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Reducing external debt in a world with imperfect asset and imperfect commodity substitution

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Three alternatives for eliminating U.S. external debt are analysed. Besides a reduction in government spending, attention is paid to the possibility of eliminating debt by inflating the economy and to a financial crisis in case foreign investors lose confidence. The analysis is performed on the base of a two-country model with a portfolio choice between money, domestic and foreign assets which are imperfect substitutes on the one hand and imperfect commodity substitution on the other hand. The model deals with balance of payments dynamics, government debt dynamics, capital accumulation, monetary growth and exchange rate expectations. A simplified version of the model is solved analytically. The full version is applied by working through numerical exercises.

1. Introduction

The continuing large U.S. external deficit is one of the central themes of contemporary economics and for that matter of economic policy. There are a number of interesting questions to be asked. First, is it really necessary for a reduction in the U.S. deficit that the dollar depreciates in nominal and in real terms? Second, what are the alternatives for realizing a decline of the deficit and subsequently of a stabilisation of foreign debt? Third, are the long-run consequences of a policy aimed at a reduction of the deficit different from the short or medium run impact?

Branson (1988) takes a strong view on the first question by criticizing the opinion held by the finance ministers of the Group of Seven countries, implying that exchange rates need not change to restore external balance in the world economy. What the Group of Seven argues for is that a fiscal reduction in the United States combined with a fiscal expansion elsewhere.

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would make a dollar depreciation unnecessary. In this theoretical paper we share Branson's view that depreciation is the very mechanism through which a fiscal shift would restore international equilibrium.

A reduction in U.S. government spending without any compensating measures in that country or elsewhere raises fears of too much deflation with unfavourable effects on output and employment. For that reason, a policy mix is usually advocated which avoids the unpleasant side effects of the medicine. Therefore, Branson (1988) proposes to combine a tightening of fiscal policy in the United States with an easing of monetary policy in Germany and Japan. Such a scenario would avoid too sudden movements in exchange rates, while it would reduce real interest rates and developing country debt service. Here we disagree with Branson. It will be shown in this paper that the Branson scenario may not work if its principal aim is to reduce U.S. external debt.

An alternative to the fiscal-adjustment view is that inflationary finance can be used to wipe out the real value of accumulated external debt. Dornbusch (1989) considers this argument but quickly rejects it, because real interest rates would be negative for a long period and the public's willingness to accept the required high rates of inflation may be limited. The inflationary-finance argument seems to have more merit than Dornbusch is willing to admit. In this paper we shall analyse the consequences of a rise in the money growth rate in the United States and show that it is a valuable alternative for a fiscal reduction.

If policy makers do not succeed in taking appropriate measures, the market may play its own decisive role. The unlimited ability of the U.S. to finance current account imbalances by selling off assets may be put into question. If the share of U.S. assets in foreign portfolios rises fast, preferences might shift against dollar denominated securities. As observed by Dornbusch (1989), the discussion ought to be about two-way diversifications rather than about international one-way lending. A shift in asset preferences of wealth owners outside the U.S. will be the third alternative to a reduction in external debt. To dramatize somewhat this alternative will be labelled as a financial crisis.

Although a reduction in the U.S. foreign deficit could be accomplished within a few years, it may be interesting and important to look at the long-run consequences of the proposed alternatives. An analysis of long-run effects calls for a proper specification of the dynamics of the model. Recently, much attention has been given to the microfoundations of two-country models [see, e.g., Buiter (1986), van der Ploeg (1991), Giovannini (1988), van de Klundert and van der Ploeg (1989)]. In these models, perfect capital mobility and uncovered interest parity are assumed. This does not seem the right scene for the problems we want to tackle. Recalling Dornbusch's statement
about a two-way diversification in the international capital market we return to the time-honoured portfolio model, which despite its rudimentary micro-underpinnings still seems to be a good working horse if one intends to deal with 'sovereign risk'. So far for the difference. What we have in common with the recent micro-foundations literature is the emphasis put on the intrinsic dynamics of the economy. Capital accumulation, government debt dynamics and monetary growth will be considered along with the core aspects of international economics, i.e., balance of payments dynamics and exchange rate expectations.

Portfolio analysis has been given ample attention in open economy macroeconomics [see, e.g., Branson (1979), Branson and Buiter (1983), Branson (1985) and Kawai (1985)]. Discussions of these issues within the context of two-country models are, however, less numerous. Tobin and de Macedo (1980) as well as Branson and Henderson (1985) provide interesting and useful exceptions. Our model differs from theirs by a more extended specification of the dynamics of the economy. This difference in specification also concerns the balance-of-payments equation by including gross interest payments. This allows a growing external debt to worsen the current account deficit.

A final point worth mentioning is that we do not intend to cope with cyclical fluctuations. Business cycles as such have nothing to do with the problem of structural equilibrium in the world economy. It will therefore be assumed throughout the paper that prices are flexible so that all markets clear.

The paper is organized as follows. In section 2, the model is presented in a general form. Because the model is rather complicated, a full analytical solution is intractable. Instead we will therefore solve a simplified version of the model, which following Branson (1988) will be called the 'fundamentals' model. The analytical solution of the fundamentals model is discussed in section 3. In section 4 we consider the three alternatives mentioned above for reducing the external debt of the U.S. To get these alternatives in proper perspective, numerical examples based on the complete model will be presented. The paper closes with some conclusions in section 5.

