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INTERTEMPORAL PRICE SPECULATION AND THE OPTIMAL CURRENT-ACCOUNT DEFICIT

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Abstract

The paper studies the effects of terms-of-trade fluctuations in an infinite-horizon optimizing model of a small open economy. While the current-account response to a transitory terms-of-trade shock is in part explicable by intertemporal smoothing, an important additional factor is the effect of anticipated future terms-of-trade shifts on the real value of the external debt in terms of the home consumption basket. When foreign borrowing is indexed to the import good, a temporary worsening of the terms of trade creates the expectation of a decline in the real value of external debt. This fall in the relevant real interest rate leads households to increase consumption while export prices are low and to decrease consumption sharply once the terms of trade recover. If an adverse price shock is of sufficiently brief duration, instantaneous utility will rise initially.

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This paper employs a simple intertemporal optimizing model to study the effects of transitory fluctuations in a small country's external terms of trade. The paper focuses on the current-account and utility paths induced by temporary terms-of-trade movements, and it compares them with those induced by temporary shocks to output. The economy modeled is one whose foreign borrowing is indexed to the goods it imports. This assumption reflects the situation of industrializing economies that have dollar-denominated foreign debts and face world import prices given in dollar terms.

In the model developed below, a transitory terms-of-trade setback creates the expectation of a future fall in the value of external debt relative to the domestic consumption basket. Temporarily, the real cost of borrowing abroad is lowered.[1/] Any transitory real income reduction causes a current-account deficit; but while the deficit an output shock induces is explicable in full by households' desire to smooth consumption through intertemporal foreign trade, the deficit induced by a terms-of-trade shock is motivated also by a desire to speculate, through borrowing, on the anticipated future fall in the relative price of imports. Because the relevant real interest rate is low while the terms of trade are poor, there is an incentive to shift consumption toward that period. The incentive disappears when the expected terms-of-trade improvement occurs, and so instantaneous utility falls discontinuously at that moment.

The analysis yields a number of interesting conclusions. The utility time profile following a transitory output reduction is flat, but as noted above, that induced by a temporary terms-of-trade shock is discontinuous. Again in contrast to the case of an output disturbance, the cumulative current deficit run during an interlude of terms-of-trade weakness depends on the degree of individual risk aversion, which measures the extent of intertemporal substitutability in consumption. Finally, it can be shown that if an unfavorable terms-of-trade movement is of sufficiently brief duration, instantaneous utility will rise initially, falling below its pre-shock level once the terms of trade have recovered.

In a closely related paper, Dornbusch (1983) examines the influence of non-traded goods on the behavior of an economy similar to the one studied below. The central point of his analysis--identical to the one made in this paper--is that the interest rate relevant for consumption decisions is the cost of external borrowing expressed in terms of the home consumption basket.[2/] Dornbusch does not study the impact of terms-of-trade disturbances, however. In addition, the analytical techniques employed here differ considerably from his, and are of independent interest in that they allow one to express the economy's equilibrium position in closed form as a function of the expected future paths of the relevant exogenous variables.

The results of transitory and anticipated relative-price shocks have been analyzed in two-period models by a number of authors.[3/] As illustrated below, however, extension of the analysis to an infinite-horizon setting can lead to a richer description of the induced current-account paths. Obstfeld (1980, 1982) and Svensson and Razin (1983) have analyzed the effects of permanent, unanticipated relative-price shocks using infinite-horizon models that emphasize the role of subjective time preference in individual saving decisions. In contrast, the model explored below makes the simplifying assumption that the representative consumer's subjective time-preference rate is constant.

The paper is organized as follows. Section I describes the preferences and intertemporal transformation possibilities that form the building blocks of the model. Section II sets out the effects of a temporary fall in output, while section III studies the consequences of a transitory terms-of-trade deterioration and contrasts them with those of an output shock. Section IV offers concluding remarks. A technical appendix substantiates some assertions made in the text.

I. The Model

The analysis concerns a small open economy consisting of identical, immortal households. Each of these planning units maximizes a welfare functional of the form

$$(1) \qquad V = \int_0^\infty u(x_t, m_t)\exp(-\delta t)dt.$$

The concave instantaneous utility function $u(\cdot,\cdot)$ appearing in (1) is defined over the household's consumption of an exportable good (x) and an importable good (m). The parameter δ is the household's constant (positive) rate of time preference.

