GOVERNMENT SPENDING AND THE REAL EXCHANGE RATE

by

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Abstract

I study the effect of government spending on the real exchange rate in a model exhibiting complementarity between consumption at different points in time. I show that the standard result of fiscal expansions causing real appreciations may hold, although not always, in this intertemporal framework. I also examine the time series from a cross section of European countries for the period 1970-1982 and find that the standard result is supported by the data. More importantly, I show that increases in government expenditures appear to have been the single most important cause behind the decline of the manufacturing sector in those countries.

I. Introduction

A stylized result in open economy macroeconomics is that increases in government expenditures add to private consumption, thus deteriorating the current account, and appreciate the real exchange rate; the real appreciation crowds out foreign demand, if all goods are internationally traded, and shifts resources to the home goods sector, if part of the output is not traded. (Marston, 1985, Sachs and Wyplosz, 1983, Branson and Buiter, 1983). In this paper, I re-examine this result by using an intertemporal monetary model that has the desirable property of generating complementarity between consumption at different points in time. The model allows for traded and nontraded goods so that domestic real interest rates can diverge from world rates--as emphasized in Bruno (1976) and Dornbusch (1983a); interest rates movements, in turn, affect both the desired holdings of real cash balances and the real exchange rate; economic agents intertemporal choices are described by the recursive utility function presented in Epstein and Hynes (1983) (EH henceforth) which ensures a unique small country steady state; finally, money is introduced à la Sidrauski so that the model expands on the work by Obstfeld (1981).[1]

I show that when the government increases expenditure on traded goods the standard results are reversed: the real exchange rate immediately depreciates and there is a more than 100 percent crowding out so that the current account moves into surplus. If the increases fall instead on nontraded goods, the model can account for both the standard result of an immediate real appreciation and for the "perverse" result of a real depreciation. There are two points that it is worth emphasizing: first, the model shows that a Mundell-Fleming type analysis of government spending in the open economy may still be valid, although not always, in an intertemporal optimizing framework;

and second, that the result of an expansionary fiscal policy depreciating the real exchange rate, and thus moving the current account into surplus, does not depend crucially on the specification of the utility function adopted and, in particular, of a time varying rate of time preference.[2]

The possibility that an increase in government expenditure may induce a real depreciation has an interesting implication for economies with real wage rigidity, a condition which is observed in most European countries (Branson and Rotenberg, 1980, Sachs 1979, 1983), because, in such a case, the fiscal expansion could reduce private sector employment by causing product wages to fall relative to real wages (measured in terms of the consumer price index) in the nontraded goods which is traditionally labor intensive (Helpman, 1976).[3] As a by-product, I also consider an expansionary policy that takes the form of lump-sum subsidies financed by an inflation tax in order to show that the steady state real exchange rate is not neutral with respect to changes in the growth rate of the money supply.

Because the model does not produce unambiguous results, I try to resolve empirically the indeterminacy of the real exchange rate response to government expenditure increases by examining the time series from a cross section of European countries for the sample period 1970-1982. European countries constitute an interesting case study during that period because they steadfastly pursued expansionary fiscal policies that led to marked increases in government expenditure to GNP ratios without affecting, perhaps with the only exception of Italy, their steady state levels of inflation. I show that the time series support the standard result of a real exchange appreciation; in addition, and more importantly, the data suggest that the substantial increase in resources absorbed by European governments in those years was the single most important factor behind the sharp decline of the manufacturing sector in those countries.

II. The Model

In the economy, agents rank alternative paths of consumption of traded and nontraded goods, 'C_T' and 'C_H' respectively and of real cash balances 'm' according to the function 'U'; following EH, U is specified as:

$$U(C_T, C_H, m) = -\int_0^\infty \exp\{-\int_0^t [u(C_T, C_H) + v(m)]d\tau\}dt \qquad (1)$$

where $u, v > 0 \quad u', v' > 0 \quad u'', v'' < 0$;

$$\lim_{C_T \to 0} u'(C_T) = \lim_{C_H \to 0} u'(C_H) = \lim_{m \to 0} v'(m) = \infty$$

and where nominal cash balances are deflated by the aggregate price level 'P' which, for convenience, is assumed to be a geometric average of the price of traded 'EP_T^*' and nontraded goods, 'P_H' or

$$P = P_H^\gamma (EP_T^*)^{1-\gamma} .$$

Given the small country assumption, P_T^* is kept constant and is set equal to one, so the domestic price of traded goods is simply the nominal exchange rate 'E'.

EH showed that the specification of the utility function in (1) provides a precise expression for the rate of time preference at any point in time T, along a locally constant path, that is, $\dot{C}_H(T) = \dot{C}_T(T) = \dot{m}(T) = 0$; EH (p. 616) showed that this rate is an increasing function of the entire future paths of the arguments of the utility function evaluated at their optimal values[4]:

$$\rho = [\int_T^\infty \exp\{-\int_T^t [u(C_T, C_H) + v(m)]d\tau\}dt]^{-1} . \qquad (2)$$

Such a definition of the rate of time preference implies complementarity between consumption at different moments, which, Hicks (1965) argued, is an intrinsic property of individuals intertemporal choices.[5] In a word, expression (2) says that an individual deciding the allocation of consumption between T and T - 1, will take into account the expected consumption levels for all the periods beyond T; thus, for any given interest rate, the higher his expected lifetime level of consumption, the greater his consumption at T. In addition to capturing an essential feature of intertemporal decisions, a variable rate of time preference, which increases in the level of future welfare, ensures stability of the model and the existence of a unique small-country steady state.[6] Finally, EH showed that the utility specification (1) encompasses the utility function introduced by Uzawa (1968);[7] in particular, the two specifications impose the same steady state solution to the model, that is, the rate of time preference is equal to the utility function evaluated at the steady state value of the arguments.[8]

For convenience, I assume that labor supply is fixed so that leisure does not appear in the utility function. I also assume that government expenditure does not yield direct utility because, in addition to the standard arguments usually adduced, I want to examine the same kind of fiscal experiment that is typically considered in the income-expenditure models of the Mundell-Fleming type in which public consumption is worthless to private consumers (Bailey, 1971). Money appears in the utility function because I want to generate a money demand sensitive to movements in the world real interest rate, the crucial element that determines the real appreciation in following an expansionary fiscal policy in the standard macro model. The stock budget constraint facing the economy is given by

$$a = m + (E/P)F \tag{3}$$

where 'a' is real wealth and F the stock of net foreign assets. Given the definition of the price level, real wealth can be rewritten as a function of the real exchange rate 'e' defined as the relative price between traded and nontraded goods

$$a = m + e^{\gamma}F \ . \tag{4}$$

The flow budget constraint can be expressed as

$$\dot{a} = P_T/P(Y_T - C_T) + P_H/P(Y_H - C_H) + (r^* + \dot{E}/E - \dot{P}/P)\frac{EF}{P} - \dot{P}/Pm + T/P \tag{5}$$

where Y_T and Y_H the domestic production of traded and nontraded goods, respectively, and T are government transfers net of taxes. Using the definition of the price level once more, I can rewrite (5) as a function of the real exchange rate 'e', or

$$\dot{a} = e^{\gamma}(Y_T - C_T) + e^{\gamma-1}(Y_H - C_H) - \pi a + \tau + (r^* + \dot{E}/E)e^{\gamma}F \tag{6}$$

where $\tau = T/P$, and π is the aggregate inflation rate. The government finances the purchase of traded and nontraded goods (G_H and G_T) by levying income taxes and through money creation; its budget constraint is therefore

$$\tau = gm - e^{\gamma}G_T - e^{\gamma-1}G_H \tag{7}$$

where g is the rate of growth of nominal cash balances. The fiscal policy experiment considered in the model is a permanent change in the level of government expenditure; because the focus of the paper is on the expenditure side of the public sector balance sheet, I only examine non-distortionary tax policies. Finally, there is no difference between tax and debt financed fiscal policies, given the infinitely-lived consumers assumption.

The solution of the model is obtained by maximizing (1) subject to (4), (6) and the intertemporal budget constraint for the overall economy

$$\int_0^\infty (C_T + G_T)e^{-r^*t}dt \leq F(0) + \int_0^\infty Y_T e^{-r^*t}dt \ .$$

In Appendix A, I show that the maximization yields the following first-order conditions:

$$\frac{U_T(C_T,\ C_H)}{U_H(C_T,\ C_H)} = e \tag{8}$$

$$\dot{U}_T/U_T = \rho[H(a)] - r^* \tag{9}$$

$$\frac{V_m(m)}{U_T(C_T,\ C_H)}\, e^\gamma = r^* + \pi + \gamma\dot{e}/e \tag{10}$$

where $U_T = \partial u/\partial C_T$; $U_H = \partial u/\partial C_H$; $V_m = \partial v/\partial m$; and a dot above a variable indicates time derivative. Equation (8) is the usual marginal condition of the theory of the household. Equation (9) determines the optimal consumption path. As explained in Appendix A, the rate of time preference at any point in time t, can be expressed as a unique function of the state variable 'a', because the rate is a function of the entire future path of consumption and real cash balances evaluated at their optimal levels. The equation clearly indicates why the model has a unique steady state: if a country, for example, accumulates wealth because of a current account surplus, the rate of time preference will increase thus boosting consumption, which, in turn, will cause the surplus to decline. Equation (10) is the money demand equation; it is worth noting that the expression at the right hand side can be rewritten as the covered foreign interest rate

$$r^* + \dot{E}/E$$

and is therefore equal to the domestic nominal interest rate.