2. A two-country model with imperfect assets and goods

It is convenient to present the model in log-linear form. Logarithms of variables evaluated at an initial steady-state solution of the model are denoted by lower-case letters. The original variables denoted by upper-case letters, will be used in definitions of coefficients and elasticities. Foreign variables are denoted by an asterisk. It suffices to present the equations for the domestic economy, because the model is symmetrical across regions.
2.1. The portfolio submodel

Domestic residents split their non-human wealth (w) between real money balances (m), domestic bonds (b_h), and foreign bonds (b_m). The rates of return on bonds are determined by the real interest rate (r), the rate of inflation (p), and the expected depreciation or appreciation of the real exchange rate (e). It is assumed that expectations are formed rationally. Assuming that money is riskless and taking account of the transaction demand for cash, the asset demand equations can be written in (semi-)log form as

\[ \dot{\lambda}_m (m - w) = -M_r (r + p) - M_r (r^* + p + e) + \varepsilon_m y, \]

\[ \dot{\lambda}_h (b_h - w) = B_r (r + p) - B_r (r^* + p + e) - \varepsilon_h y + b_{au}, \]

\[ \dot{\lambda}_f (b_m + e - w) = -F_r (r + p) + F_r (r^* + p + e) - b_{au}, \]

where a dot over a variable indicates a first derivative with respect to time. The \( \lambda s \) relate to the shares of assets in total wealth in the initial steady state.

\[ \dot{\lambda}_m \equiv \frac{M}{W} = \frac{M^*}{W^*}, \quad \dot{\lambda}_h \equiv \frac{B_h}{W} = \frac{B_h^*}{W^*}, \quad \dot{\lambda}_f \equiv \frac{E B_m}{W} = \frac{E B_m^*}{E W^*}. \]

From the usual adding-up conditions we have: \( \dot{\lambda}_m + \dot{\lambda}_h + \dot{\lambda}_f = 1. \) The partial derivatives with respect to (nominal) interest rates (\( M_r, B_r, F_r, \) and \( M_r^*, B_r^*, F_r^* \)) are evaluated at the initial equilibrium. Symmetry across nations requires

\[ M_r = M_r^* < 0, \quad M_r = M_r^* < 0, \]

\[ B_r = B_r^* > 0, \quad B_r = B_r^* < 0, \]

\[ F_r = F_r^* < 0, \quad F_r = F_r^* > 0. \]

Transaction balances are assumed to come exclusively out of domestic bond holdings. The elasticities with respect to output are defined as \( \varepsilon_m \equiv M_s Y/W \) and \( \varepsilon_h \equiv B_s Y/W. \) The exogenous variable \( b_{au} \) relates to shifts in domestic preferences. The capital stock (k) is financed by issuing bonds, which are perfect substitutes for government debt (d) in each country. The total stock of bonds is therefore given in log form by

\[ b = \eta k + (1 - \eta) d, \]

where \( \eta \equiv K/B = K^*/B^*. \)
Equilibrium in the bonds markets requires

\[ b = \zeta b_n + (1 - \zeta)b^*_m, \]  

(5)

where \( \zeta \equiv B_n/B \equiv B^*_n/B^*. \)

Real wealth consists of real domestic assets and net foreign claims \( (f) \) which could be negative,

\[ w = \hat{\lambda}_m m + (1 - \hat{\lambda}_m)b + f. \]  

(6)

In the initial steady state it is assumed that \( F = 0 \). Changes in net foreign wealth are therefore expressed as a percentage of total wealth \( (W) \). The assumption of zero foreign initial debt may seem out of place in a paper purporting to analyze macro policy under conditions of high indebtedness. However, a little experimentation shows that the short-run and long-run responses of the endogenous variables to different shocks are similar to each other in the case of net external creditor (or debtor) positions and in the case of a zero external initial debt [cf. Buiter (1986)].

### 2.2. The commodity subsystem

Denoting aggregate consumption by \( c \), income by \( y \) and lump-sum taxes by \( t \), the consumption function can be written as

\[ c = \gamma(y - t) + \nu w - \phi \frac{r}{R}, \]  

(7)

where \( \gamma, \nu, \) and \( \phi \) are elasticities of consumption with respect to disposable income, real wealth and the real interest rate,

\[ \gamma \equiv \frac{C_y Y}{C}, \quad \nu \equiv \frac{C_w W}{C}, \quad \phi \equiv \frac{C_r R}{C}. \]

It is assumed that taxes are zero in the initial steady-state equilibrium. Changes in taxes are expressed as a percentage of output. Because of the assumed symmetry of the initial solution interest rates \( (R) \) are equal across nations.

The choice between domestic goods \( (c_n) \) and foreign consumption goods \( (c_m) \) is based on a CES utility function with \( \sigma \) denoting the elasticity of substitution,

\[ c_n = c + (1 - \mu)(\sigma - 1)e, \]  

(8)
\[ c_m + e = c - \mu(\sigma - 1)e. \] (9)

The parameter \( \mu \) is the initial share of consumption of home goods in total consumption: \( \mu = \frac{C_h}{C} = \frac{C^*_h}{C^*} \).

Investment \( i \) follows from neoclassical theory,

\[ i = k - \frac{\kappa}{\delta} \left[ \frac{1}{2} \left( \frac{r}{R} - a \right) + (k - l) \right]. \] (10)

This equation can be explained as follows. The desired stock of capital \( \hat{k} \) can be found by equating the marginal product of capital and the user cost of capital (real interest rate plus rate of depreciation). The marginal product of capital is derived from a Cobb-Douglas production function with \( \alpha \) denoting the production elasticity of labour,

\[ Y = aL^\alpha K^{1-\alpha} \] so that \[ \frac{\partial Y}{\partial K} = (1 - \alpha)a \left( \frac{L}{K} \right)^\alpha = R + \delta. \]

Therefore, we may write in log-linear form:

\[ \hat{k} = \frac{1}{\alpha}(a - r/(R + \delta)) + l. \]

It is assumed that firms adjust the actual stock of capital to the desired stock with a time lag:

\[ l - k = \frac{\kappa}{\delta}(\hat{k} - k), \]

where \( \kappa \) is the acceleration coefficient. Substitution of the expression for \( \hat{k} \) and taking account of the equality between actual and desired capital stock in the initial steady state results in the formula given in eq. (10). Exogenous productivity shocks are denoted by \( a \), whereas autonomous change in labour supply is given by \( l \). The log-linear version of the production function reads

\[ y = \alpha l + (1 - \alpha)k + a. \] (11)
Equilibrium in the goods markets is given by

\[ y = \mu_c c_h + \mu_i l + g + (1 - \mu_c - \mu_i)c_m^*, \]  

(12)

where \( \mu_c \equiv C_c/Y \) is the share of consumption of domestic goods in output and \( \mu_i \equiv I/Y \) is the share of investment goods in output. Government expenditure in the initial situation equals zero by assumption. The change in government spending \((g)\) is expressed as a percentage of initial output.

