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EXCHANGE RATE MANAGEMENT: Intertemporal Tradeoffs.

By

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1. INTRODUCTION

It is now well understood that exchange rates cannot be managed without the pursuit of other policies which make the entire package internally consistent (e.g. Pollak (1957)). Governments or central banks can only temporarily target exchange rates without giving due attention to other policies. However, eventually they will have to choose or will be forced to chooce measures which validate ex-post the feasibility of their exchange rate policy. These measures will typically be anticipated by economic agents during the initial periods of exchange rate management and those anticipations will translate into immediatee pressure in various markets. Hence, the success of exchange rate management depends to a large extent on other policies, commitments to future policies, and its effects on expectations.

In this paper we study the intertemporal constraints on exchange rate management for economies in which governments precommit themselves to the future course of monetary and fiscal policies and honor their commitments. We explore the implication of such policy packages in terms of their effects on the time pattern of spending and debt.

In order to obtain real effects of exchange rate management policies we do away with the Ricardo-Barro type neutrality (see Barro (1974)) by considering consumers with finitely expected lifetime, as in Blanchard

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(1984). It is known that in the presence of Ricardo-Barro type neutrality exchange rate management has no real effects (see, for example, Helpman and Razin (1979)). On the other hand, this neutrality breaks down in the presence of various distortions, in which case exchange rate management does have real effects (see, for example, Aschauer and Greenwood (1981) and Helpman and Razin (1984)), but we do not wish to consider such distortions in the present study.

In addition to the general feasibility constraints that result from the fact that the real consequences of exchange rate management depend on the precise time pattern of the policies that support the exchange rate path, we study an example in which disinflation is achieved by means of an exchange rate freeze. This is an interesting case because several countries have recently attempted to disinflate by means of exchange rate targetting (e.g. Argentina, Chile, Israel). We show that when this policy is pursued with an initially overvalued currency and a delayed accompanying absorption policy, the result will be higher spending during the initial periods following the inception of exchange rate management, lower spending in later periods, and larger aggregate foreign debt in all time periods. The twist in the time profile of spending and the upward shift in the time profile of debt will be larger the larger the initial overvaluation and the longer the delay in the absorption policy. However, the delay in the absorption policy is bounded by the government's taxing capacity. The beneficiaries of this policy combination are individuals who are alive during its inception, while future generations suffer.

In our framework the time pattern of real variables does not depend on monetary policy if the exchange rate is freely floated and in this case the allocation of resources is efficient. Efficiency is also preserved when the exchange rate is managed, but the time pattern of real variables does depend on the policies that support the exchange rate path (contrast with Helpman and Razin (1979), Helpman (1981) and Lucas (1982)). As pointed out above, these supporting policies do affect the intergenerational distribution of welfare. Hence, in this framework there are significant differences between a managed and a floating exchange rate regime. The real effects of exchange rate targetting that we describe are closely related to the real effects of budget financing that were discussed by Blanchard (1984) and Frenkel and Razin (1984) in frameworks without money. We, naturally, take explicit account of monetary considerations.

We begin our discussion with a description of the economy in a floating exchange rate regime. In this regime monetary injections and withdrawals through the tax-transfer system have no real effects. This is followed by a detailed discussion of the channel through which exchange rate management has real effects and an illustration of the disinflation policy.

2. Floating Exchange Rate

We consider an economy with overlapping generations in which a cohort of size 1 is born in every period. Individuals survive to the next period with probability γ and this probability is age independent. The event of death is independent across individuals. Therefore, the proportion of a cohort alive at time t_1 which survives to period t_2 is:

$$\gamma^{(t_2-t_1)}$$

The age distribution of the population is constant over time and in every period there are

$$\gamma^a$$

individuals of age a. The size of the population is also constant and equal to:

$$\sum_{a=0}^{\infty}\gamma^a = 1/(1-\gamma)$$

We assume that those individuals live in a small country facing a given one-period world real interest rate r on sure loans in terms of traded goods. All loans are indexed and foreign prices of traded goods are constant and equal to one. Thus if one borrows b he has to repay Rb the next period, where $R = 1+r$ is the interest factor. Since an individual survives to the next period only with probability γ, he cannot obtain a loan with this interest rate. Foreign financial institutions who lend to domestic residents will obtain a sure repayment Rb if they charge a real interest rate of:

$$\frac{R}{\gamma} - 1$$

In order to see this, suppose that b is being lent to every individual of a given cohort. Then those who will survive to the next period will repay

$$\frac{R}{\gamma}b$$

However, only a proportion γ of the individuals will survive. Therefore total payments by the cohort will be Rb. Clearly, $(R/\gamma) - 1$ is the risk-adjusted real interest rate (see Blanchard (1984)).

There exist firms that produce y_T units of traded goods per capita and y_N units of nontraded goods per capita. The sectoral output levels are functions of the relative price of nontradables p_t and so in GNP per captita in terms of traded goods, which we denote by $y(p_t)$. Clearly, $dy(p_t)dp_t = y_N$.