Each household is endowed with an exogenous flow of y_t units of the export good. That good is perishable; the only available asset is an internationally-traded bond which carries a fixed face value equal to one unit of the importable good and entitles its owner to receive r units of the importable per unit time.[4/] If the planning period begins at time $t = 0$ and b_0 denotes the number of bonds owned by the family on that date, the desired consumption path must satisfy the intertemporal budget constraint:

$$(2) \qquad \int_0^\infty [(x_t/p_t) + m_t]\exp(-rt)dt = b_0 + \int_0^\infty (y_t/p_t)\exp(-rt)dt.$$

In (2), p_t is the price of imports in terms of exports, the terms of trade. The path of the terms of trade is exogenous from the standpoint of the small country. The world interest rate r is likewise exogenous, and is held constant throughout the analysis.[5/]

Necessary conditions for maximization of (1) subject to (2) can be derived by differentiating the Lagrangian expression

$$(3)\qquad L = \int_0^\infty u(x_t,m_t)\exp(-\delta t)dt - \lambda\left(\int_0^\infty [(x_t/p_t) + m_t]\exp(-rt)dt - b_0 - \int_0^\infty (y_t/p_t)\exp(-rt)dt\right)$$

with respect to x_t and m_t (for all t). Those conditions are

$$(4)\qquad u_x(x_t,m_t)\exp(-\delta t) = (\lambda/p_t)\exp(-rt),$$

$$(5)\qquad u_m(x_t,m_t)\exp(-\delta t) = \lambda\exp(-rt).$$

Together with the intertemporal budget constraint (2), equations (4) and (5) can be used to derive a closed-form solution for the economy's optimal consumption path $\{\tilde{x}_t,\tilde{m}_t\}_{t=0}^{\infty}$, as well as $\tilde{\lambda}$, the optimal initial shadow value of wealth. For this purpose, δ, the subjective time preference rate, is assumed to equal r, the bond rate given by the world capital market.[6/] In addition, the utility function is assumed to reside within the constant relative risk aversion family

$$(6)\qquad u(x,m) = \frac{(x^{\alpha}m^{1-\alpha})^{1-R}}{1-R},$$

where $R > 0$ and $1 > \alpha > 0$. The coefficient of risk aversion R measures the curvature of the utility function, and thus the extent to which a smooth consumption time path is desirable. When $R = 1$, $u(x,m) = \alpha\ell n(x) + (1 - \alpha)\ell n(m)$.

The optimal shadow value $\tilde{\lambda}$ and the optimal consumption path are calculated as follows. Because $\delta = r$ (by assumption), equations (4)-(6) imply that

(7) $$\tilde{x}_t/\tilde{m}_t = \alpha p_t/(1 - \alpha).$$

It follows from (5) and (7) that

(8) $$\tilde{m}_t = \left(\frac{1-\alpha}{\tilde{\lambda}}\right)^{1/R}\left(\frac{\alpha p_t}{1-\alpha}\right)^{\alpha(1-R)/R}.$$

Now $(\tilde{x}_t/p_t) + \tilde{m}_t = \tilde{m}_t/(1 - \alpha)$, by (7). The intertemporal budget constraint (2) and equation (8) therefore yield the optimal shadow value

(9) $$\tilde{\lambda} = \frac{(1-\alpha)^{1-R}\left[\int_0^\infty \left(\frac{\alpha p_t}{1-\alpha}\right)^{\frac{\alpha(1-R)}{R}} \exp(-rt)dt\right]^R}{\left[b_0 + \int_0^\infty (y_t/p_t)\exp(-rt)dt\right]^R}.$$

Equations (7) and (8) may be combined with formula (9) to yield expressions for the optimal consumption trajectories.[7/]

The shadow price $\tilde{\lambda}$ is, by (9), a function of the expected future paths of output and the terms of trade; by implication, the same is true of consumption. Any previously unanticipated change in these paths will cause $\tilde{\lambda}$ to jump to a new level. An unanticipated shift in lifetime consumption possibilities [as described by (2)] thus induces households to revise both the desired level of current consumption and the entire planned path of future consumption.

