Anticipated Shocks, Intertemporal Speculation and Speculative Run

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I. Introduction

Recent Argentine experience of the active crawling peg with the preannounced declining rate of devaluation reveals that the peso suffers the real appreciation at the outset of new regime, quite contrary to anticipations of the authorities. The current account deficit and sexternal debt accumulated with the speculative capital inflows. This above all led to the widespread belief that the peso was overvalued. People were expecting a rate of devaluation larger than that had been announced so that the credibility problem about the concurrent scheme of declining rate of devaluation arose.

In January 1979 the government announced the declining rate of devaluation which was supposedly to reach zero by March 1981 when a new administration would take charge. Instead, the devaluation pressures amounted, culminating in the collapse of three major private banks in April 1980. An eventual series of devaluations is implemented in the year of 1981 before and after the new goverment takes the office.[1] It is noteworthy that the collapse of three private banks precedes an eventual series of devaluations.

From a theoretical perspective this paper provides an intertemporal model *a la* Sidrauski (1967) to shed some light on the recent Argentine experience as briefly stated above. The conventional way of postulating a demand for money is to put real balances in the utility function we can place foregin currency in the utility function in order to investigate currency substitution between domestic and foreign money in a small open economy (Liviatan, 1983) and to derive the indeterminate exchange rate in a

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multi-country world (Kareken and Wallace, 1981). However, it is well known that the proper choice of assets to be included in nominal balances is hard in that there is no reason for including a particular class of assets rather than alternative assets in the utility function (Sargent, 1983). We will include only the domestic money in order to concentrate on the seignorage consideration on the national money before it is substituted by foreign currency. The importance of seignorage considerations is recently stressed in association with the recently enforced regime of the crawling peg (Fischer, 1982, 1983 ; Calvo, 1981 ; Obstfeld, 1981b). Thus the demand for real balances is dominated in the rate of return by the alternative assets (internationally-traded bonds or interest-bearing foreign assets in our model). The demand for assets is sensitive to policy changes in our model. Since it is derived from underlying preferences and technologies in our model, it is immune to Lucas critique(Lucas, 1976).

To reduce the difficulties inherent in an intertemporal optimizing model and to focus on the intertemporal speculation and smoothing we rely on a simple model that follows.

First, we employ an infinite-horizon optimizing model of a small open economy (Calvo, 1981 ; Obstfeld, 1981 a, b, 1982, 1984 c ; Svensson and Razin, 1983.) The infinite-horizon model has some limitations. When households have a finite rather than infinite planning horizon, government deficit and debt policy can affect the optimal current account and the path of resource allocation (Blanchard, 1984). The overlapping finite-lived generations model would do better describe the life-cycle aspects of saving behavior (Buiter, 1981 ; Persson and Svensson, 1983), while two-period models (sachs, 1981 ; svensson and Razin, 1983) are subject to the constraint that the current deficit ought to be compensated by the next period's surplus. The infinite-horizon model has the tendancy to magnify the intertemporal substitution.

Second, in this paper, the time preference rate is assumed to be equivalent to the interest rate (Obstfeld, 1983). By assuming this we escape from the issue of the dynamic stability of the adjustment upon a shock. In general, in the infinite-horizon case, stability of the stationary state implies that the rate of time preference increases with the welfare level(Svensson and Razin, 1983).

Finally, the investment is not incorporated into the model, for simplicity. The capital formulation would enable us to track the realistic optimal current account(Sachs, 1981 ; Persson and Svensson, 1983 ; Blanchard, 1983 ; Abel and Blanchard, 1983). But our model is of partial equilibrium in that output is given. The general equilibrium intertemporal models are introduced in Obstfeld (1980) and Lipton and Sachs (1983).

This paper analyzes the impact of anticipated shocks associated with the policy changes in an optimizing model of small open economy, In particular, it studies why the credibility problem about the active crawling peg of a declining rate of devaluation arose and then how the anticipated and unaticipated as well as temportary and permanent changes in the exchange rate regime that are instituted in order to improve current account are faced with the speculative run on the reserves. The major finding is that a decline in consumption is accompanied by a decline in the demand for real balances as long as the future higher rate of devaluation is anticipated. A decline in the demand for real balances will exhibit itself with either the speculative attack on the government's reserves or the rapid rise in the price level. The other finding is that the movement of exchange rate in the period when the economy faces the actual shocks and the speculative foreign borrowing is going on contradicts to the recent view about exchange rate that assigns an important role to the current account. According to the latter view, the spot exchange rate will arise with the current surplus in the current account, emphasizing the wealth effect of real balances on consumption (Rodriguez, 1980 ; Dornbusch and Fischer, 1980).

The adjustment of exchange rate (or price level) depends heavily on the degree of government's sales (or purchases) of reserves according to individual portfolio adjustment instead of the inherent laws of motion of the system. The response of government could be complete enough to produce no change in the exchange rate. If a decline in the demand for real balances is not coupled with government's sale of foreign assets, the speculators would force the government to sell them since they try to avoid capital losses on their assets via the speculative attack on goverment's reserves. The speculative run is associated with the discontinuous change in the demand for real balances. However, the speculative run on reserves might not necessarily lead to the collapse of the exchange rate regime if the government can defend it through the external borrowing (Garber, 1981 ; Obstfeld, 1984 b).

The speculative run on reserves could be a foreseeable event if we have perfect foresight on the behavior of the government which is conditioned by the movment of endogenous variables of the model. Instead, we do assume that the future timing of changes in the regime is exogenously given as a news since it is essentially uncertain(Salant and Henderson, 1978), but the market does not reflect the future change using the probabilities on some contingencies on which it depends until the news comes. The high probability is related to the imminence of future switch in the regime so that the news arrives sooner. A certain level of reserves (zero as usual) at which the authority abandons the current regime is no longer a piece of information necessary for the timing of the speculative attack. Hence, assuming the imperfect information on the condition at which the government changes the regime, the timing of the speculative attack is set by the timing of the annoucement of future shocks. If the authority hastens to abandon the current regime in the face of the speculative attack, the exchange rate continuity condition invoked by Krugman (1979) might not hold.

The paper is organized as follows. Section Ⅱ introduces the model in which the representative household derives utility from consuming a single composite commodity and holding real money balances under the stock and flow constraints. Section Ⅲ analyzes the impacts of the shock of the rate of devaluation and output. The preannouncement effect is stressed as it leads to the initial perverse movement of consumption. We point out the dilemma that the new regime that aims to reduce consumption confronts with blance-of-payments crises. Section Ⅳ studies the switch into the floating rate from the fixed rate. The current response depends on the future changes in the rule of money supply under the floating rates. The concluding remarks are provided in Section 5.

Ⅱ. The Model

The economy is represented by an infinitely-lived household whose welfare at any point of time is derived from consuming a single composite commodity and holding real money balances (Sidrauski, 1967). The household maximizes a welfare functional of the form

$$V = \int_0^{\infty} U(c_t, m_t)e^{-\delta t}dt \tag{1}$$

where t is time index, c and m stand for consumption and real (domestic) money balances. The parameter δ is the household's constant rate of time preference. The utility function is stationary. The function U(c, m) is increasing in both arguments, strictly concave, twice continuously differentiable, and satisfies the Inada conditions.

