

Anticipated budget deficits and the real exchange rate

MICHAEL B. DEVEREUX University of British Columbia

Abstract. This paper explores the relationship between government budget deficits and the real exchange rate. While the conventional view is that a deficit generates real exchange rate appreciation, the experience of many small economies appears to contradict this belief. In this model, the impact of an announced future deficit depends on the elasticity of intertemporal substitution. If it is high, an announced deficit gives rise to immediate real exchange rate appreciation, a deterioration in the trade balance, and a fall in welfare of current generations. When a low elasticity of intertemporal substitution exists, however, an announced deficit may generate a real depreciation, with the opposite impact on the trade balance and welfare. Moreover, in this case, the announcement of a future deficit will increase the intertemporal volatility of the real exchange rate but leave its average value unaffected.

Déficits budgétaires anticipés et taux de change réel. Ce mémoire explore la relation entre les déficits budgétaires anticipés des gouvernements et le taux de change réel. Si, pour la sagesse conventionnelle, un déficit engendre une appréciation du taux de change réel, l'expérience de plusieurs petites économies ouvertes semble contredire cette proposition. Dans ce modèle, l'impact d'un déficit futur annoncé dépend de l'élasticité de substitution intertemporelle. Si celle-ci est grande, un déficit annoncé entraîne immédiatement une appréciation du taux de change réel, une détérioration de la balance commerciale et une baisse dans le niveau de bien-être des générations présentes. Si l'élasticité de substitution intertemporelle est faible, un déficit annoncé peut engendrer un dépréciation du taux de change réel et des effets inverses sur la balance commerciale et le niveau de bien-être. De plus, dans ce dernier cas, l'annonce d'un déficit anticipé va accroître la volatilité intertemporelle du taux de change réel, mais elle va laisser sa valeur moyenne inchangée.

1. INTRODUCTION

Much of Doug Purvis's research was concerned with the understanding of fiscal

This paper was prepared for the special issue of the *Canadian Journal of Economics* dedicated to the memory of Doug Purvis. I am grateful to a referee for comments. In addition, I thank the Social Sciences and Humanities Research Council of Canada for research support.

policy in an open economy. In particular, in his 1985 Innis Lecture (Purvis 1985) he addressed the question of the impact of government budget deficits. The model Doug employed was one in which government budget deficits, working through the failure of Ricardian equivalence, generated trade balance deterioration and real exchange rate appreciation in an open economy. This type of model remains the standard one for understanding the crowding-out effects of budget deficits in closed and open economy.¹

Do the predictions of this model accord with observation? This paper specifically focuses on the link between movements in the real exchange rate and anticipated budget deficits in an open economy. During the early 1980s, many commentators saw the rising U.S. deficit as a central cause of the appreciation of the U.S. dollar. Feldstein (1986) and Sachs (1986) put forward the point of view that the strength of the dollar was due to anticipated future budget deficits. Likewise, it has been suggested that the recent real depreciation of the U.S. dollar relative to the yen and d-mark may be partially due to anticipated reductions in the U.S. deficit.

Experience in Canada and other small economies, however, does not seem to support the view that anticipated future budget deficits are associated with real exchange rate appreciation. In fact, if anything, the opposite would seem to be true; the recent weakness in the Canadian dollar, for instance, has persistently been linked to pessimism about the path of future budget deficits.

This paper presents a theoretical model intended to highlight a link between the real exchange rate, the trade balance, and the anticipated future budget deficits. The paper follows the conventional non-Ricardian view of budget deficits, as espoused, for instance, in Persson (1985) or Frenkel and Razin (1987). According to this view, budget deficits operate primarily through wealth effects on aggregate demand. A budget deficit involves an increase in government dis-saving which is less than fully compensated for by a rise in private sector saving. The consequence is that interest rates rise, in a closed economy. In an open economy, the result is a combination of trade deficits and a real exchange rate appreciation.

To allow for real effects of budget deficits, we use an overlapping generations model of a small open economy. To allow for real exchange rate variation, we distinguish between the traded and non-traded goods sectors. It is assumed that the economy can borrow and lend at a fixed interest rate, determined in world capital markets. Government budget deficits affect consumption opportunities for domestic residents because the government balances its budget over a longer horizon than any domestic generations. Generations are intertemporally linked to one another through the non-traded goods market. This point is actually central to the results of the paper; anticipated future movements in the real exchange rate will affect present-day consumers through movement in the consumption-based real interest rate. The importance of the real exchange rate for interest rates was pointed out first in Dornbusch (1983).

The main exercise of the paper is to examine the effects of an announced future tax reduction on the current relative price of non-traded goods (which is

1 Devereux and Purvis (1990) develop a closely related argument.

the inverse of the real exchange rate). We think of it as capturing the impact of expected worsening of the government deficit position.