The optimal path of net external bond holdings, $\{\tilde{b}_t\}_{t=0}^{\infty}$, may be derived from (9) and Bellman's principle. In the absence of disturbances that were not anticipated at time t = 0, an optimal consumption program computed on that date must coincide with an optimal program as re-computed at time t = s > 0. In other words, the optimal plan is time consistent. Because $\tilde{x}_t$ and $\tilde{m}_t$ are monotonically decreasing functions of $\tilde{\lambda}$, the optimal shadow value of wealth as of time s > 0 must therefore equal the value computed at time 0. It follows that for any s > 0,

$$(10) \qquad \tilde{\lambda} = \frac{(1-\alpha)^{1-R}\left[\int_s^{\infty}\left(\frac{\alpha p_t}{1-\alpha}\right)^{\frac{\alpha(1-R)}{R}}\exp(-r(t-s))dt\right]^R}{\left[\tilde{b}_s + \int_s^{\infty}(y_t/p_t)\exp(-r(t-s))dt\right]^R},$$

where $\tilde{\lambda}$ again represents the optimal shadow price computed at time 0 on the basis of the expected price and output paths appearing in (9). The multiplier $\tilde{\lambda}$ can change only as a result of events that were unanticipated at time t = 0.[8/]

By equating the right-hand sides of (9) and (10), we can express the optimal level of net external assets $\tilde{b}_s$ as a function of the time paths of output and the terms of trade. (Of course, $\tilde{b}_0 = b_0$ is predetermined and not subject to choice.) The current account is the time derivative of b_t,[9/] that is,

$$(11) \qquad \dot{b}_t = (y_t/p_t) + rb_t - (x_t/p_t) - m_t.$$

Equations (9) and (10) will be used in the following sections to trace out the optimal current-account responses to a number of different real income disturbances.

Before going on to these exercises, it is useful to examine the effect on the current account of an output or terms-of-trade shock that is both unanticipated and permanent. It is assumed here--and throughout the analysis below--that, prior to the shock, output and the terms of trade are expected to remain constant at $y_t = y$, $p_t = p$, for all t, so that the economy is in a stationary state. The level of the pre-shock shadow value $\tilde{\lambda}$ is then

$$(12) \quad \tilde{\lambda} = \frac{(1 - \alpha)^{1-R} \left(\frac{\alpha p}{1 - \alpha}\right)^{\alpha(1-R)}}{[rb_0 + (y/p)]^R},$$

where b_0 is the stock of bonds inherited from the past [see (9)]. An unanticipated, permanent fall in output from y to y' causes a once-and-for-all rise in $\tilde{\lambda}$ (to $\tilde{\lambda}'$, say) provided no further unexpected events occur. But the optimal shadow value can remain at $\tilde{\lambda}'$ through time with no change in the stock of foreign claims because the expected paths of output and the terms of trade are flat. It follows that if the economy is initially in a stationary position, an unanticipated, permanent shock to the terms of trade has no impact on the current account: external adjustment is immediate. The same is true of relative price shocks.[10]

II. Transitory Output Shocks

As a prelude to studying the optimal current-account response to a temporary terms-of-trade shock, we study the external asset path induced by a transitory decline in output. Before the transitory disturbance is revealed, the economy is in the stationary position described at the end of section I. After the shock is revealed (at time $t = 0$), the terms of trade are expected to remain at the level $p_t = p$ for all t, but output is expected to follow the path: $y_t = y' < y$ for $0 \leq t < T$, $y_t = y$ for $t \geq T$. It follows that at the initial instant, the shadow value of wealth jumps permanently from the level $\tilde{\lambda}$ given by (12) to a new level

$$(13) \qquad \tilde{\lambda}' = \frac{(1-\alpha)^{1-R}\left(\dfrac{\alpha p}{1-\alpha}\right)^{\alpha(1-R)}}{[rb_0 + (y'/p)(1-\exp(-rT)) + (y/p)\exp(-rT)]^R} > \tilde{\lambda}.$$

Equations (7) and (8) imply that the consumption levels of both commodities fall the moment the news of the transitory output shock arrives, but remain constant thereafter. Instantaneous utility must therefore also follow a lower, constant path.

For this to be possible, the current account must be in deficit while output is temporarily low. By equating the right-hand sides of (9) and (10), we find that for any expected output path and constant terms of trade p, the stock of external claims must satisfy

$$(14) \qquad \tilde{b}_s + \int_s^\infty (y_t/p)\exp[-r(t-s)]dt = b_0 + \int_0^\infty (y_t/p)\exp(-rt)dt$$

for all s, so that household net worth (measured in imports) remains constant over time. The constant post-shock level of expenditure equals the annuity value of (14), that is, permanent income. The economy smooths its consumption and utility by choosing the highest fixed expenditure level consistent with its new intertemporal budget constraint and borrowing from abroad while current income is below permanent income. Observe that when real income disturbances arise entirely from fluctuations in output, the induced external asset path is not dependent on the risk aversion parameter R characterizing the curvature of the utility function.