We assume a small open economy that produces a single composite tradable good. The country can trade all goods in the world market and it has free access to the world credit market at a given interest rate. The foreigners do not hold domestic money. The world price of the good is set on world market, so that the purchasing power parity will hold

$$P = EP^* \tag{2}$$

where P is the domestic price level, E is the exchange rate of domestic money for foreign money, and P^* is the foreign price level($P^*=1$).

In maximizing (1), the household is subject to three constraints. The first is a stock constraint, which requires that the total real household wealth at time t, a_t, be allocated between real balances, $m_t(=\frac{M_t}{E_t}$ where M_t is the nominal money), and real internationally-traded bond holdings, b_t:

$$a_t = m_t + b_t. \tag{3}$$

The internationally-traded bond is assumed to yield the world real interest rate, r, which is exogenous by the small country assumption. The negative real bond holdings imply the external debt.

The second is a flow constraint of the saving. The household receives y_t units of output per units of time in a partial equilibrium sense. Stressing the inflation tax on cash balances,[2] the saving constraint becomes

$$\dot{a}_t = y_t + rb_t + v_t - c_t - \varepsilon_t m_t. \tag{4}$$

where v_t represents net real transfers from the government, ε_t stands for the rate of devaluation. ε_t is equivalent to domestic inflation rate according to (2) when the world inflation rate is assumed to be zero. Under rational expectations assumed in this paper the expected inflation is equivalent to the actual inflation and the anticipated paths of $\{y_t\}$ and $\{v_t\}$ coincide with the actual paths of them.

The last, but not the least, is the interemporal budget constraint.[3)]

$$\int_0^\infty [c_t+(\varepsilon_t+r)m_t]e^{-rt}dt=a_o+\int_0^\infty (y_t+v_t)e^{-rt}dt \tag{5}$$

The necessary conditions for an optimal household plan subject to (3) and (4) are derived from the Euler equations:

$$U_c(c_t, m_t)=\lambda_t \tag{6a}$$

$$U_m(c_t, m_t)=\lambda_t(\varepsilon_t+r) \tag{6b}$$

$$\lambda^\circ_t=\lambda_t(\delta-r) \tag{6c}$$

where λ_t is the costate variable, U_c denotes the derivative of the functional U with respect to c, etc. Assuming, for simplicity, that the time preference rate, δ, is equivalent to the interest rate, r, we discard the dynamic equation (6c) and regard the costate variable λ_t as a constant.[4)]

Thus the necessary conditions are given as

$$U_c(c_t, m_t)=\lambda \tag{7a}$$

$$U_m(c_t, m_t)=\lambda(\varepsilon_t+r) \tag{7b}$$

where λ is a constant Lagrangian multiplier (the shadow price of wealth in utility terms). The necessary conditions for a maximization of (1) subject to (5) would be given the same as the above, reminding us that the intertemporal budget constraint is derived from the saving constraint with the transversality condition.

To get a closed-from solution for the economy's optimal plan, $\{c_t, m_t\}_{t=0}^{\infty}$, we will assume a specific form of the utility function:

$$U(c_t, m_t)=\frac{1}{1-\theta}(c_t^\alpha m_t^{1-\alpha})^{1-\theta} \tag{8}$$

where $\theta>0$ and $0<\alpha<1$. The form of the utility function belongs to a constant relative risk aversion function with the parameter θ measuring the relative risk aversion ($\frac{1}{\theta}$ measuring the elasticity of intertemporal substitution). When $\theta=1$, $U(c_t, m_t)=\alpha\log(c_t)+(1-\alpha)\log(m_t)$.

From (7) and (8) we get

$$\frac{c_t}{m_t}=\frac{\alpha}{1-\alpha}(\varepsilon_t+r) \tag{9}$$

and $$c_t=\left\{\frac{\alpha}{1-\alpha}\right\}^{\alpha\frac{1-\theta}{\theta}+1}\left\{\frac{1-\alpha}{\lambda}\right\}^{\frac{1}{\theta}}\left\{\varepsilon_t+r\right\}^{\frac{1}{\theta}(\alpha-1)(1-\theta)} \tag{10}$$

$$m_t=\left\{\frac{\alpha}{1-\alpha}\right\}^{\alpha\frac{1-\theta}{\theta}}\left\{\frac{1-\alpha}{\lambda}\right\}^{\frac{1}{\theta}}\left\{\varepsilon_t+r\right\}^{\frac{1}{\theta}[\alpha(\alpha-1)(1-\theta)]} \tag{11}$$

The relative demand for consumption goods and real balances depends on the opportunity cost of holding real balances, ε_t+r, and the share of consumption goods in utility, α, and nothing else. The demand for consumption goods and the demand for real balances, respectively, depends on the additional factors of θ and λ. c_t and m_t are monotonically decreasing function of λ. While the magnitude of θ will determine the direction of changes in c_t in response to changes in the opportunity cost, ε_t+r, the demand for real balances responds negatively to the opportunity cost of holding real balances regardless of the size of θ.

The magnitude of θ represents consumption preferences of the household. In general, the sufficient diminishing returns that also imply the sufficient life-time utility smoothing guarantees the positive response of consumption and real balance holdings to the opportunity cost. Under the specific form of utility function of (8) it happens when $\theta>1$, recalling (10). When $\theta<1$, consumption responds negatively. When $\theta=1$, consumption is neutral to inflation.[5)]

The larger the share of consumption in utility(α larger), the smaller the elasticity of comsumption and the larger the elasticity of real balance holdings with respect to one-time change in the opportunity cost.

The optimal shadow value $\bar{\lambda}$ is determined with the intertemporal budget constraint. Substituting (10) and (11) into the intertemporal budget constraint (5) produces

$$\bar{\lambda} = \frac{\alpha^{1-\theta}\left[\int_0^\infty \left[\frac{\alpha}{1-\alpha}(\varepsilon_t + r)\right]^{\frac{1}{\theta}(\alpha-1)(1-\theta)} e^{-rt}dt\right]^\theta}{\left[a_0 + \int_0^\infty (y_t + v_t)e^{-rt}dt\right]^\theta} \tag{12}$$

Since the optimal shadow price $\bar{\lambda}$ is a function of expected future paths of the rate of devaluation(or future inflation), output, government transfers, and the predetermined level of initial real wealth according to (12) the anticipated shocks have the impacts on the current optimal consumption and optimal demand for real balances according to (10) the (11).[6] Any previously anticipated disturbance cannot change the value of $\bar{\lambda}$. Only the previously unanticipated future disturbances can change it. The change in λ exerts a uniform effect on the time profile of c_t and m_t over the infinite horizon. Therefore it is closely related to elasticity of intertemporal substitution, $\frac{1}{\theta}$.

When the exchange rate is allowed to float, equations (10) and (11) become differential equations for the exchange rate. In contrast, with the crawling peg instituted, the rate of devaluation at each point of time will determine the optimal consumption and the optimal demand for real balances as we will see later.