I first eliminate C_T and C_H from the model by expressing them as a function of the real exchange rate. In order to do so, I have to specify the supply equations in the goods market. I initially assume that there are no labor market rigidities and that labor is the only factor of production so that the level of output in the traded and nontraded sectors is uniquely determined by the real exchange rate, that is

$$Y_{He} = \frac{\partial Y_H}{\partial e} < 0 \quad \text{and} \quad Y_{Te} = \frac{\partial Y_T}{\partial e} > 0 \ .$$

Substituting the nontraded goods market equilibrium condition

$$C_H - G_H = Y_H(e)$$

into (8) I can express the consumption of traded goods as a function of G_H and e

$$C_T = C_T(e,\ G_H) \qquad C_{Te},\ C_{TG_H} < 0 \tag{11}$$

where the sign of the partial derivatives depends on the assumption that both traded and nontraded goods are normal goods.[9] I can derive an expression for C_H in an analogous way.

$$C_H = C_H(e,\ G_H) \qquad C_{He},\ C_{HG_H} < 0 \tag{12}$$

Taking the derivative with respect to time in (11) and (12) and substituting the resulting expressions into (9) I get the first dynamic equation of the model

$$\dot{e} = \frac{U_T(e,\ G_H)}{K}\{\rho[H(a)] - r^*\} \tag{13}$$

where $K = U_{TT}C_{Te} + U_{TH}C_{He}$ which is always positive under the reasonable assumption that traded and nontraded goods are gross substitutes ($U_{TH} < 0$).[10]

The percentage change in the aggregate price level ($\dot{P}/P = \pi$) changes so as to make the growth rate of money 'g' consistent with the desired rate of change of real cash balances,

$$\pi = g - \dot{m}/m \tag{14}$$

Substituting (14) into (10), I obtain the second dynamic equation of the model

$$\dot{m} = m[g + r^* + \gamma\, \dot{e}/e - X(e, m, G_H)] \tag{15}$$

where

$$X(e, m, G_H) = e^{\gamma}\left[\frac{V_m(m)}{U_T(e, G_H)}\right], \quad X_m, X_{G_H} < 0 \; ; \quad X_e \gtrless 0 .$$

The effect of a real depreciation on money market equilibrium is ambiguous: on the one hand, a depreciation reduces consumption and, for any given interest rate, a reduction in real cash balances is needed to restore the ratio of the marginal utility of money to consumption; on the other hand, the depreciation increases the value of the utility of traded goods consumption in terms of the aggregate price deflator thus increasing the demand for real cash balances. In Appendix B, I show that the model is always stable when the first effect dominates the second and thus, I proceed with the assumption that X_e is negative.

The third dynamic equation of the model describes the change in net foreign assets; the derivation is identical as in Obstfeld (1981) and it is only sketched here. First, I use the budget constraint of the government given in (7); second, I substitute (7) and an expression for the inflation rate (A10) into the asset accumulation equation (6); and third, I use the equilibrium condition in the nontraded goods market to obtain

$$\dot{F} = Y_T(e) + C_T(e, G_H) - G_T + r^*F \ . \tag{16}$$

The complete model is thus characterized by the three equations (13), (15) and (16) that determine the equilibrium paths of the real exchange rate, real cash balances and net foreign assets.

III. Dynamics and the Steady State

To investigate the dynamics of the model in the neighborhood of the steady state, I linearize (13), (15) and (16) around the steady state. Because the analysis of the dynamics does not contain any novel element, I relegate it to Appendix B. In the Appendix, I show that the model may be characterized by saddle path stability and that the equations of motion of the endogenous variables along the trajectory to the new steady state are

$$\begin{aligned} e(t) - \bar{e} &= ke^{\lambda t} \\ m(t) - \bar{m} &= w_{12}ke^{\lambda t} \qquad & w_{12} \gtrless 0 \\ F(t) - \bar{F} &= w_{13}ke^{\lambda t} \qquad & w_{13} < 0 \end{aligned} \tag{17}$$

where k is a constant determined by the initial value of the stock of net foreign assets 'F(0)', $[1 \ w_{12} \ w_{13}]'$ is the eigenvector associated with the unique stable root λ, and a bar above a variable indicates steady state values.

From (17), the real exchange rate always depreciates along the saddle path when the current account is in deficit--and vice versa--a relationship that typically emerges in exchange rate models, that is

$$[e(t) - \bar{e}] = 1/w_{13}[F(t) - \bar{F}] \tag{18}$$

There is no unique relationship, however, between changes in real cash balances and in real exchange rates or the current account because the sign of w_{12} is indeterminate:

$$[m(t) - \bar{m}] = w_{12}[e(t) - \bar{e}] = w_{12}/w_{13}[F(t) - \bar{F}] \ . \tag{19}$$

To find the steady state of the model, I set the time derivatives equal to zero in (13), (15) and (16), and I use the property that $\bar{\rho} = u(\bar{C}_T, \bar{C}_H) + v(\bar{m})$ in the steady state (see footnote 8):

$$\begin{aligned} 0 &= Y_T(\bar{e}) - C_T(\bar{e}, \bar{G}_H) - \bar{G}_T + r^*\bar{F} \\ 0 &= \bar{g} + r^* - X(\bar{e}, \bar{m}, \bar{G}_H) \\ 0 &= u[C_T(\bar{e}, \bar{G}_H), C_H(\bar{e}, \bar{G}_H)] + v(\bar{m}) - r^* \end{aligned} \tag{20}$$

Clearly, the steady state exists and is unique providing that $\bar{g} + r^* > 0$.

a. Government Spending Increases

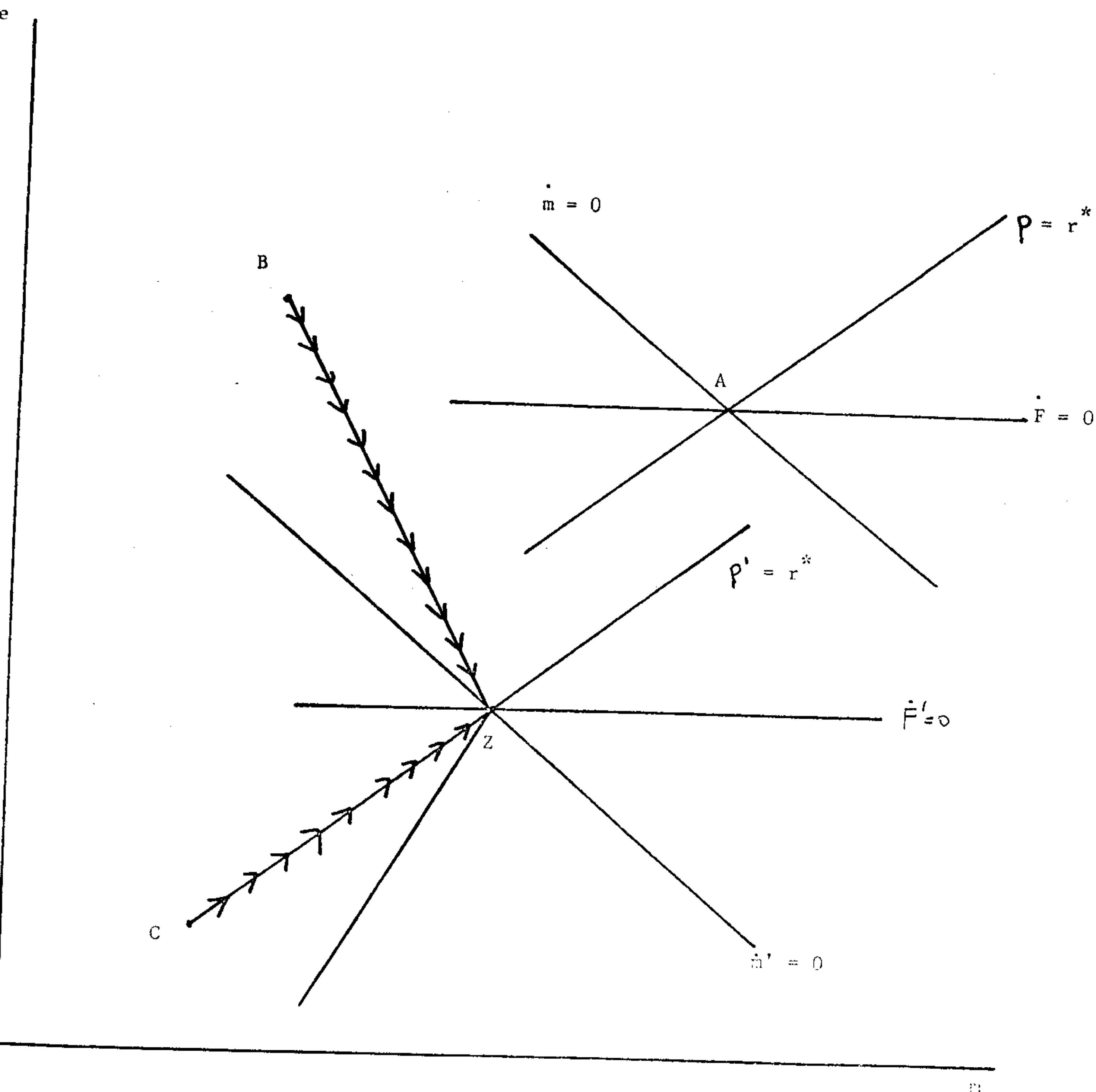
The first experiment is to consider an increase in government expenditure on traded goods. Simply by inspecting (20), one can see that $\bar{G}_T$ does not affect either the money market equilibrium condition or the rate of time preference so that $\bar{e}$ and $\bar{m}$ are unaffected by fiscal policy. The increase in $\bar{G}_T$ must then be offset by an increase in $\bar{F}$.[11] Notwithstanding the larger demand for traded goods by the government, the private sector maintains the level of both its consumption and production in the new steady state; as a consequence, the balance of payments constraint is satisfied only if a larger inflow of interest payments, which stems from an improved asset position vis-a-vis the rest of the world, finances the increase in imports. Thus, in the transition, the country accumulates net foreign assets, so that the real exchange rate initially has to depreciate in order to reduce private sector consumption and to shift production away from nontraded goods. This is essentially Obstfeld's (1981) result on the impact of government spending on the nominal exchange rate in a model where purchasing power parity always holds; the result thus applies to the real exchange rate as well.

