Re-Distribution, State Trading Enterprises and Optimal Tariffs

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Abstract: State trading enterprises (STEs) can be viewed as instruments of trade policy through which the government manipulates market structure by providing exclusive rights and where the objective of the STE reflects the re-distributional aims of the government. In an open economy, such redistribution is likely to affect imports and thus state trading enterprises will act as an alternative to more conventional trade policy instruments, in particular, tariffs. In this paper, we investigate the tariff equivalence of state trading enterprises and show that the sign and magnitude is contingent on the nature of the exclusive rights, the policy bias in the government's objective function and the nature of the market structure that is assumed would exist in the absence of the STE. Therefore, the use of an STE influences the case for the optimal tariff. In some circumstances, the STE is a perfect substitute for the optimal tariff which, in the presence of an STE, can be zero.

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'…the consequences of the State monopolisation of production, consumption or trade in any commodity are essentially similar to the consequences of State intervention through taxes or subsidies and through quantitative restrictions' (Meade, 1955, p. 176).

Introduction

State trading enterprises (STEs) are instruments of government policy through which the government re-distributes income between consumers, producers, profits and taxpayers by the manipulation of market structure. STEs are typically allocated exclusive rights which provide them with monopsony/monopoly control over the procurement and distribution of imports and, in other cases, monopoly control over exports. To the extent that an STE affects market access or influences competition on export markets, it acts in a manner similar to more conventional trade policy instruments such as tariffs and export subsidies. STEs are widely used in developed and developing countries, they are particularly prevalent in agricultural trade, involving some of the major exporters and importers including Canada, China, India, Indonesia, Japan and Korea among many others.[1] Concerns about their potential to distort trade has led to STEs being an issue in the Doha Round negotiations on agriculture.

Despite their prevalence in some international markets, little attention has been paid to STEs as an implicit barrier to trade and the research literature remains relatively sparse. There is the early observation by Meade noted above, while Lloyd (1982) highlighted the potential trade policy equivalence of STEs. As far as we are aware, in recent years the only paper to analyse rigorously the issue of STEs in importing countries is McCorriston and MacLaren (2005). In that paper, they investigated the implicit tariff effects using specific functional forms and showed that the creation of monopsony/monopoly power for the STE can affect market access. More generally, the relationship between border and behind-the-border competition policy measures was explored in the context of tariff reductions by Horn and Levinsohn (2001). They

[1] For a general discussion of the objectives and types of STEs to be found in developed and developing countries, see OECD (2001).

concluded that governments may have the incentive to pursue more relaxed anti-trust policy regarding mergers because increased market access through tariff reduction may act as a substitute for domestic competition policy. Bagwell and Staiger (2002) concluded that, because domestic competition policy may affect market access and the terms of trade, STEs should be subject to WTO disciplines.[2] However, little attention has been paid to the manipulation of market structure through the use of state trading enterprises and the consequent effects on market access.[3]

In this paper, we analyse the trade effects of STEs in importing countries. Our central premise is that STEs are implicit trade policy instruments, although often put in place largely to pursue the objective of domestic redistribution of consumer surplus, producer surplus and profits. Therefore, they are a non-tariff measure. As such, the motivation for their use is similar to that for the use of tariffs and their effect on market access suggests that they are substitutes for these more conventional policy instruments (c.f. Meade, 1955).

We explore the analysis of STEs in two ways. First, we identify the tariff equivalence of STEs against a counter-factual benchmark in which private firms alone participate in the market and thereby provide a more general account of the conditions in which an STE acts as an implicit barrier to trade. Second, to the extent that STEs are alternatives for more conventional policy instruments, the argument for the optimal tariff will be modified. Key to determining the extent to which STEs distort trade and, consequently, influence the optimal tariff argument are the re-distributional objectives of government and the specific designation of exclusive rights that apply to the STE. The main result of this paper is to show that STEs in importing countries are trade distorting and, in turn, that they influence the case for, and the magnitude of, the optimal tariff compared with the case where only private firms characterise the market. Since, in the case of the STE, the government has effectively two instruments

[2] The existing disciplines in the WTO to which STEs are already subject are summarised in the following section.

[3] The literature on the export side is similarly sparse, Hamilton and Stiegert (2002) tested whether the existence of a state trading enterprise could act as a rent-shifting mechanism similar to an export subsidy. McCorriston and MacLaren (2007a) analysed the trade distorting effects of exporting STEs and used a calibrated model to estimate the size of the trade distortion as measured by the tariff equivalent. They employed the same approach (McCorriston and MacLaren (2007b)) in assessing the effect of the Australian Wheat Board on that country's exports of wheat.

to meet its re-distributional objectives, we show that the STE can act as a substitute for the optimal tariff and, under some circumstances, the optimal tariff is zero in the presence of the trade distorting STE.

The paper is organised as follows. In section 1, we provide some background material on STEs, how they are treated in the World Trade Organization and the issues that have arisen in the context of the Doha Round. In section 2, we identify the tariff equivalence of importing STEs and highlight the factors that will determine the magnitude of their trade distorting effect. These factors emerge as (i) the range of exclusive rights enjoyed by the STE, (ii) the government's policy bias and (iii) the number of firms in the counter-factual. Optimal tariff policies in the presence of STEs are then analysed in section 3 through a comparison of the re-distributive optimal tariff in the presence of only private firms and in the presence of only an STE. In section 4, we summarise and conclude.

1. State Trading and the WTO

State trading enterprises are used in both the goods and the services sectors, they cover developed and developing countries and apply to both exporters and importers.[4] In terms of trade in goods, most attention has been paid to the state trading enterprises that arise in agriculture. Many of the major countries involved in agricultural trade employ, or until recently have employed, state enterprises including, *inter alia*, on the export side, Australia, Canada, China and India, while on the import side, where they are more numerous, China, India, Indonesia, Japan and Korea. Many less significant exporters and importers also use state trading.

STEs have legal status in GATT 1994, where they have been defined as:

> Governmental and non-governmental enterprises, including marketing boards, which have been granted exclusive or special rights or privileges, including statutory or constitutional powers, in the exercise of which they influence through their purchases or sales the level or direction of imports or exports. (WTO 1995, p. 25)

[4] In the context of the WTO, trade in goods is separated from trade in services. State trading arises in both sector but the rules relating to services are covered by the General Agreement on Trade in Services (GATS). In relation to trade in goods, the majority of the state trading enterprises notified relate to trade in agricultural commodities. Mattoo (1998) gives a discussion on state trading issues as they arise in the services sector.

There are three observations noteworthy from this definition. First, state trading is not an issue of state ownership *per se*; a state trading enterprise may or may not be state owned. Second, the key aspect of a state trading enterprise is the nature of the exclusive rights that apply to it. Third, the extent to which the WTO is concerned about state trading relates to the degree to which the designation of these exclusive rights affects trade.

Efforts to limit the impact of state trading on market access and export competition are covered in a range of GATT Articles specific to state trading. Article XVII:1(a) requires that state trading enterprises act in a manner consistent with the GATT principle of non-discrimination and most-favoured nation treatment, and Article XVII:1(b) requires that they operate on the basis of commercial considerations (WTO, pp. 509-510).[5] In importing countries, state trading enterprises should not have mark-ups in excess of bound tariffs (Ad Article XVII:4(b)) and their existence and objectives should be notified to the WTO.

2. The Tariff Equivalence of STEs

(i) Preliminary Issues

In order to assess the trade distorting effect of state trading, it is necessary to define the benchmark or counter-factual against which to measure the distortion. It is defined here as a private *n*-firm Cournot oligopoly/oligopsony where, for present purposes, the number of competing firms is given exogenously.[6] This set up has two attractive features: first, by varying the number of firms in the benchmark, we capture alternative characterisations of the market that range from a private firm monopoly/monopsony outcome through to the competitive outcome; second, given that much of the debate on reforming STEs has revolved around what the counter-factual market structure would be and the concerns that would arise if the STE were replaced by a private sector monopoly/monopsony, we can be flexible in addressing the sensitivity of the trade distorting effect, contingent on different perceptions of the

[5] In an Appellate Body decision (WTO 2004), it was decided that 'commercial considerations' and 'profit-maximising behaviour' are not to be interpreted as being synonymous and that, in the context of Article XVII, commercial considerations are compatible with the pursuit of an objective other than profit maximisation.

[6] While it is possible to set up the model with *n* being endogenous, doing so diverts attention away from the essential results in the paper while, at the same time, adding unnecessary complexity.

counter-factual.[7] Note that in this characterisation, and subsequently the state trading enterprise introduced below, firms do not produce or process commodities but act as intermediaries in procurement and distribution. As such, they play the role of middlemen in international trade, a role that has been largely ignored (Lahiri and Ono, 1999).

Apart from the number of firms competing in the market, a further difference between the private firms and the STE is their respective pay-off functions. For the private firm benchmark, we assume as usual that firms maximise profits. However, in the case of the STE, given that it is an instrument of government policy, the pay-off function is assumed to reflect the government's objectives towards re-distribution.[8] We assume that the objective function for the STE can be biased towards either consumers or producers or towards neither, with the profit maximising STE being embedded in this objective function with the weights on consumer and producer surplus set equal to zero. This specification is related to the formal literature on the public firm (see, for example, Cremer *et al.* (1989) and de Fraja and Delbono (1990) for an overview). However, the role of the public firm in an open economy context has received only limited attention. Fjell and Pal (1996) and Pal and White (1998) are examples, although the focus in their papers was how the presence of a state firm affected the argument for rent-shifting export subsidies. The framework specified here is different from this characterisation of public firms because we are interested in the potential trade distorting effect of state trading and, in turn, the argument for an optimal tariff. It is the designation of exclusive rights that apply to the STE and the aim of re-distribution that are the principal characterisations of the government's use of a state trading enterprise as an instrument of trade policy.

The final preliminary comment relates to the characterisation of the trade distortion created by the STE. The tariff equivalence is defined as the implicit specific tariff (t^e) that would bring about equality between the level of imports procured by the state

[7] This is a desirable means of assessing potential differences in the perceptions for the use of STEs. In the early discussions in the Doha Round on STEs, considerable differences emerged among negotiating countries regarding how competitive markets would be in the absence of STEs. As such, we are agnostic as to the size of n.

[8] There are a number of other reasons cited for the use of STEs – see OECD (2001) for a broader discussion. However, in this paper, we confine the discussion to the case of re-distribution, reflecting the biases in agricultural policies thatare typically observed in developed and developing countries.

trading enterprise and that of the private sector benchmark, i.e., $Q_m^{priv}(t^e) = Q_m^{STE}$, where superscript *priv* (*STE*) represents the private (state trading) outcome the subscript *m* denotes that the source is imports.[9] Intuitively, the tariff equivalence measures the tariff that would have to be imposed on the *n* private firms to give the same level of imports that would arise when, instead, the state trading enterprise exists. This implicit tariff equivalence can be: either positive (negative), if imports are lower with the STE than in the benchmark, i.e., imports by private firms have to be reduced (increased) to make them equal to imports by the STE; or zero, if they are already equal. The sign will depend on the specific characterisation of the exclusive rights bestowed on the state trading enterprise, the direction of income redistribution sought by government and the value of *n* in the benchmark.

