

MACROECONOMIC ADJUSTMENT UNDER A SLIDING PEG EXCHANGE RATE AND IMPERFECT CAPITAL MOBILITY

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I. Introduction

In their efforts to find non-traditional ways to curtail inflation various Latin American countries devised an antiinflationary strategy based on the preannouncement of the exchange rate. Traditionally, these countries fought inflation through tight monetary policy; in particular, their objective was to reduce the rate of growth of the money supply. This type of policy was widely used during the 1960s and early 1970s, and despite the rise in unemployment that usually accompanied the implementation of these plans, in general, they eventually succeeded in reducing the rate of inflation.

An alternative policy was followed in the southern countries of Latin America. The novel element in these policies was the choice of an exchange rate rule consisting in the preannouncement of the future values of the exchange rate. These future values embodied a drastic reduction in the rate of devaluation of the exchange rate from their prevailing levels (ranging from 80 to 300 percent). In the long run, this reduction in the rate of devaluation should translate into a proportional reduction in the rate of inflation.

One possible motivation for the choice of an exchange rate target was the important role played by foreign currency in these economies. The U.S. dollar was extensively used as a unit of account, and in some instances, even as a medium of exchange. An additional advantage of following this rule is that the exchange rate, as opposed to money, is a price in itself, the price of foreign currency, whose value was widely known and followed in these economies.

Argentina, Chile and Uruguay implemented this preannouncement policy in the late 1970s by issuing a schedule including the future values of the exchange rate.¹ These stabilization efforts, which are now widely known as the "Southern Cone stabilization plans", were unique experiences that attracted the attention of researchers and policy makers since their initial implementation.

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¹This schedule was known as "la tablita"—which in Spanish means the table. The extent of period for which the value of the forward exchange rate was preannounced varied from country to country and even for the same country from period to period.

The characteristics of the macroeconomic adjustment during this period certainly constitute one of the most important aspects of these stabilization policies. In particular [2; 4; 5; 6; 7; 8; 9; and 13] are just a few examples of papers dealing with this issue.

The present paper extends the existing literature by introducing a model that can successfully explain, in a rational expectations framework, the most relevant stylized facts of the Southern Cone experiences. In section II we present the basic model. Its main features are its emphasis on the short run adjustment of the economy², the structure of the capital account, and the explicit incorporation of money financed fiscal deficits. The model presents a plausible explanation for the persistence of differentials in the rates of return between domestic and foreign assets that prevailed for the experiences under consideration. In addition, this section highlights the problems that arise when there is an inconsistency between the size of the fiscal deficit and the exchange rate target. In section III we analyze the short run and long run effects on the economy of various policy actions that are relevant for the experiences under study. The main findings of this paper and a discussion of their implications for policy issues are presented in section IV.

II. The Basic Model

The Basic Structure of the Model

Consider a small open economy that produces a nontradable good (y_n) and an exportable good (X). The supply of both goods is assumed to be fixed and exogenous to the model. It is also assumed that domestic expenditure falls entirely on the nontradable good and on the imported good (I) while the whole production of the exportable good is sold abroad.

The economy is small in the markets for its tradable goods and thus it cannot affect the world prices of X and I . Let p_I^* and p_X^* be respectively the prices of the importable and the exportable good in terms of the foreign currency. We further assume that

$$P_X^* = P_I^* = P^* \quad (1)$$

Given that P^* is exogenous and fixed we can normalize it so that $P^* = 1$. Let E be the nominal exchange rate (i.e. the price of foreign currency in terms of domestic money). In the absence of any transport costs and other barriers to international trade the prices of X and I in terms of domestic currency will be $P_X = EP_X^* = EP_I^* = E$.

Government expenditure falls entirely on the domestic good Y_n . It is assumed that the government does not levy any taxes and hence that the budget deficit is entirely money-financed. Denoting (G) as nominal government expenditure and (D) as domestic credit, in the absence of a commercial banking system, the government budget constraint can be written as

$$\dot{D} = G \quad (1)$$

where $\dot{D} = dD/dt$. Since government expenditure falls entirely on the domestic good, we can define real government expenditure as $g = G/P$ where (P) is the price of the domestic good.