Under the present assumptions concerning the output path expected in the wake of the shock, equation (14) becomes

$$(15) \quad \tilde{b}_s = b_0 + [(y'/rp) - (y/rp)][\exp(-r(T-s)) - \exp(-rT)]$$

for $0 \leq s \leq T$, $\tilde{b}_s = \tilde{b}_T$ for $s \geq T$. Differentiation of (15) shows that between times $s = 0$ and $s = T$ the current account balance is given by

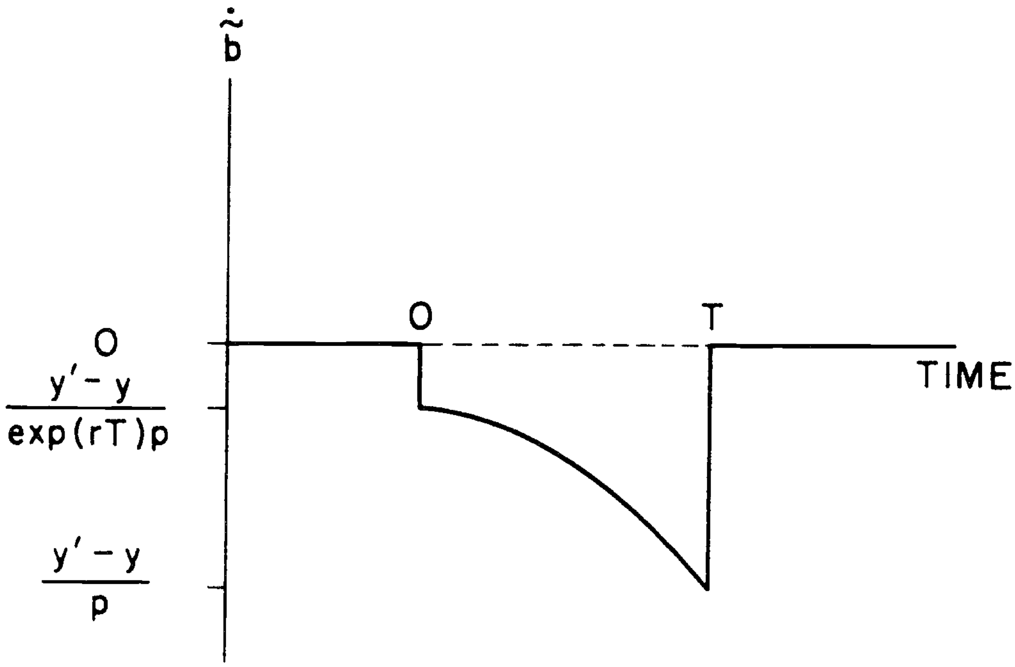
$$(16) \quad \dot{\tilde{b}}_s = [(y' - y)/p]\exp(-r(T-s)) < 0.$$

According to (16), the current account deficit grows up until time T, at which moment its level is $\dot{\tilde{b}}_T = (y' - y)/p$. When the anticipated increase in output occurs, the current account jumps to zero with no change in spending or instantaneous utility. The time path of the current account is illustrated in figure 1.

III. Transitory Terms-of-Trade Shocks

The preceding analysis serves as background for the discussion of transitory real income fluctuations caused by relative price movements. This section studies the current-account effects of a transitory terms-of-trade deterioration, assuming that the economy is initially at a stationary position and that the expected path of the terms of trade remains fixed at $y_t = y$ for all t. Once the shock occurs, the anticipated time path of the

FIGURE 1



terms of trade is given by: $p_t = p'$ for $0 \leq t < T$, $p_t = p < p'$ for $t \geq T$.