2.3. The dynamic subsystem

Capital accumulation follows from

\[ k = \delta(i - k). \]  

(13)

The government buys goods on the domestic market and pays interest on outstanding debt. These outlays are financed by imposing lump-sum taxes, by selling bonds or by printing money. The budget constraint takes the form:

\[ d = R + r + \psi(g - t) - \rho \theta, \]  

(14)

where \( \psi = Y/D, \rho = M/D, \) and \( \theta \) denotes the exogenous growth rate of nominal money supply. Government debt is indexed and constitutes a sure claim on given amounts of future goods [see, e.g., Sargent (1986)].

It is assumed that government debt is positive in the initial steady state. It should be recalled that changes in \( G \) and \( T \) are expressed as percentages of output. Feedback rules for taxation, government spending or monetary growth are required, because in the absence of such rules solvency of the government’s finances is not guaranteed. A sensible tax rule [cf. Buiter (1986)] is

\[ t = t_0 + (\xi_1/\psi)d - (\xi_2/\psi)d. \]

Ignoring currency substitution money market equilibrium is given by

\[ m = (\theta - p)m. \]  

(15)

In the initial steady state it is assumed that \( \theta = \theta^* = 0. \)

The current account of the domestic economy is the sum of the balance of

\[ \text{The case where government expenditure falls on domestic and foreign goods is discussed extensively in Frenkel and Razin (1987).} \]
trade and the balance of interest payments. This sum equals the net increase in the wealth of the nation vis-à-vis the rest of the world,

\[ \dot{f} = Rf + \lambda f (r^* - r) + \chi (c^* - c_m), \quad \chi = C^*/W = EC_m/W. \]  

(16)

It should be recalled that changes in \( F \) are expressed as percentages of \( W \).

The complete model counts 31 equations in 30 unknown variables. Applying Walras's law, one equilibrium condition can be eliminated. Moreover, eq. (5) will be rewritten for convenience. Subtracting \( w \) from both sides of the equation gives

\[ b - w = \zeta (b - w) + (1 - \zeta) (b^* - e) + (1 - \zeta) (w^* + e - w). \]

Substitution of eq. (2) and its foreign counterpart in the above expression yields

\[ (b - w) = \frac{\zeta}{\lambda_b} \left[ B_1 (r + p) - B_1 (r + p + \hat{\psi}) - \epsilon_{by} y + b_{nu} \right] \]

\[ + \frac{1 - \zeta}{\lambda_f} \left[ F_1 (r + p - \hat{\psi}) - F_1 (r^* + p^*) \right] + (1 - \zeta) (w^* + e - w). \]

From the definitions of the relevant coefficients it can be deduced that \( \zeta/\lambda_b = (1 - \zeta)/\lambda_f = 1/(1 - \lambda_m) \), assuming \( W = W^* \) and \( F = 0 \) in the initial steady state. Moreover, we have, by definition, \( (1 - \lambda_m)(1 - \zeta) = \lambda_f \). Substituting these relationships into the above expression and re-arranging gives

\[ \hat{\psi} = \frac{1}{B_1 + F_1} (B_1 (r + p) - B_1 (r + p) + F_1 (r + p) - F_1 (r^* + p^*)) \]

\[ - \epsilon_{by} y + b_{nu} - (1 - \lambda_m) b + \lambda_b w + \lambda_f (w^* + e)). \]

(17)

The model now consists of eqs. (1)–(4) and (6)–(17) which can be used together with the foreign counterparts to solve for the twenty two output variables and the eight state variables.

It should be noted that there are five backward-looking state variables (viz. \( k, k^*, d, d^* \), and \( f \)) and three forward-looking state variables (viz. \( m, m^* \), and \( e \)). For saddlepoint stability to hold, one should therefore have five stable (negative) roots and three unstable (positive) roots.
3. The fundamentals model

The fundamentals model is obtained by introducing the following simplifications. Investment and capital accumulation are ignored. As a result of this assumption we have $\eta = 0$. If the stock of capital is fixed, output will not change either. Therefore, the variable $y$ can be dropped from the consumption function and the asset demand equations (by implication we have $\gamma = 0$ and $\varepsilon_m = \varepsilon_b = 0$) Further, it is assumed that the nominal money stocks are constant ($\theta = \theta^* = 0$). As a consequence there will be no inflation and no difference between nominal and real interest rates. Moreover, we assume that in each country residents' demand for real cash balances is independent of the return on the security issued in the other country ($M_r^* = M_r^* = 0$). Branson and Henderson (1985) provide a microeconomic foundation for this assumption. Finally, it should be noted that the government budget constraint is not explicitly taken into consideration. In what manner real government expenditure is financed is now left unexplained.

Taking account of the simplifications the fundamentals model can be written in a compact form as follows:

\begin{align}
\dot{\lambda}_m (m - w) &= -M_r r, \\
\dot{\lambda}_m (m^* - w^*) &= -M_r^* r^*, \\
(1 - \lambda_m) (b - w) &= B_r r - B_{r^*} (r^* + \hat{\epsilon}) + F_r^* (r - \hat{\epsilon}) - F_{r^*} r^*, \\
w &= \lambda_m m + (1 - \lambda_m) b + f, \\
w^* &= \lambda_m m^* + (1 - \lambda_m) b^* - f, \\
\mu [vw - \phi r + (1 - \mu) (\sigma - 1) e] \\
+ (1 - \mu) [vw^* - \phi r^* + \mu (\sigma - 1) + 1] e + g = 0, \\
\mu [vw^* - \phi r^* - (1 - \mu) (\sigma - 1) e] \\
+ (1 - \mu) [vw - \phi r - \mu (\sigma - 1) + 1] e + g^* = 0, \\
f &= R f + \xi [vw^* - \phi r^* + 2 \mu (\sigma - 1) + 1] e - vw + \phi r.
\end{align}

Eqs. (18) and (19) imply equilibrium in the money market in both countries. Equilibrium in the market for domestic bonds is given in eq. (20). The composition of real wealth follows from eqs. (21) and (22). Eqs. (23) and (24)
are the equilibrium conditions for the goods market after substitution of the behavioural relations for consumption of home goods and exports. Output does not deviate from its initial steady-state value as explained above. Eq. (25) gives the balance-of-payments condition after substituting the relevant expressions for $c_m$ and $c_m^*$. As observed, the supply of domestic bonds ($b$) and of foreign bonds ($b^*$) are exogenous in the fundamentals model.

