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State Trading Enterprises as Non-Tariff Measures: Theory, Evidence and Future Research Directions

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1. Introduction

State trading enterprises (STEs) are widely used among the major agricultural importers and exporters including, *inter alia*, Canada, China, India, Indonesia, Japan and South Korea, among many others. The concerns with STEs are that, in importing markets, they inhibit market access while, in the exporter context, they provide 'unfair' advantages among competing exporters. If these concerns are justified, then STEs can be viewed as non-tariff barriers to achieving undistorted trade and, in principle, their effects can be measured in the form of tariff or export subsidy equivalents.

The potential for STEs to distort trade has been recognised in the current OECD MAST initiative (see van Tongeren *et al*. (2009)). However, the treatment of STEs in this context is inadequate, the characterisation of an STE being limited to its "monopoly status" and thus its classification as anti-competitive. This characterisation is overly-simplistic because it does not fully account for the ways in which STEs may distort trade, if at all. The determinants of this trade distortion turn out to be more complex than the monopoly characterisation and, as such, this does not fully capture the heterogeneity of STEs as they exist across countries and commodity sectors. Therefore, STEs in the importing country context are better described by the more neutral term 'non-tariff measure'. Nevertheless, assessing their trade-distorting effects pose significant conceptual and measurement challenges which we address in this paper.

We highlight the challenges in analysing the STE issue in the context of STEs as a non-tariff measure in agricultural trade and identify the key determinants of their trade-distorting effects. These determinants are not only exclusive rights but also the objective function of the STE, its possible co-existence with other instruments, its efficiency relative to that of private firms, the characterisation of the domestic market (covering both distribution and procurement) and the nature of the non-STE benchmark. As such, the treatment of STEs in the MAST initiative is overly-simplistic and does not recognise sufficiently the importance of these key features of STEs as they are currently employed in agricultural trade. Taking these issues together, suggests that at the heart of the analysis is a comparison of equilibrium outcomes across alternative characterisations of market

structure. However, we emphasise that these effects nevertheless can be summarised in tariff equivalents (and export subsidy equivalents for the corresponding exporting STE case) that provide qualitative and quantitative measures of the effect of STEs on trade when measured with respect to a given counterfactual market structure. A discussion of these challenges is followed by the outline of a theoretical framework that explicitly allows these measures to be derived. It is important to note that a small country with perfect competition in all market segments is only one possible comparator benchmark

As well as outlining a framework to deal with importing STEs in various guises, a related objective of the paper is to present some evidence on the potential trade distorting effect of a specific STE. This involves a case-study of the wheat sector in Japan. The main point to establish is that it is possible to address the trade-distorting effects of STEs via a mechanism that is transparent (in terms of the underlying concerns about the alternative market structures that may replace the STE), which can accommodate partial reforms to STEs, and where other features of the specific commodity sector may be important, for example, domestic price support.

The final aspect of the paper summarises the main features of making the trade-distorting features of STEs more transparent and, in doing so, highlights the inadequacies of the current classification of them in MAST. Future directions for research on STEs are also highlighted. In the latter context, we highlight how the presence of an STE affects the nature and extent of risk in commodity markets, an issue that is of growing interest and concern given recent events on world commodity markets.

The paper is organised as follows. In Section 2, we detail the status of STEs in the context of the WTO. In section 3, we outline the main challenges in addressing the STE issue which is followed by a presentation of a more formal theoretical framework that highlights these challenges. Although STEs can arise on both the export and import sides of markets, we focus here on importing STEs[1]. We employ this framework to derive formally tariff-equivalent measures of their trade-distorting impact. In Section 4, we apply this framework to a case study of the Japanese wheat sector. In the final section, we summarise and conclude and outline future directions in dealing with STE issues.

[1] We have analysed exporting STEs elsewhere – see McCorriston and MacLaren (2007).