Before the occurrence of the shock, when the terms of trade are expected to follow the constant path $p_t = p$ for all t, the optimal shadow value $\tilde{\lambda}$ is, once again, described by equation (12). The temporary and unanticipated rise in the price of imports causes $\tilde{\lambda}$ to jump to the new, permanent level

$$(17) \quad \tilde{\lambda}' = \frac{(1-\alpha)^{1-R}\left[\left(\frac{\alpha p'}{1-\alpha}\right)^{\frac{\alpha(1-R)}{R}}(1-\exp(-rT)) + \left(\frac{\alpha p}{1-\alpha}\right)^{\frac{\alpha(1-R)}{R}}\exp(-rT)\right]^R}{[rb_0 + (y/p')(1-\exp(-rT)) + (y/p)\exp(-rT)]^R} .$$

To determine the effect of the price shock on the current account, it is necessary to know whether $\tilde{\lambda}'$ is greater or less than $\tilde{\lambda}$. The appendix demonstrates that the sign of the derivative of (17) with respect to p', evaluated at $p' = p$, is the same as that of the expression $(1-R)(rb_0 - \tilde{m}_0) + (y/p)$, where $\tilde{m}_0$ is the consumption level of the imported good in the pre-shock stationary state. When $R < 1$, the foregoing quantity is positive because $\tilde{m}_0$ cannot exceed the initial level of permanent income, $rb_0 + (y/p)$. A sufficient condition for the quantity to be positive when $R > 1$ is that $\tilde{m}_0 > rb_0$, so that the economy is indeed a net importer of the "import" good, as we have assumed.[11/] Thus, $(d\tilde{\lambda}'/dp')|_{p'=p} > 0$ in all cases.

It follows that for small price changes,

$$(18) \quad \tilde{\lambda}' > \tilde{\lambda}$$

provided the terms-of-trade change does in fact hurt the home country. Because the newly-established shadow value $\tilde{\lambda}'$ remains constant through time and the economy is in a stationary position from date T onward,

$$(19) \qquad \tilde{\lambda}' = \frac{(1-\alpha)^{1-R}\left(\frac{\alpha p}{1-\alpha}\right)^{\alpha(1-R)}}{[r\tilde{b}_T + (y/p)]^R},$$

by (10). Equations (12), (18), and (19) imply that $b_T < b_0$. The inequality shows that the home country runs a cumulative current account deficit between times 0 and T.

In the case of the temporary fall in output studied in section II, the post-shock time profile of instantaneous utility was flat: the economy smoothed its utility stream perfectly by holding consumption constant in the face of the anticipated increase in output. This pure smoothing behavior no longer obtains when real income falls because of a transitory adverse terms-of-trade change. Because bonds have a face value fixed in terms of the import good, terms-of-trade changes alter the real value of the external debt when this is measured in terms of a basket including both importables and exportables. An anticipated improvement in the terms of trade lowers the real cost of borrowing abroad in the period before the terms of trade improve. Individual optimality therefore involves an element of intertemporal price speculation which causes a discontinuity in the time profile of utility and may even cause instantaneous utility to rise temporarily.

A detailed analysis of the time path of instantaneous utility throws light on the equilibrium response to a transitory terms-of-trade change. The intertemporal constancy of $\tilde{\lambda}'$, together with (7) and (8), implies that consumption of both commodities--and hence, utility--must be constant between times 0 and T, and again after time T. Only at time T, when the terms of trade revert to p from p', can consumption and utility change discretely. The level of utility while the terms of trade are relatively unfavorable is calculated [with the help of (6)-(8)] to be

$$(20)\qquad \frac{\left(\frac{1-\alpha}{\tilde{\lambda}'}\right)^{(1-R)/R}\left(\frac{\alpha p'}{1-\alpha}\right)^{\alpha(1-R)/R}}{1-R} \equiv u(\tilde{\lambda}',p').$$

The jump in instantaneous utility at time T is obtained by differentiating (20) with respect to the terms of trade, holding $\tilde{\lambda}'$ constant:

$$(21)\qquad -\frac{\partial u}{\partial p} = -\alpha(1-R)u(\tilde{\lambda}',p')/p'R < 0.$$

Equation (21) shows that instantaneous utility <u>falls</u> abruptly when the terms of trade improve at time T. There is thus a discontinuity in the utility path at that point.

