Exchange Rate-Based Stabilizations:

Learning and the Pattern of Real Dynamics

(rough draft)

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1. Introduction

In the last few decades, many chronic-inflation countries have implemented disinflation programs in which the exchange rate was used as the nominal anchor. Stabilizations of this type were launched in Argentina (1979-1981, 1985-1986, 1991-2001), Brazil (1985-1986, 1994-1999), Chile (1978-1982), Israel (1985-), Mexico (1987-1994), and Uruguay (1978-1982). In the early stages of these exchange rate-based stabilizations, Kiguel and Livitatan (1992) and Vegh (1992) have shown that a rising path of consumption and widening current account deficits are often observed.

Several hypotheses have been put forth to explain these stylized facts. Dornbusch (1982) and Rodriguez (1982) emphasize the role played by adaptive expectations and the adjustment of prices in the nontradable goods market. Calvo (1986) and Calvo and Vegh (1993) focus on the impact of imperfect credibility. Obstfeld (1985) and Roldos (1997) stress the effects arising from a phased reduction in the rate of devaluation. Roldos (1995) and Uribe (1997) develop models that emphasize supply side adjustments. Helpman and Razin (1987) and Drazen and Helpman (1987) highlight the role of inconsistent fiscal policies. Lastly, De Gregorio et. al. (1998) argue that the observed dynamics can be attributed to the timing of purchases of durable goods. However, most of these explanations have trouble accounting for the dynamic evolution of consumption and the current account. That is, the gradual and persistent feature of the increase in consumption and the deterioration in the current account.

In an interesting paper, Calvo and Drazen (1998) develop a framework in which to study the real effects of reform policies of uncertain duration. They consider an output enhancing policy and a trade liberalization policy that initially lack full credibility and as a consequence, agents in the economy form expectations that the policy will be abandoned at some unknown future date. Therefore, the duration of the reform policy is uncertain. One appeal of this uncertain duration of policy framework is that it adds more realism to the analysis of credibility effects compared to the models of Calvo (1986) and Calvo and Vegh (1993) in which agents are assumed to fully know the timing of the policy reversal. The other and more important appeal is that it allows optimal consumption decisions to be continuously revised over time as long as the uncertainty concerning duration exists. This feature then has the ability to produce consumption profiles, which adjust gradually. Again, this is in contrast to the perfect foresight imperfect credibility models that generate flat paths of consumption.

Lahiri (2000) examines the potential of this uncertain duration of policy framework to explain the stylized facts of exchange rate-based stabilization programs. He extends the model of Calvo and Drazen (1998) by introducing real money balances through a cash-in-advance constraint. Lahiri also incorporates a variable labor supply and relaxes the standard assumption of perfect capital mobility. He finds that his model of uncertain duration is able to produce a time profile of consumption and a time profile of the current account that adjust steadily. Unfortunately, the particular paths generated by the model do not correspond to the stylized facts. Consumption is found to rise on impact of stabilization's implementation and then gradually decline over time. This produces a path of the current account that initially worsens, but then steadily improves over time.

The purpose of this paper is to reevaluate the capability of the uncertain duration of policy framework to replicate the consumption and current account dynamics associated with the initial phase of exchange rate-based stabilization programs. The focus of the paper is on the formation of expectations regarding the duration of stabilization and how these expectations influence the pattern of real dynamics. In both Calvo and Drazen's paper and Lahiri's paper, private agents' subjective beliefs about the future date policy may be abandoned are time invariant. Thus, regardless of the degree of success that this policy might have over time, private agents continually believe the policy to be less than fully credible. By contrast, the key feature of the model developed in this paper is that private agents' expectations toward the duration of stabilization are allowed to vary over time.

The model presented below studies a small open economy's response to an exchange rate-based stabilization, which is characterized by uncertain duration. The framework of Calvo and Drazen (1998) is extended by incorporating a learning process by which private agents in the economy form expectations about the credibility of stabilization. The credibility of stabilization is assumed to depend on the consistency between domestic credit policy and the new exchange rate policy. When the stabilization program is announced, agents in the economy are not convinced that consistency will exist between the two policies and thus, the long-run viability of stabilization is initially believed not to be fully credibility. In order to learn about the true nature of domestic credit policy during stabilization, private agents form and update their beliefs on this matter in a Bayesian fashion. As such, credibility is defined in this paper as the subjective probability that the government has implemented a consistent domestic credit policy during stabilization. This information is then used by agents to form expectations about the duration of stabilization.

The paper demonstrates that the path of consumption and the path of the current account during stabilization depend on the time pattern of credibility and the size of the intertemporal elasticity of substitution. More importantly, the paper shows that learning about credibility helps to explain the stylized facts of consumption and the current account than cannot otherwise be explained in its absence.

The remainder of the paper is organized as follows. The next section outlines the underlying model used in the paper. Section three augments the basic model to study an exchange rate-based stabilization program characterized by uncertain duration. In section four, the impact of the stabilization announcement and the ensuing learning process are analyzed. Section five concludes and discusses some possible extensions.

2. The Basic Model

In this section, an open economy monetary model is outlined that closely follows the paper of Obstfeld (1985).

2.1 Representative Agent's Problem

Consider a small open economy, which is inhabited by an infinitely lived, representative agent. The agent maximizes an intertemporal utility function of the form

$$U = \sum_{t=0}^{\infty} \beta^t \frac{\left(c_t^{\alpha} m_t^{1-\alpha}\right)^{1-1/\sigma}}{1-1/\sigma}, \qquad 0<\alpha<1,\ \sigma>0, \tag{2.1}$$

where β is the subjective discount rate and σ is the intertemporal elasticity of substitution. The utility function depends on consumption (c) and real money balances (m), defined as nominal money balances (M) deflated by the domestic price level (P).

The representative agent may hold wealth in the form of domestic money or an internationally traded bond, with the latter denominated in terms of the consumption good (the numeraire in the model). All money is taken to be high-powered and the domestic banking system is ignored. The rate of interest on the bond is determined in the world capital market and is constant at the level r.

In this single good world, it is assumed that purchasing power parity holds:

$$P_t = S_t P_t^*, \tag{2.2}$$

where P is the domestic price level, S is the domestic-currency price of foreign money, and P* is the foreign price level. It is also assumed that $P^* = 1$ which implies that we can identify the domestic price level with the exchange rate.

Real financial wealth at time *t* is given by

$$a_t = m_t + b_t, \tag{2.3}$$

where b is the agent's bond holdings. Real financial wealth evolves as

$$a_{t+1} - a_t = rb_t + y_t + \tau_t - \varepsilon_t m_t - c_t, \tag{2.4}$$

where τ is government lump-sum transfers, and ε is the domestic rate of inflation. Given the above assumption of purchasing power parity, ε can also be identified with the rate of devaluation. Combining (2.3) with (2.4) yields

$$a_{t+1} = (1+r)a_t + y_t + \tau_t - (r+\varepsilon_t)m_t - c_t. \tag{2.5}$$

Solving (2.5) forward and imposing the transversality condition $\lim_{t\to\infty}\left(1/(1+r)\right)^t a_t = 0$, the agent's intertemporal budget constraint is

$$\sum_{t=0}^{\infty}\left(\frac{1}{1+r}\right)^t \left(c_t + (r+\varepsilon_t)m_t\right) = a_0 + \sum_{t=0}^{\infty}\left(\frac{1}{1+r}\right)^t \left(y_t + \tau_t\right). \tag{2.6}$$

Constraint (2.6) states that the present value of future expenditure should be equal to the agent's total lifetime wealth, which is the sum of initial real financial wealth and the present value of income plus transfers. The expenditure term includes both spending on consumption and liquidity services. The consumption price of these liquidity services (i.e. the opportunity cost of holding real money balances) is the nominal interest rate, which is simply

$$i_t = r + \varepsilon_t . \tag{2.7}$$

It is important to note from (2.7) that variation in the nominal interest rate will only be caused by variation in the rate of devaluation.

In general, the agent's problem is to maximize (2.1) subject to (2.6). However, a different approach is taken below. The problem is reformulated in terms of a "real expenditure" index.[1] Let z_t be defined as an index of total real expenditure, which is equal to $c_t^{\alpha} m_t^{1-\alpha}$. The price of a unit of this real expenditure index is obtained by solving the agent's intratemporal problem. In Appendix A, the solution to this problem is shown to produce

$$P_t^e = \frac{(i_t)^{1-\alpha}}{\alpha^{\alpha}(1-\alpha)^{1-\alpha}} , \tag{2.8}$$

This expenditure-based price index is defined as the minimum amount of expenditure in terms of the consumption good needed to purchase a unit of the expenditure index, z_t.

Now, the agent's intertemporal problem in terms of the real expenditure index can be set up and solved. The agent's period budget constraint is rewritten as

$$a_{t+1} = (1+r)a_t + y_t + \tau_t - P_t^e z_t . \tag{2.9}$$

This constraint along with (2.1) yields the following Lagrangian:

$$L = \sum_{t=0}^{\infty} \beta^t \left[\frac{z_t^{1-1/\sigma}}{1-1/\sigma} - \lambda_t \left(a_{t+1} - (1+r)a_t - y_t - \tau_t + P_t^e z_t \right) \right], \tag{2.10}$$

where λ_t is a Lagrange multiplier. Differentiation of (2.10) with respect to z_t and a_{t+1} results in the following first-order conditions:

$$z_t^{1/\sigma} = \frac{1}{\lambda_t P_t^e} , \tag{2.11}$$

$$\lambda_t = \beta(1+r)\lambda_{t+1} . \tag{2.12}$$

Equation (2.11) can be combined with its date *t+1* counterpart by using equation (2.12). This procedure produces an Euler equation for the real expenditure index:

[1] See Obstfeld and Rogoff (1996, Chp. 4) for details on this approach.

$$z_{t+1} = \beta^{\sigma}(1+r)^{\sigma}\left(\frac{P_t^e}{P_{t+1}^e}\right)^{\sigma} z_t . \tag{2.13}$$

A useful way to interpret this expression is to define the term $(1+r)(P_t^e / P_{t+1}^e)$ as the expenditure-based real interest rate. This interest rate denotes the price of future real expenditure in terms of present real expenditure. Variation in the expenditure-based price index can then be regarded to influence the growth path of total expenditures by raising or lowering the expenditure-based real rate of interest.