Ⅲ. The Crawling Peg

In this section we assume that the rate of devaluation is exogenously determined by the authorities under the regime of the active crawling peg. We want to analyze the impacts of anticipated and unanticipated as well as permanent and temporary changes in the rate of devaluation and the output on the optimal consumption and the optimal demand for real balances, using the model in Section 2.

For this we assume that the economy is in a stationary state ($\varepsilon_t = \varepsilon$, $y_t = y$, $v_t = v$ for all t) prior to the shock. Then the shadow value of wealth of (12) changes into

$$\bar{\lambda} = \frac{\alpha^{1-\theta}\left[\frac{\alpha}{1-\alpha}(\varepsilon + r)\right]^{(\alpha-1)(1-\theta)}}{[ra_o+(y+v)]\,\theta} \tag{13}$$

And

$$\bar{c} = \alpha\,(ra_o+y+v)$$

$$\bar{m} = (1-\alpha)\frac{ra_o+y+v}{\varepsilon + r}$$

Consumption never depends on the rate of devaluation in the stationary state.

When the economy is in a stationary state and the discount rate is equivalent to the interest rate, we can show that the economy is in a steady state(savings are zero) by the "principle of optimality".[7] Any change in $\{\varepsilon_t\}$, $\{y_t\}$, and the implicit rule of government with $\{v_t\}$ would move the economy out of the steady state.

Ⅲ—1. The Shock of the Rate of Devaluation and the Preannouncement Effect

We will consider the first case of the preannounced reduction in the rate of devaluation. Suppose the rate of devaluation is expected to decrease temporarily in the future($\varepsilon_t = \varepsilon$ for $O \leq t < T$ and $T+r<t, \varepsilon_t = \varepsilon' < \varepsilon$ for $T \leq t \leq T+r$), while output and real government transfer are expected to be fixed at the level $y_t = y$ and $v_t = v$ for all t. Then at time t=O, the optimal shadow price $\bar{\lambda}$ changes into

$$\bar{\lambda}' = \frac{\alpha^{1-\theta}\left[A+(A-B)(e^{-r(T+r)} - e^{-rT}\right]^{\theta}}{[ra_o+y+v]^{\theta}} \tag{14}$$

where $A = \left[\frac{\alpha}{1-\alpha}(\varepsilon + r)\right]^{\frac{1}{\theta}(\alpha-1)(1-\theta)}$

and $B = \left[\frac{\alpha}{1-\alpha}(\varepsilon' + r)\right]^{\frac{1}{\theta}(\alpha-1)(1-\theta)}$

From (13) and (14) we know that the direction of change in $\bar{\lambda}$ depends on the magnitude of the coefficient of relative risk aversion θ.

If $\theta>1$, $\bar{\lambda}'<\bar{\lambda}$. If $\theta<1$, $\bar{\lambda}'>\bar{\lambda}$.

To get the intuition on these results we transform the intertemporal budget constraint of (5) by using (9).

$$\int_0^\infty c_t e^{-rt}dt=\alpha\,[a_0+\int_0^\infty(y_t+v_t)e^{-rt}dt] \tag{15}$$

$$\int_0^\infty(\varepsilon_t+r)m_t e^{-rt}dt=(1-\alpha)[a_0+\int_0^\infty(y_t+v_t)e^{-rt}dt] \tag{16}$$

The household always consumes a fraction α of its income given the Cobb-Douglas utility function of (8). Thus the present value of life-time consumption is a fraction α of the present value of life-time income and initial real wealth. The same reson applies to the demand for real balances.

Equation (15) gives rise to a clear intuition on the direction of changes in $\bar{\lambda}$. When $\theta>1$, consumption declines at the time ε_t declines. In this case, since the life-time consumption possibilities are constant, the household should move upward the time profile of consumption($\bar{\lambda}$ declines), the degree of which depends on the intensiveness of shock and the smoothing motive(the magnitude of θ). Conversely, if $\theta<1$.

Since the direction of changes in consumption when $\theta>1$ is the opposite to that when $\theta<1$, we will consider one of two cases. The normal demand behavior of the household would be as follows. For the simple reason that, as inflation accelerates, home real interest rates decline and inflation tax on real balance arises, the household would consume more and hold less real balances. This amounts to assuming that the life-time consumption smoothing objective dominates over the income effect. On this basis we will assume afterwards that

$$\theta>1. \tag{17}$$

In our model the above restriction is supported by the chance of external borrowing. The domestic inflation lowers the real cost of borrowing abroad since it reduces the real value of external debt measured in terms of domestic consumption.[8] Therefore the restriction represents consumption preferences of the household who tries to get a speculative gain by borrowing abroad when inflation accelerates. The sufficiently risk-averse household tries to increase consumption through external borrowing. Indeed, the restriction of (17) enables us to explain the Argentine experience with a declining rate of crawl.[9)]

With (17) we know that $\bar{\lambda}' < \bar{\lambda}$ since A> B. The optimal shadow value jumps down unambiguously through the smoothing motive given the constant life-time real wealth. As the new rate of devaluation durates longer(τ larger), $\bar{\lambda}$ declines more. Furthermore, as the preannouncement comes earlier to the actual changes(T large), $\bar{\lambda}$ declines less. Conversely, the more imminently the news comes, the more $\bar{\lambda}$ falls down.

What is the effect of the preannounced reduction in the rate of devaluation on the demand behavior at time t=o? Both consumption and demand for real balances go up as $\bar{\lambda}$ declines, recalling (10) and (11) where c_t and m_t are decreasing functions of λ. The trade account worsens.

The initial increases in consumption and real balance holdings are made possible by the speculative motive. The sufficiently risk-averse household speculates to consume less and borrow less abroad between time t=T and t =T+ τ during which the inflation rate is expected to decline. This induces the household to initially consume more and maximize the expenditure level by choosing the highest possible consumption level through the smoothing motive($\bar{\lambda}$ declines) even if the permanent income(annuity value of life-time real wealth) of the household has not been changed with the shock, recalling (15). The household wants to hold more real balances between time t=T and t=T+ τ. Nevertheless, this never induces the household to hold less real balances in the initial period since total opportunity cost incurred by holding more real balances between time t=T and t=T+ τ declines. More exactly, recalling (16), the cost the household pays by holding real balances between time t=T and t=T+ τ is

$$(\varepsilon'_t+r)m_t=\left(\frac{\alpha}{1-\alpha}\right)^{\alpha\frac{1-\theta}{\theta}}\left(\frac{1-\alpha}{\bar{\lambda}}\right)^{\frac{1}{\theta}}(\varepsilon'+r)^{\frac{1}{\theta}(\alpha-1)(1-\theta)}$$

Obviously total cost has declined even if it demands more real balances between time t=T and t=T+ τ through the speculative motive. This results in decline of $\bar{\lambda}$ through the smoothing motive in order to maximize the expenditure level given the constant life-time real wealth.

