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Abstract

The current account dynamics is examined for a small open economy which is subject to exogenous changes in its static terms of trade and in world interest rates. The model used is one with overlapping finite-lived generations, which we argue gives rise to a more reasonable saving behaviour than previously used models with infinite lived consumers. In particular no restrictions on the rate of time preference is required.

Anticipated and unanticipated, as well as temporary and permanent, terms of trade changes have very different effects. There is, however, a general tendency towards cycles in both savings and investment, which gives rise to cycles in the current account.

The classic Harberger-Laursen-Metzler effect on saving of a terms of trade deterioration can have any sign for plausible parameter values, both for temporary and permanent disturbances.

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CURRENT ACCOUNT DYNAMICS AND THE TERMS OF TRADE: HARBERGER-LAURSEN-METZLER TWO GENERATIONS LATER*

by

Torsten Persson and Lars E.O. Svensson

1. Introduction

This paper deals with the current account adjustment over time of an economy which is subject to changes in its terms of trade and world interest rates. One obvious reason to analyze the current account is that governments and policymakers care about it, and intervene to affect it. The goal is often said to be a balanced current account, although from the point of view of economic theory that has no particular virtue. What is at stake is of course what might be, in some sense, the optimal current account, and whether observed actual current accounts deviate from the optimal ones. In order to specify what might be optimal, we must first understand how the <u>equilibrium</u> current account of a relatively frictionless economy is determined, and what the equilibrium response to various disturbances look like.

Another obvious reason is that international economists like to explain international capital movements, which immediately leads to the current account since it is identically equal to a country's net accumulation of foreign assets. During the 70's we have seen dramatic changes in world capital flows, related to oil price increases, OPEC's huge surpluses and the recycling of the oil revenues. These events have spurred an interest in the relation between terms of trade changes and capital flows, and resulted in a considerable literature. Recently the world has experienced considerable exchange rate volatility and interest rate changes, with corresponding terms of trade changes, both static and intertemporal, which makes a good understanding of the current account behavior no less desirable.

The current account can be written equivalently as the sum of the trade account and the service account, as income minus absorption, or as saving minus investment. It seems that different theories have sometimes favored one identity as more fundamental than another. With good general equilibrium theory the different components in the various identities are of course simultaneously determined, and no identity has a special significance, except for convenience. In this paper, we apply an intertemporal framework in discussing the current account development over time, and it will then be convenient to exploit the saving-minus-investment identity.

So, if we choose to look at the current account as the difference between saving and investment, a first question is how saving responds to a terms of trade change. Earlier, the conventional answer to this question was summarized in the classical Harberger-Laursen-Metzler effect: In different contexts, Harberger (1950) and Laursen-Metzler (1950) came to be concerned with the effect on saving of terms of trade changes. They postulated that saving out of any given income, both measured in exportables, falls with a terms of trade deterioration. They argued that the real income corresponding to a given income in exportables falls with a terms of trade deterioration, and relied on empirical evidence that the savings ratio to income tends to fall from a fall in real income.

This argument relies on a static theory of savings, however, and that has recently led some writers to reconsider the question of how terms of trade changes affect savings in an explicitly intertemporal framework, with forward-looking savings behavior.

For instance, the Harberger-Laursen-Metzler effect was recently challenged by Obstfeld (1982a). He applies intertemporal maximization, more precisely a model of a small economy consisting of an infinitely lived representative consumer with an Uzawa (1968) type utility function with the rate of time preference being an increasing function of utility, and hence indirectly of wealth. Such an economy has a target level of real wealth, where the rate of time preference is equal to the (given) world rate of intrest. If the economy suffers a terms of trade deterioration, it's real wealth is lowered. To converge to the target level, it must accumulate foreign assets and hence save. Hence, saving increases with a terms of trade deterioration, in contrast to what Harberger and Laursen and Metzler postulated.

Subsequent work by Sachs (1981) and Svensson and Razin (1983) emphasized the distinction between temporary and permanent terms of trade deteriorations. A temporary terms of trade deterioration implies a temporary fall in income and, by intertemporal consumption smoothening, consumption falls by less, which altogether deteriorates the current account. A permanent terms of trade deterioration decreases both income and consumption to about the same extent and hence has an ambigious effect on saving. These effects are income effects of terms of trade changes. Svensson and Razin (1983) also include consumption substitution effects and show, by assuming suitable separability of the preferences, how the static and intertemporal substitution effects can be organized in terms of changes in consumer price indices and real interest rates. They in addition clarify the role of assumptions about the rate of time preferences. For a permanent terms of trade deterioration, saving tends to fall with a decreasing, and rise with an increasing, rate of time preference (when the latter is regarded as a function of wealth or intertemporal welfare).

As noted by Obstfeld (1982b), the two-period analysis in Sachs (1981) and Svensson and Razin (1983) does not give much room for dynamics of the current account, since a deficit in period 1 corresponds to a surplus in period 2, and vice versa. On the other hand, the infinite-horizon analysis in continuous time in Obstfeld (1982a) and in discrete time in Svensson and Razin (1983) requires an increasing rate of time preference in wealth for stability of the steady state. This restriction of intertemporal preferences is arbitrary and even counter-intuitive. Also, the assumption of infinitely lived consumers gives rise to a very high degree of consumption smoothening and intertemporal substitution.

One could thus argue that a model with finite planning horizons seems to give rise to a more intuitively reasonable and even more realistic saving behavior. This is the case for the well known overlapping generations model (without private intergenerational gifts). Furthermore, it has nice stability properties, without arbitrary restrictions on the rate of time preference. In this paper we shall therefore use an overlapping generations model to represent saving behavior. Previous authors that have studied open economies by using overlapping generations models include Kareken and Wallace (1977), Fried (1980), Buiter (1981), Dornbusch (1982) and Persson (1983). Our overlapping generations model is standard, except that we include two consumer goods, and, as in Svensson and Razin (1983), assume conveniently separable preferences so as to be able to use consumer price indexes and real interest rates.

So much for saving. What about investment? The role of investment for current account behavior has been emphasized in, for instance, Razin (1980), Sachs (1981), Helpman and Razin (1981), Bruno (1982), Marion and Svensson (1981), and Svensson (1982). Here we use the usual straightforward representation of investment in the overlapping generations model due to Diamond (1965).

Our general findings below are that in order to understand the current account behavior over time, it is convenient to look at the induced changes in the intertemporal prices, as represented by the various real interest rates, rather than directly at the static terms of trade changes, since saving and investment may be more unambigiously related to changes in the intertemporal prices. In analogy with the work mentioned above, we find that temporary and permanent terms of trade and interest changes have different effects. So do anticipated and unanticipated terms terms of trade changes. In particular we show that cyclical adjustments in the current account are likely to occur.

The paper is in eight sections. The model is set up in Section 2. Section 3 and 4 deal with anticipated permanent and temporary terms of trade deteriorations. Section 5 treats unanticipated terms of trade deteriorations, and Section 6 changes in the world rate of interest. Section 7 discusses the Harberger-Laursen-Metzler effect in some detail. Section 8 presents a summary, qualifications, and some conclusions.

