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TEMPORARY TERMS OF TRADE DISTURBANCES, THE REAL EXCHANGE RATE AND THE CURRENT ACCOUNT

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ABSTRACT

In this paper a general equilibrium intertemporal model with optimizing consumers and producers is developed to analyze how the temporary terms of trade disturbances affect the path of real exchange rates and the current account. Changes in the internal terms of trade (due to tariff changes) and to the external terms of trade are considered. The model is completely real, and considers a small open economy that produces and consumes three goods each period. It is shown that, without imposing rigidities or adjustment costs, interesting paths for the equilibrium real exchange rate can be generated. In particular "equilibrium overshooting" can be observed. Precise conditions under which a temporary import tariff will worsen the current account in period 1 are derived. The way in which temporary and permanent external terms of trade shocks will affect the current account are analyzed. Several ways in which the model can be extended are discussed. The results obtained from this model have important implications for the design of balance of payments policy and for the analysis of real exchange rate misalignment and overvaluation.

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I. Introduction

The recent behavior of the external sector in a number of countries, including the United States, has generated concern among policymakers and academics. In fact, in the last few years policy analyses have increasingly focused on issues related to the evolution of the trade and current accounts, and some proposals aimed at altering some countries external positions have been intensively discussed. Perhaps one of the most hotly debated policy measures consists of the imposition of (temporary) import tariffs as a way of improving the internal terms of trade and, thus, a country's current account.[1]

Historically, a number of countries have many times resorted to protectionism as a means to face external payments difficulties; the imposition of temporary impediments to trade -- in the form of import tariffs or quotas, for example -- has in fact been a common practice aimed at improving the current account and/or at changing the behavior of the real exchange rate. In particular, this has been a very common feature of the Latin American countries, which have recurrently tried to use temporary protectionist measures as a way to influence the behavior of the external sector. Many times, however, these protectionist policies have failed to achieve their objectives, and in spite of increased levels of import tariffs the current account balance has not experienced any improvements.[2] Traditional trade theory has explained this phenomenon claiming that in some cases the elasticities of demand for imports and exports can be very low. These explanations, however, fail to recognize the fact that the current account basically responds to intertemporal considerations, and that for any policy measures to have an effect on its balance, it necessarily has to have an impact on the country's savings and/or investment decisions.

The purpose of this paper is to develop a fully real optimizing intertemporal general equilibrium model to analyze how disturbances to terms of trade -- both internal (due to tariff changes) and external -- affect the current account. The analysis focuses on the cases of temporary import tariffs and temporary external terms of trade shocks. In the Section IV, however, the cases of permanent disturbances is also briefly discussed. The model considers a two-periods economy that produces and consumes three goods -- exportables, importables and nontradables. Consumers maximize intertemporal utility, while producers maximize present value of profits. In this three goods setting changes in the equilibrium real exchange rate -- or equilibrium relative price of nontradables -- becomes a key intertemporal channel through which the terms of trade disturbances impact on the current account. Although in recent years it has become customary to emphasize the intertemporal nature of the current account, a large number of policy discussions have in practice ignored this proposition and have proceeded along the lines of traditional static textbook models. Also, a number of applied papers have recently discussed the effects of tariffs on current account behavior without acknowledging any intertemporal factors. On the other hand, many of the papers that have explicitly used an intertemporal setting have either used ad-hoc assumptions regarding consumers or producers, or have only considered a two-goods world, being unable to deal with the effects of import tariffs on the real exchange rate.[3]

II. The Model

In this section a real general equilibrium intertemporal model of a small open economy is derived to analyze the way in which different disturbances affect the current account. The model is based on Edwards

(1988c) and extends in several directions the intertemporal models of Svensson and Razin (1983) and Edwards and van Wijnbergen (1986).

Consider the case of a small country that produces and consumes three goods -- importables (M), exportables (X), and nontradables (N). There are two periods -- the present (period 1) and the future (period 2). Foreign borrowing and lending is allowed at the exogenously given world interest rate r^*. The country faces an intertemporal budget constraint that states that the discounted sum of the current account balances is zero. (Thias assumes that the initial debt commitment is zero.) There are a large number of producers and (identical) consumers, and perfect competition prevails. Consumers maximize utility subject to their intertemporal budget constraint, whereas firms maximize profits subject to existing technology and availability of factors of production. In ord : to simplify the exposition in the first part of the paper it is assumed that there is no investment. In Section V.2, however, investment is incorporated into the analysis.

Assuming that the utility function is time separable, with each subutility function homothetic and identical, the representative consumer problem can be stated as follows:

$$\max \Omega(u(c_N, c_M, c_X);\ U(C_N, C_M, C_X)),$$

subject to:

$$c_X + pc_M + qc_M + \delta^*(C_X + PC_M + QC_N) \leq \text{Wealth}, \tag{1}$$

where the lower case letters refer to first period variables and the upper case letters refer to second period variables. The price of the exportable has been taken to be the numeraire. Ω is the intertemporal welfare function; u and U are periods 1 and 2 subutility functions assumed, as pointed out, to be homothetic and identical. c_X, c_M, c_N, (C_X, C_M and C_N) are consumption of X, M and N in period one (two). p and P are the domestic prices of importable relative to exportables in periods 1 and 2. q and Q are prices of nontradables relative to exportables in periods 1 and 2, and δ^* is the world discount factor equal to $(1+r^*)^{-1}$. It is assumed that imports are subject to a tariff. Denoting periods 1 and 2 tariffs as t and T, domestic prices of importables are related to world prices in the following way (where an asterisk refers to a foreign variable):

$$p = p^* + t; \quad P = P^* + T \tag{2}$$

Wealth is the discounted sum of consumer's income in both periods. Income, in turn, is given in each period by three components: (1) income from labor services rendered to firms; (2) income from the renting of capital stock that consumers own to domestic firms; and (3) income obtained from government transfers. These, in turn, correspond to the proceeds from import tariffs which the government hands back to the public. In this model, then, as in most of the international trade literature, the government plays no active role besides imposing import tariffs, and handing their proceeds back to households in a nondistortionary way.[4]