To explore the properties of the tariff equivalence, we consider two generic characterisations of the market. These allow us to establish the intuition for the results that we obtain. The first is where there is no domestic production and imports supply all domestic consumption. The second is where there is domestic production and the private firms and/or STE, contingent on the designation of exclusive rights, jointly determine the level of domestic procurement and imports. Essentially, this implicit tariff provides a summary measure of the market access that occurs under different characterisations of market structure and different pay-off functions of private firms and STEs.

(ii) Import Only

We start with the simplest characterisation of the market – one with no domestic production and domestic consumption is met entirely from imports. We assume a partial equilibrium set-up where consumer utility is separable and linear in the *numeraire* good. The inverse demand function is given by

$$p = p(q) \tag{1}$$

where $p' < 0, p'' \leq 0$ and q is the quantity imported. The inverse import supply function is given as:

[9] We have chosen in what follows to specify the tariff equivalence as a specific tariff rather than an *ad valorem* tariff because the former is the more common form of tariff in markets for agricultural commodities.

$$p_m = p_m(q) \tag{2}$$

where subscript *m* denotes imports, $p'_m > 0,\ p''_m \geq 0$ and $p(0) > p_m(0)$. It is assumed that the private firms and the STE have no costs other than the purchase of imports.

As noted above, the STE's pay-off function reflects the government's objectives regarding re-distribution. In the import only case, the pay-off function comprises consumer surplus and profits from importing with the weights reflecting the importance that government attaches to each. Specifically, the weighted pay-off function is given by:

$$\begin{aligned} W &= \alpha_1 CS + \alpha_2 \pi^{STE} \\ &= \alpha_c CS + \pi^{STE} \end{aligned} \tag{3}$$

where $\alpha_c \equiv \alpha_1 / \alpha_2$ is the weight the government places on consumer surplus relative to that on profits.

Consumer surplus is given by:

$$CS = \int_0^{Q^{STE}} p(z)dz - pQ^{STE}$$

and profit by:

$$\pi^{STE} = (p - p_m)Q^{STE}$$

The first-order condition from the maximisation of (3) with respect to imports gives:

$$p + Q^{STE} p'(1 - \alpha_c) = p_m + Q^{STE} p'_m \tag{4}$$

giving the optimal level of imports as:

$$Q^{STE*} = \frac{(p - p_m)}{p'_m - p'(1 - \alpha_c)} \tag{5}$$

In contrast with the STE, private firms are concerned only with their own profits, the representative firm maximising:[10]

$$\pi_i^{priv} = (p - p_m - t^e)q_i^{priv} \tag{6}$$

[10] We assume throughout that the second-order and stability conditions hold.

where $t^e > 0\ (< 0)$ is the implicit, specific tariff (import subsidy) needed to equilibrate total imports by the private firm benchmark with those by the STE. The first-order condition gives:

$$p + q_i^{priv} p' = p_m + q_i^{priv} p'_m + t^e \tag{7}$$

Aggregating over *n* private firms and re-arranging in terms of Q^{priv} $(= \sum_{i=1}^{n} q_i^{priv})$ gives the aggregate optimal level of imports in the private sector benchmark:

$$Q^{priv*} = \frac{n(p - p_m - t^e)}{p'_m - p'} \tag{8}$$

Setting aside the implicit tariff equivalent term for the moment, note the factors that will determine the difference between imports by the STE and imports by the private sector. In equation (4), the STE maximises its objective function by equating marginal revenue with marginal expenditure on imports. Therefore, the STE will exploit its buying power with respect to exporting countries. It will also exploit its selling power with respect to domestic consumers but the extent to which it does so depends on the policy weight given to it by government. The effect (measured from $\alpha_c = 0$) of a bias towards consumers is to cause the STE's marginal revenue function to rotate to the right and intersect with the marginal expenditure function at a higher quantity imported, thereby reducing the consumer price and increasing consumer surplus. If that weight is unity, then the STE's marginal revenue function coincides with the demand function and it no longer exploits domestic consumers, although it continues to exploit exporters.

In contrast, a private firm (equation (7)) fully exploits both foreign suppliers and domestic consumers, although the extent to which it does so is reduced as the number of firms increases. The effect of increasing *n* is to rotate both perceived marginal functions (c.f. the effect of α_c) giving rise to increasing levels of imports. Comparing equations (4) and (7), it is clear that if the policy weight is zero and the benchmark is a monopoly/monopsony, then the two market structures give the same outcome. If the benchmark were a duopoly, then the private firms would import more than the STE and thus the STE would act as an implicit tariff. As *n* increases, the higher is the trade distorting effect because the gap between the level of imports by the benchmark

and the fixed level of imports by the STE grows with *n*, thereby causing the tariff equivalence of the STE to increase. However, if there is a consumer bias, then the quantity imported by the STE will increase with the increasing weight. Given these offsetting influences, it is not obvious what the overall effect will be from increasing α_c and increasing *n*. Therefore, the STE may act as either an import subsidy or a tariff, depending upon the values of α_c and *n*. To determine which, we need a general expression for the tariff equivalence of the STE.

The tariff equivalence for the general case is obtained by setting (8) equal to (5) and solving for t^e. This gives:

$$t^e = \frac{(p - p_m)[(n-1)(p'_m - p') + np'\alpha_c]}{n[p'_m - p'(1-\alpha_c)]} \tag{9}$$

Consistent with the intuition above, if $n = 1$ and $\alpha_c = 0$ in (9), then the tariff equivalence of the STE is zero: the STE does not distort trade relative to this private monopoly/monopsony benchmark. However, suppose instead that the benchmark were a duopoly and $\alpha_c = 0$. Then, the optimal level of procurement and sales will be greater than if *n* = 1 and the tariff equivalence will be $(p - p_m)/2$, which is strictly positive. For the case where $\alpha_c = 0$, the expression for the tariff equivalence can be written as $t^e = (n-1)(p - p_m)/n$, the limit of which, as *n* goes to infinity, is $(p - p_m)$, where *p* and p_m remain the values at the equilibrium defined by the STE. Thus, it has been shown: first, that the size of the tariff equivalence of the STE is positively related to the number of firms in the benchmark, ranging from zero with monopoly/monopsony to $(p - p_m)$ with perfect competition; and second, that this STE distorts trade when compared with a benchmark where $n \geq 2$.

Suppose instead of there being no policy bias towards consumers, the weight imposed by government on the STE's pay-off function were $\alpha_c = 1$. Then, with *n* = 1, (9) becomes $t^e = (p - p_m)(p'/p'_m) < 0$ and the STE now acts as an import subsidy. In general, $t^e|_{\alpha_c=1} = (p - p_m)[(1-1/n) + (p'/p'_m)/n]$ which is positive for $n > (1 - p'/p'_m) > 1$. Unlike the first case (where $\alpha_c = 0$), the sign of the tariff equivalence of the STE with $\alpha_c = 1$ is now ambiguous.

These observations are summarised in the following proposition.

Proposition 1: In the case where there is no domestic procurement, the trade distorting impact of the STE is ambiguous in general because the implicit tariff can be negative, zero or positive. The sign will depend on the competitiveness of the benchmark and the bias in the government's welfare function. In sum, it is concluded that an STE will distort trade but, a priori, the sign of that distortion is indeterminate.

(iii) Domestic Procurement and Imports

We now consider the more realistic case where there are two sources of supply, namely, imports and procurement from domestic suppliers. We maintain the assumption throughout the remainder of the paper that the domestically produced and imported goods are homogeneous. In the private benchmark, the firms choose how much to procure from these two sources. Note also that with upward sloping inverse supply functions, there is the potential for market power in procurement in both markets, the possibility for third-degree price discrimination in procurement, as well as market power with respect to consumers. By adding domestic procurement to the model, not only does it more appropriately characterise the environment in which STEs operate but it also allows for a more interesting characterisation of exclusive rights.

There are two obvious characterisations of these rights. The first is where the STE has joint exclusive rights, i.e., it is solely responsible for imports and domestic procurement as well as sales of these supplies to domestic consumers. The second is where the STE has sole rights to procure in either the import or the domestic markets or in both, and it competes with private firms in one or both of these markets. The analysis below deals with the joint exclusive rights case and, to explore the effects of exclusive rights that arise in only one market, we also explore the case where the STE has exclusive rights over imports but it competes in the distribution of these imports with private firms that procure only from the domestic market.[11]

[11] While there are different permutations of exclusive rights and prohibitions that can apply, this is arguably one of the most common. As an example, the Japanese government have recently changed the pattern of exclusive rights that apply to imports of wheat and other commodities in Japan, from the case where the state trading enterprise was responsible for domestic procurement and imports to the situation that applies now where the STE has import rights over imports only. South Korea is another example of the use of STEs where exclusive rights over imports only typically apply.

There are two amendments to be made to the model outlined above. First, profits are now generated from the sale of domestically procured supplies and profits from the sale of imports. The aggregate profit function for the *i*th firm is:

$$\pi_i^{priv} = \pi_{h,i}^{priv} + \pi_{m,i}^{priv} = (p - p_h)q_{h,i}^{priv} + (p - p_m - t^e)q_{m,i}^{priv} \tag{10}$$

where the subscript *m* (*h*) relates to the import (domestic) market as the source of supply and where p_h is the inverse supply function for the domestic market with the same properties as those given for p_m (see equation (2)). The inverse demand function is $p = p(Q^{priv})$, where $Q^{priv} = \sum_{i=1}^{n}(q_{h,i}^{priv} + q_{m,i}^{priv})$. t^e is the implicit tariff equivalent that will be used to measure the trade distorting impact of the STE relative to the benchmark, where the benchmark continues to be an *n*-firm Cournot oligopoly/oligopsony.

Second, the maximand of the STE now changes. Not only are there two sources of profits, but given that domestic supply is now a feature of the model, the government may also care about re-distribution towards producers. To allow for this possibility, producer surplus is added to the pay-off function for the STE which is given by:

$$W = \alpha_c CS + \alpha_p PS + \pi_h^{STE} + \pi_m^{STE} \tag{11}$$

where α_c is the weight on consumer surplus relative to that on profits (as before) and α_p is the weight on producer surplus relative to that on profits. Reflecting the re-distributional aims of agricultural trade policy in developed (developing) countries, the relative weight on producers (consumers) will exceed that on consumers (producers). As above, a profit maximising STE would be characterised as one with $\alpha_p = \alpha_c = 0$.

In the benchmark, the representative private firm chooses $q_{h,i}^{priv}$ and $q_{m,i}^{priv}$ to maximise (10), the first-order conditions being given by:

$$\begin{aligned} p + (q_{h,i}^{priv} + q_{m,i}^{priv})p' - p_h - q_{h,i}^{priv}p_h' &= 0 \\ p + (q_{h,i}^{priv} + q_{m,i}^{priv})p' - p_m - q_{m,i}^{priv}p_m' - t^e &= 0 \end{aligned} \tag{12}$$

The *i*th firm, as before, exploits its buying and selling power by equating perceived marginal revenue with the perceived marginal procurement cost in each market. Aggregating over the *n* firms and re-arranging gives:

$$\begin{bmatrix} Q_h^{priv*} \\ Q_m^{priv*} \end{bmatrix} = \frac{n}{\Delta_B} \begin{bmatrix} p'_m - p' & p' \\ p' & p'_h - p' \end{bmatrix} \begin{bmatrix} p - p_h \\ p - p_m - t^e \end{bmatrix} \tag{13}$$

where $Q_h^{priv*} = \sum_{i=1}^{n} q_{h,i}^{priv*}$, $Q_m^{priv*} = \sum_{i=1}^{n} q_{m,i}^{priv*}$ and $\Delta_B = (p'_h - p')(p'_m - p') - (p')^2 > 0$.