Firms sell their output in exchange for domestic money and distribute the proceeds to the living individuals at the beginning of the following period. Individuals have to pay for goods with money; with home money for home goods and foreign money for foreign goods. Thus, we assume a system with cash-in-advance constraints in which goods are bought with the seller's currency (see Helpman and Razin (1984) for a discussion of alternative monetary mechanisms).

The budget constraint of an individual of age a in period t is:

$$c_{a,t} = b_{a,t} - (R/\gamma)b_{a-1,t-1} + [e_{t-1}y(p_{t-1}) - \tilde{\theta}_t]/e_t \tag{1}$$

where $c_{a,t}$ $(\equiv c_{Ta,t} + p_t c_{Na,t})$ is his total consumption in terms of traded goods; $b_{a,t}$ is his new debt; $(R/\gamma)b_{a-1,t-1}$ is his repayment of old debts, with period minus one debt equal to zero; i.e., $b_{-1,t} = 0$ for all t; e_t is the exchange rate; and $\tilde{\theta}_t$ are the age independent nominal taxes or transfers. We also assume in (1) that money is not used for store of value purposes, which happens when the nominal effective interest rate is positive. In addition we need to impose the terminal condition that $(R/\gamma)^{-\tau}b_{a+\tau,t+\tau}$ goes to zero as τ goes to infinity.

We assume that the government has no real spending. In a freely floating exchange rate regime the government injects and withdraws money from the economy via the taxes and transfers $\tilde{\theta}_t$. Hence, if m_t is the per-capita stock of money in period t, then:

$$m_t = m_{t-1} - \tilde{\theta}_t$$

On the other hand, with positive nominal interest rates all money is spent on goods, implying:

$$m_t = e_t y(p_t)$$

Taken together the last two equations imply:

$$\text{(2)} \qquad [e_{t-1}y(p_{t-1}) - \tilde{\theta}_t]/e_t = y(p_t)$$

Using (1) and (2) it is clear that in a pure floating exchange rate regime monetary injections and withdrawals via $\tilde{\theta}_t$ have no real effects. Put differently, in this system the time pattern of consumption and debt, individual as well as aggregate, and the real exchange rate $(1/p_t)$, do not depend on the time pattern of monetary injections. This result is in line with models in which there are no overlapping generations and individuals live to the end of the economy's horizon (see Helpman (1981)).

We use this case as a benchmark for comparisons with exchange rate management policies. It should though be pointed out that neutrality of the above described monetary policy need not hold in the presence of a labor-leisure choice or externally financed investment. It also need not hold if the buyer's currency is used for transactions instead of the seller's (see Helpman and Razin (1984)). Moreover, a special feature of the current formulation of overlapping generations is that the neutrality result also depends on the assumption of an equal division of dividends amongst all living individuals. It can, for example, be shown that if this is not so, and individuals can take loans using current period output as collateral (in case they do not survive to the next period), then monetary policy will have real effects.

In what follows we will use the model described in this section in order to study real effects of exchange rate management policies. We will be interested in particular in the deviation that such policies generate from the benchmark case.

3. EXCHANGE RATE MANAGEMENT AND MOVEMENTS OF RESERVES

Suppose that in the benchmark case considered in the previous section we obtain the following solution for per-capita consumption and debt:

$$\bar{c}_t = (1-\gamma)\ \sum_{a=0}^{\infty}\gamma^a\bar{c}_{a,t}\ ,\quad \bar{b}_t = (1-\gamma)\sum_{a=0}^{\infty}\gamma^a\bar{b}_{a,t}\ ,\quad t = -\infty,\ldots$$

and the real exchange rate $\{1/\bar{p}_t\}_{t=-\infty}^{\infty}$.

Suppose also that in period $t=0$ the government begins to manage the exchange rate. The question we consider is: what are the real consequences of exchange rate management in terms of deviations of $\{c_t, b_t, p_t\}$ from the benchmark case. As we know from Helpman (1981), in a model without overlapping generations in which individual lives extend to the economy's horizon exchange rate management has no real effect as long as the government is intertemporally balanced, independently of the time pattern of taxes. The reason is that in that case the private sector fully internalizes the government's intertemporal budget constraint. This, however, cannot be expected in an economy in which individuals pay future taxes with a probability smaller than one. Therefore, the time pattern of taxes required in order to manage the exchange rate will generally have real effects (e.g. Blanchard (1984)).

Clearly, for every time pattern of exchange rates there exists a time pattern of taxes and transfers which preserves the benchmark real variables. However, while in previous models (e.g. Helpman (1981)) there was no constraint on the time pattern of the neutral taxes but only on their present value, here this pattern is unique. As is clear from (1) and (2), if in period $t=0$ the real exchange rate remains $(1/\bar{p}_0)$ and per-capita debt does not change, then for a given pattern of exchange rates $\{e'_t\}_{t=0}^{\infty}$ the taxes $\{\tilde{\theta}'_t\}_{t=1}^{\infty}$ have to satisfy:

$$\tilde{\theta}'_t = e'_{t-1}y(\bar{p}_{t-1}) - e'_t y(\bar{p}_t) \quad , \quad t = 0,1,\ldots \tag{3}$$

where $e'_{-1} = \bar{e}_{-1}$. This policy generates monetary injections and withdrawals which keep the money supply in line with the nominal value of output implied by the exchange rate e'_t and the real exchange rate $(1/\bar{p}_t)$; i.e. it assures:

$$m'_t = m'_{t-1} - \tilde{\theta}'_t = e'_t y(\bar{p}_t) \quad .$$

with no deficits or surpluses in the overall balance of payments.

