Figure 2 suggests, different values of this variable do not have much effect on required tax rates, and therefore the magnitude of the domestic inflation rate has only a small effect on the welfare benefits of taxes on inflows.

affected by the parameter η. However, estimates of intertemporal elasticities of substitution are small, and thus the magnitude of the intertemporal distortion is small.

The intratemporal distortion arises because, whereas equilibrium consumption of non-traded goods is equal to y in all periods, consumption of traded goods rises for the duration of the shock. Thus, the intratemporal marginal rate of substitution of the two consumption goods is distorted by the shock. This intratemporal distortion in consumption could be generalized by allowing for different factors, say α and α^*, applied to non-traded and traded goods respectively in the cash-in-advance constraint. Including just this additional generality in our model will not affect the welfare calculations because equilibrium consumption of non-traded goods is always equal to y; this implies that only α^* can affect welfare.[15] However, if the supply of non-traded goods is endogenous then both α and α^* would matter for welfare. Endogenizing production would, of course, complicate the analysis, but purely from the perspective of consumption distortions it is not clear whether the welfare benefits of capital controls would be any larger. On the one hand, the intratemporal distortion would actually be reduced by a temporary decline in the foreign nominal interest rate because it would bring the ratio $(1+\alpha^*(i^*+\varepsilon))/(1+\alpha(i^*+\varepsilon))$ closer to unity.[16] On the other hand, the intertemporal distortion would be exacerbated simply because when the supply of non-traded goods is endogenous then the shock introduces an intertemporal distortion in consumption of both types of consumption goods. Nonetheless, even if the response of non-traded goods consumption to the shock was of the same order of magnitude as traded goods, it appears that the welfare benefits would still be small since the elasticity of intertemporal substitution in consumption is small. To illustrate, if one simply assumes that all goods are tradable in the above model, then the intratemporal distortion is zero and the intertemporal distortion applies to all consumption goods. As Figure 3 suggests (*i.e.*, as $q \to 1$), the welfare benefits in this case are even lower than in our baseline case.

[15] Specifically, α affects the relative price of traded and non-traded goods, but not equilibrium consumption or social welfare.

[16] Of course introducing a labor-leisure choice or physical capital would introduce other intra-temporal distortions that would alter the welfare benefits (or costs) of controls. This paper is concerned with the welfare benefits of controls that are aimed at limiting excessive consumption and overborrowing. As discussed below, introducing a variety of extensions to the model produces less volatile consumption and foreign debt dynamics than our model.

One further issue to consider in evaluating the above welfare conclusions is that attention has been limited to a constant tax rate. It is possible that a constant tax rate could be a poor tax policy in response to the types of shocks being considered. To assess this possibility, we calculated how much of the gap between the Pareto optimal allocation and the competitive equilibrium when inflows are not taxed is closed under the optimal *constant* tax rate. For the range of parameterizations shown in Figure 3 the constant tax rate policy narrows this gap by 75-96 percent. Thus, even with a first-best tax policy the welfare benefits would not be much greater than for a constant tax rate.[17]

3.2.2. Domestic Monetary Stabilizations

Another circumstance with a motive for taxing capital inflows involves a purely domestic "shock", namely, a temporarily lower domestic inflation rate. There are a number of studies that use models like the one used in this paper to try to explain consumption booms, the deterioration of external accounts, and other macroeconomic regularities in countries that temporarily reduce their inflation rate (see Calvo (1986), Calvo and Vegh (1993), Calvo *et al.* (1995), and Rebelo and Vegh (1995)).

This type of event is of interest in this paper for two reasons. First, the existing literature is concerned with explaining macroeconomic regularities surrounding these events. In contrast, this paper's focus is normative: the focus is on the welfare benefit of using taxes on capital inflows to prevent excessive consumption financed by capital inflows. Second, the magnitude of the shocks considered in this literature are much larger than reasonable foreign shocks, and thus it is of interest to determine whether the welfare benefits are small for even very large shocks.

