SHORTER PAPERS

Tariffs versus Quotas under Market Price Uncertainty

Hung-Yi Chen and **Hong Hwang**

Soochow University, Taipei;
National Taiwan University and Academia Sinica, Taipei

Abstract: This paper compares the welfare effects of a tariff and a quota in an imperfectly competitive market when demand is uncertain and policy must be chosen before the uncertainty is resolved. The model assumes a Cournot duopoly market with linear demand, additive uncertainty, homogeneous products, and constant marginal costs. It is shown that the optimal policy is autarky for high levels of uncertainty, a quota at the free-trade level for intermediate levels, and a tariff at low levels. JEL no. F13
Keywords: Tariffs; quotas; price uncertainty

1 Introduction

The equivalence/non-equivalence of tariffs and quotas has received great attention during the last four decades after the seminal work by Bhagwati (1965, 1968). Bhagwati (1965) set up a two-sector general equilibrium model to demonstrate that under a given level of imports, the equivalence of tariffs and quotas holds if there is perfect competition in the domestic sector. Shibata (1968) extended the study and showed that the equivalence still holds with the introduction of a monopoly element into the foreign sector as long as monopoly does not appear in the domestic sector.

Even though Bhagwati (1965, 1968) and Shibata (1968) recognized the importance of market structure in determining the equivalence between a tariff and a quota, the study of the equivalence under an imperfectly

Remark: We are indebted to Yang-Ming Chang and Jiunn-Rong Chiou for helpful comments and to an anonymous referee for inducing us to improve our exposition and for offering several suggestions leading to improvements in the substance of the paper. Hung-Yi Chen would like to acknowledge financial support from NSC 92-2415-H-031-001. Please address correspondence to Hong Hwang, Department of Economics, National Taiwan University, 21 Hsu Chow Road, Taipei 100, Taiwan; e-mail: echong@ntu.edu.tw

 DOI: 10.1007/s10290-006-0062-z

competitive market structure did not appear until the 1980s. Itoh and Ono (1984) developed a Bertrand duopoly model with heterogeneous products and argued that the source of the non-equivalence of tariffs and quotas arises not from the monopolistic power of domestic producers over consumers, but from the behavioral relationship of domestic producers against the foreign producers. Hwang and Mai (1988) and Fung (1989) have on the other hand shown that the price equivalence holds under Cournot competition, but fails in other types of conjectural variation. Using a conjectural variations approach under duopolistic quantity competition, Hwang and Mai (1988) showed that the equivalence holds only under Cournot equilibrium. The domestic price will be higher (lower) under a tariff than the equivalent quota if the market becomes less (more) competitive than Cournot. Fung (1989) further compared the effects of tariffs and quotas under Cournot–Nash and Stackelberg, and consistent conjecture market structures and found that in a duopolistic quantity setting with heterogeneous goods, the domestic prices will be lower under a tariff than the equivalent quota if the domestic firm is a Stackelberg leader, but the two prices are equal if the domestic firm behaves as a Cournot producer. It is worth noting that all the three papers centered their discussions on the "price equivalence" of tariffs and quotas and failed to examine their "welfare equivalence' which in our opinion is more important than "price equivalence".

From the above mentioned papers, it is clear that market structure plays an important role in determining the equivalence of tariffs and quotas. Other than market structure, uncertainty is another important factor, which is likely to cause the non-equivalence of tariffs and quotas. The pioneering paper in this literature is by Weitzman (1974). He considered the choice between price and quantity instruments under uncertainty and showed that, with sufficient uncertainty, the flexibility provided by price controls is potentially desirable and is lost when quantity controls are used. Cooper and Riezman (1989) built on this insight and showed that the choice between subsidies and export quotas in a strategic export game depended on the same trade-off between the flexibility of price controls and the strategic superiority of quantity controls. In their case, high uncertainty made subsidies desirable from the exporting countries' point of view. Moreover, Fishelson and Flatters (1975) compared tariffs and quotas in a setting in which a country faces a less than perfectly elastic foreign supply curve. They concluded that even under a perfectly competitive market, the tariff-quota equivalence breaks down when the domestic and/or the foreign supply and

demand conditions are stochastic.[1] Furthermore, in a general equilibrium model with a perfectly competitive market with uncertain demand, Dasgupta and Stiglitz (1977) showed that given the expected level of government revenues, a tariff is unambiguously superior to a quota.

