Trade Restrictions with Imported Intermediate Inputs

When Does the Trade Balance Improve?

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When imports are predominantly intermediate inputs — as they
are in most developing countries — import restrictions act as a
supply shock to the economy and therefore cannot always be
relied on to improve the trade balance.

The author's model demonstrates that when imports are predominantly intermediate inputs — as they are in most developing countries — import restrictions cannot always be relied upon to improve the trade balance. Such restrictions act as a supply shock to the economy.

Unless nontraded goods are intensive users of imported intermediates, the general-equilibrium consequence of import restrictions is a large enough reduction in export supplies to swamp the direct effect of the restrictions. The result is a deterioration in the trade balance.

One can check the robustness of the author's model results with extensions that may capture more realistic features.

One extension is to consider real wage rigidity and unemploy.nent. If capital in the short run is sector-specific, the net effect of a small tariff remains ambiguous — because an increase in the domestic price of imported inputs will cause a fall in employment and thus a decrease in real income.

Another extension is to consider domestic production of the imported intermediate goods. Such production is likely to be an important factor in medium- and high-income countries, but much less so in very poor countries. The income effect of the tariff will still be negative, though less so.

This paper is a product of the Trade Policy Division, Country Economics Department. Copies are available free from the World Bank, 1818 H Street NW, Washington DC 20433. Please contact Maria Ameal, room N8-069, extension 61466 (15 pages with tables).

I. Introduction

Intermediate and capital goods typically constitute the bulk of developing countries' imports. Therefore, when import restrictions are imposed, say in response to balance-of-payments difficulties, these restrictions fall predominantly on producer goods, confronting the domestic economy with a supply shock on the input side. By reducing domestic output, this adverse supply effect can possibly outweigh the direct substitution effect of the restrictions, and thereby lead to a deterioration of the trade balance. How likely is this outcome, and can we determine the conditions under which it will occur?

Table 1 shows the average import composition of a large sample of developing countries in Africa, Asia, and Latin America over the 1975-85 period. The average share of consumer goods in total imports is in all cases less than 20 percent. Moreover, a large proportion of the imported consumer goods is food, with non-food consumer goods constituting an almost negligible fraction of total imports. These figures clearly suggest the need to increase the emphasis on models that explicitly consider imports as intermediate inputs (rather than final goods) in analyzing trade issues in developing countries. Trade policy adjustments are not likely to have significant effects on external equilibrium unless they directly affect imports of intermediates and/or capital goods.

The trade balance can be analyzed satisfactorily only in the context of a dynamic model, and much effort has gone recently into constructing such models (see, for example, Svennson and Razin, 1983, Razin and Svennson, 1983, Obstfeld, 1982, Engel and Kletzer, 1986, Edwards, 1987). These models show that the response of the current account to trade

policies or terms-of-trade shocks can vary considerably depending on the modeling strategy pursued and on the nature of the intertemporal linkages. We use here the simplest dynamic model (with two periods) to analyze the effects of temporary tariffs on the trade balance. The key difference with the earlier papers is that we focus on tariffs on intermediate rather than consumer goods. As we also abstract from the investment response, this framework simplifies the intertemporal linkages considerably. This has the desirable consequence that the effect of a (small) tariff on the trade balance can be linked in a clear-cut fashion to the productive structure of the economy.

Our main result is that the direction of change of the trade balance in the short run depends on the Rybczynski relationship between the imported intermediate inputs and non-tradables. When a decrease in the availability of intermediates leads to a fall in non-tradables production, a small enough first-period tariff must improve the trade balance in the short run. But when non-tradables expand--as they might when exportables are intensive in imported intermediate inputs--the current account will worsen. The likelihood of each scenario depends on the economy's structure. When import-competing activities that are intensive in imported inputs have been rendered effectively non-tradable thanks to quotas, the odds have to be in favor of an improvement in the trade balance. On the other hand, in an economy where non-traded goods do not significantly rely on imported inputs, the perverse response is quite possible.

Moreover, the likelihood of the perverse effect increases with the size of the tariff levels affecting inputs of intermediate goods. The larger is the tariff level the greater is the temporary fall in real income associated with a rise in temporary tariffs. Since consumers will spread

out their reduced consumption over time, a temporary fall in real income induces a negative effect on the current account in the short-run by increasing the consumption/income ratio. Thus, the effect of temporary tariff on imported inputs can be separated into two components, namely, an output composition effect and a real income effect. While the former is in general ambiguous, the latter always points toward a deterioration of the current account in the short-run.