The results suggest that in contrast to the standard model of the deficit-real exchange rate linkage, there is no clear theoretical presumption that anticipated budget deficits are followed by real exchange rate appreciation, or by a rise in the trade balance deficit, even in a model economy in which Ricardian equivalence fails by design.² In fact, the model indicates that the causation may go either way. The critical determinant of the response of the real exchange rate to an expected increase in the future deficit is the elasticity of intertemporal substitution in consumer preferences.

If the elasticity of intertemporal substitution exceeds unity, the conventional view of the impact of budget deficits is borne out in the model. An anticipated future deficit signals a higher future relative price of non-traded goods. Substituting intertemporally, households generate an immediate increase in the non-traded goods price. In this case also, the trade balance deteriorates. Subsequently the real exchange rate continues to appreciate, the magnitude of trade deficits rises, up to the time when the deficit is enacted. Then the real exchange rate and the trade balance return to their initial steady state levels as taxes rise to repay the higher level of government debt.

In this case the welfare costs of future deficits actually are borne partially by current generations. Since the real exchange rate is appreciating during the periods preceding the deficit, the consumption-based real interest rate is *lower* for all generations alive at that time. As net savers, these generations lose out.

When the intertemporal elasticity of substitution is less than unity, the response to an announced future deficit is quite different. Beginning in a steady state, the announcement causes the real exchange rate to oscillate, above and below the initial steady-state level, in wider and wider margins up to the time that the deficit takes place. Thus, in this case, while the mean value of the real exchange rate is unchanged prior to the deficit, its intertemporal volatility rises.

The same pattern is seen in the trade balance. The initial response of the real exchange rate to the announced deficit can be one of appreciation or depreciation, depending upon the time remaining until the deficit takes place. The same oscillatory behaviour is seen in the consumption-based real interest rate. This pattern implies that in the periods preceding the deficit, some generations will gain in welfare terms, while some will lose, relative to the no-change steady state.

These results suggest that the link between anticipated budget deficits, the real exchange rate, and the trade balance is more complicated than conventional accounts would suggest, *even* in an environment where deficits matter through the standard non-Ricardian aggregated demand channel. While current deficits will always cause real appreciation and trade balance deterioration, the response to expected future deficits can be in the opposite direction.

² A contemporaneous budget deficit, in this model, will always cause a real exchange rate appreciation.

In the following section the model is outlined and the solution for the time path of non-traded goods prices is derived. In section III the main results are presented. Some brief conclusions follow.

II. MODEL AND SOLUTION

The structure of the economy is as follows. There are two goods; traded and non-traded, with fixed endowments of each at every time period.³ Domestic agents take the world interest rate as given and trade freely in international capital markets. The economy is populated with an infinite sequence of two-period lived households, with each generation overlapping for one period with the previous and succeeding generation. There is no population growth. Each generation, when young, receives a given endowment of each good. There is no endowment in old age, so young people must save to finance old-age consumption. This saving takes the form of direct lending to foreigners in return for foreign assets that carry a one-period return of r , and of selling the non-traded good to the domestic old generation, also in return for assets paying a return, denoted in traded goods, of r . An equilibrium in this economy gives a sequence of relative prices of non-traded goods. We denote the real exchange rate as the inverse of this relative price.

Each generation has preferences given by

$$U = \frac{C_t^{1-\sigma}}{1-\sigma} + \frac{D_t^{1-\sigma}}{1-\sigma}, \quad (1)$$

where $C_t = C_{Nt}^\alpha C_{Tt}^{1-\alpha}$, and $D_t = D_{Nt}^\alpha D_{Tt}^{1-\alpha}$. C_{it} is the consumption by generation t while young of good i , where T denotes the traded good and N the non-traded good, and D_{it+1} the corresponding consumption during old age. The intertemporal elasticity of substitution in preferences is measured by $1/\sigma$. The results will hinge mainly on whether this measure is greater or less than unity.

Generation t faces the budget constraint

$$P_t C_{Nt} + C_{Tt} + \frac{1}{1+r} (P_{t+1} D_{Nt+1} + C_{Tt+1}) = W_t, \quad (2)$$

where $W_t = P_t Y_N + Y_T - T_t$. The endowments Y_N and Y_T are assumed constant over time. P_t is the time t relative price of non-traded goods. We shall follow the convention of denoting the real exchange rate as the ratio of the rest of the world price index to the domestic countries price index. Since the rest of the world price index is being held constant, and the traded good is the numeraire, it follows that movements in the real exchange rate are inversely related to movements in P_t . The tax liability imposed by the government on the young of generation t is represented by T_t .

³ Allowing for endogenous production and capital accumulation would be possible, but it would make the model far more complicated.