To complete the description of the utility time profile we must ask how instantaneous utility changes at time 0 when the transitory price shock is first revealed. The answer depends on the duration T of the adverse terms-of-trade movement. The initial jump in utility is given by

$$(22)\qquad du = u_{\lambda}(\tilde{\lambda},p)d\tilde{\lambda} + u_{p}(\tilde{\lambda},p)dp,$$

which is of ambiguous sign because the first summand is negative while the second is, by (21), positive. In equation (22) it is the variation $d\tilde{\lambda}$ (and that only) that is a function of T; and as the appendix demonstrates,

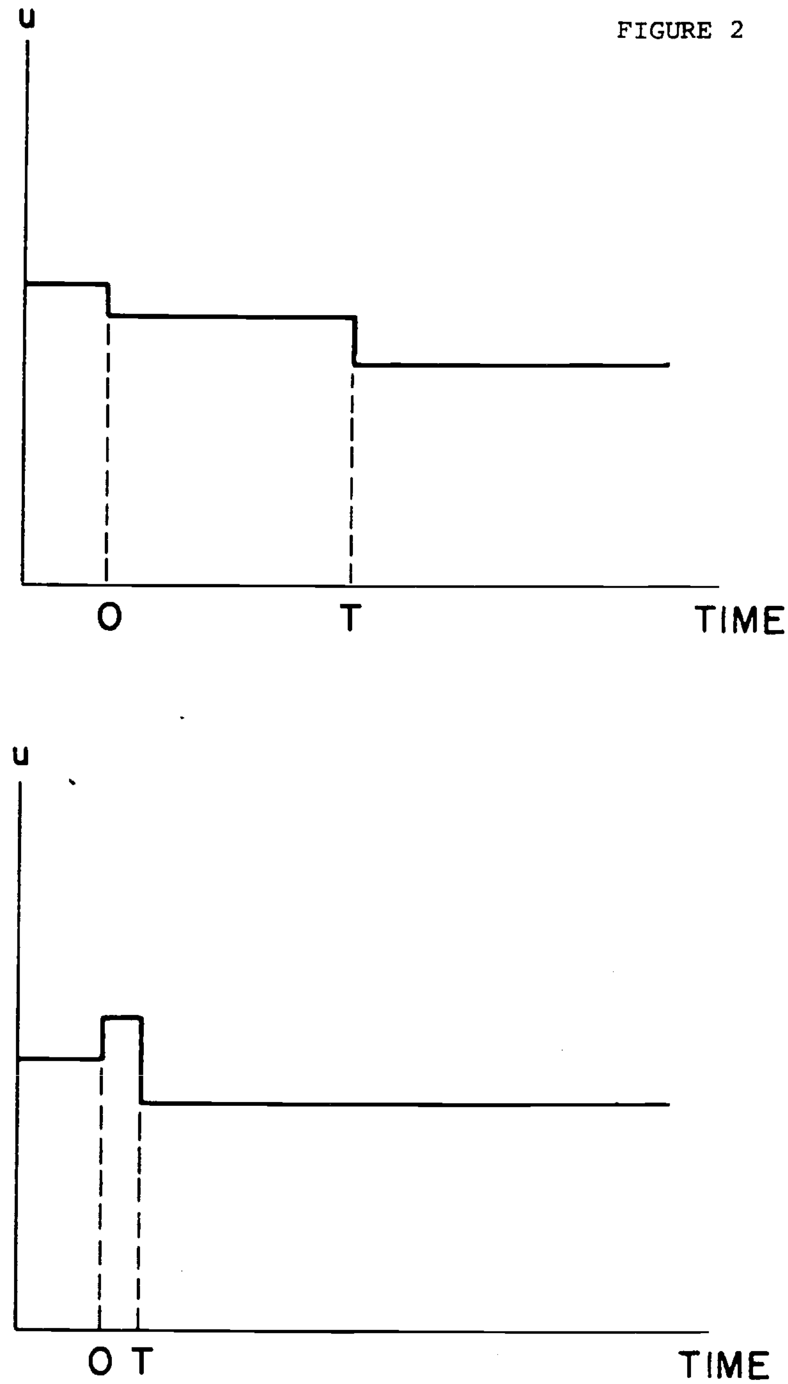
$$(23)\qquad \lim_{T\to 0} d\tilde{\lambda} = 0.$$

It follows from (23) that there are time periods T sufficiently short that the derivative (22) is positive. This implies the surprising result that for a sufficiently brief terms-of-trade deterioration, instantaneous utility can rise initially, even though the value of the intertemporal welfare functional V [given by (1)] must fall. Figure 2 depicts two possible utility time profiles, the second of which entails such an initial rise in utility.