Does the utility the household enjoys increases between time t=T and t =T+ τ? Substituting (10) and (11) into (8) we obtain

$$U_t(c_t, m_t)=\frac{1}{1-\theta}\left[\frac{\alpha}{\lambda}\left(\frac{\alpha}{1-\alpha}(\varepsilon_t+r)\right)^{\alpha-1}\right]^{\frac{1-\theta}{\theta}} \tag{18}$$

As λ declines, U_t arises since c_t and m_t arise due to the smoothing motive. As ε_t declines, the speculative motive reduces c_t, but increases m_t. The net effect is an increase in U_t since U_t is a decreasing function of ε_t. An increase in real balances overrules reduction in consumption. So the utility level jumps up at the period when the rate of crawl actually declines. From (18) we know that the time path of utility level resembles the time path of real balance holdings.

How does the household hold more real balances? We can think of two adjustment processes that are the adjustment of portfolio composition and the adjustment of the price level. The household changes composition of its portfolio due to the incipient excess demand for money, buying domestic money through sale of its own foreign bonds to the central bank. On the other hand, an incipient excess demand for money leads to a decline in the price level if prices are completely flexible. The downward pressure on the price level(and the exchange rate) forces the central bank to intervene in the foreign exchange market, buying foreign bonds and selling money. The downward pressure on the exchange rate also induces foreign investors to speculate, causing the speculative capital inflows. Furthermore, the previously unanticipated decline in the price level leads to an increase in the initial real wealth a_0, so that $\bar{\lambda}'$ declines more. This corresponds to the wealth effect of real balance holdings on consumption. The wealth effect intensifies the intertemporal smoothing effect which is obtained under a predetermined initial real wealth.

A decline in the price level depends how much the household(the government) purchases(sells) money and sells(purchases) foreign bonds. If it is immediately complete at a given exchange rate, then there is no pressure on the price level. In a polar case of net external debt in which the household has no foreign bonds to sell, the price level must adjust quickly in a significant margin unless the government prints money.

Note that our model is of partial equilibrium in which output is exogenously given and expenditure adjustment is complete. An increase in consumption does not lead to excess demand for goods and the consequent rise in the price level. In addition, our model does not consider destabilizing effect of the capital inflows and the subsequent excess supply of money on the price level(not the exchange rate) with specification of the capital inflow function.[10] Both excess demand for goods and the speculative capital inflows might have perverse impacts on the real exchange rate. These impacts are important, but we leave them beyond the scope of this paper since it assumes a single composite tradable good.

How does the optimal current account(sum of trade account and service account) evolve? We know that $\dot{m}_t=o$ as long as the time path of ε_t is step-wise under a crawling peg. This implies that the central bank supplies money at the rate of devaluation. Therefore $\dot{a}_t=\dot{b}_t$, that is, saving determines time path of foreign bond holdings(or external debt). At a time interval (t_1, t_2) where ε_t is fixed at some level, ε_{t_1}, c_t and m_t are also fixed at some level, c_{t_1} and m_{t_1} :

$$\dot{b}_t=rb_t+y-c_{t_1}+v-\varepsilon_{t_1}m_{t_1}.$$

Solving the differential equation we obtain debt dynamics:

$$b_t=q_{t1}e^{r(t-t_1)}-\frac{1}{r}(y-c_{t1}+v-\varepsilon_{t1}m_{t1}) \quad \text{for } t_1<t_2<t_3 \tag{19}$$

where $q_{t_1}=b_{t_1}+\frac{1}{r}(y-c_{t_1}+v-\varepsilon_{t_1}m_{t_1})$. The stock of internationally-traded bond grows exponentially[11]. The net debtor country($b_{t_1}=o$) accumulates its external debt unless $q_{t_1}>O$.

The current account, CA, evolves between time $t=t_1$ and $t=t_2$ as[12]

$$CA=y+rb_t-c_{t1}=r\left(b_{t1}+\frac{y-c_{t1}+v-\varepsilon_{t1}m_{t1}}{r}\right)e^{r(t-t_1)}-(v-\varepsilon_{t1}m_{t1}) \tag{20}$$

Hence the net debtor country is likely to accumlate both its external debt and current account deficit.

Consider now the next case of unpreannonced reduction in the rate of devaluation. This case is equivalent to the previous case if we set T to zero in the previous case. Suppose the rate of devaluation declines from ε to ε' at time $t=o$ the moment the announcement is made, not previously, and it is expected to remain temporarily at the level ε'($\varepsilon_t=\varepsilon'<\varepsilon$ for $o\leq\tau$, $\varepsilon_t=\varepsilon$ for $t>\tau$), while output and transfers are expected to be fixed at the level $y_t=y$ and $v_t=v$ for all t. Then at time $t=o$, the optimal shadow price $\bar{\lambda}$ changes into

$$\bar{\lambda}'=\frac{\alpha^{1-\theta}[A+(B-A)e^{-rT}]^{\theta}}{[ra_o+y+v]^{\theta}} \tag{21}$$

where A and B are those in (14). Since $e^{-r\tau}<1$, we know that $\bar{\lambda}'<\bar{\lambda}$ if $\theta>1$ and $\bar{\lambda}'>\bar{\lambda}$ if $\theta<1$. Under (17) the optimal shadow value jumps down. This leads to an increase in consumption and demand for real balances. On the other hand, the housedhold reduces consumption and raises real balance holdings by the speculative motive beween time t=o and $t=\tau$. Therefore the impact of the speculative motive on consumption is reverse to that of the smoothing motive, whereas the impact of the speculative motive on real balance holdings strengthens that of the smoothing motive. From (15) and (16) we know that the speculative motive must overshadow the smoothing motive between time t=o and $t=\tau$, that is, the household must consume less than prior to shock.[13]

To summarize, we draw time paths of c_t, m_t and U_t in the case of the preannounced and temporary reduction in the rate of crawl in Fig. 1 and those in the case of the unpreannounced and temporary reduction in the rate of crawl in Fig. 2. The paths in the unpreannounced case after t=o are qualitatively the same as those in the preannounced case after t=T. With the preannouncement of future disinflation plan from time t=T to $t=T+\tau$ the economy faces at time t=T the same situation as that of the unpreannounced reduction in ϵ_t except that smoothing is already done at time t=o in the former case.

This section stresses the perverse preannouncement effect of a future reduction in the rate of devaluation on demand behavior. With it preannounced, a risk-averse household speculates to consume less in the future so that it consumes more at the present. The trade account deficit happens and the current account deficit might accumulate by debt dynamics of (19).

It is found that exchange rate declines in the face with improvement in the current account during the period when the actual shocks arrive. This is counter to the recent view about the exchange rate. The conventional wisdom that assigns an important role to the current account is that a surplus country should have an undervalued currency(Rodriguez, 1980; Dornbusch and Fischer, 1981). The wealth effect of real balance on consumption provides the key to this result. Our model makes the room for this result only if the unanticipated post-shock increase in the current real wealth overwhelms the intertemporal speculation and substitution. As we stated earlier, initial real wealth, a_0, can arise if an increase in real balance holdings leads to a drop in the price level, which depends on how much the government defends the current level of exchange rate. If it cannot peg the exchange rate, although quite implausible in the case of the speculative run on domestic money, the unanticipated post-shock increase in real wealth exerts the same effect as the unanticipated permanent increase in output. Since life-time real wealth increases, $\bar{\lambda}$ declines further. The post-shock increase in real wealth with price adjustments is the only channel which can explain possible increase in consumption in our model when the economy is faced with the actual reduction in the rate of devaluation.

