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NEGATIVE NET FOREIGN ASSET POSITIONS AND STABILITY IN A WORLD PORTFOLIO BALANCE MODEL

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Negative net foreign asset positions have been associated with a troublesome stability problem in flexible exchange rate regimes. In this paper a symmetrically-specified, two-country, portfolio balance model is employed to provide some perspective on this problem. It is concluded that negative net foreign asset positions do not constitute an independent source of instability. Instability can arise only under nonrational expectations or because of destabilizing speculation.

1. Introduction

Can a flexible exchange rate regime be unstable in the absence of destabilizing speculation? Several writers have suggested that portfolio composition alone can be a source of dynamic instability.[1] When home-country residents have a negative net foreign asset position (net debts denominated in foreign currency), the conventional valuation effect is reversed. Home-currency depreciation lowers the home-currency value of home wealth, rather than raising it, thereby reducing demand for home-currency assets. This 'perverse' valuation effect may cause instability. If a disturbance creates excess demand for home-currency assets, restoration of short-run asset market equilibrium requires home-currency depreciation. As home residents reduce their absorption and acquire financial assets, demand for home-currency assets increases leading to further depreciation. Even if

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[1]The instability problem associated with negative net foreign asset positions is a central issue in several recent papers: Branson, Halttunen and Masson (1979), Martin and Masson (1979), Boyer (1977), and Obstfeld (1980). It is also discussed by Tobin and de Macedo (1981). Tobin (1980) summarizes a main conclusion reached in these papers. The problem is considered further by Kouri (1982) and Masson (1981). Kouri's conclusions are similar to ours, but Masson's are somewhat different.

home residents have a positive net foreign asset position, there may still be a perverse valuation effect if foreign residents have a negative net foreign asset position (net debts denominated in home-country currency).[2]

The result that a flexible exchange rate regime may be unstable when home or foreign residents have negative net foreign asset positions is not merely a theoretical curiosum. It has been a source of serious concern in the empirical implementation of portfolio balance models for some countries. Martin and Masson (1979) are faced with the fact that Canadian residents have net debts denominated in U.S. dollars. Branson, Halttunen and Masson (1979) and Obstfeld (1980) encounter the situation that foreign residents have net DM-denominated debts to West Germans.[3]

Concern about the possibility of dynamic instability associated with negative net foreign asset positions has been tempered by the identification of two potentially stabilizing effects. The first is the valuation effect that exists if foreign (home) residents have a positive net foreign asset position even though home (foreign) residents have a negative net foreign asset position. The second is the expectations effect that arises if expectations are regressive. Obstfeld finds that these two effects are large enough empirically to stabilize his estimated model of the DM/dollar rate. Neither Branson, Halttunen and Masson, nor Martin and Masson reach such sanguine conclusions.

Here we ask whether the stability problem associated with negative net foreign asset positions can arise in a model with rational expectations. If not, then it would be less worrisome. It would not be possible to identify portfolio composition as an independent source of dynamic instability in a world of flexible exchange rates.

We use a two-country, rational expectations portfolio balance model. It is distinguished by the absence of the usual simplifying assumptions that foreigners do not hold home-currency assets and that certain foreign variables are exogenous.[4] The second assumption is often referred to as the 'small-country' assumption.[5] While the stability issues studied here could also be addressed in the context of a small-country model, such an approach

[2]The negative net foreign asset case is not the only portfolio constellation that has led analysts to question the stability of open economy portfolio balance models. Enders (1977) and Masson (1980) discuss the possibility that instability might arise when positive net foreign asset positions are 'too large'. See footnote 19.

[3]Data on the German case is readily available from the statistical supplements to the *Monthly Report of the Deutsche Bundesbank*. In particular, one can use the supplement *Balance of Payments Statistics*. Tables 7 and 8 of that publication contain data on both the domestic and foreign currency assets and liabilities of German banks and firms. At the end of 1979, foreigners had a net DM-denominated debt with respect to German banks and nonbank domestic enterprises of 50 billion DM.

[4]The usual formulation would also result if it were assumed that foreigners did hold domestic assets but that their holdings were totally unresponsive to changes in their wealth and relative rates of return.

[5]Kouri (1976), Calvo and Rodriguez (1977), and Flood (1979) analyze small-country portfolio balance models.

would leave open the question of whether the results would be affected by taking into account the endogenous behavior of the rest of the world. Thus, the results presented here should be regarded as being more decisive.

In section 2 the model is described, and some properties of its long-run equilibrium are derived. Then, we analyze the stability of long-run equilibrium under static, regressive, and rational expectations in sections 3, 4 and 5. Section 6 is an extension of the stability analysis to the case of rational expectations with learning. Section 7 contains our conclusions.

2. The world portfolio balance model and its long-run equilibrium

In this section we first describe the building blocks of a two-country world portfolio balance model and then derive some properties of its long-run equilibrium.

2.1. The asset markets

The model contains two assets, home money and foreign money. Residents of both countries hold both moneys. Home net wealth (W) and foreign net wealth ($\overset{*}{W}$), both measured in units of home currency, are given by

$$W = B + EF \tag{1a}$$

and

$$\overset{*}{W} = \overset{*}{B} + E\overset{*}{F}. \tag{1b}$$

B ($\overset{*}{B}$) represents home (foreign) net private holdings of home money; F ($\overset{*}{F}$) represents home (foreign) net private holdings of foreign money. E is the exchange rate defined as the home-currency price of foreign currency. Residents of each country always hold positive amounts of the money of their country ($B, \overset{*}{F} > 0$) but may have negative holdings of the money of the other country ($\overset{*}{B}, F \gtreqless 0$). The outstanding stock of home money ($\tilde{B}$) and the outstanding stock of foreign money ($\tilde{F}$) are assumed to be constant and positive:

$$\tilde{B} = B + \overset{*}{B} > 0, \tag{2a}$$

$$E\tilde{F} = E(F + \overset{*}{F}) > 0. \tag{2b}$$

Adding (1a) and (1b), adding (2a) and (2b), and noting that the right-hand sides of the resulting sums are equal yields the world wealth constraint:

$$W + \overset{*}{W} = \tilde{B} + E\tilde{F}. \tag{3}$$

Home (foreign) residents desire to hold a proportion $b(\cdot)$ $[\overset{*}{b}(\cdot)]$ of their wealth in home money. The desired asset proportions depend on the expected rate of depreciation of the home currency (ε); they fall as the expected rate of depreciation rises ($b', \overset{*}{b}' < 0$).

