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Budget Deficit, External Official Borrowing and Exchange Rate Policy*

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Summary

During the last eight years, the governments of many industrial countries have borrowed in the international capital markets to finance sharp increases in their budget deficits. In this paper, I study the effect of this debt policy on the exchange rate when the borrowing is not used to increase investments, and the country has a relatively well-developed financial market without being a major reserve-currency country. The analysis is divided into two cases. In the first case, the government finances a temporary budget deficit, which does not affect market expectations about the future course of monetary policy, by selling debt denominated in foreign currencies to nonresidents. I show that the combined effect of the budget deficit and of the external official borrowing is to depreciate the exchange rate, both in the short and in the long run. The exchange rate depreciates in the long run in order to generate the surplus of traded goods that is required to service the official external debt. Because the private sector anticipates the long-run depreciation, it immediately shifts its portfolio into foreign assets. This portfolio shift, in turn, depreciates the exchange rate in the short run. The depreciation is thus the result of the long-run budget constraint that the economy faces. Because during the expansionary fiscal policy the economy consumes more than it produces, it receives a real transfer from the rest of the world. The exchange rate depreciates in order to allow the economy to pay for the transfer.

In the second case, the government accompanies the external financing of the budget deficit with a policy of sterilized intervention that increases the proportion of financial assets denominated in foreign

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currencies in the portfolio of domestic residents. By creating a relative scarcity of bonds denominated in domestic currency, and thus by driving up the domestic real interest rate, I show that a government can maintain the exchange rate in the face of a budget deficit in the short run (but not in the long run). In practice, however, this intervention policy may not be feasible if the external official borrowing induces expectations of a sizable long-run depreciation. For example, this can occur when the initial stock of external official debt is large. The effect of these expectations has usually been neglected in the traditional analysis of sterilized intervention. In addition, I show that, if the policy of intervention is successful, it is also very "costly." Because the exchange rate is not allowed to move, real wealth has to fall more than in the case of no intervention in order to accomplish the reduction of real domestic absorption that is needed to balance the current account. This result agrees with the conclusions of other studies which indicate that sterilized intervention is an appropriate policy only when it is used to neutralize the effect of a "pure" financial shock on the exchange rate.

I. Introduction

In this paper, I analyze what happens to the exchange rate when the government of a country with a well-developed financial market finances its budget deficit by borrowing in the international capital market. The paper was motivated by the recent experience of many industrial countries. During the last eight years, the fiscal position of many industrial countries, as measured by the ratio of the budget deficit to GNP, has deteriorated markedly. This deterioration has induced the authorities of many industrial countries to have a greater recourse to the international capital market. In addition, several small industrial countries have adopted sterilized intervention policies that have increased the proportion of financial assets denominated in foreign currencies in the portfolio of domestic residents. 1/ Chart 1 depicts the ratio of the budget deficit to GNP and the ratio of the external official debt to overall government debt in four small industrial countries. In each of these countries, the chart shows that the government debt denominated in foreign currencies rose faster than the domestic currency debt during the periods in which the budget deficits deteriorated sharply. Some examples are Belgium from 1979 to 1981, New Zealand from 1973 to 1975, Finland from 1976 to 1978 and Sweden from 1978 to 1980.

By increasing the external official borrowing, these countries have aimed at maintaining their exchange rates in the face of budget deficits. 2/ In this paper, I study the implications that an increase in the budget deficit has on the exchange rate, when the deficit is entirely financed with debt denominated in foreign currencies and does not affect market expectations about the future course of monetary policy. First, I deal with the case in which the government finances its deficit by selling foreign currency denominated debt to nonresidents. I show that the combined effect of the budget deficit and of the external official borrowing is to depreciate the exchange rate, both in the short run and in the long run. The short-run depreciation occurs because the market

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1/ Dooley (1982) showed that the major industrial countries have seldom denominated significant fractions of their debt in foreign currencies. However, France and Italy have recently stepped up their external official borrowing.

2/ The reason for maintaining the exchange rate is the perception that resources are immobile in the short run and thus inelastic with respect to exchange rate movements. It is thought that the primary effect of these movements is to affect the domestic price level, as well as the domestic wage level. The ultimate effect is to put pressure on monetary authorities in order to accommodate the initial shock, thus triggering "vicious" circles.

anticipates that the exchange rate will depreciate in the long run in order to generate the trade surplus required to service the larger stock of foreign debt. 1/

Second, I consider the case in which the authorities accompany the expansionary fiscal policy with a policy of sterilized intervention. Portfolio models of exchange rate determination indicate that sterilized intervention can be used successfully if the degree of substitution between domestic and foreign currency denominated bonds is low. However, even though bonds are poor substitutes, I show that this intervention policy may not be feasible, if the external official borrowing induces expectations of a sizable long-run depreciation of the exchange rate. This expectation effect has usually been neglected by traditional portfolio models. In addition, I show that the stabilization of the exchange rate in the face of the budget deficit may not be a desirable policy because the reduction of absorption, which is necessary to generate the needed export surplus, must then be brought about entirely by a decline in real wealth.

In this paper, I only consider the case in which the funds that the government borrows in the international capital market are not used to finance an increase in investments. This case seems to correspond to the fiscal policies that many industrial countries have followed since the first oil shock.

II. The Model

In order to analyze the effect of a budget deficit that is financed by borrowing in the international capital market, I use a portfolio model of exchange rate determination with stock/flow interactions. The economy is fully described by three equilibrium conditions: one for the financial market, one for the traded goods and one for the nontraded goods market.