Even though the literature has made it clear that market structure and uncertainty are the two most crucial elements in determining the equivalence between tariffs and quotas, no paper has considered the two factors at the same time.[2] The purpose of the paper is therefore to fill the gap whereby tariff-quota equivalence has been studied under oligopoly and uncertainty but not under both together. More specifically, this paper is to analyze how the role of market uncertainty affects the welfare ranking of a tariff and a quota under a duopoly setting with one domestic firm competing with one foreign firm in the domestic market. We shall show that unlike the findings in Weitzman (1974) and Cooper and Riezman (1989), flexibility is undesirable, so for high uncertainty, quantity controls (i.e., quotas) are preferable to price controls (i.e., tariffs). This is because quantity controls prevent the foreign firm from responding to the state of nature.

The paper is organized as follows. Section 2 lays out the model and derives the expected level of welfare for both the tariff and the quota regimes. Section 3 compares the welfare of these two trade instruments with and without market uncertainty. Section 4 presents the concluding remarks.

2 The Model

Following Hwang and Mai (1988), we assume that there are two firms, one domestic and one foreign, producing a homogeneous good and selling all their output to the domestic market, whose inverse and stochastic demand

---

[1] Fishelson and Flatters (1975) argued that the stochastic behavior of market uncertainty can arise from the random disturbances of supply and demand, random measurement error on the various functions in setting the level of tariffs or quotas, or rigidities in the legislative process due to imperfect knowledge about the changes of the economy.

[2] The only exception comes from Matschke (2003). She employed a screening model with Cournot competition and showed how asymmetric information influences the equivalence of tariffs and quotas. However, to ensure an interior solution for an optimal quota level, Matschke (2003) assumed that the domestic government possesses the entire quota rent. This assumption is quite arbitrary as admitted by the author, and will not be made in our paper. Besides, the basic setting and the results of Matschke (2003) are quite different from ours.

function is, for simplicity, assumed to take the following linear form:

$$p = a - b(q_1 + q_2) + \theta\,, \tag{1}$$

where q_1 is the quantity of output produced by the domestic firm and q_2 the quantity supplied by the foreign firm. The parameters a ($> c_i$) and b are both positive and θ represents market uncertainty with zero mean and variance σ^2.

The model, which is based on Cooper and Riezman (1989), consists of two stages. In the first stage, the domestic government selects the optimal policy level (in terms of tariff or quota) to maximize its expected welfare before the realization of θ.[3] After θ is known, both firms set their output to maximize profits given the optimal policy level imposed by the government. In doing so, we have implicitly brought into the model the so-called information asymmetry with the firms knowing better than the government the state of nature.

In the subsequent analysis, we shall use a backward induction approach to solve the subgame perfect equilibrium of the model by examining the tariff case first, followed by the quota case. The welfare ranking of the two cases will be executed in Section 3.

2.1 Import Tariffs

Suppose the domestic government imposes a tariff on imports at a rate of t. The problem of the domestic firm is to

$$\max_{\{q_1\}} \pi_1 = [a - b(q_1 + q_2) + \theta - c_1]\, q_1\,, \tag{2}$$

where c_1 is the marginal cost of the domestic firm, which is assumed to be constant. The objective function of the foreign firm is to

$$\max_{\{q_2\}} \pi_2 = [a - b(q_1 + q_2) + \theta - c_2 - t]\, q_2\,, \tag{3}$$

where c_2 is the marginal cost of the foreign firm.