The ensuing analysis concentrates on the case of a temporary tariff, which is the one for which the effect of a tariff on the current account in the context of a simple final-goods model is unambiguously positive (see Razin and Svennson, 1983). In our framework, the distinction between temporary and permanent tariffs does not play as important a role because in both cases the effect of an import tariff on the current account (in the short-run) is ambiguous.

II. The Model

We consider a small open economy which imports only intermediate inputs and where all prices are flexible. The economy produces two types of goods, an exportable and a non-tradable (finished) good. It is assumed that import-substitute finished goods are non-tradables. This presumption can be justified on the grounds that finished importable goods are typically subject to either extremely high import tariffs or binding quantitative restrictions on imports, which effectively imply that the domestic price of finished import substitutes is endogenous. On the other hand, we assume that intermediate imports are not subject to quantitative restrictions and that their domestic prices are determined by the border

prices, plus import tariffs. (The analysis remains unchanged when trade restrictions take the form of quantitative restrictions on intermediates rather than tariffs.) These assumptions are consistent with stylized facts for many LDCs, particularly in Latin America and Africa where finished-good imports are largely restricted while intermediate-good imports are subject to fewer restrictions and relatively low tariffs.

We consider a two-period model of the economy where a budget constraint assures that the present value of expenditures in the two periods equals the present value of income plus initial (net) assets:

$$
(1) \qquad E(p_n^1, \ p_x^1, \ \delta p_n^2, \ \delta p_x^2; \ W) = \pi^1(p_n^1, \ p_x^1, \ 1 + t_1)
$$

$$
+ \ \delta \ \pi^2(p_n^2, \ p_x^2, \ 1) \ - \ t_1 \pi_3^1(\bullet) \ + \ A_0
$$

where $E(\bullet)$ stands for the economy's expenditure function, which is concave and linearly homogenous in all prices; p_n^1 and p_n^2 are the prices of non-tradable (finished) goods in period 1 and 2, respectively; p_x^1 and p_x^2 are the corresponding export prices; W is a measure of welfare; t_1 is an ad-valorem tariff (or, equivalently, the quota premium) in period 1 on imports of intermediate goods; δ is the discount factor; $\pi^1(\bullet)$ and $\pi^2(\bullet)$ are GDP functions in periods 1 and 2, respectively; 1/ A_0 is the initial level of wealth; and $-\pi_3^1 \equiv - \dfrac{\partial \pi^1}{\partial t_1} = m^1$ is the quantity of intermediate imports in period 1 (using Hotelling's lemma). It is assumed in (1) that the tariff revenue is returned to the private sector in lump-sum fashion. Moreover, the world price of intermediate goods is assumed to be equal to unity. Therefore $1+t_1$ is the price of intermediate imports in period 1. The domestic price of exports is assumed exogenous and equal to the world

price. We also assume that the economy can borrow and lend freely in international capital markets, which equates δ to the world discount factor (one over one plus the world interest rate). Hence, the only endogenous variables in (1) are p_n^1, p_n^2 and W. Implicit in the GDP functions are the levels of primary factors of production, as well as the intermediates. These functions yield the maximized value of national output given that productive factors are competitively allocated between exportables and non-traded goods.

The GDP functions $\pi^1(\cdot)$ and $\pi^2(\cdot)$ are linearly homogenous and convex functions of the three prices, and their derivatives with respect to p_n^1 and p_n^2 provide the output supply equations for non-tradables in the first and second period, respectively (Hotelling's lemma). Similarly, the derivatives of the expenditure function with respect to p_n^1 and p_n^2 yield the (compensated) demand functions for non-tradables in period 1 and 2, respectively.