The shock considered in this second experiment is Rebelo and Vegh's (1995) "benchmark parameterization", which involves a temporary decrease in the rate of devaluation from an annual rate of $\varepsilon = 1.84$ to $\varepsilon = 0.0$ (a fixed exchange rate) during the time interval $[0, T]$. This parameterization is chosen by the authors because they consider Argentina to be a good reference case and this policy change corresponds closely to the situation in Argentina in the decade prior to the Convertibility Plan (which fixed the exchange rate).

[17]There exists no closed-form solution to the optimal tax problem. It is possible to show that a tax rate that is a linear function of time is not optimal; the optimal tax rate is therefore a non-linear function of time.

Although this domestic shock is about 20 times larger than the foreign shock considered above, the welfare benefit under the optimal tax policy is about 350 times larger for the baseline parameterization, and thus result is reasonably robust to alternative parameter values (see Figure 4). In economic terms, however, the welfare benefit amounts to just 0.84 percent of current GDP for the baseline parameterization. A larger value of T does increase these welfare benefits. For instance, when $T = 2.5$, which is the case considered by Rebelo and Vegh, the welfare benefits are 1.84 percent of GDP.[18] This is non-trivial, but it is not huge when viewed in the context of the magnitudes of movements in macroeconomic variables associated with this event—in the model, the stock of foreign debt, for instance, rises by 44 percent during the life of the shock. Some alternative parameterizations, and particularly a larger value of α, increase these welfare benefits, but significant differences from our baseline parameterization contradict empirical evidence on these parameter values.

3.3. Procrastination in the removal of controls

Countries implementing the types of capital controls that are considered in this paper often leave them in place longer than the shock lasts, apparently because of a concern that capital inflows will rebound if controls are lifted too soon. This "addictiveness" is, of course, costly because there is no benefit to a higher domestic real interest rate after the shock has dissipated.

Let $\hat{T} > T$ represent the date when the tax on capital inflows is eliminated. Then, for the case of a shock to the world nominal interest rate, the marginal utility of wealth is:

$$\varphi = \left(\frac{c_1 + c_2 + c_3}{(y^* / r^*) - b_0} \right)^{1-a}, \tag{28}$$

where:

$$c_1 = \left(\frac{e^{-r^* T + \gamma r T/(1-a)} - 1}{[1 + \alpha(r + \tilde{\pi}^* + \varepsilon)]^{1/(1-a)} [-r^* + \gamma r/(1-a)]} \right), \tag{29}$$

[18]The welfare benefits peak at 5.68% of GDP for T=19.2, or nearly two decades, and are decreasing in T after this point.

$$c_2 = \left(\frac{e^{-r^*\hat{T} + \gamma r\hat{T}/(1-a)} - e^{-r^*T + \gamma rT/(1-a)}}{[1+\alpha(r+\pi^*+\varepsilon)]^{1/(1-a)}[-r^* + \gamma r/(1-a)]} \right), \tag{30}$$

$$c_3 = \left(\frac{e^{-r^*\hat{T} + \gamma r\hat{T}/(1-a)} - 1}{[1+\alpha(r^*+\pi^*+\varepsilon)]^{1/(1-a)} r^*} \right). \tag{31}$$

Welfare is therefore:

$$W_0 = \left(\frac{y^{(1-q)(1-1/\eta)}}{1-1/\eta} \right) \left(\frac{q\, y^{(1-q)(1-1/\eta)}}{\varphi} \right)^{\frac{a}{1-a}} \left[\left(\frac{e^{-\beta T + a\gamma rT/(1-a)} - 1}{(-\beta + a\gamma r/(1-a))[1+\alpha(r+\pi^*+\varepsilon)]^{a/(1-a)}} \right) \right.$$

$$\left. + \left(\frac{e^{-\beta\hat{T} + a\gamma r\hat{T}/(1-a)} - e^{-\beta T + a\gamma rT/(1-a)}}{(-\beta + a\gamma r/(1-a))[1+\alpha(r+\pi^*+\varepsilon)]^{a/(1-a)}} \right) + \left(\frac{e^{-\beta T + a\gamma rT/(1-a)}}{\beta[1+\alpha(r+\pi^*+\varepsilon)]^{a/(1-a)}} \right) \right]. \tag{32}$$

The welfare function for the case of a temporary stabilization involves minor changes to (32).

