Does the Incomplete Information Matter with Export Quotas?

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Abstract: This study investigates whether or not incomplete information matters when the government adopts the export quotas in intervening in the oligopolistic export markets. Incomplete information the government has is about the unit-production cost of the domestic firm. It is shown first that quotas optimal under full information (full-information policy) result in Stackelberg outcome, the best outcome in a non-cooperative setting from the domestic firm’s point of view. When the full-information policy is implemented in the presence of incomplete information, it is found that no cost-type has an incentive to misrepresent itself as the other type. This means that full-information outcome will be achieved with incomplete information. Hence, incomplete information does not matter in the case of export quotas. This result, however, does not carry over to the case of more than one domestic firm.

Key words: Incomplete information, export quotas, strategic trade policy, oligopolistic export markets

INTRODUCTION

When implementing certain trade policies, governments will select optimal levels of the policies to achieve the best outcome. The optimal levels of trade policies are functions of certain parameters, however. Optimal tariff theorem is an example where the optimal tariff rate is a function of the elasticity of foreign demand for exports in terms of imports. Another example is from the strategic trade theory where the optimal level of the export quota depends on the unit production cost. These parameters are either related with some aspects of the market or with certain features of the targeted firm or both, about which government is likely to have incomplete information. In this case, when implementing policies, the government will have to rely on reports by those with more information. Those agents with more information will tell the truth, however, only if it is in their best interests. Otherwise, they will overstate or understate what they are reporting. If incentives not to tell the truth exist, presence of such incentives will indicate that incomplete information does matter and in this case policies must be designed taking into consideration the presence of incomplete information.

The present study investigates this issue, i.e., whether or not incomplete information matters, in the case of export quotas (also named direct-quantity controls in the literature). For this purpose, the full information assumption is relaxed and it is assumed that the government has incomplete information about the unit-production cost of the firm. To be able to find out whether incomplete information matters, we first need to derive optimal levels of export quotas under the assumption of full information, which will result in a certain outcome (full-information outcome) when implemented. If the full-information outcome is obtained when export quotas optimal under full information are implemented in the presence of incomplete information, this will mean that incomplete information does not matter. Otherwise, it will matter.

In strategic trade policy literature governments use policies to influence the outcome in oligopolistic export markets in favour of domestic firms in such a way that profits are shifted towards domestic firms. This profit shifting role rationalizes the use of trade policies in imperfectly competitive or oligopolistic export markets (Brander and Spencer, 1985). One of the policies governments can use to influence the market outcome in favour of domestic firms is export quotas. Export quotas provide domestic firms with pre-commitment so that they are able to attain a favourable outcome that is unattainable without intervention. There are several studies in the literature that have analyzed export quotas. Among them is Cooper and Reizman (1989) who investigates the choice of trade policies in an uncertain world when governments can select between export subsidies and export quotas. They find that equilibrium-policy choice depends critically on the variability of the environment and show that when uncertainty is not too severe, governments choose to employ export quotas whereas in more uncertain settings export subsidies are selected as the mode of intervention. Another study is Shivakumar (1993) who analyzes the choice of trade policy between export subsidies and export quotas in a model.
where choice of policy and time of implementation is endogenously determined and shows that choice depends on degree of uncertainty and the number of firms in each country and in the case of international duopoly both governments prefer quotas to subsidies. All these studies assume, however, that intervening government has full or complete information.

The problem of incomplete information on the part of the government has been recognized in the literature. For example, Helpman and Krugman (1989) stated, "How likely is it a government will be able to have the information necessary to conduct a successful strategic policy?" Grossman (1986) stated that "In this respect our finding is a pessimistic one. Even in the simplest model, the informational requirements of the theory are so severe as to make the correct policies difficult to implement." Despite such an early recognition of incomplete information, its incorporation into the analysis has taken place much later and only in a few studies. One such study is Kikuchi and Lee (2003) that reexamines the profit-shifting role of subsidies in an incomplete information context and finds that optimal export subsidy under incomplete information is larger than that under complete information.

In the literature either export quotas are analyzed under full information or incomplete information is taken into account but this is not done in the case of export quotas. So this study fills in this vacuum in the literature by analyzing export quotas under incomplete information.

MODEL

There are two producing countries (1 and 2). In each of these countries there is a single Cournot firm. A homogeneous good is produced for sale exclusively in a third market. Since the good is not consumed domestically, the objective of a government is to set the level of policy instrument so as to maximize the profits of the domestic firm. The inverse demand function is given by $P = a - bQ$, where Q is the total output of this homogenous good. The parameters a and b are both positive. The number and location of firms are assumed to be fixed. We allow only the government of country 1 to actively intervene in the export market. The only available policy instrument is export quotas. Sequence of moves involves two stages. In the first stage government chooses the level of export quota. In the second stage, taking as given the level of the export quota chosen in the previous stage by government, firms non-cooperatively select their output levels.