2. State Trading Enterprises in the Context of the WTO

In the General Agreement on Tariffs and Trade (GATT 1947) it was recognised that state trading enterprises had the potential to distort international trade because of government involvement in their activities. Thus the intention in Article XVII of the GATT was to make STEs behave in accordance with 'normal commercial considerations' through defining rules that constrained how they could behave legitimately (WTO, 2012b). It is important to note that 'commercial considerations' are not synonymous with 'profit maximisation'.[2] This distinction is a fundamental one because, as is discussed below, STEs have a range of objectives, only one of which is profit maximisation. Without this distinction between commercial considerations and profit maximisation, STEs could never behave as private firms would and hence the intention of the Article would be unachievable. Nevertheless, what constitutes commercial considerations remains imprecise.

With Article XVII drafted to ensure that STEs behaved in the same way as private firms with respect to their effects on international trade, it is not surprising that "the WTO does not seek to prohibit or even discourage the establishment or maintenance of state trading enterprises, but merely to ensure that they are not operated in a manner inconsistent with WTO principles and rules." (WTO, 2012a). Despite this reassurance, the behaviour of STEs engaged in international trade in agricultural products continues to cause some disquiet amongst governments that do not use STEs because they suspect that, in practice, the activities of STEs do have the potential to restrict imports or to expand exports. However, these alleged distortions make sense only if the counterfactual has been defined, a point that is developed below in sections 3 and 4.

While in GATT 1947, and especially in Article XVII, the rules that STEs were to follow had been clearly specified, exactly what kind of entity qualified as an STE had not been defined. This deficiency, amongst others, was rectified in GATT 1994 in the

[2] In the report of the Appellate Body that dealt with the complaint by the United States that the Canadian Wheat Board was acting in a manner inconsistent with Article XVII, it was made clear that 'commercial considerations' did not mean 'profit maximisation' as the United States had argued. For details of the legal arguments, see WTO (2004). It is interesting to note that the third parties to this dispute were Australia, Chile, China, Chinese Taipei, the European Union, Japan and Mexico, the important users of STEs at that time being Australia, China and Japan.

Understanding on the Interpretation of Article XVII where a working definition is provided as follows:

> 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.

There are two important features of this definition that distinguish an STE from a private firm. First, it is not ownership *per se* that matters, but the nature of the exclusive rights or special privileges that are bestowed on an entity. Second, it is the effect of these exclusive rights or special privileges on trade flows that is of significance. Consequently, the organisations that can be characterised by this definition range from state-owned government entities that have monopoly rights with respect to domestic sales and, by extension, monopsony rights with respect to procurement, through to a number of privately-owned importing firms that have been given import licenses but that otherwise compete with a private sector on sales in the domestic market.[3]

In order to ensure transparency about the existence, objectives and functions of STEs, Members are required to notify the Council for Trade in Goods and to provide regular updates.[4] The information is collated by the Working Party on State Trading Enterprises (WTO, 2011) and it ensures that STEs are not being used in ways that are inconsistent with the WTO. Transparency is also enhanced through the ability of Members to make counter-notifications, i.e., to notify the Council for Trade in Goods of the existence of other Members' STEs that have not been notified by the latter.

In summary, the GATT-legal status of STEs is now better understood than it was prior to the establishment of the WTO in 1995. However, it is only recently that they have been subject to economic analysis that permits their trade-distorting effects to be measured and which provides a framework within which to measure the tariff equivalent of this particular form of non-tariff measure.

[3] From notifications made by governments to the WTO about, *inter alia*, the existence and objectives of the STEs, a number of distinct types of STE can be identified. These include statutory marketing boards, regulatory marketing boards and canalizing agencies (WTO, 2012b). In practice, they operate to achieve given policy objectives and often do so in conjunction with other policy instruments. For a discussion of the types of STE, the objectives and the means used to pursue them, see OECD (2001).

[4] Details of the Members that have notified are to be found in (WTO, 2011, Table 1). In 1995, 59 countries out of 97 notified the WTO of their STEs.