Using (33) and the optimal tax rate from section 3.2. one can calculate the value of $\hat{T}$ such that the welfare benefit of the tax on inflows is exactly zero. Table 2 reports $\hat{T}$ expressed as a ratio to T. It is clear that, *for both types of shocks,* the welfare benefit typically disappears after just less than twice the number of years that the shock lasted. After that point, of course, the welfare benefit is negative. The reason $\hat{T}$ is roughly the same for both types of shocks even though the welfare benefit of taxes is different is that the optimal tax rate is higher when the welfare benefit of the inflow tax is higher, and thus procrastination reduces the welfare benefit at roughly the same rate per unit of time.

4. Externalities and the overborrowing distortion

The source of the welfare benefit of a tax on capital inflows above is that a temporary shock to interest rates causes excessive consumption and foreign borrowing due to a monetary distortion. These welfare benefits are small because the quantitative significance of this distortion is, for reasonable parameter values, small.

Rebelo and Vegh (1995) study temporary reductions of inflation rates in a generalized open-economy model that includes endogenous production and a flexible transactions technology. These generalizations complicate the transmission mechanism linking a shock to social welfare, but the fundamental distortion is the same. As a result, the over-reaction of consumption and foreign

borrowing to the shocks considered above are not likely to be significantly altered. In fact, for the temporary stabilization "shock" discussed above quarterly consumption in the model considered by Rebelo and Vegh increases by between 5 and 10 percent from its steady state level, whereas in the model studied above consumption rises by about 18 percent relative to the steady state. As a result, because our primary interest is measuring the potential welfare benefit of taxes on capital inflows as a policy response to excessive consumption and capital inflows, within this type of model the welfare calculations discussed above may be generous.

An alternative approach is to alter the distortion underlying excessive consumption and capital inflows. This section of the paper considers an extension to the model that relates over-borrowing to a difference between the private and social costs of foreign borrowing. Specifically, imagine that there are a large number of households in the domestic economy that individually consider the real interest rate to be exogenous to their consumption-borrowing decisions. However, at the economywide level, the cost of funds is an increasing function of the level of indebtedness of the economy. Thus, in the absence of capital controls, the real return required by foreigners for lending to the domestic economy is $r(b_t)$, where $r(b_t)$ is an increasing function.

For tractability the numerical experiments focus on the case of a discrete function $r(b_t)$.[19] In particular, the experiment studied has two main components. First, there is a temporary decrease in the foreign inflation rate during $[0,T)$ (below we also discuss the case of temporary monetary stabilizations). As above, this shock tends to raise consumption of agents in the domestic economy and increase economywide indebtedness, b_t. Second, it is assumed that, if the level of indebtedness exceeds a threshold level at some (endogenous) time $T_1 \in (0,T)$, then the required real return demanded by foreigners rises from r^* to $\tilde{r}$, where $\tilde{r} > r^*$, until time T when the initial shock is reversed and the consumption path jumps downward (thereby reversing the course of foreign debt).[20] If capital controls are to have substantially greater welfare benefits than in the earlier analysis then

[19]There is no closed-form solution for a continuous interest rate function.

[20]The higher real interest rate on impact tends to reduce consumption but leads to higher debt servicing costs. In all of the experiments considered below the debt level continues to increase after the real interest rate increases. Note that if the real interest rate remains at the higher level after the initial shock is reversed then in this model consumption and foreign debt would, in the absence of a policy response, increase indefinitely. This seems to be an uninteresting situation and thus we do not explore it further.

it would have to be because they discourage borrowing and consequently prevent the economywide cost of financing from increasing.

In the absence of capital controls, aggregate debt for $t \in (0, T_1)$ satisfies:

$$b_t = e^{r^* t} b_0 - \left(\frac{y^*}{r^*} \right) (e^{r^* t} - 1) + \left(\frac{q y^{(1-q)(1-1/\eta)}}{\varphi [1 + \alpha (r^* + \tilde{\pi}^* + \varepsilon)]} \right)^{\frac{1}{1-q(1-1/\eta)}} \left(\frac{e^{r^* t} - 1}{r^*} \right). \tag{34}$$

Debt in the presence of capital controls behaves similarly except that the nominal interest rate in the denominator of the third term reflects the effect of capital controls on the domestic real interest rate and the marginal utility of wealth φ is also affected. In all experiments it is verified that the debt level under the optimal tax never reaches the threshold level during $(0, T]$.