If (3) is satisfied, we have

$$[e'_{t-1}y(\bar{p}_{t-1}) - \tilde{\theta}'_t]/e'_t = y(\bar{p}_t), \quad t = 0,1,\ldots \tag{4}$$

which is the same as (2), implying no change in real variables. In this case no reserve movements are required in order to manage the exchange rate. Observe, however, that even when the exchange rate is maintained constant over time, <u>varying</u> taxes and transfers are required as <u>long as the real exchange rate is not constant over time</u>. <u>Hence, exchange rate management without real consequences requires a well coordinated time-varying policy of monetary injections and withdrawals</u>. No such policy is required under a free float.

It is clear from this discussion that if a policy that satisfies (3) does not accompany the exchange rate management programme there will be reserve movements. Assuming intrerest bearing services, reserve movements generate public debt which has real effects, as explained in Blanchard (1984). The time pattern of external public debt per capita is given by:

$$(5) \qquad b_t^G = Rb_{t-1}^G + \frac{1}{e_t}[e'_{t-1}y(p'_{t-1}) - e'_t y(p'_t) - \tilde{\theta}'_t], \quad t = 0,1,\ldots$$

with the initial conditions:

$$b_{-1}^G = 0, \; e'_{-1} = \bar{e}_{-1}, \; p'_{-1} = \bar{p}_{-1}.$$

We assume that the government repays its debts. Therefore its policy is restricted to satisfy (5) with the terminal condition:

$$(6) \qquad \lim_{t\to\infty} R^{-t} b_t^G = 0.$$

Equation (5) describes reserve (external interest bearing assets) movements according to the standard balance of payments mechanism. External debt grows at the rate of interest due to rollovers plus periodical additions through deficits in the overall balance of payments, the last component being represented by the terms in the square brackets. The first two terms describe the decline in the overall demand for money $[e'_{t-1}y(p'_{t-1}) - e'_t y(p'_t)$.

Part of this decline is satisfied by negative injections (withdrawals) via taxes $\tilde{\theta}'_t$. The rest is attained via foreign exchange purchases by the private sector, which bring about reserve losses. It is clear from (5) that when (3) is satisfied, we obtain the solution $p'_t = \bar{p}_t$ and $b^G_t = 0$ for all t; i.e., there are no reserve movements.

Now, suppose that the exchange rate management policy starts in period zero and the policy rule given in (3) is not followed. Then the effects of reserve movements on individual budget constraints can be seen from the following rewriting of the budget constraint (1), using (5):

$$(8) \qquad c'_{a,t} = b'_{a,t} - (R/\gamma)b'_{a-1,t-1} + y(p'_t) + (b^G_t - Rb^G_{t-1})$$

In order to see as clearly as possible the real effects of reserve movements, assume that all goods are traded; i.e., $y_N = 0$ and $y(p_t) \equiv y_T$. Then (1) and (2) imply (using the terminal condition on $b_{a+\tau,t+\tau}$):

$$(8) \qquad \sum_{\tau=0}^{\infty}(\gamma/R)^{\tau}c_{a+\tau,t+\tau} = \sum_{\tau=0}^{\infty}(\gamma/R)^{\tau}y_T - (R/\gamma)b_{a-1,t-1}$$

while (7) implies (using the terminal condition on $b_{a+\tau,t+\tau}$ and (7)):

$$(9) \qquad \sum_{\tau=0}^{\infty}(\gamma/R)^{\tau}c'_{a+\tau,t+\tau} = w'_{a,t}$$

where $w'_{a,t}$ is real wealth of an individual of age a at time t and

$$(10) \qquad w'_{a,t} = \sum_{\tau=0}^{\infty}(\gamma/R)^{\tau}y_T - (R/\gamma)b'_{a-1,t-1} - Rb^G_{t-1} + (1-\gamma)\sum_{\tau=0}^{\infty}(\gamma/R)^{\tau}b^G_{t+\tau}\,.$$

It is clear from a comparison of (8) with (10) that reserve movements have real effects and that these effects depend on the time pattern of reserve movements. Different time patterns of reserves generate different redistributions of wealth across generations, thereby effecting the time pattern of aggregate spending as we will show explicitly in the next section. Observe also that if we assume that no new cohorts are born and the probability of survival equals one, then viewed from t=0 constraint (10) coincides with (8), which implies neutrality of the exchange rate policy. This case coincides with that discussed in Helpman (1981).