2. The Model

We consider a small open economy which faces perfect world markets for goods and financial assets. There are two traded goods, home goods and foreign goods, indexed h and f. The economy produces and exports home goods and imports foreign goods. The foreign good is numeraire. Hence, in each time period t, the economy can trade freely at a given price of home goods in terms of foreign goods, p^t. Similarly, the economy can borrow and lend on the international credit market at a given interest rate. The interest rate in terms of the imported good, between period t and t+1, is denoted by r^t.

We first describe the production side of the economy. We assume that only home goods are produced at home. Production is carried out by two factors, (nondepreciating) capital and labor, according to a well-behaved neoclassical production function. There are constant returns to scale and the labor supply will be fixed at unity, so production in period t can be expressed as $y^t = f(k^t)$, where k^t is the economy's capital stock. Only home goods are used as capital goods. Little is changed if instead only foreign goods are used as capital. (In the concluding section we discuss the implications of having a more general two-sector production sector, which complicates the analysis considerably.)

Capital goods to be used in production in period t+1 must be purchased and installed in period t. With these assumptions, profit maximizing behavior implies that the capital stock in period t+1 is given by

$$(2.1) \qquad f_k(k^{t+1}) = r_h^t.$$

That is, what can be thought of as gross investment, namely the amount of physical capital held from period t to t+1, is carried to the point where the marginal productivity of capital f_k in period t+1 equals r_h^t, the home goods <u>own</u> rate of interest between period t and t+1. The latter is defined by

$$(2.2) \qquad 1 + r_h^t = (1 + r^t)p^t/p^{t+1},$$

and is thus just a way of expressing the intertemporal relative price of home goods.[1] Equation (2.1) defines k^{t+1} as a decreasing function

$$(2.3) \qquad k^{t+1} = k(r_h^t), \; k_r < 0,$$

of the home goods rate of interest. Let us denote the value of the capital stock held at the end of period t by K^t. Then, we can write K^t as a function of the terms of trade and the home goods interest rate, namely

$$(2.4) \qquad K^t = p^t k^{t+1} = p^t k(r_h^t) = K(p^t, r_h^t),$$

with the derivatives $K_p > 0$, and $K_r < 0$.

From (2.4) and the definition of the elasticity of substitution in production σ^s, the partial elasticities of this function are

$$(2.5) \qquad \varepsilon K/\varepsilon p = 1, \text{ and}$$

$$(2.6) \qquad \varepsilon K/\varepsilon r_h = -\sigma^s/\theta,$$

where Θ is labor's distributive share. For specificity in the following, we assume

$$(2.7) \qquad \sigma^s \geq \theta,$$

which makes $\varepsilon K/\varepsilon r_h \leq -1$.

Wages in period t are given as

$$(2.8) \qquad W^t = p^t(f(k^t) - k^t f_k(k^t)) = p^t w(k^t) = W(p^t, k^t);$$

an increasing function of the terms of trade and the capital stock. We note for future reference that $w(k^t)$ is the <u>product</u> real wage in period t.

Having thus described the production side of the economy, let us so turn to consumers. Since growth is not essential to our story, we assume a stationary population. All consumers live only for two periods. In each period, a young and an old generation thus overlap (we set the number of consumers of each generation equal to unity for simplicity). Both goods are consumed and we denote consumption of young consumers in period t of the two goods by c_h^t and c_f^t while consumption of old consumers in period t is d_h^t and d_f^t.

Young consumers have a fixed endowment of one unit of labor which is inelastically supplied. Part of the wages received is consumed, part is saved. Old consumers do not work but consume principal and interest on their savings. There are neither bequests nor gifts given to old people, so consumers start and end their lives with zero endowments.

Consumers are identical in all respects and their preferences over consumption as young and old can be represented by a well-behaved utility function of the special form $V(c^t, d^{t+1})$, where $c^t = U(c_h^t , c_f^t)$ and $d^{t+1} = U(d_h^{t+1} , d_f^{t+1})$. We assume that preferences are homothetically separable over time. Then we may, without loss of generality, choose the sub-utility function $U(c_h^t , c_f^t)$ linearly homogeneous. Finally, we assume that the sub-utility function is the same in both periods. These assumptions make it possible to define exact consumer price indices, which will be convenient for out analysis. Also, the scalars c^t and d^{t+1} can be interpreted as measures of real consumption in the two periods.

In determining their consumption when young, consumers maximize the utility function subject to the life-cycle budget constraint that the present value of their total consumption is equal to their wage income (which is their wealth),

$$(2.9)\qquad (p^t c_h^t + c_f^t) + (p^{t+1} d_h^{t+1} + d_f^{t+1})/(1 + r^t) = W^t.$$

Let $C^t = p^t c_h^t + c_f^t$ denote (the value of) consumption of the young in period t. Under the assumptions about the utility function, this can be written as a function

$$(2.10)\qquad C^t = C(p^t, \rho^t, W^t)$$

of the terms of trade, of the real rate of interest ρ^t, and the wage (see Appendix). The real rate of interest is defined by

$$(2.11)\qquad 1 + \rho^t = (1 + r^t)P(p^t)/P(p^{t+1}).$$

where $P(p^t)$ is the exact consumer price index in period t (given by the unit-subutility expenditure function corresponding to the subutility function $U(c_h^t, c_f^t)$). The difference between wages and consumption of the young is savings of the young, S^t. It can be written as a savings function

$$(2.12)\qquad S^t = W^t - C(p^t, \rho^t, W^t) = S(p^t, \rho^t, W^t),$$

which is also a function of the terms of trade, the real rate of interest, and wages. Since the properties of this function are crucial for our story, we will look at them in some detail. Note first that the terms of trade in period t + 1 do not enter as a separate argument in the savings function. This follows from the separability of the overall utility function $V(\cdot)$.

However, p^{t+1} does affect the savings decision indirectly via its effect on the real interest rate (cf. (2.11)).

The partial elasticities of the savings function with respect to its three arguments are (for details, see Appendix):

(2.13) $\varepsilon S/\varepsilon p = -[(1-\alpha)/\alpha]\beta(1-\gamma)$,

(2.14) $\varepsilon S/\varepsilon(1+\rho) = [(1-\alpha)/\alpha]\eta = [(1-\alpha)/\alpha](\bar{\eta}-\alpha\gamma) = (1-\alpha)(\sigma-\gamma)$, and

(2.15) $\varepsilon S/\varepsilon W = [1-(1-\alpha)\gamma]/\alpha$.

Here, $\alpha = S^t/W^t > 0$ is the savings ratio, $\beta = p^t c_h^t/C^t > 0$ is the share of home goods in consumption when young and hence also the share of home goods in the price index, and $\gamma = W^t C_W^t/C^t > 0$ is the wage (or income, or wealth) elasticity of consumption when young. Looking at (2.13), we see that current terms of trade changes affect savings via changing the price index $P(p^t)$. This by itself changes the nominal value of current consumption. However, the change in $P(p^t)$ also has a wealth effect on real consumption, which may or may not exceed the valuation effect according to whether γ is above or below unity. In the following we assume $\gamma = 1$ -- a unitary wealth elasticity. A sufficient condition for this is that the overall utility function $V(c^t, d^{t+1})$ is homothetic in real consumption when young and old. With this assumption, changes in the terms of trade do not change savings, provided that the real interest rate and wages are held constant; $\varepsilon S/\varepsilon p = 0$.