Maximizing (1) subject to (2) gives the demand functions

$$C_{Nt} = \alpha \frac{W_t}{P_t} \left(1 + \left(\frac{1}{1+r} \left(\frac{P_{t+1}}{P_t} \right)^\alpha \right)^{\frac{(\sigma-1)}{\sigma}} \right)^{-1}$$

$$D_{Nt+1} = (1+r) \left(\frac{1}{1+r} \left(\frac{P_{t+1}}{P_t} \right)^\alpha \right)^{\frac{(\sigma-1)}{\sigma}} \frac{P_t C_{Nt}}{P_{t+1}}. \quad (3)$$

The term $[1/(1+r)][(P_{t+1} + 1)/P_t]^\alpha$ represents the consumption-based real interest factor. As non-traded goods consumption constitutes part of the consumption bundle, movements in its relative price between time periods alter the effective real interest rate faced by domestic households. When P_t is rising, effective real interest rates are lower than the world real interest rate r , and vice versa. The manner in which the real interest rate affects demand depends upon the sign of $[(\sigma - 1)/\sigma]$. When $\sigma < 1$, the elasticity of intertemporal substitution exceeds unity. The substitution impacts of a rise in the consumption-based real interest rate outweigh the income effects, and current demand *falls*. On the other hand, when $\sigma > 1$, income effects dominate substitution effects, and current demand rises.

The domestic government satisfies the intertemporal budget constraint given by

$$\sum_{t=0}^{\infty} T_t \left(\frac{1}{(1+r)^t} \right) = 0.$$

The government budget constraint extends over an infinite horizon. The timing of taxes will clearly matter in a non-Ricardian sense. To keep the model as simple as possible, we abstract from any direct government spending.

Using (3) we may describe market clearing for non-traded goods at time t by

$$Y_N = C_{Nt} + D_{Nt}. \quad (4)$$

The balance of trade surplus at time t is $Y_T - C_{Tt} - D_{Tt}$. Since the elasticity of substitution between consumption of traded and non-traded goods at any time period is unity, we may write

$$C_{Tt} = \left(\frac{1-\alpha}{\alpha} \right) P_t C_{Nt}$$

$$D_{Tt} = \left(\frac{1-\alpha}{\alpha} \right) P_t D_{Nt}.$$

Therefore, given (4), it follows that the balance of trade surplus is

$$Y_T - \left(\frac{1-\alpha}{\alpha} \right) P_t Y_N \quad (5)$$

Therefore, we have a particularly simple relationship between the real exchange rate and the trade surplus; a real appreciation will decrease the trade surplus, and a depreciation will raise the trade surplus.

The economy starts out at time 0, where we endow the old of generation -1 with a given stock of foreign assets, F_0 , paying an interest rate of r , which may be used to purchase either good. Thus, at time 0 the following initial condition must hold

$$P_0 Y_N = P_0 C_{N0} + \alpha F_0 (1 + r). \quad (6)$$

Substituting (3) into (4) we obtain a second-order non-linear difference equation in P_t , given by

$$\begin{aligned} P_t Y_N = & \alpha (P_t Y_N + Y_T - T_t) \left(1 + \left(\frac{1}{1+r} \left(\frac{P_{t+1}}{P_t} \right)^\alpha \right)^{\frac{(\sigma-1)}{\sigma}} \right)^{-1} \\ & + (1+r) \alpha (P_{t-1} Y_N + Y_T - T_{t-1}) \left(\frac{1}{1+r} \left(\frac{P_{t+1}}{P_t} \right)^\alpha \right)^{\frac{(\sigma-1)}{\sigma}} \\ & \times \left(1 + \left(\frac{1}{1+r} \left(\frac{P_t}{P_{t-1}} \right)^\alpha \right)^{\frac{(\sigma-1)}{\sigma}} \right)^{-1}. \end{aligned} \quad (7)$$

In the case of $T_t = 0$, for all t , there is a unique steady-state solution for the price, given by

$$\begin{aligned} \bar{P} &= \frac{\alpha \theta}{1 - \alpha \theta} \frac{Y_T}{Y_N} \\ \theta &= \frac{1 + (1+r)^{\frac{1}{\sigma}}}{(1 + (1+r)^{\frac{1-\sigma}{\sigma}})}. \end{aligned}$$

Assuming that the economy is in a steady state at the initial time 0, we may linearize (7) around the steady state and use the initial condition (6) to solve for the response of the real exchange rate in terms of deviations from its long-run level. A natural simplifying assumption to make is that the interest rate is equal to the golden rule rate, that is, $r = 0$. This assumption implies that the steady-state trade balance is zero.

The appendix describes details of the linear approximation. The resulting equation is

$$\begin{aligned} \left(1 - \alpha/2 \left(1 + \left(\frac{\sigma-1}{\sigma} \right) \right) \right) p_t - \alpha/2 \left(1 - \left(\frac{\sigma-1}{2\sigma} \right) \right) p_{t-1} \\ + \alpha/2 \left(\frac{\sigma-1}{\sigma} \right) p_{t+1} = -\alpha/2 X(t), \end{aligned} \quad (8)$$

where $p_t = \log P_t - \log \bar{P}$, and $X(t) = (1/\bar{P}Y_N)(T_{t-1} + T_t)$. Note that this approximation requires taxes to be in levels, since the initial value of T is zero.