The redistributional effect embodied in (10) can be also seen in another way by combining it with (5) in order to obtain:

$$(11)\qquad w'_{a,t} = \sum_{\tau=o}^{\infty}(\gamma/R)^{\tau}\left(y_T - \frac{\tilde{\theta}'_{t+\tau}}{e'_{t+\tau}}\right) + \sum_{\tau=o}^{\infty}(\gamma/R)^{\tau}\left(\frac{e'_{t+\tau-1} - e'_{t+\tau}}{e'_{t+\tau}}\right)y_T - (R/\gamma)b'_{a-1,t-1}\,.$$

It is seen from here that the real wealth of an individual born at time t depends both on the given depreciation rates of the managed exchange rate and on the tax rates. An individual born at t is better off the further away in the future taxes are imposed and the exchange rate is depreciated, and the nearer in the future transfers are given and the exchange rate is appreciated. However, the taxes cannot be divorced from exchange rate movements, because from (5) and (6) they have to satisfy:

$$(12)\qquad \sum_{t=o}^{\infty}R^{-t}(\tilde{\theta}'_t/e'_t) = \sum_{t=o}^{\infty}R^{-t}\,\frac{1}{e'_t}[e'_{t-1}y(p'_{t-1}) - e'_t y(p_t)]$$

where $p'_{-1} = \bar{p}_{-1}$ and $e'_{-1} = \bar{e}_{-1}$, with $y(p_t) \equiv y_T$ in the case of traded goods only. Hence, the larger initial appreciations of the currency the larger the taxes that have to be collected.

Coming back to (11), and the case of traded goods only, observe that from period $t=1$ onward exchange rates and taxes are fully anticipated. However, at time $t=0$, when exchange rate management begins, there is an <u>unanticipated</u> change both in the exchange rate and in taxes (and in the real exchange rate whenever there are nontraded goods). It is therefore useful to decompose the contribution of period zero disposable income, inclusive of capital gains on wealth, into anticipated and unanticipated components. Given the discussion of the benchmark case it is clear that the anticipated component of real income is y_T, while from (11) total real income is:

$$y_T - \frac{\tilde{\theta}'_0}{e'_0} + \frac{\bar{e}_{-1} - e'_0}{e'_0} y_T .$$

Therefore, the last two terms represent the unanticipated components, and they can be expressed as:

$$\text{(13)} \qquad - \frac{\tilde{\theta}'_0}{e'_0} + \frac{\bar{e}_{-1} - e'_0}{e'_0} y_T = g = k - h$$

where

$$\text{(13a)} \qquad k = \left(\frac{\bar{e}_0}{e'_0} - 1\right) y_T$$

is the unanticipated capital gain on money balances and

$$\text{(13b)} \qquad h = \frac{\tilde{\theta}'_0 - \tilde{\theta}_0}{e'_0}$$

is the unanticipated increase in real taxes. The definition of the real loss due to taxes is clear from (13b), while the capital gain on money balances may require an explanation. Before the change in the exchange rate policy the private sector is expected to hold

$$\bar{m}_0 = \bar{e}_0 y_T$$

money balances at the beginning of period zero. The real value of this money was expected to be y_T. As a result of the unanticipated stabilization of the exchange rate at e_0' the real value of this money has become $\bar{e}_0 y_T/e_0'$. Hence, (13a) describes the unexpected capital gain on period zero money holdings.

Now, using $y_N = 0$ and (13) it is seen from (5) that:

$$b_0^G = g = k-h. \tag{14}$$

Namely, the initial loss of reserves is equal to the public's unanticipated capital gain on money holdings minus the unanticipated increase in tax obligations. In view of (14), condition (3) for t=0 (which describes the period zero absorption policy that is required for real neutrality of the exchange rate management policy) can be interpreted as follows: The tax rate $\tilde{\theta}_0'$ is chosen so as to make the unanticipated increase in tax liabilities h just equal to the unanticipated capital gain on money balances k. When this holds there are no initial reserve movements.

4. AN ILLUSTRATION

In order to illustrate the dynamic effects of exchange rate management, we consider in this section an explicit example. For this purpose suppose that there are traded goods only, and suppose that, as has been the case in several countries (e.g. Argentina, Chile, Israel) the government decided to reduce inflation by means of exchange rate management. For concreteness, suppose that it freezes the exchange rate at the level e from period zero to infinity. In this case real effects are prevented if $h=k$

and $\tilde{\theta}_t^* = 0$ for $t=1,2,\ldots,$ as can be seen from (3). Namely, perfect price stabilization with no real effects is achieved when the government taxes away the period zero capital gains on money holdings, and it balances its budget in all future periods by setting taxes equal to zero. In particular, price stability without real effects is achieved by choosing the period zero exchange rate equal to the period minus one exchange rate and by balancing the budget in period zero as well.

The simple policy combination that we described above is feasible only in the simple case to which it was applied. If, for example, there are nontraded goods in the system, then taxing away the capital gain on money holdings in period zero and setting taxes equal to zero in all future periods will not attain price stability, nor will it prevent real effects. As we have shown in the previous section real neutrality requires the taxes to vary over time in reaction to real exchange rate movements (see (3)). When other real world complications are added as well, such as the dependence of the velocity of circulation on the nominal interest rate, the required policy coordination for real neutrality becomes even more complicated.