A more interesting experiment is an increase in 'G_H' since government spending falls predominantly on nontraded goods in industrialized countries. To facilitate the exposition, I resort to a phase diagram (Graph 1). The upward sloping schedule in the $\bar{e}$, $\bar{m}$ plane represents the locus of points that ensures equality between the world interest rate and the intertemporal rate of substitution. The negatively sloped schedule represents equilibrium in the money market. Finally, at each point characterizing a steady state equilibrium there is a balance of payments equilibrium schedule that is parallel to the horizontal axis because the steady state value of 'F' does not depend on $\bar{m}$.

An increase in 'G_H' shifts both the $\dot{m} = 0$ and $\rho - r^* = 0$ schedules downwards so that the real exchange rate unambiguously appreciate: in equilibrium, more nontraded goods needs to be produced so that the relative price has to move in order to shift productive resources away from the traded goods sector. The impact of fiscal policy on real cash balances and the stock of net foreign assets is ambiguous instead; I focus on the latter because the sign of the change in '$\bar{F}$' determines the dynamics of the real exchange rate. In the new steady state:

$$d\bar{F}/d\bar{G}_H = \Delta^{-1}\Big[\frac{\partial C_T}{\partial G_H}(X_m\phi - V_m X_e) - V_m X_{G_H}(Y_{Te} - C_{Te})$$

$$+ U_H \frac{\partial C_T}{\partial G_H} X_m(Y_{Te} - C_{Te})\Big] \gtrless 0 \qquad (21)$$



Graph 1. An increase in government spending on nontraded goods.

$$\Delta = r^*X_m(U_T C_{Te} + U_H C_{He}) - V_m r^* X_e > 0$$

where the first term in (21) is positive while the remaining two are negative. To understand the reason for this ambiguous result, it is useful to look at the first order condition (8), which is rewritten below for convenience

$$\frac{U_T[C_H(\bar{e}, \bar{G}_H), \bar{C}_T]}{U_H[C_H(\bar{e}, \bar{G}_H), \bar{C}_T]} = \bar{e} .$$

With no changes in the real exchange rate, an increase in '$\bar{G}_H$' causes a one-to-one crowding out of private sector consumption of nontraded goods; given the assumption that both goods consumed are normal, consumption of traded goods must also decline in order to maintain consumers' equilibrium. Because the private sector cuts down its overall level of consumption below the initial level, the country needs not to increase its disposable income in the new steady state.

There is, however, a substitution effect that pulls in the opposite direction: the real appreciation causes a shift of productive resources towards the nontraded goods sector so as to mitigate the required decline in C_H. The shift also reduces the production of traded goods so that, for any level of C_T, a greater amount of interest income from foreign investments is needed to support domestic consumption.

As a consequence of the monotonicity of the dynamic path to the new equilibrium (see 17), the stock of net foreign assets continuously rises or falls in the transition according to whether $\bar{F}$ rises or falls in the new steady state. In addition, from (18) the real exchange rate appreciates (depreciates) if net foreign assets increase (decline) during the transition. Finally, by evaluating $\partial\dot{F}/\partial e$ at $t = 0$ in (16), the initial jump in the exchange rate depends on the sign of $\dot{F}$ immediately after the unanticipated increase in G_H, which as seen before, depends on the sign of $d\bar{F}/d\bar{G}_H$.

Therefore, there are two possible outcomes of the fiscal expansion and they are summarized in Graph 1. The first one is that the real exchange and 'F' follow their stylized paths after the increase in government expenditure, namely, the real exchange immediately appreciates, from A to C in the figure, and then slowly depreciates to its new equilibrium level at Z. Private consumption increases as a result of the expansionary fiscal policy so that the current account moves into deficit; capital flows into the country; and the domestic real interest rate remains above the world interest rate throughout the adjustment period as $\dot{e}/e$ is positive.

There is, however, a second possibility: that the increase in G_H causes an immediate depreciation of the real exchange rate, a fall in private consumption and an accumulation of net foreign assets which, in the steady state, enables the country to support a higher overall level of consumption. In the figure, the real exchange rate would depreciate from A to B and then slowly appreciate to Z. It is worth emphasizing that this potentially "perverse" effect of expansionary fiscal policies does not depend crucially on the specification of the utility function and, in particular, of a rate of time preference increasing in wealth, as the model can also account for the result that typically emerges within the Mundell-Fleming framework. Rather, the impact of increases in government spending on the real exchange rate, and thus on the private sector allocation of resources between manufacturing and nontraded goods sectors is mainly an empirical question, which will be taken up in Section IV. Before turning to the empirical evidence, however, I want to look briefly at two interesting implications of the model.

b. Two Implications

The first implication is that an increase in government expenditure in an economy with real wage rigidity may produce a decline in private sector employment if the increase initially depreciates the real exchange rate. The decline may occur because the depreciation raises nominal wages relative to producers' prices in the nontraded goods sector, which is traditionally labor intensive. This result is just the opposite of what is typically found in the literature on real wage rigidity in the open economy (Sachs, 1980, Kouri, 1982, Dornbusch, 1983b, and Bruce and Purvis, 1985).

Real wage rigidity could be easily incorporated into the model by assuming, for example, that they adjust over time as a function of the discrepancy between actual and full employment output. The analysis, however, would not contain interesting new element, but a fourth dynamic equation would be added to the model thus making the analytical illustration of the dynamics very cumbersome. A simple numerical example can nonetheless provide a rough estimate of the real exchange rate impact on private employment in the case of rigid real wages. Assume that a Cobb-Douglas production function characterize both traded and nontraded sector, that capital is specific to each sector, and that powerful trade unions fix the real wages in terms of the consumer price index, so that production is a function only of the real exchange rate. Then, the percentage change in private sector employment (L) will be related to the real exchange rate (e) as follows:

$$\hat{L} = \left[\left(\frac{L_T}{L}\right) \frac{\gamma}{1 - \alpha} - \left(\frac{L_H}{L}\right) \frac{1 - \gamma}{1 - \delta} \right] \hat{e}$$

where α and δ are the warranted labor shares in traded and private nontraded goods respectively, L_T and L_H employment in the sectors and a ^ indicates percentage change. In Table 1, I collected the relevant data for the six

Table 1. Traded and Non-Traded Goods Sectors in EEC Countries

(in percent)

	Proportion of Non-Traded Goods in Consumer Price Index[1]	Warranted Labor Share in Manufacturing[2]	Warranted Labor Share in Private Nonmanufacturing[2]	Employment in Manufacturing[3]
Germany	35.0	62.5	71.5	45.6
France	39.0	52.0	71.5	35.7
U.K.	36.0	70.5	69.0	36.6
Italy	30.0	63.5	70.5	46.2
Belgium	33.0	65.2	--	35.6
Netherlands	33.0	65.9	--	28.4

[1] Based on 1975 weights.

[2] The warranted labor shares for Germany, France, U.K. and Italy are approximated by the actual average labor shares during the period 1960-68 along the findings of Sachs (1983) and Artus (1984); the figures are taken from Sachs (1979) and are adjusted for the self-employed in the nonmanufacturing sector. For Netherlands and Belgium, the data for manufacturing are equal to the 1970-71 average; there are no data for the 1960s; likewise there are no data adjusted for the self-employed in nonmanufacturing.

[3] As a percentage of total private employment, average 1980-82.

Source: Eurostat, National Account ESA, 1984.

major EEC countries. Based on the table, a set of reasonable parameter values are $\gamma = .35$, $\alpha = .65$ and $\delta = .70$, and $L_T/L = .38$; with these values, a one percent real depreciation may cause private sector employment to decline by approximately one percentage point. Thus, if increases in government expenditures cause the real exchange rate to depreciate, there may be a strong recessionary impact on the private sector economy.

The second implication of the model is that changes in the growth rate of money are not neutral with respect to the real exchange rate in the steady state. To show this result, I assume that the government increases its lump-sum transfers to the private sector by stepping up the rate of money creation. By differentiating the equilibrium conditions (20),

$$\frac{d\bar{e}}{d\bar{g}} = \frac{r^* V_m}{\Delta} < 0 \quad \frac{d\bar{m}}{d\bar{g}} = \frac{r^*\phi}{\Delta} < 0 \quad \frac{d\bar{F}}{d\bar{g}} = \frac{V_m(Y_{Te} - C_{Te})}{\Delta} > 0 .$$