As for (2.14), $\eta = \bar{\eta} - \alpha\gamma = -(1+\rho^t)(\partial C/\partial(1+\rho^t))/C^t \gtrless 0$ is the negative of the elasticity of consumption when young with respect to one plus the real interest rate, $\bar{\eta} = \alpha\sigma > 0$ is the negative of the same compensated elasticity, and $\sigma > 0$ is the elasticity of substitution between real consumption in the two periods. Expression (2.14) thus follows from the Slutsky equation on elasticity form. It is seen that savings increase in the real interest rate, that is $\varepsilon S/\varepsilon(1+\rho) > 0$, if the intertemporal substitution effect on consumption when young dominates the wealth (income) effect. Subsequently, we indeed take this to be our "normal" case, that is we assume $\sigma > \gamma$.

The wage elasticity of savings expressed in (2.15) is positive as long as goods are normal. When $\gamma = 1$, as we have already assumed, this elasticity is unity.

In summary, we have thus assumed $\sigma > \gamma = 1$, which gives

(2.16) $S_p = 0,\ S_\rho > 0,\ \text{and}\ S_W > 0.$

In the same way as with our earlier assumption with regard to capital formation, these assumptions are mainly for specificity so as to avoid a taxonomic catalog of comparative static results. For any other set of assumptions, the reader can easily work out his/her own results by help of (2.6) and (2.13)-(2.15).

Since there are no bequests, total wealth at the end of period t A^t is identically equal to the savings of the young generation, namely

(2.17) $A^t = S^t = S(p^t,\rho^t,W^t).$

The economy's total claims on the rest of the world are the difference between the total wealth of consumers and the value of the capital stock. Denoting (the value of) foreign assets at the end of period t by F^t, we thus have

$$(2.18) \quad F^t = A^t - K^t.$$

It is explicitly assumed that foreigners do not hold claims on the home capital stock (equities). Hence, the net and gross holdings of foreign financial assets (debt) coincide.

We may now readily define the current account surplus B^t in period t as the increase in foreign assets from period t-1 to t, that is

$$(2.19) \quad B^t = F^t - F^{t-1},$$

which, of course, can be rewritten as

$$B^t = (A^t - A^{t-1}) - (K^t - K^{t-1}),$$

that is saving minus investment. We note that total saving is saving by the young $S^t = A^t$ plus saving by the old which is $-A^{t-1}$ since the old generation dissaves by selling all its assets.

If the internationally given interest rate and terms of trade are constant, the economy will converge to a stationary state where all variables are constant.[2] It is not necessary, but convenient, to assume that before the changes in the terms of trade that we shall discuss, the economy is in a stationary state. In such a stationary state we have, for all periods t,

$$
\begin{aligned}
&p^t = p, \\
&r^t = r_h^t = \rho^t = r \\
&k^t = k = k(r), \\
&K^t = K = pk(r), \\
(2.20)\qquad &W^t = W = W(p,\ r), \\
&A^t = A = S(p,\ \rho,\ W), \\
&F^t = F = A - K, \text{ and} \\
&B^t = B = 0.
\end{aligned}
$$

It is worth observing that although the current account is zero in a stationary state, the trade balance is not, as long as F is non-zero. If the economy has positive foreign assets, say, it has interest income from abroad (GNP is higher than GDP) which allows a higher consumption than production, that is a deficit in the trade account.

3. An anticipated permanent terms of trade deterioration

Let us suppose that the terms of trade change permanently in period 1, when the economy previously has been in a stationary state. To fix ideas, we consider a terms of trade deterioration. The foreign goods interest rate stays constant, however. In a more complete treatment where the terms of trade change is seen as an endogenous response to some world-wide disturbance, that same disturbance would be likely to affect also the world interest rate. Our treatment of terms of trade changes in isolation is thus not motivated by realism, but may hopefully help in clarifying the different channels through which the current account adjusts. In Section 6 we consider the effects of isolated world interest changes, so the effects of any combined terms of trade and interest rate change can be found as the appropriate linear combination of our results.

The adjustment over time of all the variables of interest is compactly summarized in Figure 1. Here we have relied on the assumptions about parameters regarding technology and preferences that were made in the previous section.

(F i g u r e 1)

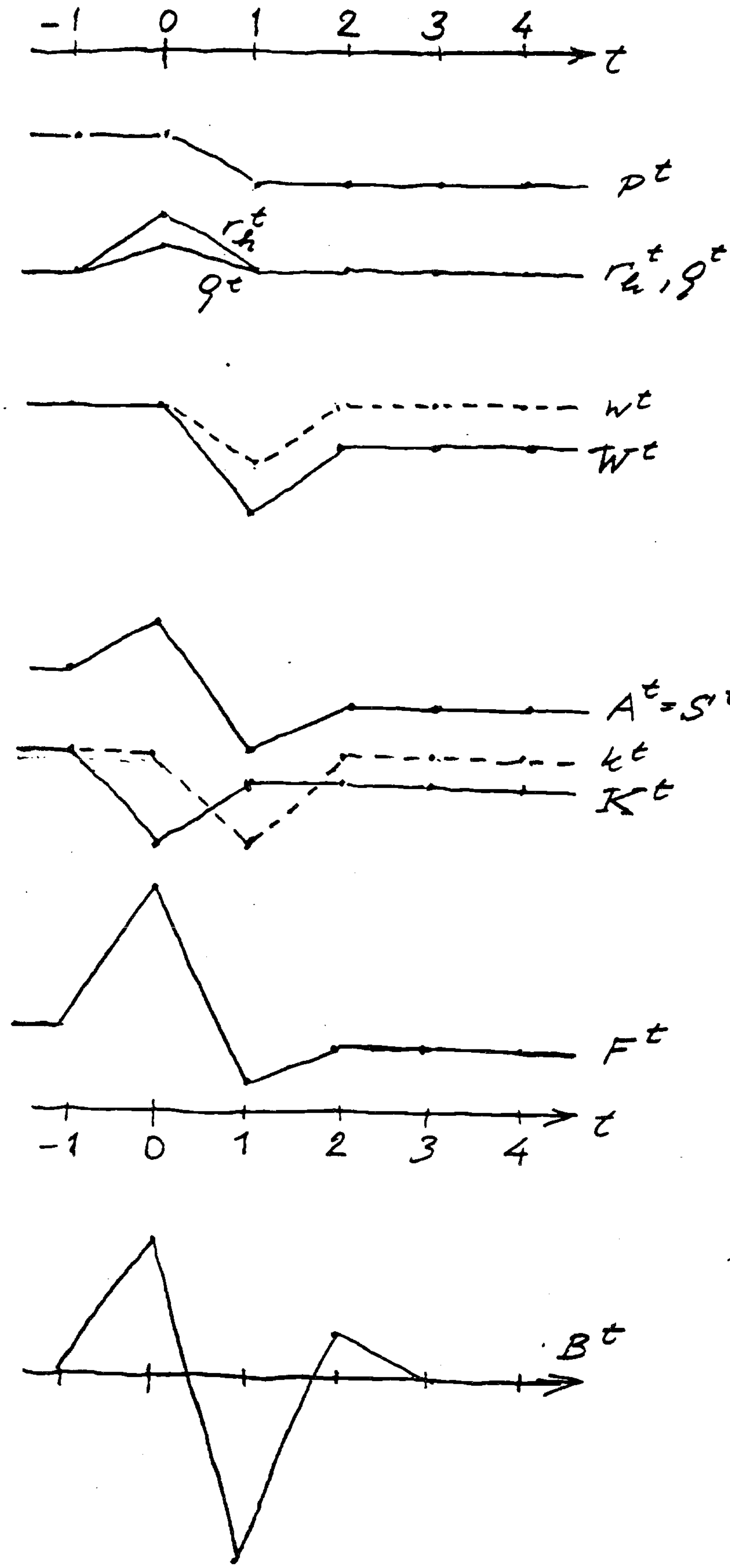
In this section we treat an <u>anticipated</u> terms of trade deterioration, that is, all agents have perfect foresight about its occurence. Then, as illustrated in the figure, the home goods and real rates of interest increase in period 0, the former by more since the price of home goods in period 1 falls more than the price index.[3] For all other periods the two interest rates do not change.

