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TARIFFS, THE REAL EXCHANGE RATE AND THE TERMS OF TRADE: ON TWO POPULAR PROPOSITIONS IN INTERNATIONAL ECONOMICS

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ABSTRACT

In this paper we investigate the relation between tariff changes, terms of trade changes and the equilibrium real exchange rate. For this purpose we use two models of a small open economy: (1) a three goods version of the Ricardo-Viner model; and (2) a three goods model with full intersectoral factor mobility. We show that, in general, it is not possible to know how the equilibrium real exchange rate will respond to these two disturbances. Moreover, we show that the traditional wisdom that establishes that a tariff hike will always result in a real appreciation, while a terms of trade worsening will generate an equilibrium real depreciation, is incorrect.

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I. Introduction

The following two propositions are found repeatedly in policy discussions regarding the developing countries:

Proposition 1: In a small country the increase of import tariffs will result in an appreciation of the real exchange rate.

Proposition 2: In a small country the worsening of the terms of trade will result in a depreciation of the real exchange rate.

In most cases these propositions have been made in a rather loose way, usually without making clear what specific model the author has in mind. However, it is fair to state that both of them are widely accepted by economists and policy makers. Proposition 1 has usually been made within the context of trade liberalization in developing countries, whereas proposition 2 is made in discussions on real exchange rates and external shocks. See for example, Diaz-Alejandro (1983, p. 33), Balassa (1982, p. 16), Johnson (1969, p. 159), Harberger (1984, p. 34) and Dornbusch (1980, p. 111).[1/] It turns out, however, that these two propositions are generally inconsistent. Under general conditions they don't hold simultaneously. Moreover, in a popular class of models -- the three-goods-two-factors model -- the two propositions can never hold at the same time. However, in another class of model -- the three-goods and specific factors model -- both propositions hold simultaneously only under very special conditions.

The purpose of this paper is to provide a clarifying discussion regarding these two propositions. We first show that in a traditional

$$a_{LM}w + a_{KM}r = P_M \tag{1}$$

$$a_{LX}w + a_{KX}r = P_X \tag{2}$$

$$a_{LN}w + a_{KN}r = P_N \tag{3}$$

$$P_X = EP_X^* \tag{4}$$

$$P_M = P_M^*(1+t)E \tag{5}$$

$$P_T = P_M^{\alpha}P_X^{1-\alpha} \tag{6}$$

$$e = P_T/P_N \tag{7}$$

$$E = P_X^* = 1 \tag{8}$$

where the a_{ij}'s are input-output coefficients; w and r are the wage rate and the rental rate of capital; P_M, P_X and P_N refer to the domestic price of importables, exportables and nontradables; P_X^* and P_M^* are the world prices of X and M; t is the tariff rate, P_T is the domestic price of tradables; α and $(1-\alpha)$ are weights used in the construction of P_T; and e is the real exchange rate.

Equations (1) and (2) can be used to determine the effects of a tariff change on factor rewards. In Jones's (1965) familiar notation:

$$\hat{w} = \left(\frac{\Theta_{KX}}{\Theta_{KK}-\Theta_{KM}}\right)(\widehat{1+t}) \; ; \quad \hat{r} = -\left(\frac{\Theta_{LX}}{\Theta_{KX}-\Theta_{KM}}\right)(\widehat{1+t})$$

Heckscher-Ohlin setting with importables, exportables and nontradables and no specialization, the two propositions are always inconsistent (Section II). In Section III we use a factor-specific model to derive the conditions under which both propositions hold simultaneously. It is found that this can only happen if income effects generated by the terms of trade change care very large. Section IV contains brief concluding remarks.