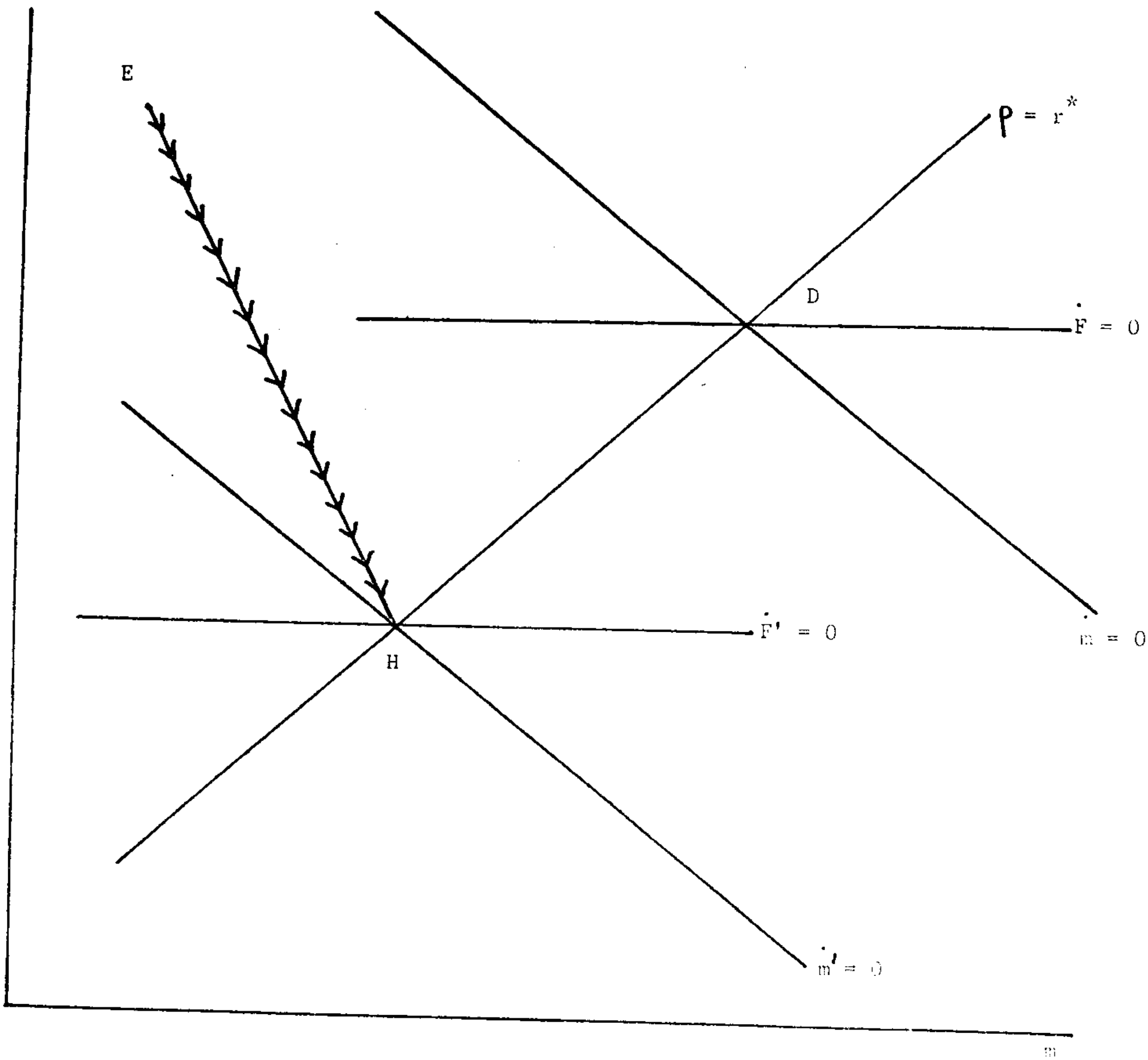
Thus an increase in $\bar{g}$, which is a tax on money holdings, causes economic agents to move away from money and into net foreign assets and consumption; the increase in foreign income finances the higher consumption of traded goods while an increase in production, brought about by the real appreciation, is needed to support higher consumption of nontraded goods.

In the traded-nontraded goods models of Calvo and Rodriguez (1977), Liviatan (1981) and Calvo (1985) money is neutral with respect to the real exchange rate in the long run because only one portfolio shift, from money into foreign assets, takes place when the growth rate of money accelerates; consumption decisions are unaffected by the level of the inflation tax. The nonneutrality of money in this model, however, does not stem from the specification of the rate of time preference, but from the assumption that net foreign assets yield a positive interest rate.[12]

As for the dynamics, following the monetary expansion, the country accumulates net foreign assets by cutting down consumption so that the real exchange rate must initially depreciate. (From D to E in Graph 2.) Subsequently, it appreciates along with the current account surplus. (From E to H.) The dynamics of the model is thus identical to that of Calvo and Rodriguez (1977) which is then validated in an intertemporal optimizing framework.[13]

IV. The Empirical Evidence

In this section, I try to resolve empirically the indeterminacy of the real exchange rate response to government expenditure increases by looking at annual data (1970-1982) from the six major European countries (Germany, France, U.K., Italy, Netherlands, and Belgium). A secondary objective of the section is to check whether the model can adequately explain the actual resource shifts between traded and nontraded goods sectors in those economies. The European countries during the 1970s represent an interesting semi-controlled experiment as they followed fiscal policies quite similar to the policy experiment analyzed in the model, namely, a non-inflationary permanent increase in real government expenditure on nontraded goods (Figures 1 through 6). First, all six countries increased the share of government expenditure in GNP steadily throughout the twelve years of the sample period--from a minimum increase of 2 percentage points for the Netherlands, to a maximum of 5 percentage points for Belgium and Italy; by invoking forward looking expectations, it is therefore reasonable to argue that the fiscal expansions were perceived to be of a permanent nature or, at least, not temporary. Second, most of the government expenditure increases fell on nontraded goods; and third, with the only exception of Italy, the fiscal



Graph 2. The effect of a monetary expansion.

Fig 1: GERMANY.

(1970–1982; in Percent).

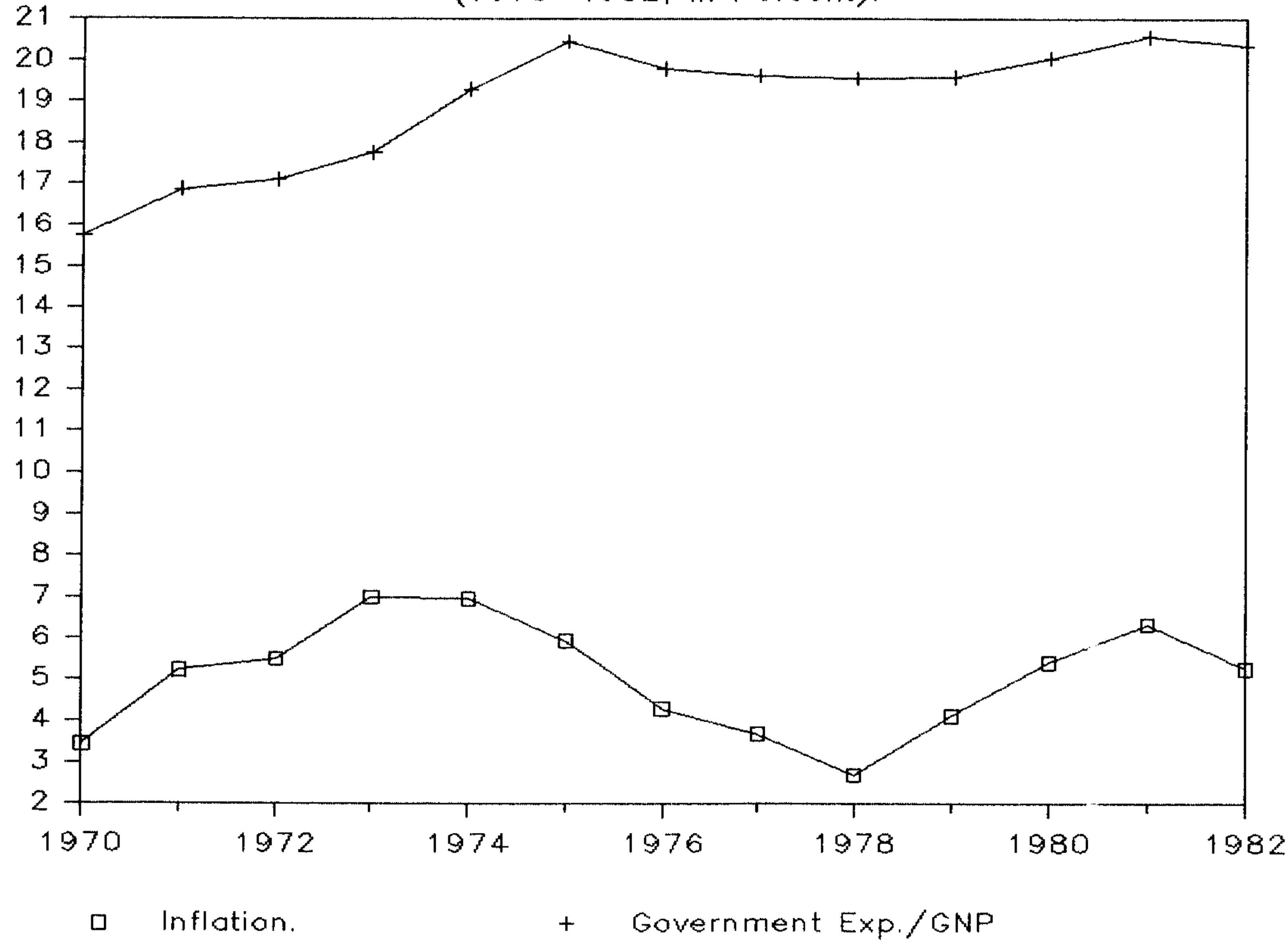


Fig 2: FRANCE.
(1970–1982; in Percent).