There are two possible values that the unit cost of a firm can take on, $c_h$ (high) and $c_l$ (low), with $c_h < c_l$. Probability of occurrence of $c_i$ is $\delta$. This means that $1-\delta$ represents the probability of occurrence of $c_h$. Parameters of the model are assumed to be such that an interior solution always exists.

It is assumed that the information between the two firms, the firm from country 1 and the firm from country 2, is symmetric. That is, they both know each other’s cost. This assumption implies that, regardless of whether firm 1 reports truthfully its unit cost to the government, firm 2 knows the true type. Since the foreign government does not intervene and the domestic firm knows the unit cost of the foreign firm, the unit cost of the foreign firm will be represented as $c_i$ throughout the analysis.

THE OPTIMAL LEVELS OF EXPORT QUOTAS UNDER FULL INFORMATION

Here full information is assumed, meaning that the government knows $c_i$ with certainty.

The objective function of the firm in country 1 is given by

$$\pi_1 = (a - b(q_1 + q_2))q_1 - c_i q_1$$

(1)

Where $\pi_1$ is the profits of firm 1 and $q_1$ and $q_2$ are quantities produced by firm 1 and firm 2, respectively.

Similarly, the firm in country 2 has the objective of maximizing its profits given by

$$\pi_2 = (a - b(q_1 + q_2))q_2 - c_i q_2$$

(2)

With export quotas, government 1 decides the output level for the domestic firm, firm 1. Taking the production level of firm 1 as given, firm 2 selects its output level in order to maximize its profits given in (2). Resulting output level for firm 2 as a function of output level of firm 1 is

$$q_2(q_1) = \frac{(a - c_i - bq_1)}{2b}$$

(3)

Since there is no domestic consumption of the good, what the government is concerned about are profits of the domestic firm. Hence the government in country 1 has the following objective function,

$$W_1 = (a - b(q_1 + q_2))q_1 - c_i q_1$$

(4)

Taking into account the decision rule (best-response function) of firm 2 in the subsequent stage given in 3, the government chooses the level of quota for the domestic firm to maximize the objective function in 4. This results in the following quota level for firm 1;

$$q^*_1 = \frac{(a + c_i - 2c_l)}{2b}, \quad \text{where } c_i = c_h \text{ or } c_l$$

(5)
Note that the government has the same objective function as the domestic firm. For this reason the quota level that maximizes the government's objective function also maximizes that of the firm. In a setting where firms behave non-cooperatively, since the government's objective is to maximize profits of the domestic firm, this happens at the Stackelberg outcome. Therefore, this is the outcome that is attained when \( q_i^* \) is implemented.

In the literature, besides export quotas, a variety of policy instruments have been considered under the assumption that the government has full information. Among them is an export subsidy. Assuming that there is no cost associated with the redistribution of income, the government has the same objective function with export subsidy as with export quota. Therefore, subsidies that will be chosen by the government when it employs an export subsidy will yield the same outcome as these quotas in 5. This means that export quotas and export subsidies are equivalent under the full information in the sense that both policies lead to the same outcome.

The equilibrium levels of the profits and the quota for the low-cost type are given by 6 and 7, respectively.

\[
\pi_n = \frac{(a + c_i - 2c_e)^2}{8b}
\]
(6)

\[
q_{il} = \frac{(a + c_i - 2c_e)}{2b}
\]
(7)

And the expressions in (8) and (9) represent the equilibrium levels of the profits and the quota for the high-cost type, respectively.

\[
\pi_{ha} = \frac{(a + c_e - 2c_e)^2}{8b}
\]
(8)

\[
q_{ha} = \frac{(a + c_e - 2c_e)}{2b}
\]
(9)

The welfare level resulting from government intervention through export quotas (\( W^q \)) is

\[
W^q = \frac{(a + c_i - 2(\delta c_i + (1 - \delta)c_e))^2}{8b}
\]
(10)

And the welfare level in the case of no intervention is

\[
W^* = \frac{(a + c_i - 2(\delta c_i + (1 - \delta)c_e))^2}{9b}
\]
(11)

Comparing two welfare levels reveals that the intervention through the export quotas improves the national welfare, i.e., \( W^q > W^* \).