The welfare benefits of capital controls are calculated using the same procedure as above for the two types of shocks.[21] For comparison with the earlier findings, the main focus is on the baseline parameterization. Various values for T_1 (and thus implicitly various threshold debt levels) and $\tilde{r}$ are considered. We use as a baseline $\tilde{r} = 0.035$ and $T_1 = 0.5$.

For the case of a foreign inflation shock, the main conclusion is that the welfare benefits of capital controls are magnified considerably: they are more than 50 times larger than the earlier welfare calculations for the baseline case (see Table 3). Nonetheless, the absolute level of the welfare benefit is still small, amounting to just 0.12 percent of current GDP. A larger value of $\tilde{r}$ increases these welfare benefits, but they remain small. For example, if $\tilde{r} = 0.045$ --*i.e.*, a 50 percent increase in the real interest rate in the home country—the welfare benefit increases to 0.37 percent of current GDP.[22] The welfare benefit for all parameterizations shown in Figure 3 never exceeds 0.4 percent.

For the case of temporary reductions in the domestic inflation rate, unless the externality is very large, the welfare benefits are not greatly affected. The reason is that the original distortion is not trivial, so a fairly small increase in the real interest rate due to debt accumulation does not greatly alter that conclusion. However, a large externality from debt accumulation does alter this conclusion

[21]The nine percentage point decrease in the foreign nominal interest rate is, of course, a large shock in practice. However, focusing on a smaller shock would not greatly affect the welfare findings because most of the welfare benefit comes from avoiding the increase in real interest rates.

to some degree. For the baseline case, the welfare benefits increase from 0.84 to 1.2 percent of GDP when $\tilde{r} = 0.045$, and a tripling of the real interest rate (not shown in Table 3) to $\tilde{r} = 0.09$ increases the welfare benefits to 2.3 percent.[23] The effects of other parameters mirrors the previous analysis, scaled roughly by the multiples reflected in Table 3 to account for the externality.[24]

For this extended model we also calculated how much procrastination in the removal of the tax on inflows can be tolerated before the welfare benefits vanish. The only exception to the earlier conclusion of just less than twice the period of time as the shock itself lasts is for the foreign shock. In that case, the amount of procrastination that can be tolerated is slightly greater for some parameterizations.

5. Concluding remarks

There are four main findings of this paper. First, temporary controls on capital inflows are only likely to be effective if the controls are highly punitive and the associated domestic real interest rates are very high. Second, the use of capital inflow taxes to inhibit inefficient private sector borrowing abroad generally has a relatively small welfare benefit. Third, because there is potential for only modest welfare benefits of taxing capital inflows, if the tax rate on capital inflows is not sufficiently close to the optimal tax rate then these welfare benefits could easily be lost and may in fact be negative (welfare losses) and significant. Fourth, the potential welfare benefits can also be lost, or even reversed, in a relatively short period of time when there is procrastination in removing the capital inflow tax.

The analysis in the paper is centered on well-defined distortions that, in tandem with a shock to domestic or foreign interest rates, are the ultimate cause of excessive capital inflows. This possibility is of interest because several experiences with controls on inflows were motivated in part

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[22] For higher values of $\tilde{r}$ (and the other parameters set at the baseline parameterization) there does not exist a perfect foresight equilibrium in which the debt level at T_1 in the absence of controls exceeds the debt level at T under optimal taxation of foreign borrowing.

[23] In contrast to the case of a shock to the foreign inflation rate, there do exist perfect foresight equilibria for quite high values of $\tilde{r}$. The reason is that the shock is much larger so even a large increase in the real interest rate is likely to not reduce the debt level below the debt level that prevails at the same point in time but when inflows are taxed.

[24] We calculated for this extended model how much procrastination in the removal of the tax on inflows is required before the welfare benefits vanish. The only exception to the earlier conclusion of just less than twice the period of time as the shock itself lasts is for the foreign shock. In that case, procrastination in the removal of controls does not eliminate the welfare benefits until a somewhat longer period of time elapses.

by a concern that a surge in capital inflows was being used mainly to finance excessive private consumption. The calculations are a direct measure of the welfare benefits of using taxes on capital inflows in these circumstances.