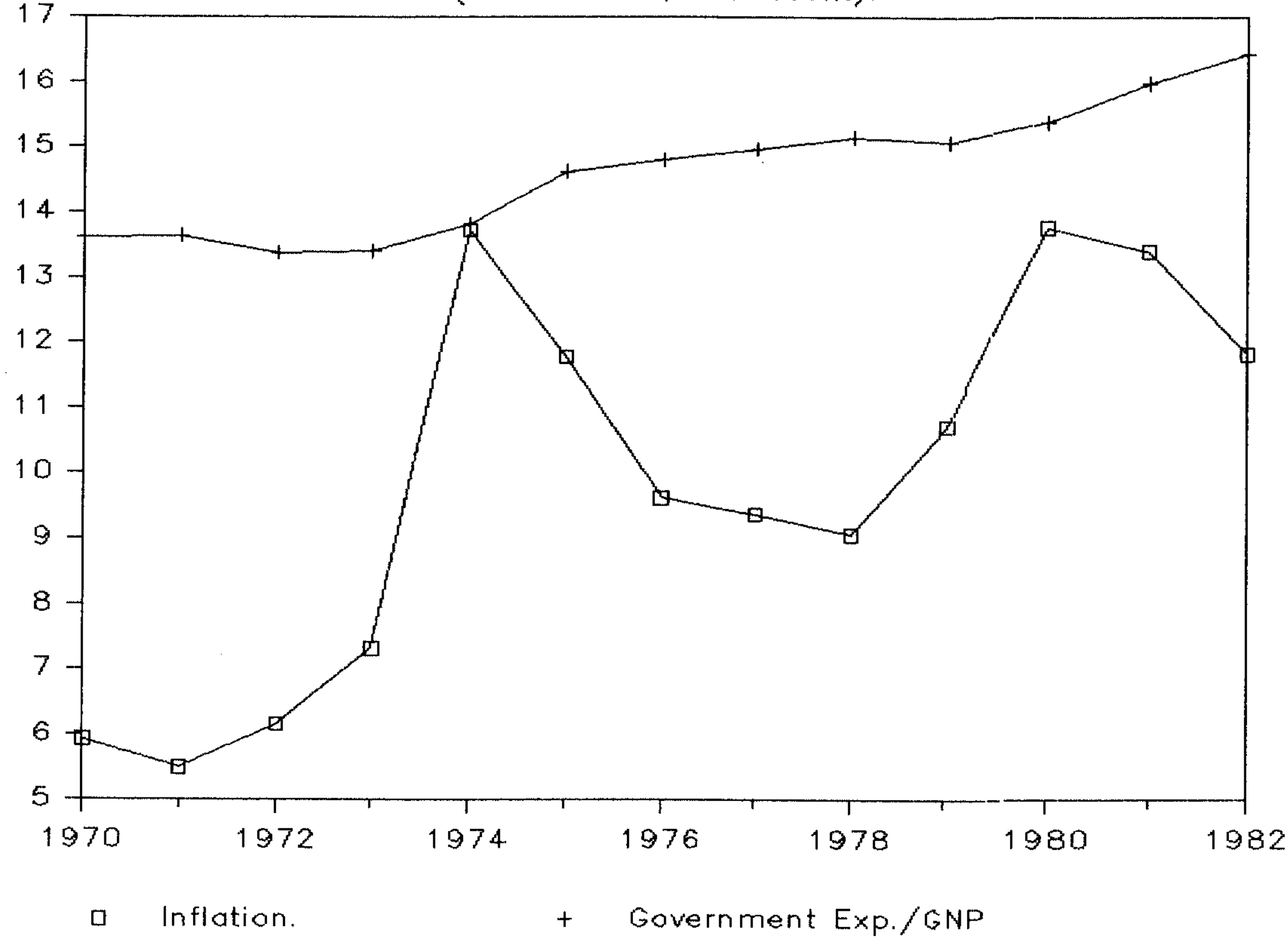


Fig 3: ITALY.

(1970–1982; in Percent).

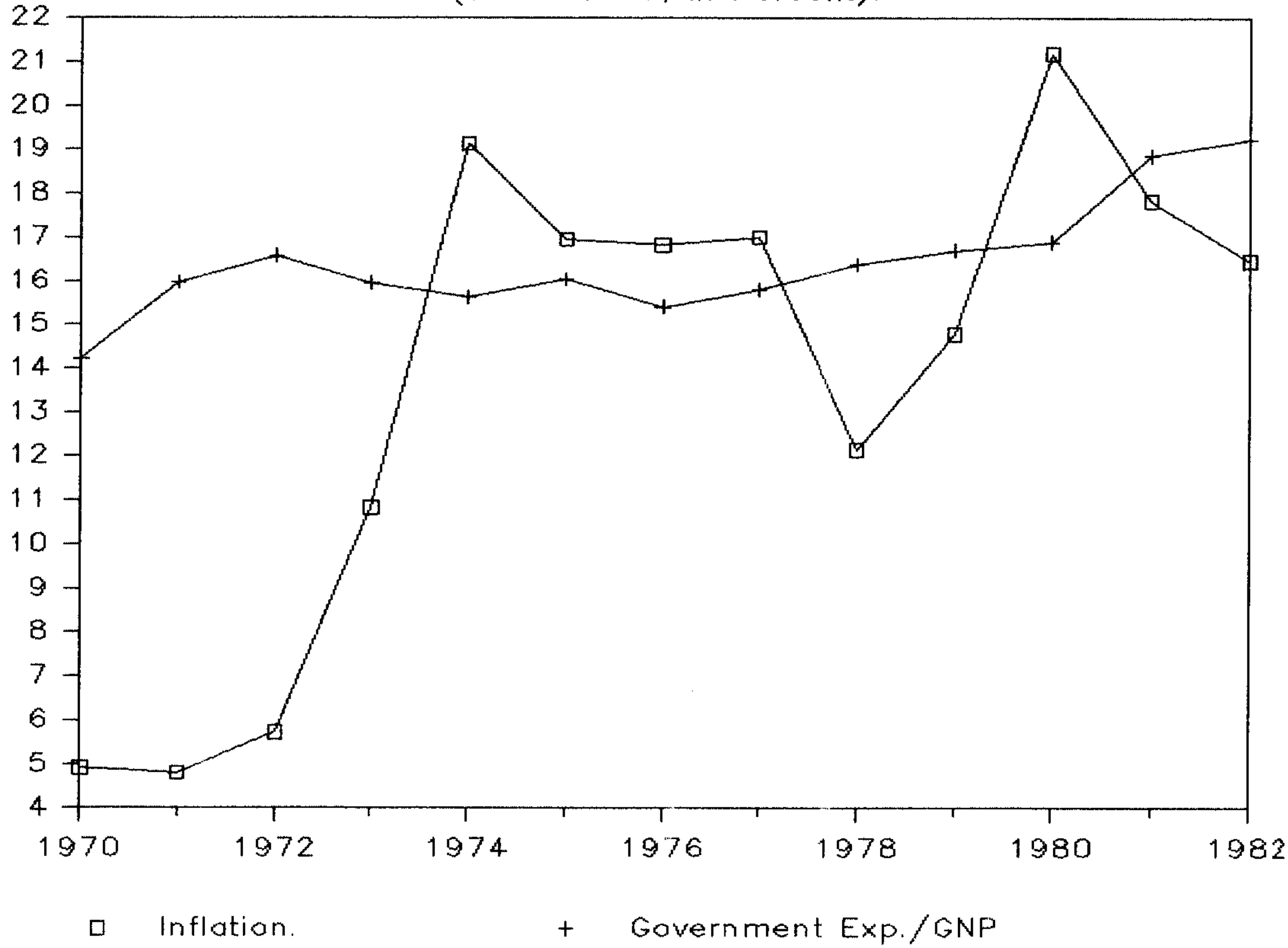


Fig 4: U.K.

(1970–1982; in Percent).

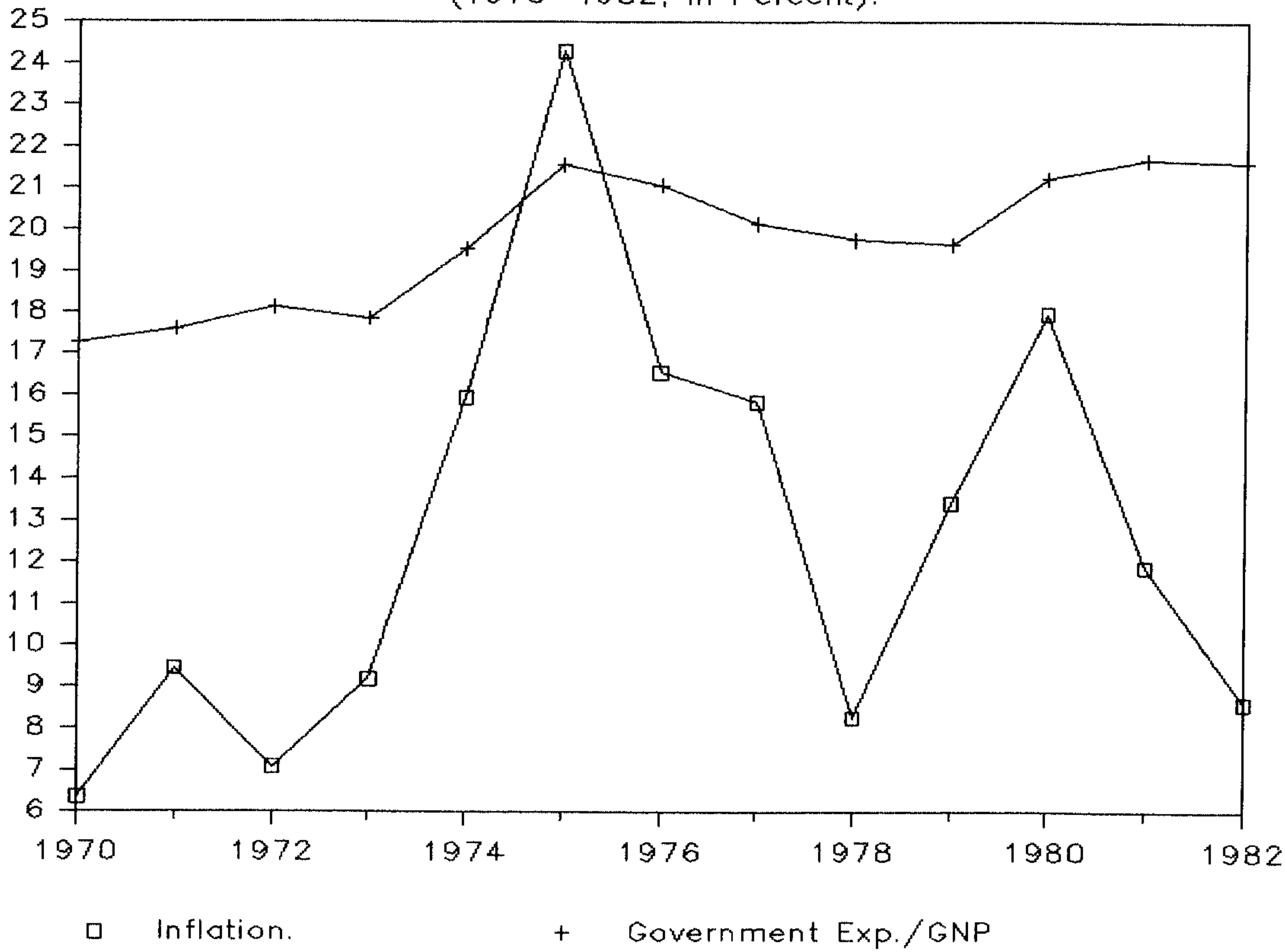


Fig 5: NETHERLANDS.
(1970–1982; in Percent).