Equation (2.13) can be easily rewritten solely in terms of the consumption good. Using the fact that the demand for the consumption good can be expressed as $c_t = \alpha P_t^e z_t$ and assuming that $\beta = 1/(1+r)$ yields[2]

$$c_{t+1} = \left(\frac{P_t^e}{P_{t+1}^e}\right)^{\sigma-1} c_t . \tag{2.14}$$

According to (2.14), the rate of consumption growth between periods depends on the size of the intertemporal elasticity of substitution and the growth rate of the expenditure-based price index, which in turn depends on the path of the nominal interest rate. An expression characterizing the growth in real money balances between period t and $t+1$ can also be derived from equation (2.13). Noting that the demand for real money balances can be written as $m_t = \left[(1-\alpha)/(r+\varepsilon_t)\right] P_t^e z_t$ and substituting this expression into (2.13) obtains

$$m_{t+1} = \left(\frac{i_t}{i_{t+1}}\right)^{1+(1-\alpha)(\sigma-1)} m_t . \tag{2.15}$$

As with consumption growth, the growth rate of real money balances between periods is a function of the size of the intertemporal elasticity of substitution and the path of the nominal interest rate.

2.2 Government's Budget Constraint

The government comprises both a central bank and a fiscal authority. At any time t, the central bank's balance sheet is given by

$$M_t = F_t + D_t , \tag{2.16}$$

where M_t is the monetary base, D_t is the level of domestic credit, and F_t is the level of foreign reserves, which are valued in domestic currency at the current exchange rate, S_t. The fiscal authority's objective is to finance a level of government spending g_t and

[2] The assumption that $\beta = 1/(1+r)$ is made in order to eliminate unnecessary dynamics in the model.

lump-sum transfers τ_t. It accomplishes this objective through the interest earnings on the central bank's foreign reserves and the expansion of domestic credit. Thus, the fiscal authority's budget constraint is

$$g_t + \tau_t = rf_t + (D_{t+1} - D_t)/P_{t+1}, \tag{2.17}$$

where f_t is the level of real reserves (i.e. $f_t = F_t / P_t$). Equation (2.17) implies that the fiscal authority itself does not issue interest-bearing debt to the public.

It is convenient to consolidate the budgets of the central bank (2.16) and the fiscal authority (2.17) to yield the following 'government' budget constraint:

$$f_{t+1} - f_t = rf_t + \Delta m_{t+1} + \varepsilon_t m_t - g_t - \tau_t, \tag{2.18}$$

where the expression $\left(M_{t+1} - M_t\right)/P_{t+1} = \Delta m_{t+1} + \varepsilon_t m_t$ has been utilized. The term $\left(\Delta m_t + \varepsilon_t m_t\right)$ reflects the fact that the government collects seigniorage by supplying money to accommodate increases in desired real balances and to insure that the agent can maintain a given level of real balances in the face of inflation. Assuming that the government does not hold net foreign reserves asymptotically, the government's intertemporal budget constraint is

$$\sum_{t=0}^{\infty}\left(\frac{1}{1+r}\right)^t g_t + \tau_t = f_0 + \sum_{t=0}^{\infty}\left(\frac{1}{1+r}\right)^t \left(\Delta m_{t+1} + \varepsilon_t m_t\right). \tag{2.19}$$

The present value of government spending plus lump-sum transfers is constrained by the initial value of foreign reserves and the present value of seigniorage.

2.3 Consumption and the Current Account

An economy wide intertemporal budget constraint is obtained by combining the agent's budget constraint and the government's budget constraint. Combining (2.3), (2.5), and (2.18) yields

$$h_{t+1} = (1+r)h_t + y_t - g_t - c_t, \tag{2.20}$$

where $h_t = b_t + f_t$ denotes total foreign asset holdings in the economy. Solving (2.20) forward obtains

$$\sum_{t=0}^{\infty}\left(\frac{1}{1+r}\right)^t c_t = h_0 + \sum_{t=0}^{\infty}\left(\frac{1}{1+r}\right)^t (y_t - g_t), \tag{2.21}$$

where the transversality condition $\lim_{t\to\infty}\left(1/(1+r)\right)^t h_t = 0$ has been imposed. The present value of aggregate consumption cannot exceed the economy's initial stock of total foreign assets plus the present value of output net of government expenditures.

To derive an expression for optimal consumption on data $t = 0$, Euler equation (2.14) is combined with the constraint (2.21) to yield

$$c_0 = \frac{h_0 + \sum_{t=0}^{\infty}\left(\frac{1}{1+r}\right)^t y_t - g_t}{1+\left[\sum_{t=1}^{\infty}\left(\frac{1}{1+r}\right)^t \left(P_t^e\right)^{1-\sigma} / \left(P_0^e\right)^{1-\sigma}\right]}, \tag{2.22}$$

Equation (2.22) implies that optimal consumption on any date $t \geq 0$ is

$$c_t = \frac{(1+r)h_t + \sum_{s=0}^{\infty}\left(\frac{1}{1+r}\right)^s (y_{t+s} - g_{t+s})}{1+\left[\sum_{s=1}^{\infty}\left(\frac{1}{1+r}\right)^s \left(P_{t+s}^e\right)^{1-\sigma} / \left(P_t^e\right)^{1-\sigma}\right]} \tag{2.23}$$

The numerator of equation (2.23) shows that optimal consumption is a function of the economy's total lifetime wealth. It is also readily seen from this expression how the path of the nominal interest rate and intertemporal elasticity of substitution can influence optimal consumption. The denominator in (2.23) consists of the ratio of the discounted future levels of the expenditure-based price index to the current level of the price index. Any difference between future levels of this index and the current level then causes optimal consumption to increase or decrease. This would occur anytime future nominal interest rates are expected to be different from today's rate. On the other hand, a constant nominal interest rate for all time implies that the current level of the price index does not differ from future levels, and all other things equal, the level of optimal consumption does not change. The size of the intertemporal elasticity relative to unity determines the direction of change in consumption. For example, if $\sigma < 1$ and future nominal interest rates are expected to be lower than the current rate, optimal consumption rises. If $\sigma > 1$ and future nominal interest rates are expected to be lower than the current rate and, optimal consumption decreases. When $\sigma = 1$ consumption does not respond to changes in the nominal interest rate.

Finally, an expression for the current account can be obtained by rewriting (2.20) as

$$ca_t = rh_t + y_t - g_t - c_t\,. \tag{2.24}$$

Substitution of (2.23) into (2.24) yields

$$ca_t = \left(rh_t + y_t - g_t\right) - \left(\frac{(1+r)h_t + \sum_{s=0}^{\infty}\left(\frac{1}{1+r}\right)^s (y_{t+s} - g_{t+s})}{1 + \left[\sum_{s=1}^{\infty}\left(\frac{1}{1+r}\right)^s \left(P_{t+s}^e\right)^{1-\sigma} / \left(P_t^e\right)^{1-\sigma}\right]} \right). \tag{2.25}$$

According to (2.25), current account imbalances are a result of the difference between the value of the economy's total wealth in the current period and the long-run average value of its total lifetime wealth. Current period total wealth above (below) the long-run average value of total lifetime wealth contributes to a current account surplus (deficit).

3. Learning and Uncertain Duration of Stabilization

This section uses the model outlined above to analyze an economy implementing an exchange rate-based stabilization program characterized by uncertain duration of policy. The object is to derive functions for consumption and the current account in this new environment. The following scenario is considered. At time $t = 0$ the government announces the launch of a stabilization program via exchange rate management in order to rid itself of high inflation. Prior to the announcement, the economy was in a high inflation steady state in which the rate of devaluation was expected to remain constant at $\varepsilon^H > 0$ forever. The new exchange rate policy specifies that beginning next period the rate of devaluation will be decreased permanently to a lower rate of $\varepsilon_t^L = 0$.[3] This implies that $\varepsilon_0 = \varepsilon^H$. Private agents, however, do not consider this announced stabilization program to be fully credible. As a consequence, they expect the program to be abandoned at some future date, which is unknown to them as of date *t=0*.

3.1 Definition and Measure of Credibility

The credibility of the announced stabilization program is assumed to depend on whether the government pursues a domestic credit policy consistent with its new exchange rate policy. In a fixed exchange rate regime, if domestic credit expands at a greater rate than the demand for real balances, reductions in central bank foreign reserves become necessary to achieve money market equilibrium. Assuming that the central bank cannot or will not defend the current peg after its reserves reach a lower bound, a prolonged period of excessive domestic credit creation will induce a speculative attack.[4] Such an attack will force the government to abandon the current fixed exchange rate policy. Therefore, a compatible domestic credit policy is essential for the long-term viability of the stabilization program.

[3] In the following section, the case of a gradual decline in the devaluation rate along the lines of Obstfeld (1985) will also be considered when undertaking simulations of the model.