There are, of course, other distortions and associated reasons why capital inflows might be inefficiently large. For example, Summers (1988) has suggested that it might be desirable for governments temporarily to stem capital inflows if the inflows are purely speculative. Krugman (1987) suggests that this sort of policy might also be desirable if capital inflows cause a real exchange rate appreciation that has hysteresis effects on exports. Taxing capital inflows might also be desirable if capital inflows distort the incentives and decisions of financial intermediaries, or if large reversals of capital inflows can cause financial and balance-of-payments crises (see Dooley (1996)). It would be interesting in future research to study in a general equilibrium framework the potential welfare benefit of taxes on capital inflows when these types of distortions are present. An interesting question in this regard is whether the potential welfare benefit of taxes on inflows in these types of environments are substantial, in contrast to the findings of this paper.

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Table 1: Recent Surges in Capital Inflows
(Net long-term international private capital inflows as a percentage of GDP)

country	*inflow episode*[*]	*cumulative inflows/GDP at end of episode*	*largest annual inflow*
Argentina	1991-94	9.7	3.8
Brazil	1992-94	9.4	4.8
Chile	1989-94	25.8	8.6
Colombia	1992-94	16.2	6.2
Hungary	1993-94	41.5	18.4
India	1992-94	6.4	2.7
Indonesia	1990-94	8.3	3.6
Korea	1991-94	9.3	3.5
Malaysia	1989-94	45.8	23.2
Mexico	1989-94	27.1	8.5
Morocco	1990-94	18.3	5.0
Pakistan	1992-94	13.0	4.9
Peru	1991-94	30.4	10.8
Philippines	1989-94	23.1	7.9
Poland	1992-94	22.3	12.0
Sri Lanka	1991-94	22.6	8.2
Thailand	1988-94	51.5	12.3
Tunisia	1992-94	17.6	7.1
Turkey	1992-93	5.7	4.1
Venezuela	1992-93	5.4	3.3

[*] The period during which the country experienced a significant surge in net private capital inflows.

Sources: World Bank data; IMF, *World Economic Outlook data base*; IMF, *International Financial Statistics data base*.

Table 2: Years That Controls Are Left in Place Before Welfare Benefits Vanish

(as a ratio (x) to the duration of the shock)

Foreign shock

T	x	η	x	α	x	q	x
0.5	1.27	0.1	1.76	0.1	1.76	0.1	1.79
1	1.76	0.5	1.77	0.3	1.77	0.3	1.77
2	1.73	1.5	1.77	0.5	1.79	0.5	1.77
3	1.75	2.5	1.77	0.7	1.84	0.7	1.77
4	1.74	3.5	1.77	0.9	1.88	0.9	1.71

Domestic shock

T	x	η	x	α	x	q	x
0.5	1.77	0.1	1.70	0.1	1.72	0.1	1.75
1	1.74	0.5	1.74	0.3	1.81	0.3	1.74
2	1.73	1.5	1.77	0.5	1.91	0.5	1.73
3	1.74	2.5	1.78	0.7	2.01	0.7	1.73
4	1.75	3.5	1.79	0.9	2.10	0.9	1.72