The model can be reduced to a system of two simultaneous differential equations in $e$ and $f$. The real exchange rate ($e$) is a forward-looking variable, whereas foreign debt ($f$) is a backward-looking variable. The interest rates $r$ and $r^*$ and the wealth variables $w$ and $w^*$ can be found from eqs. (18), (19), (21), (22), (23), and (24). Substitution of the results in eqs. (20) and (25) yields

$$j = Rf + \frac{2\mu(\sigma - 1) + 1}{2\mu - 1}e + \frac{\kappa}{2\mu - 1}(g - g^*),$$

$$\dot{e} = \frac{A_1}{A_2} \left[ \left( \frac{2\nu}{1 - \lambda_m} + \frac{\nu M_r + \phi(1 - \lambda_m)}{(1 - \lambda_m)A_1} \right)f + \frac{2(1 - \mu)(2\mu(\sigma - 1) + 1)}{2\mu - 1}e \\
+ \nu(b - b^*) + \frac{1}{2\mu - 1}(g - g^*) \right],$$

where

$$A_1 \equiv F_r + F_r^* > 0,$$

$$A_2 \equiv (\nu M_r/(1 - \lambda_m) + \phi)(F_r^* + F_r) > 0.$$
the $\dot{f}=0$ locus can be explained as follows. Starting from a point on the curve, a depreciation of the real exchange rate of the domestic currency ($e\uparrow$) induces a foreign trade surplus which is to be offset by lower interest receipts through falling foreign claims ($f\downarrow$). The negative slope of the $\dot{e}=0$ locus can be interpreted in a similar vein. An increase in $e$ induces an expected real exchange depreciation ($\dot{e}>0$) which can be offset by a decline in the stock of foreign claims restoring asset market equilibrium.

As shown in fig. 1, the slope of the $\dot{e}=0$ locus is assumed to be larger in absolute value than the slope of the $\dot{f}=0$ locus. As can easily be checked, the system is saddlepoint stable in this case. The stable arm (separatrix) of the saddlepoint is indicated by $SS'$. For saddlepoint stability it is therefore required that

$$\frac{1}{(1-\lambda_m)(1-\mu)} \left( \nu + \frac{\nu M_r+(1-\lambda_m)\phi}{2A_1} \right) > \frac{R}{\chi}.$$  

For the coefficient $\chi$ we may write: $\chi=\tilde{\chi}(1-\mu)(1-\lambda_m)$ with $\tilde{\chi}\equiv C/B = 1$ by proper scaling of variables. Substitution of this expression and that for $A_1$ in the inequality results in
For reasonable values of the parameters this inequality will hold. For instance, realistic values may be $v = 0.1$ and $R = 0.05$ which is sufficient to obtain the required condition. Therefore, it may be concluded that the model is saddlepoint stable. The inequality condition implies that the determinant of the state matrix is negative. Consequently, both eigenvalues (roots) have opposite signs, which is what one expects in the case where one of the state variables is backward-looking and the other one is a (forward-looking) jump variable. If the determinant of the state matrix is positive, both eigenvalues are positive because the trace of the state matrix is also positive. The model is then unstable, which may be checked by analysing the appropriate phase diagram.

The model can be used to analyse policy shocks. Identical shocks originating in both regions ($g = g^*$ and $b = b^*$) have no impact on the real exchange rate ($e$) and foreign debt ($-f$) as should be the case in a symmetric two-country model. The effects of a decrease in government spending in the foreign country, say the U.S., are shown in fig. 2. A fall in $g^*$ leads to a downward shift of both the $f = 0$ and the $\dot{e} = 0$ loci. It is reasonable to assume $\chi < 1$, so that the shift of the $\dot{e} = 0$ locus is relatively larger. A fall of
government expenditure leads on impact to an appreciation of the domestic currency unit. This is indicated by the change from point A to point B in fig. 2. The balance of payments of the U.S. improves and $f$ declines gradually along the stable arm of the new saddlepoint.

The dollar real exchange rate overshoots its long-run equilibrium and after the initial jump appreciates smoothly to maintain asset market equilibrium. The appreciation is required because the U.S. interest rate falls under influence of a rise in national savings. In the new steady state (point A'), external debt of the U.S. is lower and the dollar has depreciated in real terms compared with the initial situation as can be shown by considering the long-run solution of eqs. (26) and (27):

$$f = -\frac{1}{\Omega} \left( \frac{1}{2} v(b - b^*) + \frac{1.5 - \mu}{2\mu - 1} (g - g^*) \right),$$

$$e = \frac{1}{A} \left( \frac{1}{2} v(b - b^*) + \frac{1.5 - \mu}{2\mu - 1 - \frac{x\Omega}{1}} (g - g^*) \right),$$

where

$$\Omega \equiv \left\{ \frac{(1 - \mu)R}{\chi} + \frac{v}{1 - \lambda_m} + \frac{vM_r + \phi(1 - \lambda_m)}{2A_1(1 - \lambda_m)} \right\},$$

$$A \equiv \frac{2\mu(\sigma - 1) + 1}{2\mu - 1} \frac{\chi}{R}.$$

From eq. (28) it follows that $\partial f/\partial g^* > 0$, so that a fall in government expenditure abroad induces a rise in foreign debt at home. As appears from eq. (29),

$$\text{sign} \frac{\partial e}{\partial g^*} = -\text{sign} \left[ R(1.5 - \mu) - \chi\Omega \right]$$

$$= -\text{sign} \left[ 0.5R - \frac{v}{1 - \lambda_m} \left( 1 + \frac{M_r}{2A_1} \right) - \frac{\phi}{2A_1} \right].$$

As $v$ and $1 - \lambda_m$ are roughly of the same magnitude, it is reasonable to assume that the expression between brackets on the right-hand side is negative. Therefore, we may conclude that $\partial e/\partial g^* > 0$, so that a fall in U.S. government expenditure leads to a real depreciation of the dollar in the long run. This result can be explained as follows. A decline in U.S. government spending requires a depreciation of the dollar to crowd-in net exports. However, the 'coupon' effect [cf. Stevenson et al. (1988)] works in the opposite direction because interest payments on foreign debt decrease, which
puts less pressure on the dollar. Ultimately, the 'crowding-in' effect still dominates the 'coupon' effect and the real exchange rate \((e)\) falls.