²Throughout the paper we define short run equilibrium as one in which the economy is in internal and external balance, but in which the current account is not necessarily in balance (i.e. the country is increasing or decreasing its stock of foreign assets). This short run model can be extended for the case in which the current account is in balance. We analyze this case in an appendix (available from the author upon request) and show that the results presented in this paper should hold in the extended model as well.

We define real income (y), real monetary balances (m) and the real exchange rate (e) as

$$y = Y/P \quad (2.a)$$

$$m = M/P \quad (2.b)$$

$$e = EP_I^*/P = E/P \quad (2.c)$$

where (Y) is nominal income (M) is the stock of money supply (which in the present model corresponds to the monetary base), and where the numerator in (2.c) corresponds to the price of the importable good.

The demand for domestic output is a positive function of the real exchange rate, real money balances, real income and government expenditure;

$$y_n^d = F(e, m, y, g). \quad (3)$$

The trade balance is a function of domestic expenditure on the foreign good and of the exogenously determined exports. In reduced form the trade balance can be written as

$$T = t(e, m, y, X) \quad (4)$$

where $t_1, t_4 > 0$ while $t_2, t_3 < 0$.

The capital account of the balance of payments is postulated to be of the following form,

$$K = \theta(i - i^* - v^e - \sigma) \quad \theta > 0 \quad (5)$$

where K denotes inflows of financial capital, θ measures the speed of adjustment of capital flows, i^* is the foreign nominal interest rate (assumed to be exogenous and fixed), v^e is the expected rate of depreciation of the exchange rate, and σ is a parameter that measures the degree of substitutability between domestic and foreign assets. According to equation (5) capital flows move in or out of the country whenever there is a difference between the rates of return on domestic and foreign assets. This response is not instantaneous; the larger θ the faster capital flows react when a differential exists.

This behavior of the capital account is particularly appealing to describe the behavior of capital flows in semi-industrialized countries. It also provides a natural way to model the capital movements that occurred during the stabilization policies applied in the "Southern Cone" of Latin America. This can clearly explain why many of the works that study these experiences—such as [1; 10 and 12]—postulate a similar framework for the behavior of the capital account.³

The price of the domestic good, though sticky in the short run, gradually adjusts in response to excess demand pressures in the goods market. The behavior of prices in our model is presented in equation (6)

$$\dot{p}/p = \hat{p} + \beta(y_n^d - y_n) \quad (6)$$

where β is a positive constant that denotes the speed of adjustment of domestic prices in response to excess demand pressures in the market for the domestic good, and \hat{p} denotes the trend rate of inflation. In what follows we will assume that the trend rate of inflation is given by the rate of growth of the money supply.

³It should be recalled that this paper is primarily concerned with the medium term equilibrium of the economy. For this reason, it does not seem unreasonable to model the equilibrium flow of capital and not its stock, even if there might be capital inflows or outflows at the stationary equilibrium. Furthermore, it can be shown that the specification of the capital account is consistent with a portfolio balance model, in which at the stationary equilibrium the current account is balanced.

The demand for real money balances is a positive function of real income and a negative function of the nominal interest rate (i)

$$m = l(y, i). \quad (7)$$

We postulate that the money market continuously clears and hence that equation (7) is always satisfied. We can solve from (7) for the value of the nominal interest rate to obtain

$$i = h(m, y); \quad h_m < 0 \quad \text{and} \quad h_y > 0. \quad (7')$$

The stock of domestic money, in the absence of a commercial banking system, is formed entirely of high-powered money and equals the assets of the central bank; composed of domestic credit (D) and international reserves (R). As a result, changes in the money supply are given by

$$\dot{M} = \dot{D} + E\dot{R} \quad (8)$$

As discussed in equation (1) changes in domestic credit are tied to the value of the government's budget deficit. Changes in international reserves are determined by the balance of payments surplus or deficit and are given by⁴

$$\dot{R} = CA + K \quad (9)$$

where CA is the current account. We assume that the country is a net debtor and hence that an increase in the foreign interest rate will deteriorate the current account. In this model we assume that agents have perfect foresight regarding the behavior of nominal and real variables of the economy. In particular, these assumptions imply that the expected rate of depreciation of the exchange rate will equal the actual one. We can substitute equations (4) and (5) into (9) to obtain

$$\dot{R} = CA(t(e, m, y), i^*) + \theta(i - i^* - v - \sigma). \quad (10)$$

Notice that under this specification the economy can reach balance of payments equilibrium with a surplus (deficit) in the capital account that is offset by a deficit (surplus) in the current account.