These time profiles can be explained by our earlier observation that an anticipated terms-of-trade improvement effectively lowers the real interest rate relevant for external borrowing decisions. As in the case of a temporary output shock, the economy's reaction to a temporary adverse price shift arises in part from a desire to smooth the feasible utility stream: this explains the emergence of an external deficit. But in addition, households know that the real value of any debt incurred between times 0 and T will decline abruptly when p' falls to p. Thus, while the reduction in permanent income induces them to cut consumption, the expected price change leads them to increase their consumption while the terms of trade are unfavorable and reduce consumption sharply once the anticipated capital gains have been realized. The fall in consumption at time T corresponds to the discontinuous drop in instantaneous utility pictured in figure 2. The possibility of an initial increase in instantaneous utility arises because the speculative (or real interest rate) effect of a transitory price shock may outweigh the income effect when the shock is of brief duration.

The parameter R plays a key role in determining the optimal current-account deficit, again in contrast to the case of a temporary fall in output.

FIGURE 2



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From (17) and (19) the cumulative current surplus between times 0 and T is is the negative quantity

$$b_T - b_0 = \frac{(1-\exp(-rT))[(\alpha p)^{\frac{\alpha(1-R)}{R}}\left(b_0+\frac{y}{rp'}\right) - (\alpha p')^{\frac{\alpha(1-R)}{R}}\left(b_0+\frac{y}{rp}\right)]}{(1-\exp(-rT))(\alpha p')^{\alpha(1-R)/R} + \exp(-rT)(\alpha p)^{\alpha(1-R)/R}}.$$

By differentiating the foregoing expression one finds that

$$\text{sign}\left(\frac{db_T}{dR}\right) = \text{sign}\ \{\log(p'/p)[(1-\exp(-rT))\left(b_0+\frac{y}{rp'}\right) + \exp(-rT)\left(b_0+\frac{y}{rp}\right)]\},$$

so that $db_T/dR > 0$. As the measure of risk aversion R increases, the smoothing motive becomes more important relative to the speculative motive and the cumulative current-account deficit run while the terms of trade are poor declines. Increased concavity of the utility function makes it more costly (in welfare terms) to shift consumption from the post-T period to the period in which the terms of trade are temporarily unfavorable and the cost of borrowing is, correspondingly, low. 12/

The assumption that all international lending is indexed to the imported good is clearly central to the results derived above. If bonds were indexed instead to exports, an expected future terms-of-trade improvement would raise rather than lower the perceived cost of borrowing abroad during a spell of low export prices; and this rise in the relevant real interest rate would reinforce rather than oppose the income effect on spending of the temporary terms-of-trade shock. The assumption of import-indexed lending seems, however, to be the more realistic one for the industrializing economies which have experienced such marked terms-of-trade volatility over the last decade. These countries' external debts are primarily dollar denominated, while a substantial fraction of their imports is priced in dollars on world markets.

In a setting of perfectly integrated capital markets it would be natural to introduce alongside import-indexed bonds a bond linked in value to exports and paying an own-interest rate ρ. A consequence of the perfect-foresight assumption, however, is the arbitrage relation

$$(24) \quad \rho = r + (\dot{p}/p),$$

which, given ρ and r, severely restricts the possible terms-of-trade paths that can be analyzed. In particular, (24) precludes anticipated, discrete shifts in the price of imports of the type analyzed in this paper. A two-country model would allow the endogenous determination of ρ and r and yield predictions concerning the current-account and (smooth) terms-of-trade paths induced by various shocks to the world economy. Those predictions would in general depend on the countries' initial portfolio compositions, which, again because of the perfect-foresight assumption, are indeterminate. A satisfactory resolution of the difficulty requires an explicitly stochastic model of the type explored by Lucas (1982).

IV. Conclusion

This paper has studied the effects of transitory terms-of-trade fluctuations on a small open economy. Using a simple intertemporal optimizing model of individual behavior, the paper showed that a temporary worsening in the terms of trade occasions a current-account deficit which persists until the terms of trade return to their initial level.

This current-account path is explicable in part by households' desire to smooth their consumption streams; but a complete explanation must recognize also that the expected future improvement in the terms of trade gives households an opportunity to speculate intertemporally by incurring an import-indexed foreign debt whose real value is certain to decrease. The result is that the economy's utility time profile is discontinuous, with instantaneous utility <u>rising</u> initially if the duration of the terms-of-trade shock is sufficiently brief.