Given the nature of preferences, the consumer optimization process can be thought of as taking place in two stages. First, the consumer decides how to allocate his(her) wealth across periods. Second, he(she) decides how to distribute each period (optimal) expenditure across the three goods. The solution to the consumers optimizing problem is conveniently summarized by the following intertemporal expenditure function:[5]

$$E = E(\pi(1,p,q),\ \Pi(1,P,Q),\Omega). \tag{3}$$

where π and Π are exact price indexes for periods 1 and 2. Under the assumptions of homotheticity and separability these price indexes correspond to unit expenditure functions (Svensson and Razin, 1983). A convenient property of the expenditure function is that its derivative with respect to each price is equal to the compensated demand curve for that good. For instance, the compensated demand function for nontradables in period 1 (where a subindex refers to a partial derivative with respect to that variable) is given by:

$$E_q = E_\pi \pi_q .$$

Another important property of expenditure functions is that they are concave. Moreover, given our assumption of a time separable utility function, expenditure in periods 1 and 2 are substitutes. As a result, all intertemporal cross demand effects are positive (i.e., $E_{pQ}, E_{qP}, E_{qQ}, E_{pP} > 0$).[5]

It is assumed that firms use conventional technology to produce N, X and M. There are three factors of production -- capital, labor and natural resources. Consequently, factor price equalization does not hold in either period. At this point it is assumed that there is no investment, and that all factor prices are fully flexible. Later, in Section V, however, both assumptions will be relaxed. The producers' maximization problem can be stated, in each period, in the following way (where v and V are vectors of factors of production; w and W are vectors of their rewards, and s_j and S_j are outputs of good j in periods 1 and 2.)

$$\text{period 1} \quad \max \text{ profits} = (ps_M+qs_N+s_X) - wv$$
$$\text{period 2} \quad \max \text{ Profits} = (PS_M+QS_N+S_X) - WV \qquad (4)$$

The outcome of this optimization process can be conveniently summarized by two revenue functions -- r for period 1 and R for period 2 -- which are functions of prices and factor endowments.

$$r = r(1,p,q;v)$$
$$R = R(1,P,Q;V) \quad (5)$$

Revenue functions have a number of useful properties that will be used extensively below. First, they are convex. Second, their partial derivative with respect to each price is the supply function of that particular good. And third, their partial derivative with respect to the endowment of a particular factor is equal to the marginal product of that factor (Dixit and Norman, 1980).

Equilibrium in this economy is obtained by the simultaneous solutions of the consumers and producers optimization problems, and by the requirements that the nontradable market clears every period and that full employment prevails. The solution to this problem will determine the equilibrium path of nontradable prices, equilibrium real exchange rates in both periods, quantities produced and consumed of X, M and N, the current account, and factors rewards. This equilibrium is fully captured by a set of three equations. The first is the intertemporal budget constraint that states that the present value of income has to equate the present value of expenditure:

$$r(1,p,q;v) + \delta^{*}R(1,P,Q;V) + t(E_p-r_p) + T(E_p-R_p) = E(\pi(1,p,q),\delta^{*}\Pi(1,P,Q);\Omega). \quad (6)$$

where $t(E_p-r_p)$ and $T(E_p-R_p)$ are tariff revenues in periods 1 and 2. Notice that in (6) we have used the world discount factor δ^{*} implying that there are no impediments (taxes) on foreign borrowing. For models with controls on capital movements see Edwards and van Wijnbergen (1986), Edwards (1988c), van Wijnbergen (1985b), and Edwards (forthcoming).

The other two equations are the nontradables market equilibrium conditions for periods 1 and 2:

$$E_q = r_q \tag{7}$$

$$E_Q = R_Q. \tag{8}$$

Since we have assumed that this country can borrow from abroad, expenditure in any period can exceed income; that is, the current account can be different from zero. Moreover, since in this model it is assumed that the initial foreign debt is zero, the amount of foreign borrowing is equal to the stock of foreign debt at the end of period 1. However, equation (6) imposes the restriction that if in period 1 there is a current account deficit, in period 2 there should be a current account surplus large enough to pay the debt.

The current account in period 1 is defined as income minus expenditure in that period.

$$ca = r(1,p,q;v) + t(E_p - r_p) - \pi E_\pi \tag{9}$$

Given that we have assumed that there is no investment, this equation corresponds to savings in period 1. In Section V.2 below, however, the more general case with investment is briefly discussed.

II.1 Terms of Trade, the Equilibrium Real Exchange Rate and the Current Account

Intertemporal models of the current account have emphasized that in order for policy measures (or other disturbances) to affect the current account they should have an effect on savings and/or investment decisions. In models such as the ones developed by Svensson and Razin (1983), Razin and Svensson (1983) and Edwards and van Wijnbergen (1986), terms of trade changes have a direct effect on intertemporal consumption decisions. The model developed in this paper goes beyond this direct effect and incorporates an important, indeed crucial, additional channel through which terms of trade (internal and external) disturbances have an effect on the current account. This additional channel is the <u>real exchange rate</u> or relative price of nontradables. Terms of trade shocks will have an impact on the equilibrium real exchange rate and, in turn, this will have an additional effect on intertemporal expenditure and investment decisions. In fact, when this additional channel is incorporated into the analysis it is possible to obtain some results that have usually been ruled out in more simple discussions.