The effects of an autonomous increase in domestic government debt (i.e., an increase in \(b\)) are presented in fig. 3. A change in \(b\) has here no effect on the \(f=0\) locus. The \(\dot{e}=0\) locus shifts downwards and the new steady state equilibrium is at point \(A'\). Compared with the initial steady state, foreign debt is higher and the dollar real exchange rate has appreciated. In contrast there is a real dollar depreciation on impact of the supply shock (movement from \(A\) to \(B\) in fig. 3). The real exchange rate depreciation following the initial negative jump is required to maintain asset market equilibrium. A rise in the supply of domestic securities raises the interest rate in Europe, so that agents shift to domestic assets. To restore portfolio equilibrium, the rate of return on foreign securities must rise, which induces a real dollar depreciation. The initial appreciation induces a balance of payments deficit in Europe, which increases foreign debt \((-f)\).

The dynamic implications of the government budget constraint along with other complications of the fundamentals model will be taken into account in the next section. As an analytical solution of the full size model is intractable, the effect of policy shocks will be analysed by studying numerical examples. The conclusions of the present section may be useful in explaining the results obtained with the complete model.

4. Alternative routes to reducing U.S. external debt

There are several alternatives which lead to reduction of the current
account deficit of the U.S. economy. As shown in section 3, a cut in government expenditure will do the job. Another way to get rid of foreign debt is to inflate the economy by increasing the growth of money. If policy measures are not effectuated, a financial crisis may force the economy on the right track. These different options will be studied in this section by presenting numerical exercises based on the extended model presented in section 2. The parameter values applied are given in Appendix A.

4.1. A cut in government spending

The consequences of a fall in government expenditure abroad (say the U.S.) in the full-scale model are illustrated in table 1. It is assumed that the government cuts its expenses by 5% in relation to output in the initial steady state. The fall in public expenditure is used to reduce the government budget deficit. Therefore, the supply of foreign bonds declines in accordance with the dynamics of the government budget constraint.

A fall in government expenditure in the U.S. \( g^* \) leads to a real depreciation of the dollar on impact in accordance with the short-run result obtained in section 3. Excess supply in the U.S. goods market is choked off by a fall in the real interest rate which leads to crowding-in of domestic expenditure. The rise of U.S. net exports reinforces this result. The real depreciation of the dollar induces excess supply in the European goods market, which is also choked off by a fall in the real interest rate. The nominal interest rate declines in the U.S., which induces a shift in the portfolio from bonds towards real cash balances. Asset equilibrium in the world market requires a rise in the European nominal interest rate, which leads to an opposite shift, i.e., away from real cash balances towards bonds.

The increase in net exports of the U.S. economy caused by a real exchange rate depreciation of the dollar leads to a decline of external debt in the course of time as can be seen from the figures for the medium run \( t = 3 \) presented in table 1. The stock of capital increases in the U.S. because investment is fostered by lower real interest rates. In the medium run, the dollar does not appreciate in real terms as should be expected from the analysis in section 3, but depreciates still further. This can be explained by the rise in output which relates to the increase in the capital stock. An increase in the supply of goods in the U.S. (which is higher than that in Europe) puts pressure on the real dollar exchange rate, which was not the case in our earlier analysis.

These tendencies are reinforced in the long run. The U.S. capital stock rises gradually to a new steady state value which is substantially higher than the initial value. Investment is crowded in as a result of the decline in real

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4Computations are based on the algorithm developed in Markink and van der Ploeg (1989).
Table 1

A cut in government spending abroad ($g^* = -5$).

<table>
<thead>
<tr>
<th>Variable*</th>
<th>Period</th>
<th>0</th>
<th>3</th>
<th>$\infty$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Europe</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Real cash balances ($m$)</td>
<td>-9.31</td>
<td>-9.89</td>
<td>-27.26</td>
<td></td>
</tr>
<tr>
<td>Real interest rate ($r$)</td>
<td>-0.04</td>
<td>-0.01</td>
<td>0.08</td>
<td></td>
</tr>
<tr>
<td>Real wealth ($w$)</td>
<td>-0.93</td>
<td>-1.72</td>
<td>-17.79</td>
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</tr>
<tr>
<td>Capital stock ($k$)</td>
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<td>0.20</td>
<td>-2.17</td>
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</tr>
<tr>
<td>Inflation ($p$)</td>
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<td>0.18</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Consumption domestic goods ($c_1$)</td>
<td>0.09</td>
<td>-0.64</td>
<td>-4.50</td>
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</tr>
<tr>
<td>Consumption foreign goods ($c_2$)</td>
<td>4.65</td>
<td>4.19</td>
<td>1.24</td>
<td></td>
</tr>
<tr>
<td>Stock domestic bonds ($b_1$)</td>
<td>1.17</td>
<td>0.88</td>
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<tr>
<td>Stock foreign bonds ($b_2$)</td>
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<tr>
<td><strong>U.S.</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td>21.41</td>
<td>22.14</td>
<td>39.93</td>
<td></td>
</tr>
<tr>
<td>Real interest rate ($r^*$)</td>
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<td>-0.12</td>
<td>-0.19</td>
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</tr>
<tr>
<td>Real wealth ($w^*$)</td>
<td>2.14</td>
<td>1.39</td>
<td>17.43</td>
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<td>1.45</td>
<td>5.14</td>
<td></td>
</tr>
<tr>
<td>Inflation ($p^*$)</td>
<td>-0.25</td>
<td>-0.23</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Consumption domestic goods ($c_1^*$)</td>
<td>3.44</td>
<td>5.79</td>
<td>10.55</td>
<td></td>
</tr>
<tr>
<td>Consumption foreign goods ($c_2^*$)</td>
<td>-1.12</td>
<td>0.95</td>
<td>4.81</td>
<td></td>
</tr>
<tr>
<td>Stock domestic bonds ($b_1^*$)</td>
<td>0.03</td>
<td>-1.89</td>
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<tr>
<td><strong>World</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Real exchange rate ($e$)</td>
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<td>-2.42</td>
<td>-2.87</td>
<td></td>
</tr>
<tr>
<td>Foreign debt U.S. ($f$)</td>
<td>0</td>
<td>-0.84</td>
<td>-13.82</td>
<td></td>
</tr>
</tbody>
</table>