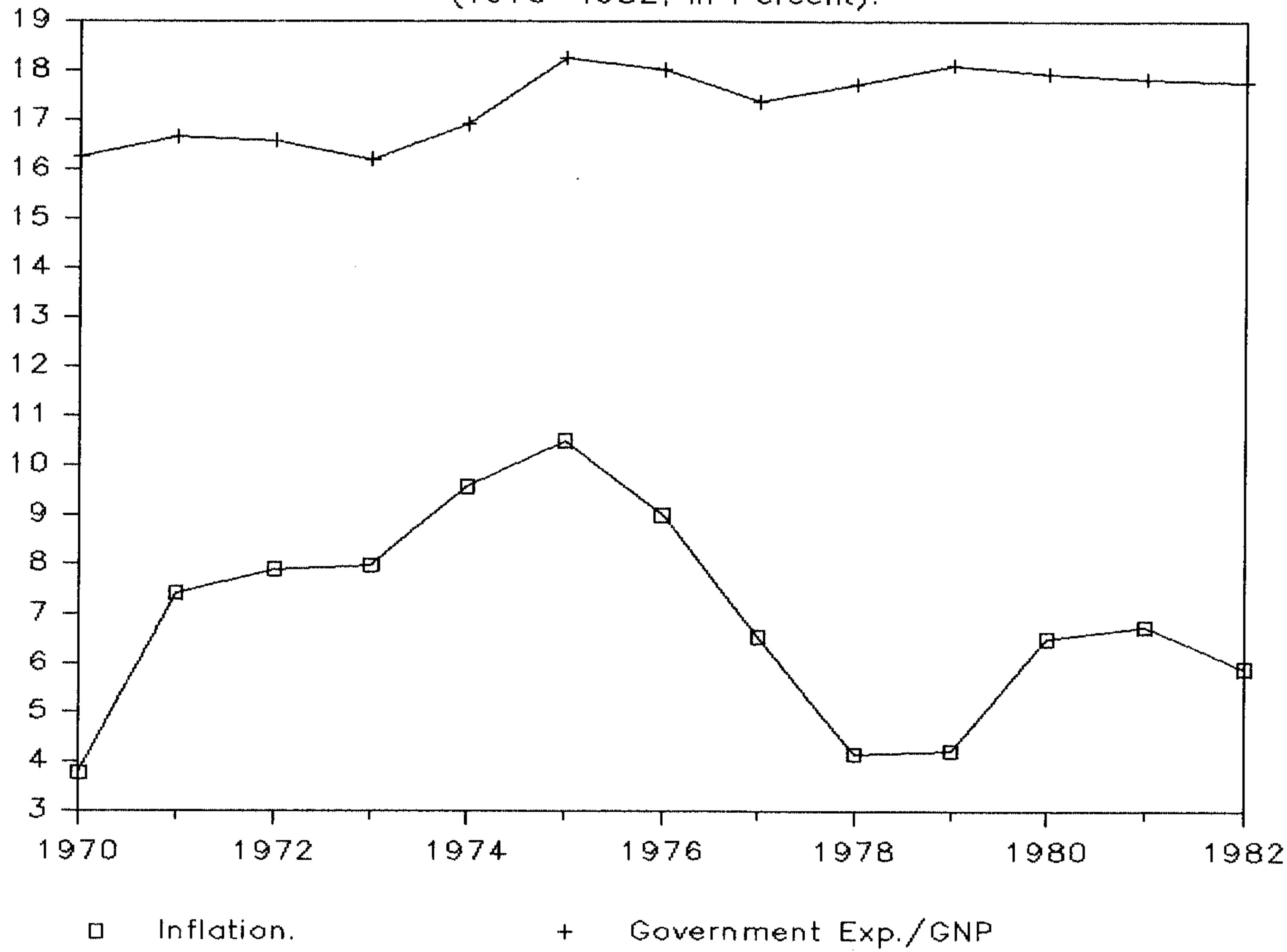
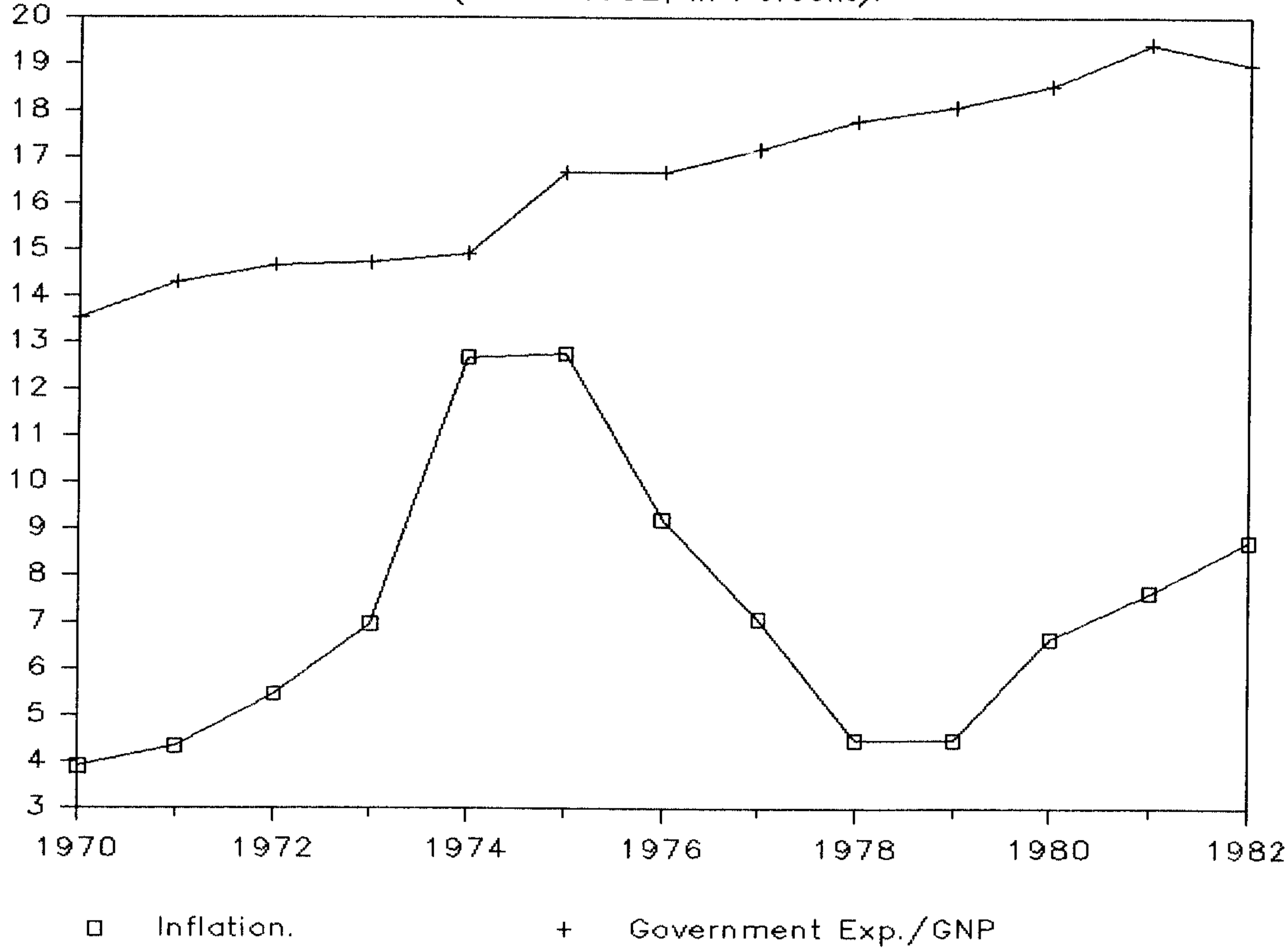


Fig 6: BELGIUM.

(1970–1982; in Percent).



expansions do not seem to have altered the trend level of their inflation rates.

The proper empirical procedure would be to test the cross-equation restrictions that the model imposes on the first order conditions (20); unfortunately, this approach would also pose the untractable problem of deriving the explicit functional form of H(a), which instead cannot be obtained. Conversely, the estimation of unrestricted reduced forms with the real exchange rate as dependent variable and government expenditure as independent variable would be feasible but the problem of specifying the form of the dynamic equation for the exchange rate would still remain so that the approach would be rather uninformative.

There is, however, a testable implication of the model that can shed light on the relationship between government spending and the real exchange rate. In the previous section, I showed that if a fiscal expansion appreciates the real exchange rate upon impact, the rate will remain above its steady state level throughout the adjustment period; one would then expect that a steady increase in government expenditure will cause a shift of production towards nontraded goods thus shrinking the manufacturing sector that, in the six European countries, approximates the traded goods sector very well.

Pooling the time series from the six European countries, I thus fitted a regression in which the ratio of value added at factor costs and constant prices in manufacturing to that in private nonmanufacturing, $(VA^T/VA^H)_{it}$, was the dependent variable (the subscript i indicates the country, while t indicates time); as independent variables, I initially used those that appear in the model, namely, the ratio of government expenditure to GNP, $(G/Y)_{it}$, the rate of growth of the money supply, $\hat{M}_{it}$, the differential between the domestic and the world (ex-post) real rate of interest, $(r_i - r^*)_t$ and the terms of trade approximated by the ratio of oil prices to countries export unit values $(P^O/P^E)_{it}$, both denominated in dollars. By using this variable, I avoided a potential omitted variable problem due to the two oil shocks; for the same purpose, I also excluded energy products from value added in the traded goods sector. Because no major changes in trade policy occurred in the EEC during the sample period, I did not try to account for the effect of trade measures.

Each equation contained a country specific dummy, often significant but not reported in the paper. and was estimated in first differences because the theoretical model is specified in deviations from the trend and because I wanted to avoid the spurious correlation problem due to the upward trend followed by (G/Y) and (VA^H/VA^T) in each country during the sample period. Finally, I did not impose any structure on the variance-covariance matrix of the disturbances, but I used the procedure presented in White (1980) to test the residuals for homoscedasticity, that is, I tested whether there was a country specific element in the residuals: in almost every case, however, I was unable to reject the null hypothesis at every reasonable significance level.