In this particular model there are two real exchange rates (RERs) in each period: the relative price of importables to nontradables (p/q), (P/Q), and the relative price of exportables to nontradables $(1/q)$, $(1/Q)$. In order to simplify the exposition, in this paper we will focus on the (inverse) of real exchange rate for exports (q and Q). The <u>equilibrium</u> (exportable) RER in a particular period is defined as the relative price of exports that, for given values of other variables such as world prices, technology and tariffs, equilibrates <u>simultaneously</u> the external and internal (i.e., nontradables) sectors.[7] In terms of the model, the vector of equilibrium RERs is given by those relative prices of N that simultaneously satisfy equations (6), (7) and (8), for given values of the other fundamental variables.

III. <u>Temporary Import Tariffs, Equilibrium Real Exchange Rates and the Current Account</u>

This section investigates how temporary changes in the internal terms of trade, generated by changes in import tariffs in period 1, affect the current account. The discussion proceeds by steps, investigating first the effect of temporary tariffs on equilibrium real exchange rates, and then analyzing the current account's reaction to the change in internal terms of trade. In order to simplify the discussion and to use a diagramatical analysis it is first assumed that initial import tariffs are equal to zero: $t = T = 0$. In this way first order income effects can be ruled out.

Figure 1 summarizes the initial equilibrium in the nontradables market in periods 1 and 2.[8] Schedule hh depicts the combination of q and Q consistent with equilibrium in the nontradable goods market in period 1. Its slope is equal to:

$$\left.\frac{dq}{dQ}\right|^{hh} = \frac{E_{qQ}}{(r_{qq} - E_{qq})} > 0 \tag{10}$$

where E_{qQ} is an intertemporal cross demand term that captures the reaction of the demand for N in period 1 (E_q) to an increase in nontradables prices in period 2. Given the time separable nature of the utility function this term is positive.[9] r_{qq} is the slope of the supply curve of N in period 1 and E_{qq} is the slope of the compensated demand curve in that period. Consequently, the term $(r_{qq} - E_{qq})$ is also positive. The intuition behind the positive slope of hh is the following: an increase in the price of N in period 2 will affect the consumption discount factor $(\delta^*\Pi)/\pi$, making consumption in that period relatively more expensive. As a result, there will be a substitution away from period 2 and towards period 1 expenditure. This will put pressure on the market for N in period 1, and an incipient excess demand for N in that period will develop. The reestablishment of nontradable equilibrium in period 1 will require an increase the relative price ofnontradables.

Schedule HH depicts the locus of qQ compatible with nontradable market equilibrium in period 2. Its slope is positive and equal to:

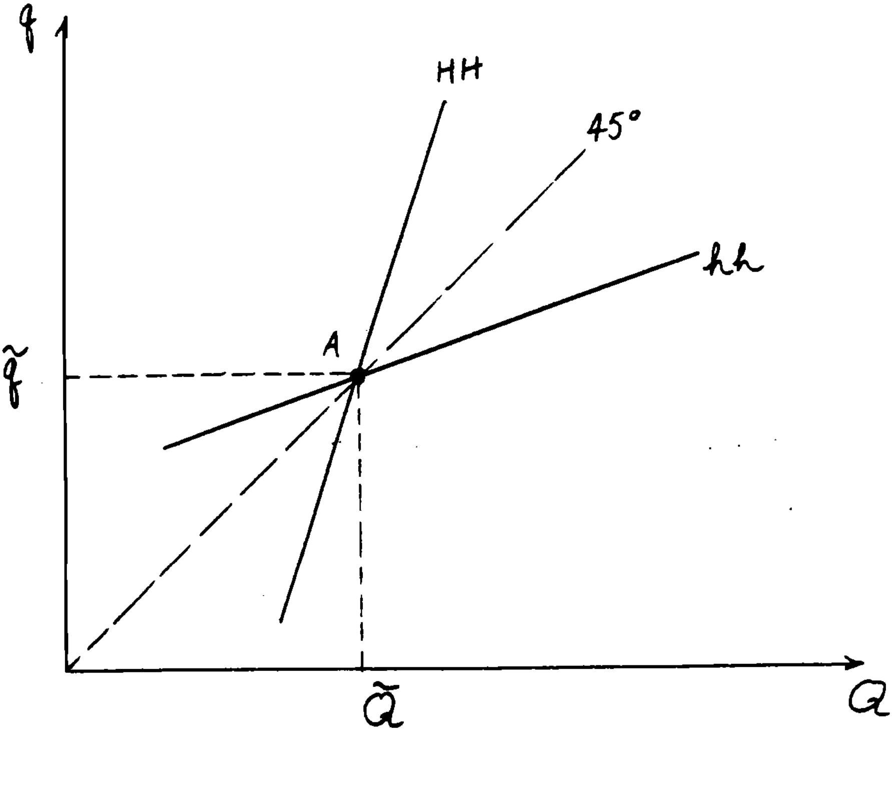

Figure 1

$$\left.\frac{dq}{dQ}\right|^{HH} = \frac{(R_{QQ} - E_{QQ})}{E_{qQ}} > 0. \tag{11}$$

The intuition behind this positive slope is analogous to that of the hh schedule: an increase in q will make current consumption relatively more expensive, shifting expenditure into the future. As a result there will be a pressure on Q, which will have to increase to reestablish equilibrium. It is easy to show that the HH schedule is steeper than the hh schedule.[10]

The intersection of hh and HH at A characterizes the (initial) relative prices of nontradable goods markets in periods 1 and 2 $(\tilde{q},\tilde{Q})$ compatible with the simultaneous attainment of intertemporal external equilibrium and internal equilibrium in both periods. In order to make the exposition clearer we have assumed that these equilibrium prices $\tilde{q}$ and $\tilde{Q}$ are equal; the 45° line passes through the initial equilibrium point A. Notice that the existence of intertemporal substitution in consumption is what makes these schedules slope upward. If there were no intertemporal substitution hh would be completely horizontal, while HH would be vertical. A similar result would occur if this country had no access to borrowing in the international financial market.