Returning to the simple case with traded goods only, we choose to analyze the following policy experiment. Suppose that the exchange rate e is chosen below $\bar{e}_0$ and taxes are not changed in period zero. Starting with period $t=1$ no taxes are imposed until period $t=T$. From $t=T$ onwards fixed real taxes $\tilde{\theta}_t = \theta'/e$ are collected in order to pay interest on public foreign debt, so that the government's budget is balanced for $t=T, T+1,\ldots$. In this case exchange rate management begins with an overvalued currency; we wish to explore the resulting real effects and their dependence on the timing of the contractionary policy.

Observe that under this policy experiment:

$$h = 0$$

$$g = k > 0$$

while from (5) and (14):

(15) $$b_t^G = \begin{cases} R^t g \ , & 0 \leq t \leq T-1 \\ R^{T-1} g \ , & t \geq T \end{cases}$$

i.e., the government's foreign debt grows at the rate of interest until period T-1 and remains constant afterwards.

From (12) and (13a) we obtain the real taxes:

$$\theta_t = (R-1)R^{T-1}g \ , \ t = T, T+1, \ldots,$$

i.e., taxes from T onwards pay the interest on government foreign debt. Since no taxes are imposed between period 1 and T-1, the individual budget constraint (1) can be written as:

(16) $$b_{a,t} = (R/\gamma)b_{a-1,t-1} + c_{a,t} - (y_T - \theta_t)$$

where:

(17) $$\theta_t = \begin{cases} -g & , \quad t = 0 \\ 0 & , \quad 1 \leq t \leq T-1 \\ (R-1)R^{T-1}g & , \quad t \geq T \end{cases}$$

while (9) and (11) can be written as:

$$\sum_{\tau=0}^{\infty}(\gamma/R)^{\tau}c_{a+\tau,t+\tau} = \sum_{\tau=0}^{\infty}(\gamma/R)^{\tau}(y_T-\theta_{t+\tau}) - (R/\gamma)b_{a-1,t-1} \equiv w_{a,t} \tag{18}$$

and we drop the prime from variables in the fixed exchange rate regime.

Now, assume that individuals maximize expected lifetime utility:

$$E_t \sum_{\tau=0}^{\infty}\delta^{\tau}u(c_{a+\tau,t+\tau}) = \sum_{\tau=0}^{\infty}(\gamma\delta)^{\tau}u(c_{a+\tau,t+\tau})$$

subject to (19), with $u(\cdot)$ being logarithmic. Then:

$$c_{a,t} = (1-\gamma\delta)w_{a,t}$$

and per capita consumption is:

$$c_t = (1-\gamma\delta)\sum_{a=0}^{\infty}\gamma^{a}c_{a,t} = (1-\gamma\delta)(1-\gamma)\sum_{a=0}^{\infty}\gamma^{a}w_{a,t}.$$

Using the right hand side of (18), we obtain:

$$c_t = (1-\gamma\delta)\left[\sum_{\tau=0}^{\infty}(\gamma/R)^{\tau}(y_T-\theta_{t+\tau}) - Rb_{t-1}\right], \qquad t \geq 0 \tag{19}$$

and by aggregating (16) over all age groups we obtain:

$$b_t = Rb_{t-1} + c_t - (y_T - \theta_t) \quad , \quad t \geq 0 \tag{20}$$

with the initial condition $b_{-1} = \bar{b}_{-1}$.

Equations (19)-(20) represent a dynamic system of consumption and debt accumulatio that can be solved for every sequence $\{\theta_t\}$. In our case $\theta_0 = -g = h-k$ represents the difference between unanticipated taxes and capital gains, while θ_t, $t = 1,2,\ldots$, represent anticipated future taxes. The benmark solution $\{\bar{c}_t, \bar{b}_t\}$ is obtained by setting $\theta_t = 0$ for all t, and it is:

$$(21) \qquad \bar{c}_t = (1-\gamma\delta)R\{\frac{y_T}{R-\gamma}[1 - \gamma(1-\delta R)\frac{1-(\gamma\delta R)^t}{1-\gamma\delta R}] - (\gamma\delta R)^t \bar{b}_{-1}\}$$

$$(22) \qquad \bar{b}_t = (\gamma\delta R)^{t+1}\bar{b}_{-1} + \frac{\gamma(1-\delta R)}{R-\gamma}\,\frac{1-(\gamma\delta R)^{t+1}}{1-\gamma\delta R}\, y_T$$

Thus, if say $\bar{b}_{-1} = 0$ and $\delta R < 1$, then $\bar{c}_t$ is declining over time and $\bar{b}_t$ is rising over time, both reaching a steady state as shown in Figure 1. If, on the other hand, $\bar{b}_{-1} = 0$, $\delta R > 1$, and $\gamma\delta R < 1$, then $\bar{c}_t$ is rising over time and $\bar{b}_t$ is declining over time, both reaching a steady state as shown in Figure 2. If $\bar{b}_{-1} = 0$ and $\gamma\delta R > 1$, then $\bar{c}_t$ is rising and $\bar{b}_t$ is declining without bound; i.e., there is no steady state. If $\gamma\delta R = 1$ then consumption and debt remain constant over time.