At time 0, the initial condition (6) applies. The linearization of this condition gives

$$(1 - \alpha/2(1 + (\sigma - 1/\sigma)))p_0 + \alpha/4 \left(\frac{\sigma - 1}{\sigma} \right) p_1 = -\frac{\alpha}{2\bar{P}Y_N} T_0. \tag{9}$$

Equation (8) may be solved using the general method for the solution of linear difference equations (e.g., Sargent 1987). Denote the lag operator as L , where $LZ_t = Z_{t-1}$. Then we rewrite (8) as

$$\left(\frac{1 - \sigma}{1 + \sigma} - \frac{\left(1 - \alpha/2 \left(1 + \left(\frac{\sigma - 1}{\sigma} \right) \right) \right)}{(\alpha/4\sigma)(1 + \sigma)} L + L^2 \right) \alpha/2 \times \left(1 - \left(\frac{\sigma - 1}{2\sigma} \right) \right) p_{t+1} = -\alpha/2X(t). \tag{10}$$

The expression inside the large parentheses may be factorized as $(\lambda_1 - L)(\lambda_2 - L)$. The appendix demonstrates that the two roots λ_1 and λ_2 have the following properties. One root is always positive and above unity. Let this be λ_1 . Then λ_2 is less than unity in absolute value and is greater than zero (equal to zero, less than zero) for $\sigma < 1$ ($\sigma = 1, \sigma > 1$). Then the general solution to (8) may be written as

$$p_t = \frac{1}{\lambda_1} p_{t-1} - \frac{2\sigma}{\lambda_1(1 + \sigma)} \sum_{i=0}^{\infty} \lambda_2^i X(t + i). \tag{11}$$

Note, however, that the relative price is not a predetermined variable. In order to determine the initial price, we must use the initial condition (9). Setting $t = 1$ in (11), we may use (9) to solve for P_0 , which gives

$$p_0 = -\alpha/(2\Delta) \frac{T_0}{\bar{P}Y_N} - (\alpha(1 - \sigma)/(2\Delta\lambda_1(1 + \sigma)) \sum_{i=0}^{\infty} \lambda_2^i X(1 + i), \tag{12}$$

where

$$\Delta = (\alpha/(4\lambda_1)) \left(\frac{\sigma - 1}{\sigma} \right) + \left(1 - \alpha/2 \left(1 + \left(\frac{\sigma - 1}{\sigma} \right) \right) \right) > 0.$$

Equation (10) completely determines the response of the real exchange rate to a current or announced future alteration in the sequence of government taxes, starting from a steady state, when this policy becomes known at time 0. Succeeding

movements in the real exchange rate can then be determined through recursions on equation (10).

III. THE EFFECTS OF AN ANTICIPATED BUDGET DEFICIT

Some general features of the solution are worth mentioning. For $\lambda_2 \neq 0$, the real exchange rate will respond to all new information about future taxes, as indicated by the second term in (10). In addition, however, the real exchange rate will display persistence, as indicated by the first term in (10). This is a natural feature of the overlapping-generations structure. The relative price of non-traded goods at any given date depends partly upon the demands of the old generation, which in turn is influenced by the relative price that obtained in the previous period.

It is interesting that this persistence arises without any persistence at all in fundamentals. This result is quite consistent with observed properties of real exchange rates noted by many writers (e.g., Frankel and Meese 1987). Recently Rogoff (1992) has developed a model with a similar property to this one. In his model an infinitely lived household chooses a consumption profile with unlimited access to foreign capital markets. Under certain conditions both traded goods consumption and the real exchange rate will display random-walk behaviour, irrespective of the fundamentals of the model.

In the special case where preferences are logarithmic, we have $\lambda_2 = 0$, and p_t is independent of all future taxes. In this case, in fact, demand for non-traded goods is entirely independent of the consumption-based real interest rate. The real exchange rate becomes a purely 'backward-looking' variable.

1. Contemporaneous deficits

We now examine the impact of government budget deficits. In order to see how the model behaves, we first examine the response to a current budget deficit. Take the following policy announcement. Let the government make a transfer (i.e., reduce taxes) at time 0 to the young of generation 0, so that $T_0 < 0$. Assume that this transfer was previously unanticipated. Then let taxes at time 1 be raised so as to eliminate the impact of the initial tax reduction on government debt. Thus $T_1 = -T_0$.