II. The Three-Goods-Two-Factors Case

Consider the case of a small economy that produces exportables (X), importables (M) and nontradables (N), using two non-tradable factors of production, capital (K) and labor (L). Assume also that technology has constant returns to scale, that there is perfect competition, that there is a fixed unitary nominal exchange rate and that there is an initial tariff on the importation of M. Finally, assume that both factors of production can move freely across sectors.[2/] Under these circumstances, and ruling out specialization,[3/] the world prices of exportables (P_X^*) and importables (P_M^*) plus the tariff (t) determine unequivocally the rewards of both factors (w and r). These factors rewards, under the assumption of perfect competition, determine the nominal price of nontradables (P_N). Demand conditions for nontradables, in turn, determine total output of nontradables and total factors used in their production. This leaves a certain amount of factors (K and L) that is used in the production of exportables and importables in a traditional Heckscher-Ohlin fashion. It is assumed throughout that all three goods are produced.

The model is given by equations (1) through (8).[4/]

where $\theta_{KX} = \frac{a_{KX}r}{P_X}$; $\theta_{LX} = 1-\theta_{KX}$; $\theta_{KM} = \frac{a_{KM}r}{P_M}$; $\theta_{LM} = 1-\theta_{KM}$

and hats stand for percentage changes.

If it is assumed, as is the most plausible case for developing countries, that importables have the highest capital-labor ratio, then $(\theta_{KX} - \theta_{KM}) < 0$ and $[\hat{w}/(1\hat{+}t)] < 0$ and $[\hat{r}/(1\hat{+}t)] > 0$. This of course is the Stolper-Samuelson theorem. The effect of the tariff change on the price of nontradables is:

$$P_N = [\frac{\theta_{KX}-\theta_{KN}}{\theta_{KX}-\theta_{KM})}](1\hat{+}t)$$

It is possible to see from this expression that the effect of a change in t on the price of nontradables will depend on the difference in capital intensity between exportables and nontradables. From this and (7) the change in the real exchange rate is

$$\hat{e}/(1\hat{+}t) = [\alpha-(\theta_{KX}-\theta_{KN}) \;/\; (\theta_{KX}-\theta_{KM})] \tag{9}$$

From equation (9) it can be seen that proposition 1 is not always true. In order for it to hold, it is required that $\hat{e}/(1\hat{+}t) < 0$. This will be the case if $\alpha < (\theta_{KX}-\theta_{KN})/(\theta_{KX}-\theta_{KM})$.

Let's look now at the effect of an exogenous increase in the world price of imports (i.e., a terms of trade worsening) on the real exchange rate. The resulting expression, of course, is exactly the same as (9):

$$\hat{e}/\hat{P}_M^* = [\alpha-(\theta_{KX}-\theta_{KN})/(\theta_{KX}-\theta_{KM})] \tag{10}$$

Then proposition 2 will be true if $\alpha > (\theta_{KX}-\theta_{KN})/(\theta_{KX}-\theta_{KM})$. Of course this latter condition contradicts the requirement for proposition 1 to be true. In this setting, the popular propositions 1 and 2 cannot hold simultaneously.

Another way of looking at it goes as follows: As long as the economy produces both exportables and importables, the zero profit conditions in the T-sector $[P_X = C_X(r,w),\ P_M = C_M(r,w)$, where C_i is the unit cost function in sector i] determine factor prices for given values of P_X and P_M. Constant returns to scale in NT production then determine the price of nontraded goods P_N from the cost side only via the zero profit condition $P_N = C_N(r,w)$. Income effects have no influence whatsoever on the real exchange rate under this production structure, so whether P_M increases because of a higher tariff t or a higher world price P_M^* is irrelevant for the impact on the real exchange rate.

The model analyzed in this section assumes full factor mobility between the three sectors in the economy. In practice, of course, such reallocation may take years to bring about, especially for physical capital. From a short run perspective the assumption of imperfect mobility of at least capital would seem of greater interest. In the next section we therefore construct a very general specific factor model of an economy where factor prices are not uniquely tied down by the price vector of traded goods. We demonstrate that propositions P1 and P2 cannot <u>in general</u> be both correct. We do show one special case where strong income effects produce a sign difference between $\frac{dP_N}{dt}$ and $\frac{dP_N}{dP_M^*}$. Without such strong income effects, P1 and P2 are incompatible.