Due to the increase in the interest rate the capital stock used in period 1 is lowered, relative to the stationary state. Therefore the value of capital in the end of period 0 is lower. From the end of period 1 onward the physical capital stock is again at its unchanged stationary level, but its value is lower. As illustrated in the diagram, the drop in K^0 exceeds that in K^1, though.[4]

What about wages? Well, they go down in period 1, both because home goods prices are lower and because the capital stock is lower. From period 2 on they are lower, relative to the previous stationary state, since prices are lower, although higher than in period 1, since the product real wage is back to its unchanged long-run level.

Knowing the above, we also know how savings and hence also how total wealth respond. Savings go up in period 0 because of the

FIGURE 1



rise in the rate of interest. In period 1 savings go down because wages are lower. The terms of trade are lower too, but this by assumption has no direct effect. Savings are lower in period 2 and on, but less so than in period 1, since wages are then higher than in period 1.

Given all this it is clear how foreign assets develop, and from the changes in foreign assets it is easy to read off the development of the current account over time. As can be seen from the figure the current account undergoes a three period oscillating pattern of surplus-deficit-surplus.

In drawing Figure 1, we have assumed that the country has positive foreign assets initially. In the new stationary state this is still the case but the foreign assets are smaller. Indeed, as the reader can verify from (2.5), (2.8) and (2.15), under our assumption that preferences are homothetic ($\gamma=1$) the stationary level of foreign assets is linear in the terms of trade.

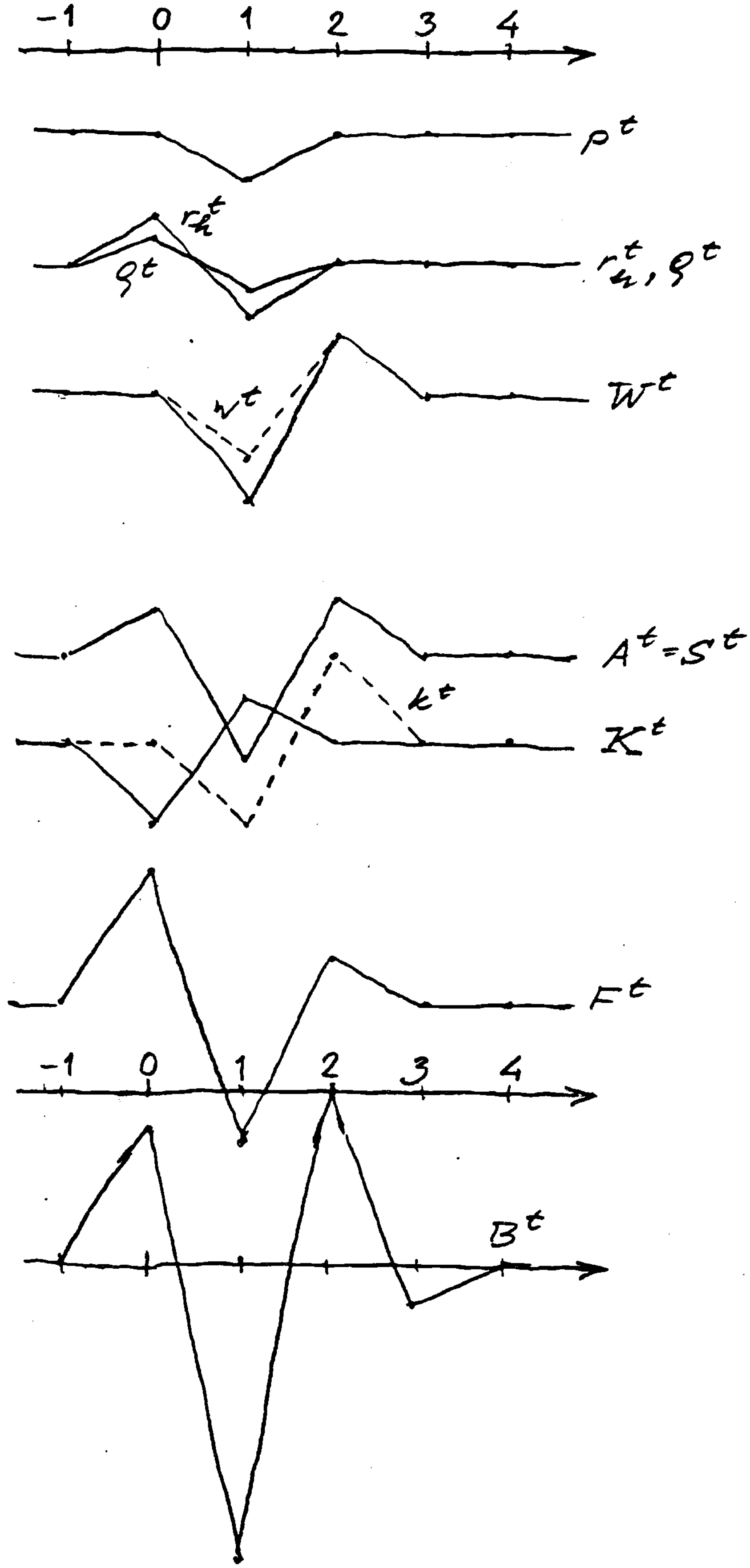
4. An anticipated temporary terms of trade deterioration

Think now instead of an anticipated temporary terms of trade deterioration occurring in period 1. The economy's adjustment to this shock is portrayed in Figure 2.

(F i g u r e 2)

As for the permanent terms of trade deterioration, the home goods and real rates of interest go up in period 0. But, in period 1, when the terms of trade are temporarily low, future goods are relatively more expensive, which means that these interest rates go down, relative to their stationary state level.

FIGURE 2


-1 0 1 2 3 4
p^t
r_h^t
ϱ^t
r_h^t, ϱ^t
w^t
W^t
$A^t = S^t$
k^t
K^t
F^t
-1 0 1 2 3 4
B^t

Because of the response of optimal capital intensity to the changes in the home goods rate of interest that we illustrate in the figure, the physical capital stock is lower in the end of period 0 and higher in the end of period 1. Its value follows the same pattern, since the valuation effect of the lower prices of home goods in period 1 is domintated by the volume effect.[5]

With regard to wages, they develop in the same way as capital intensity in production, going down in period 1 and up in period 2. As in the previous experiment, the negative effect of a lower product wage in period 1 is further reinforced of the lower product prices.

Savings by the young generation and thereby total wealth adjust as follows: upwards in period 0 because the real interest rate is higher; downwards in period 1 because wages and the interest rate are both lower; and upwards in period 2 because wages are higher.