*All variables are expressed as percentage deviation from their initial steady values (except $f$ for which it is the deviation as a percentage of $W$ in the initial steady state and $r$, $r^*$, for which it is 100 times the absolute deviation).

interest rates. In contrast, investment is crowded out in Europe because the real interest rate rises. Such a divergence of interest rates is typical for a portfolio model. In the case of perfect substitutability of international tradable assets crowding-out or crowding-in is spread evenly among different regions. As a consequence of these developments, the fall in the dollar real exchange rate is even more pronounced than on impact of the shock. External debt of the U.S. economy is significantly reduced, which induces a small positive wealth effect despite the decline in bonds issued by the domestic government. The cut in government spending is favourable for the U.S. in terms of the long-run consumption of both domestic and foreign goods. Europe incurs a loss in real wealth, but gains from an increase in its terms of trade. The long-run consumption of domestic good falls, but long-
run imports rise as foreign goods become relatively cheaper. Bond holdings in Europe decline, whereas the stock of European and domestic bonds held by U.S. residents increases, which manifests the changed international composition of wealth.

Finally, it should be noted that we have assumed equal asset preferences in both regions. However, there may be asymmetries. For example, as the U.S. has a prominent role in the world most foreign investors (Japanese) may have a stronger preference for dollar denominated assets than assumed in the simulation experiment. If so, there has to be a larger cut in U.S. government spending to obtain the same result with respect to a reduction in foreign debt. The reason is that with relatively stronger preferences for dollar denominated bonds the dollar would depreciate less than in the symmetrical case.

4.2. Inflating the problem away

There are, of course, alternatives for U.S. policy makers to reduce foreign debt. Another way out is to inflate the economy. The effects of an increase in the growth rate of money in the U.S. are presented in table 2. The results of a unilateral increase in the growth rate of money are of course more complicated than those of a uniform increase in money growth across regions. In the latter case, the development is governed by the familiar Mundell–Fischer effect and the Tobin effect. Real interest rates decline in the short run as prices are expected to rise. Because allowance is made for capital accumulation, there will also be (positive) long-run effects on output [cf. Marini and van der Ploeg (1988)].

A rise in $\theta^*$ induces a substantial upward price jump on impact in the U.S. The price increase in Europe is far less and the dollar depreciates in real terms, which leads to an improvement of the U.S. current account. The real interest rates rises in the U.S. economy to choke off excess demand in the goods market, caused by the real dollar depreciation. Therefore, the U.S. capital stock falls in the medium term so that there is a negative income effect leading to lower imports from Europe.

Monetary policy, as conceived here, reduces consumption in the U.S., but stimulates consumption in Europe in the short and medium term. It is therefore a kind of 'beggar-thy-self' policy. This remarkable result follows from a fall in real interest rates in Europe. In this region, the real interest rate must decline to eliminate excess supply in the goods market. Inflation in Europe is a spill-over effect from the U.S. economy originating in the

Dornbusch (1989) qualifies this possibility as an alternative no-need-to-adjust view, but refrains from a more elaborate analysis.
A rise in money growth abroad ($\theta^* = 1$).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Period</th>
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<th>3</th>
<th>$\infty$</th>
</tr>
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<tr>
<td><strong>Europe</strong></td>
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<td></td>
</tr>
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<td>Real cash balances ($m$)</td>
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<td>-8.47</td>
<td>-37.14</td>
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<tr>
<td>Real interest rate ($r$)</td>
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<td>-0.03</td>
<td>-0.03</td>
<td>0.08</td>
</tr>
<tr>
<td>Real wealth ($w$)</td>
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<td>-1.30</td>
<td>-27.79</td>
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<td>0</td>
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<td>-2.14</td>
</tr>
<tr>
<td>Inflation ($p$)</td>
<td></td>
<td>0.17</td>
<td>0.19</td>
<td>0</td>
</tr>
<tr>
<td>Consumption domestic goods ($c_d$)</td>
<td>0.41</td>
<td>0.47</td>
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</tr>
<tr>
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<td>0.83</td>
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</tr>
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<td>-4.02</td>
<td>22.61</td>
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<td>-0.16</td>
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<td>Inflation ($p^*$)</td>
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<td>Consumption domestic goods ($c_d^*$)</td>
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<td>-0.55</td>
<td>4.80</td>
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</tr>
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<td>Consumption foreign goods ($c_m^*$)</td>
<td>-1.28</td>
<td>-0.90</td>
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<tr>
<td>Stock domestic bonds ($b_d^*$)</td>
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<td>5.16</td>
<td>6.39</td>
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<tr>
<td><strong>World</strong></td>
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<tr>
<td>Real exchange rate ($e$)</td>
<td></td>
<td>-0.34</td>
<td>-0.17</td>
<td>0.15</td>
</tr>
<tr>
<td>Foreign debt U.S. ($f$)</td>
<td></td>
<td>0</td>
<td>-0.65</td>
<td>-22.84</td>
</tr>
</tbody>
</table>

*See footnote a to table 1.*

portfolio subsystem. A rise in nominal interest rates in the U.S. induces a rise in nominal interest rates in Europe to restore asset market equilibrium. An increase in domestic nominal interest rates corresponds to a fall in domestic real cash balances. With the money stock in Europe fixed this means that prices must rise.