[4] For more detail on the mechanics of such an attack, the reader is referred to 'first-generation' balance-of-payments crises models, e.g. Krugman (1979) and Flood and Garber (1984).

To motivate private agents initial belief that stabilization lacks full credibility, it is assumed that fiscal policy is not influenced by exchange rate policy as in Blanco and Garber (1986) and Cumby and van Wijnbergen (1989). This assumption is meant to reflect the fact that the formulation of fiscal policy is often constrained by domestic political factors. The potential influence of these factors raises concern that the government's commitment to a new fixed exchange rate regime will not necessarily supersede its fiscal policy objectives. In the context of this paper, private agents are fully aware of what the implications are of a permanent reduction in the rate of devaluation in terms of the future course of fiscal policy. The above assumption, however, implies that there is no guarantee that the government will automatically change its domestic credit policy at $t=0$ in order to be compatible with the new announced rate of devaluation.[5] Therefore, private agents require more than the mere initial announcement of stabilization in order to be convinced that the program is sustainable in the long-run. Instead, private agents are assumed to learn about the true nature of domestic credit policy over time and form their beliefs about its "consistency" according to Bayesian updating rules.

Suppose in the pre-stabilization, high-inflation period that domestic credit evolved in the following fashion

$$D_{t+1} - D_t = \theta_t^H + v_{t+1}^H, \qquad (3.1)$$

where θ^H is the growth rate of domestic credit and v_{t+1}^H is an i.i.d. normal disturbance term with mean zero and variance σ_H^2. During this period, the government sets domestic credit policy such that the proceeds of the inflation tax plus interest from reserves minus a given level of government expenditure are rebated back to private agents. The foregoing policy rule means that (2.17) in this case becomes

$$\tau_{H,t} = rf_t + \varepsilon_t^H m_t - g_t. \qquad (3.2)$$

This policy rule ensures consistency between the process in (3.1) and the prevailing devaluation rate of ε_t^H.[6] Substitution of (3.2) into the government budget constraint (2.18) shows that foreign reserves are not depleted in this case.

If in fact at $t=0$ the government does change its domestic credit policy to be consistent with the new exchange rate regime, money creation is generated by

$$D_{t+1} - D_t = \theta_t^L + v_{t+1}^L. \qquad (3.3)$$

[5] As is common in the literature, the analysis here does not address the question of why a government would undertake fiscal policies in the first place that would knowingly undermine the success of the announced stabilization program. For some insight into this issue, see the literature on macroeconomic policy and credibility, which is reviewed in Persson and Tabellini (1990).

[6] Another way to interpret this policy rule is that given money demand and government expenditures, lump-sum transfers adjust endogenously so that foreign reserves are not depleted.

where v_{t+1}^{L} is an i.i.d. normal disturbance term with mean zero and variance σ_L^2. In this case, domestic credit policy is set based on the policy rule

$$\tau_{L,t} = rf_t + \varepsilon_t^L m_t - g_t . \tag{3.4}$$

Again, this ensures consistency between the process in (3.3) and the anticipated new devaluation rate of ε_t^L during stabilization. Equations (3.2) and (3.4) also imply that $\theta_t^L < \theta_t^H$ for $t > 1$. Thus, both processes for domestic credit have the same form except with different growth rates and variances. In addition, another implication of the policy rule in (3.4) worth noting is that $\Delta f_{t+1} = \Delta m_{t+1}$. To increase their holdings of real money balances, private agents must sell foreign bonds.

The basic problem faced by private agents at $t = 0$ is not knowing whether domestic credit policy during stabilization will follow the new process in (3.3) or continue being governed by the old process in (3.1). To assess the likelihood of which process is actually generating lump-sum transfers, private agents form Bayesian forecasts. Hence, at the beginning of any given period while the stabilization program exists, private agents have some prior subjective probability about the true nature of θ_t. To obtain the best forecast of this probability, private agents combine any new information available to them at the beginning of the period regarding the growth rate of domestic credit with their prior belief in order to form a posterior subjective probability about θ_t. The Bayesian updating rule in this instance is

$$q_{t+1} = \frac{q_t f(\Delta D_t \mid \theta^L)}{q_t f(\Delta D_t \mid \theta^L) + (1 - q_t) f(\Delta D_t \mid \theta^H)} , \tag{3.5}$$

where q_{t+1} is individuals' posterior subjective probability that the current domestic credit process is consistent, q_t is individuals' prior subjective probability that the current domestic credit process is consistent, $f(\Delta D_t \mid \theta^L)$ is the likelihood function of observing ΔD_t given that the domestic credit is governed by the new process, and $f(\Delta D_t \mid \theta^H)$ is the likelihood function of observing ΔD_t given that domestic credit is governed by the old process. Therefore, the variable q_{t+1} can be thought of as measuring stabilization's degree of credibility. As such, credibility is specifically defined in this paper as the subjective probability that domestic credit policy is consistent with the current exchange rate regime.[7] This definition of credibility is then tied directly to variables within the model. In this way, credibility can be properly regarded as an endogenous variable. In addition, q_{t+1} will simply be referred to as the subjective probability of a credible stabilization from here on out to highlight its role as the measure of credibility.

[7] For a similar definition of credibility, see Baxter (1985).

To examine how this subjective probability changes over time, the analysis presented in Lewis (1988) is followed. First, the posterior odds ratio in terms of this probability is given as

$$\left(\frac{q_{t+1}}{1-q_{t+1}}\right)=\left(\frac{q_t}{1-q_t}\right)\left[\frac{(1/\sigma_L)\exp\left(-1/2\left[\frac{\Delta D_t-\theta^L}{\sigma_L}\right]^2\right)}{(1/\sigma_H)\exp\left(-1/2\left[\frac{\Delta D_t-\theta^H}{\sigma_H}\right]^2\right)}\right], \tag{3.6}$$

which simply expresses the posterior odds in favor of the current observation of ΔD_t being generated by a consistent domestic credit policy. As evident by (3.6), the posterior odds are just the product of the prior odds ratio and the likelihood ratio.

The expression in (3.6) shows that any difference between the prior odds and the posterior odds depends upon the current observation of the change in domestic credit. Let ΔD_t^* be defined as the change in domestic credit where the probability of being under either (3.1) or (3.3) is the same. This implies that the likelihood ratio is unity and the prior odds ratio equals the posterior odds ratio. Thus, the subjective probability that stabilization is credible does not change from period *t* to *t+1*. But observations different from ΔD_t^* will cause the subjective probability to be revised. If $\Delta D_t > \Delta D_t^*$, the denominator of the likelihood ratio in (3.6) increases, and the entire likelihood ratio falls. In turn, the posterior odds in favor of a consistent domestic credit policy decreases from period *t* to *t+1* (i.e. $q_{t+1} < q_t$). If $\Delta D_t < \Delta D_t^*$, the exact opposite dynamic occurs. The posterior odds in favor of a consistent domestic credit policy increases between periods *t* and *t+1* (i.e. $q_{t+1} > q_t$). Therefore, private agents' beliefs about the credibility of stabilization evolve over time according to the realizations of the random variable ΔD_t. Nevertheless, as shown in Appendix B, given the true process for domestic credit, the subjective probability, q_{t+1}, will either converge toward zero or one. The former outcome occurs if domestic credit policy is inconsistent, while the latter outcome occurs if policy is consistent.

3.2 Probability of Collapse

Because stabilization in the beginning is not deemed fully credible, this triggers expectations that stabilization might collapse in the future. Private agents then must also assign a probability to stabilization's likely duration. Let $(p_{t+T} \mid I_t)$ be private agents' subjective probability that stabilization exists in period t+*T* given information available as of date t, and $1-(p_{t+T} \mid I_t)$ be private agents' subjective probability that the stabilization program has collapsed and does not exist in period t+*T*. With these definitions, the probability distribution of the time until stabilization is expected to collapse is easily derived. Since $1-(p_{t+s} \mid I_t)$ for $s=1,2,3,....$ are all based on information as of time t, the agent's subjective probability of stabilization collapsing at a future date must be equal to

$1-(p_{t+1} \mid I_t)$. In addition, the probability of reaching a date t+*T* without stabilization collapsing is $(p_{t+1} \mid I_t)^{T-1}$. It follows from this that the probability distribution as of time t of stabilization collapsing at date t+*T* is $(p_{t+1} \mid I_t)^{T-1}\left(1-(p_{t+1} \mid I_t)\right)$. Thus, the probability distribution as of time t of stabilization existing at date t+*T* is $(p_{t+1} \mid I_t)^{T}$.

As implied above, private agents' belief that stabilization might collapse at some future date is directly related to their belief that stabilization is not fully credible. Thus, $\left(p_{t+1} \mid I_t\right)$ is somehow linked to q_{t+1}. To formalize this notion, an explicit function connecting these two subjective probabilities is specified. It is assumed that the simplest possible function relates these two probabilities; that is

$$\left(p_{t+1} \mid I_t\right) = q_{t+1}. \tag{3.7}$$

Hence, the more (less) agents believe domestic credit policy to be consistent, the more (less) they believe stabilization to be permanent.

3.3 Representative Agent's Problem

While the duration of stabilization is uncertain, the sequence of events facing private agents each period is the following. First, agents must calculate their subjective probability, q_{t+1}, that stabilization is credible. In turn, they use this information to form their subjective probability, $\left(p_{t+1} \mid I_t\right)$, that stabilization will not collapse. Private agents then make their optimal consumption decisions based on these assessments. But once the uncertainty concerning the duration of stabilization is resolved, it is assumed that there are only two possible states of nature. If private agents believe with probability one that stabilization will not collapse, the current exchange rate regime represented by ε^L is assumed to last indefinitely. On the other hand, if private agents learn with probability one that stabilization will collapse, a speculative attack ensues and the stabilization program collapses. In this state of the world, it is assumed that the economy returns indefinitely to its high inflation steady state with the rate of devaluation set again at ε^H. Furthermore, it is assumed that markets are incomplete and thus, there is no way private agents can insure themselves against the event that stabilization collapses.