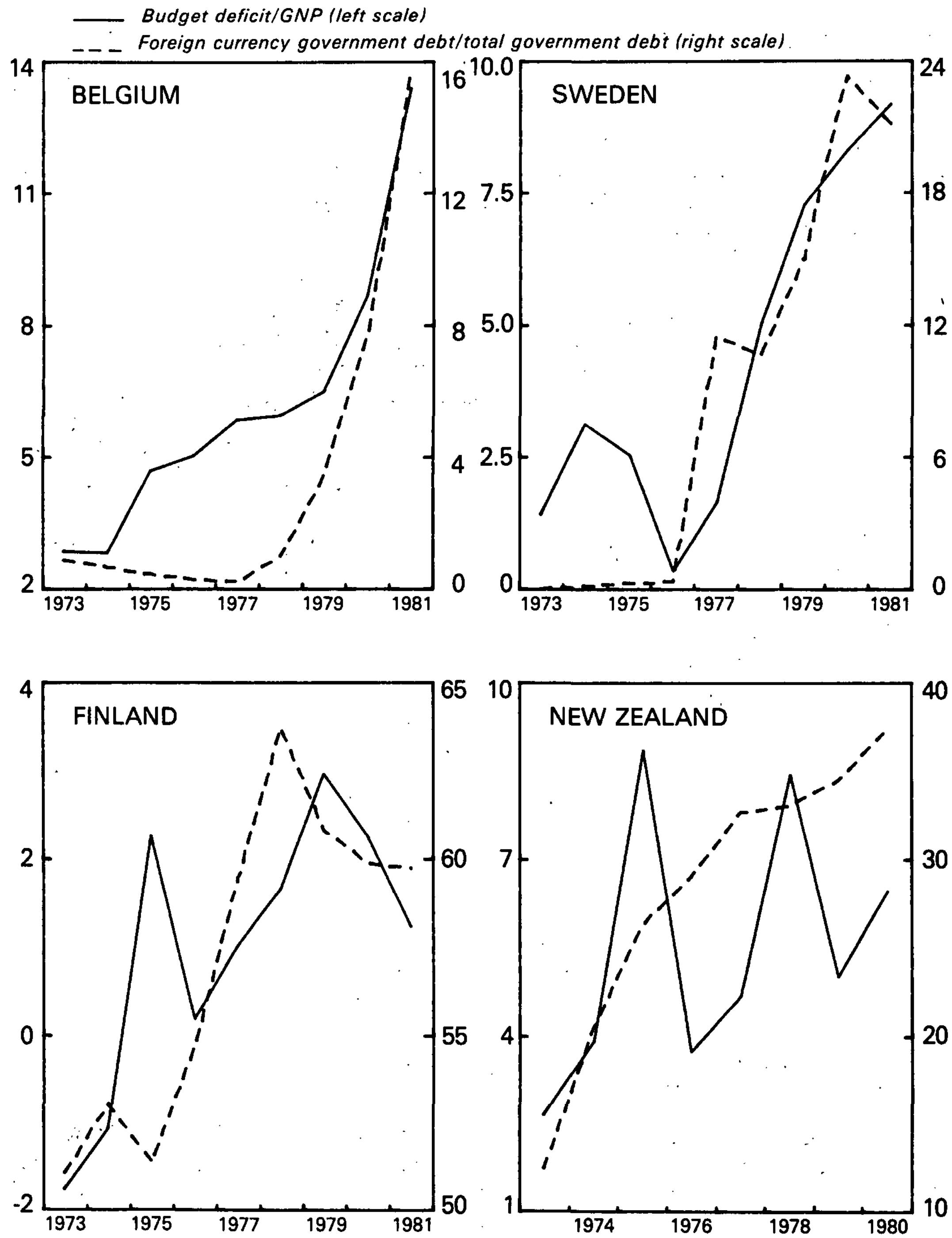
1/ The framework developed in this paper could be used to underpin the content of an article (In Western Europe, Some Countries Due Big Sums to Foreigners) published in the Wall Street Journal on December 4, 1982:

> "Bankers agree that most of this foreign debt has been accumulated over the years to enable many European governments to continue their high levels of public spending, particularly for generous social welfare programs." The article goes on by quoting a financial analyst: "In general, we are concerned about these high levels of debt as well as about the ability of several of these countries to maintain annual interest payments."

CHART 1

BUDGET DEFICIT AND EXTERNAL OFFICIAL BORROWING[1]

(In per cent)



Source: IMF, *International Financial Statistics.*

[1] The domestic and external government debt for Sweden was taken from Sveriges Riksbank, *Annual Report,* 1981. The budget deficit for New Zealand was taken from OECD, *Economic Surveys,* New Zealand, 1982.

(a) The financial market

In the domestic financial market there are three assets: bonds denominated in domestic currency (B^T), which are held by both residents (B) and nonresidents (B*), bonds denominated in foreign currency (A) and domestic money (M), which are held by residents. I assume that the economy is not growing, so that only the government issues bonds denominated in domestic currency. I also assume that the country is small so that changes in the domestic demand or supply of bonds denominated in foreign currency do not affect the interest rate prevailing in the world capital market; furthermore, an issue of domestic currency bonds leaves foreigners' wealth practically unchanged. 1/ For convenience, I assume that the private sector of the country has a positive foreign asset position, i.e., A is positive, and I neglect the capital gains and losses stemming from interest rates movements. 2/ The full flexibility of financial asset yields ensures that portfolio equilibrium is attained at every point in time. The equilibrium in the financial market can be described by the following set of equations that characterizes portfolio models in the open economy:

$$(1) \quad M = m(i, i^*, \dot{e})\,W \qquad m_1, m_2, m_3 < 0$$

$$(2) \quad B = b(i, i^*, \dot{e})\,W \qquad b_1 > 0 \; b_2, b_3 < 0$$

$$(3) \quad B^* = eb^*(i, i^*, \dot{e})\,W^* \qquad b_1^* > 0 \; b_2^*, b_3^* < 0$$

$$(4) \quad eA = a(i, i^*, \dot{e})\,W \qquad a_1 < 0 \; a_2, a_3 > 0$$

$$(5) \quad W = M + B + eA$$

$$(6) \quad B^T = B + B^*$$

where W is the domestic nominal wealth, W* the foreign nominal wealth, e the domestic price of a unit of foreign currency, i the domestic interest rate, i* the interest rate prevailing in the world capital market, and $\dot{e}$ the expected change in the exchange rate which is equal to the actual change if market participants' expectations are rational. 3/

1/ The small country assumption is justified by the remarks presented in the introduction.

2/ Various authors have argued that exchange rate models may become unstable if the country has a negative foreign asset position. For example, see Masson (1981). By contrast, Henderson and Rogoff (1981) found that the private sector's portfolio composition is not a source of exchange rate instability in portfolio balance models with rational expectations.

3/ A dot above a variable indicates a time derivative.

There are two endogenous variables to be determined in the financial market for a given expectation of the future exchange rate: the domestic nominal interest rate and the exchange rate. First, I use the money market equilibrium condition (1) to obtain a reduced form equation for the domestic nominal interest rate

$$i = \phi(i^*, \dot{e}, M, W) \qquad \phi_1, \phi_2, \phi_3 < 0 \; \phi_4 > 0$$

Second, I substitute (2) and (3) into (6) and I use the reduced form for the nominal interest rate to obtain a reduced form for the equilibrium condition in the market of domestic currency bonds

$$B^T = \psi(i^*, \dot{e}, e, M, W, \overset{*}{W}) \qquad \psi_1, \psi_2, \psi_4 < 0 \quad \psi_3, \psi_5, \psi_6 > 0$$

By inverting this equation, I obtain a reduced form which summarizes the equilibrium conditions in the financial market

$$(7) \qquad \dot{e} = \gamma(B^T, i^*, M, W, \overset{*}{W}, e) \qquad \gamma_1, \gamma_2, \gamma_3 < 0 \quad \gamma_4, \gamma_5, \gamma_6 > 0$$