Thus, equilibrium in the non-tradable market in each period requires:

(2) $E_1(p_n^1, p_x^1, \delta p_n^2, \delta p_x^2; W) = \pi_1^1(p_n^1, p_x^1, 1 + t_1)$

and

(3) $E_3(p_n^1, p_x^1, \delta p_n^2, \delta p_x^2; W) = \pi_1^2(p_n^2, p_x^2, 1)$

where $E_1 \equiv \dfrac{\partial E}{\partial p_n^1}$, $\pi_1^1 \equiv \dfrac{\partial \pi^1}{\partial p_n^1}$, etc. The equation system (1) to (3) can be used to solve simultaneously for the three endogenous variables, p_n^1, p_n^2 and W.

The trade balance in period 2 is given by:

(4) $\quad B^2 = p_x^2 (\pi_2^2 - E_4) + \pi_3^2,$

where the arguments of each function are omitted. The first term in paren-
theses represents exports of the exportable, while the last term is the
imports of the intermediate (with a negative sign). Since intertemporal
balance requires $B^1 + \delta B^2 + A_0 = 0$, 2/ it is clear that an improvement in
the trade balance in period 2 necessarily implies a deterioration in the
trade balance in period 1 and vice versa. As the expression for B^2 does not
contain t_1, the effects of a temporary tariff must work through p_n^1, p_n^2, and
W. Since it proves easier to work with B^2, we will derive the effect on
the short-run balance B^1 by performing comparative statics on B^2.

Differentiating (1) totally, and using conditions (2) and (3) we
can solve for the effect on welfare:

(5) $\quad dW = - \dfrac{t_1 \, \pi_{33}^1}{E_w} \, dt_1$

which is negative for any strictly positive level of the tariff. Differ-
entiating (2) and (3) using (5) we obtain:

(6)

(i) $\quad (E_{11} - \pi_{11}^1) \, dp_n^1 + \delta E_{13} dp_n^2 = [\pi_{13}^1 + \dfrac{t_1 \, E_{1w} \pi_{33}^1}{E_w}] \, dt_1$

(ii) $\quad E_{31} \, dp_n^1 + (\delta E_{33} - \pi_{11}^2) \, dp_n^2 = \dfrac{t_1 \, E_{3w} \, \pi_{33}^1}{E_w} \, dt_1$

If initially the tariff is zero (i.e., $t_1 = 0$) then there is no "income" effect ($dW=0$) and we obtain,

$$\text{(i)} \qquad \frac{dp_n^1}{dt_1} = \frac{\pi_{13}^1 \, (E_{33} - \pi_{11}^2)}{\mid H \mid}$$

(7)

$$\text{(ii)} \qquad \frac{dp_n^2}{dt_1} = - \frac{\pi_{13}^1 \, E_{13}}{\mid H \mid}$$

where $H \equiv \begin{vmatrix} (E_{11} - \pi_{11}^1) & \delta E_{13} \\ E_{13} & (\delta E_{33} - \pi_{11}^2) \end{vmatrix}$

which is positive given concavity of the $E(\bullet)$ function and convexity of the GDP functions $\pi^1(\bullet)$ and $\pi^2(\bullet)$. Under the reasonable assumption that non-traded goods are intertemporal substitutes ($E_{13} > 0$), it is clear from (7) that the prices of the non-traded goods must move in the same direction in the two periods. (Note that $E_{33} - \pi_{11}^2 < 0$ under regular curvature assumptions). This is required for the second-period market for non-traded goods to clear: when p_n^1 falls (rises), the incipient excess supply (demand) for the non-tradable in the second period -- caused by inter-temporal substitution -- has to be eliminated by a similar movement in p_n^2.

Whether the prices of non-tradables increase or decrease depends in turn on the sign of $\pi_{13}^1 = \partial Q_n^1 / \partial t_1$, where Q_n^1 is the output of nontradables in period 1. In general ambiguous, this sign depends on the nature of the general-equilibrium Rybczynski relationship between imported intermediates and non-tradables. As t_1 increases, the demand for intermediates

naturally falls. Whether this reduces or spurs the production of non-tradables depends on how "intensive" non-tradables are in intermediates. It is usually presumed that exports in most LDCs, mostly agricultural and other natural-resource based commodities, are less intensive users of imported inputs than import-substituting and other nontradables, usually manufactured goods. When this is the case, an increase in the price of intermediates will reduce the supply of nontradables, i.e. $\pi^1_{13} < 0$. But when it is exportables that are relatively more intensive in imported intermediates it is possible that the resources released by the exportables sector as it contracts could lead to an <u>expansion</u> of the non-tradables sector ($\pi^1_{13} > 0$). In the first case, the "real" exchange rate faced by consumers (p_x/p_n) would <u>appreciate</u> in both periods as $dp^1_n/dt_1 > 0$ and $dp^2_n/dt_1 > 0$; in the second, it would depreciate.