III. A Specific Factor Model

In the specific factor Ricardo-Viner model (Jones (1971)) each sector employs labour and a factor (capital) specific to that sector. There are therefore four factors; hence demand conditions have to be brought into the picture explicitly. We do that by using an expenditure function.

We summarize production technology and resource allocation by using a revenue function R. R gives the maximum revenue obtainable given factor supplies v and relative prices:

$$R = R(P_X, P_M, P_N; v) \tag{11}$$

We assume a Ricardo-Viner structure (see Jones (1971)) so that factor price equalization does not hold. This model is therefore perhaps best seen as a short-run model.

Similarly consumer preferences and budget allocation are summarized by an expenditure function (E), giving the minimum expenditure necessary to reach welfare level U given the relative price structure:

$$E = E(P_X, P_M, P_N; U) \tag{12}$$

A convenient property of revenue functions is that their derivatives with respect to prices give the corresponding commodity supply functions. Similarly, the derivatives of E with respect to prices equal to (Hicksian) demand for the corresponding goods. Accordingly nontraded goods market clearing requires:

$$R_N = E_N \tag{13}$$

The model is closed by the budget constraint:

$$R(P_X, P_M, P_N; v) + tP_M^*(E_M - R_M) =)P_X, P_M, P_N; U) \tag{14}$$

Define, for notational convenience, the "net" expenditure function $Z = E-R$. Differentiation of (14) immediately yields the welfare effects of changes in relative prices:

$$(1 - tP_M^* C_M)\, E_U dU = \tag{15}$$

$$- (Z_M - tP_M^* Z_{MM})\, dP_M + tP_M^*\, Z_{MN} dP_N$$

$$+ Z_M (P_M^*\, dt + t dP_M^*)$$

$C_M = E_{MU}\, E_U^{-1}$, the pure income effect on demand for importables; $Z_M = \partial Z/\partial P_M$, etc. Note that changes in the price of NT goods P_N have first order welfare effects in the presence of tariffs. Although a country has by definition a zero net export position in NT goods, an increase in P_N will, through substitution effects, induce more consumption and less production of importables. Since these are underconsumed and overproduced due to the tariff, welfare increases when P_N goes up.

Differentiation of the NT goods market clearing equation and substitution into (15) allows derivation of the total welfare effects of tariff changes and terms of trade shocks. A terms of trade shock implies $dP_M = (1+t)\, dP_M^*$, $dt = 0$; a tariff increase on the other hand implies $dP_M = P_M^*\, dt > 0$. Inserting that into (13) and (15) yields the simple expression:

$$E_U \frac{1}{(1+t)} \frac{dU}{dP_M^*} = E_U \frac{1}{P_M^*} \frac{dU}{dt} - \frac{Z_M}{\gamma(1+t)} < E_U \frac{1}{P_M^*} \frac{dU}{dt} < 0 \tag{16}$$

$$\gamma = 1 - tP_M^* C_M + C_N P_M^* \, tZ_{MN}/Z_{NN} > 0 \quad \text{in stable models.}$$

A terms of trade shock inflicts a larger welfare loss than an <u>equivalent</u> tariff increase. The reason is that, in the case of the tariff, a country at least retains the additional tariff revenues $Z_M dt$.