3. Determinants of the Effects of STEs on Market Access

Analysing the effect of state trading enterprises on trade poses several challenges. In this section, we outline the nature of these challenges and how they are likely to impact on identifying the trade distorting effect of STEs. As noted above, the focus here is on the import case; the analytical issues nevertheless spill over to the export case. We first summarise the essential challenges in dealing with the trade effects by posing a series of questions that constitute the necessary ingredients for the theoretical framework. This is followed by a more detailed exposition of a theoretical model that encompasses these features[5].

The Main Issues

(i) What is the benchmark market structure?

With the presence of the STE, the market structure has been determined by the government. In the simplest case, an STE may be the sole actor on the market such that it has both monopsony and monopoly status. The STE case is not restricted to this specification as private firms could be licensed by the government to operate in (segments of) the market. But it poses the obvious question: if there were no STE, what would the underlying market structure look like? Perceptions of this structure may differ, ranging from a competitive outcome (i.e., if the STE were disbanded, there would be a large number of private firms that would enter the market and there would be no market power distortions either in procurement or in sales) through to concerns that the non-STE outcome would be dominated by private firms that could exert market power (in the simplest case, the STE monopoly/monopsony would be replaced by a private monopoly/monopsony).

This uncertainty about the market structure in the counterfactual has two important implications for the modelling of the trade effects of STEs. First, in addressing the *anti-monde* market structure, we want to allow for these different perceptions to exist so that the analyst does not impose an unsuitable market structure and pre-determine the outcome. In doing so, this suggests a framework such that the impact of STEs can be measured and where the analysis can also reflect debate about these potentially different perceptions. Second, the modelling framework has to be sufficiently general and transparent to allow for

[5] This discussion and the theoretical framework that follows draw on a series of papers: see, in particular, McCorriston and MacLaren (2005); addressing importing STEs in a normative context, see McCorriston and MacLaren (2011a); the domestic and trade distorting aspects of STEs are addressed in McCorriston and MacLaren (2011b).

these differences and where the tariff-equivalent effect can clearly reflect a range of competitive outcomes ranging from the private monopoly/monopsony case through to the competitive case.

(ii) How do the objectives of the STE differ from those of the private firm?

A simple characterisation of the STE issue is that because market structure is manipulated by the government, the market structure issue is all about the number of firms. Since in the most straightforward case, the market is characterised by the existence of the STE only, the issue reduces to the trade impact of the existence of a monopoly/monopsony agent dominating the market. Indeed, this could be the case; but it is overly-simplistic. STEs, and the manipulation of market structure that the presence of the STE involves, are essentially instruments of government policy and, as such, the pay-off function of the STE may reflect the underlying aims of government policy. So, while it is reasonable to assume that the pay-off function for the private firm is the maximisation of profits, the pay-off function for the STE could reflect welfare maximisation, or re-distribution in favour of producers or consumers, or the maximisation of profits. Alternatively, it may reflect some weighted combination of the arguments in a welfare function. In this context, the STE issue parallels the industrial organisation/public economics literature where the objective of a public firm is different from the characterisation of a private firm since the pay-off function differs between these two cases[6].

The important point then is that the STE issue is not just about the number of firms but also about the differences in the nature of the pay-off function between these private firm/STE cases. This difference has a crucial impact on the outcome. If the (single) private firm is a market intermediary between consumers and producers, a profit maximising firm will exploit both monopoly and monospony power on both sides of the market. This would then be reflected in two market distortions because both domestic procurement and sales will be too low. However, a welfare maximising STE will take these two distortions into account, resulting in procurement and sales both being higher, procurement prices greater and consumer prices lower compared to the profit maximising case. In this setting, the welfare maximising STE replicates the competitive outcome and, therefore, this STE can hardly be classified as uncompetitive. Note that the number of intermediaries in these two cases

[6] The welfare maximising objectives of the public firm is evident in theoretical approaches as surveyed by de Fraja and Delbono (1990) though these models deal almost exclusively with the closed economy case.

equals one but the outcome is very different because of the characterisation of the pay-off function differs across both cases. However, the private firm case may lead to more imports compared with the STE case. even though there is only a single market intermediary in both examples, since there is more domestic procurement with the welfare maximising STE and a lower level of imports because the STE exploits the terms of trade distortion.