Putting the pieces together, we get the development of foreign asset holdings and the current account in the figure. In the new stationary state, foreign assets have, of course, returned to their previous long-run level, since the change in the terms of trade is only a temporary one. The adjustment towards the new stationary state stretches out during four periods under which the current account undergoes a sequence of surplus-deficit-surplus-deficit.

At this point it may be useful to pause a little and try to understand what it is that lies behind this quite asymmetric adjustment. As a starting point we may then take the cycle in home goods and real interest rates illustrated in figure 2, that the temporary drop in the terms of trade gives rise to. The changes in interest rates by themselves drive gross saving (total wealth) and investment (the value of the capital stock) in different directions with immediate consequences for foreign assets and the current account. But also, the slump and the following boom in investment affect capital intensity and hence wages one period later. Since saving and wages are positively related, the investment cycle thus leads to a similar cycle in saving but with a one-period lag. This too contributes to the cycles in the current account.

These features of the adjustment are not only limited to the present experiment, but the same intuition explains also the results in the previous and subsequent sections.

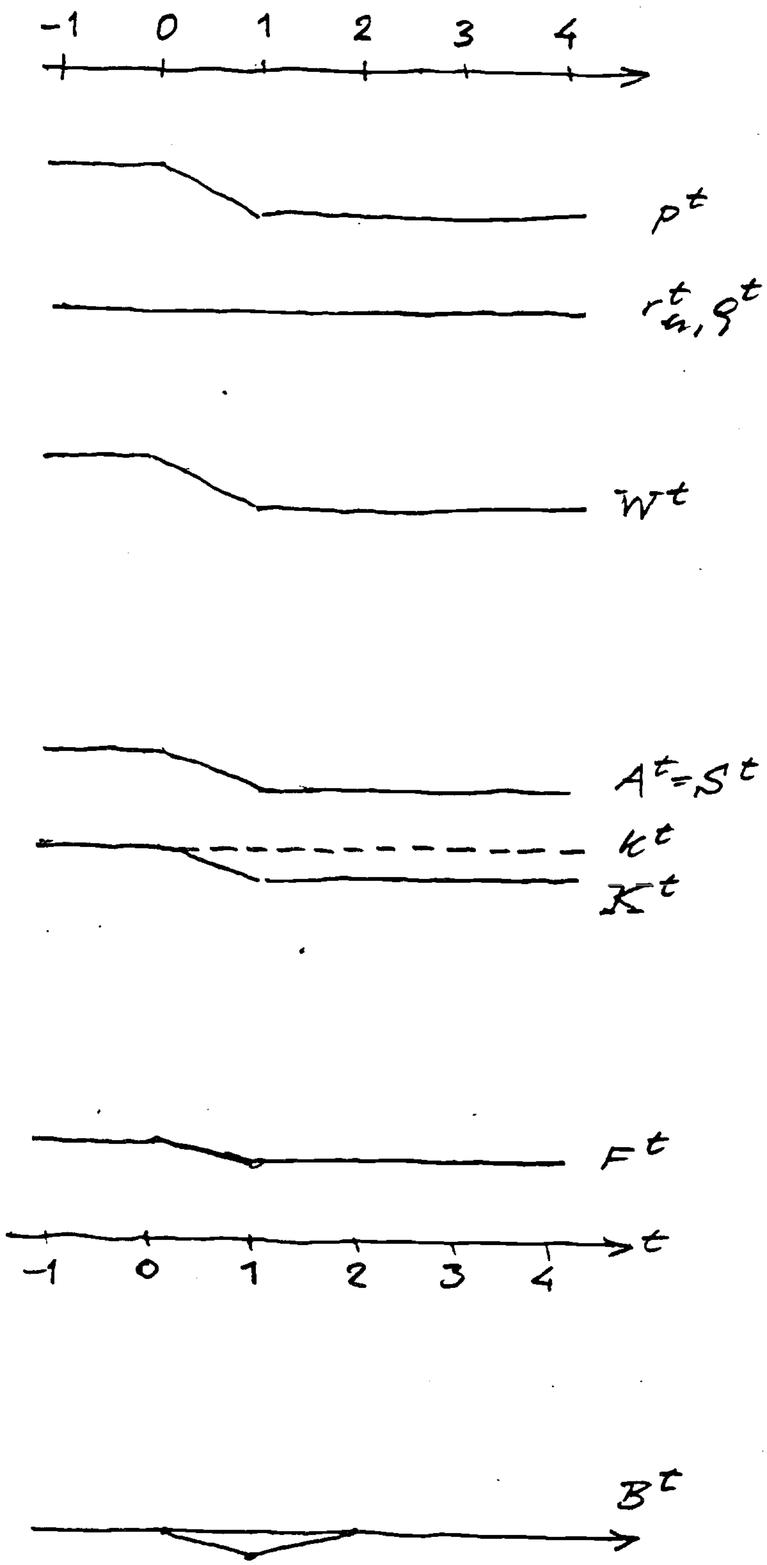
5. Unanticipated deteriorations in the terms of trade

Suppose now that there is a permanent terms of trade deterioration in period 1, which, unlike the other cases we have considered, is unanticipated. That is, it occurs as a surprise in period 1. The consequences for the economy of such an unanticipated change in the terms of trade are illustrated in Figure 3.

(F i g u r e 3)

The important difference to the case with an anticipated terms of trade deterioration is that there the intertemporal relative prices relevant for decision making, that is the (expected) home goods and real rates of interest, do not change in period 0. This means that

FIGURE 3



the whole path of interest rates is not affected at all. Then, of course, the physical capital stock stays constant, and the change in its value is limited to the effect of the fall in home goods prices from period 1 and onward.

Similarly, the effect on wages is just that of the fall in prices, and this change in wages is indeed the only channel whereby saving is affected.