The representative agent's problem is now formally taken up. The representative agent's expected lifetime utility function needs to take into account all possible dates of transition into either future state. Let date *T* denote the possible date of transition and expected utility can then be written as

$$EU = \sum_{T=1}^{\infty}\left[\sum_{t=0}^{T-1}\beta^t \frac{\left(z_t\right)^{1-1/\sigma}}{1-1/\sigma} + q_{t+1}^{T}\sum_{t=T}^{\infty}\beta^t \frac{\left(z_{L,t}\right)^{1-1/\sigma}}{1-1/\sigma} + q_{t+1}^{T-1}(1-q_{t+1})\sum_{t=T}^{\infty}\beta^t \frac{\left(z_{H,t}\right)^{1-1/\sigma}}{1-1/\sigma}\right]. \tag{3.8}$$

where $z_{L,t}$ is the real expenditure index given that stabilization is believed to be permanent, and $z_{H,t}$ is the real expenditure index given that stabilization has collapsed.

The agent's optimization problem is solved by differentiating the following Lagrangian expression

$$
\begin{aligned}
L = \sum_{T=1}^{\infty} \Bigg\{ & \sum_{t=0}^{T-1} \beta^t \left[\frac{z_t^{1-1/\sigma}}{1-1/\sigma} - \lambda_t \left(a_{t+1} - (1+r)a_t - y_t - g_t - \tau_t + P_t^e z_t \right) \right] \\
& + q_{t+1}^{T} \sum_{t=T}^{\infty} \beta^t \left[\frac{z_{L,t}^{1-1/\sigma}}{1-1/\sigma} - \lambda_{L,t} \left(a_{t+1} - (1+r)a_t - y_t - g_t - \tau_{L,t} + P_{L,t}^e z_{L,t} \right) \right] \\
& + q_{t+1}^{T-1}(1-q_{t+1}) \sum_{t=T}^{\infty} \beta^t \left[\frac{z_{H,t}^{1-1/\sigma}}{1-1/\sigma} - \lambda_{H,t} \left(a_{t+1} - (1+r)a_t - y_t - g_t - \tau_{H,t} + P_{H,t}^e z_{H,t} \right) \right] \Bigg\}, \quad (3.9)
\end{aligned}
$$

where $P_{L,t}^e = \left(r + \varepsilon_t^L\right)^{1-\alpha} / \alpha^{\alpha} \left(1-\alpha\right)^{1-\alpha}$ is the expenditure-based price index given that stabilization is believed to be permanent, $P_{H,t}^e = \left(r + \varepsilon_t^H\right)^{1-\alpha} / \alpha^{\alpha} \left(1-\alpha\right)^{1-\alpha}$ is the expenditure-based price index given that stabilization has collapsed, and $\lambda_{i,t}$ is the Lagrange multiplier for each possible future state with $i = L, H$. The resulting first-order conditions with respect to $z_t, z_{L,t+T}, z_{H,t+T}$ and a_{t+1} are

$$z_t^{1/\sigma} = \frac{1}{\lambda_t P_t^e}, \quad (3.10)$$

$$z_{L,t+T}^{1/\sigma} = \frac{1}{\lambda_{L,t+T} P_{L,t+T}^e}, \quad (3.11)$$

$$z_{H,t+T}^{1/\sigma} = \frac{1}{\lambda_{H,t+T} P_{H,t+T}^e}, \quad (3.12)$$

$$\lambda_t = \beta(1+r)\left[q_{t+1}\lambda_{L,t+1} + (1-q_{t+1})\lambda_{H,t+1} \right]. \quad (3.13)$$

Using the fact that $c_t = \alpha P_t^e z_t$, $m_t = \left[(1-\alpha)/(r+\varepsilon_t)\right] P_t^e z_t$, and assuming the world discount rate is equal to the subjective discount rate, equations (3.10)-(3.13) become in terms of consumption and real money balances

$$c_t = \frac{\alpha \left(P_t^e\right)^{1-\sigma}}{\lambda_t^{\sigma}}, \quad (3.14)$$

$$m_t = \frac{(1-\alpha) i_t^{(1-\alpha)(1-\sigma)-1}}{k^{1-\sigma} \lambda_t^{\sigma}}, \quad (3.15)$$

$$c_{L,t+T} = \frac{\alpha\left(P^e_{L,t+T}\right)^{1-\sigma}}{\lambda^\sigma_{L,t+T}}, \tag{3.16}$$

$$m_{L,t+T} = \frac{(1-\alpha)i_{L,t+T}^{(1-\alpha)(1-\sigma)-1}}{k^{1-\sigma}\lambda^\sigma_{L,t+T}}, \tag{3.17}$$

$$c_{H,t+T} = \frac{\alpha\left(P^e_{H,t+T}\right)^{1-\sigma}}{\lambda^\sigma_{H,t+T}}, \tag{3.18}$$

$$m_{H,t+T} = \frac{(1-\alpha)i_{H,t+T}^{(1-\alpha)(1-\sigma)-1}}{k^{1-\sigma}\lambda^\sigma_{H,t+T}}, \tag{3.19}$$

$$\lambda_t = q_{t+1}\lambda_{L,t+1} + (1-q_{t+1})\lambda_{H,t+1}, \tag{3.20}$$

where $k = \alpha^\alpha(1-\alpha)^{1-\alpha}$, the variable $i_{L,t+T}$ denotes the nominal interest rate given that stabilization is believed to be permanent, and $i_{H,t+T}$ denotes the nominal interest rate given that stabilization has collapsed.

Consumption and real money balances on any date *t* given that the duration of stabilization is unknown can be related to the potential future paths of the economy by substituting equation (3.20) into (3.14) and (3.15) to yield

$$c_t = \frac{\alpha\left(P^e_t\right)^{1-\sigma}}{\left(q_{t+1}\lambda_{L,t+1} + (1-q_{t+1})\lambda_{H,t+1}\right)^\sigma}, \tag{3.21}$$

$$m_t = \frac{(1-\alpha)i_t^{(1-\alpha)(1-\sigma)-1}}{k^{1-\sigma}\left(q_{t+1}\lambda_{L,t+1} + (1-q_{t+1})\lambda_{H,t+1}\right)^\sigma}. \tag{3.22}$$

The two Lagrange multipliers as of date time t+1 represent the possible future paths of the economy.

The economy wide intertemporal budget constraint for each possible state as of date *t+1* is

$$\sum_{s=1}^{\infty}\left(\frac{1}{1+r}\right)^{s-1} c_{i,t+s} = (1+r)h_{t+1} + \sum_{s=1}^{\infty}\left(\frac{1}{1+r}\right)^{s-1}(y_{t+s} - g_{t+s}), \tag{3.23}$$

with $i = L, H$. Because all uncertainty is resolved in either state of nature, each Lagrange multiplier will be constant. This implies that substitution of (3.16) into (3.23) obtains

$$\lambda_{L,t+1} = \left[\frac{\alpha\sum_{s=1}^{\infty}\left(\frac{1}{1+r}\right)^{s-1}\left(P^e_{L,t+s}\right)^{1-\sigma}}{(1+r)h_{t+1} + \sum_{s=1}^{\infty}\left(\frac{1}{1+r}\right)^{s-1}(y_{t+s} - g_{t+s})}\right]^{1/\sigma}, \tag{3.24}$$

while substitution of (3.18) into (3.23) obtains

$$\lambda_{H,t+1} = \left[\frac{\alpha \sum_{s=1}^{\infty} \left(\frac{1}{1+r} \right)^{s-1} \left(P^{e}_{H,t+s} \right)^{1-\sigma}}{(1+r)h_{t+1} + \sum_{s=1}^{\infty} \left(\frac{1}{1+r} \right)^{s-1} (y_{t+s} - g_{t+s})} \right]^{1/\sigma} . \tag{3.25}$$

In general, equations (3.21), (3.24), and (3.25) characterize the dynamic path of consumption over time as long as stabilization's duration is uncertain. Given the implicit assumption that the path of output net of government expenditures does not differ whether the agent believes stabilization to be permanent or if stabilization has collapsed, in Appendix C, substitution of (3.24) and (3.25) into (3.21) is shown to produce

$$c_t = \frac{(1+r)h_t + \sum_{s=0}^{\infty} \left(\frac{1}{1+r} \right)^{s} (y_{t+s} - g_{t+s})}{1 + \frac{1}{r} \frac{\left[q_{t+1} \left(i_L^{(1-\alpha)(1-\sigma)} \right)^{1/\sigma} + (1-q_{t+1}) \left(i_H^{(1-\alpha)(1-\sigma)} \right)^{1/\sigma} \right]^{\sigma}}{i_t^{(1-\alpha)(1-\sigma)}}} . \tag{3.26}$$

According to (3.26), optimal consumption conditional on the duration of stabilization being unknown as of date t is a function of the economy's total lifetime wealth, the future path of the nominal interest rate, the subjective probability of a credible stabilization, and the intertemporal elasticity of substitution. The difference between the certainty case in the last section and the uncertain duration case here is the fact that optimal consumption now depends on the ratio of the discounted *expected* future path of the nominal interest rate to the current value of the nominal interest rate. The expected future path of the nominal interest rate (bracketed term in the denominator) consists of the lower rate that prevails if stabilization is believed to be permanent and the higher rate that exists if stabilization collapses. Each potential future level is weighted by the subjective probabilities q_{t+1} and $(1-q_{t+1})$.