The long-run outcomes ($t \to \infty$) are dominated by the 'coupon' effect. The terms of trade move against Europe, because the U.S. becomes more of a rentier economy. Consumption of both goods rises in the U.S. and declines in Europe. Inflation, therefore, pays in the long run. U.S. prices increase proportionally to the money stock, while the European price level is stable. The real interest rate in the U.S. falls and the capital stock increases. Both movements are reversed in Europe. The change in the long-run real (and nominal) interest rates is caused by the reallocation of domestic and foreign bonds from Europe to the U.S. Because regions have a preference for their
A change in European preferences towards domestic bonds ($b_w = 5$).

<table>
<thead>
<tr>
<th>Variable*</th>
<th>Period</th>
<th></th>
<th></th>
</tr>
</thead>
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<td>$\infty$</td>
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<td><strong>Europe</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Real cash balances ($m$)</td>
<td>-10.31</td>
<td>-11.02</td>
<td>-48.94</td>
</tr>
<tr>
<td>Real interest rate ($r$)</td>
<td>-0.04</td>
<td>-0.04</td>
<td>0.10</td>
</tr>
<tr>
<td>Real wealth ($w$)</td>
<td>-1.03</td>
<td>-1.69</td>
<td>-36.76</td>
</tr>
<tr>
<td>Capital stock ($k$)</td>
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<td>0.46</td>
<td>-2.78</td>
</tr>
<tr>
<td>Inflation ($p$)</td>
<td>0.22</td>
<td>0.25</td>
<td>0</td>
</tr>
<tr>
<td>Consumption domestic goods ($c_d$)</td>
<td>0.49</td>
<td>0.63</td>
<td>-6.19</td>
</tr>
<tr>
<td>Consumption foreign goods ($c_f$)</td>
<td>1.59</td>
<td>1.20</td>
<td>-6.69</td>
</tr>
<tr>
<td>Stock domestic bonds ($b_d$)</td>
<td>4.30</td>
<td>3.96</td>
<td>-23.78</td>
</tr>
<tr>
<td>Stock foreign bonds ($b_f$)</td>
<td>-8.06</td>
<td>-9.61</td>
<td>-58.90</td>
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<td><strong>U.S.</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Real cash balances ($m^*$)</td>
<td>10.31</td>
<td>11.02</td>
<td>48.94</td>
</tr>
<tr>
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<td>0.04</td>
<td>-0.10</td>
</tr>
<tr>
<td>Real wealth ($w^*$)</td>
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<td>1.69</td>
<td>36.76</td>
</tr>
<tr>
<td>Capital stock ($k^*$)</td>
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<td>2.78</td>
</tr>
<tr>
<td>Inflation ($p^*$)</td>
<td>-0.22</td>
<td>-0.25</td>
<td>0</td>
</tr>
<tr>
<td>Consumption domestic goods ($c_d^*$)</td>
<td>-0.49</td>
<td>-0.63</td>
<td>6.19</td>
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<tr>
<td>Consumption foreign goods ($c_f^*$)</td>
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<td>-1.20</td>
<td>6.69</td>
</tr>
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<td>4.37</td>
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<td>-7.06</td>
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<tr>
<td>Foreign debt U.S. ($f$)</td>
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<td>-0.85</td>
<td>-30.26</td>
</tr>
</tbody>
</table>

*See footnote a to table 1.

own securities ('local asset preference': $\lambda_b > \lambda_f$), the interest rate in Europe rises and the U.S. interest rate falls.

4.3. A financial crisis

Ongoing deficits on the U.S. current account may lead to a loss of confidence in the rest of the world. This may become manifest by a sudden change of preferences away from foreign bonds towards domestic bonds in Europe. The effects of such a financial crisis are presented in table 3 ($b_{aw} = 5$).

The results in both countries are mirror images. This holds also for the mutations in bond holdings if the figures for Europe are corrected for the direct impact of the change in preferences ($b_{aw}/\lambda_b$ for the stock of domestic

*Our exogenous variable $b_{aw}$ corresponds to the 'safe haven' parameter in Branson (1985).
bonds, \( b_n \), and \( b_{aw}/\lambda_f \) for the stock of foreign bonds \( b_m \)). This characteristic of the outcome is understandable, because a change in preferences takes the form of a zero-sum shock in an otherwise symmetrical two-country model. In Europe, nominal interest rates rise in the short and medium run to induce agents to substitute domestic for foreign securities. The dollar depreciates in real terms as U.S. bonds become less attractive. As a consequence, the European goods market is an excess supply and the real interest rate must decline to restore equilibrium. Exact the opposite holds in the U.S. where a rise in the real interest rate must choke off excess demand in the goods market. The real dollar depreciation reduces the U.S. foreign deficit and therefore external debt.

Capital is accumulated in Europe and decumulated in the U.S. in the medium run. The corresponding supply effects lead to a gradual real appreciation of the dollar. The 'coupon' effect reinforces this development. The long-run situation is again dominated by the 'coupon' effect. The real exchange rate in dollars has appreciated compared with the initial steady state. This results in a reversal of signs with respect to the interest rates, consumption levels and capital stocks. The reason is, of course, that the excess demand in the European goods market must be choked off by a rise of the real interest rate, whereas the opposite situation of excess supply holds in the U.S.

A financial crisis leads to a substantial improvement of the U.S. external debt position. However, it should be observed that if the shock of confidence is sudden and large, a significant balance-of-payments and foreign debt improvement may already be realised in the medium run. A severe financial crisis will lead to a substantial real depreciation of the dollar. After things are settled, preferences may go back to their original values. Therefore, the short and medium run effects in table 3 may be more important than the long-run outcomes, which may not be realised after all.