Again, we assume that the second-order and stability conditions hold.

The STE chooses Q_h^{STE} and Q_m^{STE} to maximise (11), the first-order conditions being given by:

$$\begin{aligned} p + (Q_h^{STE} + Q_m^{STE})(1 - \alpha_c)p' - p_h - Q_h^{STE}(1 - \alpha_p)p'_h = 0 \\ p + (Q_h^{STE} + Q_m^{STE})(1 - \alpha_c)p' - p_m - Q_m^{STE} p'_m = 0 \end{aligned} \tag{14}$$

Note that if $\alpha_c = \alpha_p = 1$, then (14) can be re-written for the welfare-maximising STE as:

$$\begin{aligned} p - p_h = 0 \\ p - p_m - p'_m Q_m^{STE} = 0 \end{aligned} \tag{14′}$$

i.e., the STE will remove any domestic distortion (the domestic procurement price and the selling price being made equal) but it will take account of the terms of trade distortion in relation to imports (the selling price equalling marginal expenditure on imports) and this is its only source of its profits.

Re-arranging (14) gives:

$$\begin{bmatrix} Q_h^{STE*} \\ Q_m^{STE*} \end{bmatrix} = \frac{1}{\Delta_S} \begin{bmatrix} p'_m - (1 - \alpha_c)p' & (1 - \alpha_c)p' \\ (1 - \alpha_c)p' & (1 - \alpha_p)p'_h - (1 - \alpha_c)p' \end{bmatrix} \begin{bmatrix} p - p_h \\ p - p_m \end{bmatrix} \tag{15}$$

where $\Delta_S = [(1 - \alpha_p)p'_h - (1 - \alpha_c)p'][p'_m - (1 - \alpha_c)p'] - [(1 - \alpha_c)p']^2 > 0$. Note that both policy weights directly enter the expressions for the optimal quantity imported but only the consumer weight directly enters the expression for domestic procurement. However, both policy weights affect the determinant Δ_S. It is shown

below (equation (23)), that a change to the nature of the exclusive rights alters these relationships between the weights and the expressions for the optimal quantities by altering the structure of the matrix.

To derive the implicit tariff measure, set Q_m^{priv} from (13) equal to Q_m^{STE} from (15) and solve out for t^e. The result is given by:

$$t^e = \frac{(p-p_h)}{(p_h'-p')}\left\{p' - \frac{\Delta_B}{n\Delta_S}[(1-\alpha_c)p']\right\} + \frac{(p-p_m)}{(p_h'-p')}\left\{(p_h'-p') - \frac{\Delta_B}{n\Delta_S}[p_h'(1-\alpha_p) - p'(1-\alpha_c)]\right\} \tag{16}$$

It is difficult to sign (16) in its most complete form but, in principle, the trade effect of the STE will depend upon the redistributive bias in the STE's objective function and the competitiveness of the underlying benchmark against which the STE is compared. To explore the intuition, it is useful to assume a complete bias in favour of producers (consumers) while at the same time putting zero weight on consumer (producer) welfare and then to reverse these weights.

Assume initially that the government redistributes income to producers and does not care about consumers, then $\alpha_c = 0, \alpha_p = 1$. From (15) this would give a level of imports equal to:

$$Q_{m,p}^{STE*} = \frac{1}{-p_m'}(p_m - p_h) \tag{17}$$

where the subscript *p* denotes the producer surplus maximising case of the STE. Then $Q_{m,p}^{STE*} \geq 0$ if and only if $(p_m - p_h) \leq 0$; and $Q_{m,p}^{STE*} = 0$ otherwise. Given the assumed homogeneity of the two goods, this condition is intuitively obvious. Set (17) equal to the level of imports in the private benchmark (13) and solve out for t^e or, equivalently, set $\alpha_c = 0$ and $\alpha_p = 1$ in (16) and simplify. Either approach gives the implicit tariff equivalence as:

$$t_p^e = \frac{1}{(p_h'-p')}\left\{p'(p_m - p_h)[1 - \frac{p_h'(p_m'-p') - p_m'p'}{-p'p_m'n}] + p_h'(p-p_m)\right\} \tag{18}$$

If $(p_m - p_h) = 0$, then $t^e = p_h'(p-p_m)/(p_h'-p') > 0$ and this STE, which redistributes income towards producers, will inhibit trade and will act like a tariff. With the more realistic assumption that $(p_m - p_h) < 0$, a sufficient condition for the

tariff equivalence to be positive is that [.] > 0. With the denominator being positive, the sign of [.] depends on the sign of $-p'_m[p'_h+(n-1)p']+p'p'_h$, obtained after re-arranging terms. The greater is *n*, the more likely it is that this expression will be positive that [.] > 0 and, hence, that $t^e > 0$. Therefore, while some ambiguity remains about the sign of the tariff equivalence, it is probable that the STE will act as a tariff when it has a bias towards producers. Furthermore, the more competitive the benchmark, the more the tariff equivalence increases and the more trade distorting is this STE.

Consider now the case where the bias is towards consumers and the government attaches a zero weight to producer welfare. From (15), the level of imports is given by:

$$Q_{m,c}^{STE*} = \frac{1}{p'_m}(p - p_m) \tag{19}$$

where the subscript *c* denotes the bias towards consumers. With the government's bias in favour of consumers, imports are always positive. Following the same procedure as above, either set (19) equal to the level of imports from the private sector benchmark and solve for the tariff equivalent or set $\alpha_c = 1$ and $\alpha_p = 0$ in (16) and simplify, to give:

$$t_c^e = \frac{1}{(p'_h - p')}\left\{p'(p_m - p_h)+(p-p_m)[p'_h - \frac{\Delta_B}{np'_m}]\right\} \tag{20}$$

Suppose that $(p_m - p_h) = 0$. Then the sign of t_c^e is given by the sign of [.]. This expression can be re-written as $(np'_m)^{-1}[p'_h p'_m(n-1)+p'(p'_h+p'_m)]$ which is strictly negative if *n* = 1 but, otherwise, is ambiguous. However, the greater is *n*, the more likely it is that the tariff equivalence will be positive. Taking the more realistic case that $(p_m - p_h) < 0$, then the first term is positive and the larger is *n*, the more likely it is that the tariff equivalence (from the second term) will be positive and that the STE will restrict imports relative to this *n*-firm Cournot benchmark.

Finally, compare a profit maximising STE with the private benchmark. Now the only determinant of the tariff equivalence of the STE will be the number of competing firms in the benchmark. To see this, return to (16), set $\alpha_c = \alpha_p = 0$ and re-write it as:

$$t_{\pi}^{e} = \frac{1}{(p_h' - p')}[p'(p_m - p_h) + p_h'(p - p_m)](1 - \frac{1}{n}) \qquad (21)$$

with the subscript π denoting the profit maximising case. If $(p_m - p_h) = 0$, then the tariff equivalence of the STE is unambiguously positive for $n > 1$ and zero for $n = 1$. In the latter case, the two market structures are of course identical and there is no distortion of imports by the STE relative to those by the monopoly/monopsony benchmark. However, when the number of firms in the benchmark exceeds one, then the STE unambiguously restricts trade relative to the benchmark. When $(p_m - p_h) < 0$ and $n > 1$, the STE continues to act as a tariff compared with the benchmark. This outcome follows directly from the fact that in a Cournot model, industry output increases with the number of firms and because the profit-maximising STE is equivalent to a monopoly/monopsony. Thus, as n increases, so too does the difference between output in the n-firm benchmark and the unchanged output by the STE. Therefore, the implicit tariff has to increase to equate imports.

The results obtained from equation (16) can be illustrated through the following numerical example. Let the inverse demand function be $p = 3000 - 0.2(Q_h + Q_m)$; the inverse domestic supply function be $p_h = 500 + 0.1Q_h$; and the inverse import supply function be $p_m = 50 + 0.1Q_m$. Then the calculated values for t^e as a function of the policy weights are shown in Figure 1 for a counter-factual with n =3. While the tariff equivalence is calculated in specific form, the values are shown in Figure 1 in ad valorem equivalent form. The effect of n on t^e with fixed policy weights is shown in Figure 2.

FIGURES 1 AND 2 HERE

The surface in Figure 1 shows clearly that the tariff equivalence is a decreasing (and concave) function of the policy weight on consumers (α_c). This is intuitive because the greater this weight, the more the STE will import, especially given that $p_m < p_h$, and the size of the gap between its imports and those in the benchmark will narrow. On the other hand, the tariff equivalence is an increasing (and convex) function of the policy weight given to producers. Again, this is intuitive because the STE is forced at the margin to switch away from import procurement towards domestic procurement as the policy weight on producers increases. The effect of the number of firms in the

counter-factual on the sign and the size of the tariff equivalence is shown in Figure 2 for $\alpha_c = \alpha_p = 1$. For 'small' *n*, the sign switches from negative (import subsidy) to positive (tariff) and the size of the tariff equivalence is very sensitive to the value of *n*. That sensitivity declines as *n* becomes 'large'.

These observations are summarized in the following proposition:

Proposition 2: In the case of a state trading enterprise with joint exclusive rights, the tariff equivalence can be positive, negative or zero. However, in most instances the tariff equivalence will be positive and the STE will restrict imports when compared with the n-firm benchmark.

STE with Import Rights Only/Domestic Market with Private Firms

In the previous section, the effects on the tariff equivalence of the government's policy bias and the number of firms in the counter-factual have been investigated. The third factor that influences the tariff equivalence of an STE is the designation of its exclusive rights. Therefore, we now change the nature of exclusive rights that apply to the STE. The market still comprises a domestically-sourced good that competes with imports in the consumer market but the state trading enterprise now has exclusive rights to import only and it is not permitted to procure in the domestic market. The STE competes with *m* private firms for sales but these firms cannot purchase imports and are confined to procuring only from domestic producers. Employing (10), but noting that the representative private firm can now only choose $q_{h,i}$ to maximise profits from domestically-procured supplies and employing (11) for the STE, which can now choose only Q_m^{STE} to maximise weighted welfare from imported supplies, the first-order conditions are given by:

$$\begin{aligned} p - p_h - (p_h' - p')q_{h,i}^{priv} &= 0 \\ p - p_m - [p_m' - (1-\alpha_c)p']Q_m^{STE} &= 0 \end{aligned} \tag{22}$$

Aggregating over the *m* private firms and re-arranging, (22) can be re-written as:

$$\begin{bmatrix} Q_h^{priv*} \\ Q_m^{STE*} \end{bmatrix} = \frac{1}{\Delta_M} \begin{bmatrix} [p_m' - (1-\alpha_c)p'] & 0 \\ 0 & p_h' - p' \end{bmatrix} \begin{bmatrix} m(p - p_h) \\ p - p_m \end{bmatrix} \tag{23}$$

where $\Delta_M = (p'_h - p')[p'_m - (1-\alpha_c)p']$. Note now that the STE cannot directly influence producer surplus because of the absence of that component from its objective function.