An expression for the current account is found by substituting (3.26) into (2.24) which yields

$$ca_t = \left(rh_t + y_t - g_t \right) - \left(\frac{(1+r)h_t + \sum_{s=0}^{\infty} \left(\frac{1}{1+r} \right)^{s} (y_{t+s} - g_{t+s})}{1 + \frac{1}{r} \frac{\left[q_{t+1} \left(i_L^{(1-\alpha)(1-\sigma)} \right)^{1/\sigma} + (1-q_{t+1}) \left(i_H^{(1-\alpha)(1-\sigma)} \right)^{1/\sigma} \right]^{\sigma}}{i_t^{(1-\alpha)(1-\sigma)}}} \right) . \tag{3.27}$$

Again, current account imbalances are a result of the difference between the value of the economy's total wealth in the current period and the long-run average value of its total lifetime wealth.

4. The Real Effects of Stabilization

This section examines the effects of stabilization on consumption and the current account based on equations (3.26) and (3.27). The initial impact of stabilization is discussed first and then the transitional dynamics while learning about stabilization's credibility takes place are examined.

4.1 Announcement Effect

Before the stabilization program is announced, private agents expect the devaluation rate to remain constant at the level ε^H. This implies that the nominal interest rate will also remain constant at the level i_H. To help focus the analysis, it is also assumed that before and after the announcement output net of government expenditures is constant at the level $\bar{y}-\bar{g}$. From equation (2.23), all of this implies that the pre-announcement level of consumption can be expressed as

$$c_{-1} = \frac{(1+r)h_{-1} + \left((1+r)/r\right)(\bar{y}-\bar{g})}{1+\frac{1}{r}}. \tag{4.1}$$

Once the stabilization program is announced, however, private agents have to confront the issue regarding the credibility of the new exchange rate regime. According to equation (3.26), optimal consumption at time $t=0$ then becomes

$$c_0 = \frac{(1+r)h_0 + \left((1+r)/r\right)(\bar{y}-\bar{g})}{1+\frac{1}{r}\frac{\left[q_1\left(i_L^{(1-\alpha)(1-\sigma)}\right)^{1/\sigma} + (1-q_1)\left(i_H^{(1-\alpha)(1-\sigma)}\right)^{1/\sigma}\right]^{\sigma}}{i_{H,0}^{(1-\alpha)(1-\sigma)}}}. \tag{4.2}$$

Comparison of equation (4.2) with equation (4.1) reveals that the impact effect of the announcement on consumption is determined by two factors: a) the anticipated fall in the nominal interest rate relative to the current level and b) private agents' initial prior regarding the credibility of stabilization. But the precise direction of consumption's response depends on the value of the intertemporal elasticity of substitution. There are three cases to consider: $\sigma=1$, $\sigma<1$, and $\sigma>1$. When $\sigma=1$, equation (4.2) collapses into equation (4.1) if no change in the stock of net foreign assets is assumed. In this instance, the announcement of the stabilization program has no impact on consumption and thus, does not affect the current account as well. This result stems from the fact that the utility function takes the logarithmic form $u(c,m) = \alpha \log(c) + (1-\alpha)\log(m)$ when the elasticity of substitution is unity. Since the utility function is separable in its two arguments, consumption becomes independent from exchange rate policy.

When $\sigma < 1$, the anticipated fall in the devaluation rate causes consumption to rise in period $t = 0$. The decline in rate of devaluation next period implies that the future level of the nominal interest rate is expected to be lower as well. As a consequence, real money balances are expected to increase. Since the condition $\sigma < 1$ is equivalent to the condition that U_{cm} is negative, the marginal utility of consumption is also expected to decline next period and this causes agents to substitute toward current consumption.

The magnitude of this anticipated disinflation effect is determined by agents' initial prior about the credibility of stabilization, q_1. On the one extreme, if private agents' prior is that the announcement has no credibility whatsoever, q_1 is equal to zero and (4.2) collapses into (4.1) again. The result is no change in consumption. If private agents believe the announcement to be fully credible, q_1 is equal to one and consumption rises to the fullest possible extent given the expected fall in the rate of devaluation. Therefore, the larger is q_1, the greater the impact of the anticipated disinflation effect on consumption. Because output is constant and consumption rises, the current account registers a deficit on impact of the announcement.

If $\sigma > 1$, the exact opposite dynamics are produced. In this case, agents still anticipate an increase in their real money balances next period due to the expected decline in the nominal interest rate. Since U_{cm} is now positive, this expected increase in real money balances, however, implies that the marginal utility of consumption is expected to increase. Hence, private agents substitute toward the future and current consumption falls. Again, the value of agents' initial prior about stabilization's credibility determines the magnitude of this substitution effect. The current account in this case registers an initial surplus.

The interplay between consumption's response and the size of the elasticity of substitution can also be explained in terms of the expenditure-based real interest rate. As noted in section two, this interest rate is equal to $(1+r)(P_t^e / P_{t+1}^e)$. The expected decline in the nominal interest rate implies that the expenditure-based price index increases next period. The expenditure-based real rate of interest rises as a result. Other things the same, a rise in the expenditure-based real interest rate makes saving more attractive in the current period and induces agents to substitute toward future expenditures. This intertemporal effect tends to tilt the agent's optimal consumption profile toward the future. But the expected decline in the nominal interest rate also causes a 'within' period expenditure switching effect. Because the price of liquidity services is expected to fall, this leads agents to hold less real money balances in the current period. The result is more expenditure falling on consumption and this intratemporal effect tends to tilt the agent's optimal consumption profile toward the present. When $\sigma > 1$, the intertemporal effect wins out and consumption falls. When $\sigma < 1$, the intratemporal effect dominates and consumption rises.

4.2 Transition Effects

In the periods following the announcement, private agents' expectations about the future level of the nominal interest rate changes in a fundamental way. In the announcement period, private agents expected, at worst, no change in the nominal interest rate, and at best, a decline in the nominal interest rate. After this initial period, however, private agents have to contend with the possibility that the nominal interest rate might actually increase in the next period if stabilization collapses. For example, optimal consumption in period $t=1$ is given by

$$c_1 = \frac{(1+r)h_1 + \big((1+r)/r\big)(\overline{y}-\overline{g})}{1+\dfrac{1}{r}\dfrac{\left[q_2\left(i_L^{(1-\alpha)(1-\sigma)}\right)^{1/\sigma} + (1-q_2)\left(i_H^{(1-\alpha)(1-\sigma)}\right)^{1/\sigma}\right]^{\sigma}}{i_{L,1}^{(1-\alpha)(1-\sigma)}}}. \tag{4.3}$$

In the denominator of (4.3), the ratio of the expected future path of the nominal interest rate to its current level illustrates how the possibility of stabilization's collapse now affects agents' expectations. Agents, at best, expect no change in the nominal interest rate and, at worst, expect an increase in the nominal interest rate. Therefore, the anticipation of possible re-inflation, rather than disinflation influences consumption behavior.

In the case of $\sigma < 1$, the possibility of a higher nominal interest rate next period implies that real money balances might fall. In turn, agents anticipate that their marginal utility of consumption might also increase. This causes private agents to substitute toward the future and current consumption tends to fall. As time passes, so long as the duration of stabilization is uncertain, the anticipation of possible re-inflation each period then contributes to a path of consumption that declines over time. In turn, the economy's holding of foreign assets falls over time and this entails an improvement in the current account balance.

The effect of learning about stabilization's credibility can either have the opposite or same influence on consumption as the anticipated re-inflation effect. Each period after the announcement, private agents update their expectations about the credibility of stabilization according to the Bayesian rule set out in (3.5). If the current observation of the change in domestic credit leads agents to believe that it is more likely that a consistent domestic credit policy is in place, the subjective probability of a credible stabilization program increases over last period's level. This receipt of "good" news implies that agents believe stabilization to be more permanent in nature. All other things the same, this induces agents to substitute towards the present and consumption tends to rise. Thus, the substitution effect arising from learning in this case is the exact opposite of the anticipated re-inflation effect. On the other hand, if the arrival of new information regarding the change in domestic credit causes agents to revise their subjective probability of a credible stabilization downwards, this receipt of "bad" news induces agents to substitute towards the future and consumption tends to fall.

The combined impact of anticipated re-inflation and learning on the time path of consumption and the time path of the current account depends on whether the subjective probability of a credible stabilization increases or decreases over time. If the probability continuously falls, the time path of consumption unambiguously declines and the time path of the current account unambiguously improves. If the probability continuously rises and the substitution effect arising from this action is stronger (weaker) than the substitution effect stemming form anticipated re-inflation, the path of consumption rises (falls) and the path of current account deteriorates (improves) over time.

When $\sigma > 1$, the dynamics are again the exact opposite of what has just been described. In this case, the possible decrease in real money balances next period implies that the marginal utility of consumption is expected to decline as well. Private agents substitute toward the current period and consumption tends to rise. Learning about the credibility of stabilization can then either reinforce this substitution effect if the subjective probability rises or it can produce the opposite effect if the subjective probability decreases. Thus, consumption and the current account balance could rise or fall over time depending on the time pattern of this subjective probability.

The foregoing analysis indicates that a rising path of consumption and widening current account deficits during stabilization occur only under certain conditions. The various dynamics produced by the model are summarized in Table 1. Only in one case can the stylized facts be replicated. This is when the elasticity of substitution is less than unity and the subjective probability of a credible stabilization steadily increases over time. But this result also hinges on the requirement that the substitution effect arising from learning must dominate the substitution effect stemming from anticipated re-inflation. While the plausibility of the first two conditions can be gleaned from the data and real world experience, the third requirement cannot, which brings us to the next section.