III.1 <u>Equilibrium Real Exchange Rates</u>

A temporary import tariff in period 1 will shift both the hh and HH schedules, generating a new vector of equilibrium relative prices of nontradables. Let's first consider the case of HH. A temporary import tariff means that the price of imports in period 1 will increase, making present consumption as a whole relatively more expensive. Consequently, via the intertemporal substitution effect, consumers will substitute expenditure away from period 1 and into period 2. This will result in an increase in the demand for all goods (including nontradables) in period 2, and in a higher Q. As a result, the HH curve will shift to the right. The magnitude of this horizontal shift is equal to:

$$dQ\Big|_{dq=0}^{HH} = \{E_{Qp}/(R_{QQ}-E_{QQ})\}\ dt \tag{11}$$

This movement in the HH curve is a reflection of the degree of intertemporal substitutability in consumption: it will be greater or smaller depending on whether E_{Qp} is large or small. In the extreme case of no intertemporal substitution ($E_{Qp} = 0$), the HH schedule will be vertical, and will not shift as a result of a temporary tariff.

The imposition of a temporary import tariff will also affect the hh schedule. In this case, however, there will also be an <u>intra</u>temporal effect related to the change in relative prices within period 1. The higher domestic price of M in period 1, resulting from the higher tariff, will reduce the quantity demanded of M in that period. Notice that since there are three goods in this model, any two of them can be complements in consumption. This means that the intratemporal cross effects on demand cannot be signed <u>a priori</u>. Depending on whether importables and nontradables are substitutes or complements in consumption in the same period, the quantity demanded of N will increase or decline. Formally, the vertical shift of hh is equal to:

$$dq\Big|_{dQ=0}^{hh} = \frac{(E_{qp} - r_{pq})}{(r_{qq} - E_{qq})}\ dt \gtrless 0 \tag{12}$$

It is clear from (12) that the sign indeterminacy stems from the fact that E_{qp} can be either positive or negative. A sufficient condition for the hh schedule to shift up is that N and M are substitutes, so that $E_{pq} > 0$. On the other hand, a necessary condition for the hh to shift down is that $E_{pq} < 0$.

At this level of aggregation, however, the most plausible case corresponds to all goods being substitutes. Notice that even in this case it is not possible to know a priori whether the hh or the HH schedules will shift by more (compare (11) with (12)). In terms of the diagram, if $E_{pq} > 0$, the new equilibrium can be above or below the 45° line. This gives rise to the possibility of some interesting equilibrium paths for the RERs. For example, it is possible to observe an "equilibrium overshooting", where (relative to the no-tariff case) $\tilde{q}$ increases by more than $\tilde{Q}$. This would be the case if the hh shifts up by more than what HH shifts to the right. In such a case the new equilibrium point would be above the 45° line, as illustrated in Figure 2.

Figure 3 illustrates two alternative new equilibria. Point A characterizes the initial equilibrium. Point B corresponds to the case when N and M are substitutes and the intratemporal effect is strong enough to shift up the hh schedule significantly. The new (after tariff imposition) equilibrium schedules are $\tilde{h}\tilde{h}$ and $\bar{H}\bar{H}$. In this case the temporary import tariff results in a higher relative price of nontradables in periods 1 and 2. That is, the equilibrium exportables RER appreciates in both periods, as a result of the temporary tariff. Point C in Figure 3 is the new equilibrium under the assumption that nontradables and importables are complements in consumption in period 1 and that this effect dominates so that the hh schedule will shift down to a position such as $\tilde{\tilde{h}}\tilde{\tilde{h}}$. Under this assumption Figure 3 shows that as a result of a temporary tariff the equilibrium path of the real exchange rate will be characterized by wide