Following the same procedure as above, set Q_m^{STE*} from (23) equal to Q_m^{priv*} from (13) and solve out for t^e. The implicit tariff equivalent in this case is given by:

$$t^e_{MO} = \frac{p'(p - p_h)}{p'_h - p'} + (p - p_m)\left[1 - \frac{\Delta_B}{n\Delta_{MO}}\right] \tag{24}$$

where the subscript *MO* denotes the case of exclusive rights over imports only. The sign of the first term is negative and that of the second is positive. The numerator of the term in square brackets can be re-written using the definition of Δ_{MO} as

$$\frac{(p'_h - p')[(n-1)(p'_m - p') - \alpha_c p'] + (p')^2}{n\Delta_{MO}}$$

which is always positive. However, it is not obvious what the sign of t^e_{MO} will be as α_c and *n* vary.

The numerical example already used above can be used to explore these effects of α_c, *n* and *m* on the tariff equivalence of the import-only STE. The results are shown in Figure 3 where, in order to keep the total number of firms in each case identical, we set $n = m + 1$. The size of the tariff equivalence is a decreasing (but now convex) function of the policy bias towards consumers. Its sign may be positive or negative depending upon the values of α_c and *m*. It is an increasing (and again concave) function of the number of domestic firms (*m*). In general, this STE acts as a tariff compared with a *n*-firm counter-factual, unless the policy weight on consumers is 'high' and *m* and *n* are 'small' in which instance it acts as an import subsidy.

FIGURE 3 HERE

These observations are summarised in the following proposition.

Proposition 3: In the case where the STE has exclusive rights over imports only and it competes with private firms that procure only from domestic suppliers, the tariff equivalence can be positive, zero or negative. The less weight on consumer welfare and the more competitive the underlying counter-factual benchmark, the greater is the tariff equivalence and the higher the import-restricting effect of the STE.

In sum, the above analysis confirms that state trading enterprises do have the potential to distort trade and to act in a manner similar to an import tax/subsidy. However, the sign and magnitude of the trade distortion caused by the STE has been shown to depend on three factors: first, the nature of the exclusive rights that apply (i.e., whether they apply to domestic procurement and imports or to imports only); second, the re-distributive bias in the STE's objective function; and third, the competitiveness of the underlying benchmark as measured by *n*.

3. Re-Distribution, State Trading and Optimal Tariffs

In section 2, it has been established that, in general, an STE will distort a country's imports when compared with the situation in which imports under procured by an *n*-firm Cournot oligopsony/oligopoly. This finding suggests that if there were an argument in support of an optimal tariff in this private firm benchmark, then that argument might need to be modified for a market structure that, instead, was an STE, the exact modification being dependent upon the re-distributive intent of government policy, the designation of exclusive rights and the size of *n* in the benchmark.

In the case of the private firm benchmark, it is conventional to assume that the use of the optimal tariff is designed to maximise welfare and it is typically assumed that the government has only one trade instrument at hand to do so. However, when a state trading enterprise is employed, there is an additional policy instrument, namely, the government's explicit manipulation of market structure through the STE. In this section, we explore formally whether the presence of the STE amends the argument for, and the sign and size of, the optimal tariff.

Intuitively, it is straightforward to understand why the existence of a state trading enterprise could influence the case for the optimal tariff.[12] In the standard private sector case, the government selects the optimal tariff knowing that the firms maximise profit. The firms choose quantities subject to the choice of this tariff. When an STE is employed, the government decides on the exclusive rights to give the STE and it then decides on the re-distributive aims of policy which, in turn, define the objective of the

[12] Recall that we are dealing with domestic firms that procure from the world market rather than foreign firms that sell in the domestic market. The role of the latter has been dealt with in the trade policy literature where the tariff may be used to extract rent from the foreign firm(s). See, for example, Brander and Spencer (1984) and references therein.

STE. The optimal tariff faced by the STE is contingent on this preceding determination of market structure. Given the analysis in the previous section, it is known that the STE will distort trade and have an effect equivalent to an import tax or an import subsidy. Thus, it is conjectured that the optimal tariff will play a more marginal role in the STE environment than it does in the standard private firm case. In some instances, the tariff may even be redundant – the STE acting as a perfect substitute for it.

To evaluate this conjecture, the analysis can be considered as a three-stage game. In the first stage, the government decides on market structure: an *n*-firm Cournot oligopsony/oligopoly or an STE (and the exclusive rights that will apply to the STE). In the second stage, it decides on the weights to be given to consumers, producers and profits in its (the government's) welfare function. In the third stage, the firms or the STE, depending upon the government's choice of market structure, maximise their respective objective functions. As is conventional, the model is solved in reverse order, i.e., the firms or the STE solve their optimisation problem given the size of the tariff.

(i) Import Procurement Only

Consider first of all the private benchmark ((equations (1), (2) (6) and (7)). The government is assumed to maximise a welfare function comprising consumer surplus, profits and tariff revenue through its choice of a specific tariff, *t*. In order to allow for an objective of re-distribution, as well as one solely of welfare maximisation in the conventional sense, the welfare function is weighted and given by:

$$W_{priv} = \alpha_c CS + \pi + tnq = \alpha_c[\int_0^{nq} p(z)\mathrm{d}z - p(nq)] + (p - p_m - t)(nq) + t(nq) \qquad (25)$$

where q is the quantity of imports procured by the representative firm.[13]

Totally differentiating (25) gives:

[13] To keep the discussion on the role of the relative weights consistent with previous sections, in this specification, it has been assumed that profits and tariff revenue each receive a weight of unity. Of course, this need not be the case and tariff revenue, just as with consumer surplus, could receive a smaller weight and we could explore the role of revenue maximizing tariffs. This, however, is not pertinent to the issues explored here and is therefore left aside.

$$\begin{aligned} \mathrm{d}W_{priv} &= \alpha_c[pn\mathrm{d}q - p'(nq)\mathrm{d}q - pn\mathrm{d}q] + (p' - p'_m)(nq)\mathrm{d}q + (p - p_m)n\mathrm{d}q \\ &= n\mathrm{d}q[p'(1-\alpha_c)q - p'_m q + p - p_m] \end{aligned}$$

Dividing through by $\mathrm{d}t$, making use of the first-order conditions (equation (8)) to substitute out $(p - p_m - p'_m q^*)$, and setting $\mathrm{d}W/\mathrm{d}t = 0$, gives:

$$\frac{\mathrm{d}W_{priv}}{\mathrm{d}t} = n(t - p'q^*\alpha_c)\frac{\mathrm{d}q^*}{\mathrm{d}t} = 0\,.$$

where q^* is the optimal quantity imported. Now, from equation (7), $\mathrm{d}q^*/\mathrm{d}t \neq 0$ and, with $n \geq 1$, the optimal tariff is:

$$t^o_{priv} = p'q^*\alpha_c \tag{26}$$

From (26), the sign of t^o_p is unambiguously negative (unless $\alpha_c = 0$), implying that the optimal intervention is always an import subsidy, the size of which depends upon the policy weight: the greater is that weight, the larger is the import subsidy. If the policy weight is one, then the welfare maximum occurs at $t^o_{priv} = p'q^*$. If the government chooses to be concerned only with profits (and tariff revenue) and not with consumer surplus, then $\alpha_c = 0$ and the optimal setting of the tariff is zero. In this case, the private firm(s) are already exploiting their market power and if the government does not 'care' about consumers, it will not pay a subsidy to encourage imports in order to increase consumer surplus. On the other hand, if there is a policy bias towards consumers, the government will want more to be procured than the profit-maximising private firms will import and to encourage them to increase imports, an import subsidy is necessary.

Suppose now that only an STE operates (equations (1), (2) (3) and (4)). As before, the government is assumed to maximise a weighted welfare function, which is defined here as:

$$W_{STE} = \alpha_c[\int_0^{Q^{STE}} p(z) - pQ^{STE}] + (p - p_m - t)Q^{STE} + tQ^{STE} \tag{27}$$

Totally differentiating (27) gives:

$$\mathrm{d}W_{STE} = \mathrm{d}Q^{STE}[p'Q^{STE}(1-\alpha_c) - p'_m Q^{STE} + p - p_m]\,,$$

then dividing by $\mathrm{d}t$, setting $\mathrm{d}W/\mathrm{d}t = 0$ and making use of the first-order condition (equation (4) with the term p_m replaced with $p_m + t$) to substitute out $(p - p_m - p'_m Q^{STE})$ gives:

$$\frac{\mathrm{d}W_{STE}}{\mathrm{d}t} = \frac{\mathrm{d}Q^{STE*}}{\mathrm{d}t}(t) = 0 \tag{28}$$

From equation (5) with p_m replaced with $p_m + t$, $\mathrm{d}Q^{STE*}/\mathrm{d}t \neq 0$ and, therefore, the optimal tariff faced by the STE is $t^o_{STE} = 0$. Thus, if an STE has sole rights to import, then it attains the government's objective on its own because the policy weight is already built into its objective function (see equation (3)) and its first-order condition (equation (4)). Therefore, there is no need for the additional policy instrument. As a consequence, in the case where there is no domestic market for procurement, the optimal tariff is zero, no matter the weight on consumer welfare. These insights are summarised in the following proposition:

Proposition 4: In the case where there is no domestic procurement, if the government cares about consumer welfare (i.e., when $\alpha_c > 0$) the optimal tariff facing private firms is negative, and it is zero otherwise ($\alpha_c = 0$). In the presence of a state trading enterprise, the optimal tariff is zero whatever the weight on consumer welfare – the STE is a perfect substitute for the optimal tariff.

(ii) Domestic Procurement and Imports

(a) Optimal Tariffs in the Private Firm Benchmark

Consider now the more complex situation in which there is domestic procurement, imports, and third-degree price discrimination (see equations (12) and (13)). Note that, in contrast with the conventional literature on optimal tariffs with oligopoly, there is no rent-shifting between domestic and foreign firms in this benchmark because the domestic firms are responsible for both domestic procurement and imports. We define the welfare function that the government maximises to allow for the possibility that it may want to set the tariff to re-distribute income between consumers, producers and profits rather than only to maximise welfare through setting $\alpha_c = \alpha_p = 1$, as is conventional.