4.3 Simulation Exercises

Given the ambiguity of the dynamics in the case mentioned above, some simple simulation exercises are undertaken in order to provide further insight into the model's dynamics.

The first set of simulation exercises verifies the convergence of the subjective probability of a credible stabilization to either one or zero given the true process for domestic credit creation. Assume that the pre-stabilization domestic credit process given by equation (3.1) follows a N(0.5,0.25) distribution while the new and consistent process given by (3.3) follows a N(0.0,0.1) distribution. These distributions are supposed to mimic the situation of an economy possibly moving from an expansionary to a non-increasing domestic credit policy. The following two experiments are conducted. The first experiment assumes the true process for domestic credit during stabilization is consistent. In this case, the government does reduce the growth rate of domestic credit to be in line with the reduction in the devaluation rate. The second experiment assumes the true process for domestic credit during stabilization is not consistent and hence, money creation continues to grow at the higher, pre-stabilization rate.

To see how the subjective probability q_t evolves under each experiment, artificial time series for domestic credit are computed based on the above distribution assumptions for each process.[8] The simulated data along with the means and variances for each process are then used to calculate a time series for q_t based on the Bayesian updating rule (3.5). The initial prior for q_t is assumed to be 0.25 for each experiment. Each experiment is repeated 1000 times and the results are summarized in Table 2.

Given that the true process for domestic credit is consistent, the subjective probability of a credible stabilization does converge to one 100 percent of the time by the end of the sample. The majority of the time this occurs by the 10th period. The second experiment also confirms that the subjective probability of a credible stabilization does converge to zero 100 percent of the time if the true process is not consistent.

The next set of simulation exercises concerns consumption and current account dynamics. A benchmark model is parameterized using the following values. The intertemporal elasticity of substitution, σ, is set equal to 0.40. This value is based on the empirical study of Ostry and Reinhart (1992). Using data from 13 developing countries over the period 1968-1987, they estimate this parameter to lie in the range of 0.38 – 0.50. Moreover, they find that the range shrinks to 0.37 – 0.43 when the parameter is estimated using data solely from the four Latin American countries in their study. The share of real money balances in total expenditures, $1-\alpha$, is set to 0.05. This value is based on Eckstein and Leiderman (1992), who estimate the parameter using data from Israel over the period 1970-1988. The world rate of interest, r, is set to the value of 0.04.

The benchmark model is simulated considering two different magnitudes of the reduction in the devaluation rate. In one case, the preannounced fall in the rate of devaluation is assumed to be 20 percent. This implies that $i^H = 0.24$ and $i^L = 0.04$. In the other case, the preannounced fall in rate of devaluation is assumed to be 80 percent. This implies that $i^H = 0.84$ and $i^L = 0.04$. In addition, since the object here is to see if the model can replicate the stylized facts, the series for q_t is taken from one of the runs in the first set of simulations, which assumes that the true process for domestic credit is consistent. This series is shown in Figure 1.

The results of these simulations are contained in Figures 2-5. Four cases are displayed in each of the figures. The first case assumes a constant subjective probability of a credible stabilization of 0.50 and a one-time fall in the devaluation rate. This case is supposed to imitate the dynamics produced by the models of Calvo and Drazen (1998) and Lahiri (2000). The second case uses the simulated series for q_t displayed in Figure 1 and assumes a one-time fall in the devaluation rate. The third case again uses this simulated series for q_t, but a gradual decline in the devaluation rate is assumed. The decline in the devaluation rate is assumed to occur over 12 periods in equal increments. The fourth case assumes a constant subjective probability of 0.50 and the same gradual decline in the devaluation rate as the previous case.

From Figures 2-5, the following observations are highlighted. First, the only difference between the simulations that assume a 20 percent fall in the devaluation rate as opposed to an 80 percent fall is the magnitude of the effects. Otherwise, the time pattern

[8] These series consist of 40 observations. In actuality, 140 observations were computed for each process, but the first 100 observations were tossed out in order to eliminate any dependency on the initial conditions.

of the dynamics remains the same.[9] Second, case 1 and case 4 in each figure confirm that in the absence of a learning process about the credibility of stabilization, the stylized facts of consumption and the current account cannot be replicated. Third, case 3 and case 4 in each figure demonstrate that the effect of learning about stabilization's credibility helps to explain the stylized facts only when a gradual decline in the devaluation rate is assumed. Lastly, case 4 shows that the effect of a gradual decline in the devaluation rate is not enough by itself to reproduced the stylized facts. This indicates that the dynamics produced in case 3 have more to do with learning than with a gradual disinflation process.

5. Conclusion

This paper has analyzed how a learning process about the credibility of stabilization can influence consumption and current account dynamics. In particular, the paper extended the uncertain duration of policy framework by introducing a Bayesian learning scheme concerning the consistency of domestic credit policy in relation to the new exchange rate policy. The primary finding of the paper is that the introduction of this learning process helps explain the stylized facts of consumption and the current account during the initial stages of exchange rate-based stabilizations that cannot otherwise be explained in its absence. An interesting implication of this finding is that the booms in consumption and the widening of current account deficits reflect increases in credibility rather than a lack of credibility.

The model presented in this paper is highly stylized, and hence, there are many directions in which it can be extended. One factor not analyzed in the current paper is the role of income effects. One could easily imagine a policy rule, opposite of what was assumed in the paper, which specifies government expenditures to adjust passively in order to ensure that a given level of transfers is always given to private agents. This would imply that the level of government expenditures would be different in the case where stabilization collapses than in the case where agents believe stabilization to be permanent. Thus, in addition to the fear of re-inflation, which induces substitution effects, the fear of a fall in net output (output minus government expenditures) would elicit a consumption-smoothing response from the agent.

Another important issue not addressed in the paper concerns the dynamics of the real exchange rate. The gradual appreciation of the real exchange rate is also a known stylized fact of exchange rate-based stabilization programs. The paper could then be extended to include a non-traded consumption good to analyze how learning might influence the dynamics of this variable.

[9] This result was also found to be true when different values of the world real interest rate or the intertemporal elasticity of substitution were used in place of the benchmark values.

Appendix A

Derivation of Equation (2.8)

The agent's intratemporal problem is to maximize $c_t^{\alpha} m_t^{1-\alpha}$ subject to the total expenditure constraint, $te_i = c_t + \left(r + \varepsilon_t\right) m_t$. The resulting first-order conditions are

$$\alpha c_t^{\alpha-1} m_t^{1-\alpha} - \lambda = 0\,, \tag{a.1}$$

$$(1-\alpha) c_t^{\alpha} m_t^{-\alpha} - \lambda (r + \varepsilon_t) = 0\,, \tag{a.2}$$

Combining (a.1) and (a.2) yields

$$c_t = \frac{\alpha (r + \varepsilon_t) m_t}{1-\alpha}\,, \tag{a.3}$$

The demand for real money balances and consumption is obtained by substituting (a.3) into the total expenditure constraint. The resulting demand functions are

$$m_t = \frac{(1-\alpha)}{(r + \varepsilon_t)} te_t\,, \tag{a.4}$$

$$c_t = \alpha te_t\,. \tag{a.5}$$

Substituting (a.4) and (a.5) into $z_t = c_t^{\alpha} m_t^{1-\alpha}$ and since the definition of P_t^e is the minimum expenditure such that z_t=1, the solution is

$$P_t^e = \frac{\left(r + \varepsilon_t\right)^{1-\alpha}}{\alpha^{\alpha} \left(1-\alpha\right)^{1-\alpha}} = \frac{\left(i_t\right)^{1-\alpha}}{\alpha^{\alpha} \left(1-\alpha\right)^{1-\alpha}}\,. \tag{a.6}$$

Appendix B

This appendix shows that q_t will tend towards one over time if domestic credit policy is truly consistent and will tend towards zero over time if domestic credit policy is truly inconsistent. Again, what follows below is taken from the analysis of Lewis (1988). It is convenient to first linearize the posterior odds ratio to yield

$$\log\left(\frac{q_{t+1}}{1-q_{t+1}}\right) = \log\left(\frac{q_t}{1-q_t}\right) + \log\left[\frac{(1/\sigma_L)\exp\left(-1/2\left[\frac{\Delta D_t}{\sigma_L}\right]^2\right)}{(1/\sigma_H)\exp\left(-1/2\left[\frac{\Delta D_t - \theta^H}{\sigma_H}\right]^2\right)}\right]. \tag{b.1}$$

Without loss of generality, it is assumed that $\sigma_l = \sigma_h = \sigma$. This allows the last term of the above expression to be written as

$$\log\left[\frac{(1/\sigma)\exp\left(-1/2\left[\frac{\Delta D_t}{\sigma}\right]^2\right)}{(1/\sigma)\exp\left(-1/2\left[\frac{\Delta D_t - \theta^H}{\sigma}\right]^2\right)}\right] = \frac{\left[(\Delta D_t - \theta^H)^2 - \Delta D_t^2\right]}{2\sigma^2}.$$

Using this expression and solving equation (b.1) forward T periods yields

$$\log\left(\frac{q_{t+T}}{1-q_{t+T}}\right) = \log\left(\frac{q_t}{1-q_t}\right) + \sum_{s=0}^{T-1}\left(\frac{\left[(\Delta D_{t+s} - \theta^H)^2 - \Delta D_{t+s}^2\right]}{2\sigma^2}\right). \tag{b.2}$$