Finally, we need to specify the exchange rate rule. We assume that the monetary authority follows a policy of pegging the rate of devaluation of the exchange rate at a rate which is consistent with its other policy targets (i.e. with the size of the fiscal deficit and the steady state rate of inflation). This type of exchange rate policy implies that while the exchange rate is fixed at any point in time, its nominal value is continuously being adjusted through changes in its rate of change. This type of exchange rate rule closely corresponds to the one followed in Argentina, Chile and Uruguay during the late 1970s and early 1980s, a policy generally known as sliding peg or "La Tablita".

The Dynamic Behavior of the System

The dynamics of the system can be described by two differential equations showing the evolution over time of real money balances and the real exchange rate. Differentiating equations (2.b) and (2.c) with respect to time, using the rate of growth of the money supply as the trend rate of inflation and equations (3), (6), (7) and (10) and rearranging

⁴The reader should be aware that when the interest rate elasticity of the demand for money is greater than one and government expenditure increases, the $\dot{m} = 0$ schedule will shift to the left. While the real exchange rate would still appreciate in this case, the effect on real money balances (and the interest rate) is now ambiguous. In the paper we discuss the interest inelastic case because it appears to show the most plausible outcomes.

we obtain the following system of differential equations expression for the domestic rate of inflation

$$\begin{aligned} \dot{m} &= \dot{M}/M - \dot{M}/M - \beta(F(e, m, y, g) - y_n) \\ &= -\beta(F(e, m, y, g) - y_n). \end{aligned} \quad (11.a)$$

$$\begin{aligned} \dot{e}/e &= v - \dot{M}/M - \dot{m} \\ &= vm - g - et(e, m, y) - e\theta(h(m, y) - i^* - v - \sigma). \end{aligned} \quad (11.b)$$

The reader could easily verify that the stability conditions are always satisfied. It is interesting to note that the stability conditions do not depend—as was the case in [2 and 12]—on the degree of capital mobility (which in the present paper is measured by the parameters θ and σ). The main reason for this difference lies on the specification of the price adjustment mechanism. In (2) capital inflows cause an excess supply of money, increase aggregate demand and could lead to a path of ever growing inflation. In our model, it is also true that capital inflows will raise inflation, however, this increase will only be temporary. The higher rate of inflation leads to an initial appreciation of the real exchange rate which reduces the demand for domestic output. Eventually, this contraction in demand will slow down the rate of inflation. As a result, real money balances will increase, put downward pressure on the domestic interest rate and reduce capital inflows.

The system of equations (11) implies that at the stationary equilibrium the following condition must hold,

$$\dot{P}/P = \dot{M}/M = \bar{v} \quad (12)$$

However, condition (12) does not imply that the external sector of the economy will be in balance. This condition will be satisfied if and only if $g = vm$; in other words when the budget deficit is consistent with the steady state value of the cost of holding real money balances (i.e. the inflation tax). Accordingly, when $vm > g$ the stationary solution implies that the economy will have a balance of payments surplus.

If we want to restrict our analysis to cases in which at the stationary equilibrium the balance of payments is in equilibrium, then the government cannot view the inflation target and the government budget deficit as two independent instruments. This result becomes apparent if we assume that the demand for money function is similar to the one used by Cagan in the dynamics of hyperinflation. Once we substitute this type of demand for money function into the government budget constraint we obtain the familiar expression

$$g = (\dot{p}/p)m = (\dot{p}/p)e^{-\alpha i}wy. \quad (13)$$

One could decompose the nominal interest rate such that

$$i = r + \dot{p}/p$$

where (r) is the real rate of interest. If (r) remains fixed, then any changes in the rate of inflation will be accompanied by equal changes in the nominal interest rate. The value of the inflation tax revenue depends on the inflation rate and on the semielasticity of the demand for money with respect to the interest rate (α). Unless otherwise specified we will be assuming that the government adjusts its fiscal policy according to its inflation target. The possibility of an inconsistency between these two policy objectives will be fully discussed in section III.