Most government intervention in agricultural markets does not, of course, reflect the aim of welfare maximisation but rather re-distribution in favour of farmers or consumers. Thus, the pay-off function for the STE may reflect the government's weighted welfare objective or welfare bias, the bias reflecting the overall nature of government policies. The nature of this bias will therefore partially offset the (but not necessarily full) extent of the procurement or consumption distortions that may otherwise exist with a profit-maximising single intermediary. In turn, the bias will affect the levels of procurement and consumption and, by extension, the impact on trade and market access.

(iii) The Characterisation of Exclusive Rights

It is often assumed that "state trading" implies state ownership. This is not the crucial characteristic associated with state trading in the context of the WTO as has been discussed above in Section 2. The main characteristic relates to "exclusive rights". Thus, while a state trading enterprise may indeed be state owned, a private firm (or a given number of them) may be defined as a state trading enterprise if it has been allocated exclusive rights by the government. It is how these exclusive rights subsequently impact on trade flows and market access that is at the heart of the concerns of the WTO. Of course, when these exclusive rights interact with the re-distributive characterisation of the STE's pay-off function, and how the trade outcome compares with the outcome in the private firm benchmark, only then are we able to address the broader concerns associated with STEs.

Exclusive rights may cover all or segments of a given market. Suppose the importing country can be specified where there are two sources of procurement for the raw product: domestic production and imports. These two sources of the commodity are then distributed to consumers. We assume that the private firms/STE act as intermediaries between the procurement markets and consumers. At the consumer stage, the product may or may not be differentiated. The nature of exclusive rights determines which segments of the market the STE can operate in. There are three obvious possibilities: (i) the STE has exclusive

rights over both sources of procurement and, in turn, over distribution to consumers; (ii) the STE has exclusive rights over imports but only private firms procure from the domestic agricultural sector such that the STE and the private firms compete in the distribution market; and (iii) the STE has sole rights over domestic procurement but private firms can procure imports and, like the previous case, both private firms and the STE compete in the distribution market. The latter case would be the most obvious case where we have, say, a domestic marketing board but note, that even though the STE is not directly involved in imports, it is still a concern in a WTO context since the exclusive rights that apply in the domestic context can still potentially affect market access. In the former case, the STE has *joint* exclusive rights whereas in the latter two cases, the STE has partial exclusive rights; while in the former, it is only the STE that characterises the market, in the latter two cases, the STE co-exists with private firms. Note also where there are exclusive rights and where the pay-off function for private firms and the STE can differ, we can characterise the market as a mixed oligopoly.

There are possibly more complex characterisations of exclusive rights. For example, in the allocation of tariff-rate quotas, the STE can co-exist with private firms (China and the role of COFCO would be an example of this case)[7]. Alternatively, the state trader may co-exist with private firms in procurement in the domestic market but have exclusive rights over imports (India and the role of the Food Corporation of India would fit with this characterisation).

(iv) How do you measure the tariff equivalent effect?

The discussion in points (i)-(iii) has highlighted some of the central concerns in modelling an STE-related market and how these outcomes may compare with the private sector *anti-monde*. As should now be clear, the issue is not only about numbers *per se* but it also relates to the potential differences in the pay-off functions of the STE and private firms and to the designation of exclusive rights that determine in which segments of the market the STE can operate. It is the combination of these three characteristics of STEs that lead to the potential impact on trade. The one remaining challenge is to capture the potential trade distorting effects of STEs in a single tariff equivalent measure.

[7] See McCorriston and MacLaren (2010a, 2010b) for an assessment of COFCO on international commodity markets.