---

[3] Arvan (1991) and Shivakumar (1993) discussed the timing of government commitments in which governments move either before or after the demand shock. We only discuss the case in which governments move prior to observing the state of nature because the timing of government's response is not our major concern.

From (2) and (3), we can easily solve the output of the two firms for any given tariff t as follows:

$$\begin{aligned} q_1 &= \frac{1}{3b}(a+\theta-2c_1+c_2+t) \quad \text{and} \\ q_2 &= \frac{1}{3b}(a+\theta-2c_2+c_1-2t)\,. \end{aligned} \tag{4}$$

The value of θ affects the optimal output levels, and both firms have higher outputs if θ is positive.

In the second stage, the government maximizes the expected welfare with respect to tariffs, given the output conditions in (4). The welfare function of the domestic country is specified as the sum of consumer surplus, domestic profits, and tariff revenues. That is:

$$\begin{aligned} EW^T &= CS+\pi+tq_2^T \\ &= E\left[\frac{b}{2}\left(q_1^T+q_2^T\right)^2+\left(p^T-c_1\right)q_1^T+tq_2^T\right], \end{aligned} \tag{5}$$

where superscripts T denote that the variables are associated with the tariff case. Taking the derivative of (5) with respect to t, we obtain the optimal tariff $t^* = 1/3(a-c_2)$. Note that the introduction of uncertainty has no effect on the optimal tariff.[4] This is of no surprise as, by assumption, the domestic government does not know θ while making the decision. Substituting the optimal tariff into (4) and (5) yields the equilibrium levels of output and the expected welfare as follows:

$$\begin{aligned} q_1^T &= \frac{1}{9b}(4a+3\theta-6c_1+2c_2), \\ q_2^T &= \frac{1}{9b}(a+3\theta+3c_1-4c_2), \quad \text{and} \end{aligned} \tag{6}$$

$$\mathrm{E}W^T = \frac{\sigma^2}{3b}+\frac{1}{18b}\left[6(a-c_1)^2+(a-c_2)^2+3(c_1-c_2)^2\right]. \tag{7}$$

These equations will be compared with those derived under an import quota policy. Before we do so, let us solve first the equilibrium for the quota case.

[4] This partially generalizes the model of Brander and Spencer (1984) which assumes no uncertainty.

2.2 Import Quotas

Instead of imposing a tariff, the domestic government now chooses to limit the quantity of imports by a quota. We assume that the quota is a volume quota limiting the total quantity of imports from the foreign firm to $\bar{q}_2$. We also assume that the domestic firm becomes the sole price maker with respect to the market demand less the quota under the quota regime. Hence, the problem for the domestic firm is to:

$$\max_{\{q_1\}} \pi_1 = \left[a - b(q_1 + \bar{q}_2) + \theta - c_1\right] q_1 \,. \tag{8}$$

Solving (8), we can obtain the output level of the domestic firm (firm 1), given the quota constraint $\bar{q}_2$:

$$q_1 = \frac{1}{2b}(a + \theta - c_1) - \frac{1}{2}\bar{q}_2 \,. \tag{9}$$

Assume all the quota rents go to the foreign firm.[5] The domestic welfare function under the quota regime is defined as consumer surplus plus domestic profits under the quota regime. Substituting (9) into the domestic welfare function yields the expected welfare for any given quota level:

$$\mathrm{E}W^Q = E\left[\frac{b}{2}\left(q_1^Q + q_2^Q\right)^2 + \left(p^Q - c_1\right)q_1^Q\right], \tag{10}$$

where superscript Q represents the case of a quota. The first- and the second-order conditions for welfare maximization with respect to quotas are derivable as follows:

$$d\mathrm{E}W^Q/dq_2 = E\left[\frac{3b}{4}q_2 - \frac{1}{4}(a + \theta - c_1)\right] = 0 \,, \tag{11}$$

$$d^2\mathrm{E}W^Q/dq_2^2 = 3b/4 > 0 \,. \tag{12}$$

By (12), the second-order condition for welfare maximization is not satisfied due to the convexity of the welfare function. There is no interior solution.[6] The optimal quota will equal either zero (i.e., autarky) or the expected free-trade import level, depending on the welfare levels at the two

[5] This assumption which implies that the quota is really a VER, is in line with the setting of McCorriston and Sheldon (1997) and Collie and Su (1998). It is convenient but not crucial to our results. The other case in which all the quota rents are retained by the domestic country will be commented on later.