Asset market equilibrium obtains when the outstanding stock of home money is willingly held in private portfolios:

$$\tilde{B} = b(\varepsilon)W + \overset{*}{b}(\varepsilon)\overset{*}{W}. \tag{4}$$

When the market for home money clears, the market for foreign money also clears by Walras' law.[6]

2.2. The goods market

The model contains one good. The law of one price holds:

$$P = E\overset{*}{P}. \tag{5}$$

P ($\overset{*}{P}$) is the home (foreign) currency price of the single good. In our model $\overset{*}{P}$ is an endogenous variable, while in many other monetary and portfolio balance models of open economies under flexible exchange rates it is taken to be exogenous.[7]

Private demand behavior in the home and foreign countries is characterized by Metzler-type, target-wealth savings functions, $S(\cdot)$ and $\overset{*}{S}(\cdot)$.[8] Both home and foreign residents save in order to gradually reduce gaps between their target and actual real wealth levels. Real outputs in the home and foreign countries are equal to their fixed, full employment levels, $\tilde{Y}$ and $\tilde{\overset{*}{Y}}$. Target real wealth levels, $\alpha\tilde{Y}$ and $\overset{*}{\alpha}\tilde{\overset{*}{Y}}$, are proportional to incomes (outputs). Investment, government spending, and taxes are assumed to be zero in both countries. Equilibrium in the market for the world good obtains when world savings is zero:

$$S(\alpha\tilde{Y} - W/P) + \overset{*}{S}(\overset{*}{\alpha}\tilde{\overset{*}{Y}} - \overset{*}{W}/P) = 0, \tag{6}$$

where $S', \overset{*}{S}' > 0$.

[6]That is, $E\tilde{F} = f(\varepsilon)W + \overset{*}{f}(\varepsilon)\overset{*}{W}$, where $f(\varepsilon) \equiv 1 - b(\varepsilon)$ and $\overset{*}{f}(\varepsilon) \equiv 1 - \overset{*}{b}(\varepsilon)$ are the proportions of their wealths that home and foreign residents, respectively, desire to hold in foreign money. Adding this equation to (4) yields (3).

[7]Since $\overset{*}{P}$ can be determined once P and E are known, $\overset{*}{P}$ and eq. (5) are not referred to again except in footnote 12.

[8]Our savings functions are identical to the ones used by Calvo and Rodriguez (1977), Dornbusch and Fischer (1980), and Henderson (1980).

2.3. *Asset accumulation*

Home residents' total asset purchases equal home nominal saving:

$$\dot{B}+E\dot{F}=PS(\alpha\tilde{Y}-W/P). \tag{7}$$

$\dot{B}$ and $\dot{F}$ are the time derivatives of home residents' holdings of home and foreign currency respectively. When (2a), (2b), (6) and (7) hold, foreign residents' total asset purchases equal foreign nominal saving. Foreign residents' total asset purchases are the negative of home residents' total asset purchases, and foreign saving is the negative of home saving.[9]

In our model, eq. (7), which determines home residents' total asset purchases, conveys the same information as a balance-of-payments equation. The time derivative of (2a) implies that home residents' total asset purchases $(\dot{B}+E\dot{F})$ equal the home capital account deficit $(-\dot{\overset{*}{B}}+E\dot{F})$. Home saving equals the home current account surplus since investment, government spending, and taxes are zero.

2.4. *The long-run equilibrium*

If the exogenous variables of the model are fixed, both nominal and real endogenous variables are stationary in long-run equilibrium. Although the model is highly nonlinear, long-run equilibrium is unique.[10] Here we prove the uniqueness result and discuss a corollary that is useful in what follows.

In long-run equilibrium both the expected rate of depreciation of the home currency and home residents' total purchases of assets are zero:

$$\bar{\varepsilon}=\dot{\bar{B}}+\bar{E}\dot{\bar{F}}=0. \tag{8}$$

A variable with a bar over it represents the long-run equilibrium value of that variable. Given restrictions (8), eqs. (3), (4), (6) and (7) imply a unique long-run equilibrium. Since $S(\cdot)$ is single-valued, (7) determines a unique value of $\bar{W}/\bar{P}$. Since $\overset{*}{S}(\cdot)$ is single-valued, (6) then determines a unique value of $\bar{\overset{*}{W}}/\bar{P}$. Since $b(\cdot)$ and $\overset{*}{b}(\cdot)$ are monotonic, $b(0)$ and $\overset{*}{b}(0)$ are unique. Thus, given $\tilde{B}$, (4) divided by $\bar{P}$ determines a unique value of $\bar{P}$ which in turn implies unique values of $\bar{W}$ and $\bar{\overset{*}{W}}$. Given $\tilde{F}$, (3) then determines a unique value of $\bar{E}$.

It is a corollary of the uniqueness result that a transfer of a combination of home and foreign money from foreign to home residents has no effects in the long run. Since such a 'transfer of wealth' affects none of the exogenous

[9] That is, $\dot{\overset{*}{B}}+E\dot{\overset{*}{F}}=P\overset{*}{S}(\overset{*}{\alpha}\tilde{\overset{*}{Y}}-\overset{*}{W}/P)$. To confirm that $\dot{\overset{*}{B}}+E\dot{\overset{*}{F}}=-(\dot{B}+E\dot{F})$, add the time derivatives of (2a) and (2b) and cancel the terms involving $\dot{E}$.

[10] In the two-good model of Kouri (1982), long-run equilibrium may not be unique.

variables, it does not affect long-run equilibrium. A transfer of wealth can be accomplished by confiscating a combination of home and foreign money from foreign residents and distributing this combination to home residents.

3. The model with static expectations

Before the stability properties of the model can be analyzed, it must be closed with an assumption about expectations formation. In this section expectations are assumed to be static, so that $\varepsilon = \bar{\varepsilon} = 0$.

3.1. Some preliminaries

We first select a state variable for the system and then express the model in deviation form. Home residents' wealth valued at the long-run exchange rate (w), where

$$w = B + \bar{E}F, \tag{9}$$

is a convenient state variable because it does not 'jump' (that is, move discretely at a point in time) when the exchange rate jumps. The time derivative of w equals home residents' asset accumulation in the neighborhood of long-run equilibrium:

$$\dot{w} = \dot{B} + \bar{E}\dot{F}. \tag{10}$$

In deviation form, the equilibrium conditions for the home money market, eq. (4), and for the goods market, eq. (6), and the expression for home residents' asset accumulation, eq. (7), become[11]

$$(b\bar{F} + \overset{*}{b}\bar{\overset{*}{F}})\,\mathrm{d}e + (b - \overset{*}{b})\,\mathrm{d}w = 0, \tag{11}$$

$$(S'\bar{W} + \overset{*}{S}'\bar{\overset{*}{W}})\,\mathrm{d}p - (S'\bar{F} + \overset{*}{S}'\bar{\overset{*}{F}})\,\mathrm{d}e - (S' - \overset{*}{S}')\,\mathrm{d}w = 0, \tag{12}$$

$$\dot{w} = S'\bar{W}\,\mathrm{d}p - S'\bar{F}\,\mathrm{d}e - S'\,\mathrm{d}w. \tag{13}$$