Let the welfare function in the benchmark be:

$$W_{priv} = \alpha_c[\int_0^{nq_h+nq_m} p(z)d(z) - pnq_h - pnq_m] + \alpha_p[p_h nq_h - \int_0^{nq_h} p_h(v)d(v)] \\ + (p - p_h)nq_h + (p - p_m - t)nq_m + tnq_m \tag{29}$$

Totally differentiating (29) gives:

$$\mathrm{d}W_{priv} = n\mathrm{d}q_h[p'q_h(1-\alpha_c) - p_h'q_h(1-\alpha_p) + (p - p_h)] \\ + n\mathrm{d}q_m[p'q_m(1-\alpha_c) + (p - p_m - p_m'q_m)]$$

Dividing through by dt, making use of the first-order conditions in (12) to substitute out $(p - p_h)$ and $(p - p_m - p_m'q_m)$, and equating $\mathrm{d}W/\mathrm{d}t$ to zero, allows the optimal tariff to be expressed as:

$$t^o_{priv} = p'(q_h^* + \alpha_c q_m^*) + [q_h^*(\alpha_c p' - \alpha_p p_h') + p'q_m^*]\left(\frac{\mathrm{d}q_h^*/\mathrm{d}t}{\mathrm{d}q_m^*/\mathrm{d}t}\right)$$

To evaluate the sign of $\left(\frac{\mathrm{d}q_h^*/\mathrm{d}t}{\mathrm{d}q_m^*/\mathrm{d}t}\right)$, totally differentiate the first-order conditions (12).

To keep the insights tractable, assume that $p'' = p_h'' = p_m'' = 0$ (i.e., linearity). After re-arranging, we get:

$$\begin{bmatrix} \mathrm{d}q_h^*/\mathrm{d}t \\ \mathrm{d}q_m^*/\mathrm{d}t \end{bmatrix} = \frac{1}{\Delta_B}\begin{bmatrix} p_m' - p' & p' \\ p' & (p_h' - p') \end{bmatrix}\begin{bmatrix} 0 \\ -1 \end{bmatrix} \tag{30}$$

Then:

$$\theta \equiv \left(\frac{\mathrm{d}q_h^*/\mathrm{d}t}{\mathrm{d}q_m^*/\mathrm{d}t}\right) = \frac{-p'}{p' - p_h'} \text{ , with } -1 < \theta < 0$$

and

$$t^o_{priv} = p'(q_h^* + \alpha_c q_m^*) + [q_h^*(\alpha_c p' - \alpha_p p_h') + p'q_m^*]\theta \tag{31}$$

The sign of the optimal tariff in (31) is ambiguous: the first term is negative but the term, [.]θ, is positive.

To provide insights into the role played by each of the policy weights, we begin where these weights are zero. At $(\alpha_c, \alpha_p) = (0, 0)$, the optimal tariff, from (31), is:

$$t^o_{priv} = p'(q_h^* + \theta q_m^*)$$

With the government assuming that firms will maximise profits from the two sources of procurement, the tariff will be set to equalise perceived marginal expenditure on domestically procured input and on imports:

$$t = p_h + q_h^* p_h' - p_m - q_m^* p_m'$$

In what follows, we assume that the marginal expenditure function for domestic procurement of the homogeneous good lies above that for imports in the neighbourhood of equilibrium. Then marginal expenditure on domestic procurement is greater than that on imports and:

$$t^o_{priv}(0, 0) = p'(q_h^* + \theta q_m^*) > 0 \tag{32}$$

which implies, since $p' < 0$, that $(q_h^* + \theta q_m^*) < 0$ or $q_m^* / q_h^* > -1/\theta$, i.e., that imports exceed domestically-procured input by a certain proportion. With the ratio of imports to domestically procured input below this critical value, an import subsidy would be the optimal policy for the government that is not at all concerned about consumers and producers.

We now want to investigate the direction of change in the optimal tariff when the policy weights individually increase from zero. These directions are given by:

$$\frac{\partial t^o_{priv}(0, 0)}{d\alpha_c} = p'(q_m^* + q_h^*\theta); \text{ and } \frac{\partial t^o_{priv}(0, 0)}{\partial \alpha_p} = -p_h' q_h^* \theta \tag{33}$$

Focussing first on the effect of increasing the weight on consumer surplus, from (32), with $q_m^* / q_h^* > -1/\theta$ then:

$$q_m^* + \theta q_h^* = q_h^*(q_m^* / q_h^* + \theta) > q_h^*(-1/\theta + \theta) = q_h^*(-1 + \theta^2)/\theta$$
$$\therefore p'(q_m^* + \theta q_h^*) < p' q_h^*[(-1 + \theta^2)/\theta] < 0$$
$$\text{and } \frac{\partial t^o_{priv}(0, 0)}{d\alpha_c} < 0$$

With the optimal tariff positive at $(\alpha_c, \alpha_p) = (0, 0)$, as the policy weight on consumer surplus increases, the size of this tariff decreases and it may become negative. Evaluating the optimal tariff at $(\alpha_c, \alpha_p) = (1, 0)$, from (31):

$$t^o_{priv}(1, 0) = p'(q_h^* + q_m^*) + [q_h^* p' + q_m^* p']\theta$$
$$= p'(1 + \theta)(q_h^* + q_m^*) < 0$$

Therefore, as the policy weight on consumers increases from zero to one, the size of the optimal tariff diminishes and it becomes an import subsidy, the size of which increases with α_c.

With respect to the weight on producer surplus, from (33) its size increases with the weight given to producers. At the point, $(\alpha_c, \alpha_p) = (0, 1)$, from (31), the optimal tariff is:

$$t^o_{priv}(0,1) = p'(q^*_h + \theta q^*_m) - p'_h q^*_h \theta$$

the sign of which of which is positive, the first term being positive from (32). Therefore, the optimal tariff remains positive as the policy bias towards producers increases.

The final point at which we evaluate the sign of the optimal tariff is $(\alpha_c, \alpha_p) = (1, 1)$. From (31):

$$t^o_{priv}(1,1) = q^*_h[\theta(p' - p'_h) + p'] + p' q^*_m(1+\theta)$$

Using the definition of θ in the square brackets makes the first term zero, so that:

$$t^o_{priv}(1,1) = p' q^*_m(1+\theta) < 0$$

i.e., the welfare maximising government would use an import subsidy.

The nature of the optimal tariff surface can be obtained from the second derivatives of (31) with respect to α_c and α_p. It can be shown that they are, respectively:

$$\frac{\partial^2 t^o_{priv}(\alpha_c, \alpha_p)}{\partial \alpha_c^2} = 0 \text{ and } \frac{\partial^2 t^o_{priv}(\alpha_c, \alpha_p)}{\partial \alpha_p^2} = 0$$

Therefore, the optimal tariff surface is a plane that is tilted downwards in the α_c direction and upwards in the α_p direction.

The numerical example used previously can be used again here to generate the surface of the optimal tariff as a function of the policy weights for a given number of firms. Assume as before that n = 3. The resulting surface is shown in Figure 4. The characteristics of that surface are consistent with the theoretical results just obtained for the value of the optimal tariff at each of the four points $(\alpha_c, \alpha_p) = (0,0), (1,0), (0,1)$ and $(1,1)$.

FIGURE 4 HERE

These observations are summarised in the following proposition:

Proposition 5: In the case of private firms with two sources of procurement, the optimal tariff can be negative, zero or positive, the sign depending on the government's relative bias towards/against producer and consumer welfare and the associated ratio of imports to domestic procurement. The greater (smaller) is the weight on consumers and the smaller (greater) the weight on producers, the more likely it is that the optimal intervention will be an import subsidy (tariff).

(b) Optimal Tariffs with a State Trading Enterprise with Joint Exclusive Rights

Let the government choose the tariff to maximise weighted welfare, as given by:

$$W_{STE,JR} = \alpha_c[\int_0^{Q_h^{STE}+Q_m^{STE}} p(z)\mathrm{d}z - pQ_h^{STE} - pQ_m^{STE}] + \alpha_p[p_hQ_h^{STE} - \int_0^{Q_h^{STE}} p_h(v)\mathrm{d}v] \\ +(p-p_h)Q_h^{STE} + (p-p_m-t)Q_m^{STE} + tQ_m^{STE} \tag{34}$$

Totally differentiating, dividing through by $\mathrm{d}t$, making use of (14), with p_m replaced with $p_m + t$, to substitute out $(p - p_h)$ and $(p - p_m - p'_mQ_m^{STE})$, and simplifying, gives:

$$t^o_{STE,JR} = p'(1-\alpha_c)[Q_h^{STE*} + Q_m^{STE*}\left(\frac{\mathrm{d}Q_h^{STE*}/\mathrm{d}t}{\mathrm{d}Q_m^{STE*}/\mathrm{d}t}\right)]$$

The first-order conditions for the STE were given by equation (14), as now modified by replacing p_m with $p_m + t$. Totally differentiating these expressions, setting $p'' = p''_h = p''_m = 0$ and inverting, gives:

$$\begin{bmatrix}\mathrm{d}Q_h^{STE*}/\mathrm{d}t \\ \mathrm{d}Q_m^{STE*}/\mathrm{d}t\end{bmatrix} = \frac{1}{\Delta_1}\begin{bmatrix}2p'_m-(2-\alpha_c)p' & (2-\alpha_c)p' \\ (2-\alpha_c)p' & (2-\alpha_p)p'_h-(2-\alpha_c)p'\end{bmatrix}\begin{bmatrix}0 \\ -1\end{bmatrix} \tag{35}$$

from which $\phi \equiv \left(\frac{\mathrm{d}Q_h^{STE*}/\mathrm{d}t}{\mathrm{d}Q_m^{STE*}/\mathrm{d}t}\right) = \frac{-(2-\alpha_c)p'}{(2-\alpha_c)p'-(2-\alpha_p)p'_h}$, with $-1 < \phi < 0$.

Making this substitution gives the optimal tariff as:

$$t^o_{STE,JR} = p'(1-\alpha_c)[Q_h^{STE*} + \phi Q_m^{STE*}] \tag{36}$$

Focus first on the relationship between the optimal tariff and the policy bias. Assume as before that marginal expenditure on domestic procurement is greater than that on import procurement in the neighbourhood of equilibrium. Then it follows that $t^o_{STE,JR} > 0$, $(Q_h^{STE*} + \phi Q_m^{STE*}) < 0$, and $\frac{Q_m^{STE*}}{Q_h^{STE*}} > -\frac{1}{\phi}$, where $\phi = \theta$ at $(\alpha_c, \alpha_p) = (0, 0)$.

The effect of increasing the weights on the size of the optimal tariff is given from (36) by:

$$\frac{\partial t^{o}_{STE,JR}}{\partial \alpha_c} = -p'(Q_h^{STE*} + \phi Q_m^{STE*}) - \frac{(p')^2(1-\alpha_c)Q_m^{STE*}p_h'(2-\alpha_p)}{[p'(2-\alpha_c) - p_h'(2-\alpha_p)]^2}; \text{ and}$$

$$\frac{\partial t^{o}_{STE,JR}}{\partial \alpha_p} = \frac{(p')^2 p_h'(1-\alpha_c)(2-\alpha_c)Q_m^{STE*}}{[p'(2-\alpha_c) - p_h'(2-\alpha_p)]^2}$$

At $(\alpha_c, \alpha_p) = (0, 0)$, these expressions simplify to:

$$\frac{\partial t^{o}_{STE,JR}(0,0)}{\partial \alpha_c} = -p'(Q_h^{STE*} + \theta Q_m^{STE*}) - 0.5\theta^2 Q_m^{STE*} p_h'; \text{ and}$$

$$\frac{\partial t^{o}_{STE,JR}(0,0)}{\partial \alpha_p} = 0.5\theta^2 Q_m^{STE*} p_h'$$

The first of these equations is negative, because $(Q_h^{STE*} + \theta Q_m^{STE*}) < 0$, while the second is positive. Therefore, beginning at $(\alpha_c, \alpha_p) = (0, 0)$, the optimal tariff decreases with α_c and it may become negative for some values of the policy weight. At the point $(\alpha_c, \alpha_p) = (1, 0)$, the optimal tariff, from (36), is zero. However, as shown below in Figure 4, the relationship between $t^{o}_{STR,JR}$ and α_c is not necessarily monotonic and the optimal policy could be an import subsidy over some range of values of α_c.