The ultimate effect on the current account can be derived by totally differentiating B^2 with respect to t_1:

$$(8) \qquad \frac{dB^2}{dt_1} = (\pi^2_{21} p^2_x + \pi^2_{31} - \delta p^2_x E_{34}) \frac{dp^2_n}{dt_1} - p^2_x E_{41} \frac{dp^1_n}{dt_1}$$

(Remember that $dW = 0$ at $t_1 = 0$.) Noting that under the assumption of non-complementarity in consumption $E_{14} \geq 0$, $E_{34} \geq 0$ and, by linear homogeneity of π^2, that $\pi^2_{21} p^2_x + \pi^2_{31} = - \pi^2_{11} p_n < 0$, it is clear that the sign $B^2 = -$ sign $\frac{dp^1_n}{dt_1} = -$ sign $\frac{dp^2_n}{dt_1}$. Also since $dB^1 = -\delta dB^2$ we obtain that a (small) temporary tariff on imports in period 1 will cause an improvement in the trade balance in the short-run only if p^1_n and p^2_n increase, i.e., only when the consumer real exchange rate appreciates in both periods. As

discussed above, this is the case when non-tradables are intensive in imported intermediate inputs ($\pi^1_{13} < 0$).

These results can be summarized and interpreted as follows. The effect that a (small) temporary tariff placed on intermediate imports has on the current account depends entirely on the production response. This in turn is determined by the economy's structure. When non-tradables are intensive in imported intermediates, the tariff acts as a supply shock in this sector ($\pi^1_{13} < 0$). The current account improves both on the account of the direct substitution effect of the tariff and on account of resources released from non-tradables which can now go to exportables.

When the input tariff leads to an _expansion_ of the non-tradables sector ($\pi^1_{13} > 0$), the explanation is a bit more subtle. Now the indirect effect of the tariff is negative -- as the necessary contraction of the exportables sector reduces export supply. The net effect on the current account could be thought ambiguous. It is in fact not so, due to inter-temporal linkages. Remember that the prices of non-tradables must move in the same direction in the two periods: otherwise the second-period market for non-tradables would not clear. Now, when $\pi^1_{13} > 0$, we have $dp^1_n/dt_1 < 0$, so that $\frac{dp^2}{dt_1} < 0$. This increases the relative price of exportables in the second period, and spurs their production. Consumption of exportables, on the other hand falls, as consumers substitute towards chapear non-tradables (in both periods). And since there is no tariff in the second period, the effect on the second-period current accrunt is unambiguously positive. By implication, the first-period current account _must_ deteriorate. In other words, in the short-run the indirect negative effect of the tariff on the current account must outweigh its direct positive effect.

So far, the discussion has focussed on a small tariff starting from a zero base. If the initial tariff is non-zero, then a tariff increase has a first-order welfare effect and (7) becomes:

(7')

(i)
$$\frac{dp_n^1}{dt_1} = \frac{\pi_{13}^1(E_{33} - \pi_{11}^2) + (t_1\pi_{33}^1/E_w) \, [E_{1w}(E_{33} - \pi_{11}^2) - E_{13}E_{3w}]}{|\,H\,|}$$

(ii)
$$\frac{dp_n^2}{dt_1} = \frac{-\pi_{13}^1 E_{33} + (t_1\pi_{33}^1/E_w) \, [(E_{11} - \pi_{11}^1) - E_{13}E_{1w}]}{|\,H\,|}$$

where given the assumptions about substitution and normality ($E_{13} > 0$, $E_{1w} > 0$) the expressions in square brackets are negative and $t_1\pi_{33}^1/E_w > 0$. The expression for the change in the second period trade balance (8) in turn has the additional term $-p_x^2 E_{4w}dW$ on the right-hand side, which tends to improve the second-period balance as W falls. Thus, even if the non-traded sector is intensive in imported inputs (i.e., even if $\pi_{13} < 0$) it is now possible that p_n^1 and p_n^2 will fall, and that the effect on B^1 will be negative, generating a perverse trade balance effect in the short run.