[11]In deriving eqs. (11), (12) and (13) we have made use of the following relationships:

$$\overset{*}{w} = \overset{*}{B} + \bar{E}\overset{*}{F}; \qquad \mathrm{d}W = \mathrm{d}w + F\,\mathrm{d}e; \qquad \mathrm{d}\overset{*}{W} = \mathrm{d}\overset{*}{w} + \overset{*}{F}\,\mathrm{d}e;$$

$$\mathrm{d}\overset{*}{w} = \mathrm{d}\overset{*}{B} + \bar{E}\,\mathrm{d}\overset{*}{F} = -\mathrm{d}B - \bar{E}\,\mathrm{d}F = -\mathrm{d}w,$$

where $\overset{*}{w}$ is foreign residents' wealth valued at the long-run exchange rate. To derive the last relationship, sum eqs. (2) in deviation form and cancel the terms involving $\mathrm{d}E$.

A variable with a d in front of it represents the deviation of that variable from its long-run value. p and e are the natural logarithms of P and E so that $\mathrm{d}p = \mathrm{d}P/\bar{P}$ and $\mathrm{d}e = \mathrm{d}E/\bar{E}$, and $\bar{P}$ and $\bar{E}$ are set equal to one for convenience.[12]

3.2. Stability analysis under static expectations

We use two schedules in the analysis of stability under static expectations. Examples of these two schedules appear in fig. 1. The $\dot{w}$ schedule shows the pairs of w and e that are compatible with both zero saving and goods market equilibrium. The A_S schedule shows the pairs of w and e that are compatible with asset market equilibrium under static expectations.

The $\dot{w}$ schedule is referred to as the zero saving schedule. The first step in deriving the relationship between w and e represented by this schedule is to solve (12) for $\mathrm{d}p$ and substitute the result into (13) to obtain:[13]

$$\dot{w} = \psi(b - \overset{*}{b})\bar{W}\bar{\overset{*}{W}}\,\mathrm{d}e - \psi(\bar{W} + \bar{\overset{*}{W}})\,\mathrm{d}w, \tag{14}$$

where

$$\psi = S'\overset{*}{S}{}'/(S'\bar{W} + \overset{*}{S}{}'\bar{\overset{*}{W}}) > 0. \tag{15}$$

The second step is to set $\dot{w}$ equal to zero.

[12]A version of the conventional small-country portfolio balance model with static expectations can be obtained as a limiting case of our model. Dividing eqs. (11), (12) and (13) by $\bar{w}$ noting that $\bar{w} = \bar{W}$ and $\mathrm{d}\overset{*}{p} = \mathrm{d}p - \mathrm{d}e$ yields

$$[b(1-b) + \overset{*}{b}(1-\overset{*}{b})(\bar{\overset{*}{W}}/\bar{W})]\,\mathrm{d}e + (b - \overset{*}{b})(\mathrm{d}w/\bar{w}) = 0, \tag{11'}$$

$$[S' + \overset{*}{S}{}'(\bar{\overset{*}{W}}/\bar{W})]\,\mathrm{d}\overset{*}{p} + [S'b + \overset{*}{S}{}'\overset{*}{b}(\bar{\overset{*}{W}}/\bar{W})]\,\mathrm{d}e - (S' - \overset{*}{S}{}')(\mathrm{d}w/\bar{w}) = 0, \tag{12'}$$

$$\dot{w}/\bar{w} = S'\,\mathrm{d}\overset{*}{p} + S'b\,\mathrm{d}e - S'(\mathrm{d}w/\bar{w}). \tag{13'}$$

The state variable is $w/\bar{w}$. Suppose that the home country becomes small in the sense that $\bar{\overset{*}{W}}/\bar{W} \to \infty$. Suppose also that the home country remains large in the home money market in the sense that as $\bar{\overset{*}{W}}/\bar{W} \to \infty$ changes in e continue to lead to finite changes in the demand for home money [$\overset{*}{b}(\bar{\overset{*}{W}}/\bar{W}) \to m$, where m is a finite constant]. It follows that the home country becomes small in the goods market in the sense that $\overset{*}{p}$ must remain unaffected by changes in e and $w/\bar{w}$. Thus, $\overset{*}{p}$ can be taken as exogenous, and eq. (12′) can be ignored. With $\mathrm{d}\overset{*}{p} = 0$, eqs. (11′) and (13′) constitute a version of the conventional small-country portfolio balance model. Limiting small-country versions of our model can also be obtained for the cases of regressive and rational expectations by making the additional assumption that as $\bar{\overset{*}{W}}/\bar{W} \to \infty$, $\overset{*}{b}{}'(\bar{\overset{*}{W}}/\bar{W}) \to n$, where n is a finite constant.

Our approach to obtaining small-country versions of a portfolio balance model rests on less restrictive assumptions than the usual approaches. Conventionally it is assumed either that foreign residents do not hold the home money or that their holdings are invariant to changes in their wealth and changes in the expected depreciation of the home currency ($\overset{*}{b} = \overset{*}{b}{}' = 0$). Under either conventional assumption the usual state variable F can be used instead of $w/\bar{w}$ since all changes in home residents' wealth must take the form of changes in their holdings of foreign currency.

[13]Note that $\bar{\overset{*}{F}}\bar{B} - \bar{F}\bar{\overset{*}{B}} = (1-\overset{*}{b})b\bar{W}\bar{\overset{*}{W}} - (1-b)\overset{*}{b}\bar{W}\bar{\overset{*}{W}} = (b - \overset{*}{b})\bar{W}\bar{\overset{*}{W}}$.