Now, for the experiment with exchange rate management that we described above $\{\theta_t\}$ satisfies (17), and we obtain the following solution:

$$(23) \quad c_t - \bar{c}_t = \begin{cases} (1-\gamma\delta)g[1 - \frac{R-1}{R-\gamma}\gamma^T - \frac{R-1}{R-\gamma}(1-\gamma)\gamma^T\,\frac{1-(\gamma^2\delta)^{-t}}{1-(\gamma^2\delta)^{-1}}(\gamma^2\delta)^{-1}](\gamma\delta R)^t, & 0 \leq t \leq T-1 \\[2ex] (1-\gamma\delta)g[1 - \frac{R-1}{R-\gamma}\gamma^T - \frac{R-1}{R-\gamma}(1-\gamma)\gamma^T\,\frac{1-(\gamma^2\delta)^{-T+1}}{1-(\gamma^2\delta)^{-1}}(\gamma^2\delta)^{-1}](\gamma\delta R)^{T-1} \\ \qquad - g(1-\gamma\delta)\frac{R-1}{R-\gamma}(1-\gamma)R^T\,\frac{1-(\gamma\delta R)^{t+1-T}}{1-\gamma\delta R}, & t \geq T \end{cases}$$

$$g[(1-\gamma\delta)\frac{R-1}{R-\gamma}\gamma^{T}\frac{1-(\gamma^{2}\delta)^{-t-1}}{1-(\gamma^{2}\delta)^{-1}}+1](\gamma\delta R)^{t} \quad , \quad 0 \leq t \leq T-1$$

(24) $\bar{b}_t - b_t =$

$$(\bar{b}_{T-1} - b_{T-1})(\gamma\delta R)^{t+1-T} + g\gamma(1-\delta R)\frac{R-1}{R-\gamma}R^{T-1}\frac{1-(\gamma\delta R)^{t+1-T}}{1-\gamma\delta R} \quad , \quad t \geq T$$

It is clear from this solution that for $g > 0$ average consumption c_t is larger than $\bar{c}_t$ for $t=0$ and possibly for other small values of t, and that $c_t < \bar{c}_t$ for t large enough. Hence, the initial overvaluation of the currency brings about higher spending levels initially and lower spending levels in the future, as compared to the benchmark case. On the other hand, the initial overvaluation of the currency makes private foreign debt lower in all time periods. Nevertheless, a direct calculation shows that total debt $b_t + b_t^G$ is larger than $\bar{b}_t$ in all time periods, which means that public debt increases by more than private debt declines. A comparison of the time path of consumption and debt for the case $\delta R < 1$ is illustrated in Figure 3. It is seen from (23) that the initially higher spending level is larger the later taxes are imposed, and that the eventually lower spending level is smaller the later taxes are imposed. Thus, the longer the delay in the required contractionary policy the larger are the real effects of exchange rate management. Moreover, the contractionary policy cannot be delayed at will, because given a limit on taxing capacity, say x percent of GNP (possibly hundred percent), taxes which eventually have to equal $g(R-1)R^{T-1}$ cannot exceed x percent of y_T. These results are in line with the observed responses of spending and debt to the dissinflation attempts in Israel during 1982-1983 and in Chile and Argentina during the late seventies.

The economics behind these results is as follows. The capital gain from the overvalued currency is appropriated by the individuals who are alive in period zero. To them the present value of future tax liabilities is smaller than the capital gain, and they respond by raising spending in all periods. All future generations face larger tax liabilities and reduce spending; the later an individual is born the larger his tax liability in present value terms (except that all those who were born after $T-1$ have the same tax liability). Over time the population share of individuals who were alive at $t=0$ declines and the share of those with heavier tax liabilities increases. Therefore, aggregate spending is initially larger and it becomes smaller far enough in the future.

REFERENCES

Aschauer, David and Greenwood, Jeremy, "A further exploration in the theory of exchange rate regimes," Journal of Political Economy, 91, (October 1983), 868-875.

Barro, Robert J., "Are government bonds not wealth ," Journal of Political Economy, 82 (November/December 1974), 1095-1117.

Blanchard, Olivier, J., "Debt, deficits and finite horizons," NBER Working Paper No.1389, June 1984.

Frenkel, Jacob A. and Razin, Assaf. "Budget deficits and rates of interest in the world economy," NBER Working Paper No.1354, May, 1984.