It is simple to work out the effect of this policy on the real exchange rate. It is given by

$$p_0 = -\frac{\alpha}{2\bar{P}Y_N\Delta}(1 - \lambda_2^2)T_0. \quad (13)$$

This result is unambiguously positive. Thus, a current budget deficit always leads to a real exchange rate appreciation, in this economy. Then from (5), we know that the trade balance will deteriorate.

This experiment, however, does not capture the importance of expectations of deficits that is emphasized in the policy discussion. In order to do so, we need to

examine the response of the real exchange rate to an announcement of a deficit to take place in the future.

2. *Anticipated future deficits*

Now let us examine the following fiscal policy. Assume that the government announces at time 0 that it will make a transfer to the young of generation τ , so that $T_\tau < 0$. It raises this transfer by issuing bonds. Following this, generation $\tau + 1$ will be taxed to pay for this transfer, that is, to repay the government bonds. Thus $T_{\tau+1} = -T_\tau$.

The response of the period 0 relative price of non-traded goods to this policy is

$$p_0 = -\frac{\alpha}{2\bar{P}Y_N\Delta} \lambda_2^\tau (1 - \lambda_2^2) T_\tau, \tag{14}$$

and the response for period $t \leq \tau$ is

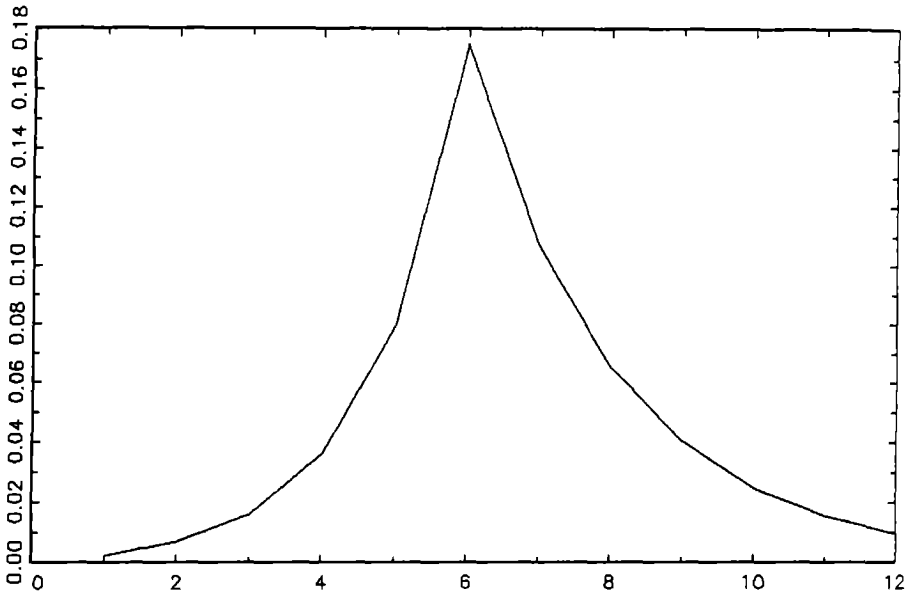
$$p_t = \frac{1}{\lambda_1} p_{t-1} - \frac{2\sigma}{\lambda_1(1 + \sigma)} \lambda_2^{\tau-t} (1 - \lambda_2^2) \frac{\alpha}{2\bar{P}Y_N} T_\tau. \tag{15}$$

Equations (14) and (15) indicate that the response of the real exchange rate to an announcement of a future deficit depends crucially on the size of σ , or the elasticity of intertemporal substitution. First take the case of $\sigma < 1$, or a high elasticity. Then the current real exchange rate appreciates in response to the expected future deficit. p_0 rises immediately, and by using (14) and (15) together, it is shown in the appendix that p_t gradually rises up until time τ . Then the appreciation is reversed and $p_{\tau+1}$ for $i > 0$ will fall. Figure 1 illustrates this pattern of response. Since the increase in government debt is temporary, p_t will converge to zero. Note that the domestic real interest rate falls upon the announcement of the future deficit and remains below its steady-state level up to τ , since the relative price of non-traded goods will be rising monotonically up to τ .

The trade deficit will respond in the same direction as p_t responds. At time 0, there is an immediate trade deficit. It grows until time τ , and thereafter corrects itself.

The intuitive explanation for this path of the trade deficit is easy to see. At time τ the young of generation τ experience a rise in disposable income. Their demand for non-traded goods rises. For any given $p_{\tau-1}$ and $p_{\tau+1}$, p_τ must rise to clear the non-traded goods market. For the young of generation $\tau - 1$, the anticipated rise in P_τ implies a fall in the consumption-based real interest rate. Given $\sigma < 1$, a rise in their demand for non-traded goods is precipitated. For a given $P_{\tau-2}$, $P_{\tau-1}$ must therefore rise. This increase in turn reinforces the rise in P_τ , as it raises the time τ demand for non-traded goods of the old of generation $\tau - 1$. But then this rise in $P_{\tau-1}$ will raise the real interest rate facing generation $\tau - 2$ young, leading to a rise in $P_{\tau-2}$ through exactly the same channels, and so on. Thus all prices rise from the date of the original announcement of the deficit policy.