Beginning again at $(\alpha_c, \alpha_p) = (0, 0)$, increasing α_p and moving to the point $(\alpha_c, \alpha_p) = (0, 1)$, the optimal tariff, from (36), is:

$$t^{o}_{STE,JR}(0,1) = p'(Q_h^{STE*} + \phi_{\alpha_p} Q_m^{STE*}), \text{ where } \phi_{\alpha_p} \text{ is } \phi \text{ with } \alpha_c = 0$$

the sign of which is positive but it decreases in size from $t^{o}_{STE,JR}(0,0)$ because $\partial Q_h^{STE*}/\partial \alpha_p > 0$, $\partial Q_m^{STE*}/\partial \alpha_p < 0$ and $\partial \phi / \partial \alpha_p < 0$. However, making use of (15) and ϕ evaluated at $(\alpha_c, \alpha_p) = (0, 1)$, it can be shown that $t^{o}_{STE,JR}(0,1) > 0$, the optimal intervention remains a tariff.

The nature of the optimal tariff surface for the STE can be judged from the second derivatives of (36) with the respect to the policy weights. It can be shown that:

$$\frac{\partial^2 t^o_{STE,JR}(\alpha_c,\alpha_p)}{\partial \alpha_c^2} > 0 \text{ and } \frac{\partial^2 t^o_{STE,JR}(\alpha_c,\alpha_p)}{\partial \alpha_p^2} < 0$$

Thus, the surface is decreasing and convex in the consumer direction and decreasing and concave in the producer direction.

The numerical example (Figure 5) illustrates the negative relationship between the optimal tariff rate and the policy bias towards consumers and its non-monotonic nature. The negative relationship between the optimal tariff rate and the policy bias towards producers is also illustrated as well as the possibility that the optimal intervention may be an import subsidy.

FIGURE 5 HERE

The following proposition summarises the role of the optimal tariff in the presence of an STE with joint exclusive rights:

Proposition 6: In the presence of a state trading enterprise with joint exclusive rights, the optimal tariff may be negative, zero or positive. For a consumer-welfare maximising STE, the optimal tariff is zero. When there is a bias towards either consumers' or producers' welfare, the sign of the optimal tariff is ambiguous.

(c) Optimal Tariffs with the STE with Import Rights Only

In this case, the extent of the exclusive rights has diminished with the STE having sole rights over imports only and competing with *m* private firms that procure only from domestic suppliers. As above, the government chooses the optimal tariff to maximise weighted welfare, the objective function being given by:

$$W_{STE,MO} = \alpha_c[\int_0^{mq_h+Q_m^{STE,MO}} p(z)\mathrm{d}z - p(mq_h) - p(Q_m^{STE,MO})] + \alpha_p[p_h(mq_h) - \int_0^{mq_h} p_h(v)\mathrm{d}v]$$
$$+ (p - p_h)mq_h + (p - p_m - t)Q_m^{STE,MO} + tQ_m^{STE,MO} \tag{37}$$

Totally differentiating, dividing through by $\mathrm{d}t$ and using equations (22), with p_m replaced with $p_m + t$, to substitute out $(p - p_h)$ and $p - p_m - p'_m Q_m^{STE,MO}$ gives:

$$t^o_{MO} = mq_h^{priv*}(p'\alpha_c - p'_h\alpha_p)\left(\frac{\mathrm{d}q_h^{priv}/\mathrm{d}t}{\mathrm{d}Q_m^{STE,MO}/\mathrm{d}t}\right) \tag{38}$$

The last term in parentheses can be evaluated from totally differentiating the first-order conditions (22), setting $p'' = p''_h = p''_m = 0$ and inverting, to get:

$$\begin{bmatrix} \mathrm{d}q_h^{priv}/\mathrm{d}t \\ \mathrm{d}Q_m^{STE,MO} \end{bmatrix} = \frac{1}{\Delta_2}\begin{bmatrix} p'(2-\alpha_c)-2p'_m & -p' \\ -mp' & (m+1)(p'-p'_h) \end{bmatrix}\begin{bmatrix} 0 \\ 1 \end{bmatrix} \tag{39}$$

where $\Delta_2 = [(m+1)(p'-p'_h)][(2-\alpha_c)p'-2p'_m]-m(p')^2 > 0$.

Then, $\left(\frac{\mathrm{d}q_h^{priv}/\mathrm{d}t}{\mathrm{d}Q_m^{STE,MO}/\mathrm{d}t}\right) = \frac{-p'}{(m+1)(p'-p'_h)} < 0$, where $-1 < \left(\frac{\mathrm{d}q_h^{priv*}/\mathrm{d}t}{\mathrm{d}Q_m^{STE,MO*}/\mathrm{d}t}\right) < 0$.

Equation (38) is unambiguously positive and the size of the optimal tariff depends upon the number of private firms in the domestic market, *m*, and the values taken by the policy weights. Differentiating (38) partially with respect to each of these parameters gives:

$$\frac{\partial t^o_{MO}}{\partial m} = \frac{-p'q_h(p'\alpha_c - p'_h\alpha_p)}{(m+1)^2(p'-p'_h)} > 0$$

$$\frac{\partial t^o_{MO}}{\partial \alpha_c} = \frac{-(p')^2 mq_h}{(m+1)(p'-p'_h)} > 0$$

$$\frac{\partial t^o_{MO}}{\partial \alpha_p} = \frac{p'\,p'_h\,m\,q_h}{(m+1)(p'-p'_h)} > 0$$

Therefore, an increase in the in the policy weights or in the number of domestic firms increases the size of the optimal tariff. Figure 6 represents the properties of the optimal tariff for the import only case.

FIGURE 6 HERE

In sub-sections (ii)(a) and (ii)(b), the private firms and the STE, respectively, were able to price discriminate between imports and domestic procurement since it was the same entity that could gain access to both sources of supply. This discrimination introduced an ambiguity about the sign of the optimal trade intervention, i.e., an import subsidy or a tariff. In this sub-section where the domestic firms and the STE co-exist but where each entity is confined to procuring from a single source, the market structure prevents such discrimination and, in doing so, removes the ambiguity. The optimal intervention is a tariff imposed on the STE, the size of which depends in part on the level of domestic procurement by the private firms, mq_h.

The role of the optimal tariff in this characterisation of the STE is summarised below:

Proposition 7: When the state trading enterprise has exclusive rights over imports only and is excluded from domestic procurement, the optimal tariff is always positive, no matter the size of m or the relative weights on producer or consumer welfare.

(d) The Size of the Optimal Tariff in the Presence of an STE

While the presence of a state trading enterprise has been shown in sub-sections (ii)(b) and (ii)(c) to influence the case for, and the magnitude and sign of, an optimal tariff, there remains to be investigated the relationship between the optimal tariff and the tariff equivalence that arises due to the presence of the STE. Specifically, we would wish to know whether the trade distortion arising from the employment of the STE causes the optimal tariff to increase or to decrease relative to its value when there are only private, profit-maximising firms.

To obtain some insights into this relationship, it is most useful to compare the optimal tariff outcomes in the private firm case and the STE case when the designation of exclusive rights that apply mirror the role of the private firms in the counterfactual. This confines the comparison to the cases where there is (i) no domestic source of procurement and (ii) where there is domestic procurement and the STE has joint rights.

Taking first the case where there is no domestic procurement, the optimal tariff, when there are private firms, is given by equation (26). As noted, this tariff is negative if $0 < \alpha_c \leq 1$ or zero if $\alpha_c = 0$. When there is an STE, the corresponding optimal tariff (derived from equation (27)) is always zero no matter the weight on consumer welfare. Thus, in this case of no domestic procurement, the use of the STE is a perfect substitute for the optimal tariff because the government has already been built into the objective function of the STE its policy objective.

Consider second the case where the private firms can procure from both imports and the domestic market. The government sets an optimal tariff, which may also reflect re-distribution, that tariff being either positive, zero or negative (see equation (31) and Proposition 4). When there is an STE, the optimal tariff may also be positive, zero or negative (see equation (36) and Proposition 5). To compare the optimal tariffs between these two cases, we make use of their respective values at the four extreme

points evaluated earlier and, know that shape the optimal tariff surface for each, we can conjecture about the differences in the size of the optimal tariff between these two market structures.

For the private firms, from (31), the optimal tariff is $t^o_{priv} = p'(q^*_h + \theta q^*_m) > 0$ and for the STE, from (36), the optimal tariff is $t^o_{STE,JR} = p'[Q^{STE*}_h + \phi Q^{STE*}_m] > 0$. Then the difference between these optimal tariffs is:

$$t^o_{priv}(0,0) - t^o_{STE,JR}(0,0) = p'(q^*_h + \theta q^*_m) - p'[Q^{STE*}_h + \phi Q^{STE*}_m] \quad (40)$$

Now at $\alpha_c = \alpha_p = 0$, $\phi = \theta$. Then (40) becomes:

$$t^o_{priv}(0,0) - t^o_{STE,JR}(0,0) = p'(q^*_h - Q^{STE*}_h) + \theta(q^*_m - Q^{STE*}_m) \quad (41)$$

But from equations (13) and (15), if $n = 1$:

$$q^*_h = Q^{STE*}_h \text{ and } q^*_m = Q^{STE*}_m$$

Therefore, $t^o_{priv}(0,0) - t^o_{STE,JR}(0,0) = 0$ for $n = 1$. However, if $n > 1$, then $t^o_{priv}(0,0) - t^o_{STE,JR}(0,0) > 0$.

We know that in the consumer direction, the optimal tariff surface for the benchmark is linear, decreasing and is negative at (1, 0) (see Figure 4). On the other hand, the optimal tariff surface for the STE with joint exclusive rights is convex, decreasing and is zero at (1, 0) (see Figure 5). It is probable that the optimal tariff function for the benchmark will lie below that of the STE and that $t^o_{priv}(\alpha_c, 0) - t^o_{STE,JR}(\alpha_c, 0) < 0$. In the producer direction, the optimal tariff surface for the benchmark is linear, increasing and it remains positive. On the other hand, the optimal tariff surface of the STE is concave and decreasing (see Figure 5). It is probable that the optimal tariff function for the benchmark will lie above that of the STE and that $t^o_{priv}(0, \alpha_p) - t^o_{STE,JR}(0, \alpha_p) > 0$.