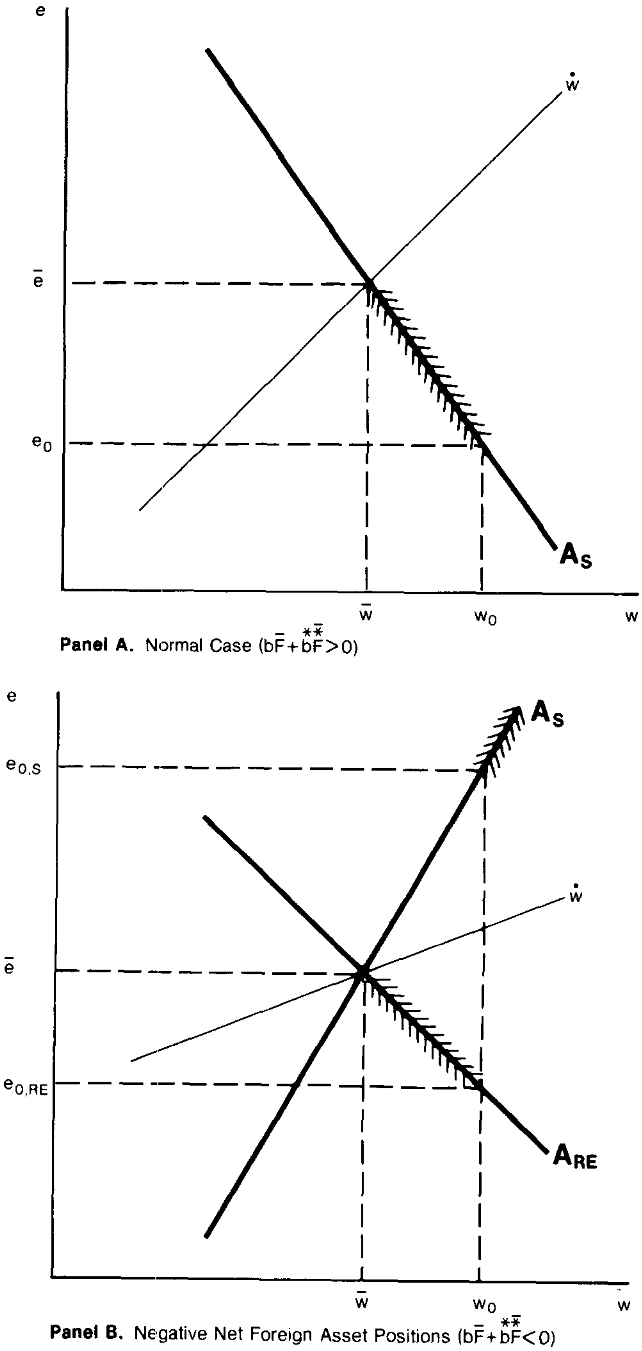


Fig. 1. Wealth transfer, static and regressive expectations.

The zero saving schedule is upward sloping, as in both panels of fig. 1, under the usual assumption (made everywhere in the text) that home residents hold a larger proportion of their wealth in home money than do foreign residents ($b>\mathring{b}$).[14] An increase in w represents a transfer of wealth from foreigners to home residents which reduces home savings.[15] Since $b>\mathring{b}$, a depreciation of the home currency (a rise in e) is required to raise home savings back to zero.[16]

The A_S schedule is referred to as the asset market equilibrium schedule under static expectations. The relationship between w and e represented by this schedule is given by eq. (11). 'Perverse' valuation effects that may be associated with negative net foreign asset positions have their impact through this relationship.

The asset market equilibrium schedule under static expectations is downward sloping, as in panel A, in the 'normal' case. In this case normal valuation effects dominate any perverse valuation effects ($b\bar{F}+\mathring{b}\mathring{\bar{F}}>0$). As shown by (11), since $b>\mathring{b}$, an increase in w raises the demand for home money. An appreciation of the home currency (a fall in e) is required to reduce home money demand to its previous level. However, the A_S schedule is upward sloping, as in panel B, in the perverse case. In this case perverse

[14]If $b<\mathring{b}$, the $\dot{w}$ schedule is downward sloping. See footnote 19.

[15]As shown by (13) the transfer causes home savings to decline directly. It also has an indirect effect on home savings though its effect on the price level required to clear the market for the world good. As is evident from (12), there are two cases to consider. If $S'<\mathring{S}'$ so that the decrease in home savings is smaller than the increase in foreign savings, then the price level must decline in order to maintain equilibrium in the market for the world good. As shown by (13), this decline further reduces home savings. Alternatively, if $S'>\mathring{S}'$, then the price level must rise. However, this price level rise is not large enough to raise home savings back up to their pre-transfer level. If the price level rise were this large, there would be excess supply in the world goods market because foreign savings would be higher than their pre-transfer value.

[16]There are three cases to consider. First, suppose $\bar{F}>0$ and $S'\bar{F}+\mathring{S}'\mathring{\bar{F}}>0$. Then, as shown by (13), a depreciation causes home savings to decline directly. However, since the depreciation also lowers foreign savings, the price level must rise in order to maintain equilibrium in the market for the world good as shown by (12). The increase in home savings induced indirectly by this rise in the price level more than offsets the direct decline. If the price level rose only by enough to keep home savings unchanged [$\mathrm{d}p=(\bar{F}/\bar{W})\mathrm{d}e>0$], there would still be an excess demand for the world good. Foreign saving would have fallen $\{[\mathring{\bar{W}}(\bar{F}/\bar{W})-\mathring{\bar{F}}]\mathrm{d}e<0\}$ because the proportion of foreign money in foreign portfolios ($\mathring{\bar{F}}/\mathring{\bar{W}}=1-\mathring{b}$) is larger than the proportion of foreign money in domestic portfolios ($\bar{F}/\bar{W}=1-b$) since $b>\mathring{b}$. Second, suppose $\bar{F}<0$ and $S'\bar{F}+\mathring{S}'\mathring{\bar{F}}>0$. Then the depreciation causes home savings to rise both because of its direct effect and because of its indirect effect through the induced rise in the price level. Third, suppose $\bar{F}<0$ and $S'\bar{F}+\mathring{S}'\mathring{\bar{F}}<0$. Then the depreciation causes home savings to rise directly, but it also causes the price level to fall. However, the positive direct effect of the depreciation on home savings dominates the negative indirect effect of the induced price level decline. If the price level declined by enough to keep home savings unchanged, there would be an excess demand for the world good since foreign savings would have fallen.

valuation effects dominate any normal valuation effects $(b\bar{F}+\overset{*}{b}\bar{\overset{*}{F}}<0)$. An increase in w must be matched by a depreciation of the home currency.[17]

Valuation effects always satisfy the restriction required for the normal case if there are no negative net foreign asset positions $(\bar{F},\overset{*}{b}>0)$. When $\bar{F}$ and $\overset{*}{b}$ are positive, an appreciation unambiguously lowers the demand for home money because it lowers home and foreign wealth. Valuation effects may violate the restriction required for the normal case if either home residents or foreign residents have a negative net foreign asset position and definitely violate this restriction if both groups have negative net foreign asset positions. If home residents have a negative net foreign asset position $(\bar{F}<0)$, an appreciation raises their wealth and, therefore, increases their demand for home money. If foreign residents have a negative net foreign asset position $(\overset{*}{b}<0)$, an appreciation lowers their wealth. However, their demand for home money rises as their wealth falls.

We investigate the stability of long-run equilibrium by analyzing an unanticipated transfer of wealth from foreign residents to home residents. This particular disturbance is convenient because, as has been demonstrated above, it leaves the long-run equilibrium values of the endogenous variables unchanged. Furthermore, recent commodity price increases have generated substantial interest in the effects of this kind of disturbance.