The estimated equation is reported in Table 2 (equation 1) and clearly indicates that increases in government spending have generally caused a shift of resources into the nonmanufacturing sector thus supporting the standard result that fiscal expansions cause real appreciations. As expected, changes in the real price of oil caused a relative contraction of the manufacturing sector, which was relatively energy intensive, even though the size of its estimated coefficient is by far smaller than that of government spending. There are no indications instead that monetary policy or foreign real interest rate shocks had any impact on the private sector allocation of resources. I

Table 2. Government Spending and Private Sector Allocation of Value Added in EEC Countries: 1970-1982[1]

Dependent variable: $\Delta \ell n(VA^T/VA^H)_{it}$

Independent Variables

	$\Delta \ell n(G/Y)_{it}$	$\Delta\hat{M}_{it}$	$\Delta \ell n(P^O/P^E)_{it}$	$\Delta(r-r^*)_{it}$	$(r-r^*)_{it}$	$\hat{M}_{it}$	$\Delta \ell n(PR^T/PR^H)_{it}$	$\Delta\hat{Y}_{it}$	$\Delta\hat{U}_{it}$	R^2	HW(d.f.)
(1)	-.49 (4.85)	-.05 (0.78)	-.02 (1.94)	-.03 (0.25)	--	--	--	--	--	.38	3.63(10)
(2)	-.49 (4.70)	--	-.02 (2.16)	--	.03 (0.20)	.02 (0.25)	--	--	--	.38	5.38(10)
(3)	-.26 (2.32)	.01 (.09)	.01 (.23)	-.07 (0.63)	--	--	--	-.01 (3.54)	--	.49	26.1(15)
(4)	-.45 (4.30)	-.03 (0.55)	-.02 (1.79)	-.06 (0.52)	--	--	--	--	-.01 (1.45)	.40	4.2(15)
(5)	-.23 (4.02)	-.01 (0.15)	-.02 (3.98)	-.02 (0.34)	--	--	.77 (12.6)	--	--	.83	28.6(15)
(6)	-.19 (2.92)	.01 (0.16)	-.02 (2.43)	-.03 (0.48)	--	--	.74 (11.2)	-.01 (1.28)	--	.83	42.2(21)
(7)	-.20 (3.56)	.01 (0.11)	-.02 (3.32)	-.04 (0.68)	--	--	.76 (12.7)	--	-.01 (1.76)	.83	35.5(21)

[1]The meaning of the symbols used to denote the time series is explained in the text; Δ is the first difference operator; a '^' indicates percentage change; t statistics are reported below the coefficients; HW is the White's (1980) statistics testing the hypothesis that the residuals are homoscedastic and it is distributed χ^2 with K(K + 1)/2 degrees of freedom where K is the number of regressors (the degrees of freedom for each equation are reported in parentheses near the HW statistics; the relevant values from the χ^2 distribution are $\chi^2_{.05}(10) = 18.31$, $\chi^2_{.05}(15) = 24.99$ and $\chi^2_{.05}(21) = 32.67$); the sources of the data were Eurostat, National Account ESA, 1984 and IMF, International Financial Statistics.

checked the results against a misspecification of the functional form by entering the real interest rate differential, and the rate of growth of money as levels instead of first differences, but the results did not change (Equations 2 and 3).

The high negative correlation between the sectoral allocation of value added and government expenditure that emerges from equation 1 (Table 2) could be due to the omission of a variable capturing the effect of the business cycle as both government expenditure and the fluctuations of value added in manufacturing relative to the rest of the economy tend to be highly procyclical. In order to check this possible misspecification, I alternatively added the rate of growth of output, $\hat{Y}_{it}$, and the unemployment rate, $\hat{U}_{it}$, (both in first differences) at the right hand side of the regression (Table 2, equations 3 and 4). As one would expect, the cyclical variable is always estimated precisely and increases the value of the R^2; the coefficient of government spending, however, remains highly significant, even though, in one case, the value of the point estimate declines from -.49 to -.26.

An additional factor that may account for the decline of the manufacturing sector in European countries is the different strength of trade unions in the two sectors. An analysis often encountered in the financial press is that stronger trade unions in manufacturing have been able to impose a real wage structure that has penalized that sector; consequently, in order to maintain profit margins, producers of manufactures have both cut the labor force employed and slow the accumulation process down thereby freeing productive resources that have been partially absorbed by the nontraded sector. Clearly, one cannot obtain a direct measure of this effect, which, nonetheless, could be partially approximated by the differential growth rates of productivity between traded and nontraded sector, $\Delta \ell n(PT^{T}/PR^{H})_{it}$. Because this differential is equal to the equilibrium relative real wage structure, any change in the differential indicates a discrepancy with the structure imposed by the trade unions if it is assumed that this was fixed during the sample period.

The estimated regressions with the relative productivity term are shown in Table 2, equation (5) through (7), and they show that the negative correlation between government spending and the allocation of resources between traded and nontraded goods sectors does not disappear when a proxy for relative real wage rigidity is taken into account. All the regressions, however, fail the White's test at the 95% significance level; because the test is a joint test of exogeneity and homoscedasticity, it is then likely that relative productivity changes are correlated with the disturbance term given that the variability of these changes is dominated by the variability of relative value added (relative employment levels are rather stable), which is the dependent variable.

A conclusion emerging from Table 2 is that the estimated negative correlation between government spending and the share of manufacturing in private value added is a rather robust empirical finding. The evidence thus indicates that the increasing share of GDP absorbed by the governments of European countries has been a major factor causing the decline of the manufacturing sector relative to private nonmanufacturing. For example, according to the regressions, an increase in the ratio of government expenditure to GDP from 15 to 20 percent during the 1970s could have generated a decline of the manufacturing share in private sector value added from 40 to 33 percent.

As indicated before, unrestricted reduced forms of the real exchange rate cannot provide valid inference unless the form of the structural dynamic equation governing the motion of the rate is known. Nonetheless, some of these reduced forms are presented in Table 3. The real exchange rate is alternatively measured by the relative value added deflator in manufacturing and private nonmanufacturing $(P^T/P^H)_{it}$ and by the relative product wages adjusted for productivity changes (W^T/W^H). In a flexible price general equilibrium model the two variables should be identical; in practice, however, their simple correlation coefficient is very low, .22 for the cross section and the sample period considered. For each dependent variable, I fitted two regressions, one with the four exogenous variables of the model and another one with the relative productivity changes added to them, as suggested by the empirical work of Hsieh (1982).

All the equations are estimated very poorly, thus substantiating the need for additional information on the equilibrium dynamics of the real exchange rates. Notwithstanding the low R^2s, the coefficient of government spending in the regressions with the relative price deflator as dependent variable is negative and significant, a result that is consistent with the regressions presented in Table 2. When the relative product wages is the dependent variable (Table 3, lower half), however, the coefficient of government spending is either insignificant--but the estimate of the coefficient is likely to be inconsistent in view of the sharp increase in HW statistics--or positive, which is in contrast with what found in all the regressions presented before. The only conclusion that one can draw from these last results is that relative product wages is not a good indicator of either the private sector allocation of resources between manufacturing and nonmanufacturing sectors or the relative price movements.

Table 3. Government Spending and the Real Exchange Rate in EEC Countries: 1970-1982[1]

Independent Variables

	$\Delta \ell n(G/Y)_{it}$	$\Delta \hat{M}_{it}$	$\Delta \ell n(P^0/P^E)_{it}$	$\Delta(r-r^*)_{it}$	$\Delta \ell n(PR^T/PR^H)_{it}$	R^2	HW(d.f.)
a) Dependent Variable: $\Delta \ell n(P^T/P^H)_{it}$							
	-.20 (1.80)	.10 (1.50)	-.01 (0.56)	-.06 (0.46)	--	.20	5.1(10)
	-.30 (2.64)	.09 (1.29)	-.01 (0.56)	-.06 (0.50)	-.31 (2.47)	.27	7.1(15)
b) Dependent Variable: $\Delta \ell n(W^T/W^H)_{it}$							
	.24 (2.00)	.09 (1.14)	.01 (0.15)	.19 (1.32)	--	.21	6.8(10)
	-.05 (0.63)	.04 (0.79)	.01 (0.49)	.18 (2.07)	-.86 (10.3)	.71	31.3(15)

[1]The symbols used are explained in the note of Table 2.

V. Conclusions

A growing literature has recently re-examined some of the standard macro policy propositions that had emerged from the Mundell-Fleming framework. This paper adds to the literature by focussing on the rel..tionship between government expenditure and the real exchange rate: it is shown that, contrary to the standard result, a fiscal expansion may depreciate the real exchange rate, with a potentially recessionary impact on private sector employment if real wages are rigid. The answer as to the sign of the real exchange rate change, however, must ultimately depend on the empirical evidence. Because there is surprisingly little empirical work done in the area of fiscal policy in the open economy, I examine the time series from a cross section of European countries. The empirical analysis supports the Mundell-Fleming result that government expenditure increases appreciate the real exchange rate and also reveals how the fiscal policies pursued by European governments have been a major factor behind the shift of private sector resources from manufacturing into the nontraded goods sector that has taken place since the beginning of the 1970s in those countries.