[6] Eldor and Levin (1990) have had a similar outcome.

corners. In what follows, we shall derive and then compare the expected welfare levels at the two corners to determine the optimal quota level.

Zero Quota

In this case, the domestic firm becomes a monopolist. The expected welfare is derivable as follows:

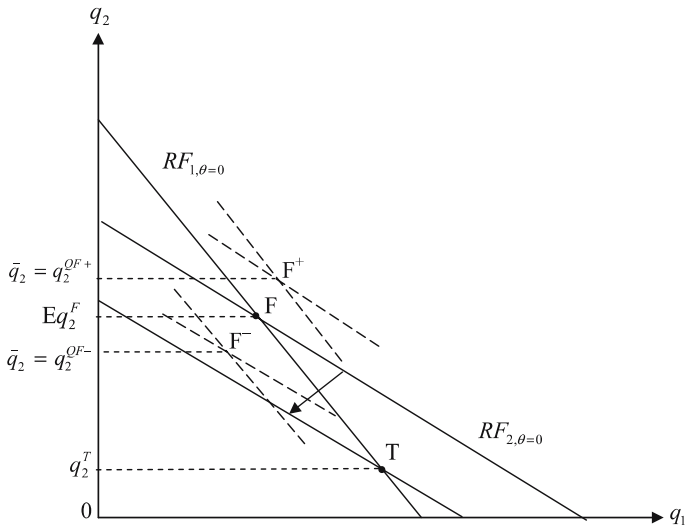
$$\mathrm{E}W^{QA} = \frac{3}{8b}\left[(a - c_1)^2 + \sigma^2\right], \tag{13}$$

where $\mathrm{E}W^{QA}$ is the welfare of the domestic country when $\bar{q}_2$ is set equal to zero or the domestic economy is at autarky.

Free-Trade Quota

If the quota is set at the expected free-trade level, the market equilibrium is slightly complicated, as the quota can be either binding or non-binding depending on the noise of price uncertainty. This can be illustrated by the reaction functions in Figure 1. Assume first that there is no price uncertainty. The reaction curves for the domestic and the foreign firms (i.e., $RF_{1,\theta=0}$ and $RF_{2,\theta=0}$) intersect at point F. As the mean of price uncertainty is assumed to be zero, point F is also the expected equilibrium under price uncertainty.

Figure 1: *Reaction Functions*



The expected output of the foreign firm under free trade, which is also the quota level set by the domestic government in this case, is therefore Eq_2^F. Now let us assume the noise of price uncertainty is positive. The two reaction curves will both shift to the right and intersect at point F^+. At the equilibrium, the foreign firm's ideal output q_2^{QF+} would be higher than the quota which is Eq_2^F. Under such a circumstance, the quota is effective and binding and the foreign firm can export only up to the quota level. Thus, we have

$$q_2^{QF} = Eq_2^F = \frac{1}{3b}(a - 2c_2 + c_1)\,. \tag{14}$$

The domestic firm takes (14) as given and chooses its output to maximize

$$\pi_1 = [a - b(q_1 + q_2) + \theta - c_1]\, q_1\,. \tag{15}$$

The optimal output of firm 1 is

$$q_1^{QF} = \frac{1}{6b}(2a + 3\theta - 4c_1 + 2c_2)\,. \tag{16}$$

The expected level of welfare where the noise is positive (denoted it as EW^{QF+}) becomes

$$EW^{QF+} = \frac{1}{24b}\left[8(a - c_1)^2 + 9\sigma^2 + 4(c_1 - c_2)^2\right]. \tag{17}$$