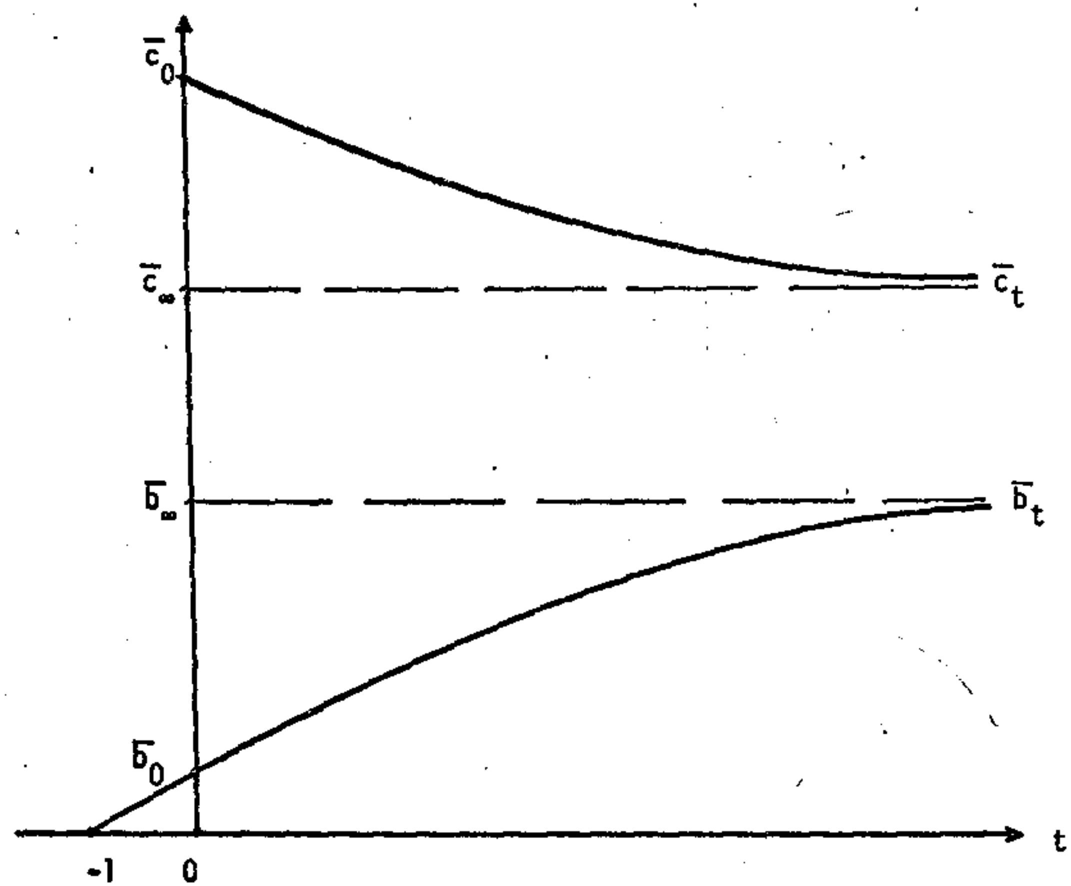
Helpman, Elhanan, "An exploration in the theory of exchange rate regimes," Journal of Political Economy, 89 (October 1981), 865-890.

Helpman, Elhanan and Razin, Assaf, "Towards a consistent comparison of alternative exchange rate regimes," Canadian Journal of Economics, 12 (August 1979), 394-409.

Helpman, Elhanan and Razin, Assaf, "The role of saving and investment in exchange rate determination under alternative monetary mechanisms," Journal of Monetary Economies, 13 (May 1984), 307-325.

Lucas, Robert, E.Jr., "Interest rates and currency prices in a two-country world," Journal of Monetary Economies, 10 (November, 1982), 335-360.

Pollak, J.J., "Monetary analysis of income formation and payments problems." IMF Staff Papers, 6 (November 1957-58), 1-50.