Taking expectations of (b.2) conditional on the true value of the growth rate of domestic credit, θ^i, and the initial prior probabilities, one obtains

$$E_t\left\{\log\left(\frac{q_{t+T}}{1-q_{t+T}}\right)\right\} = \log\left(\frac{q_t}{1-q_t}\right) + (T-1)\left(\frac{\left[(\theta^i - \theta^H)^2 - (\theta^i)^2\right]}{2\sigma^2}\right). \tag{b.3}$$

If the government does enact a consistent domestic credit at $t = 0$ policy by appropriately lowering the growth rate of domestic credit (i.e. $\theta^i = 0$), then equation (b.3) becomes

$$E_t\left\{\log\left(\frac{q_{t+T}}{1-q_{t+T}}\right)\right\} = \log\left(\frac{q_t}{1-q_t}\right) + (T-1)\left(\frac{(-\theta^H)^2}{2\sigma^2}\right). \tag{b.4}$$

If we take the limit of (b.4) as T goes to infinity, the expected value of the log ratio of the subjective probabilities converges to positive infinity. This implies that the subjective probability of a consistent domestic credit policy, q, converges to one. Likewise, if the government does not implement a consistent domestic credit policy (i.e. $\theta^i = \theta^H$), equation (b.3) becomes

$$E_t\left\{\log\left(\frac{q_{t+T}}{1-q_{t+T}}\right)\right\} = \log\left(\frac{q_t}{1-q_t}\right) - (T-1)\left(\frac{(\theta^H)^2}{2\sigma^2}\right). \tag{b.5}$$

If we take the limit of (b.5) as T goes to infinity, the expected value of the log ratio of the subjective probabilities converges to negative infinity. This implies that the subjective probability of a consistent domestic credit policy, q, converges to zero.

Appendix C

Derivation of (3.26)

Substitution of text equations (3.24) and (3.25) into (3.21) first yields

$$c_t = \frac{\alpha\left(P_t^e\right)^{1-\sigma}}{\left[q_{t+1}\left(\dfrac{\alpha\sum_{s=1}^{\infty}\left(\dfrac{1}{1+r}\right)^{s-1}\left(P_{0,t+s}^e\right)^{1-\sigma}}{(1+r)h_{t+1}+\sum_{s=1}^{\infty}\left(\dfrac{1}{1+r}\right)^{s-1} y_{t+s}-g_{t+s}}\right)^{1/\sigma} + (1-q_{t+1})\left(\dfrac{\alpha\sum_{s=1}^{\infty}\left(\dfrac{1}{1+r}\right)^{s-1}\left(P_{1,t+s}^e\right)^{1-\sigma}}{(1+r)h_{t+1}+\sum_{s=1}^{\infty}\left(\dfrac{1}{1+r}\right)^{s-1} y_{t+s}-g_{t+s}}\right)^{1/\sigma}\right]^{\sigma}} \tag{c.1}$$

The denominator of (c.1) can be simplified to yield

$$c_t = \frac{\alpha\left(P_t^e\right)^{1-\sigma}}{\left[\left(\dfrac{\alpha}{(1+r)h_{t+1}+\sum_{s=1}^{\infty}\left(\dfrac{1}{1+r}\right)^{s-1} y_{t+s}-g_{t+s}}\right)^{1/\sigma}\left(q_{t+1}\left(\sum_{s=1}^{\infty}\left(\dfrac{1}{1+r}\right)^{s-1}\left(P_{0,t+s}^e\right)^{1-\sigma}\right)^{1/\sigma} + (1-q_{t+1})\left(\sum_{s=1}^{\infty}\left(\dfrac{1}{1+r}\right)^{s-1}\left(P_{1,t+s}^e\right)^{1-\sigma}\right)^{1/\sigma}\right)\right]^{\sigma}}$$

Further manipulating the above expression produces

$$c_t = \frac{\left(P_t^e\right)^{1-\sigma}\left[(1+r)h_{t+1}+\sum_{s=1}^{\infty}\left(\dfrac{1}{1+r}\right)^{s-1} y_{t+s}-g_{t+s}\right]}{\left[q_{t+1}\left(\sum_{s=1}^{\infty}\left(\dfrac{1}{1+r}\right)^{s-1}\left(P_{0,t+s}^e\right)^{1-\sigma}\right)^{1/\sigma} + (1-q_{t+1})\left(\sum_{s=1}^{\infty}\left(\dfrac{1}{1+r}\right)^{s-1}\left(P_1^e\right)^{1-\sigma}\right)^{1/\sigma}\right]^{\sigma}}. \tag{c.2}$$

Using the fact that $h_{t+1} = (1+r)h_t + y_t - g_t - c_t$, equation (c.2) can be rearranged as

$$\left(P_t^e\right)^{1-\sigma}(1+r)c_t + \left[q_{t+1}\left(\sum_{s=1}^{\infty}\left(\frac{1}{1+r}\right)^{s-1}\left(P_{0,t+s}^e\right)^{1-\sigma}\right)^{1/\sigma} + (1-q_{t+1})\left(\sum_{s=1}^{\infty}\left(\frac{1}{1+r}\right)^{s-1}\left(P_1^e\right)^{1-\sigma}\right)^{1/\sigma}\right]^{\sigma} c_t$$

$$= \left(P_t^e\right)^{1-\sigma}\left[(1+r)^2 h_t + (1+r)(y_t - g_t) + \sum_{s=1}^{\infty}\left(\frac{1}{1+r}\right)^{s-1} y_{t+s} - g_{t+s}\right].$$

Multiplying each side by $1/(1+r)$ and solving for consumption produces

$$c_t = \frac{(1+r)h_t + \sum_{s=0}^{\infty}\left(\frac{1}{1+r}\right)^s y_{t+s} - g_{t+s}}{1+\frac{\left[q_{t+1}\left(\sum_{s=1}^{\infty}\left(\frac{1}{1+r}\right)^{s-1}\left(P_{0,t+s}^{e}\right)^{1-\sigma}\right)^{1/\sigma} + (1-q_{t+1})\left(\sum_{s=1}^{\infty}\left(\frac{1}{1+r}\right)^{s-1}\left(P_{1,t+s}^{e}\right)^{1-\sigma}\right)^{1/\sigma}\right]^{\sigma}}{\left(1+r\right)\left(P_t^e\right)^{1-\sigma}}}. \quad \text{(c.3)}$$

Finally, since the constant devaluation rate in each state of nature implies that each expenditure-based price index will be constant as well, the summation terms in the denominator can be pulled out of the bracketed term. This allows (c.3) to be written as

$$c_t = \frac{(1+r)h_t + \sum_{s=0}^{\infty}\left(\frac{1}{1+r}\right)^s y_{t+s} - g_{t+s}}{1+\frac{1}{r}\frac{\left[q_{t+1}\left(i_0^{(1-\alpha)(1-\sigma)}\right)^{1/\sigma} + (1-q_{t+1})\left(i_1^{(1-\alpha)(1-\sigma)}\right)^{1/\sigma}\right]^{\sigma}}{i_t^{(1-\alpha)(1-\sigma)}}}. \quad \text{(c.4)}$$

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Table 1: Outcomes of Possible Consumption and Current Account Dynamics Given the Size of the Intertemporal Elasticity of Substitution (IES) and the Time Path of Credibility

Case:	IES > 1		
	Impact Effect	Transition dynamics	Match Stylized Facts?
Subjective prob. of credibility increases	C ↓ CA ↑	C ↑ CA ↓	No
Subjective prob. of credibility decreases	C ↓ CA ↑	C ↑ or ↓ CA ↓ or ↑	No
	IES < 1		
	Impact effect	Transition dynamics	Match Stylized Facts?
Subjective prob. of credibility increases	C ↑ CA ↓	C ↑ or ↓ CA ↓ or ↑	Maybe
Subjective prob. of credibility decreases	C ↑ CA ↓	C ↓ CA ↑	No

Table 2: Convergence Experiments Regarding the Subjective Probability of a Credible Stabilization Program

Experiment:	% of times q reaches one by period 5	% of times q reaches one by period 10	% of times q reaches one by period 15	% of times q reaches one by period 20	% of times q reaches one by end of sample
True domestic credit process is consistent	0.0%	61.3%	89.7%	97.9%	100%
	% of times q reaches zero by period 5	% of times q reaches zero by period 10	% of times q reaches zero by period 15	% of times q reaches zero by period 20	% of times q reaches zero by end of sample
True domestic credit process is not consistent	75.5%	95%	98.9%	99.6%	100%

Notes: The artificial series for domestic credit in each case consists of 40 observations. In actuality, 140 observations were computed, but the first 100 observations were tossed out in order to eliminate any dependency on the initial conditions. The experiments were replicated 1000 times. The initial prior for each experiment is set equal to 0.25.