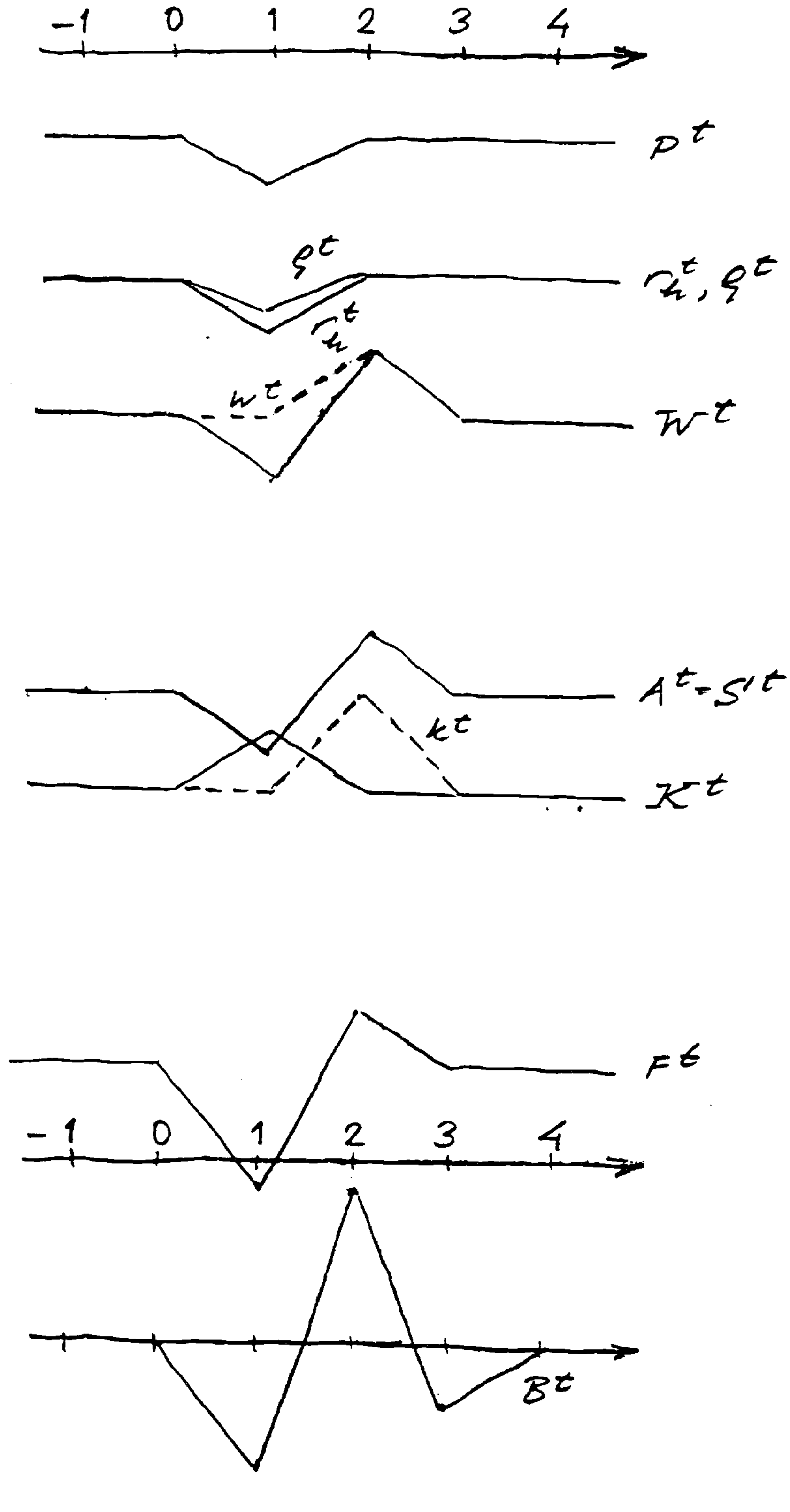
The fact that saving and investment do not react in advance to take advantage of the forthcoming price change, thus leads to the smooth adjustment illustrated in the figure. The economy settles directly on its new stationary state path with a (proportionally) lower level of foreign assets, which is reached via a one-shot deficit in the current account.

If the deterioration in the terms of trade is unanticipated but temporary, we get a different picture, as Figure 4 illustrates.

(F i g u r e 4)

Here, the period 1 home goods and real interest rates fall, since the terms of trade are back at their initial level from period 2 and onward. We do not have to go into a detailed explanation of the different pieces of the adjustment process. The resulting sequence of deficit-surplus-deficit in the current account is really precisely the same as that for the expected temporary terms of trade change (cf. Figure 2), with the important difference that the adjustment in period 0, the period before the terms of trade change actually occurs, is absent in the present case.

FIGURE 4


-1
0
1
2
3
4
p^t
ϱ^t
r_h^t, ϱ^t
r_h^t
w^t
W^t
$A^t = S'^t$
k^t
K^t
F^t
-1
0
1
2
3
4
B^t

6. Changes in the world rate of interest

A fall in the world rate of interest is also of interest when discussing terms of trade changes in the present context. One reason is that every young person is a net lender. Hence from each individual's point of view a fall in the interest rate is a deterioration in the intertemporal terms of trade. Whether a fall in the world market rate of interest is a deterioration in the intertemporal terms of trade for the country as a whole depends on its net position vis-a-vis the rest of the world. Indeed, it is a deterioration if the country is a creditor (F is positive), but an improvement if it is a debtor (F negative).

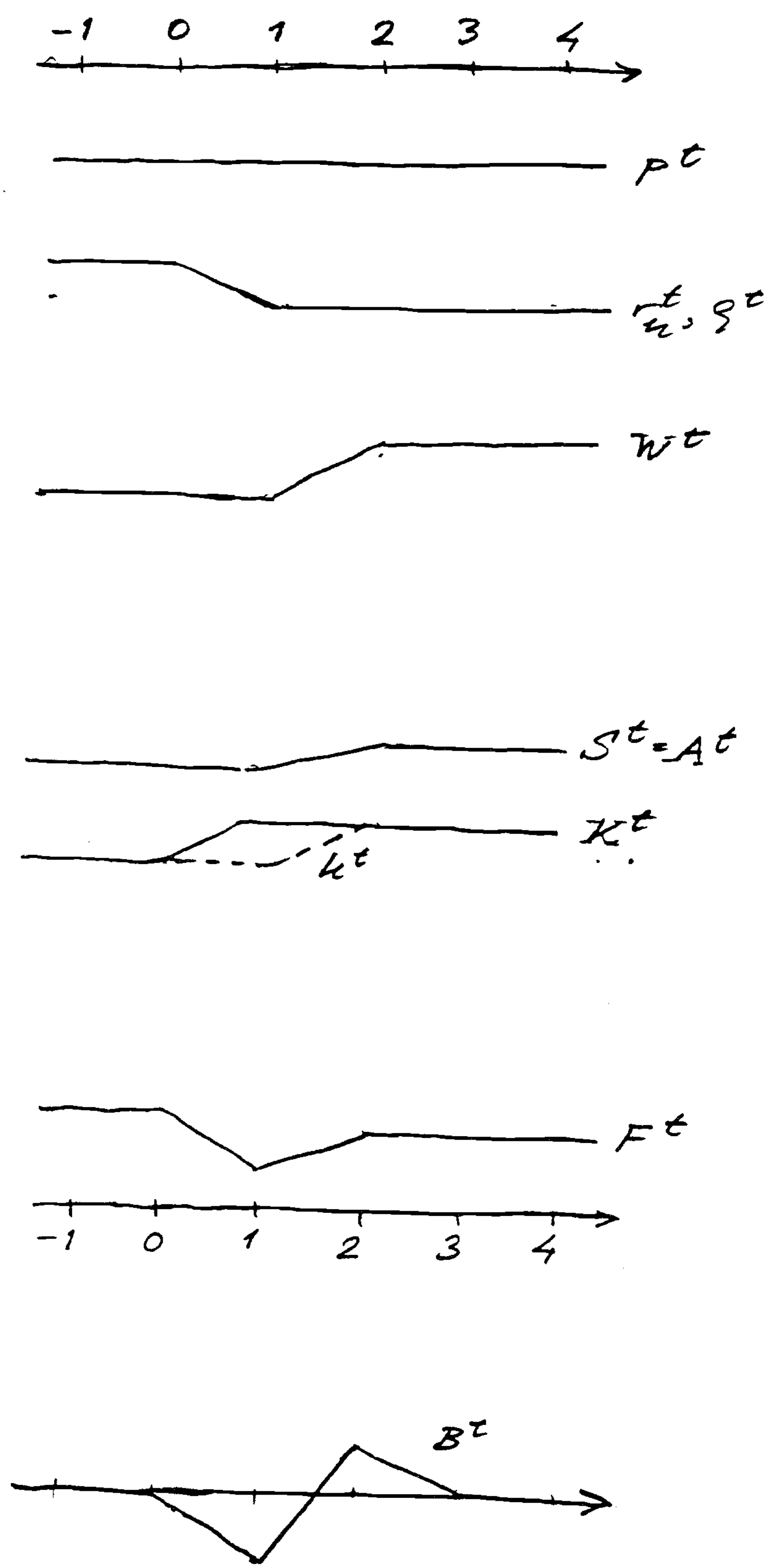
Consider first the adjustment to a permanent fall in the world rate of interest occurring in period 1, which is summarized in Figure 5.