(b) The goods markets

I now turn to describe the equilibrium conditions in the goods markets. In order to do so, I have to spell out the way in which a budget deficit affects the economy. In this paper, I analyze a budget deficit that is caused by an increase in government expenditure on nontraded goods and is financed by an issue of debt denominated in foreign currency. I assume that this expansionary fiscal policy does not affect the behavior of economic agents abroad; is independent of monetary policy and does not initially increase the saving of the domestic private sector. The first condition is satisfied by the small country assumption. The second condition is satisfied by the assumption that the budget deficit is not expected to persist. This ensures that the private sector will not revise its expectations about the future course of monetary policy when the change in the budget deficit takes place. As a result, I keep both the money stock and inflationary expectations constant throughout the paper. The third condition is likely to be satisfied by an increase in government expenditures that the private sector believes to be temporary. It is reasonable to assume that temporary changes in government expenditure have a very low degree of substitutability for private sector consumption; consequently, the changes do not reduce the private consumption of goods, as Bailey (1971) pointed out. 1/

1/ In addition, Barro (1981) argued that, if the private sector does not anticipate sustained budget deficits, permanent changes in government expenditure increases the present value of future taxes thus reducing the expected permanent disposable income. The reduction in income causes an immediate fall in private consumption.

The simplest way to model a transitory expansionary fiscal policy is to assume that the initial increase in government expenditure, which occurs at times t_o, declines over time until it reaches its initial level at time τ. I also assume that the private sector perfectly anticipates the time path of government expenditure, i.e., when the budget deficit, which is caused by the rise in expenditure, unexpectedly occurs, the private sector immediately anticipates that it will disappear in the periods ahead. If G(t) is the level of nominal government expenditure at any point in time, the expansionary fiscal policy can be described as follows. 1/

$$G(t) = b(t-\tau) \qquad t_o < t < \tau;\ b < 0$$

$$G(t) = 0 \qquad t > \tau$$

The path of government expenditures is illustrated in Figure 1. It is reasonable to assume that government expenditure declines to its initial level, and thus the budget deficit disappears, before the economy reaches its steady state equilibrium. Thus, in the neighborhood of steady state equilibrium $G(t) = 0$. Let F be the stock government debt denominated in foreign currency; due to the government budget constraint F is equal to:

$$F(t) = \int_{t_o}^{t} G(s)\,ds \qquad t_o < t < \tau$$

Given the assumptions made before, as soon as the government increases its expenditures, the private sector anticipates the amount of official foreign debt that the country will eventually accumulated as a result of the expansionary fiscal policy. In the long run, the stock of official foreign debt $(\overline{F})$ is then equal to

$$(8) \quad \overline{F} = 1/2b(\tau^2 - t_o^2)$$

In the real sector, two goods are demanded and produced: traded goods and nontraded goods. I assume that wage flexibility ensures full employment at any point in time. The domestic demand for traded goods is a function of the relative price of traded to nontraded goods (P_T/P_N) and of the stock of real wealth (W/P), where P is the aggregate demand deflator. I assume that the deflator is a geometric average of the prices of traded and nontraded goods, i.e., $P = P_T^{\alpha} P_N^{1-\alpha}$. Arbitrage in the market

1/ For simplicity, I assume that the initial level of government expenditure is zero. Nothing changes if another level of government expenditure is chosen.

for traded goods ensures that purchasing power parity always holds in this market, so that $P_T = e P_T^*$. I assume that the domestic production and consumption of traded goods cannot affect the world price of traded goods P_T^*. Thus, P_T^* is constant and I set it equal to 1. The relative price of traded goods can then be written as e/P_N. The excess demand for traded goods is equal to:

$$T = T(e/P_N, W/P) \qquad T_1 < 0 \qquad T_2 > 0$$

The negative of the excess demand is equal to the trade account. For simplicity, I assume that the service account of the balance of payments only depends on the stock of official external debt F. 1/ Due to the balance of payments constraint, the capital account is equal to the trade account plus the service account:

$$(9) \quad -\dot{B}^* + e\dot{A} = -e[T(e/P_N, W/P) + i^*F]$$

In the market of nontraded goods, demand is a positive function of the relative price of traded goods (e/P_N), as well as of real government expenditure (G/P_N) and real wealth (W/P). The excess demand for nontraded goods can then be expressed as:

$$(10) \quad X(e/P_N, G/P_N, W/P) = 0 \qquad X_1, X_2, X_3 > 0$$

By totally differentiating equation (10), it is possible to obtain a reduced form for the equilibrium condition in nontraded goods market.

$$(11) \quad X(e, P_N, G, W) = 0 \qquad X_1 \gtrless 0, X_2 < 0, X_3, X_4 > 0$$

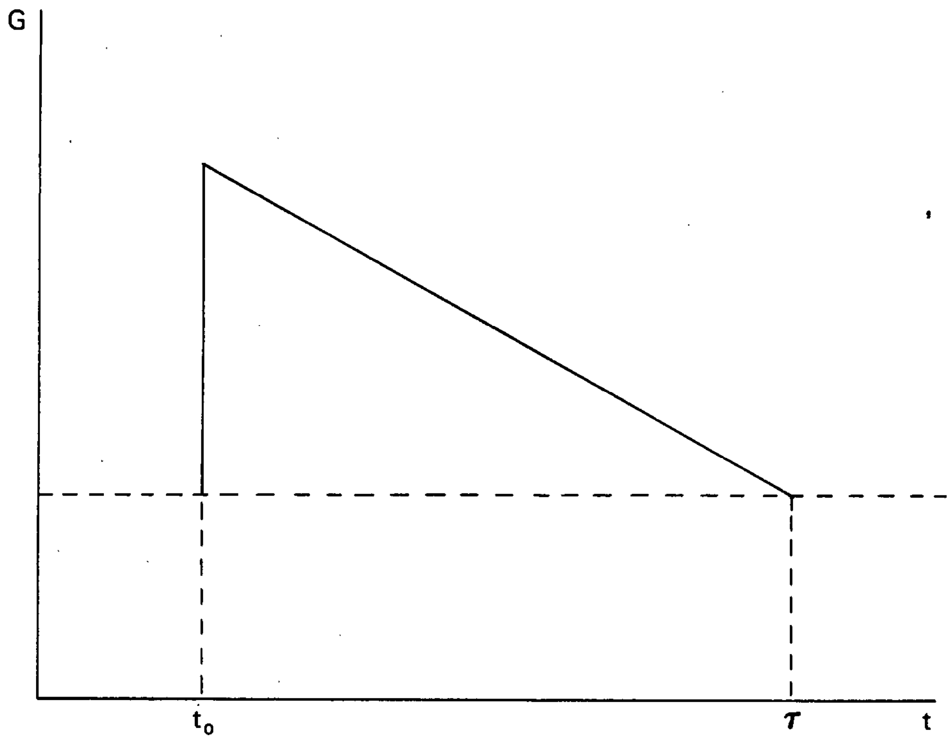
The sign of the partial derivative of the exchange rate is ambiguous. A depreciation, on the one hand, creates an excess demand for nontraded goods because it increases the relative price of traded goods; on the other hand, a depreciation reduces demand because it pushes the general price level up, thus reducing real wealth. In this paper I assume that X_1 is negative. 2/ As a result, I assume either that the main impact of exchange rate movements is on the aggregate price level, and thus on real wealth, or that resources are rather inelastic with respect to relative price movements.

