THE NON-EQUIVALENCE OF EXPORT AND IMPORT QUOTAS

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Abstract: The Lerner symmetry theorem asserts the equivalence between import and export policies. In this note we use a standard general equilibrium trade model to show this symmetry does not apply to the equilibrium of a strategic game with quotas. We assume *N* (identical) large countries non-cooperatively set their import (or export) quotas to maximize domestic welfare. We show that the equilibrium in which all countries use import quotas differs from, and is superior to, the equilibrium in which countries use export quotas. The difference arises because the elasticity of the residual foreign import demand schedule differs between the two equilibria.

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Abstract: The Lerner symmetry theorem asserts the equivalence between import and export policies. In this note we use a standard general equilibrium trade model to show this symmetry does not apply to the equilibrium of a strategic game with quotas. We assume *N* (identical) large countries non-cooperatively set their import (or export) quotas to maximize domestic welfare. We show that the equilibrium in which all countries use import quotas differs from, and is superior to, the equilibrium in which countries use export quotas. The difference arises because the elasticity of the residual foreign import demand schedule differs between the two equilibria.

1 - Introduction

There exists a substantial literature on the (non)equivalence of price versus quantity instruments in microeconomic theory. Traditionally, this analysis is carried out within a partial equilibrium framework. In a general equilibrium setting, there is a sizable literature which studies the (non)equivalence of tariffs and quotas for open economies[1]. However, perhaps due to the general acceptance of the well-known Lerner (1936) symmetry theorem, there is less attention devoted to the (non)equivalence of export and import policies in international trade. As is well-known, the optimal tariff for a (single) large country equals the reciprocal of the foreign export supply elasticity [Johnson (1953)]. This equilibrium can be supported through import tariffs or quotas, or - due to the Lerner symmetry theorem - through export tariffs or quotas. The Lerner symmetry theorem can be generalized to many goods and is unaffected by the presence of goods not traded internationally. The main assumption is a zero balance of trade condition[2].

[1] A number of papers have studied conditions under which import tariffs and import quotas are not equivalent. See Young and Anderson (1980, 1982), Young (1980) and Lapan and Choi (1988) for a discussion on the non-equivalence of tariffs and quotas under uncertainty. McCulloch (1973) discusses the non-equivalence of tariffs and quotas under monopolistic domestic production. A useful survey of the non-equivalence of instruments in strategic trade policy is found in Brander (1995).

[2] Kaempfer and Tower (1982) derive a more general result. A tax on all balance of payments debits is symmetric to a tax on all balance of payments credits.

In this note, we show that the symmetry between export and import quotas crucially depends on the world market structure. We consider a general equilibrium model in which there is more than one policy active country importing (and exporting) the same good and behaving non-cooperatively. The perceived residual foreign export supply faced by a policy-active country is less elastic in the import quota game than in the export quota game. Consequently, *in equilibrium*, the import quota implies a more restrictive tariff equivalent than the export quota.

2 – The Model

Consider a two-good world with a small number of (*N>1*) countries, each of which imports good 1 and exports good 2. We assume these countries non-cooperatively exercise their market power. The rest of the world (ROW), which exports good 1 and imports good 2, consists of a large number of countries which behave passively (and thus pursue free trade). Let $\bar{p}_1, \bar{p}_2$ denote prices in ROW, $\bar{X}_1(\bar{p}_1, \bar{p}_2)$ denote the ROW export supply of good 1, and $\bar{M}_2(\bar{p}_1, \bar{p}_2)$ their import demand for good 2. From the zero balance of trade condition: $\bar{M}_2(\bar{p}_1, \bar{p}_2) = (\bar{p}_1/\bar{p}_2)\bar{X}_1$. In what follows, we assume the *N* large countries use quotas (either import or export) as their strategic policy variable.

In the import quota game, the import quota m_j of country *j*, $j \neq i$ is taken as given by country *i*. Thus, the residual supply curve of good 1, faced by country *i*, is: $m_{i,1}^s = \bar{X}_1 - \sum_{j \neq i} m_{j,1}$. Hence, we have:

$$\left(dm_{i,1}^s / d\bar{p}_1\right) = \left(\partial \bar{X}_1 / \partial \bar{p}_1\right) \equiv \bar{X}_1' \qquad (1)$$

where we choose good 2 as the numeraire. Country *i* chooses its own import quota level, treating all other quotas as given, to maximize domestic welfare. For simplicity, we work with the primal problem and use the direct utility function and production possibility frontier. Thus, country *i* optimizes:

$$\underset{q_{i,1},q_{i,2},m_{i1}}{Max}\ U^i\left(q_{i,1}+m_{i,1},q_{i,2}-\bar{p}_1 m_{i,1}\right) \text{ such that } g\left(q_{1i},q_{2i}\right)=0 \tag{2}$$

where $g\left(q_{i,1},q_{i,2}\right)=0$ denotes the domestic production possibility frontier. We have substituted in (2) the domestic market equilibrium conditions ($d_{i,1}=q_{i,1}+m_{i,1}$ and $d_{i,2}=q_{i,2}-x_{i,2}$) and the balance of trade constraint $x_{i,2}=\bar{p}_1 m_{i,1}$, with $\bar{p}_2\equiv 1$. The first order conditions are:

$$\frac{U_1}{U_2}-\frac{g_1}{g_2}=0\,;\quad p_{i,1}\equiv\frac{U_1}{U_2} \tag{3}$$