On the other hand, if the noise is negative, the two reaction curves move inward and intersect at F^-; the output of the foreign firm q_2^{QF-} is lower than the quota level Eq_2^F. The quota is not binding in this case.[7] The foreign firm would produce at q_2^{QF-} in Figure 1. The output level is derivable as follows:

$$\begin{aligned} q_1^F &= \frac{1}{3b}(a + \theta - 2c_1 + c_2) \quad \text{and} \\ q_2^F &= \frac{1}{3b}(a + \theta - 2c_1 + c_2)\,, \end{aligned} \tag{18}$$

where q_1^F and q_2^F are the domestic and foreign firms' output under free trade. The expected level of welfare in this case (denoted as EW^{QF-}) becomes

$$EW^{QF-} = \frac{1}{6b}\left[2(a - c_1)^2 + 2\sigma^2 + (c_1 - c_2)^2\right]. \tag{19}$$

[7] This case is in contrast to Hwang and Mai (1988) and Fung (1989) in which the quota set by the government is always binding in a certainty market.

Since θ has a bounded uniform distribution with a zero mean, we can combine (17) and (19) to derive the expected level of welfare when the quota is set at the expected free-trade level as follows:

$$\begin{aligned} \mathrm{E}W^{QF} &= \int_{-\infty}^{0} EW^{QF}(\theta)d\theta + \int_{0}^{\infty} EW^{QF}(\theta)d\theta \\ &= \frac{1}{2}\mathrm{E}W^{QF+} + \frac{1}{2}\mathrm{E}W^{QF-} \\ &= \frac{1}{48b}\left[16(a-c_1)^2 + 17\sigma^2 + 8(c_1-c_2)^2\right]. \end{aligned} \tag{20}$$

With (13) and (20) in hand, we are now ready to compare the domestic welfare at the two corners. Subtracting (20) from (13) yields

$$\begin{aligned} \Delta\mathrm{E}W^{Q} &= \mathrm{E}W^{QA} - \mathrm{E}W^{QF} \\ &= \frac{1}{48b}\left\{2\left[(a-c_1)^2 - 4(c_1-c_2)^2\right] + \sigma^2\right\}. \end{aligned} \tag{21}$$

Equation (21) indicates that the domestic government should set the quota at the free-trade (autarky) level if $\Delta\mathrm{E}W^{Q} < (>)\ 0$. Note that the sign of (21) depends on the costs of the domestic and the foreign firms and the price uncertainty. In general, the higher (lower) the production efficiency of the domestic firm and/or the greater (smaller) the price uncertainty, the more likely autarky (free trade) is to be optimal.

From (7), (13), and (20), we can establish the following proposition:

PROPOSITION 1. *Market uncertainty necessarily raises the expected welfare of the domestic country under both the tariff and quota regimes.*

Proof: From (7), (13), and (20), it is straightforward to show that the larger the variance σ^2, the higher the expected social welfare.

Moreover, from (21), we can establish:

PROPOSITION 2. *With a sufficiently large degree of market uncertainty, the optimal quota policy is a policy of autarky.*

Proof: By (21), it is clear that $\mathrm{E}W^{QA}$ necessarily outweighs $\mathrm{E}W^{QF}$ when σ^2 is sufficiently large.

The economic intuition goes as follows. As shown in Proposition 1, market uncertainty necessarily increases the expected welfare of the domestic

country, no matter whether the optimal quota lies at zero or at the free-trade level. But the increase in expected welfare is higher in the former than the latter. This can be proved by $\partial \mathrm{E}W^{QA}/\partial\sigma^2 - \partial \mathrm{E}W^{QF}/\partial\sigma^2 = \sigma^2/48b$. Hence, if the market uncertainty becomes sufficiently large, autarky becomes the optimal policy.