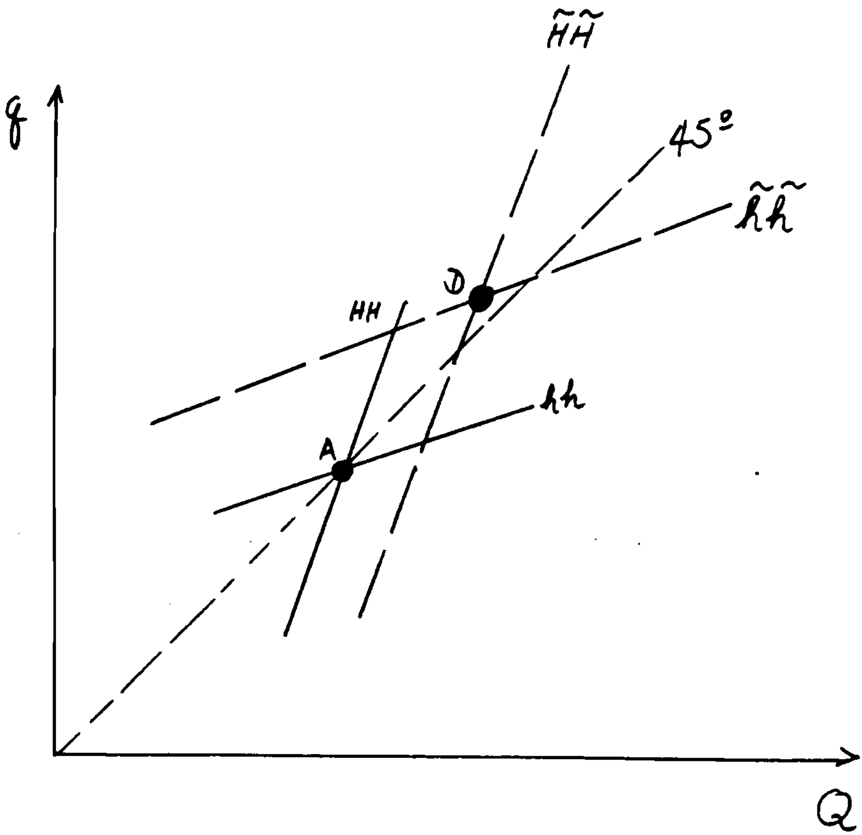

Figure 2

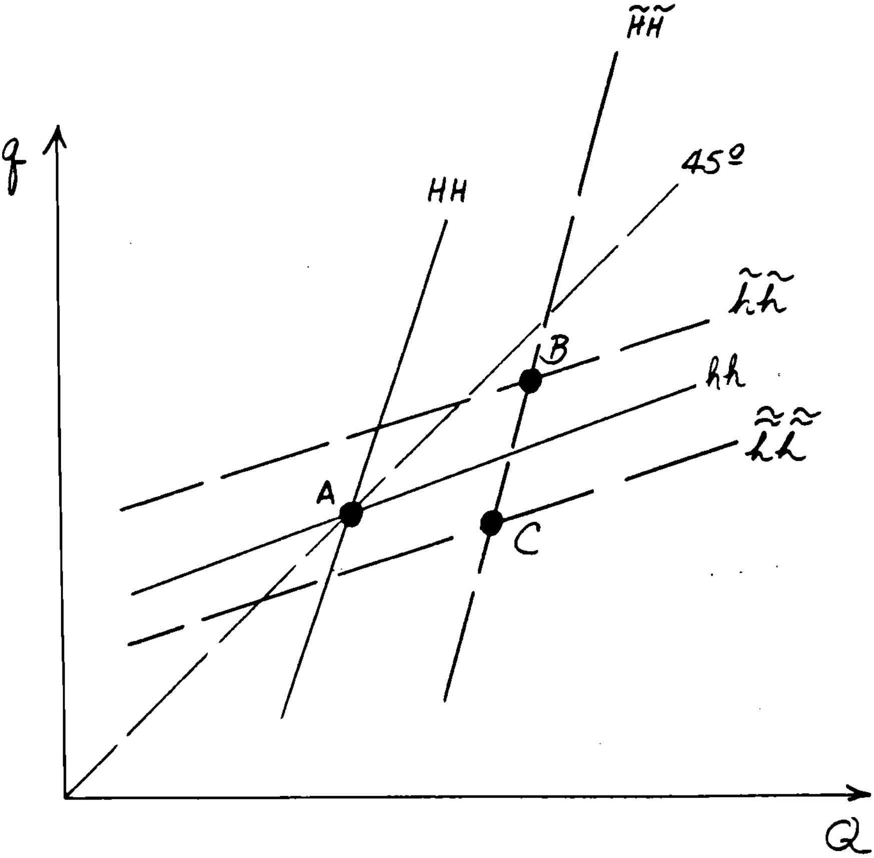
q
Q
HH
$\tilde{H}\tilde{H}$
45º
$\tilde{h}\tilde{h}$
hh
$\tilde{\tilde{h}}\tilde{\tilde{h}}$
A
B
C

Figure 3

swings: it will depreciate in period 1, and it will appreciate significantly in period 2. Although this path is clearly characterized by equilibrium movements in each period, observers may think that the RER has moved in the "wrong direction" in period 1.

To sum up, then, formally it is not possible to know whether the equilibrium changes in q and Q as a result of the temporary import tariff will be positive or negative:[11]

$$\frac{dq}{dt} \gtrless 0 \tag{13}$$

$$\frac{dQ}{dt} \gtrless 0 \tag{14}$$

III.2 The Current Account

From equation (9) it is now possible to find out how the current account in period 1 will respond to the temporary tariff:

$$\frac{d(ca)}{dt} = -(\pi\, E_{\pi\pi}\, \pi_p) - (\pi\, E_{\pi\pi}\, \pi_q)\left(\frac{dq}{dt}\right) - \delta^{*}\pi E_{\pi\Pi}\Pi_Q\left(\frac{dQ}{dt}\right) \tag{15}$$

Where $E_{\pi\Pi}$ captures the reaction of real expenditure in period 1 (E_{π}) to a change in the exact price index in period 2, and where $E_{\pi\pi}$ captures the reaction of period 1 expenditure to a change in that period's exact price index. The presence of either a $E_{\pi\pi}$ or a $E_{\pi\Pi}$ term in every one of the RHS terms of equation (15) clearly highlights the fact that the temporary tariff will only affect the current account via intertemporal channels. The first term in the RHS of equation (15) is the traditional direct effect and it is positive. The intuition for this positive effect is straightforward. The temporary tariff makes period 1 consumption relatively more expensive, and as a result of this the public substitutes consumption away from period 1 into period 2, generating an improvement of the current account balance in period 1. The magnitude of this effect will depend both on the term $E_{\pi\pi}$ and on the initial share of imports on period 1 expenditure π_p.