In figure 1 we use a phase diagram to describe the dynamic behavior of the economy. The $\dot{m} = 0$ schedule shows the pairs of real money balances and the real exchange rate such that the market for the nontradable good is in equilibrium. It is downward sloping because a larger amount of real money balances increases expenditure and creates an excess demand

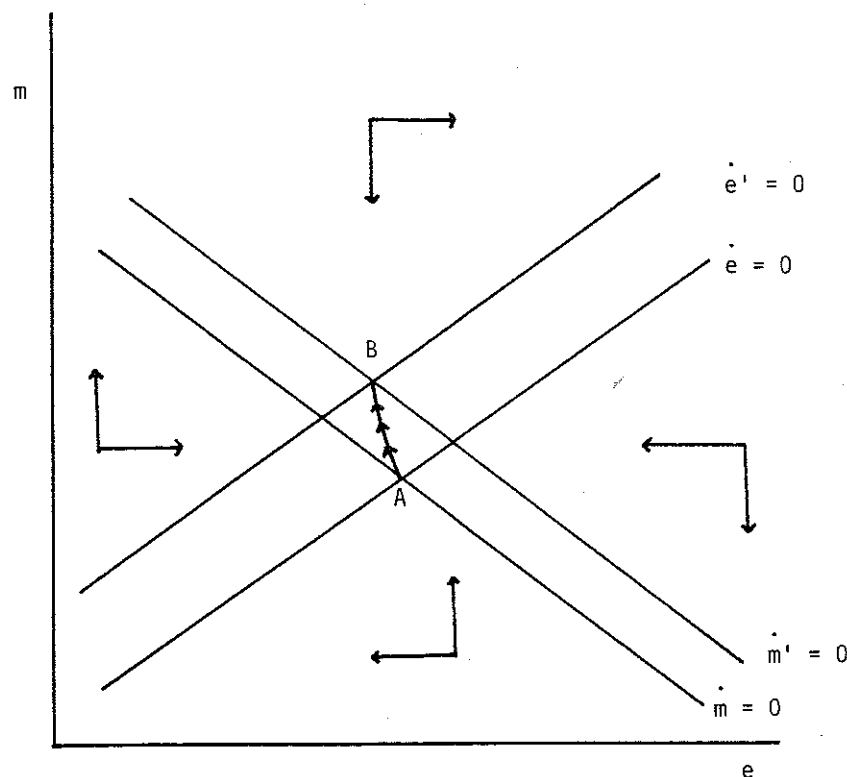


Figure 1

for the domestic good; to restore equilibrium, the exchange rate needs to appreciate in real terms.

When the government budget deficit is consistent with the steady state rate of inflation, the $\dot{e} = 0$ schedule shows the conditions for external balance. It is upward sloping because an increase in real money balances will reduce the domestic nominal interest rate and capital inflows on the one hand, while at the same time it increases expenditures which deteriorates the trade balance. Both of these effects worsen the balance of payments and hence, a devaluation of the real exchange rate is required to restore equilibrium in the external sector of the economy.

III. Policy Actions and Their Effects on the Economy

The model presented in section II is particularly valuable for the discussion of short term macroeconomic policy and the analysis of the adjustment process. We will now utilize this model to analyze the stabilization and liberalization policies that were implemented during the late 1970s in Argentina, Chile and Uruguay. Our main objective is to explain the appreciation of the real exchange rate that took place during this period.

A Change in the Rate of Devaluation of the Exchange Rate

The central element of the anti-inflation strategies in these countries was an exchange rate

rule embodying a lower rate of devaluation than in previous periods. In the present model a reduction in the rate of devaluation of the exchange rate leads to a proportional reduction in the steady state rates of inflation and of monetary growth. Moreover, when the interest rate elasticity of the demand for money is less than unity, consistency requires that the new exchange rate policy is accompanied by a reduction in government expenditure. In terms of the system of equations (11), the change in (v) will cause an upward shift in both schedules. When the shift in the $\dot{e} = 0$ schedule is greater than the shift in the $\dot{m} = 0$ one, then the new equilibrium will be characterized by an appreciated real exchange rate, higher real money balances and a lower nominal interest rate. Moreover, from equations (4), (5) and (10) we can infer the structure of the balance of payments at the new equilibrium. The appreciation of the real exchange rate and the higher level of real money balances clearly deteriorate the trade balance; however, since under the current set of assumptions the balance of payments remains in equilibrium, the capital account must improve. In the present model this improvement is accomplished through an increase in the real rate of interest.