After deriving the expected welfare under both the tariff and quota regimes, we are able to analyze the domestic government's optimal choice of policy instruments. This will be accomplished in the following section.

3 Welfare Comparison

The welfare comparison can be carried out by comparing the welfare under the optimal tariff and the optimal quota. As discussed in the previous section, the optimal quota can be either zero or at the free-trade level, depending on the degree of uncertainty and the relative costs of the domestic and the foreign firms. Hence, the welfare comparison of the two regimes has to be carried out separately. If the cost of the foreign firm is higher than that of the domestic firm and/or the degree of uncertainty is high so that the domestic government chooses autarky under the quota regime, the welfare ranking of the two regimes can be completed by subtracting (13) from (7), which yields:

$$\begin{aligned} \mathrm{E}W^{T} - \mathrm{E}W^{QA} &= \frac{1}{72b}\big[-3(a-c_1)^2 + 12(c_1-c_2)^2 \\ &\qquad + 4(a-c_2)^2 - 3\sigma^2\big] \\ &= \frac{1}{72b}\left\{[(a-c_1) + 4(c_1-c_2)]^2 - 3\sigma^2\right\}. \end{aligned} \tag{22}$$

On the other hand, if the foreign firm has a significant cost advantage over the domestic firm and the degree of uncertainty is small, so that the domestic government sets the quota at the free-trade level, the welfare ranking under the two regimes can be derived by subtracting (20) from (7), which yields:

$$\mathrm{E}W^{T} - \mathrm{E}W^{QF} = \frac{1}{72b}\left\{4[(a-c_1) + (c_1-c_2)]^2 - \frac{3}{2}\sigma^2\right\}. \tag{23}$$

From (22) and (23), we can establish the following two propositions:

PROPOSITION 3. *In the market with certainty, the social welfare is unambiguously higher under tariffs than under quotas.*

Proof: The finding follows directly from setting σ^2 in (22) and (23) to zero.

This result is consistent with the conventional wisdom that tariffs are better than quotas if the domestic government can retain the tariff revenues but not the quota rents.

PROPOSITION 4. *In the market with uncertainty, social welfare under a tariff regime is, however, not always greater than that under a quota regime. With a large variance σ^2, the expected welfare under quotas is higher than that under tariffs.*

Proof: It can be easily proved by (22) and (23).

By Proposition 1, the expected social welfare is higher as the variance σ^2 becomes larger under either regime; but its magnitudes are not the same—welfare is more responsive to variance under the quota than under the tariff regime (i.e., $\partial \mathrm{E}W^{QA}/\partial\sigma^2$ and $\partial \mathrm{E}W^{QF}/\partial\sigma^2$ are higher than $\partial \mathrm{E}W^{T}/\partial\sigma^2$ by $\sigma^2/24b$ and $\sigma^2/48b$, respectively). Therefore, if the variance of uncertainty is high enough, the conventional welfare ranking may be reversed. In sum, the variance σ^2 has a significant impact on the government's policy choice. With a small amount of variance σ^2, the government's dominant strategy is to tax imports. However, if the market environment becomes sufficiently volatile, the domestic government should choose quotas as the means of restricting imports.