The gradual real appreciation that takes place from time t onwards implies that the consumption-based real interest rate is actually lower during the interval (t, τ) .

FIGURE 1 Price movement: $\sigma < 1$

Since, by construction, each generation is a saver, the rise in real interest rates will reduce welfare of all generations preceding τ , from the time of the announcement on. Thus, the future deficit imposes costs not only on generations that have to repay the debt, but on all generations alive before the deficit takes place, if the deficit is anticipated.

This pattern in the real exchange rate and trade balance is consistent with much of the popular discussion throughout the 1980s. But do anticipated budget deficits necessarily cause real exchange rate appreciation? As discussed in the introduction, it would seem that the opposite is the case in many small economies.

Let us now look at the impact of deficit announcements in the case where $\sigma < 1$. In this case, the root λ_2 is now negative. Thus, given $T_\tau < 0$, p_0 rises (falls) when τ is even (odd). Furthermore, using (14) and (15), it is shown in the appendix that, for $0 < t < \tau$, p_t will oscillate around its initial steady-state (zero) level. As the budget deficit approaches, the real exchange rate path is characterized by successive appreciation and depreciation. This pattern implies that the trade balance moves successively from deficit to surplus. Figure 2 illustrates the behaviour of p_t for some numerical assumptions. The fluctuations will increase in magnitude until the budget deficit actually occurs. There is thus no presumption that the current announcement of a future deficit will lead to an immediate real exchange rate appreciation. Rather, the expected deficit will leave the average real exchange rate constant over time, while progressively increasing its variability. The variability is also seen in the domestic real interest rate. It will fall in periods of real depreciation and rise in periods of real appreciation.

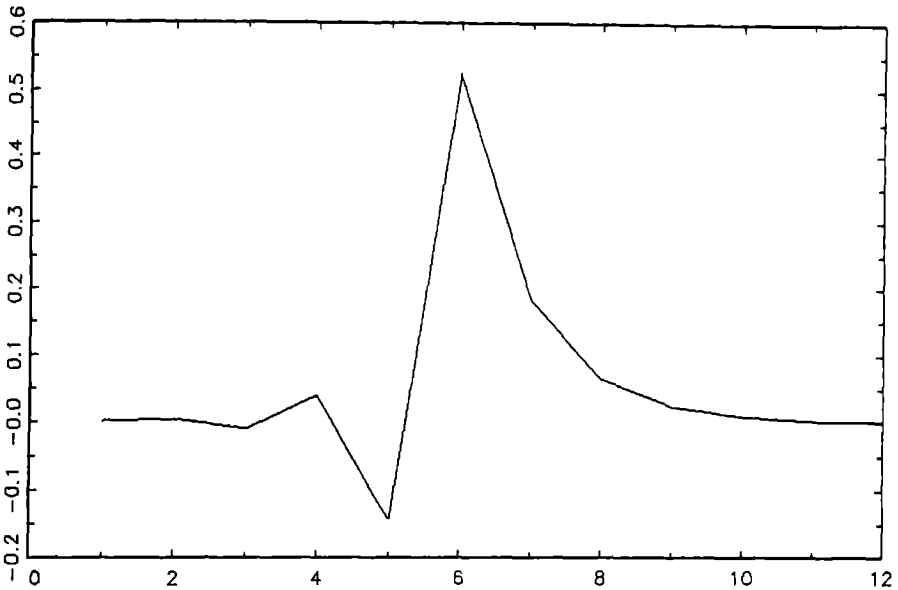


FIGURE 2 Price movement: $\sigma > 1$

The underlying behaviour leading to these dynamics comes from the fact that when $\sigma > 1$, the intertemporal elasticity of substitution in consumption is less than unity, and the income effect of a real interest rate change dominates the substitution effect. Thus, in response to a fall in the consumption real interest rate, current demand *falls*. Take again the situation at time τ . Given $p_{\tau+1}$ and $p_{\tau-1}$, the deficit-induced rise in demand at time τ necessarily induces a rise in p_{τ} . This rise leads to a fall in the real interest rate for generation $\tau - 1$. But now it causes a *fall* in demand for non-traded goods at time $\tau - 1$, given $p_{\tau-2}$. Thus $p_{\tau-1}$ *falls*. This fall now leads to a *rise* in the real interest rate for generation $\tau - 2$, which in turn implies that the demand of generation $\tau - 2$ rises, causing an increase in $p_{\tau-2}$. The process works backward in this fashion, with the price of non-traded goods experiencing increasing variability relative to the initial steady-state level. After period τ the price falls and then converges gradually back to the original steady state.