Appendix

The appendix calculates the effect of a transitory rise in the terms of trade p on the optimal shadow value of wealth, $\tilde{\lambda}$. That effect is simply the derivative of the right-hand side of (17) with respect to p', evaluated at p' = p:

$$\text{(25)}\quad \left.\frac{d\tilde{\lambda}'}{dp'}\right|_{p'=p} = \frac{(1-\exp(-rT))(1-\alpha)^{1-R}}{p[rb_0 + (y/p)]^{1+R}} \left(\frac{\alpha p}{1-\alpha}\right)^{\alpha(1-R)} \{\alpha(1-R)(rb_0 + \frac{y}{p}) + \frac{Ry}{p}\}.$$

Clearly, the limit of (25) as $T \to 0$ is 0, as equation (23) asserts. To sign (25), we must analyze the term in braces, $\alpha(1-R)[rb_0 + (y/p)] + (Ry/p)$. It follows from (8) and (12) that the pre-shock level of consumption of the imported good, $\tilde{m}_0$, is given by $(1 - \alpha)[rb_0 + (y/p)]$. Thus

$$\alpha(1 - R)(rb_0 + \frac{y}{p}) + \frac{Ry}{p} = (1 - R)(rb_0 - \tilde{m}_0) + \frac{y}{p} > 0$$

as asserted in the paragraph following equation (17).

Footnotes

* The research reported in this paper was begun while I was a visiting scholar in the International Finance Division of the Board of Governors of the Federal Reserve System. I am grateful for the suggestions of participants in seminars at Columbia University and the University of Pennsylvania. Also appreciated are the comments of the editor and the referees. Financial support from the National Science Foundation is acknowledged with thanks.

1. Dornbusch (1982) argues that the consumer price index is the appropriate deflator for an external foreign-currency debt.

2. This point is also made by Obstfeld (1981) in a variant of this paper's model and by Mussa (1983) in a descriptive model of current-account determination. As in Dornbusch (1983), the model used below assumes preferences of the constant relative risk aversion variety. Given these preferences, the representative individual's instantaneous utility is an increasing function of the consumption index studied by Dornbusch. The results below, which are expressed in terms of the instantaneous utility level, are therefore easily translated into statements about the time path of the consumption index.

3. See, among others, Bruno (1982), Marion (1982), Sachs (1981), and Svensson and Razin (1983). Dornbusch and Krugman (1976) emphasize the distinction between permanent and transitory changes in an informal discussion of the current-account effects of relative-price shocks.

4. The assumption that borrowing is indexed to imports introduces a certain asymmetry into the model. The implications of the assumption are discussed at the end of section III, below.

5. Because perfect foresight is assumed, no notational distinction between expected and realized variables is made. Note that the intertemporal budget constraint (2) implies the transversality condition $\lim_{t\to\infty} b_t \exp(-rt) = 0$, which rules out excessive foreign borrowing [see Obstfeld (1982)]. Constraint (2) alone is therefore sufficient to

preclude an unbounded consumption and borrowing program in which all interest payments are met through further borrowing.

6. Without this assumption the economy would not possess a stationary state.

7. By (2), the denominator of (9)--household net worth--must always be positive. Thus $\tilde{\lambda} > 0$. It is assumed throughout that all real-income shocks are sufficiently small that they would not result in non-positive household net worth even if they were permanent.

8. The multiplier $\tilde{\lambda}$ can be interpreted as an asset price; see Obstfeld (1981). The assertion that it cannot jump discretely in response to events that were previously anticipated is analogous to the corresponding statement concerning asset prices established in efficient markets.

9. While b_t is a continuous function of time, it need not be differentiable: the current-account balance $\dot{b}_t$ can change sharply. At points where b_t is not differentiable, equation (11) below is interpreted as describing the <u>right-hand</u> derivative of b_t.

10. If the economy is not initially in a stationary position, however, permanent shifts in the expected future paths of output or the terms of trade will influence the current account.

11. If the economy's endowment of the foreign good, rb_0, exceeds desired consumption, that good will be exported, not imported.

12. Recall that the condition $\tilde{m}_0 > rb_0$ is sufficient (but not necessary) to ensure that a temporary rise in p leads to a current deficit. Even a small country that benefits from a transitory rise in p may run a deficit because it can gain from raising consumption temporarily and incurring a debt whose real value is sure to decrease. As $R \to \infty$, however, the condition $\tilde{m}_0 > rb_0$ becomes necessary as well as sufficient for a deficit.

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