Stationary equilibrium is unambiguously stable under static expectations in the normal case. This result can be demonstrated with the use of panel A. Suppose that there is a one-time wealth transfer to home residents from foreign residents, causing the initial value of w, w_0, to rise above $\bar{w}$. From eq. (14) it follows that the direct effect of a positive $\mathrm{d}w$ is to cause $\dot{w}$ to become negative. The transfer also has an indirect effect on $\dot{w}$ through the change in the exchange rate required to clear the home money market. Since the home money market always clears, the initial value of the exchange rate must be the one implied by the A_S schedule when $w=w_0$. From eq. (11) it follows that if $\mathrm{d}w>0$, the home currency must appreciate relative to its long-run equilibrium value $(\mathrm{d}e<0)$ since the transfer increases the demand for home money. Thus, the indirect effect of the transfer through the induced appreciation of the home currency reinforces the direct effect in causing a negative $\dot{w}$. The economy proceeds along the A_S schedule until it reaches long-run equilibrium.

Stationary equilibrium is definitely unstable in the perverse case. This result can be demonstrated with the use of panel B. Once again, the direct effect of the transfer is to cause $\dot{w}$ to become negative. Just as in the normal case, the transfer raises the demand for home money. However, in contrast to the normal case, a depreciation of the home currency is required to restore equilibrium in the home money market. Furthermore, the indirect effect of

[17]If $\dot{b}<\overset{*}{b}$, the A_S schedule is either upward or downward sloping as $b\bar{F}+b\bar{\overset{*}{F}}\gtreqless 0$. See footnote 19.

the transfer on home savings through the induced depreciation more than offsets the direct effect, so the net effect is a positive $\dot{w}$. In terms of panel B, the A_S schedule is steeper than the $\dot{w}$ schedule.[18] The economy moves away from stationary equilibrium along A_S.[19]

The stability properties of the model under static expectations can be summarized by solving (11) for de and substituting the result into (14) to obtain[20]

$$\dot{w} = -\psi[\tilde{B}\tilde{F}/(b\bar{F} + \overset{*}{b}\bar{\overset{*}{F}})]\,\mathrm{d}w. \tag{16}$$

Stationary equilibrium is locally unstable ($\mathrm{d}\dot{w}/\mathrm{d}w > 0$) if and only if perverse valuation effects dominate any normal valuation effects ($b\bar{F} + \overset{*}{b}\bar{\overset{*}{F}} < 0$). Since stationary equilibrium is unique, local instability implies global instability.

4. The model with regressive expectations

In this section the assumption that private agents have static expectations is replaced with the assumption that they have *ad hoc* regressive expectations so that $\varepsilon = \theta(1 - E/\bar{E})$, where $\theta > 0$. Under regressive expectations it is more likely that a transfer of wealth to home residents will cause the home currency to appreciate initially and that stationary equilibrium will be stable.

Under regressive expectations there is a change in the asset market equilibrium schedule. This schedule is again derived from the deviation form of the home money market equilibrium condition (4), which becomes

$$[(1/\phi)\theta + (b\bar{F} + \overset{*}{b}\bar{\overset{*}{F}})]\,\mathrm{d}e + (b - \overset{*}{b})\,\mathrm{d}w = 0, \tag{17}$$

[18]The slope of the A_S schedule minus the slope of the $\dot{w}$ schedule is equal to $-V/Z$, where

$$V = (b - \overset{*}{b})^2 \bar{W}\bar{\overset{*}{W}} + (b\bar{F} + \overset{*}{b}\bar{\overset{*}{F}})(\bar{W} + \bar{\overset{*}{W}}) = \tilde{B}\tilde{F} > 0,$$

$$Z = (b - \overset{*}{b})\bar{W}\bar{\overset{*}{W}}(b\bar{F} + \overset{*}{b}\bar{\overset{*}{F}}).$$

Therefore, $\mathrm{sgn}(-V/Z) = -\mathrm{sgn}(Z)$. If $b\bar{F} + \overset{*}{b}\bar{\overset{*}{F}} < 0$ so that both the A_S and $\dot{w}$ schedules have positive slopes as in panel B, then $Z < 0$, so the A_S schedule is steeper.

[19]Long-run equilibrium is definitely stable in another perverse case, the case in which valuation effects are normal ($b\bar{F} + \overset{*}{b}\bar{\overset{*}{F}} > 0$) but net foreign asset holdings are 'large' ($b < \overset{*}{b}$). In this case the $\dot{w}$ schedule is downward sloping and the A_S schedule is upward sloping. As before, the direct effect of the transfer is to cause $\dot{w}$ to become negative. In contrast to the normal case, the home currency must depreciate ($\mathrm{d}e > 0$) since the transfer reduces the demand for home money. However, with $\overset{*}{b} > b$ a depreciation of the home currency also reduces home savings, so once again the indirect effect of the transfer through the induced change in the exchange rate reinforces the direct effect in causing a negative $\dot{w}$. The 'perverse' asset market effect is offset by the 'perverse' effect of the exchange rate on home savings. Thus, the Enders (1977) problem of instability caused by large net foreign asset positions cannot arise in our model. The results for this case are intuitively appealing because the assumption that $\overset{*}{b} > b$ simply implies that the roles of home and foreign residents in the analysis are reversed; transferring wealth to home residents in this case is like transferring wealth to foreign residents in the normal case.

[20]The numerator of the fraction in brackets in (16) is equal to the V of footnote 18.

where

$$\phi = -1/(b'\bar{W} + \overset{*}{b}'\bar{\overset{*}{W}}) > 0, \tag{18}$$

since b', $\overset{*}{b}' < 0$. Whatever its impact through valuation effects, a depreciation of the home currency relative to its long-run equilibrium level ($\mathrm{d}e > 0$) is more likely to increase demand for home money because of the expectations effect. A depreciation causes private agents to expect the home currency to appreciate and, therefore, to increase their demand for home money $[(1/\phi)\theta > 0]$. Consider the perverse case represented in panel B of fig. 1 ($b\bar{F} + \overset{*}{b}\bar{\overset{*}{F}} < 0$). Under static expectations the asset market equilibrium schedule is upward sloping and steeper than the $\dot{w}$ schedule. However, under regressive expectations, if the expectations effect is strong enough $[(1/\phi)\theta + (b\bar{F} + \overset{*}{b}\bar{\overset{*}{F}}) > 0]$, the asset market equilibrium schedule represented by A_{RE} is downward sloping.