1/ The conclusions of the paper do not change if this assumption is relaxed.

2/ Dornbusch (1976) makes this assumption. By contrast, Mundell (1971) assumes that a depreciation creates an excess demand for nontraded goods. See also footnote 1/ on page 11.

FIGURE 1

THE PATH OF GOVERNMENT EXPENDITURE



Summing up, the entire model is composed of three reduced forms, (7), (9), and (11), which determine three endogenous variables, the exchange rate, the stock of nominal wealth, the price of nontraded goods and, consequently, the aggregate price level.

III. Some Comparative Static Results

In this section I analyze the effect of a budget deficit, which is caused by an increase in government expenditure and is financed in the world capital market, on the steady state values of the endogenous variables. The analysis is divided into two special but instructive cases. In the first case, I assume that the government acquires foreign exchange by selling government debt denominated in foreign currency to nonresidents. Then, the government exchanges domestic currency for the foreign exchange with the central bank. Finally, it purchases goods and services from the private sector with the domestic currency. Because I assume that the money stock remains constant, the monetary authorities induce a change in bank reserves in order to prevent the increase in official international reserves from having an expansionary effect on the money supply. As a result, the budget deficit initially affects neither the currency composition of the domestic residents' portfolio nor their wealth. Because the currency composition does not change, I call this case the case of no intervention. In the second case, the case of intervention, the government adopts a debt management policy that reduces the proportion of bonds denominated in domestic currency in the portfolio of domestic residents. This can occur either because domestic residents absorb part of the government debt denominated in foreign currency, or because the authorities adopt a policy of sterilized intervention. 2/ In the case of intervention, the government borrows abroad in excess of what it plans to spend on domestic goods. With the foreign exchange, it purchases domestic currency from the private sector; then, it conducts an open market operation that reduces the stock of government debt denominated in domestic currency. In both cases, I assume that the government, in order to service its external debt, either levies a tax on foreign exchange earnings or asks residents to convert these earnings into domestic currency.

(a) The case of no intervention

In this case, the budget deficit leaves the stock of domestic currency bonds (B^T) and of foreign currency bonds owned by residents (A) unchanged. Because $B^T = B + B^*$ and $\dot{B}^T = 0$, it follows that $\dot{B} = -\dot{B}^*$. Thus the balance of payments equilibrium can be rewritten as

$$(12) \quad \dot{B} + e\dot{A} = -e[T(e/P_N, W/P) + i^*F]$$

1/ See Dooley (1979) for a description of sterilized intervention.

In order to analyze the impact of the budget deficit, I have to choose the state variables of the system. I follow Henderson and Rogoff (1981) and I choose the exchange rate and the stock of wealth evaluated at the long-run exchange rate (w) as the state variables. 1/ Thus,

$$w = M + B + \bar{e}A$$

where a bar above a variable indicates its value in the steady state. The change in w in the neighborhood of long-run equilibrium is equal to 2/

$$(13) \quad (w-\bar{w}) = (B-\bar{B}) + \bar{e}(A-\bar{A})-(W-\bar{W})-\bar{A}(e-\bar{e})$$

In addition

$$(14) \quad \dot{w} = \dot{B} + \bar{e}\dot{A}$$

In order to find the steady state response of the endogenous variables to an increase in external official borrowing, first, I set $\dot{e} = \dot{w} = 0$ in equations (7) and (12), and second, I totally differentiate (7), (11) and (12) 3/

$$(15) \quad 0 = \gamma_W d\bar{w} + (\gamma_W\bar{A} + \gamma_e)d\bar{e} \qquad \gamma_W, \gamma_e > 0$$

$$(16) \quad 0 = (X_e+\bar{A}X_W)d\bar{e} + X_{P_N} d\bar{P}_N + X_W d\bar{w} \qquad X_e, X_{P_N} < 0 \quad X_W > 0$$

$$(17) \quad 0 = (\theta_e + \theta_W\bar{A})de + \theta_W d\bar{w} + \theta_{P_N} d\bar{P}_N + \theta_F dF$$

$$\theta_e > 0 \quad \theta_W, \theta_F < 0 \quad \theta_{P_N} \gtrless 0$$

The ambiguity about the sign of the partial derivative with respect to P_N in the equation for the traded goods mirrors that of the exchange rate in the equation for the nontraded goods. An increase in the price of

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1/ This state variable is particularly convenient for analyzing the dynamic response of the system to sterilized intervention.

2/ In order to obtain (13) I used the fact that $M-\bar{M} = 0$.

3/ In doing so, I use the assumptions that the country is small, that fiscal policy is independent of monetary policy and that the level of government expenditure goes back to its initial level in the steady state, i.e., $d\bar{M} = d\bar{i}^* = d\bar{w}^* = d\bar{G} = 0$. In addition, I use the fact that $d\bar{W} = d\bar{w} + \bar{A}d\bar{e}$.

nontraded goods on the one hand creates an excess demand for traded goods because it changes their relative price; on the other hand, it increases the general price level which, in turn, decreases real wealth thus reducing aggregate demand. In what follows, I assume that θ_{P_N} is negative, i.e., that the relative price effect outweighs the wealth effect. 1/

I can eliminate one equation from the system by obtaining an expression for $d\bar{P}_N$ in equation (16). Then, I substitute this expression into (17). The steady state equilibrium in the goods market is now described by one equation, which is equal to:

$$(18) \quad 0 = (Z_W\bar{A} + Z_e)d\bar{e} + Z_W d\bar{w} + \theta_F d\bar{F}$$

where $Z_W = \theta_W - \theta_{P_N}(X_W/X_{P_N}) < 0$

$$Z_e = \theta_e - \theta_{P_N}(X_e/X_{P_N}) > 0$$

The two equations (15) and (18) show the combination of the values of the exchange rates and of w's that are compatible with steady state equilibrium in both goods and financial markets. The two schedules in Figure 2 illustrate this equilibrium. I call them the $\dot{e} = 0$ and $\dot{w} = 0$ schedules. The $\dot{e} = 0$ schedule is negatively sloped. By contrast, the sign of the slope of the $\dot{w} = 0$ schedule is ambiguous. 2/ The ambiguity is caused by the capital gains and losses on financial assets that a depreciation generates. In general, a depreciation improves the current account by increasing the relative price of traded goods and by reducing real wealth (Z_e is positive). However, a depreciation increases wealth by generating capital gains for the holders of foreign assets (Z_W is negative). The increase in wealth induces an increase in expenditure. If this second effect outweighs the first, a depreciation causes the current account to deteriorate. I assume that a depreciation always improves the current account; thus I assume that the slope of the $\dot{w} = 0$

1/ Later on, I show that a sufficient (but not necessary) condition for the stability of the model is that both θ_{P_N} and X_e are negative, as I assume in the paper. The ambiguity about the signs of θ_{P_N} and X_e can be circumvented by assuming that bonds are indexed. For example, see Dornbusch (1975).