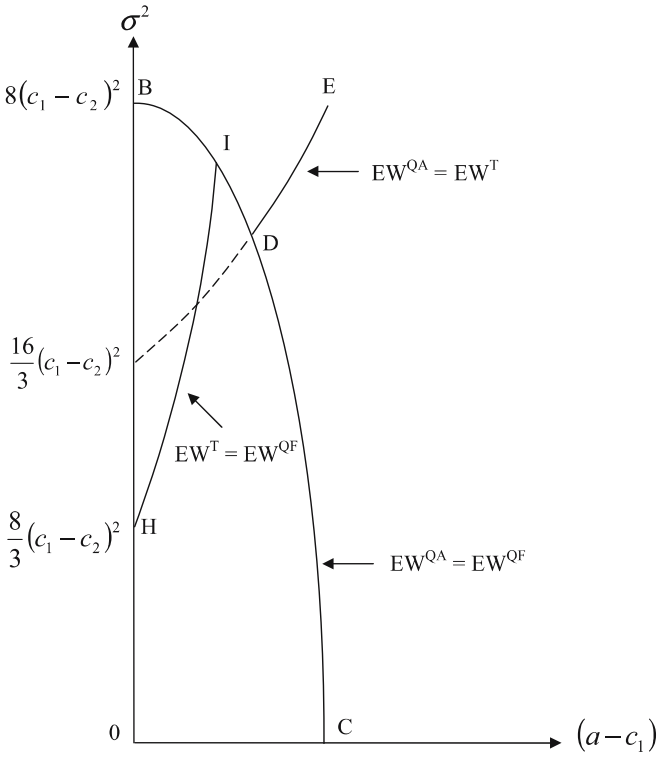
Proposition 4 is related to the pioneer paper by Weitzman (1974) who considered the choice between price and quantity instruments under uncertainty and showed that, with sufficient uncertainty, the flexibility provided by price controls is potentially desirable and is lost when quantity controls are used. Cooper and Riezman (1989) built on this insight and showed that the choice between subsidies and export quotas in a strategic export game depended on the same trade-off between the flexibility of price controls and the strategic superiority of quantity controls. In their case, high uncertainty made subsidies desirable from the exporting countries' point of view. The result of the present paper is an extension of this one to the case of an importing country. It has shown that unlike the findings in Weitzman (1974) and Cooper and Riezman (1989), flexibility is undesirable, so for high uncertainty, quantity controls (i.e., quotas) are preferable to price controls (i.e., tariffs). The intuition for our result is straightforward. Import tariffs allow the foreign firm to respond to the state of nature whereas import quotas do not provide this flexibility. When the market uncertainty goes up, the gains of the domestic country from this inflexibility become

large and make the quota a more attractive instrument to the domestic government.

Moreover, the result underlying Proposition 4 for the effect of differences in relative efficiency levels on the nature and sign of the optimal intervention could be related to the existing results along these lines for the export game (Neary 1994).

Finally, we can infer from Propositions 2, 3, and 4 that the optimal policy is autarky for high levels of uncertainty, a quota at the free-trade level for intermediate levels, and a tariff at low levels. This result could easily be illustrated in a diagram. There are only three separate variables, $a - c_1$, $c_1 - c_2$, and σ^2 in (21), (22), and (23). If we fix c_1 and c_2, it is then possible to illustrate the boundaries between the different regimes in which one of the three policies (tariffs, autarky, or a quota at the free-trade level) is optimal in the space of $a - c_1$ and σ^2. This is accomplished in Figure 2.

Figure 2: *The Welfare Ranking of Trade Policies*



In the figure, BC, which represents (21), characterizes the boundary of the free trade and autarky under the quota regime. For the area above BC, autarky is the equilibrium. This together with DE which represents (22) indicates that autarky is optimal for high levels of uncertainty. Similarly, for the area below BC, the quota should be set at the free-trade level. This together with HI which is derived from (23), implies that a quota at the free-trade level (a tariff) is optimal for intermediate (low) levels of uncertainty.

Hence, the conventional wisdom which suggests that with certainty a tariff is in general superior to a quota, does not hold if the market has a high level of uncertainty. This is because import tariffs allow foreign firms to respond to the state of nature whereas import quotas do not provide this flexibility. When the uncertainty is sizable, the domestic government should choose a quota instead of a tariff as a means of restricting imports so as to prevent the foreign firm from responding to the state of nature.