(F i g u r e 5)

With no changes in relative goods prices the home goods and real interest rates, of course, change as the world interest rate. This means that the capital stock used in production increases from period 2 and onward, and thus that the value of the capital stock is higher from the end of period 1. Also, wages increase from period 2.

Saving and total wealth go down in period 1 as a result of the fall in the real interest rate. Although we have drawn an

FIGURE 5



increase in saving from period 2 and onward, saving may actually fall depending on the relative force of the (negative) intertemporal substitution effect, compared to the (positive) effect of increased wages.

With our earlier assumptions about parameters, and if labor's factor share is not very low, it follows that the value of the capital stock must increase proportionally by more than total wealth in the long run.[6] Then, if the share of the capital stock in total wealth is not too small, foreign assets must fall, resulting in the two-period adjustment with a deficit followed by a surplus in the current account.

What about the case of a temporary drop in the world rate of interest? Well, here we may directly rely on our results regarding a temporary unanticipated terms of trade deterioration. Noting that in that case too, there is a one-period fall in the home goods and real rates of interest, we realize that the results must be qualitatively although not quantitatively identical in the two cases (the quantitative differences deriving from the fact that here the two interest rates change in the same proportion).

7. The Harberger-Laursen-Metzler effect

Let us finally see what all this has to do with the Harberger-Laursen-Metzler effect. Harberger (1950) -- in discussing the effect on the trade balance of a devaluation -- and Laursen and Metzler (1950) -- in discussing the transmission of disturbances in a two country world with endogenous terms of trade and balanced trade (which they identified with a flexible exchange rate regime) -- looked at the effect on spending, measured in home goods, of a terms of trade change. They postulated that expenditure out of any given income, measured in home goods, should rise with a terms of trade deterioration, and hence that saving out of any given income should fall. Let us examine this proposition in the context of our model. We refer to Svensson and Razin (1983) for a discussion of the controversies around the Harberger-Laursen-Metzler effect and for references to the literature.

We consider the effect on saving in period t, measured in home goods, of a terms of trade deterioration in periods t and t+1, holding the foreign goods rate of interest constant, which implies that wages (measured in home goods) are constant too. (This corresponds most closely to the case with a given domestic income measured in home goods.) Denoting saving measured in home goods by S_h, we hence differentiate

$$(7.1) \qquad S_h^t = S(p^t, \rho^t, W^t)/p^t \ .$$

Now, with the same notation as in Section 2, $(\widehat{1+\rho^t}) = \beta^t\hat{p}^t - \beta^{t+1}\hat{p}^{t+1}$, and $\hat{W}^t = \hat{p}^t$. Then, relying on our earlier results (2.13)-(2.15), we may derive

$$(7.2) \qquad \hat{S}_h^t = \hat{S}^t - \hat{p}^t$$

$$= (1 - \alpha)(\sigma - \gamma)(\beta^t\hat{p}^t - \beta^{t+1}\hat{p}^{t+1}) +$$

$$+ [(1 - \alpha)/\alpha](1 - \beta^t)(1 - \gamma)\hat{p}^t \ ,$$

where $0 < \beta^t = p^t c_h^t/C^t$ $(= p^t d_h^t/(p^t d_h^t + d_f^t)) < 1$ is the share of home goods in consumption period t.

Let us first consider a <u>permanent</u> terms of trade deterioration, that is $\hat{p}^t = \hat{p}^{t+1} = \hat{p} < 0$, and assume that the share of home goods in consumption is the same in both periods, that is $\beta^t = \beta^{t+1} = \beta$. Then the first term on the right hand side in (7.2) is zero and

$$(7.3) \qquad \hat{s}_h^t = [(1 - \alpha)/\alpha](1 - \beta)(1 - \gamma)\hat{p} \lesseqgtr 0 \text{ for } \gamma \lesseqgtr 1.$$

Savings falls if $\gamma < 1$, that is, if period t consumption is less than unitary elastic in wages (wealth), which corresponds to the case of a rate of time preference which is decreasing in wealth. Saving is unaffected if $\gamma = 1$, which corresponds to intertemporally homothetic preferences and a constant rate of time preference. Saving increases if $\gamma > 1$, which corresponds to a rate of time preference which is increasing in wealth.

Let us also consider a <u>temporary</u> terms of trade deterioration, that is, $\hat{p}^t = \hat{p} < 0$ and $\tilde{\hat{p}}^{t+1} = 0$. Then we have

$$(7.4) \qquad \hat{s}_h^t = [(1 - \alpha)/\alpha][\beta\alpha(\sigma - \gamma) + (1 - \beta)(1 - \gamma)]\hat{p} .$$

Saving falls if the second bracket, the weighted sum of the intertemporal price elasticity of consumption ($\eta = \alpha(\sigma - \gamma)$) and of one minus the wealth elasticity of consumption $(1 - \gamma)$ is positive. That happens, for example, if preferences are homothetic ($\gamma = 1$) and the substitution effect dominates over the wealth effect ($\sigma > \gamma = 1$). We note that the Cobb-Douglas case, which has $\sigma = \gamma = 1$, gives a zero effect on saving measured in home goods for both temporary and permanent terms of trade deteriorations.

We conclude that the Harberger-Laursen-Metzler effect indeed can be of either sign for plausible parameters, both for temporary and permanent terms of trade deteriorations.

8. <u>Discussion</u>

In discussing the dynamic adjustment of the current account to terms of trade changes, we have included the substitution effects within each period ("expenditure switching"), which usually receives a great deal of attention in static treatments. We have, however, also included the effects of static terms of trade changes on intertemporal relative prices, as measured by various real interest rates, and how these changes in interest rates might influence savings and investment. Indeed, we have found it very convenient to emphasize those induced changes in intertemporal prices in order to understand the current account dynamics.

Our results suggest that it is crucial to make a distinction not only between temporary and permanent but also between anticipated and unanticipated changes in the terms of trade. From this viewpoint, it seems that attempting to derive unqualified statements about the dynamic adjustment of the current account to terms of trade changes is a futile kind of exercise.

However, there is one phenomenon that reoccurs in virtually all of our experiments, namely a cyclical adjustment in the current account. What lies behind the swings is, to repeat our earlier argument, that terms of trade changes induce fluctuations in investment goods real rates of interest which implies cycles in investment which with a lag lead to cycles in wages and income. Induced cycles in consumer real rates of interest lead to cycles in savings as do the lagged cycles in income. Altogether, this gives cycles in the current account.

Our model is of course extremely simplified in that the horizons for consumption and investment decisions coincide, and in that consumers earn wage income only in the first period. Allowing for costs of adjustment of the capital stock would lengthen the planning horizon for investment, and changes in the optimal capital stock would lead to investment changes over several periods. Allowing for consumers to live more than two periods, and earning wage income in several periods, would also spread out savings adjustment to several periods. Nevertheless the general tendency towards cycles in total wealth and capital stock, and hence towards cyclical fluctuations in the current account, would seem to remain, although the specific dynamics of the current account might be different.