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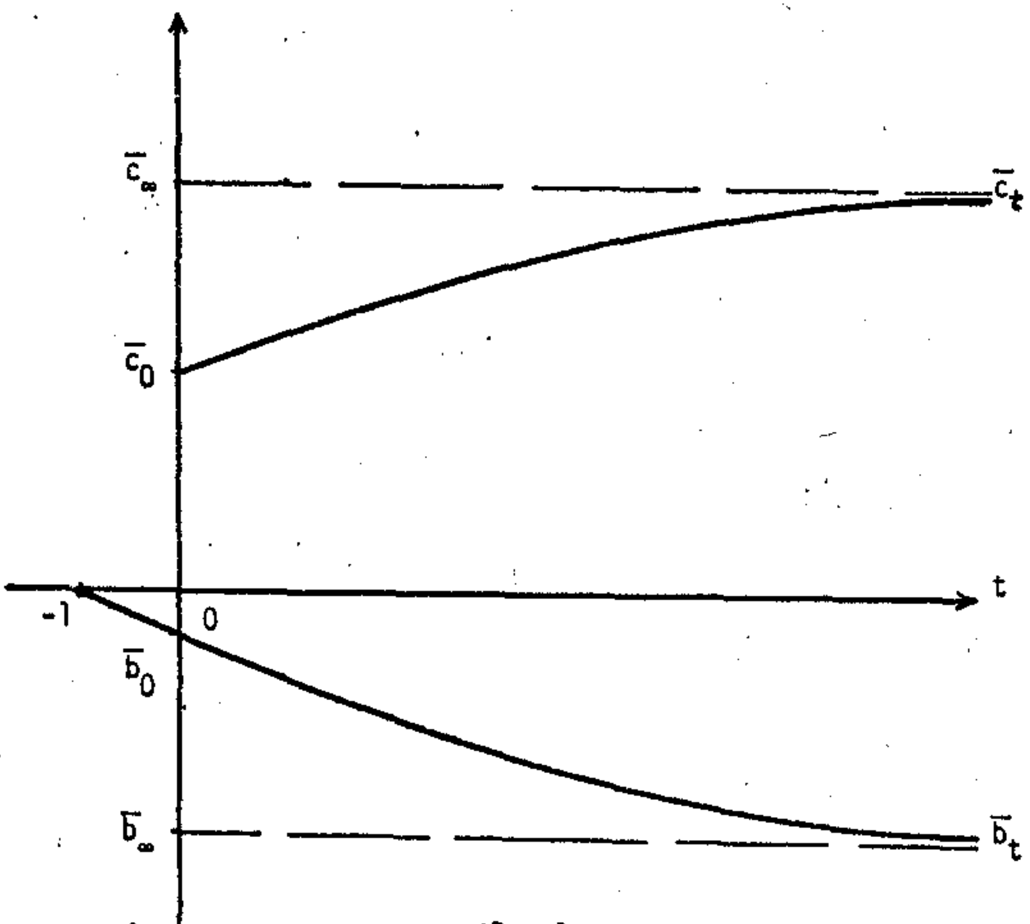

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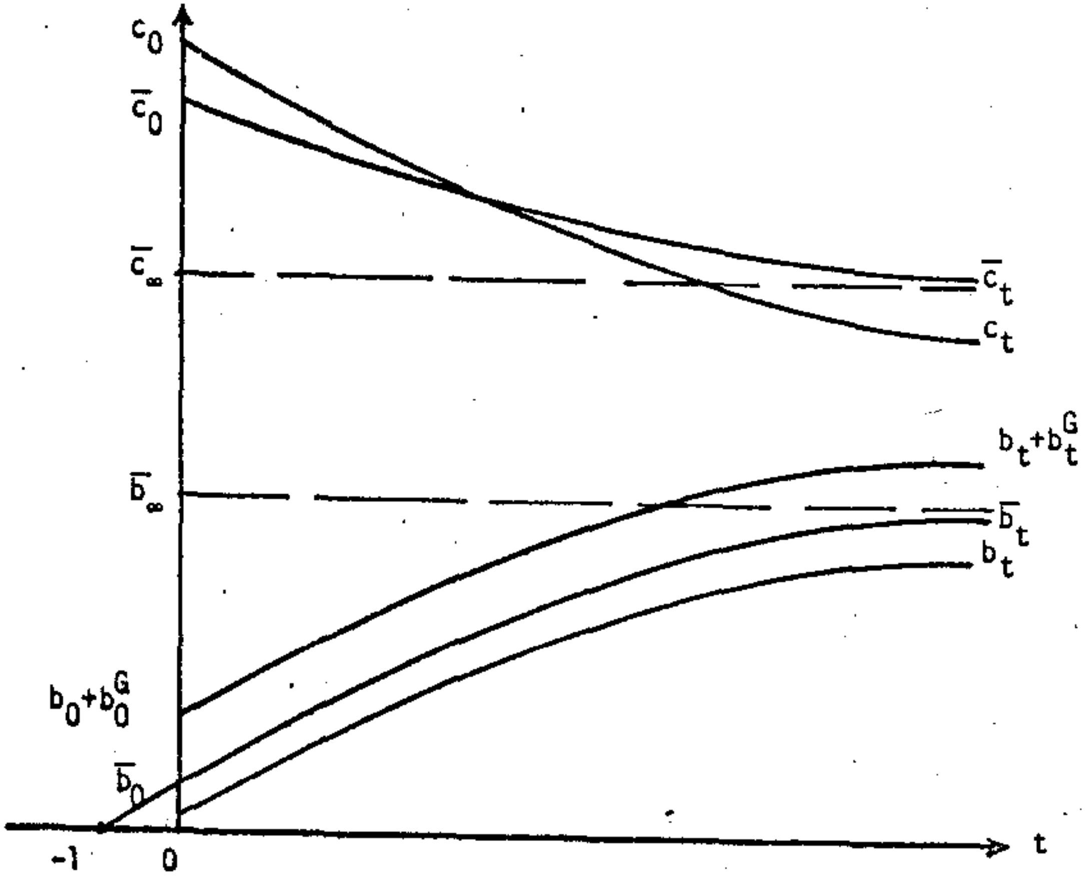
c_0
$\bar{c}_0$
$\bar{c}_\infty$
$\bar{b}_\infty$
$b_0+b_0^G$
$\bar{b}_0$
$\bar{c}_t$
c_t
$b_t+b_t^G$
$\bar{b}_t$
b_t
-1
0
t

$\delta R < 1$