There are two parts to this. The first is to be clear that when we are addressing the STE issue (with the various components of it that we have detailed above), we are essentially comparing alternative market structures. Assume, for example, we had an STE with a producer-biased pay-off function that had joint exclusive rights. To answer the question about the trade-distorting effect, we are essentially asking "what is the level of market access that would arise in this particular characterisation of the market compared with one which was characterised by the existence of private firms only?" Given the discussion above, this private firm only case may be more or less competitive. More directly, we are comparing how market access differs across alternative and discrete characterisations of market structure. Similarly, with an STE that is consumer-biased and has exclusive rights to import only, the specific question is "what is the level of market access that arises in this characterisation of market structure compared with the private sector benchmark?" It is the comparison across these discrete characterisations of markets and how the level of market access varies across each case which is at the heart of the conceptual issue in assessing the trade distorting effect of STEs.

Given this discrete difference in market structures, how does one capture the trade distorting impact in a single measure? The concept we employ is to define an implicit tariff that will bring about a correspondence in the level of imports across these alternative characterisations of market structure. For example, suppose we had a producer-biased STE that had joint exclusive rights; we can solve out for the level of imports that would arise in this specification of the market. We then ask the question: what is the level of the implied tariff that would have to be imposed on private firms in the *anti-monde* case to give the same level of imports as in the STE characterisation? The level of this implicit tariff then becomes the tariff-equivalence measure.

There are several advantages to this measure. First, it can bring about a concordance for any given characterisation of an STE (reflecting both exclusive rights and the pay-off function) with the private firm benchmark. Hence, it can capture a large part of the heterogeneity of STEs that exist both within (i.e. across commodity sectors) and across many importing countries. Second, we are not prescriptive about the nature of the underlying benchmark: if one analyst/trade negotiator has a different perception of what the market would look like in the absence of the STE from another, we can capture these different perceptions in our tariff-equivalent measure. Third, we can allow for other policy

instruments that may exist or alternative features of the importing country in question. For example, the importing country may be small or large: the framework used can capture this and will be reflected in the implicit tariff measure. Similarly, if the country employed domestic price support, again the framework is flexible enough to account for this feature. Finally, but arguably most importantly, the implicit tariff equivalent can be measured. This is principally done by employing partial equilibrium models that can be calibrated with country-specific data, or at least data which are broadly reflective of a given agricultural market. While, of course, there may be arguments about the precision of the tariff equivalent measures in these cases, the argument and discussion can then focus on the factors that are most likely to impact on the trade-distorting outcome that arises from the presence of the STE however specified.

With this measurement of the trade-distorting effect comes several benefits. The most obvious is transparency. Associated with this transparency comes the ability to compare across different characterisations of STEs either by commodity sector or by country, or both. We can also address the question of reforms to STEs. Across many countries, the role of STEs has been frequently changed, either the change in the pay-off function and/or the change in exclusive rights that apply to the STE. So, when STE reform has been undertaken, it does not necessarily involve the complete de-regulation of STEs such that the market looks like the private firm outcome but rather where the STE's exclusive rights change and it co-exists with private firms. By measuring the changes in the implicit tariff-equivalent measure, we can then approximate the trade liberalising effect of these changes to market structure which STE reform involves. In the example below, we highlight these issues with reference to the role of the STE in the wheat sector in Japan.

Putting These Challenges into a Formal Framework

These main challenges are analysed in a formal framework that allows measurement of the trade-distorting effect of STEs. We start with identifying the pay-off functions for the STE.

(i) The STE Pay-Off Function

The welfare function, W, for the STE is given by:

$$W = \alpha_1 PS + \alpha_2 CS + \alpha_3 \pi$$

which, normalising on α_3, can be re-written as:

$$W = \alpha_p PS + \alpha_c CS + \pi \qquad (1)$$

where *PS* is producer surplus, *CS* is consumer surplus, π is the STE's profits and the αs are the policy weights. We leave for the present the specific characterisation of the source of profits, but note that if $\alpha_p = \alpha_c = 0$, we have an STE that acts like a private firm and solely maximises profits. Alternatively, for $\alpha_p = \alpha_c = 1$, we have a welfare maximising STE. Adjusting the weights in the welfare function will therefore reflect the overall bias of government policy; with $\alpha_p > 1, \alpha_c < 1$, reflecting re-distribution towards producers (as in developed countries) and $\alpha_p < 1, \alpha_c > 1$ reflecting re-distribution towards consumers (as in many developing countries).