The explanation is as follows. The current account in any period is the difference between income and expenditure. When the initial tariff is positive, trade restrictions cause first-period real income to fall. Private consumption does not fall one-for-one in the short-run, however, as consumers prefer to spread the implied reduction in consumption over both periods. In other words, they dissave in the first period. This makes it more likely for the trade balance to deteriorate in the first period (and improve in the second period) in response to a temporary tariff increase.

If $\pi_{13}^1 > 0$, then of course, the perverse short-run effect on the trade balance will be unambiguous. 3/

III. Concluding Remarks

Our model demonstrates that when imports are predominantly intermediate inputs, as in most developing countries, import restrictions cannot be always relied on to generate an improvement in the trade balance. Such restrictions act as a supply shock to the economy. Unless non-traded goods are particularly intensive in imported intermediates, the general-equilibrium consequence of import restrictions is a large enough reduction in export supply to swamp the direct effect of the restrictions, thus leading to a deterioration of the trade balance.

The model used is, of course, very stylized. It is important to check the robustness of the results with extensions that may capture more "realistic" features. One possible extension is to consider real wage rigidity and unemployment. If capital is in the short-run sector specific, under the plausible assumption of gross complementarity between labor and imported inputs π_{13} is in this case necessarily negative, thus pointing toward an improvement in the trade account due to the output composition effect. However, now even a small import tariff will necessarily have a negative income effect, which points toward a perverse effect on the trade account. This is due to the fact that under gross complementarity an increase in the domestic price of imported inputs causes a fall in employment and, hence, a decrease in real income. Therefore, the net effect of a small tariff remains ambiguous.

Another extension would consider the possibility of domestic production of the imported intermediate goods. This is likely to be important in the context of medium-income and large countries but much less so for very poor countries. In this case the likelihood of the perverse effect is of course diminished because the negative income effect of the tariff would be weaker. Nonetheless, the output composition effect would still critically depend on the sign of f_{13} and it is still possible that the net effect of a tariff on the trade balance will be perverse.

Table 1. Import Composition in Developing Countries
For the Period 1975-85 [1]

Import Share of \ Region	Africa[2]	Asia[3]	Latin America[4]
- Consumer Goods · (food)	0.175 (0.124)	0.138 (0.107)	0.152 (0.098)
- Intermediates & Capital (Intermediate Inputs)	0.825 (0.487)	0.862 (0.577)	0.848 (0.528)

Source: The World Bank (CECTP)

[1] Simple country average shares in total country imports.

[2] The sample includes 13 African countries: Ivory Coast, Ghana, Nigeria, Zaire, Zambia, Malawi, Senegal, Morocco, Tunisia, Zimbabwe, Tanzania, Kenya, and Tunisia.

[3] The 11 Asian countries are: Pakistan, India, Turkey, Indonesia, Singapore, Malaysia, Philippines, Korea, Thailand, Bangladesh, and Sri Lanka.

[4] The 14 Latin American countries are: Argentina, Brazil, Colombia, Chile, Mexico, Peru, Uruguay, Venezuela, Costa Rica, Guatemala, Panama, Guyane, Ecuador and Jamaica.

Footnotes

1/ The $\pi^i(\bullet)$ (i=1,2) are defined as follows:

$$\pi^i \equiv \max_{mi} \, [R^i(p_n^i, \, p_x^i, \, m^i) - (1 + t_i) \, m^i] \, .$$

where $R^i(\bullet)$ is the revenue function in period i, which reflects the optimal output allocation of a <u>given</u> level of imported intermediate inputs and primary factors (omitted in $R(\bullet)$). Thus, π^i is the maximum GDP level given p_n^i, p_x^i and $1 + t_i$, and given that primary factors (assumed fixed) have been competitively allocated to the production of the two final goods.

2/ This can be derived, by Walras' law, by using equations (1) - (3). Note also that in the initial equilibrium the first-period current account need not be in balance.

3/ Incidentally, when there exists an initial distortion, p_n^1 and p_n^2 need no longer move in the same direction if $\pi_{13}^1 < 0$, although both will fall when $\pi_{13}^1 > 0$.

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