The second and third terms on the RHS of equation (15) are <u>indirect</u> effects, that operate via changes in periods 1 and 2 equilibrium real exchange rates. Since, as was established above, the signs of (dq/dt) and (dQ/dt) cannot be determined <u>a priori</u>, the signs of these two terms in (15) are generally undetermined, as will be the sign of the current account equation (15) as a whole. However, the interpretation of these two indirect terms is quite straightforward. If the temporary tariff results in an equilibrium real appreciation in period 1, $(dq/dt) > 0$, there will be an additional force towards a current account improvement. The reasoning is again simple. If the temporary tariff results in a higher equilibrium price of nontradables in period 1 (i.e., in a real appreciation in 1), there will be substitution away from period 1 expenditure, generating an improvement in the current account in that period. The third term on the RHS relates the change in period 2's RER to period 1's current account. If as a consequence of the temporary tariff Q increases, there will be a tendency to substitute expenditure away from period 2 into period 1, generating forces that will tend to worsen the current account in period 1. Notice that the presence of these two terms involving the real exchange rate introduce important differences to the more traditional intertemporal analysis, as the one pioneered by Svensson and Razin (1983).

The total effect of the temporary import tariff on period 1's current account will depend on the strength of the intertemporal price effects, on the initial expenditure on imports and nontradables, and on the effects of the tariff on the RER vector. It is possible, however, that as a consequence of the temporary import tariff the current account will worsen in the period when the tariffs are imposed, generating a quasi-perverse effect. This result suggests that policy makers should be very careful when imposing temporary trade restrictions as a way to improve the current account.

IV. External Terms of Trade, Real Exchange Rates and the Current Account

The discussion in Section III has concentrated exclusively on substitution channels, ignoring income effects. This was possible thanks to the simplifying assumption of a zero initial tariff. However, in real world situations income effects are important and can have an important influence on the current account. There are two circumstances when income effects will be particularly important: when there are tariff changes in the presence of large initial tariffs, and when there are disturbances to external terms of trade -- the world price of importables relative to exportables. In this section we analyze the way in which the temporary disturbances to the external terms of trade affect the current account. The analysis focuses on the role of income effects and the results obtained are compared to those of Section III. As in the previous section, the discussion proceeds by steps: we first inquire how a temporary shock to the external terms of trade affects the vector of equilibrium real exchange rates. We then discuss how period 1 current account is affected by this shock.

IV.1 Equilibrium Real Exchange Rates

When there are income effects the diagrammatic apparatus of Section III cannot be used to analyze the behavior of equilibrium RERs. Still assuming that $t = T = 0$, a temporary shock in the external terms of trade will affect the vector of equilibrium RERs in the following way:[12]

$$\frac{dq}{dp*} = -\frac{1}{\Delta}\{(E_{pq} - r_{pq})(R_{QQ} - E_{QQ}) + E_{Qp}E_{Qq}\}$$

$$+ (\frac{1}{\Delta})\ (E_p - r_p)\ \{E_{qQ}\ \Pi_Q\ E_{\Pi\Omega} + \pi_q E_{\pi\Omega}(R_{QQ} - E_{QQ})\} \gtrless 0 \qquad (16)$$

and

$$\frac{dQ}{dp*} = -\frac{1}{\Delta}\{(E_{pq} - r_{pq})E_{qQ} + E_{Qp}(r_{qq} - E_{qq})\}$$

$$+ \frac{1}{\Delta}\ (E_p - r_p)\ [\pi_q\ E_{Qq}\ E_{\pi\Omega} + (r_{qq} - E_{qq})\ \Pi_Q E_{\Pi\Omega}] \gtrless 0 \qquad (17)$$

where Δ is negative and is defined in footnote 11, and where the terms $E_{\pi\Omega}$ and $E_{\Pi\Omega}$ capture the income effects in periods 1 and 2, and are positive.

A number of important results emerge from these equations. First, due to the existence of foreign borrowing, a temporary terms of trade shock that only increases the current international price of imports, will affect both the current and future equilibrium value of the real exchange rate. Second, contrary to the case of a temporary tariff, even under the assumption of substitutability in demand everywhere, the change in the relative price of nontradables cannot be signed. The reason for this is, of course, that in addition to the substitution effects, we now have a (negative) first order income effect associated to the worsening of the terms of trade. These income effects are given by the second RHS term in equations (16) and (17). As is usually the case these income effects are proportional to the level of imports in period 1 $(E_p - r_p)$. Notice that if the income effect dominates the substitution effect, $(dq/dp*)$ and $(dQ/dp*)$ can be negative even if we assume substitutability in consumption everywhere. This is because the worsening of the terms of trade will result in a decline in demand for all goods in every period, generating a downward pressure on the relative price of nontradables in all periods.

In order to highlight the relation between tariffs and terms of trade effects, we can rewrite equation (16) in the following way (a corresponding expression can be written for equation (17)):

$$\frac{dq}{dp^*} - \frac{dq}{dt} = \left(\frac{1}{\Delta}\right) (E_p - r_p) \, (E_{qQ} \, \Pi_Q \, E_{\Pi\Omega} + \pi_q E_{\pi\Omega}(R_{QQ} - E_{QQ})), \quad (18)$$

where, clearly the RHS of equation (18) is negative under our assumptions regarding intertemporal substitutability in demand.[13]

IV.2 The Current Account

More than thirty-five years ago Laursen and Metzler (1950) and Harberger (1950), using essentially static models, established conditions under which terms of trade shocks would worsen the current account. More recently, Obstfeld (1982), Svensson and Razin (1983), and Persson and Svensson (1985) have relooked at the relation between terms of trade shocks and the current account using models where intertemporal considerations are explicitly taken into account. The specific question asked in these papers was: since the current account is equal to the difference between savings and investment, what are the mechanisms through which a terms of trade shock will affect these intertemporal decisions? None of these studies, however, considered the presence of home goods and the additional effects that terms of trade shocks can exert via changes in the RER.