As for other qualifications, the assumption of only one production sector is a convenient simplification, but it is also important for some of our results. Suppose we instead adopted a two-sector production structure as in the Heckscher-Ohlin model. That would clearly introduce static substitution effects in production in response to terms of trade changes, but also alter the intertemporal substitution effects - so as to make the effects on investment dependent on relative factor intensities, as in Razin (1980). Furthermore, such an extension would have implications also on the consumption side. In particular, the response of savings to terms of trade changes, would also depend on relative factor intensities. This is so because these intensifies would determine the relative changes in wages and capital income, associated with very different marginal propensities to save.

Appendix: Properties of the consumption and saving function

Consider maximizing the weakly homothetically separable utility function

(A.1) $v^t = V(c^t, d^{t+1})$ where $c^t = U(c_h^t, c_f^t)$ and $d^{t+1} = U(d_h^{t+1}, d_f^{t+1})$,

and where the subutility function $U(c_h, c_f)$ is linearly homogenous. We shall interpret the scalars c^t and d^{t+1} as real consumption in period t and t+1 for a consumer who is young in period t. The budget constraint is

(A.2) $(p^t c_h^t + c_f^t) + (p^{t+1} d_h^{t+1} + d_f^{t+1})/(1 + r^t) = W^t$.

It is well known that the solution to maximizing (A.1) subject to (A.2) can be described as follows: First, nominal consumption in both periods, $C^t = p^t c_h^t + c_f^t$, and $D^{t+1} = p^{t+1} d_h^{t+1} + d_f^{t+1}$, can be written as the product of a price index and the corresponding real consumption,

(A.3) $C^t = P(p^t)c^t$ and $D^{t+1} = P(p^{t+1})d^{t+1}$.

Here, the exact consumer price index $P(p) = \min\{p\, c_h + c_f\colon U(c_h, c_f) = 1\}$ is the unit-subutility expenditure function associated with the subutility function $U(c_h, c_f)$.

Second, the optimal amount of real consumption is the solution to maximizing $V(c^t, d^{t+1})$ subject to the budget constraint

(A.4) $P(p^t)c^t + [P(p^{t+1})/(1 + r^t))]d^{t+1} = W^t$.

Defining the real discount factor $q^{t+1} = P(p^{t+1})/[P(p^t)(1 + r^t)]$ and real wealth (wages) $w^t = W^t/P(p^t)$, we can write the optimal real consumption in period t as a function $c^t = c(q^{t+1}, w^t)$. Defining the real rate of interest ρ^t according to $q^{t+1} = 1/(1 + \rho^t)$, we can then define the (nominal) consumption function

(A.5) $C^t = C(p^t, \rho^t, W^t) = P(p^t)c(1/(1 + \rho^t), W^t/P(p^t))$.

Straightforward differentiation gives the elasticities

$$\varepsilon C/\varepsilon p^t = \varepsilon P/\varepsilon p^t + (\varepsilon c/\varepsilon w)(-\varepsilon P/\varepsilon p^t) = \beta^t(1 - \gamma),$$

$$\text{(A.6)} \quad \varepsilon C/\varepsilon(1 + \rho^t) = -\varepsilon c/\varepsilon q^{t+1} = -\eta = -(\bar{\eta} - \alpha^t\gamma) = -\alpha^t(\sigma - \gamma), \text{ and}$$

$$\varepsilon C/\varepsilon W^t = \varepsilon C/\varepsilon w^t = \gamma ,$$

where we note that $\alpha^t = q^{t+1}d^{t+1}/w^t$ is the share of savings in wealth, $\beta^t = \varepsilon P/\varepsilon p^t$ is, by standard properties of the price index, the share of home goods in consumption $(p^t c_h^t/C^t)$, γ is the wealth elasticity of real consumption, η is the total, and $\bar{\eta} = \alpha^t\sigma$ is the compensated elasticity of real consumption with respect to the discount factor, and σ is the intertemporal elasticity of substitution of the V(c, d) function. The savings function is defined as

$$\text{(A.7)} \quad S(p^t,\rho^t,W^t) = W^t - C(p^t,\rho^t,W^t) \quad .$$

Since by logarithmic differentiation,

$$\text{(A.8)} \quad \hat{S} = \hat{W}/\alpha - [(1 - \alpha)/\alpha]\hat{C} \ ,$$

the elasticities of the savings function in (2.13)-(2.15) follow.

Footnotes

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1. We note that (2.1) and (2.2) can be written $[p^{t+1}f_k(k^{t+1}) + (p^{t+1} - p^t)]/p^t = r^t$, which can be interpreted as stating that the return in period t + 1 to investing in capital goods in period t, measured in foreign goods and including capital gains, equals the return to investing in the foreign asset, the rate of interesr r^t.

2. With a given world interest rate r and given world market price p the economy is always stable. (The given world market prices and interest rate fix the capital stock, which gives wages and hence they also fix savings.)

3. We have, from (2.2) and (2.11), $(1 \hat{+} r_h^o) = -\hat{p}^1 >$ and $(1 \hat{+} \rho^o) = -\beta^1\hat{p}^1$.

4. We have $\hat{K}^1 = \hat{p} < 0$ and $\hat{K}^o = (\varepsilon K/\varepsilon r_h)\hat{r}_h^o = (-\sigma^s/\theta)[(1 + r_h)/r_h](-\hat{p}) = (\sigma^s/\theta)[(1 + r_h)/r_h]\hat{p} < 0$. Clearly $\hat{K}^o < \hat{K}^1 < 0$ if $\sigma^s > \theta$, as we have assumed in (2.7).

5. This follows, since $\hat{K}^1 = (\varepsilon K/\varepsilon p)\hat{p}^1 + (\varepsilon k/\varepsilon r_h)\hat{r}_h^1 =$ $\hat{p}^1 - (\sigma^s/\theta)((1 + r_h^1)/r_h^1)\hat{p}^1 > 0$, as long as $\sigma^s \geq \theta$.

6. We have, if $\gamma = 1$, $\hat{S} = (1 - \alpha)(\sigma - 1)(1 \hat{+} r) + \hat{W}$, and $\hat{W} = (\varepsilon w/\varepsilon r_h)$ $[(1 + r)/r](1 \hat{+} r) = -[(1 - \theta)/\theta][(1 + r)/r](1 \hat{+} r)$, where we have used $\varepsilon w/\varepsilon r_h = -(1 - \theta)/\theta$. Hence, $\hat{S} = \{(1 - \alpha)(\sigma - 1) - [(1 - \theta)/\theta]$ $[(1 + r)/r]\}(1 \hat{+} r)$. Furthermore, $\hat{K} = (\varepsilon K/\varepsilon r_h)[(1 + r)/r](1 \hat{+} r) =$ $-(\sigma^s/\theta)[(1 + r)/r](1 \hat{+} r)$. Thus $\hat{A} - \hat{K} = \{(1 - \alpha)(\sigma - 1) + [(\sigma^s - (1 - \theta))/\theta]$ $[(1 + r)/r]\}(1 \hat{+} r) < 0$ if $\sigma > 1$ and $\sigma^s \geq \theta$, provided $\theta > 1/2$.

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