The pattern of price movements for $t < \tau$ implies that the real interest rates facing each generation will also display increased variability up to the time of the deficit. In welfare terms, the generations preceding the deficit will successively gain and lose in turn as a result of the announcement. Those generations experiencing a real interest rate increase will gain, while those experiencing a decrease will lose.

This case establishes that in fact there is no necessary direct connection between anticipated future budget deficits and real appreciation, even in a case where Ricardian equivalence fails for the traditional reasons. The link between deficits and the real exchange rate is fundamentally ambiguous, depending on parameters

of preferences. In the most empirically likely case, where $\sigma > 1$, the future deficit announcement generates an increase in the variability of the real exchange rate, but no change in its average level.

IV. CONCLUSION

This paper explores the link between anticipated budget deficits and the real exchange rate. The predictions of the model are consistent with the ambiguity of the empirical evidence on this link. Anticipated deficits can cause either real appreciation or real depreciation, depending on the structural characteristics of aggregate savings functions. This finding is true, despite the fact that the economy does not exhibit Ricardian equivalence, owing to the presence of finite-horizon consumers.

The model is too simple, however, to come to grips with all the issues surrounding budget deficits in small open economies. For instance, the model abstracts entirely from government spending. It is a standard technique in the literature to hold government spending constant while investigating the impact of tax policies. Nevertheless, for a full understanding of the relationship between fiscal policy and the real exchange rate it is probably important to incorporate spending policies into the equation (see, e.g., Kollman 1993, Yi 1993).

There is a convincing argument that in many small economies, pessimistic budget deficit predictions tend to generate real exchange rate depreciation. While expectations effects play a crucial role in our model, in reality it is probably the interaction among expectations, credibility, and endogenous policy-making that is important for understanding this argument. This conclusion suggests that a full understanding of the phenomenon would require a model of the political economy of budget deficits.⁴

APPENDIX

A. Equation (7) may be written implicitly as

$$\log P_t = G(\log P_t, \log P_{t-1}, \log P_{t+1}, T_t, T_{t-1}).$$

We may approximate the RHS of this expression by the Taylor series

$$G(\log \bar{P}, \log \bar{P}, \log \bar{P}, 0, 0) + G_1(\log P_t - \log \bar{P}) + G_2(\log P_{t-1} - \log \bar{P}) \\ + G_3(\log P_{t+1} - \log \bar{P}) + G_4 T_t + G_5 T_{t-1}.$$

Substituting in for the values of the G and G_i functions, we arrive at equation (8) of the text.

B. The roots that factorize the expression in square brackets in equation (10) satisfy

$$\lambda_1 \lambda_2 = \frac{1 - \sigma}{1 + \sigma} \quad (\text{A1})$$

$$\lambda_1 + \lambda_2 = \frac{\left(1 - \frac{\alpha}{2} \left(1 + \left(\frac{\sigma - 1}{\sigma}\right)\right)\right)}{(\alpha/4\sigma)(1 + \sigma)}. \quad (\text{A2})$$

4 Alesina and Perotti (1994) survey the literature on models of political economy and budget deficits. They do not, however, specifically address the behaviour of the real exchange rate.

Lambda2

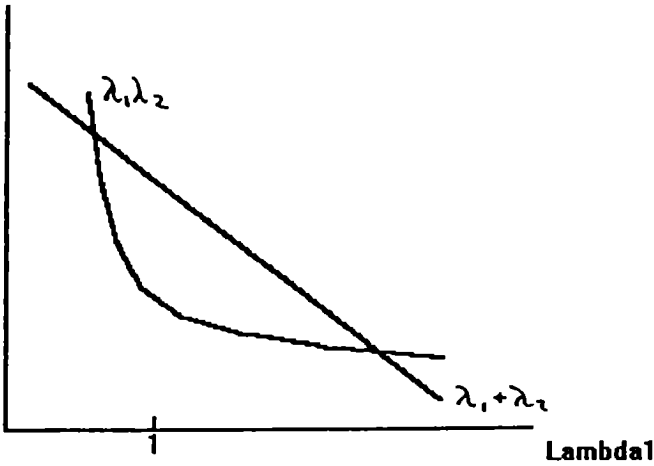


FIGURE A1

If $\sigma < 1$, both roots are of the same sign, and because $\lambda_1 + \lambda_2 > 0$, both must be positive. Take this case first. Since $\lambda_1 \lambda_2 < 1$, at least one of the roots must be less than unity. Let it be λ_2 . Figure A1 illustrates the characteristics of the two roots. By conditions (A1) and (A2) the $\lambda_1 + \lambda_2$ curve must cut the $\lambda_1 = 1$ vertical line above the $\lambda_1 \lambda_2$ curve. Thus, $\lambda_1 > 1$ must hold.