2/ The slope of the $\dot{e} = 0$ schedule is equal to $-\gamma_W/(\gamma_W A + \gamma_e) < 0$; the slope of the $\dot{w} = 0$ schedule is equal to $-Z_W/(Z_W\bar{A} + Z_e) \gtrless 0$.

schedule is always positive. 1/ A justification for this assumption is that, in industrial countries, capital gains and losses associated with exchange rate movements account for a very small proportion of changes in private sector wealth.

In order to find the steady state changes in the exchange rate and in the stock of wealth that are caused by a temporary increase in the budget deficit, I solve the equations (15) and (18) for $d\bar{e}$ and $d\bar{w}$:

$$d\bar{e}/d\bar{F} = K^{-1} (\gamma_W \theta_F) > 0$$

$$d\bar{w}/d\bar{F} = -K^{-1} (\gamma_W \bar{A} + \gamma_e) \theta_F < 0$$

where K is the determinant of the matrix of the coefficients of the two equations of the model; as I show in Section III, the stability of the system implies that K is always negative. The change in nominal wealth, which can be found by substituting the expressions for $d\bar{e}$ and $d\bar{w}$ into the definition of $d\bar{W}$, is equal to

$$d\bar{W}/d\bar{F} = -K^{-1} \gamma_e \theta_F < 0$$

In order to find the change in the price of nontraded goods, I totally differentiate equation (11):

$$d\bar{P}_N/d\bar{F} = -(X_W/X_{P_N}) d\bar{W}/d\bar{F} - (X_e/X_{P_N}) d\bar{e}/d\bar{F} < 0$$

Because the exchange rate depreciates and the price of nontraded goods declines, the real exchange rate (e/P_N) depreciates in the steady state. Finally, by using equation (10), I can show that the depreciation of the real exchange rate implies a fall in real wealth when the economy reaches the new steady state equilibrium

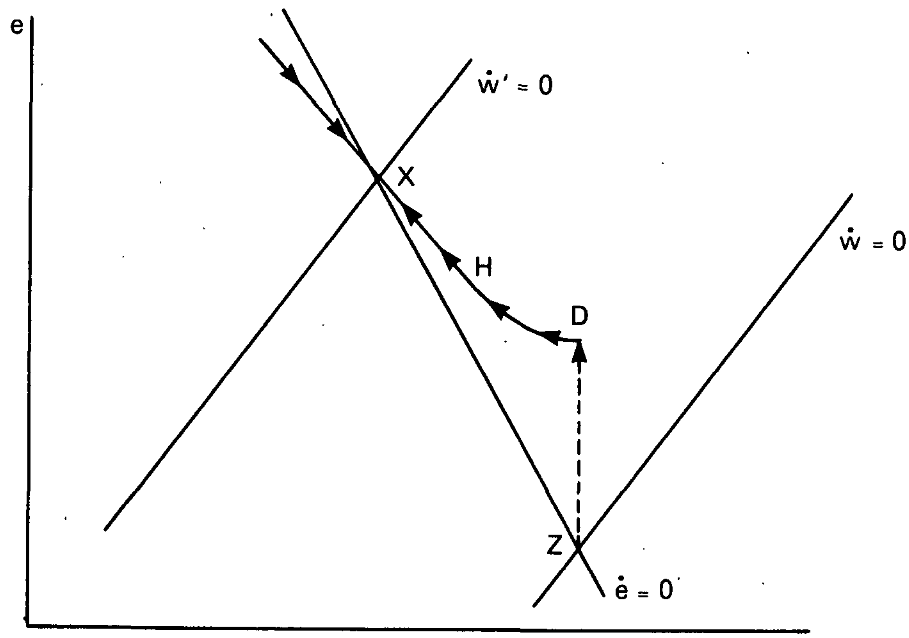
$$d(\overline{W/P})/d(\overline{e/P_N}) = -X_{e/P_N}/X_{W/P} < 0$$

In terms of the figure, the budget deficit shifts the $\dot{w} = 0$ schedule to the left ($\dot{w}' = 0$) without affecting the $\dot{e} = 0$ schedule. Thus, in the long run, the budget deficit depreciates the exchange rate (from Z to X

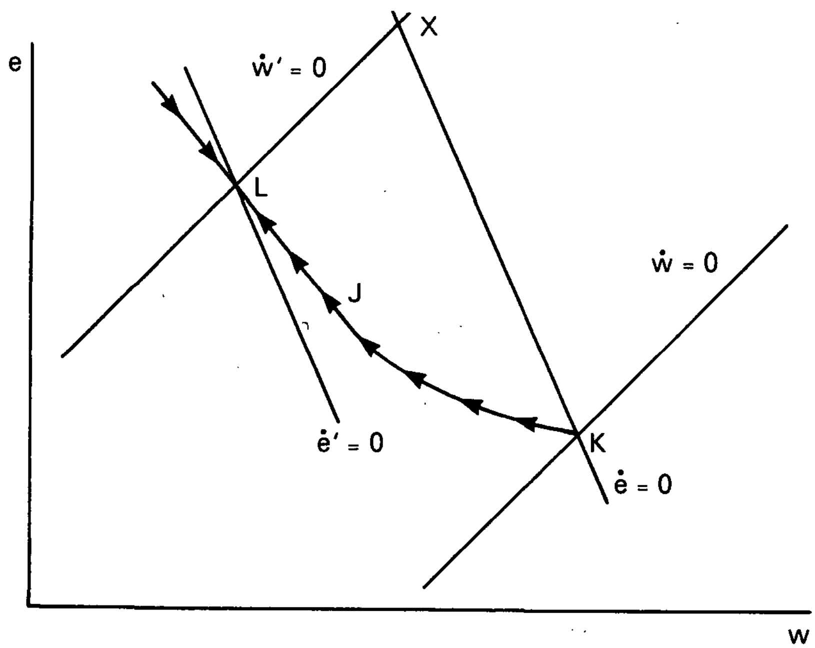
1/ This ambiguity, which is caused by the capital gains and losses induced by a depreciation, often appears in the international economics literature. To the best of my knowledge, the $\dot{w} = 0$ is always assumed to be positively sloped. For example, see Dornbusch and Fisher (1980), Henderson and Rogoff (1981), Boyer and Hodrick (1982), and Sachs (1980).