Equation (19) provides an expression for changes in the current account of period 1 as a result of temporary external terms of trade shocks under our maintained assumption that $t = T = 0$:

$$\frac{dca}{dp^*} = - \pi \, E_{\pi\pi} \, \pi_p - \pi \, E_{\pi\pi} \, \pi_q \left(\frac{dq}{dp^*}\right) - \delta^* \, \pi \, E_{\pi\Pi} \, \Pi_Q \left(\frac{dQ}{dp^*}\right)$$

$$- (E_p - r_p) - E_{\pi\Omega} \, \pi \left(\frac{d\Omega}{dp^*}\right) \quad (19)$$

It is clear from equation (19), that in the present model it is not possible to know with certainty whether a temporary worsening in the terms of trade will improve or worsen the current account. The first three RHS terms of equation (19) are equivalent to those in equation (15) for the temporary tariff case, and their economic interpretation is virtually the same. The fourth RHS term in (19) is equal to period 1 imports and since it is preceded by a minus sign, it is negative. The last RHS term in (19) captures the (negative) income effect generated by a deterioration of the terms of trade, and is positive since $(d\Omega/dp^*) < 0$ (i.e., the negative terms of trade shock reduces aggregate utility and real income). These last two terms capture the effects of the reduction in expenditure in both periods on the current account in period 1: the decline in wealth prompted by the terms of trade shock will generate forces towards improving the current account in that period.

It is interesting to compare the effects of a temporary external terms of trade shock to those obtained from a permanent disturbance to the world relative price of imports. In the case in which $dp^* = dP^*$ the change in the current account of period 1 will be:

$$\left.\frac{dca}{dP^*}\right|_{permanent} = \left.\left(\frac{dca}{dp^*}\right)\right|_{temporary} - (\delta^*\pi\ E_{\pi\Pi}\ \Pi_P) \qquad (20)$$

Notice that, as before, the response of the current account in period 1 to a <u>permanent</u> terms of trade shock cannot be signed unequivocally. In this model, even if there is a permanent terms of trade shock we cannot know *a priori* whether the first period current account will improve or worsen. What we do know from (20), however, is that, whatever the sign is, the magnitude of the change will be different than in the case of a temporary shock. Naturally, this is due to the fact that the term $-(\delta^*\pi E_{\pi\Pi}\Pi_P)$ is negative. As a consequence, a permanent negative terms of trade shock will either worsen the current account in period 1 by more, or improve it by less, than a temporary shock. The reason for this is that when the terms of trade shock is permanent the negative income effect affects both periods, and there is no intertemporal substitution of expenditure for consumption smoothing reasons.

V. Extensions: Factor Price Rigidities and Investment

In order to make the exposition clearer, the model presented above has been derived under a number of simplifying assumptions. In this section we briefly sketch how the model can accommodate two important extensions.

V.1 Factor Price Rigidities

All of the exercises performed above have assumed that all prices, including those of factors, are fully flexible. This is not always the case, especially in the developing countries. Rigidities in some factor prices can be easily introduced into the analysis. Assume, for example, that the (real) wage rate (w) is fixed at a level $\bar{w} = \bar{W}$, lower than r_ℓ and R_L, where r is the unconstrained revenue function in period 1, R is the unconstrained revenue function in period 2, and ℓ and L represent the labor force in each of those periods. In this case, then, we have to define constrained revenue functions $(\tilde{r}, \tilde{R})$ (see Neary 1985):

$$\tilde{r}(\bar{w},p,q;k) = \max_{s,\ell} \{s^X + qs^N + ps^M) - \bar{w}\ell\}$$

and

$$\tilde{R}(\bar{W},P,Q;K) = \max_{S,L} \{(S^X + QS^N + PS^M) - \bar{W}L\} \tag{21}$$

where s^i and S^i $i = X,M,N$ refer to output of exportables, importables and nontradables in periods 1 and 2. Now the nontradable market equilibrium conditions need to be replaced by:

$$\tilde{r}_q = E_q. \qquad (22)$$

Neary (1985) has shown that under fixed factor prices the following relation exists between restricted and unrestricted revenue functions:

$$\tilde{r} = r[p,q,\tilde{\ell}(\tilde{w},p,q,k)] - \tilde{w}\tilde{\ell}(\tilde{w},p,q,k) \qquad (23)$$

where $\tilde{\ell}$ is the amount of labor employed in the constrained case. Once the revenue functions have been redefined in this way it is easy to find how the relative price of nontradables reacts to a tariff change in an economy with fixed real wages. After this effect has been found, the way the current account will react can be derived in the same way as in Section IV above.

For a number of years trade theorists have been preoccupied with the relation between tariffs and employment (van Wijnbergen 1987). In the model developed in this paper, if wages are flexible, tariffs have no effects on aggregate employment. However, if there is real wage rigidity tariffs will indeed have an effect on the level of total employment in the economy. For example, equation (24) gives the response of labor employed in period 1 to a temporary tariff in that period:

$$\frac{d\ell}{dt} = -(\tilde{r}_{\ell p}/r_{\ell\ell}) - (\tilde{r}_{\ell q}/\tilde{r}_{\ell\ell})\,(dq/dt) \qquad (24)$$

where the term (dq/dt) captures the change in the relative price of N in period 1 to that period's tariff increase. Both $\tilde{r}_{\ell p}$ and $\tilde{r}_{\ell q}$ are Rybczinski type terms whose signs will depend on factor intensities. Depending on the sign of (dq/dt) and on factor intensities in the different sectors $(d\tilde{\ell}/dt)$ can be positive or negative.