Now take the case $\sigma > 1$. Then one root must be positive and one negative; and since $\lambda_1 \lambda_2 < 1$, one root must be less than unity in absolute value. Take λ_2 as the negative root. It is illustrated in figure A2. Since the $\lambda_1 + \lambda_2$ line cuts the horizontal axis at $\lambda_1 > 1$, the solution must involve $\lambda_1 > 1$. Moreover, λ_2 must be less than unity in absolute value.

C. Using equations (14) and (15) we may solve successively for p_t as a function of p_0 , for $0 \leq t \leq \tau$

$$p_1 = \left(\frac{1}{\lambda_1} - \frac{\Delta}{\alpha(\sigma - 1)/(4\sigma)} \right) p_0 = \theta_1 p_0$$

$$p_1 = \left(\frac{\theta_1}{\lambda_1} - \frac{\Delta}{\lambda_2 \alpha(\sigma - 1)/(4\sigma)} \right) p_0 = \theta_2 p_0$$

$$p_2 = \left(\frac{\theta_2}{\lambda_1} - \frac{\Delta}{\lambda_2^2 \alpha(\sigma - 1)/(4\sigma)} \right) p_0 = \theta_3 p_0,$$

and so on.

Given $\sigma < 1$, then $\lambda_2 > 0$ and we must have $\theta_t > 0$, for $0 \leq t \leq \tau$. Moreover, by the definition of Δ it must be the case that $\theta_1 > 1$. Then given $\lambda_2 < 1$, it follows that $\theta_t > \theta_{t-1} > \dots > \theta_1$, for $0 < t \leq \tau$. Thus p_t rises monotonically up to p_τ .

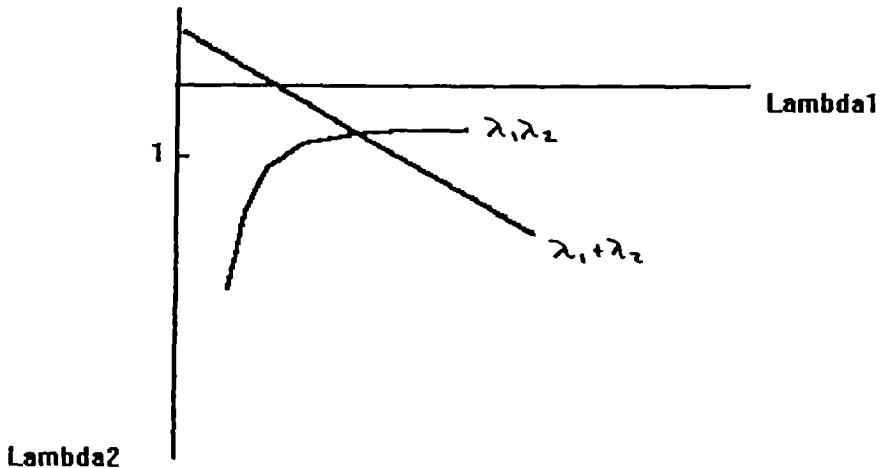


FIGURE A2

For the case $\sigma > 1$, using the definition of Δ , it must be the case that $\theta_1 < 0$; and then, since $\lambda_2 < 0$ and $abs(\lambda_2) < 1$, $\theta_2 > 0$, $\theta_3 < 0$, etc. Thus, for this case, the price oscillates about the steady-state value until time τ .

REFERENCES

- Alesina, A., and Perotti, C. (1994) 'The political economy of budget deficits.' NBER Discussion Paper No. 4637
- Devereux, M., and D.D. Purvis (1990) 'Fiscal policy and the real exchange rate.' *European Economic Review* 34, 1201-12
- Dornbusch (1983) 'Real interest rates, home goods, and optimal external borrowing.' *Journal of Political Economy*
- Feldstein, M. (1987) 'The budget deficit and the dollar.' In *NBER Macroeconomics Annual* (Cambridge, MA: MIT Press)
- Frenkel, J., and A. Razin (1987) *Fiscal Policies and the World Economy* (Cambridge, MA: MIT Press)
- Kollman, R. (1993) 'Fiscal policy, technology shocks, and the us trade balance deficit.' Mimeo, University of Montreal
- Persson T. (1985) 'Deficits and intergenerational welfare in open economies.' *Journal of International Economics* 19, 1-19
- Purvis, D. (1985) 'Public sector deficits, international capital movements, and the domestic economy: the medium term is the message.' *This Journal* 18, 723-42
- Rogoff, K. (1992) 'Traded goods prices and the random walk behaviour of the real exchange rate.' NBER Discussion Paper No. 4119
- Sachs, J. (1986) 'The dollar and the policy mix.' *Brookings Papers on Economic Activity*
- Sargent, J. (1987) *Macroeconomic Theory* (New York: Academic Press)
- Yi, Kei-Mu (1993) 'Can government purchases explain the recent us net export deficits?' *Journal of International Economics* 27, 201-25