FIGURE 2

THE CASE OF NO INTERVENTION



THE CASE OF INTERVENTION



in the upper part of the figure) and reduces real wealth. This occurs because the policy increases the stock of net official foreign debt. The larger stock of debt implies that the country must develop a trade surplus sufficient to service the external debt in order to meet the long-run constraint of a balanced current account. The trade surplus is induced by a depreciation of the nominal exchange rate that reduces the consumption of traded goods by raising their relative price and by causing a decline in real wealth. This also explains why a temporary fiscal shock causes a permanent depreciation of the real exchange rate. Because the expansionary fiscal policy is temporary, the excess demand for nontraded goods, which is induced by the government, disappears in the steady state. However, real wealth declines in order to permanently reduce the domestic consumption of traded goods. But this reduction also causes an excess supply of nontraded goods. A real exchange rate depreciation, which permanently reduces the relative price of nontraded goods, is thus needed to restore equilibrium in that market.

The effect of an expansionary fiscal policy on the exchange rate can be seen from another angle. Given the assumption of full employment, the expansionary fiscal policy induces an excess demand for goods that is financed by borrowing abroad. Thus, the country consumes more goods than it produces. The excess of consumption is equivalent to a transfer of real goods from the foreigners to the residents of the country. Eventually, this transfer of real goods must be paid for. This can only occur if the country reduces its absorption by reducing real wealth, and shifts resources into the production of traded goods by depreciating the real and nominal exchange rate.

(b) The case of sterilized intervention

In the previous case, the expansionary fiscal policy depreciates the exchange rate because it initially affects only the goods market. In terms of Figure 2, the policy shifts only the $\dot{w} = 0$ schedule. The authorities can maintain the exchange rate in the face of an expansionary fiscal policy if they shift the $\dot{e} = 0$ schedule to the left. They can do this by adopting a policy of sterilized intervention that increases the part of financial assets denominated in foreign currencies in the portfolio of domestic residents. In order to implement this policy the authorities borrow abroad in excess of the deficit; they then exchange this excess of foreign exchange for domestic currency bonds held by the private sector, thus creating an excess demand for bonds denominated in domestic currency that appreciates the exchange rate.

The simplest way to introduce sterilized intervention into the model is to assume that the foreign borrowing exceeds the cumulated government expenditure by a constant (β), which is greater than 0. Thus, the steady state stock of official external debt in the case of sterilized intervention ($\overline{F}'$) is equal to

$$\overline{F}' = (1+\beta)\overline{F}$$

Where $\overline{F}$ is the stock of official external debt when no intervention occurs. The reduction in the stock of domestic currency bonds ($d\overline{B}^T$) caused by the policy of sterilized intervention is then equal to $\beta d\overline{F}$. 1/ The two equations describing the steady state equilibrium in the goods and financial markets, now become

$$0 = (\gamma_e + \gamma_W\overline{A})d\overline{e} + \gamma_W d\overline{w} + \gamma_B \beta d\overline{F}$$

$$0 = (Z_W\overline{A} + Z_e)\ d\overline{e} + Z_W d\overline{w} + \theta_F(1+\beta)d\overline{F}$$

The system of the two equations can be solved for $d\overline{e}$ and $d\overline{w}$.

$$(19)\quad d\overline{e}/d\overline{F} = K^{-1}(Z_W\gamma_B\beta + \gamma_W\theta_F(1+\beta)) \gtrless 0$$

$$(20)\quad d\overline{w}/d\overline{F} = -K^{-1}[(\gamma_W\overline{A} + \gamma_e)(1+\beta)\theta_F + \gamma_B\beta Z_W\overline{A} + Z_e)] < 0$$

The expression (19) shows that the change in the long-run exchange rate is uncertain. The first term in the parenthesis of equation (19) shows the amount of the appreciation that is induced by the intervention policy. As in every portfolio model, the appreciation is negatively related to the substitutability between domestic and foreign currency denominated bonds. The second term captures the long-run depreciation that puts downward pressure on the exchange rate as soon as the budget deficit and the intervention policy take place. This term is usually neglected by traditional portfolio models, like Girton and Henderson (1976) and Branson, Haltunen and Masson (1977). 2/ As a result, in these models, the authorities can always achieve their exchange rate targets, both in the short and in the long run. Two examples are Argy (1982) and Kenen (1982). Equation (19) shows that, theoretically, the authorities may achieve their exchange rate target in the face of a budget deficit if β and the degree of substitutability between bonds (γ_B) are sufficiently large and if the expectations of the long-run depreciation ($\theta_F(1+\beta)$) are

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1/ If the stock of domestic bonds declines, taxes are reduced due to the government budget constraint. However, taxes do not appear in the equations describing the equilibrium in the goods market because I assume that changes in taxes have a negligible impact on the private sector's saving ratio.

2/ Genberg (1981) observes that sterilized intervention has an impact on the exchange rate by affecting the service account of the balance of payments. However, he thinks that this effect reinforces the effectiveness of intervention.

negligible. In practice, however, sterilized intervention may not be successful or feasible for various reasons. The expectations of an exchange rate depreciation may be very strong if the initial stock of external debt is very high. The value of $\theta_F(1+\beta)$ is then so high that every level of intervention fails to maintain the exchange rate. Furthermore, the size of official external borrowing that is consistent with the authorities' exchange rate target may not be feasible because, unlike in the model, small countries do not face an infintely elastic supply of funds in the international capital market due to default and political risks.

Expression (20) shows that the larger the β, the larger the reduction in wealth. This occurs because the authorities prevent the exchange rate from moving. Thus, wealth has to fall more than in the case of no intervention in order to reduce the demand of both traded and nontraded goods at the levels consistent with long-run equilibrium. This aspect of sterilized intervention is implicit in Henderson's (1982) analysis. He showed that an intervention policy is very costly in terms of real output variability if the policy is implemented in order to neutralize the effect of a real shock on the exchange rate. As I showed before, a budget deficit, which is caused by an increase in government expenditure and is financed abroad, is equivalent to a real shock.

The same can be seen in the lower part of Figure 2. For any given leftward movement in the $\dot{w} = 0$ schedule, a policy that seeks to maintain the exchange rate must shift the $\dot{e} = 0$ to the left ($\dot{e}' = 0$ in the figure), thus intersecting the $\dot{w}' = 0$ curve at a lower level of w, and hence of W. In the figure, I show the case in which the authorities decide to maintain the exchange rate in the short run, by adopting a policy of sterilized intervention. The long run equilibrium position moves from K to L. The level of w at L is lower than at X, which is the position that the economy would have attained in the absence of sterilized intervention.