V.2 Investment

Since the discussion presented above has ignored investment, the current account in each period is equal to savings in that particular period. Investment, however, can be introduced in a straightforward fashion. Once investment is added to the analysis, the intertemporal budget constraint has to be altered and an equation describing the process governing investment decisions has to be added to our system. Denoting investment by I and assuming that there is time to build, the intertemporal budget constraint becomes (where v is now the vector of factors of production other than capital):

$$r(1,p,q;k,v) + \delta^{*}R(1,P,Q;k+I,v) + t(E_p-r_p) + \delta^{*}T(E_P-R_P) - I(\delta^{*}) = E(\pi(1,p,q),\delta^{*}\Pi(1,P,Q),\Omega] \tag{25}$$

Possibly the simplest way to deal with investment is by assuming that investment decisions are governed by the condition that in equilibrium Tobin's "q" equals 1. Further assuming that investment goods correspond to the numeraire good, the investment equation can be written in the following way:

$$\delta^{*}R_K = 1 \tag{26}$$

The manipulation of (25) and (26) and the two conditions for equilibrium in the nontraded goods market in period 1 and 2 will now yield the corresponding expressions for changes in the RERs and the current account. In this case the current account equation should be modified by subtracting I to the RHS of equation (9).

VI. Concluding Remarks

In this paper I have developed an intertemporal, fully optimizing model of a small open economy with nontradable goods to analyze how temporary terms of trade shocks affect the current account. The analysis distinguished between disturbances to the internal terms of trade, generated by tariff changes, and disturbances to the external terms of trade. In this general setting changes in the (equilibrium) real exchange rate -- or relative price of nontradables -- provided an important channel through which a change in the terms of trade will influence the current account. For this reason the analysis of the current account behavior was preceded by an analysis of the determinants of real exchange rates. It was shown that in this intertemporal setting a temporary tariff will affect the equilibrium real exchange rate both in the current and future periods. However, it is not possible to know *a priori* the direction of this effect. In fact, it is possible that, contrary to popular belief, a temporary tariff will result in a real exchange rate depreciation in the current period, which is later reversed.

The analysis has shown that it is possible for a temporary import tariff to *worsen* the current account in the period when it is imposed. This indicates that policy makers should be particularly careful when using temporary protectionist policies for balance of payments purposes. Not only will these policies result in welfare reducing inefficiencies, but may very well fail to achieve their intended objective of improving the current account and the degree of competitiveness.

The model can be expanded in several ways. The cases of anticipated and permanent terms of trade shocks follow directly from the analysis presented here. Two interesting extensions are related to increasing the dimensionality of the model either in terms of periods and/or countries.

The case of more than two periods is analytically straightforward; the algebra, however, is messier. In that case the scope for unconventional results is expanded, since with more than two periods it is possible to have intertemporal complementarity in demand. The case of two (large) countries is slightly more difficult, since world market clearing conditions have to be incorporated. An interesting feature of the large country case is that even if tariffs are initially zero, tariff changes will still result in first order income effects. The reason, of course, is that in the large country case tariff changes will affect the international terms of trade.

FOOTNOTES

[1]On the recent discussions on protectionism in the U.S., see, for example, the Wall Street Journal, Monday, May 16, 1988, page 1.

[2]See Edwards (1988a) for a detailed analysis of the effects of tariffs and exchange controls on the balance of payments in a group of Latin American countries.

[3]Svensson and Razin (1983), van Wijnbergen (1984) and Edwards and van Wijnbergen (1986), among others, have emphasized the intertemporal nature of the current account. These papers, however, have only dealt with two goods economies. On intertemporal models of the current account with nontradables see Frenkel and Razin (1986, 1987), Edwards (1987) and Ostry (1988).

[4]See, however, Edwards (forthcoming) for a related model where the government uses tariffs proceeds to finance its own consumption.

[5]See Dixit and Norman (1980) for the use of duality in static trade models. Svensson and Razin (1983) and Edwards and van Wijnbergen (1986) use duality in intertemporal models without nontradables.

[6]If we allow some of the goods to enter as an input in the production of another good, some of these cross derivatives could be negative. However, in order to maintain the analysis at a simple level, in what follows we ignore that possibility.

[7]Notice that implicit in this definition is the requirement of full employment.

[8]This type of diagram has a long tradition in international economics. See, for example, Dornbusch (1980), Haaparanta and Kahkonen (1986), and van Wijnbergen (1987).

[9] The exact expression for E_{qQ} is obtained after taking the derivative of the equation $E_q = E_\pi \pi_q$.

[10] See, for instance, Edwards (1987), Edwards (forthcoming) and Ostroy (1988).

[11] Formally,

$$\frac{dq}{dt} = -\left(\frac{1}{\Delta}\right)\{(E_{pq} - r_{pq})(R_{QQ} - E_{QQ}) + E_{Qp}E_{qQ}\}$$

$$\frac{dQ}{dt} = -\left(\frac{1}{\Delta}\right)\{E_{Qq}(E_{pq} - r_{pq}) + E_{Qp}(r_{qq} - E_{qq})\}$$

where $\Delta = -[(r_{qq} - E_{qq})(R_{QQ} - E_{QQ}) - E_{Qq}E_{qQ}] < 0$.

[12] Naturally, when there is an external terms of trade shock, even if initial tariffs are equal to zero there will be a non-zero income effect.

[13] Edwards (1987) develops analogous expressions for the effect of anticipated and permanent external terms of trade shocks on the vector of equilibrium RERs.

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