4.4. The Branson scenario

It is frequently advocated by policy makers that a fiscal expansion in Europe and Japan should match a fiscal contraction in the U.S. to prevent a deflationary development in the world economy as a whole. Moreover, it is argued that this policy mix could be a substitute for a real dollar depreciation. This view is strongly attacked by Branson (1988), who makes perfectly clear that a change in the real exchange rate is a complement rather than a substitute to a fiscal shift in the world economy, except under most unusual circumstances. Our analysis strongly supports this view. The effects of an increase in government expenditure at home \((g > 0)\) are exactly the same as the outcomes of a reduction in government spending abroad \((g^* < 0)\).
A fiscal shift as advocated by the Group of Seven therefore simply doubles the results presented in table 1.

To avoid sudden movements of the exchange on impact of policy shocks, Branson (1988) suggests a different scenario. Short-run exchange stability could be attained by combining a fiscal contraction in the U.S. with a monetary expansion in Europe and Japan. This scenario has the additional benefit of lowering world real interest rates and being a stimulus to demand in Europe and Japan to offset the potential contraction in the U.S. What does this mean in terms of our model? Because the model is linear and symmetric, the effects of a policy mix can be found by adding the outcomes of separate shocks. The consequences of a higher growth rate of money in Europe can be determined by interchanging country results and altering the signs of \( e \) and \( f \) in table 2. The Branson scenario can therefore be obtained by combining these outcomes with the results presented in table 1.

As can be seen, a short-run stabilisation of the real exchange rate can be obtained by an appropriate mix of both policies. However, such a policy would not work. The dollar would indeed gradually depreciate in real terms, but the U.S. foreign deficit and debt would increase. In Europe, the decline in real cash balances depresses consumption. In contrast, U.S. consumption is strongly pushed by the substantial fall in the real interest rate. Combining these absorption effects leads to a rise in the U.S. deficit on current account. These effects are reinforced in the medium run, whereas in the long run the coupon effect is not strong enough to offset these developments. The Branson scenario scores on all points (lower real interest rates, less deflation, gradual dollar depreciation) in our exercise, but fails at the main point of a reduction of U.S. external debt. This raises the question in what respect Branson's model, which also ignores cyclical output effects of policy changes, differs from ours. The decisive point is that Branson ignores the role of absorption effects in the import equations of both countries. The developments of the trade balances are therefore exclusively determined by real exchange rate movements in his model.

5. Conclusions

It is shown that a reduction in U.S. external debt can be attained by a fiscal contraction or by a rise in the monetary growth rate. Both options serve the same goal but there are important differences as may be expected. A fiscal contraction in the U.S. leads to a decline in prices in the short and medium run. In contrast, an increase in the monetary growth rate raises inflation in the U.S. in the short and long run. Such an inflation erodes non-human wealth and depresses consumption. From a short-run perspective, the inflationary solution seems therefore less attractive. But the long-run consequences may not be so bad. A substantial reduction in external debt induces
positive wealth and income effects, which lead to a real dollar appreciation and an increase in consumption of domestic and foreign goods. In the case of a fiscal contraction, there is also a rise in long-run consumption in the U.S., but this time it is more strongly supported by capital accumulation. As a result, the European economy suffers less from a reduction in U.S. foreign debt in the long run than in the case of a monetary expansion. For this reason, a fiscal contraction may be preferable after all.

It is often argued by policy makers that fiscal contraction in the U.S. should be matched by fiscal expansion in Europe and Japan to avoid a deflationary development world-wide. In our symmetric model with flexible prices, a fiscal expansion in Europe generates exactly the same effects as a fiscal reduction in the U.S. A fiscal shift is therefore no substitute for a real dollar depreciation as argued forcefully by Branson (1988). The symmetry argument carries over to other cases. A reduction in monetary growth in Europe will have the same effects as a rise in monetary growth in the U.S. This is the very reason why the Branson scenario may not work. Branson (1988) proposes a combination of fiscal contraction in the U.S. and easing of monetary policy in Europe and Japan. Such a policy-mix may prevent sudden changes in the exchange rate, but then the final goal of a reduction in U.S. external debt may not be attained as we have shown in this paper.

The present analysis can be extended in several directions. From a policy point of view, it could be attractive to add more realism to the model. One way to do this is to pay proper attention to labour markets in different economies and the institutional differences that may exist between the U.S. and Europe [see, e.g., van de Klundert and van der Ploeg (1989)]. Another point is hysteresis in export markets which may complicate the problem of international adjustment after a disturbance of the equilibrium as observed by Dornbusch (1989).

Appendix A. Parameter values

In the numerical exercises presented in section 4, the following numerical values have been chosen:

**Portfolio subsystem**

\[-M_r = -M^*_r = -5 \quad -M_d = -M^*_d = 0 \quad \lambda_m = 0.1 \quad \varepsilon_m = 1 \quad \eta = \frac{3}{2} \]

\[B_r = B^*_r = 10 \quad -B_d = -B^*_d = -10 \quad \lambda_b = 0.6 \quad -\varepsilon_b = -1 \]

\[-F_r = -F^*_r = -5 \quad F_d = F^*_d = 10 \quad \lambda_f = 0.3 \quad \eta = \frac{3}{2} \]

\[0 \quad 0 \quad 1\]
Commodity subsystem
Consumption: $\gamma = 0.6, \nu = 0.1, \phi = 20, \mu = 0.75, \sigma = 2$,
Investment: $\kappa = 0.1, \delta = 0.05, \alpha = 0.75$,
Output shares: $\mu_c = 0.5, \mu_i = 0.1$.

Dynamic subsystem
Government budget constraint: $\psi = 1, \rho = \frac{2}{3}, \xi_1 = 0.5, \xi_2 = 0$,
Balance of payments constraint: $\chi = 0.12$,
Real interest rate: $R = 0.05$.

Consistency requires that the following relations hold:

$$\mu_i = \frac{\eta}{1 - \eta} \frac{\delta}{\psi} \quad \text{and} \quad \chi = (1 - \mu_c - \mu_i)(1 - \eta)(1 - \lambda_m)\psi.$$

Exogenous variables are equal to zero unless otherwise specified (see tables 1–3).
The roots of the system satisfy the required saddlepath stability condition:

$$-0.4567, \quad -0.4502, \quad -0.1384, \quad -0.1354, \quad -0.0082, \quad 0.0191, \quad 0.0287, \quad 0.3313.$$

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