**IMPLEMENTATION OF FULL-INFORMATION POLICY UNDER INCOMPLETE INFORMATION**

The firm knows \( c_i \), but the government has only imperfect information about \( c_i \) as represented by a probability distribution over possible types. Therefore, the government offers to the domestic firm the two quotas optimal under full information, namely \( q_{il} \) and \( q_{il} \) given in (7) and (9) and lets the firm choose one of them. For each type to choose the quota optimal from the government's perspective, it must be the case that the quota is incentive compatible; that is, each type chooses the quota intended for it. In order for this to happen, profits each type makes when it tells the truth must be no less than those obtained when it mimics the other type. Let \( \pi_{ji} \) represent the profits the firm will obtain when its true cost is \( i \) and the cost it reports is \( j \), with \( i = 1, h \) and \( j = 1, h \). Then \( \pi_{ij} \) will be the profits when the low-cost firm reports its cost as \( c_i \) (reporting truthfully). Similarly, when the low-cost firm reports its cost as \( c_e \) (mimicking the high-cost firm), its profits will be equal to \( \pi_{ji} \).

Profits each type will make when they report truthfully are given in Eq. 6 and 8.

Profits the low-cost firm will obtain when it mimics the high-cost firm, thus reporting \( c_e \), is equal to

\[
\pi_{hi} = \frac{(a + c_i + 2c_e - 4c_e)(a + c_i - 2c_e)}{8b}
\]
(12)

To find out whether the low-cost firm will disguise its true cost and misrepresent itself as the high-cost firm, profits it obtains by claiming to be high cost (\( \pi_{hi} \) in 12) must be less than those made by telling the truth (\( \pi_{ji} \) in 6).

Comparison reveals that

\[
\pi_{hi} - \pi_{ji} = \frac{(c_i - c_e)^2}{2b} > 0
\]
(13)

This means that the low-cost firm has no incentive to misrepresent itself and therefore it will truthfully reveal its cost and produce \( q_{il} \) in (7). Thus, full-information outcome will be achieved with low-cost firm under incomplete information.

Profits the high-cost firm will make when it reports \( c_i \) as its cost, thus misrepresenting itself as the low-cost firm, is equal to

\[
\pi_{hi} = \frac{(a + c_i + 2c_e - 4c_e)(a + c_i - 2c_e)}{8b}
\]
(14)

Comparing this profit level with the one that will be obtained by telling the truth (\( \pi_{ji} \) in 8) reveals that

\[
\pi_{hi} - \pi_{ji} = \frac{(c_i - c_e)^2}{2b} > 0
\]
(15)
Like the low-cost type, high-cost firm has no incentive at all to claim that its unit cost is $c_t$. Hence, full-information outcome will be achieved under incomplete information with the high-cost firm as well.

As pointed out in the previous section, the export quotas optimal under the full information $(g_t)$ in (5) result in the Stackelberg outcome. In a non-cooperative setting this is the best outcome from the domestic firm’s point of view. Any deviation from the Stackelberg outcome will lead to a decrease in the profits of the domestic firm. When a type behaves as if it were the other type, the outcome will no longer be the Stackelberg one. As a result, profits will decrease. This is true for both types. Therefore, no type benefits from misrepresenting itself. This means that implementing the full-information policy under incomplete information will result in the full-information outcome. Hence, incomplete information does not matter.

**DISCUSSION**

This study has explored whether or not incomplete information matters when export quotas are employed by the government in intervening in the product market. Export quotas optimal when the government has full information (full-information policy) are first derived, which results in the Stackelberg outcome, the best outcome in a non-cooperative setting from the domestic firm’s point of view. Full-information policy is then implemented in the presence of incomplete information the government has about the unit cost of the domestic firm. It is found that no cost type has an incentive to misrepresent itself, i.e., full-information policy is incentive compatible. Hence, full-information outcome will be achieved under incomplete information, meaning that incomplete information does not matter in the case of export quotas.

It should be pointed out, however, that the above finding that incomplete information does not matter will not carry over to the case of more than one domestic firm due to the fact that the objective of the government will now be to maximize the sum of profits of all domestic firms, not the profit of a single firm. Such an objective will result in an optimal export quota that will lead to a cartel-type outcome. As we know from microeconomic theory (Kreps, 1990) that each firm in a cartel will have an incentive to cheat on the cartel agreement by producing more than the assigned-quota. In the context of the incomplete information this means that less-efficient types (high-cost) will mimic the more efficient types (low-cost) to be able to produce more. Therefore, implementing full-information policy in the presence of incomplete information will not result in full-information (cartel-type) outcome, i.e., incomplete information will matter.

**REFERENCES**