The difference between the optimal tariff in the benchmark case and the STE joint rights case is shown more clearly in Figures 7 and 8 (using the same values used to derive the previous figures). In Figure 7, the optimal tariff for the STE case is positive for low values of α_c and declines as the weight on consumer welfare decreases. But it

is always positive and when $\alpha_c = 1$, the optimal tariff is zero. However, in the benchmark case, if the government is concerned about re-distribution towards consumers, the optimal tariff 'quickly' becomes a subsidy. The reason for this difference is that the STE is already capturing the re-distributive component in its objective function leaving less of a role for the optimal tariff to fulfil this objective. Figure 8 shows the outcome for the case when the bias is towards producers and again it is clear that the optimal tariff is lower in the STE case.

FIGURES 7 AND 8 HERE

As these derivations highlight, when the STE is employed, the case for the use of an optimal tariff (either positive or negative) is amended. Indeed, in certain cases, there is no need for the use of an optimal tariff at all. The reason for this amendment relates to the underlying implicit trade distortions that arise from the STE. From a theoretical perspective, the use of the STE changes the sequencing of the setting of the optimal tariff; since the timing now relates to the government making decisions over the manipulation of market structure and the re-distributive aims of the STE which precede the timing of the setting of the optimal tariff. These earlier stages in the timing of the interaction between the government and the private firms/STE result in the case for, and/or magnitude of, the optimal tariff being affected. These observations are summarised in the following proposition:

Proposition 8: *The implicit trade distorting effect of the STE influences the case for (and magnitude of) the optimal tariff. Since the STE can affect market access, the optimal tariff has only a marginal role to play as an instrument in maximising weighted welfare rather than the sole role that it has in the benchmark. The precise relationship between the STE and the optimal tariff will depend on the characterisation of exclusive rights and the relative weights in the government's objective function.*

4. Summary and Conclusions

State trading enterprises are widely used to manage trade and they are particularly prevalent in agricultural trade. They involve not only some of the major agricultural exporters and importers but also a large number of more minor participants in trade, especially among developing countries. Despite their widespread use, little attention has been paid in the research literature to their potential to distort trade. This paper has focussed on STEs used by importing countries and has analysed the conjecture offered by Meade (1955) that state trading enterprises act as implicit barriers to trade.

Given the explicit manipulation of market structure that arises through the allocation of exclusive rights and the asymmetry between the objectives of the STE and private firms, the use of STEs can in turn influence the case for, and the sign and magnitude of, the optimal tariff.

The theoretical model outlined here has highlighted those features of STEs that distinguish them from private, profit-maximising firms. These features are the exclusive rights that apply (in accordance with the WTO definition of an STE) and their re-distributive aims. It has been shown, through deriving expressions for their tariff equivalence, that STEs can be trade distorting and affect market access in a manner similar to the more conventional and transparent trade policy instruments of tariff and import subsidies..

The overall policy insight that arises from this paper is that by focussing on conventional trade policy instruments and ignoring the role of state trading enterprises, trade negotiators are oblivious to their interaction. In the presence of an STE, a reduction in a tariff may not necessarily result in an increase (or as much of an increase) in market access as trade negotiators would expect because of the implicit tariff effect of the STE. As such, it is desirable that state trading enterprises should be subject to stricter WTO disciplines and accepted as non-tariff barriers in those situations in which they restrict imports. By symmetry, in those situations in which an STE implicitly subsidises imports, it is attracting additional flows of imports to the detriment of other importing countries through raising the international price.

The issue of state trading deserves further research. State trading enterprises can vary by type (i.e., in the characterisation of exclusive rights) and purpose. With regard to the latter, we have considered the role of re-distribution, which fits broadly with the characterisation of agricultural policies in both developed and developing countries. However, as noted in OECD (2001), the stated intent of STEs do vary considerably across countries and across sectors and, as such, further investigation of their objectives and their interaction with other policy instruments warrants further attention.

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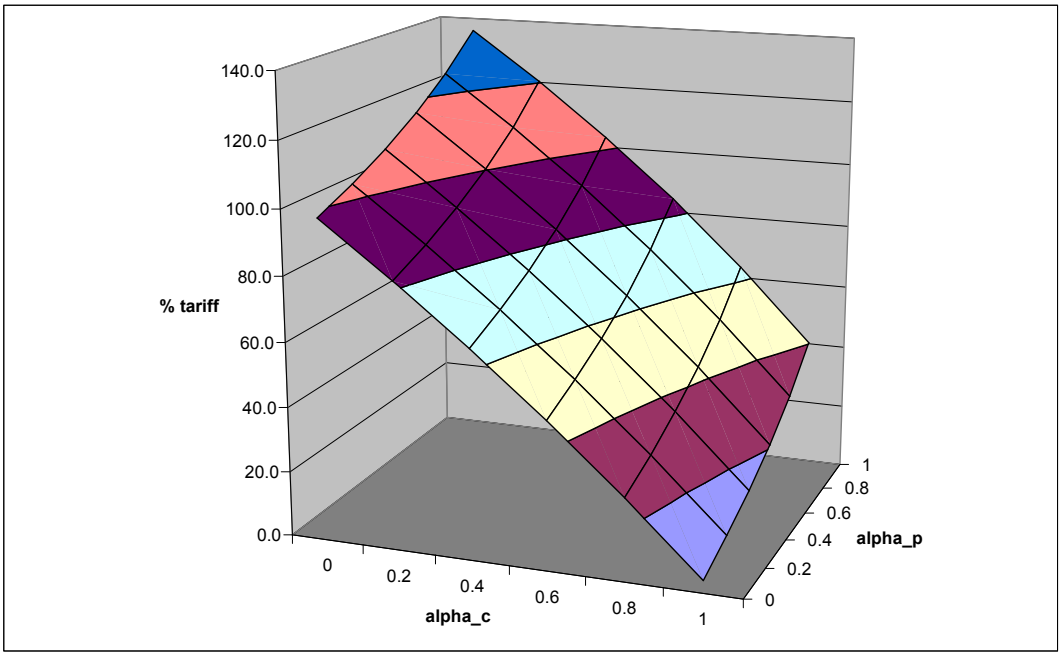
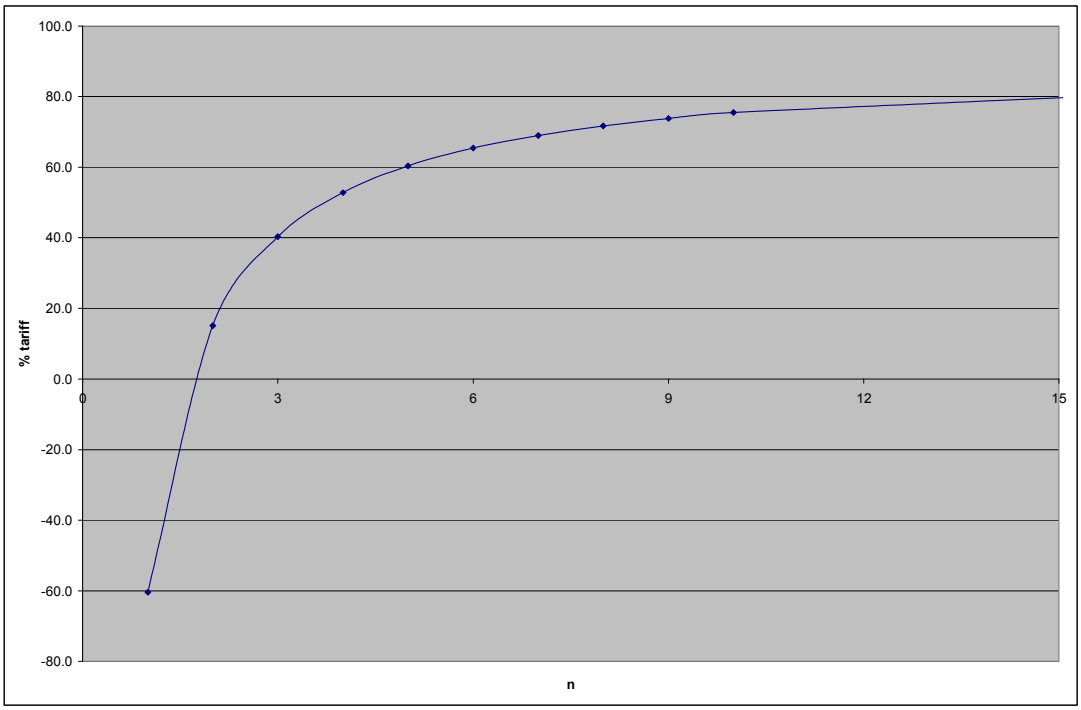
Figure 1: Tariff Equivalence of the STE with Joint Exclusive Rights as a Function of the Policy Weights [a]



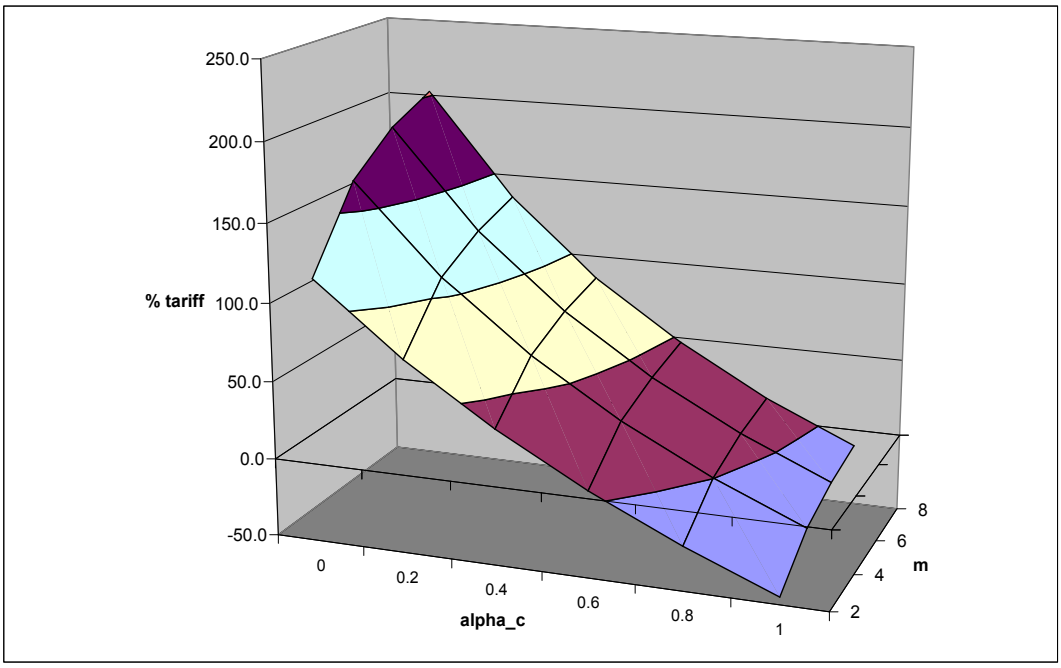
Note: [a] The equivalence is calculated from a counter-factual of a 3-firm Cournot oligopsony/oligopoly in specific form and converted to an ad valorem equivalent

Figure 2: Tariff Equivalence of the STE with Joint Exclusive Rights as a Function of the Number of Firms [a]



Note: [a] The equivalence is calculated from a counter-factual of an *n*-firm Cournot oligopsony/oligopoly in specific form and converted to an ad valorem equivalent