Results obtained under static expectations may be reversed under regressive expectations. In the case of panel B, under static expectations a transfer of wealth to home residents causes the home currency to depreciate initially, and long-run equilibrium is unstable. However, when the effect of regressive expectations is strong enough that the A_{RE} schedule is downward sloping, the home currency appreciates initially, and stationary equilibrium is stable.

The stability properties of the model under regressive expectations can be summarized by solving (17) for $\mathrm{d}e$ and substituting the result into (14) to obtain[21]

$$\dot{w} = -\psi\{[\tilde{B}\bar{F} + (1/\phi)\theta(\bar{W} + \bar{\overset{*}{W}})]/[(1/\phi)\theta + (b\bar{F} + \overset{*}{b}\bar{\overset{*}{F}})]\}\,\mathrm{d}w. \tag{19}$$

If stationary equilibrium is stable under static expectations ($b\bar{F} + \overset{*}{b}\bar{\overset{*}{F}} > 0$), it must also be stable under regressive expectations.[22] However, even if stationary equilibrium is unstable under static expectations ($b\bar{F} + \overset{*}{b}\bar{\overset{*}{F}} < 0$), it is stable under regressive expectations if the expectations effect is strong enough $[(1/\phi)\theta + (b\bar{F} + \overset{*}{b}\bar{\overset{*}{F}}) > 0]$.

5. The model under rational expectations

In this section it is assumed that private agents have rational expectations so that $\varepsilon = \dot{e}$. Under rational expectations stationary equilibrium is always

[21]The first term in the numerator of the fraction in brackets in (19) is equal to the V of footnote 18.

[22]However, regressive expectations can cause an unstable positive root to become more positive. If $(1/\phi)\theta + (b\bar{F} + \overset{*}{b}\bar{W}) < 0$ so that the root of (19) is positive, increased in $(1/\phi(\theta)$ make the root more positive.

saddle-point stable. If speculation is stabilizing in a sense to be defined below, stationary equilibrium is definitely stable whether or not perverse valuation effects that arise from negative net foreign asset positions dominate any normal valuation effects. However, if speculation is destabilizing, stationary equilibrium is unstable. Thus, under rational expectations, whether stationary equilibrium is stable depends only on whether speculation is stabilizing.

Under rational expectations the approximation of the home money market equilibrium condition (4) becomes

$$-(1/\phi)\dot{e}+(b\bar{F}+\overset{*}{b}\bar{\overset{*}{F}})\,\mathrm{d}e+(b-\overset{*}{b})\,\mathrm{d}w=0. \tag{20}$$

Of course, it is impossible to obtain a unique relationship between w and e that is compatible with money market equilibrium without first solving for $\dot{e}$.

In order to determine $\dot{e}$, it is necessary to solve the system of two differential equations made up of eqs. (20) and (14). This system can be written in matrix form as

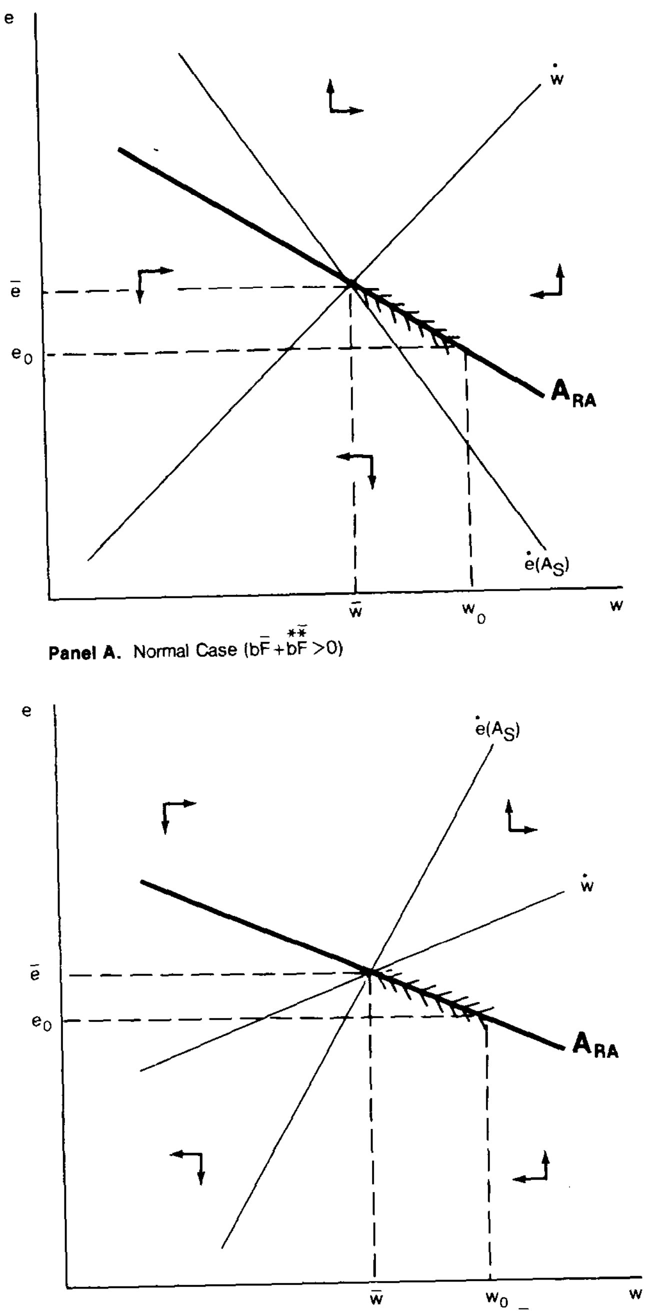
$$\begin{bmatrix} \dot{e} \\ \dot{w} \end{bmatrix} = \begin{bmatrix} \phi(b\bar{F}+\overset{*}{b}\bar{\overset{*}{F}}) & \phi(b-\overset{*}{b}) \\ \psi(b-\overset{*}{b})\bar{W}\bar{\overset{*}{W}} & -\psi(\bar{W}+\bar{\overset{*}{W}}) \end{bmatrix} \begin{bmatrix} \mathrm{d}e \\ \mathrm{d}w \end{bmatrix}. \tag{21}$$

Panel A of fig. 2 is a phase diagram for system (21). It is constructed under the assumption that $b\bar{F}+\overset{*}{b}\bar{\overset{*}{F}}>0$. Under rational expectations the $\dot{w}$ schedule has the same interpretation as it has under static and regressive expectations. The $\dot{e}$ schedule shows the pairs of w and e that are compatible with home money market equilibrium when the rate of depreciation is zero. It coincides with the home money market equilibrium schedule under static expectations and is derived by setting $\dot{e}=0$ in (20). For a given w, a value of e higher than the one on the $\dot{e}$ schedule leads to an excess demand for money, so $\dot{e}$ must be positive if the home money market is to be in equilibrium. Panel B of fig. 2 is a phase diagram for system (21) under the assumption that $b\bar{F}+\overset{*}{b}\bar{\overset{*}{F}}<0$.