Table 3: Debt Externalities and the Welfare Benefits of Taxes on Inflows

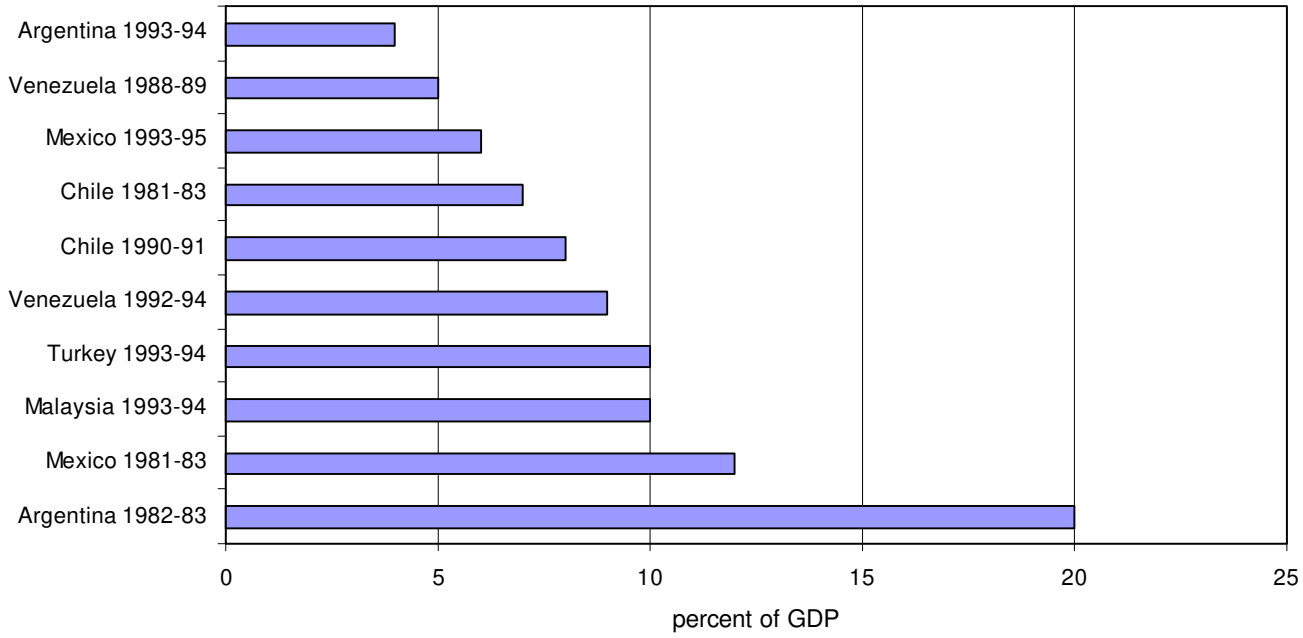
Foreign Shock

T_1	Benefit	Relative to no Externality	$\tilde{r}$	Benefit	Relative to no Externality
0.25	0.186	77.5	0.031	0.0268	11.15
0.5	0.124	51.67	0.035	0.124	51.67
0.75	0.063	26.25	0.041	0.2713	113.04
1.00	0.0024	1.00	0.045	0.369	153.75