The casual empiricism in Argentina goes well with the analysis in the above. In January 1979 the Argentine government announced future exchange rate in the manner of a declining rate of devaluation that will be effective from October 1979. It promised to continue with that regime until it reaches zero by March 1981 when a new government would take office. However, facing with the new regime, the trade account did not improve and the economy suffered from persistent accumulation of current account deficit. The huge capital inflows occurred, leading to a real appreciation. This led people to think that the peso was overvalued. They did not believe that the preannounced rate of devaluation will be effective eventually. In other words, the credibility problem about the ruling exchange rate regime arose. These empirical facts are explicable within our model of intertemporal speculation.

Fig. 1. Preannounced Temporery Reduction in the Rate of Devaluation

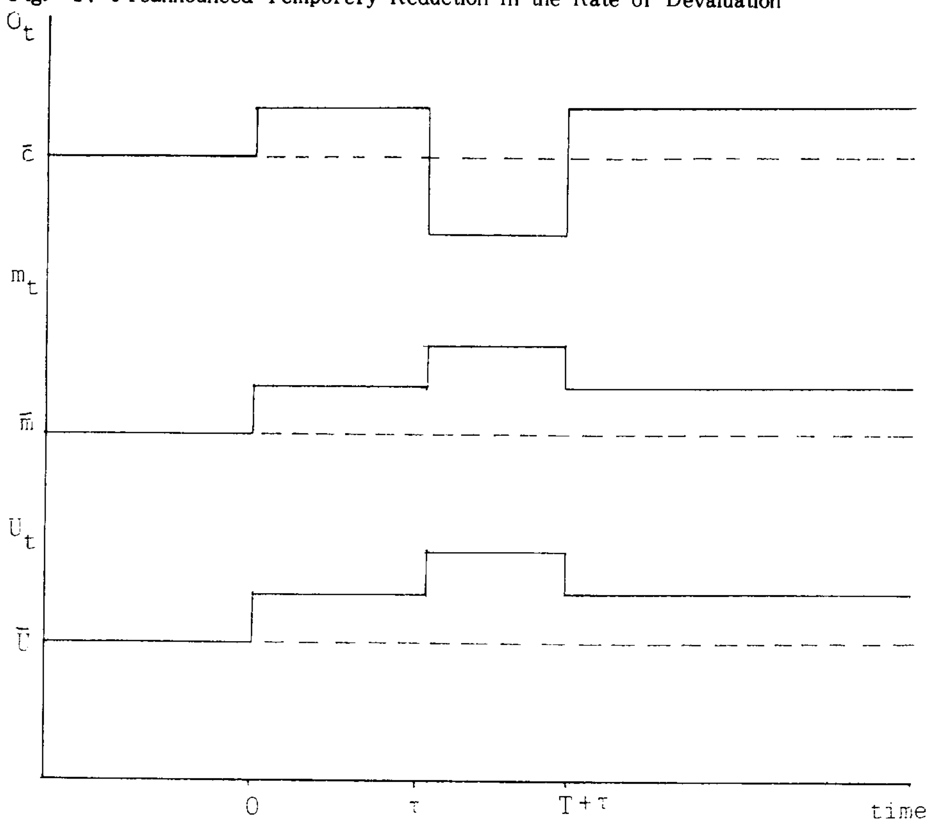


Fig. 2. Unpreannounced Temporary Reduction in the Rate of Devaluation

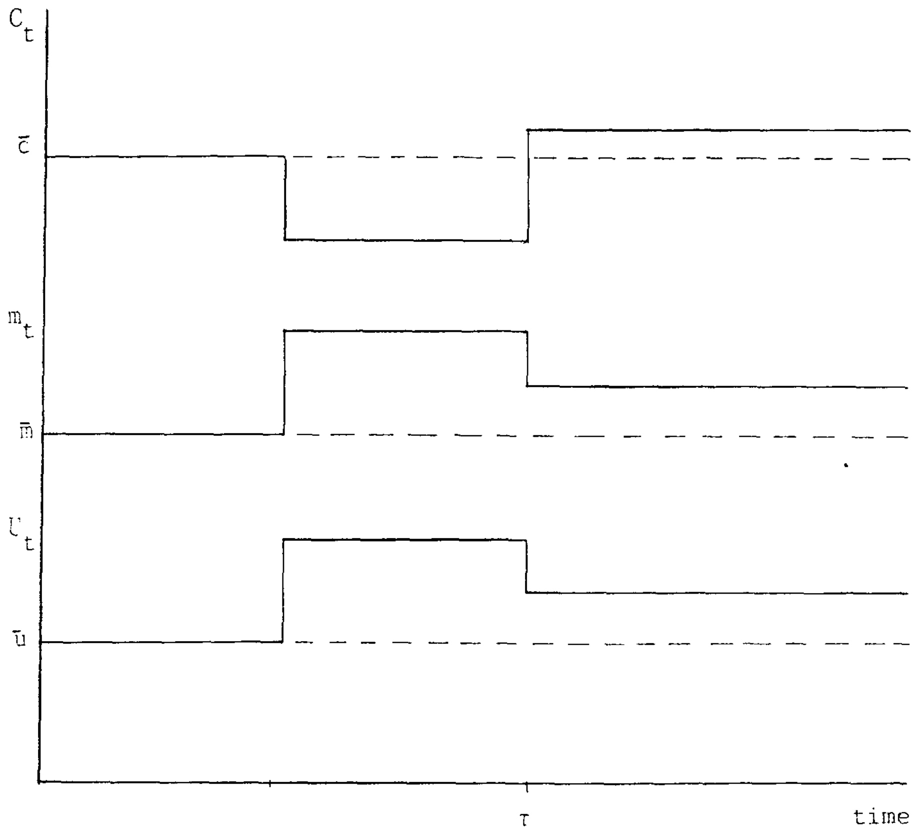
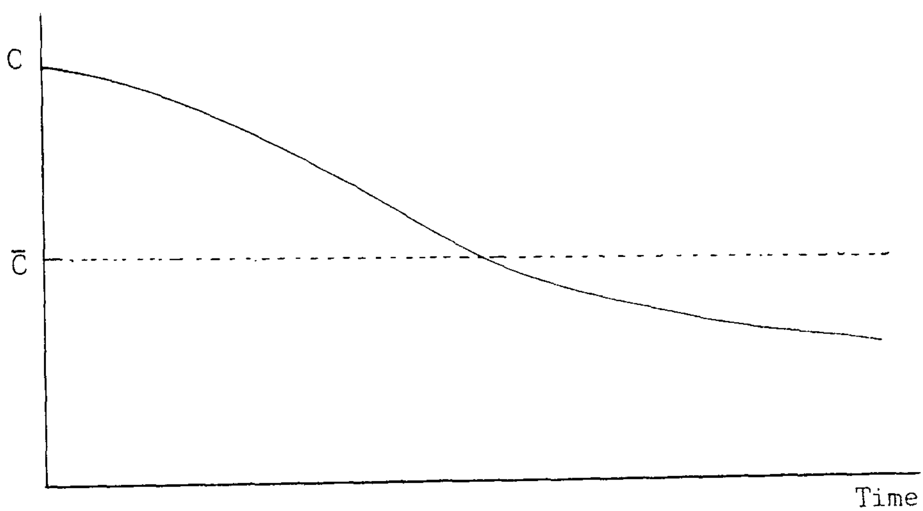