We are now ready to compare the real exchange rate effects of an increase in tariffs t and a deterioration in the external terms of trade dP_M^* of equal magnitude. Consider first the increase in tariffs. Differentiating the NT goods market equilibrium equation and using (15) and $dP_M^* = 0$, $dP_M = dt > 0$ yields:

$$\frac{1}{P_M^*} \frac{dP_N}{dt} = \underset{(A;\ +)}{\frac{(1-tP_M^* C_M)\, Z_{NM}}{(-\gamma\, Z_{NN})}} + \underset{(B;\ -)}{\frac{C_N t\, P_M^*\, Z_{MM}}{(-\gamma\, Z_{NN})}}$$

(A) is a substitution effect: higher tariffs draw resources out of the NT sector and divert consumption towards it (if we rule out complementarity in consumption). Both effects increase net demand for NT goods and so put upward pressure on the relative price of non-traded goods. (B) is an income effect that comes into play only if the tariff increase starts from a positive initial tariff. The increase in distortionary cost of the existing tariff reduces welfare and therefore expenditure and so reduces demand for NT goods, exerting <u>downward</u> pressure on the relative price of non-traded goods. So proposition P1 is correct unless the economy is very distorted to begin with.

Consider now an adverse terms of trade shock, $dP = dP_M^* > 0$, $dt = 0$. Following similar procedures, it can easily be seen that

$$\frac{1}{(1+t)} \frac{dP_N}{dP_M^*} = \frac{1}{P_M^*} + \frac{C_N Z_M}{\gamma(1+t)Z_{NN}}$$

$$< \frac{1}{P_M^*} \frac{dP_N}{dt}$$

Furthermore, (17) and (18) refer to P_N, not to the real exchange rate $e = P_M^\alpha P_X^{1-\alpha}/P_N$. Straightforward arithmetic shows that

$$\frac{de}{dt} = \frac{\alpha e}{(1+t)} - \frac{e}{P_N} \frac{dP_N}{dt}$$

and

$$\frac{de}{dP_M^*} = \frac{\alpha e}{P_M^*} - \frac{e}{P_N} \frac{dP_N}{dP_M^*} \qquad (19)$$

$$= \frac{(1+t)}{P_M^*} \frac{de}{dt} - \frac{e}{P_N} \frac{C_N Z_M}{\gamma Z_{NN}}$$

(18) and (19) show two things. First proposition P2 is not in general true. As in the case of higher tariffs, the substitution effect itself will lead to

an increase in the relative price of non-traded goods (item A in (17)). On the other hand, high initial distortions (item (B) in (17)) or a large income effect due to the terms of trade deterioration (the term proportional to Z_M in (18)) reduce aggregate demand and so depress the real exchange rate. Therefore, unless the net import position in good M is sufficiently large or the economy is very distorted to begin with, a terms of trade deterioration will cause an increase in the relative price of non-traded goods, in contradiction to proposition P2. In fact, and this is our second point, P2 is the only true if income effects are large enough to swamp the substitution effect. This is not impossible, and in fact becomes less unlikely the more distorted the economy is (the larger t is). Nevertheless dominance of income effects over substitution effects is generally considered an anomaly; if so, so is proposition P2.

FOOTNOTES

1/ It is easy to find quotes in the literature that refer either to propositions 1 or to proposition 2, or to both at the same time. For example, Carlos Diaz-Alejandro (1983) states: [S]tandard models would predict that the following variables would influence its real exchange rate...an improvement [in terms of trade] will lead to appreciation...; higher import and export taxes will lead to appreciation." The authors cited above also make explicit references to at least one of the popular propositions.

2/ Also, as in most discussions on the subject, it is assumed that the capital account is exogenously given.

3/ This is not an unusually restrictive assumption, because the third commodity is non-traded. Introducing trade in the third good would create a knift edge equilibrium, with a strong presumption towards specialization. This feature disappears when there are barriers to trade in at least as many goods as there are more goods (or traded factors) than non-traded factors (Neary (1985)). Incomplete specialization requires that the aggregate capital-labor ratio net of capital and labor employed in the NT sector, falls between the capital-labor ratios in each traded sector that guarantee zero profits at positive activity levels for given world trade goods prices. Since these latter two ratios will in general be different, the set of equilibria characterized by incomplete specialization has positive measure.

4/ Note that since we are dealing with effects on prices and factor rewards only, there is no need to specify the demand side of the model [Corden and Neary (1982)]. This property of the model is actually crucial for our result regarding the inconsistency of the two propositions.

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