Domestic Shock

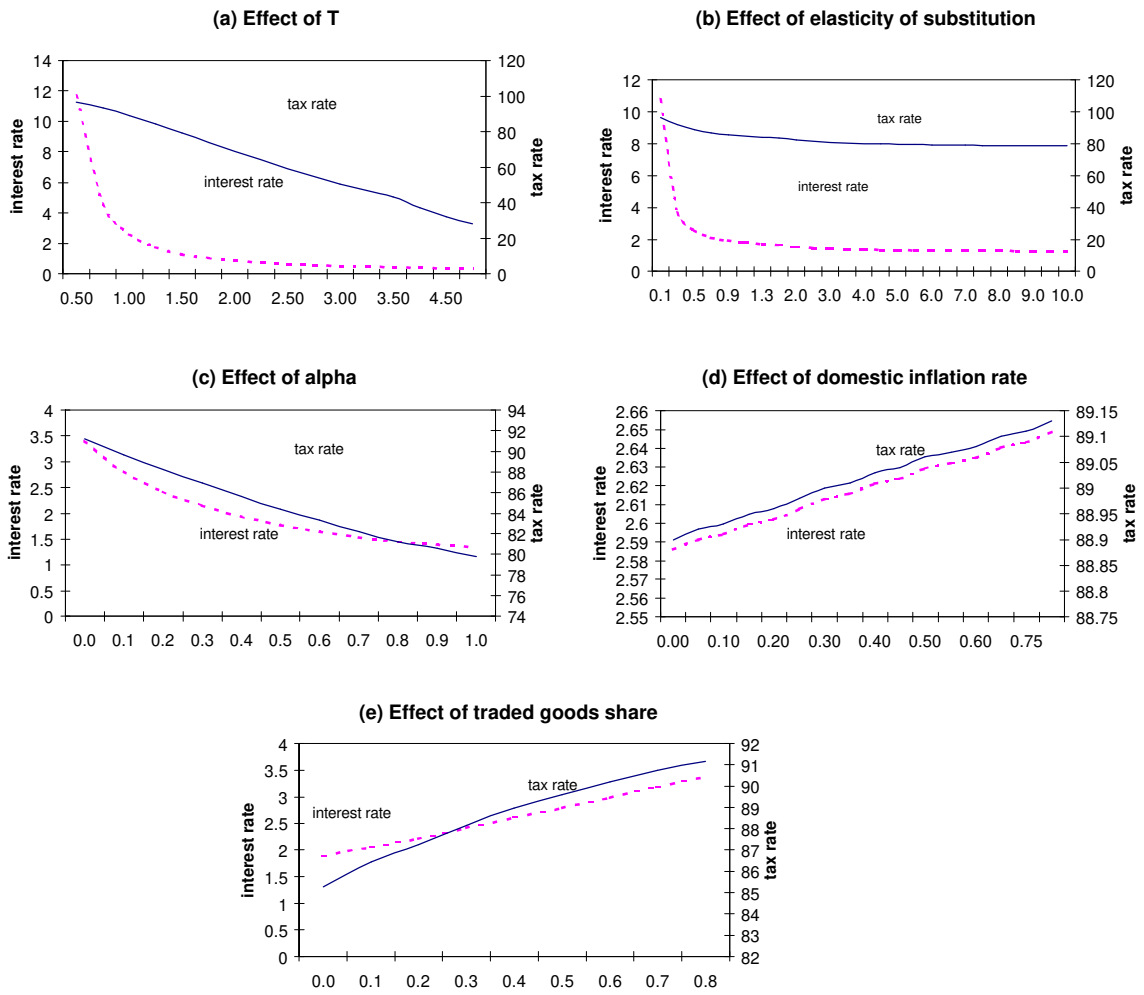
T_1	Benefit	Relative to no Externality	$\tilde{r}$	Benefit	Relative to no Externality
0.25	1.02	1.21	0.031	0.865	1.02
0.5	0.96	1.14	0.035	0.961	1.14
0.75	0.9	1.07	0.041	1.08	1.28
1.00	0.841	1.00	0.045	1.2	1.42

Figure 1: Large Reversals in Net Private Capital Flows



Notes: net capital flows includes short-term and long-term flows. The source for the data is IMF, World Economic Outlook Database.

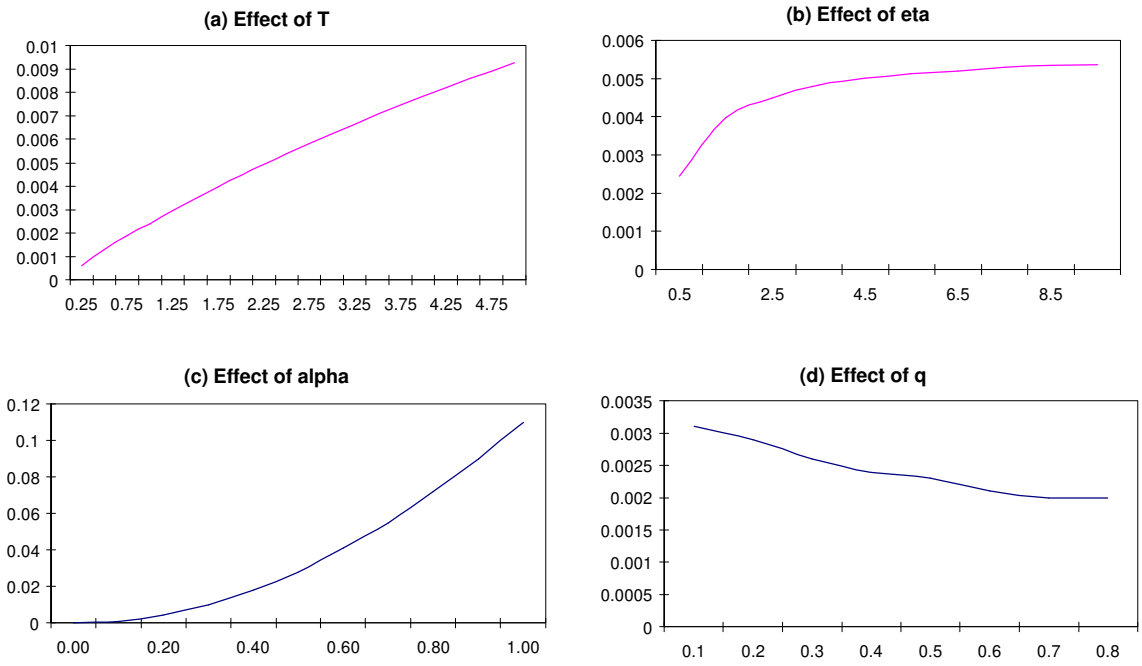
Figure 2: Tax/Interest Rate Required to Reduce Foreign Debt by 5% of GDP