III. The Short-Run Dynamics

To study the dynamic paths that the exchange rate and w follow after market participants learn about the changes in fiscal policy, I linearize the system of equations (7), (11) and (12) in the neighborhood of the steady state; I solve for $(P_N-\bar{P}_N)$ in (11) and substitute it into (12); I use expressions (13) and (14); and I express the system in matrix form:

$$(21) \quad \begin{bmatrix} \dot{e} \\ \dot{w} \end{bmatrix} = \begin{bmatrix} \gamma_w\bar{A} + \gamma_e & \gamma_e \\ Z_w\bar{A} + Z_e & Z_w \end{bmatrix} \begin{bmatrix} e-\bar{e} \\ w-\bar{w} \end{bmatrix} + \begin{bmatrix} 0 \\ \theta_F \end{bmatrix} (F-\bar{F})$$

In the case of sterilized intervention, the vector multipyling $(F-\bar{F})$ becomes $[-\gamma_B\beta \quad \theta_F(1+\beta)]'$. The determinant of the matrix of the coefficients is equal to

$$K = (\gamma_W\bar{A} + \gamma_e)Z_W - \gamma_W(Z_W\bar{A} + Z_e) = \gamma_e Z_W - \gamma_W Z_e < 0$$

and is always negative. Thus, the model, like virtually every exchange rate model with stock/flow interactions, is characterized by saddle path stability, i.e., there is only one trajectory that brings the system back to equilibrium after an initial shock. After the initial shock, the exchange rate jumps to a value that lies on the stable arm of the saddle path and then moves along the path until it reaches the new long-run equilibrium value. In this section I describe the dynamics of the system with the help of Figure 2 and I relegate the proof of the results to the Appendix. As before, the upper part of the figure shows the case of no intervention; the lower part shows the case in which sterilized intervention maintains the exchange rate in the short run.

In the case of no intervention, when government expenditures increase, the private sector immediately reckons the stock of official foreign debt that the country will eventually accumulate as a result of the expansionary fiscal policy. As a result, the private sector anticipates that the country will develop a trade surplus sufficient to service the external debt in order to meet the long-run constraint of a balanced current account. Because the current account ties down the long-run equilibrium exchange rate, the exchange rate must depreciate in the long run. If expectations are rational, market participants immediately adjust their portfolios by moving into foreign assets, thus depreciating the actual exchange rate. In the figure, an unanticipated budget deficit causes an immediate depreciation of the exchange rate equal to ZD. 1/ From the level reached at D, the exchange rate continues to depreciate towards its long-run equilibrium level at X, in order to reduce expenditure and to generate the surplus of traded goods. However, the exchange rate does not reach the steady state at a uniform rate of depreciation. It initially depreciates at a slow (but increasing) rate because the excess demand for nontraded goods, which is induced by the temporary budget deficit, tends to raise the relative price of nontraded goods and thus to appreciate the exchange rate. After a while (precisely when $t = \tau$)

1/ In analyzing the dynamics of the model, I hold w constant immediately after the fiscal disturbance. This is true in the case of no intervention because the disturbance does not affect either A or B. However, w constant is only an approximation when the fiscal disturbance is accompanied by sterilized intervention. Nonetheless, the size of the approximation is very small and can be neglected. See Henderson and Rogoff (1981). The approximation is exactly equal to the private sector purchase of foreign assets from the authorities multiplied by the immediate change in the exchange rate that is caused by the policy of sterilized intervention.

the pressure of the budget deficit on the relative price of nontraded goods disappears because the deficit is temporary. In the figure, this occurs at H. From H, the exchange rate depreciates at a constant rate that is determined by the decline in wealth caused by the current account deficit. Thus, external official borowing can neither avoid nor delay the depreciation of the exchange rate in the face of an expansionary fiscal policy.

In the case of sterilized intervention, the authorities prevent the exchange rate from depreciating immediately because they accommodate the portfolio adjustment of the private sector. They do this by purchasing bonds denominated in domestic currency from domestic investors in exchange for bonds denominated in foreign currency. As a result, sterilized intervention maintains the exchange rate at K, even though the budget deficit induces expectations of an exchange rate depreciation. From K, the exchange rate follows a path similar to the path described before. In the lower part of the figure, the exchange rate initially depreciates at a slow (but increasing) rate until it reaches J. From the level reached at J, it depreciates at a constant rate in order to accomplish the adjustment process that I described before. Eventually, the exchange rate reaches its new long-run equilibrium position at L, at a level that is lower than in the case of no intervention (which is shown by X in the lower part of the figure). 1/

IV. Summary and Conclusions

Since the beginning of the floating period, the governments of many small industrial countries have often borrowed in the international capital markets in order to finance sharp increases in their budget deficits. By borrowing abroad, these governments have tried to maintain the exchange rate in the face of the deficits. In the paper, I argue that such a policy cannot be successful. By using a standard portfolio model with stock/flow interactions, I show that a budget deficit, which is entirely financed by selling debt denominated in foreign currencies to nonresidents, depreciates the exchange rate both in the short and in the long run. The exchange rate depreciates in the long run, in order to generate the surplus of traded goods that is required to service the official external debt. If expectations are rational, the private sector immediately anticipates the long-run depreciation and shifts its portfolio into

1/ Although the shapes of the path followed by the exchange rate in the two cases are similar, the rate of depreciation from D to H differs from the rate from K to J. Furthermore, I show in the Appendix that the exchange rate might initially appreciate faster than along the straight part of the stable arm of the saddle path, if γ_B is very large (exactly if $\gamma_B > X_1 \theta_F$).

foreign assets. This portfolio shift, in turn, depreciates the exchange rate in the short run. The depreciation is thus the result of the long-run budget constraint that the economy faces. Because during the expansionary fiscal policy the economy consumes more than it produces, it receives a real transfer from the rest of the world. The exchange rate depreciates in order to allow the economy to pay for the transfer. The importance of the long-run budget constraint has been emphasized by various authors, like Rodriguez (1979), Sachs (1980), and Boyer and Hodrick (1982).