As the arrows in panel A and panel B indicate, stationary equilibrium is a saddle point under rational expectations. Let A represent the matrix of coefficients of system (21). Since the determinant of A is negative,

$$\det A=-\psi\phi\tilde{\bar{B}}\tilde{\bar{F}}<0, \tag{22}$$

the two roots of the characteristic equation of system (21) are real, distinct, and of opposite sign, so stationary equilibrium is a saddle point. What is remarkable is that this result holds not only in the normal case but also in



Panel A. Normal Case $(b\bar{F}+\overset{**}{b}\bar{F}>0)$

Panel B. Negative Net Foreign Asset Positions $(b\bar{F}+\overset{**}{b}\bar{F}<0)$

Fig. 2. Wealth transfer, rational expectations.

the perverse case. It is usual to find that if stationary equilibrium is stable under static expectations, it is a saddle point under rational expectations. However, in our model stationary equilibrium is a saddle point under rational expectations even if it is unstable under static expectations.[23]

The negative and positive roots are given by λ_1 and λ_2 respectively:

$$\lambda_1 = C - D, \tag{23}$$

$$\lambda_2 = C + D, \tag{24}$$

where

$$C = \tfrac{1}{2}[\phi(b\bar{F} + \overset{*}{b}\bar{\overset{*}{F}}) - \psi(\bar{W} + \bar{\overset{*}{W}})],$$

$$D = [C^2 + \phi\psi\tilde{B}\tilde{F}]^{1/2} = [H^2 + \phi\psi(b - \overset{*}{b})^2\bar{W}\bar{\overset{*}{W}}]^{1/2},$$

$$H = \tfrac{1}{2}[\phi(b\bar{F} + \overset{*}{b}\bar{\overset{*}{F}}) + \psi(\bar{W} + \bar{\overset{*}{W}})].$$

The A_{RA} schedule in panel A represents the stable arm of system (21) when $b\bar{F} + \overset{*}{b}\bar{\overset{*}{F}} > 0$, and the A_{RA} schedule in panel B represents the stable arm when $b\bar{F} + \overset{*}{b}\bar{\overset{*}{F}} < 0$. The stable arm is the path the economy must follow after a disturbance if it is to reach stationary equilibrium. Let w_0 and e_0 represent the values of w and e immediately following a disturbance. Given w_0, stationary equilibrium is stable if and only if e_0 is chosen so that the solutions for e and w do not involve the positive root (λ_2), in which case

$$\mathrm{d}e_t = \mathrm{d}w_0 J \exp(\lambda_1 t), \tag{25}$$

$$\mathrm{d}w_t = \mathrm{d}w_0 \exp(\lambda_1 t). \tag{26}$$

(Jk, k) is the characteristic vector corresponding to λ_1 where

$$J = \phi(b - \overset{*}{b})/[\lambda_1 - \phi(b\bar{F} + \overset{*}{b}\bar{\overset{*}{F}})], \tag{27}$$

and k is an arbitrary constant. The equation of the stable arm is the relationship between e and w implied by (25) and (26):

$$\mathrm{d}e = J\,\mathrm{d}w. \tag{28}$$

[23]It is possible to construct models with stationary equilibria that are definitely locally unstable under both static and rational expectations. One example is a modified version of the model of Dornbusch (1976) in which the Marshall–Lerner condition is violated ($\delta < 0$) and the money supply is deflated by a price index that includes the exchange rate.

Since $b>\overset{*}{b}$, the stable arm is always downward sloping no matter what the sign of $b\bar{F}+\overset{*}{b}\bar{\overset{*}{F}}$ because

$$\lambda_1-\phi(b\bar{F}+\overset{*}{b}\bar{\overset{*}{F}})=-H-[H^2+\psi\phi(b-\overset{*}{b})^2\bar{W}\bar{\overset{*}{W}}]^{1/2}<0. \tag{29}$$

The A_{RA} schedules in panel A and panel B can also be interpreted as the asset market equilibrium schedules under rational expectations when $\dot{e}$ is consistent with stability of long-run equilibrium. If the solution for e is given by (25), then

$$\dot{e}=\lambda_1\,\mathrm{d}e. \tag{30}$$

Substituting (30) into (20) yields (28).

Now we define stabilizing and destabilizing speculation. Suppose that immediately after a transfer of wealth to home residents the value of w is w_0 in panel A or panel B. w can only adjust gradually over time through current account deficits or surpluses. However, under rational expectations the exchange rate jumps to clear the home money market, just as it did under static and regressive expectations. If the bidding of market participants causes the exchange rate to jump to e_0, the exchange rate on the A_{RA} schedule corresponding to w_0, it will be said that speculation is stabilizing. When speculation is stabilizing the home currency appreciates, and stationary equilibrium is stable no matter what the sign of $b\bar{F}+\overset{*}{b}\bar{\overset{*}{F}}$. It the exchange rate remains unchanged at $\bar{e}$ or jumps to any value other than e_0, it will be said that speculation is destabilizing. When speculation is destabilizing, stationary equilibrium is unstable, as indicated by the arrows in panel A and panel B. Under rational expectations instability can arise only because of destabilizing speculation and not because of perverse valuation effects associated with negative net foreign asset positions.

Destabilizing speculation is not ruled out by the assumptions made thus far. However, it is now conventional in rational expectations models to impose the additional assumption that speculation is stabilizing.[24] Assuming stabilizing speculation makes sense in our model since private agents in at least one country would probably want to avoid the situation that would result if the world economy followed any path other than the stable arm. It can be shown that along any path that began above e_0, there would come a

[24]Sargent (1973) argues that it is sensible to impose this 'no speculative bubbles' assumption. Kouri (1976) and Calvo and Rodriguez (1977) make it in models of the same general type as ours. Whether unstable paths can be ruled out because they are suboptimal in monetary models based on explicit utility maximization is an open question addressed by Brock (1975), Obstfeld and Rogoff (1981), and Gray (1982).

time after which home real wealth would always be falling.[25] As home real wealth fell farther below target real wealth, home saving would increase. However, home consumption could never fall below zero.[26] It can be shown that if home consumption reached zero in finite time, it would remain at this lower limit forever, and home real wealth would never again rise above the level it attained when consumption first reached its lower limit.[27] Thus, home residents would probably want to avoid paths that began above e_0. A similar line of argument leads to the conclusion that foreign residents would probably want to avoid paths that began below e_0.