Figure 3: Tariff Equivalence of the STE with Import-Only Rights [a]



Note: [a] The equivalence is calculated from a counter-factual of an *n*-firm Cournot oligopsony/oligopoly in specific form and converted to an ad valorem equivalent, where $n = m + 1$

Figure 4: Optimal Tariff Rate for the Benchmark ($n = 3$)

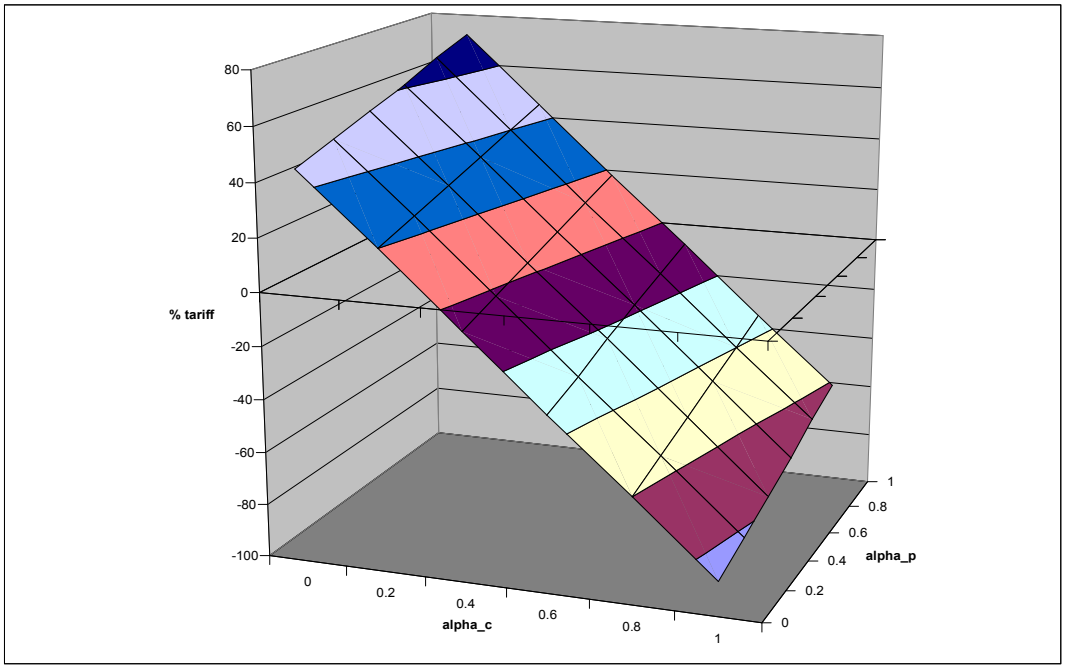


Figure 5: Optimal Tariff Rate for the STE with Joint Exclusive Rights

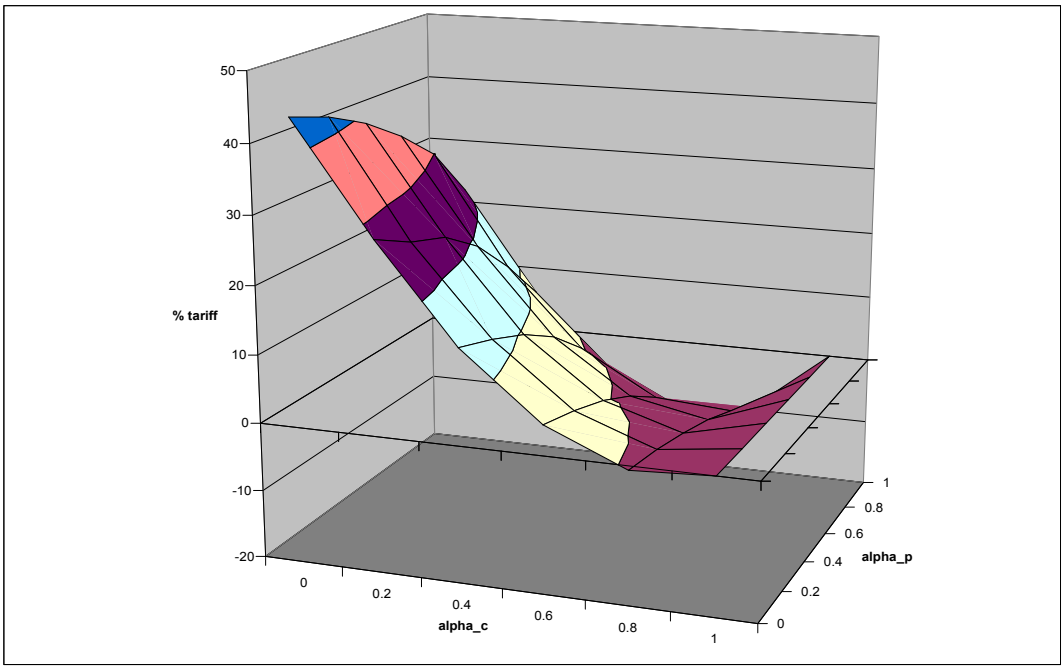


Figure 6: Optimal Tariff for the STE with Import Rights Only (n = 3)

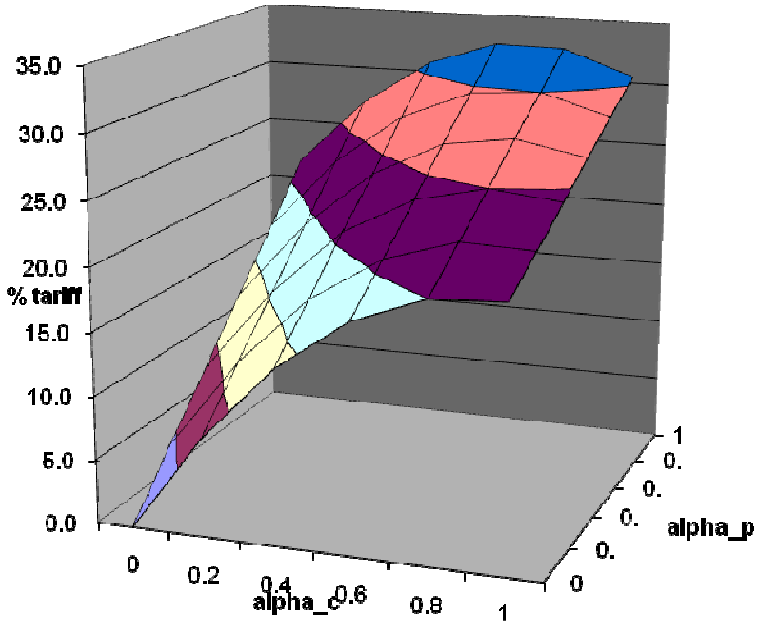
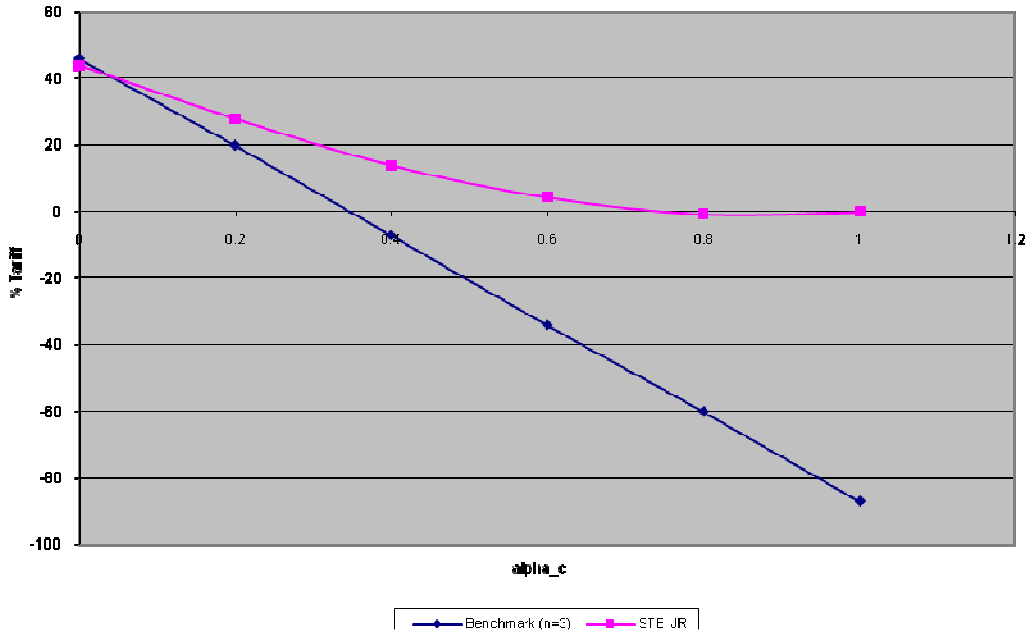
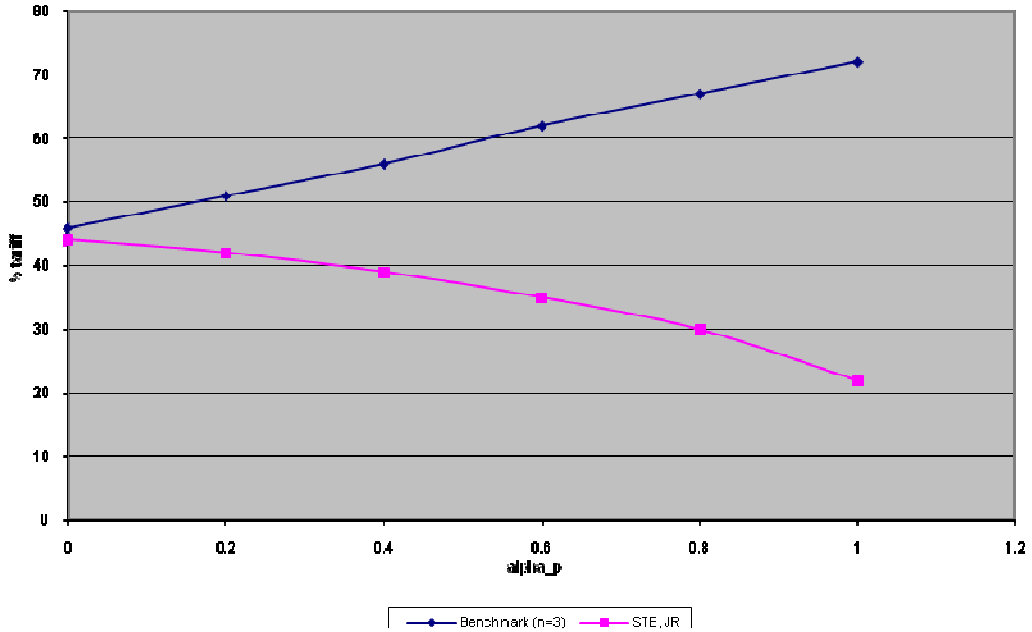


Figure 7: Optimal Tariffs as a Function of the Consumer Bias [a]



Note: [a] the producer policy weight is $\alpha_p = 0$

Figure 8: Optimal Tariffs as a Function of the Producer Bias [a]



Note: [a] the consumer policy weight is $\alpha_c = 0$ and $n = 3$