Notes: the tax rate (monthly interest rate, respectively) for the baseline parameterization is 88.94% (2.6%). The baseline parameterization is:

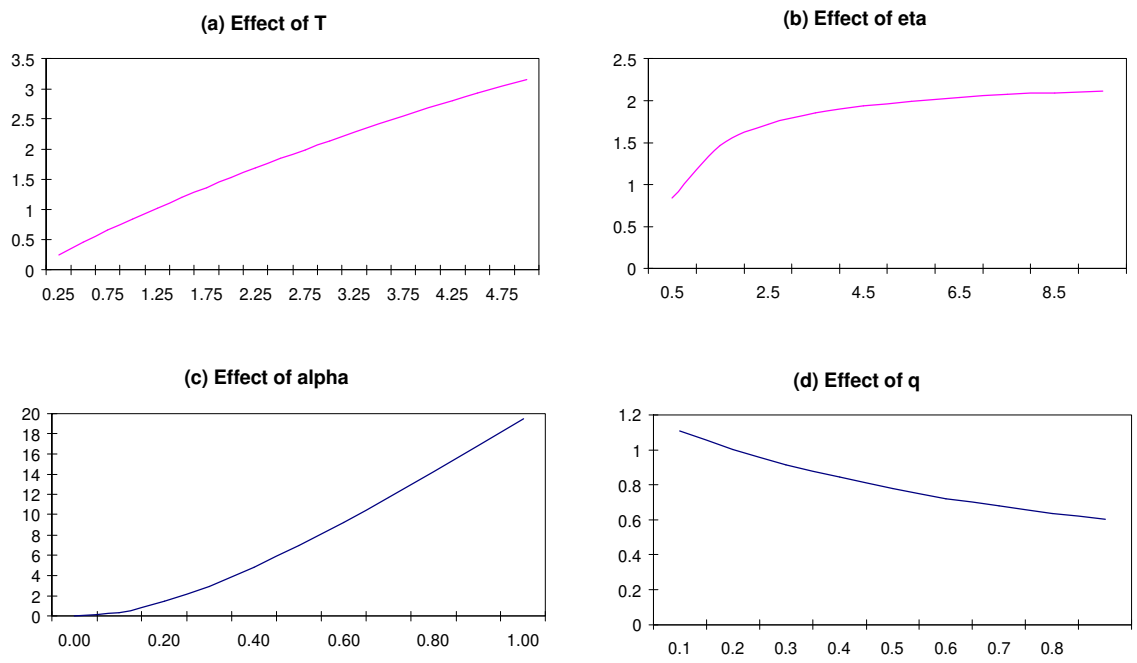
$q = 0.4, \alpha = 0.15, \beta = r^* = 0.03, i^* = 0.13, \eta = 0.5, y = y^* = 1, b_0 = 1$ and $T = 1$

Figure 3: Welfare Benefit of Taxes: World Nominal Rate Falls 9 Percentage Points



Notes: the welfare benefit for the baseline parameterization is 0.0024% of GDP. The baseline parameterization is as in Figure 2.

Figure 4: Welfare Benefit of Taxes: Temporary Domestic Stabilization



Notes: the welfare benefit for the baseline parameterization is 0.841% of GDP. The baseline parameterization is as in Figure 2 and the rate of devaluation temporarily falls from 1.84 (annually) to zero.