The adjustment process towards the stationary solution is portrayed in figure 1. Point A denotes the initial equilibrium of the economy while B is the equilibrium point that corresponds to the new lower rate of inflation. Initially, there is an increase in capital inflows due to the lower rate of return on foreign assets that results from the fall in (v) while there is no change in the domestic nominal interest rate (because real money balances are predetermined). These capital inflows maintain the rate of inflation above the rate of devaluation and cause the appreciation of the real exchange rate. Over time, as real money balances grow, the nominal interest rate falls, and capital inflows decrease until the economy finally reaches its stationary equilibrium at point B.

Actually, the dynamic process just described captures important aspects of the macroeconomic adjustment of the Southern Cone countries during the preannouncement period. During that time the economies experienced continuous capital inflows, a trade balance deficit, and a rate of return on domestic assets that was consistently higher than the return on foreign assets. The model also successfully explains the appreciation of the domestic currency and the high real rate of interest. In this model, as in [6], the initial increase in the rate of inflation stems from the increase in the rate of growth of the money supply that occurs during the early stages of this policy as a result of the capital inflows.

The adjustment process just discussed differs in several respects from other works that studied this subject. It differs from [13] since in that model capital is perfectly mobile; moreover, in [13] a reduction in the rate of devaluation of the exchange rate would lead to an instantaneous fall in the nominal interest rate (due to the interest rate parity condition). As a result, [13] cannot incorporate the possibility of a discrepancy between the rates of return of domestic and foreign assets which appears as one of the most relevant and puzzling features of the Southern Cone experiences. It also differs from [11] not only in the dynamics assumed for the price equation (domestic prices are fully flexible in that model), but more importantly, because that model predicts that a reduction in the rate of devaluation would lead to a depreciation of the real exchange rate as opposed to the real appreciation discussed in the present paper. This opposite behavior also extends to the dynamics of the trade balance, although the predictions regarding capital inflows are the same in both models.

It should also be noticed that in the present model capital inflows are the main force driving the appreciation of the real exchange rate. This type of relationship was also discussed in [6]. In that model, capital inflows increase aggregate demand and hence put upward pressure on prices; on the other hand, in the present model, capital inflows affect prices through their effect on the trend rate of inflation. In this respect, the present model also

differs from [4] since in that model, the appreciation of the exchange rate during the early stages of the adjustment process is derived from the wealth effect.

Liberalization of the Financial Markets

The greater degree of integration between the domestic and the world financial markets was an important goal of the "Southern Cone" policies. The governments drastically reduced the restrictions on international capital flows (although the timing and the degree of the liberalization measures were different in the three countries) and very few regulations were maintained on the exchange rate market. In our model the degree of financial integration can be measured by the speed of adjustment of the capital account (i.e. the value of θ) and/or by the equilibrium size of the differential in the rates of return between domestic and foreign assets (σ). If θ is small so is the degree of capital mobility and hence a large differential in the rates of return between domestic and foreign assets would have a small effect on the capital account of the balance of payments. On the other hand, a large value of θ implies that small differences in the rates of return lead to large movements of capital. A large value of σ indicates low substitutability between domestic and foreign assets. A policy of greater financial integration is likely to make both assets better substitutes for each other and to reduce the value of σ . We can analyze the effects of greater liberalization in the financial markets by increasing the values of θ and/or reducing the value of σ .

An increase in θ or a fall in σ has no effect on the $\dot{m} = 0$ schedule while it will cause the $\dot{e} = 0$ schedule to become steeper and to shift to the left. At the new stationary equilibrium real money balances are larger while the real exchange rate appreciates. As the economy moves towards the new equilibrium there is a continuous rise in real money balances accompanied by an appreciation in the real exchange rate. Throughout this period the country runs a balance of payments surplus and experiences a fall in domestic interest rates. The above discussion implies that the liberalization of the financial markets during the period of the preannouncement of the exchange rate is likely to have been an additional force behind the appreciation in the real exchange rate.

Inconsistencies Between Policy Objectives

The successful implementation of a stabilization plan requires that the values of the various policy targets and the values of the respective instruments are consistent with each other. The existence of inconsistencies in the Southern Cone anti-inflationary plans, has been raised (see for example [7]; [9] and [14] among others) regarding the relationship between the exchange rate policy and the government budget deficit and between the exchange rate target and the wage policy.