$$\frac{U_1}{U_2}-\bar{p}_1-m_{i,1}\frac{d\bar{p}_1}{dm_{i,1}}=0 \tag{4}$$

where $p_{i,1}$ denotes the domestic relative price of good one. Equation (3) is the standard result that the domestic marginal rate of substitution should equal the marginal rate of transformation. Using (1), rewrite the FOC in (4) as: $p_{i,1}-\bar{p}_1-m_{i,1}\big/\bar{X}_1{}'=0$. Let t_i^{imp} denote the ad-valorem tariff equivalent to the import quota. In elasticity form we have:

$$t_i^{imp}=\frac{a_i}{\bar{e}\left(\bar{p}_1\right)} \qquad \bar{e}\equiv\left(\bar{p}_1\cdot\bar{X}_1'/\bar{X}_1\right) \tag{5}$$

where $\bar{e}$ is the foreign export supply elasticity and a_i is country *i*'s share of world imports. Assuming symmetry among the policy active countries yields $t_i^{imp}=\left(1/N\bar{e}\right)\left(\bar{p}_1\right)$.

In the export quota game (i.e., all N countries use export quotas) we have, from the perspective of the import market, $\bar{p}_1 m_{j,1} = x_{j,2}$ where $x_{j,2}$ is the fixed quota level. Thus, the residual export supply curve for good 1 faced by country i, given the export quotas of all other (large) countries, is: $m_{i,1}^s = \bar{X}_1 - \sum_{j \neq i} \left(x_{j,2} / \bar{p}_1 \right)$. Differentiate to get:

$$\frac{dm_{i,1}^s}{d\bar{p}_1} = \bar{X}_1' + \left(\bar{p}_1 \right)^{-1} \left\{ \sum_{j \neq i} \left(x_{j,2} / \bar{p}_1 \right) \right\} \tag{6}$$

Substituting (6) into (4) gives the optimal rule for the tariff equivalent for the export quota, given that all other countries use export quotas[3]. Hence we have:

$$p_{i,1} - \bar{p}_1 - \frac{m_{i,1}}{\bar{X}_1' + \left(\bar{p}_1 \right)^{-1} \left\{ \sum_{j \neq i} \left(x_{j,2} / \bar{p}_1 \right) \right\}} = 0 \tag{7}$$

Let t_i^{ex} be the ad-valorem tariff equivalent for the export quota. From (7), assuming symmetry among the N policy active countries, the Nash equilibrium export quota yields:

$$t^{ex} = \frac{\left(1/N \right)}{\bar{e}\left(\bar{p}_1 \right) + \left(\left(N-1 \right)/N \right)} = \frac{1}{N \cdot \bar{e}\left(\bar{p}_1 \right) + \left(N-1 \right)} \tag{8}$$

Comparing equation (5) to equation (8), it is clear that for $N > 1$, the (*equilibrium*) tariff equivalent of the export quota is smaller than that for the import quota - i.e., $t^{ex} = \frac{1}{N\bar{e} + \left(N-1 \right)} < t^{imp} = \frac{1}{N\bar{e}}$ for $N > 1$, whereas - as is well-known - the two policies are equivalent for a single country. Since, for $N > 1$, the non-cooperative import quota

[3] As always, any given country is indifferent as to which tool *it* uses to restrict trade. The important assumption is the belief of country i about what type of instrument other countries are using.

equilibrium is less restrictive than the collusive optimum, it follows that, for $N > 1$, the export quota equilibrium is inferior to the import quota equilibrium[4].

The rationale for this result is as follows. In the import quota game, as each country expands its imports, it assumes the imports of other countries remain fixed. Hence, the increase in the relative world price depends only upon the foreign export supply elasticity. However, in the export quota game, an increase in imports (exports) of country *i* which drives up the world price of good 1 causes imports of other nations to fall (as exports are assumed fixed), thus lessening the overall impact on relative world prices and thereby encouraging country *i* to further increase its exports (imports).

It is worth noting that the equivalence between an import tariff and an export tariff does not break down in our model. Under (either type of) tariff, country *i* knows that as it increases its imports (decreases its tariff), taking other countries' tariffs as given, the imports of those countries will fall as world prices rise, thus making the (residual) export supply curve seem more elastic. Indeed, it is for this reason that the non-cooperative tariff equilibrium is inferior, from the perspective of the policy-active countries, to the non-cooperative import quota equilibrium[5].

3 - Conclusion

We have shown that when *N* policy active countries face passive foreign countries that pursue free trade, import quotas are collectively welfare superior to export quotas

[4] The result is identical if we work from the perspective of the export market.

[5] The equilibrium of an import (export) tariff is not equivalent to that for an import (export) quota. Given that other countries use a tariff, the residual foreign export supply curve faced by a policy active country is more elastic than when the strategy space of all countries is restricted to a quota. The tariff equilibrium will be less restrictive than the import quota equilibrium. Hence, from the perspective of the policy-active countries, a quota has to be a superior instrument to a tariff in this case. This result is merely equivalent to the Bertrand versus Cournot competition model in a partial equilibrium framework.

from the policy active countries' perspective. Under our world market structure, the Lerner symmetry theorem breaks down in the sense that the Nash equilibrium differs for the two games. Possible extensions would include studying the sequential equilibrium of our game. In a simultaneous move game, each country is indifferent as to whether it uses an import or export quota, given the policy of the other country. However, in a sequential move game, the first mover will prefer the import quota over the export quota.

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