Figure 1: Time Path of the Subjective Probability used in Consumption and Current Account Simulations

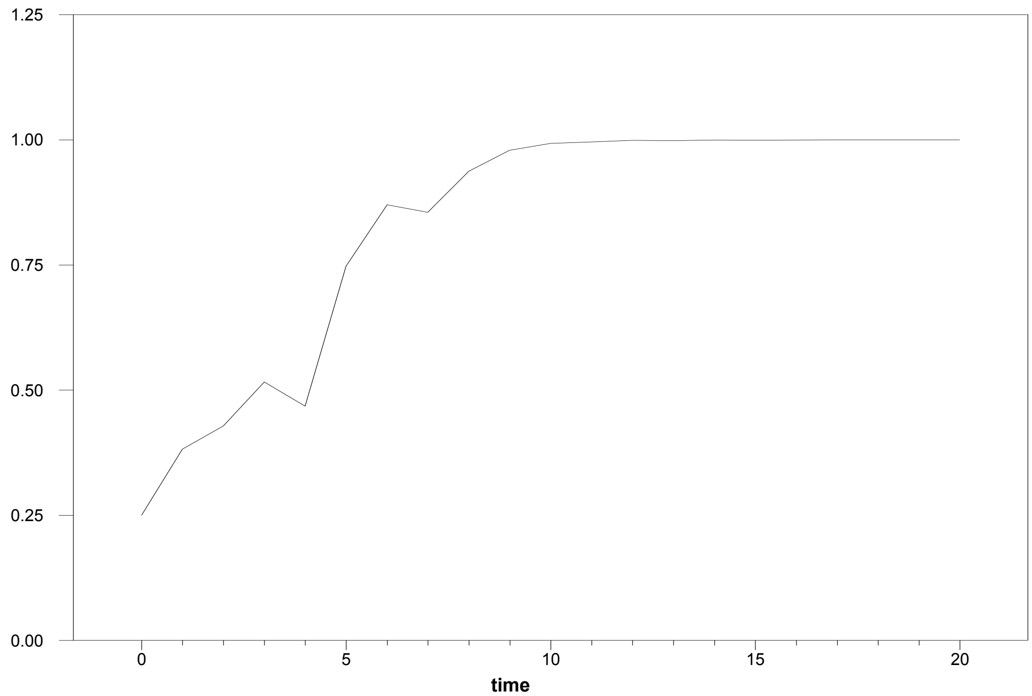

Figure 2: Consumption Dynamics with 20 percent fall in Devaluation Rate

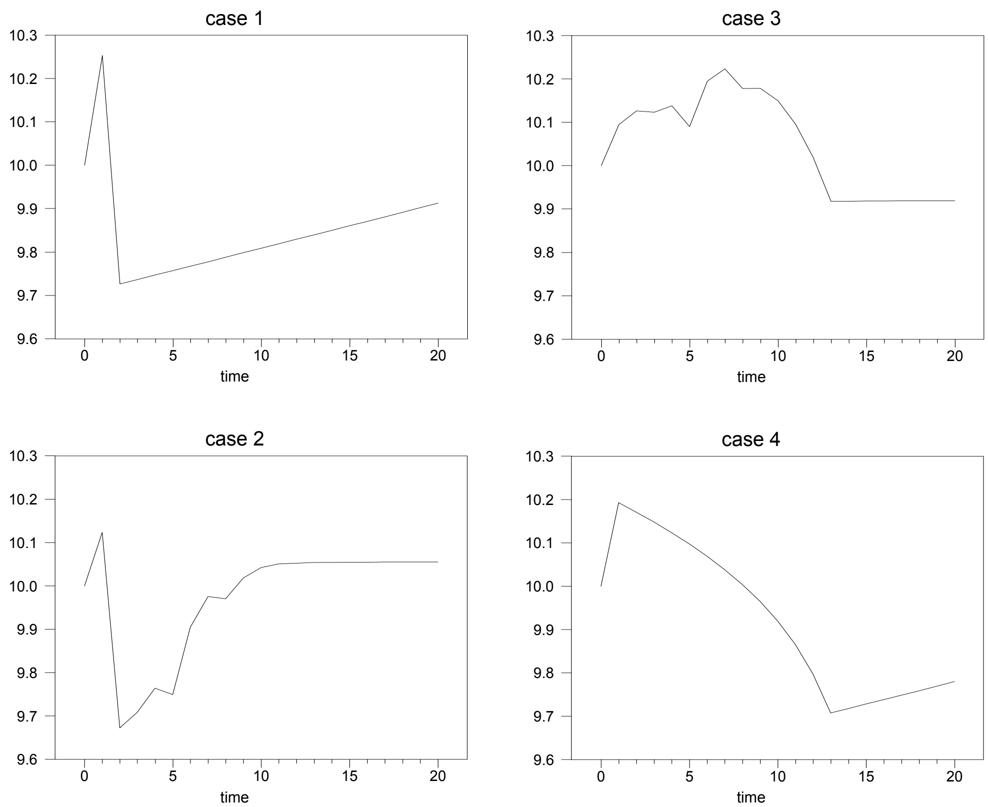

Figure 3: Current Account Dynamics with 20 percent fall in Devaluation Rate

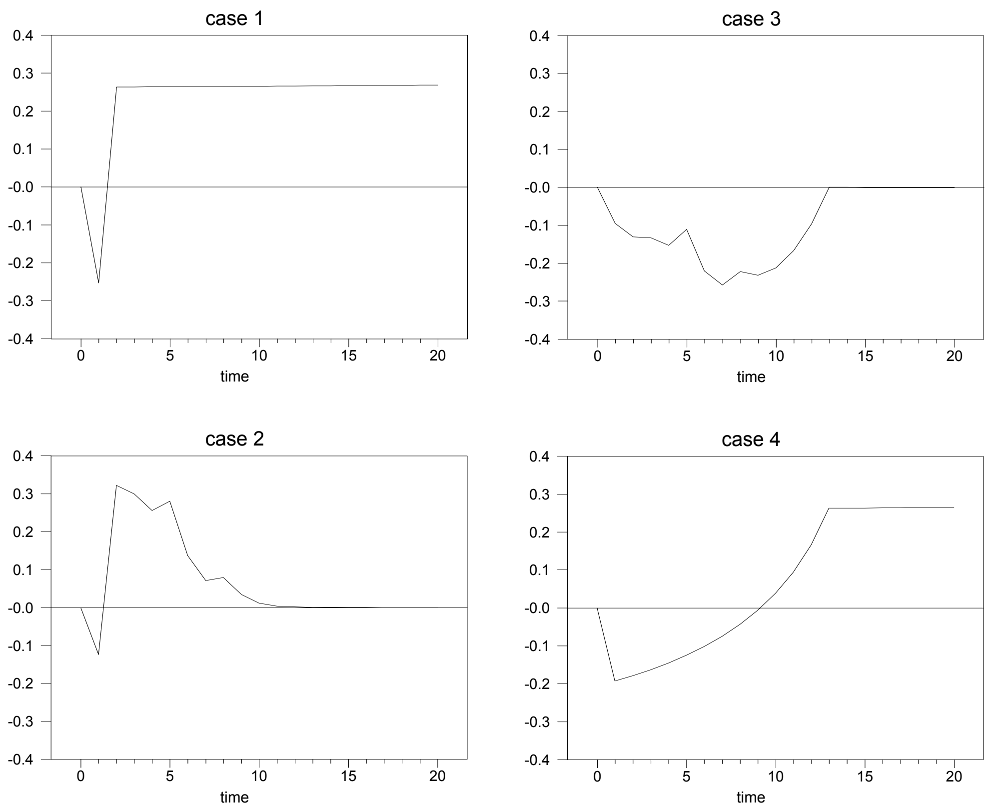

Figure 4: Consumption Dynamics with 80 percent fall in Devaluation Rate

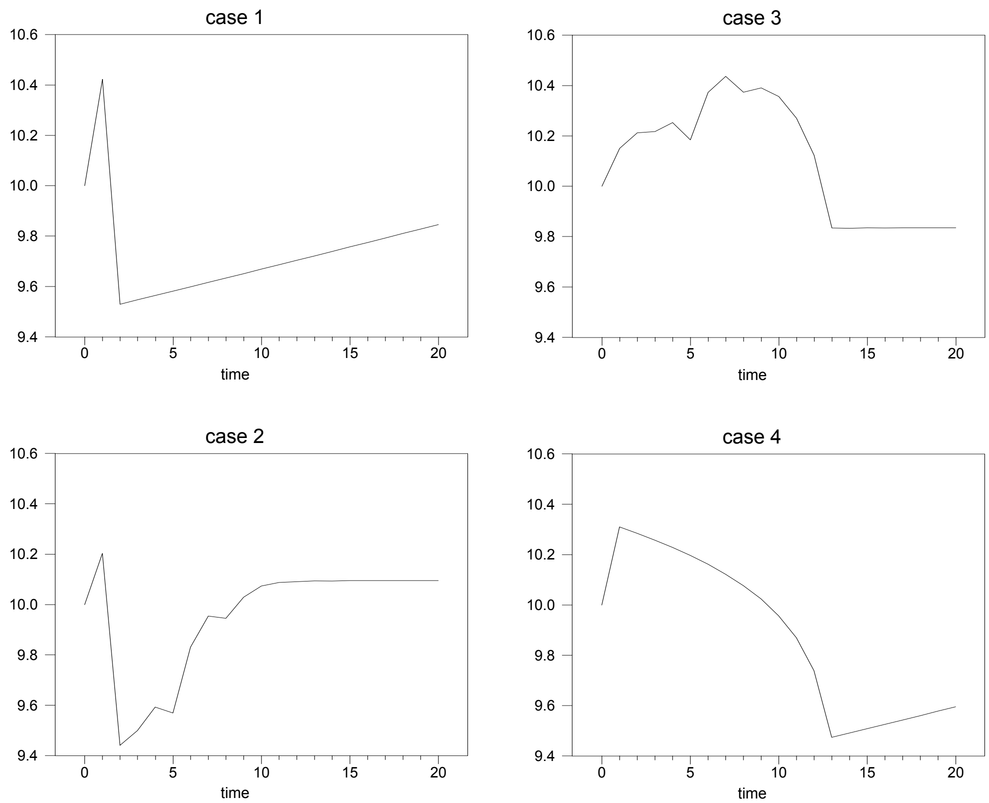

Figure 5: Current Account Dynamics with 80 percent fall in Devalution Rate