In the present model an inconsistency could arise between the exchange rate policy and the government budget deficit. This relationship can be visualized from equation (11.b). As it was previously discussed in this paper, if we assume that the government wants to attain an equilibrium that satisfies the conditions for internal and external balance, then, at the stationary equilibrium the rate of devaluation (v) must be equal to the rate of growth of domestic credit (g/m) which clearly depends on the size of the budget deficit. The relation between these two policy variables imposes a clear constraint on the choice of policy options.

In order to illustrate the problems that could arise from the implementation of an inconsistent policy, we will assume that initially $nm = g$ and that the economy is in internal and external balance. We will also assume that when the central bank decides to reduce the rate of devaluation of the exchange rate while the treasury does not adjust the government budget deficit in any way. The reduction in the n reduces the new equilibrium rate of inflation and increases the demand for money. Depending on the value of the interest rate elasticity

of the demand for money the value of the inflation tax (and hence the sustainable government budget deficit) can increase or fall. When the interest rate elasticity of the demand for money is very low (as is likely to occur in countries with very high rates of inflation) there will be a reduction in the inflation tax revenues. If the treasury does not reduce the government budget deficit accordingly the country will run a balance of payments deficit. In other words, the government loses part of its revenues from monetizing the deficits through a depletion in international reserves (i.e. $vm = g + \dot{R}$).

There are two important differences with respect to the case in which the deficit is actually adjusted. First, since in this case there is a smaller increase in real money balances, we can infer that the surplus in the capital account is going to be greater. Second, as the result of the larger appreciation of the real exchange rate, the deficit in the current account will also be greater. This obviously needs to be so, since there will be a balance of payments deficit in spite of the larger surplus in the capital account.

The solution of the system would certainly be inconsistent in the long run since a non-growing economy cannot finance a permanent imbalance in the foreign sector through reserves or debt. At the same time, it can also be inconsistent in the medium term—which is the time horizon of this paper—if the economy does not have enough resources to finance the balance of payments deficit. As is usually the case in semi-industrialized countries, the economy will eventually face a constraint in its external sector and it will be forced to either change its exchange rate policy or to reduce the budget deficit. Under these circumstances it is foreseeable that the policy is bound to fail. Some economists would argue that this discussion provides an plausible interpretation of the failure of the anti-inflationary experiment in Argentina.

IV. Summary and Conclusions

This paper presented a dynamic model of the open economy that, in our opinion, captures the most interesting features of the anti-inflation policies implemented in the southern cone of Latin America during the late 1970s. The model is able to explain some of the most relevant stylized facts of this period such as the large deficits in the current account, the continuous capital inflows and the persistence of a differential between the returns on domestic and foreign assets.

In this paper we also extensively discuss the adjustment of relative prices. It was shown that in response to a reduction in the rate of devaluation of the exchange rate one should expect an initial appreciation of the real exchange rate—as it actually occurred for the experiences where this policy was followed. In fact, the rate of inflation can initially rise, if the capital inflows are sufficiently large as to increase the rate of growth of the money supply. It is only in this sense that international capital flows were found to represent a potentially destabilizing factor on the economy. As a result the imposition of controls on capital flows might be useful to reduce the extent of the overvaluation of the domestic currency. On the other hand, it was shown that the magnitude of the capital flows cannot lead the economy to an unstable path characterized by increasing rates of inflation. In this respect, the results of the present model sharply differ from the ones found by [2] and [12]. In addition, the model suggests that the favorable terms of trade that the countries faced at the early stages of the anti-inflationary policies and the opening of the domestic financial markets were additional factors contributing to the appreciation of the domestic currency.

The paper also argues that the exchange rate rule should be consistent with the target for the budget deficit. In particular, when the government reduces the rate of devaluation of the exchange rate without adjusting the government budget deficit, rate of growth of domestic credit is likely to remain at the old high levels. Under these circumstances, the monetization

of the deficit will create an excess supply of money and lead to a balance of payments deficit. Eventually, the continuous loss of reserves will make the policy unsustainable. After all, consistency between the various policy instruments is a necessary condition for the success of any stabilization policy.

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