Fig. 3. Consumption Patterns under Continuously Declining Rate of Devaluation



Ⅲ-2. The Recurrent Shock

In order to investigate the Argentine case of the continuously declining rate of devaluation we will consider the simplest case of the following. It is assumed that the rate of devaluation is further reduced at time $t=T+\tau$ in the rate of devaluation is further reduced at time $t=T+\tau$ ($\varepsilon_t=\varepsilon$ for $o<t<T$, $\varepsilon_t=\varepsilon'<\varepsilon$ for $T\leq t<T+\tau$, $\varepsilon_t=\varepsilon''<\varepsilon'$ for $t>T+\tau$). Then $\bar{\lambda}$ changes into

$$\bar{\lambda}'=\frac{\alpha^{1-\theta}[A+(B-A)e^{-rT}+(c-B)e^{-r(T+\tau)}]^{\theta}}{[ra_o+y+v]^{\theta}} \tag{22}$$

where $C=[\frac{\alpha}{1-q}(\varepsilon''+r)]^{\frac{1}{\theta}(\alpha-1)(1-\theta)}$. We know that $\bar{\lambda}'<\bar{\lambda}$ if $\theta>1$ ($\bar{\lambda}'>\bar{\lambda}$ if $\theta<1$), but $\bar{\lambda}'$ in (22) is smaller than that in (14). Thus the household consumes more in the initial period with the recurrent reduction in the rate of devaluation after $t=T+\tau$. The question left is whether the smoothing motive due to the reccurrent reduction after $t=T+\tau$ is strong enough to offset an decrease in consumption between $t=T$ and $t=T+\tau$ through the speculative motive. At a glimpse we know that it depends on the intensiveness of the shock. As T, τ, ε''(compared with ε') get smaller, the smoothing motive dominates the speculative motive so that the household can consume more between time $t=T$ and $t=T+\tau$. Obviously consumption declines after $t=T+\tau$.

It is straightforward to infer that consumption jumps up at the beginning and then declines below the stationary state level as shown in Fig. 3 when a continuously declining rate of devaluation is implemented.

Ⅲ-3. Anticipated Regime Changes and the Speculative Run

Contrary to anticipations of the authorities when it announced future exchange rate with a declining rate of devaluation, the insurmountable devaluation pressures coupled with accumulation of current account deficit that is argued in the foregoing to have been caused by the preannouncement effect would force the government to do the devaluation in the level and/or in the rate. If the authorities intend to change the regime, it is noted that the collapse of the current regime is not attributable to the gradual depletion of reserves since the Argentine experience shows that the international reserves in the central bank increased through the speculative capital inflows. Rather it is attributable to either the deterioration in the current account or inability of the government to reduce the money supply in the face of the capital inflows. To peg the exchange rate both in the level and in the rate the government must not only have enough reserves but also reduce the money growth rate according as the rate of devaluation declines.

Envisaged with capital inflows the literature on the balance-of-payments crises beginning with the work of Krugman(1979) cannot be suitable to explain the switch in the regime. A balance-of-payments crisis is characterized as a sudden speculative attack that rapidly reduces the government's reserves, generally well before the gradual depletion of reserves. The speculative attack on the reserves occurs since speculators attempt to avoid windfall capital losses on domestic money if the regime changes. In addition, the literature studies the timing of the speculative run with the exchange-rate continuity principle. The two assumptions are needed for the study. First, the speculators have perfect information on the level of reserves at which the government changes the regime, usually from fixed to floating rate. Second, the function of reserve formation(or domestic credit supply as its counterpart) is completely specified. However, once we don't have perfect information on the condition at which the government changes the regime[14] and we cannot specify the function of reserve formation adequately, we never depend on the literature to explain the speculative run on the reserves. Instead, we assume that policy changes are exogenously given. Upon receiving the news of switches in the regime, the speculators attempt to alter the composition of their porfolio. The timing of the speculative run is set by the time when the household receives the news of future switches in the regime owing to government's indefensibility of the ruling regime.

Suppose the rate of devaluation is adjusted upward to improve the current account deficit. This is never done without any cost. When the news of higher rate of devaluation arrives, the household will hold less real balances[15] and demand more foreign bonds. Such change in the protfolio composition in preference for foreign bonds might result, unhappily, in the speculative run on reserves. The crises might happen if the government cannot peg the exchange rate. The exchange-rate jumps up, implying that the plan of crawling peg has been collapsed. The exchange-rate continuity principle might not hold so that the speculators reap some capital losses as a price of imperfect information. It is notable that the capital outflows gain momentum with the upward pressure on the exchange rate.

In the Argentine case the speculative run on the reserves with the speculative withdtawal of bank deposits resulted in the collapse of the three major bank rather the collapse of the exchange rate regime in April 1980. This is expected since the reserves in the central bank increased with the speculative capital inflow. Reflecting the fact that the major changes in the regime are implenented in the tear of 1981 shortly before and after the new government takes the oath of the office, it might be true that the anticipated changes in the regime under the new government have the impact effect on the banking collapse in April 1980.

The interesting thing is that the anticipated future one time increase in the level of exchange rate has no effect and the anticipated duration of higher level of exchange rate only exacerbates current account deficit since the rate of devaluation is downward adjusted to be nil. The results could be different if we introduce nontraded goods in the model or if we divide traded goods into the exportables and importables. However, the current (anticipated or unanticipated) one-time increase in the level of exchange rate has real effect via a decline in the initial real wealth. The current account improves, which coincides with the conventional wisdom. The demand for real balances decreases, but real supply of money also drops more. The incipient excess demand for money forces the government to print money and/or induces the capital inflow with downward pressure on the exchange rate.

The upshot of this section is as follows. With the existence of intertemporal speculation policy authorities that aim to stabilize the economy through a preannounced declining rate of devaluation encounter with an initial increase in consumption. The credibility about the implemented regime tapers off associated with accumulation of current account deficit, ushering in the prevalent anticipations of future switches in the regime. The government that intends to reduce consumption by way of future implementation of higher rate of devaluation also finds the intrinsic obstacle of the speculative attack on its reserves since the rational household tries to hold less real balance in anticipation on future increase in opportunity cost of holding it.