4 Concluding Remarks

The literature on the welfare equivalence of tariffs and quotas has suggested that tariffs are superior to quotas when there is no uncertainty. In contrast, this paper has incorporated demand uncertainty into a duopoly model with a domestic firm competing against a foreign firm in the domestic market and found that the optimal policy is sensitive to the level of uncertainty. The optimal policy is autarky for high levels of uncertainty, a quota at the free-trade level for intermediate levels, and a tariff at low levels. Hence, the conventional ranking between quotas and tariffs holds only for low levels of uncertainty. This is because import tariffs allow foreign firms to respond to the state of nature whereas import quotas do not provide this flexibility.

For simplicity, we have assumed all the quota rents go to the foreign country. This assumption has of course given the quota regime a disadvantage in the welfare ranking. If it is relaxed by allowing the entire rents or part of the rents to be kept by the domestic country, our main result that quotas are superior to tariffs under demand uncertainty is strengthened—the expected welfare under quotas is higher than that under tariffs even under milder demand uncertainty.

References

Arvan, L. (1991). Flexibility versus Commitment in Strategic Trade Policy under Uncertainty. *Journal of International Economics* 31 (3): 341–355.

Bhagwati, J. N. (1965). On the Equivalence of Tariffs and Quotas. In: R. E. Baldwin et al. (eds.), *Trade, Growth, and the Balance of Payments: Essays in Honor of Gottfried Haberler.* Chicago: Rand McNally.

Bhagwati, J. N. (1968). More on the Equivalence of Tariffs and Quotas. *American Economic Review* 58 (1): 142–146.

Brander, J. A., and B. J. Spencer (1984). Tariff Protection and Imperfect Competition. In H. Kierzkowski (ed.), *Monopolistic Competition and International Trade*. Oxford: Oxford University Press.

Cooper, R., and R. Riezman (1989). Uncertainty and the Choice of Trade Policy in Oligopolistic Industries. *Review of Economics Studies* 56 (1): 129–140.

Collie, D. R., and Y. T. Su (1998). Trade Policy and Product Variety: When Is a VER Superior to a Tariff? *Journal of Development Economics* 55 (1): 249–255.

Dasgupta, P., and J. Stiglitz (1977). Tariffs vs. Quotas as Revenue Raising Devices under Uncertainty. *American Economic Review* 67 (5): 975–981.

Eldor, R., and D. Levin (1990). Trade Liberation and Domestic Monopoly: A Welfare Analysis. *International Economic Review* 31 (4): 773–782.

Fishelson, G., and F. Flatters (1975). The (Non-)Equivalence of Optimal Tariffs and Quotas under Uncertainty. *Journal of International Economics* 11 (4): 385–393.

Fung, K. C. (1989). Tariffs, Quotas, and International Oligopoly. *Oxford Economic Paper* 41 (4): 749–775.

Hwang, H., and C. C. Mai (1988). On the Equivalence of Tariffs and Quotas under Duopoly. *Journal of International Economics* 24 (3): 373–380.

Itoh, M., and Y. Ono (1984). Tariffs vs. Quotas under Duopoly of Heterogeneous Goods. *Journal of International Economics* 17 (3): 359–373.

McCorriston, S., and I. M. Sheldon (1997). The (Non-)Equivalence of Tariffs and Quantity Restraints as 'Rent-Shifting' Policies. *Canadian Journal of Economics* 30 (4b): 1220–1233.

Matschke, X. (2003). Tariff and Quota Equivalence in the Presence of Asymmetric Information. *Journal of International Economics* 61 (1): 209–223.

Neary, P. (1994). Cost Asymmetries in International Subsidy Games: Should Governments Help Winners or Losers? *Journal of International Economics* 37 (3): 197–218.

Shibata, H. (1968). A Note on the Equivalence of Tariffs and Quotas. *American Economic Review* 58 (1): 137–142.

Shivakumar, R. (1993). Strategic Trade Policy: Choosing between Export Subsidies and Export Quotas under Uncertainty. *Journal of International Economics* 35 (1): 169–183.

Weitzman, M. L. (1974). Prices vs. Quantities. *Review of Economic Studies* 41 (4): 477–491.