6. Learning and stability

In the previous section we described the effects of an unanticipated wealth transfer when private agents have rational expectations and immediately recognize that the transfer is permanent. Here we sketch out what happens when private agents with rational expectations have imperfect information, and therefore take time to discover that the wealth transfer is indeed permanent. Our brief discussion indicates that if speculation is stabilizing, then the model is stable even if agents are not instantaneously fully informed.

Recall the analysis of a one-time permanent wealth transfer from foreign residents to home residents. The path the system follows under full information is a part of the A_{RA} schedule in fig. 3. First the economy jumps from $\bar{a}$ to a_0, and then it moves slowly back along the A_{RA} schedule to $\bar{a}$.

Now suppose that agents live in a world of ongoing wealth transfers. Some of these wealth transfers are permanent and some are transitory; agents are able to distinguish between the two possibilities only through inference.[28] The extent to which any given wealth transfer is inferred to be permanent depends on the relative variance of the two types of transfers.[29] So even

[25]Proofs of the correctness of this assertion and the one made later in this paragraph are available from the authors on request.

[26]The lower limit on home consumption might be a subsistence level above zero.

[27]The discussion in the text is based on the assumption that home consumption would reach its lower limit when real wealth was still positive. This assumption is required because, as it stands, our model makes sense only when real wealth in both countries is positive. However, the model could be modified to make possible consideration of negative values of real wealth for one country or the other. In the modified model it would be possible to consider paths along which home consumption approached its lower bound asymptotically and home real wealth declined without limit.

[28]Private agents would behave in an analogous way in the face of another shock, such as a world central bank intervention operation or a disturbance to exogenous real income, which they thought might be either permanent or temporary.

[29]This section draws on results which have been derived when learning behavior is modeled as a Kalman filter problem. An early application of this approach in an open economy context is Mussa (1975). When learning behavior is modeled in this way, the economy reaches an ergodic state where the endogenous variables fluctuate around the full information path. While the short-run dynamics are quite different in the learning case, the long-run dynamic stability of the economy is unaffected.

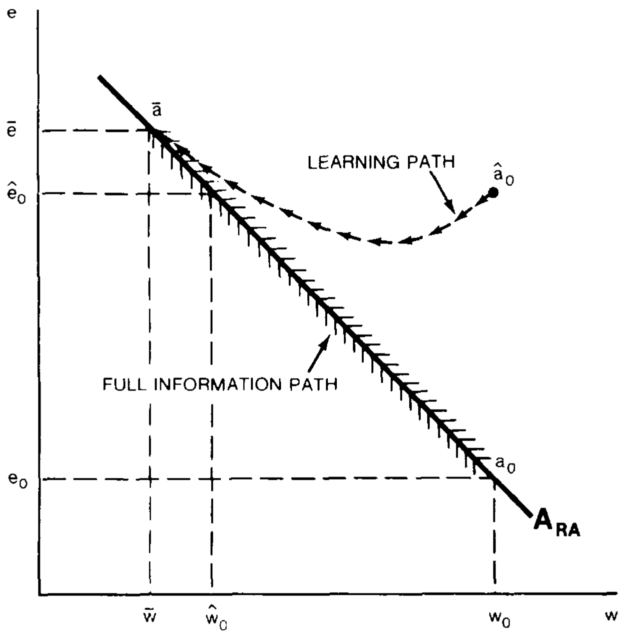


Fig. 3. Permanent wealth transfer, rational expectations $(b\bar{F}+\dot{b}\bar{F}\gtreqless 0)$.

when faced with a truly permanent transfer, such as the one under consideration, rational agents will optimally, albeit incorrectly, infer that a part of the transfer is temporary.

The dashed line in fig. 3, designated as the learning path, represents one type of path the economy might follow in the absence of further disturbances. Actual post-transfer wealth valued at the long-run equilibrium exchange rate is w_0. However, agents condition their behavior on the smaller $\hat{w}_0$ because their best guess is that a portion of the transfer, $w_0-\hat{w}_0$, will be immediately reversed. The exchange rate at time zero, $\hat{e}_0$, is therefore the same exchange rate that would obtain under full information if this portion of the transfer really was going to be reversed. Thus, under imperfect information, the economy jumps initially to $\hat{a}_0$. Subsequent movements along the learning path reflect not only a decumulation of assets but also agents' gradual recognition that no part of this particular transfer is going to be reversed. On the learning path in fig. 3, downward exchange rate movements resulting from expectations revisions initially dominate upward exchange movements resulting from asset decumulation. A monotonic approach to equilibrium is also possible and is more likely the larger is the variance of permanent transfers relative to the variance of transitory transfers. Of course, $\hat{e}_0$ must always be above the initial full information exchange rate, e_0, and the exchange rate on the learning path can never be higher than $\bar{e}$.

7. Conclusions

In this paper a two-country portfolio balance model is developed. This symmetrically-specified model is employed to provide some perspective on the stability problem associated with negative net foreign asset positions. In theoretical work on portfolio balance models, this problem has been regarded as a worrisome possibility, and in empirical applications it has been treated as a major practical difficulty.

We conclude that negative net foreign asset positions do not constitute an independent source of instability. Instability can arise only under nonrational expectations or because of destabilizing speculation. Others have shown, and we have confirmed, that negative net foreign asset positions in conjunction with static or regressive expectations can cause instability. Our central result, which holds whether or not there are negative net foreign asset positions, is that under rational expectations long-run equilibrium is always stable if and only if private agents bid the exchange rate to one particular value immediately following a disturbance. If agents do not bid the exchange rate to the proper value, we say speculation is destabilizing.

While instability may arise in some cases, we believe we have provided good reasons for doubting that these are the most important cases. Expectations might not be rational. But then private agents would either neglect information that they have or fail to learn efficiently from their systematic forecast errors. Of course, even if expectations are rational, speculation might not be stabilizing. Our model, like those of other contributors to the negative net foreign assets stability debate, is not built up from an explicit description of individuals' maximizing behavior, so we cannot prove that the paths resulting from destabilizing speculation are definitely suboptimal. However, we report that such paths are certainly very unusual.

The stability analysis provides the basis for two further conclusions. First, there is a type of transfer problem that can only arise if our model is dynamically unstable. Under nonrational expectations a transfer of nominal wealth from foreigners to home residents leads to an instantaneous net reduction in home residents' real wealth if and only if the model is unstable because of negative net foreign asset positions. Under rational expectations this type of transfer problem can only arise if speculation is destabilizing. Second, under rational expectations and stabilizing speculation, both the short-run and long-run qualitative effects of wealth transfers are the same with or without negative net foreign asset positions. Thus, there is no presumption that a transfer of wealth to Canadian residents will lead to a depreciation of the Canadian dollar just because these agents have a negative net U.S. dollar asset position, even though such a depreciation is a possibility in a static expectations model.

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