Ⅲ—4. The Output Shock

We will compare the output shock with the shock of the rate of devaluation. Suppose the output is expected to decline temporarily in the future, other things being equal ($y_t = y$ for $o \leq t < T$ and $T + \tau < t$, y_t

$= y' < y$ for $T \leq t \leq T+\tau$, $\varepsilon_t = \varepsilon$, $v_t = v$ for all t). The $\bar{\lambda}$ is arranged into

$$\bar{\lambda}' = \frac{\alpha^{1-\theta}[\frac{\alpha}{1-\alpha}(\varepsilon + r)]^{(\alpha-1)(1-\theta)}}{[ra_0 + y + v + (y' - y)e^{-rT}(1 - e^{-r\tau})]^{\theta}} \tag{23}$$

We know that $\bar{\lambda}' > \bar{\lambda}$ regardless of $\theta > 1$ or $\theta < 1$. The household reduces both consumption and real balance holdings through the smoothing motive since the life-time real wealth falls down envisaged with a shock of future decline in output. It smooths them out so that time paths of c_t, m_t, and U_t move uniformly downward. The horizontal movement gets larger according as the shock arrives sooner and lasts longer.

The future decline in output improves the trade account, though trade account deteriorates between time $t = T$ and $t = T+\tau$. To cite a case, the discovery of oil well in Mexico and Norway recalls trade deficit initially. The possibility of the speculative attack on the government's reserves remains since the household plans to hold less real balances in the face with the future shock. Nontheless, it would not lead to a crisis since consumption also declines and, consequently, the trade account improves.

Ⅳ. The Floating Rate

We are concerned with the switch in the regime into the floating rate. Suppose the exchange rate is expected to float temporarily between time $t = T$ and $t = T+\tau$. The economy is assumed to be initially in a stationary and steady state, i.e., $\varepsilon_t = \varepsilon$, $y_t = y$, and $v_t = v$ for all t. The difference between the crawling peg and the floting rate lies in that ε_t is, under the flexible rate, not exogenously given but determined largely by the exogenous money supply.

Equation (11) turns into a differential equation of the Bernoulli form for $T < t < T+\tau$. The solution is:

$$E_t = [E_{T+\tau} e^{-rk}(t - T - \tau) - K\ell^{-k} \int_t^{T+\tau} (M_s) k_e rk(s-t) ds]^{\frac{1}{k}}$$

$$\text{for } T < t < T + r \tag{24}$$

where $K = \frac{\theta}{\alpha(1-\theta)-1}$, $\ell = (\frac{\alpha}{1-\alpha})^{\alpha \frac{1-\theta}{\theta}} (\frac{1-\alpha}{\lambda})^{\frac{1}{\theta}}$ and M_s denotes the nominal money supply at time t=s. The exchange rate at time t is influenced by the future money supply, $\{M_s\}_t^{T+\tau}$ and the expected exchange rate at time $dt = T+\tau$. Since $k < 0$ regardless of the size of θ, it leads to a forward-looking behavior of the household to predict the exchange rate.

To calculate the endogenous rate of devaluation we transform (11) into

$$\varepsilon_t = -r + \left(\frac{M_t}{\ell E_t}\right)^k \text{ for } T < t < T + \tau \tag{25a}$$

$$\varepsilon_t = \varepsilon \text{ for } 0 < t < T,\ t > T + \tau \tag{25b}$$

Substituting (25) into (12) produces the new optimal shadow value, $\bar{\lambda}'$.

$$\bar{\lambda}' = \frac{\alpha^{1-\theta}[e^{-r(T+\tau)} - e^{-rT} + 1) + \int_T^{T+\tau} \left(\frac{\alpha}{1-\alpha}\left(\frac{M_t}{\ell E_t}\right)^k\right)^{\frac{1}{\theta}(\alpha-1)(1-\theta)} e^{-rt} dt]^\theta}{[a_o + \frac{y+v}{r}]^\theta} \tag{26}$$

where A is that in (14).

However, to get a tractable solution for $\bar{\lambda}'$, we concede to the case that the floating rate continues forever after time t=T, i.e., $\tau = \infty$. If not, the solution of $\bar{\lambda}'$ includes the messy β function. In addition, we assume that money supply rule under the floating rate is such as

$$\frac{M_t}{M_t} = \mu \tag{27}$$

where μ is a positive constant.

In this special case, assuming that the term $E_{T+\tau} e^{k\tau}$ converges to zero as τ goes to infinity,

$$E_t = (r+\mu)^{-\frac{1}{k}} \frac{M_t}{\ell}\ . \tag{28}$$

Therefore,

$$\varepsilon_t = \mu \text{ for } T \le t \tag{29a}$$

$$\varepsilon_t = \varepsilon \text{ for } 0 < t < T \tag{29b}$$

The rate of devaluation is determined entirely by the increasing rate of money only if the floating rate continues indefinitely and money stock grows at a constant rate in our model of intertemporal optimization where the intertemporal budget constraint plays the important role.

Also, it follows that

$$\bar{\lambda}' = \frac{\alpha^{1-\theta}[A + (C-A)e^{-rT}]^\theta}{[ra_0 + y + v]^\theta} \tag{30}$$

where $A = [\frac{\alpha}{1-\theta}(\varepsilon + r)]^{\frac{1}{\theta}(\alpha-1)(1-\theta)}$

and $C = [\frac{\alpha}{1-\alpha}(\mu + r)]^{\frac{1}{\theta}(\alpha-1)(1-\theta)}$.

When μ is expected to be the same as ε, the news of future permanent switch into the flexible rate does not disturb the economy. The economy continues to stay in the stationary state. When the central bank is expected to reduce the money supply rate below the current level with the future implementation of floating rate, $\bar{\lambda}'$ is smaller than $\bar{\lambda}'$ if $\theta > 1$. The household consumes more in the initial period and hold more real balances. The trade account deteriorates.

However, these two cases are implausible in reality. If the switch into the floating rate is made, it would be made because either the government cannot reduce the money growth rate or its reserves are running down under the fixed rate (Obstfeld, 1984a). Thus the central bank is expected to increase money supply rate above the current one when the floating rate is instituted. As impacts the trade account improves initially due to the preannouncement effect, but the speculative attack on the government's reserves might happen since the household attempts to hold less real balances. The exchange rate jumps up since the government no longer endeavors to peg the exchange rate through the intervention in the foreign exchange market. This will upset the speculators. The literature on the balance-of-payments crises has motivation to this situation.

In our model of interemporal optimization in which the intertemporal budget constraint plays the important role the impacts of future switch into the floating rate is very similar to the impacts of future change in the rate of devaluation under the crawling peg regime. The domestic money is exogenous under the floating rate while it is endogenous under the crawling peg. The authority faces the same dilemma under either regime that the announcement of higher rate of monetary expansion (and higher rate of devaluation) reduces consumption at the cost of the speculative run.

V. Concluding Remarks

Under rational expectations this paper has studied the impacts of the shock of the rate of devaluation under the crawling peg, shock of the monetary expansion under the flexible rate, and output shock, which are anticipated or unanticipated as well as temporary or permanent, using an infinite horizon optimizing model of a small open economy envisaged with external debt.

We have concentrated on the intertemporal speculation and substitution with seignorage consideration. When the household faces an intertemporal budget constraint, a decision to alter future indebtedness implies the current change in indebtedness or *vice versa*. Hence the sufficiently risk-averse household speculates and substitutes consumption opportunities intertemporally. As the rate of devaluation declines, home real interest rate in terms of domestic consumption opportunities arises. Thus the household consumes more by horrowing abroad. It also holds more real balance since the opportunity cost of holding it decreases.