Appendix A

In this appendix I derive the first order conditions of the optimization problem in Section II. Following FH, I define a new variable

$$z = \int_0^t [u(C_T, C_H) + v(m)]d\tau$$

so that

$$\dot{z} = u(C_T, C_H) + v(m)$$

The Hamiltonian L is then equal to

$$L = -\exp(-z) + \lambda\{e^{\gamma}(Y_T - C_T) + e^{\gamma-1}(Y_H - C_H) + \tau +$$

$$(r^* + \dot{E}/E)e^{\gamma}F - \pi a\} + \mu\{u(C_T, C_H) + v(m)\} + \theta(a - m - e^{\gamma}F)$$

The first order conditions are then

$$\mu U_T - \lambda e^{\gamma} = 0 \quad \text{(A1)}$$

$$\mu U_H - \lambda e^{\gamma-1} = 0 \quad \text{(A2)}$$

$$\mu V_m - \theta = 0 \quad \text{(A3)}$$

$$\lambda(r^* + \dot{E}/E) - \theta = 0 \quad \text{(A4)}$$

$$\dot{\lambda} = \lambda\pi - \theta \quad \text{(A5)}$$

$$\dot{\mu} = e^{-z(t)} . \quad \text{(A6)}$$

Clearly

$$\mu(t) = \int_t^{\infty} e^{-z}d\tau$$

since

$$\frac{d\mu}{dt} = \frac{d}{dt}\int_t^{\infty} e^{-z}d\tau = e^{-z(t)}$$

so that[14]

$$\dot{\mu}/\mu = -\left[\int_t^\infty e^{-[z(\tau)-z(t)]}d\tau\right]^{-1} = \left[U({}_tC_T,\ {}_tC_M) + V({}_tm)\right]^{-1} \tag{A7}$$

by using (1) and adopting the same notations as EH, so that the subscript t before a variable indicates the entire path of the variable beyond time t evaluated at its optimal values. Because the arguments in the utility function are evaluated at their optimal values, by using a standard result of the maximum principle, (A7) can be rewritten as

$$\dot{\mu}/\mu = [H(a)]^{-1}$$

and, using the expression for the rate of time preference (2)

$$\dot{\mu}/\mu = -\rho[H(a)] \ .$$

Note that $\rho_H > 0$ and that the partial derivative of $H(\cdot\cdot)$ with respect to 'a' evaluated at the steady state is simply the shadow price of wealth evaluated at the steady state, which is always positive. This result will be utilized for analyzing dynamics in Appendix B.

Using (A1) and (A2), I obtain equation (8) in the text. Next, I use (A1) and (A3) to solve out for μ,

$$(V_m/U_T)\ e^{\gamma} = \theta/\lambda \tag{A8}$$

Substituting (A4) into (A8)

$$(V_m/V_T)e^{\gamma} = r^* + \dot{E}/E \tag{A9}$$

I then obtain equation (10) in the text by using the definition of the price level, that is:

$$\dot{P}/P = \pi = \dot{E}/E - \gamma\dot{e}/e \tag{A10}$$

I differentiate logarithmically (A1)

$$\dot{\mu}/\mu + \dot{U}_T/U_T = \dot{\lambda}/\lambda + \gamma\dot{e}/e \qquad (A11)$$

and substituting (A4), (A5), (A6), and (A10) into (A11) I obtain equation (9) in the text.

Finally, because the solution of the optimization problem is a dynamic system that converges to a unique steady state (see Appendix B), it must be that

$$\lim_{t\to\infty} F(t)e^{-r^*t} = 0$$

But

$$\int_0^\infty (C_T + G_T - Y_T)e^{-r^*t}dt = \int_0^\infty (r^*F - \dot{F})e^{-r^*t}dt$$

by integrating the right-hand side by parts

$$\int_0^\infty (r^*F - \dot{F})e^{-r^*t}dt = F(0) - \lim_{t\to\infty} F(t)e^{-r^*t} = F(0)$$

so that along the convergent path the intertemporal budget constraint is satisfied.

Appendix B

In this appendix I investigate the dynamic properties of the model in the neighborhood of the steady state. I linearize equations (13), (15) and (16) around the steady state and I use (13) to eliminate $\dot{e}$ from (15). In matrix notations, the linearized model can be expressed as:

$$\begin{vmatrix} \dot{e} \\ \dot{m} \\ \dot{F} \end{vmatrix} = \begin{vmatrix} Z_e & Z_m & Z_F \\ H_e & H_m & H_F \\ \alpha & 0 & r^* \end{vmatrix} \begin{vmatrix} e - \bar{e} \\ m - \bar{m} \\ F - \bar{F} \end{vmatrix} \qquad \text{(B1)}$$

where

$$D = \frac{U_T}{K} \rho_H H_a > 0$$

$$Z_e = D\gamma \bar{e}^{\gamma-1} \bar{F} > 0$$

$$Z_m = D > 0$$

$$Z_F = D\bar{e}^{\gamma} > 0$$

$$H_e = \frac{\bar{m}}{\bar{e}} \gamma D \bar{e}^{\gamma-1} \bar{F} - \bar{m}X_e \gtrless 0$$

$$H_m = \frac{\bar{m}}{\bar{e}} \gamma D - \bar{m}X_m > 0$$

$$H_F = \frac{\bar{m}}{\bar{e}} \gamma D \bar{e}^{\gamma} > 0$$

$$\alpha = y_{Te} - C_{Te} > 0$$

The trace of the principal matrix of (B1) is always positive, so that at least one eigenvalue is always positive

$$\text{trace} = Z_e + H_m + r^* > 0$$

The sign of the determinant is instead uncertain.

$$\text{Determinant} = \alpha[Z_m H_{\bar{F}} - Z_{\bar{F}} H_m] + r^*[Z_e H_m - Z_m H_e]$$

$$= \bar{m}D[X_m \bar{e}^{\gamma-1} (\alpha\bar{e} - r^*\gamma\bar{F}) + r^* X_e]$$

The first term inside the square brackets is negative if a depreciation improves the current account, that is, if the substitution in consumption and production 'α' dominates the wealth effect of the capital gains that a depreciation induces when the country has a positive net foreign assets position 'F'. This condition, which is typical of many exchange rate models, is assumed to be satisfied in the paper. The second term in the square brackets can be positive or negative depending on whether a real depreciation creates an excess demand for or supply of money, that is, X_e can be positive or negative. If $X_e < 0$, the determinant is negative, and, therefore, there is a unique stable path to the new steady state.

Because one eigenvalue is positive, a negative determinant implies that the two remaining eigenvalues are of opposite sign so that the system is characterized by saddle path stability. In particular, e and m jump on the unique trajectory to the new steady state equilibrium when the system is perturbed. However, if X_e is positive, the determinant may be positive; the system can then be unstable or it may converge to the new steady state in an oscillatory way. This case will not be considered here.

Assume that λ is the stable root, the movements of the three endogenous variables towards the steady can then be described by

$$e(t) - \bar{e} = ke^{\lambda t}$$

$$m(t) - \bar{m} = w_{12}ke^{\lambda t}$$

$$F(t) - \bar{F} = w_{13}ke^{\lambda t}$$

Using the third row in the principal matrix of (B1)

$$w_{13} = \frac{-\alpha}{r^* - \lambda} < 0$$

Using the first row in (B1)

$$w_{12} = \frac{-\left[w_{13}Z_F + (Z_e - \lambda)\right]}{Z_m} \gtrless 0$$

given that the first term of the numerator is negative while the second is positive.

Footnotes

[1]See also Turnovsky (1985).

[2]For example, the specification of the utility function turns out to be a crucial element to determine the impact of terms of trade changes on the current account (Obstfeld, 1982 and Svensson and Razin, 1983).

[3]See also Cuddington and Vinals (1984) on the potentially recessionary effect of expansionary fiscal policies.

[4]Precisely, let $V_{T,i}$ be the Volterra derivative at T with respect to the ith argument of the function given in (1) (call it x_i); then

$$\rho = -\frac{d}{dT} \log V_{T,i}\Big|_{\dot{x}_i=0} .$$

[5]Hicks (1965, p. 267): "It is nonsense to assume that successive consumptions are independent; the normal condition is that there is a strong complementarity between them."

[6]Svensson and Razin (1983) and Obstfeld and Stockman (1985) contain a discussion of the role of the rate of time preference in models of the open economy.

[7]A more general specification of (1) is (FH, p. 618)

$$U[C_T, C_H, m] = \int_0^{\infty}[H(C_T, C_H) + K(m)]\exp\{-\int_0^{t}[u(C_T, C_H) + v(m)]d\tau\}dt .$$

The Uzawa's utility function imposes the constraint that

$$\delta[u(C_T, C_H) + v(m)] = H(C_T, C_H) + K(m)$$

where δ is the rate of time preference.

[8]In the steady state, utility $\bar{R} = u(\bar{C}_T, \bar{C}_H) + v(\bar{m})$ is a constant. From (2), the rate of time preference in the steady state then becomes

$$\bar{\rho} = [\int_T^{\infty} \exp\{-\bar{R}(t - T)\}dt]^{-1} = [-\frac{1}{\bar{R}}(e^{-\bar{R}(t-T)}\Big|_T^{\infty})]^{-1} = \bar{R} .$$

[9] I assume that

$$\frac{d(U_T/U_H)}{dC_H} > 0 > \frac{d(U_T/U_H)}{dC_T} .$$

[10] Gross substitutability implies:

$$\frac{dC_T}{dP_H} = X_{CP_H} + C_T \frac{(-P_H U_{TH} + P_T U_{HH})}{\Delta} > 0$$

where X_{CP_H} is the compensated substitution effect, which is positive because the two goods must be "Hicks" substitutes; Δ is the determinant of the bordered Hessian matrix, which is also positive. Clearly, if the compensated substitution effect is small, $U_{TH} < 0$ is a necessary condition for the two goods to be gross substitutes; $U_{TH} < 0$, however, is not a necessary condition for Hicksian substitutability.

[11] The increase in net foreign assets is equal to

$$d\bar{F}/d\bar{e} = [X_m(U_T C_{Te} + U_H C_{He}) - V_m X_e]/$$

$$[(U_T C_{Te} + U_H C_{He})(r^* X_m) - V_m(r^* X_e)] > 0 .$$

[12] The models by Calvo and Rodriguez (1977) and Liviatan (1981) and Calvo (1985) are recursive and the real exchange rate is independent of the other endogenous variables of the model in the steady state.

[13] Liviatan (1981) and Calvo (1985) show that a monetary expansion can trigger an immediate appreciation and a long-run fall in F depending on whether F and m are 'complements' and on the relative magnitude of the elasticity of substitution between consumption and liquidity services and between m and F.

[14] There is a typo in FH on p. 633: $[\int_t^\infty e^{-(z-t)} d\tau]^{-1}$ should be $[\int_t^\infty e^{-[z(\tau)-z(t)]} d\tau]^{-1}$. This point was clarified with the authors in private correspondence.

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