In addition, there is evidence that the governments of various small industrial countries have adopted policies of sterilized intervention during periods in which their budget deficits deteriorated sharply. By creating a relative scarcity of bonds denominated in domestic currency, and thus driving up the domestic real interest rate, I show that a government can theoretically achieve its exchange rate target in the short run. In practice, however, the size of the external official borrowing, which is needed to maintain the exchange rate, may not be feasible if the private sector expects a substantial long-run depreciation of the exchange rate and if the initial stock of external official debt is very large. Furthermore, I show that, if the policy of sterilized intervention is successfull, it is also very "costly." Because the exchange rate is not allowed to move, real wealth has to fall more than in the case of no intervention in order to accomplish the reduction of real domestic absorption that is needed to balance the current account. This conclusion is implicit in Henderson's (1982) analysis of sterlized intervention. He showed that an intervention policy is costly in terms of real output variability when it is used to neutralize the effect of a real shock on the exchange rate. A budget deficit which is financed by external official borrowing, is equivalent to a real shock, because it does not have an impact on the domestic residents' portfolio.

The Dynamics of the System

In this appendix, I investigate the dynamic paths followed by the exchange rate and w when they move towards their long-run equilibria. I first deal with the case of no intervention.

For convenience, I assume that $t_o = 0$; in addition, I make the following changes in notation: $e(t) = e-\bar{e}$; $w(t) = w-\bar{w}$ and $F(t) = F-\bar{F}$. The solution of the system of differential equations (21) is then: 1/

$$e(t) = X_1 e^{\lambda_1 t} [C_1 + M \int_o^t F(s) e^{-\lambda_1 s}] + X_2 e^{\lambda_2 t} [C_2 + N \int_o^t F(s) e^{-\lambda_2 s} ds] \quad (*)$$

$$w(t) = e^{\lambda_1 t} [C_1 + M \int_o^t F(s) e^{-\lambda_1 s} ds] + e^{\lambda_2 t} [(C_2 + N \int_o^t F(s) e^{-\lambda_2 s} ds] \quad (**)$$

where $\lambda_1 < 0$ and $\lambda_2 > 0$ are the two eigenvalues of the system; X_1 and X_2 are the eigenvectors associated with λ_1 and λ_2 and they are equal to

$$X_1 = \gamma_W / [\lambda_1 - (\gamma_e + \gamma_W \bar{A})] \quad < 0$$

$$X_2 = (Z_W \bar{A} + Z_e) / [\lambda_2 - (\gamma_e + \gamma_W \bar{A})] \gtrless 0$$

N and M are two constants equal to

$$M \quad -X_2 \theta_F / (X_1 - X_2)$$

$$N = X_1 \theta_F / (X_1 - X_2)$$

C_1 and C_2 are two constants determined by the initial and terminal conditions respectively. I find C_i by letting $t \to 0$ in (**)

$$w(o) = C_1 + C_2$$

Because λ_2 is the positive root, the system is stable if 2/

1/ See Kaplan (1958).
2/ See Gray and Turnovsky (1979).

$$\lim_{t\to\infty} \left[C_2 + N \int_o^t F(s)\, e^{-\ _2 s} ds\right] = 0$$

or

$$C_2 = -N \int_o^\infty F(s) e^{-\lambda_2 s} ds$$

I assume that this condition is satisfied. Thus,

$$C_1 = w(o) + N \int_o^\infty F(s) e^{-\lambda_2 s} ds$$

Substituting the expressions for C_1 and C_2 into (*) and (**) the solution becomes:

$$e(t) = X_1 e^{\lambda_1 t} \alpha(t) - X_2 e^{\lambda_2 t} N \int_t^\infty F(s) e^{-\lambda_2 s} ds$$

$$w(t) = e^{\lambda_1 t} \alpha(t) - e^{\lambda_2 t} N \int_t^\infty F(s) e^{-\lambda_2 s} ds$$

where $\alpha(t) = w(o) + N \int_o^\infty F(s) e^{-\lambda_2 s} ds + M \int_o^t F(s) e^{-\lambda_1 s} ds$

In order to find the equation describing the stable arm of the saddle path, I solve the two equations for $e^{\lambda_1 t} \alpha(t)$ and I equate them:

$$e(t) = X_1 w(t) + (X_1 \theta_F) H(t)$$

where

$$H(t) = e^{\lambda_2 t} \int_t^\infty F(s) e^{-\lambda_2 s} ds$$

When $t > \tau$, i.e., when the budget becomes balanced, the stock of government debt $F(s)$ is a constant equal to $\overline{F}$. The equation for the stable arm is thus,

$$e(t) = X_1 w(t) + (X_1\theta_F F)/\lambda_2$$

which is negatively sloped because X_1 is negative. The rate of depreciation is given by

$$\dot{e}(t) = X_1\dot{w}(t)$$

which is a constant for any given $\dot{w}(t)$.

When $t < \tau$, i.e., when government expenditures induce an excess demand for nontraded goods, the function H(t) can be rewritten as

$$H(t) = e^{\lambda_2 t}\int_t^{\infty} F(s)e^{-\lambda_2 s}ds = e^{\lambda_2 t}\left[\int_t^{\tau} F(s)e^{-\lambda_2 s}ds + \int_{t>\tau}^{\infty} F(s)e^{-\lambda_2 s}ds\right] =$$

$$= P(t) + \bar{F}/\lambda_2$$

where

$$P(t) = e^{\lambda_2 t}\int_t^{\tau} F(s)e^{-\lambda_2 s}ds$$

The equation for the stable arm is thus:

$$e(t) = X_1\, w(t) + (X_1\theta_F\bar{F})/\lambda_2 + (X_1\theta_F)P(t)$$

The rate of depreciation is

$$\dot{e}(t) = X_1\, \dot{w}(t) + (X_1\theta_F)\, P(t)$$

which is now a function of $\dot{P}(t)$, for any given $\dot{w}(t)$. In order to study how the stable arm moves through time, I calculate the sign of $\dot{P}(t)$.

$$\dot{P}(t) = -F(t)\,(1+1/\lambda_2^2) - G(t)/\lambda_2^3 + b/\lambda_2^4\,[1-(1/e^{\lambda_2(\tau-t)})] < 0$$

which is always negative because b is negative and $(\tau-t)$ is always positive. As a result, for any $\dot{w}(t)$, the exchange rate will depreciate at an increasing rate between t_o and τ.

In the case of sterilized intervention, the equations or the stable arm of the saddle path are:

$$e(t) = X_1 \, w(t) + h\bar{F}/\lambda_2 \qquad t > \tau$$

$$e(t) = X_1 \, w(t) + hP(t) \qquad 0 < t < \tau$$

where

$$h = X_1\theta_F + \beta \, (X_1\theta_F + \gamma_B)$$

For any given $\dot{w}(t)$, the rate of depreciation along the straight segment of the stable arm is the same as in the case of no intervention. However, between t_o and τ, the rate of depreciation in the two cases will differ by $\beta(X_1\theta_F + \gamma_B)$. The lower part of Figure 2 is drawn under the assumption that h is positive. However, if γ_B is very large, h can be negative so that the exchange rate depreciates at a decreasing rate between t_o and τ.

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