The future decline in consumption due to the speculative motive induces the current increase in consumption through the smoothing motive (the preannouncement effect). Therefore the temporary disturbances can have the persistent effects through the intertemporal substitution. The recurrent downward (or upward) adjustment of the rate of devaluation is shown to give rise to the preannouncement effect. The money is not superneutral to the anticipated future inflation.

The switch to the new type of exchange rate regime in order to improve current account encounters with the speculative attack on the government's reserves since an increase in the rate of devaluation leads to the reduction in real balance holdings. In the period when speculative foreign borrowing and/or repatriation is going on the analysis provides the evidence, unless the wealth effect on consumption is enormous, against the presumption that a surplus country should have an undervalued currency.

Our model has some limitations that are stated in the introduction. In addition, we would investigate the impacts of destabilizing capital inflow and devaluation in the level by discarding the purchasing power parity assumption and introducing the real exchange rate or the terms of trade to the model.

Footnotes

1) Calvo(1983) provides a survey of recent Argentine experience.
2) Fischer (1982) provides the empirical significance of seignorage considerations.
3) The intertemporal budget constraint is derived from the saving constraint, where we assume the transversality condition $\lim_{t \to \infty} a_t e^{-rt}=0$ is satisfied. The transversality condition implies no excessive borrowing abroad and no interest payment through further borrowing to avoid Ponzi games. In addition, it implies that (5) will hold with equality at the optimal value of $\{c_t, m_t\}_{t=0}^{\infty}$. The importance of the intertemporal budget constaint has been emphasized in Krugman (1981) under the perfect capital mobility and Obstfeld (1983).
4) The differential equation of the costate variable plays the important role in the dynamic analysis of state variables (Sidrauski, 1967; Obstfeld, 1981 a, b, 1982). Obstfeld (1981a, b, 1982) introduces the Uzawa formulation of the time preference rate for a dynamic analysis of state variables in an intertemporal optimization model (Uzawa, 1968). However, Uzawa-type function is still hard to defend due to its own *ad hoc* properties.
5) Since marginal utility of consumption Uc should be constant by (7a) and it is insepar-

able by (8), the coefficient of relative risk aversion θ works to make the direction of changes in Ue with respect to m depend on θ (Obstfeld, 1984c). Then marginal utility of consumption is a decreasing function of both c and m if $\theta > 1$. If $\theta < 1$, it is a decreasing function of c, but an increasing function of m. The demand for real balances always responds negatively to the opportunity cost so that c_t changes in the different direction according as $\theta \gtreqless 1$. Later we will assume $\theta > 1$.

6) Wilson (1979) studies the impacts of anticipated shocks on exchange rate dynamics. It concerns basically about how the economy moves to the saddle path when the future shock is anticipated. So the inherent laws of motion of the system plays the key role on the movement of state variables. Contrastingly, our paper emphasizes the role of saving constraint and the consequent intertemporal budget constraint instead of the dynamics.

7) The constancy of the optimal shadow value λ is implied by the intertemporal optimization and the condition that $\delta = r$, recalling (6c). λ computed at time $t=0(\lambda_0)$ and λ computed at time $t=s(\lambda_s)$ should be identical unless any previously unanticipated event happens. From (12) it follows that

$$\lambda_0 = \frac{a^{1-\theta}[\frac{\alpha}{1-\alpha}(\epsilon + r)]^{(\alpha-1)(1-\theta)}}{[ra_0+y+v]^{\theta}},$$

$$\lambda_s = \frac{\alpha^{1-\theta}[\frac{\alpha}{1-\alpha}(\epsilon + r)]^{(\alpha-1)(1-\theta)}}{[ra_s+y+v]^{\theta}}$$ therefore, $a_0 = a_s$.

8) The difference of home interest rate relevant for consumption decisions from the world interest rate has been emphasized in Dornbusch (1983), among others.

9) Note that we don't assume the perfect capital mobility on an uncovered basis. In that case home real interest rate would be equal to the world interest rate. In fact we don't distinguish between the world nominal interest rate and the world real interest rate since we assume that world inflation is zero. The assumption of the perfect capital mobility precludes the impacts of the relevant home real interest rate on consumption decisions.

10) See Rodriguez (1981) and Turnovsky and Bhandari (1982).

11) The transversality condition $\lim a_t e^{-rt} = 0$ that holds at the optimal value of $\{c_t, m_t\}_{t=0}^{\infty}$ also implies that $m_t + b_t + \int_t^{\infty} [y_s - c_s + v_s - (\epsilon_s + r)m_s]ds = 0$ for all t(see Obstfeld, 1981a, Appendix B). The first implication of this is that the external debt cannot grow exponentially at the rate of r in the end. In our example of the preannounced temporary reduction in the rate of devaluation, it follows that $b_{T+\tau} + \frac{1}{r}(y - c_{T+\tau} + v - \epsilon^{T+\tau} m_{T+\tau}) = q_{T+\tau} = 0$ where $c_{T+\tau}$ and $m_{T+\tau}$ are constant optimal values at a time interval $(T+\tau, \infty)$. Therefore $\{b_t\}_{T+\tau}^{\infty}$ is constant. The second implication is that b_t depends on the future paths of trade account surplus, transfer, and seignorage.

12) If we assume that money is supplied as a government transfer, i.e., $vt = \dot{M}_t / E_t$, then $m_t = v_t - \epsilon_t m_t$, which will be trivial since the optimal demand for real balances is a step function of time. In result, money transfers compensate for depreciation of holding money. The current account alone determines the increment of external debt. Meanwhile, Obstfeld (1981b, 1984b,c) consolidates accounts of the central bank and government sector by assuming that the government transfers interest income on the reserves to the public, but without much gains that are deserved to complications. In our model b represents the stock of claims on foreigners owned by the country as a whole. The complete specification of reserves in the central bank is implausible unless we specify a capital inflow function and a domestic credit supple rule.

13) Algebraically, we compare prior-to-shock consumption at time t=0, co, with post-shock

consumption at time t=0,

$$C_0{}'\frac{C_0}{C'}=\left(\frac{\bar{\lambda}'}{\lambda}\right)^{\frac{1}{\theta}}\left(\frac{\epsilon+r}{\epsilon'+r}\right)^{\frac{1}{\theta}(\alpha-1)(1-\theta)}=\frac{B+(A-B)e^{-r\tau}}{A}\cdot\frac{A}{B}$$

Let $x=\frac{A}{B}(x>1)$, then $\frac{C_0}{C_0{}'}=1+(x-1)e^{-r\tau}=f(x)$. f(x) is a monotonically increasing function of x, and f(1)=1. So $C_0'<C_0$. The household consumes less after a shock.

14) The reserves can be negative at the time of speculative attack if the government tries to defend the current regime through external borrowing (Garber, 1981; Obstfeld, 1984b).

15) It holds only when $\theta>1$. If $\theta<1$, then the household will hold more real balances through the smoothing motive.

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