(b) Identifying the Impact of STEs

The principal aim is to compare market access with the STE with what would have been the case in the private firm benchmark. This benchmark range from monopoly/monopsony or, to varying degrees, oligopoly/oligopsony, or it can converge on a competitive outcome. Specifically, we pose the question, what would the implicit tariff that would have to be imposed on private firms to induce them to reproduce the outcome with the STE? To see this, consider the following profit functions for a representative domestic firm where subscript $h\,(m)$ relates to profits from the sale of domestically-procured (imported) agricultural commodities, $p_h\,(p_m)$ is the retail price of the domestically-procured (imported) commodity, $q_h\,(q_m)$ is the quantity of domestically-procured (imported) commodity and p_A and p_w are farm-level and world prices respectively. Then,

$$\begin{aligned} \pi_h &= (p_h - p_A)q_h \\ \pi_m &= (p_m - p_w - t^e)q_m \end{aligned} \qquad (2)$$

The variable t^e is the implicit policy measure we will use to identify the trade distorting effects of the STE which we will solve for explicitly in the following section. This variable is defined as the implicit tariff equivalent that would have to be imposed on private firm imports to replicate the level of imports that would arise in the state trading case (Q_m^{STE}). Explicitly, aggregating over n private firms (such that $Q_m = nq_m$), the tariff equivalent effect solves:

$$Q_m(t^e) = Q_m^{STE} \qquad (3)$$

To illustrate the intuition, take a simple example. Suppose the private firm set-up were characterised by a small number of firms that could exert oligospony power in the procurement of agricultural supplies and market power in the sale of them in the domestic market. By restricting the level of domestic procurement, farmers are potentially worse off, the ability of the private firms to do this being greater because they can price discriminate between the domestic and import markets in the procurement of these supplies. Against this, consider the effect of an STE and assume the objective function of this STE is to maximise producer surplus and profits from the sale of domestically-procured and imported commodities in the domestic market. Assume also the STE has joint exclusive rights, i.e., it has sole rights over domestic procurement, imports and the sale of the commodities in the domestic market. In this case, domestic procurement by the STE may increase beyond that procured by the private firms;. if imports decrease as a consequence,, there will be a positive tariff equivalent effect. Clearly, the magnitude of the trade distorting effect will depend on the objective function of the STE and the nature of the private firm benchmark the STE replaces. In general, however, the sign of t^e is ambiguous. In addition, these effects will also depend on the nature of exclusive rights that apply to the STE, i.e., the extent to which it has market power in the procurement markets and in the sale of commodities to domestic consumers. These are considered next.

(c) Exclusive Rights

In the private sector benchmark, a representative firm chooses how much to procure domestically and how much to import before final sale to consumers. Total profit π (in equation (2)) is made up of the two components π_h and π_m. Products sourced from different markets may or may not be differentiated. Assuming market segmentation, the representative firm can therefore act as a discriminating oligopsonist in the procurement market and as an oligopolist in the output market. As the number of competing firms (n) increases, the ability to exert market power in either of these markets diminishes. Assuming Cournot behaviour, the representative firm (i) chooses quantities to maximise joint profits as given by:

$$\pi_i = \pi_{hi} + \pi_{mi} = (p_h - p_A)q_{hi} + (p_m - p_w - t^e)q_{mi} \tag{4}$$

These exclusive rights of the STE can take several forms though here we deal with the two most obvious. First, we assume that the STE has sole rights in the procurement of both

domestic and imported commodities and in the sale of these commodities. The extent to which it acts as a textbook monopsonist/monopolist will depend on the nature of its objective function as given by (1) with the profit component of the welfare function detailed in equation (1) for this STE being given by:[8]

$$\pi^{STE} = \pi_h^{STE} + \pi_m^{STE} = (p_h - p_A)Q_h^{STE} + (p_m - p_w)Q_m^{STE} \tag{5}$$

An alternative characterisation of an STE is where it has sole rights to import and it is excluded from domestic procurement. The private sector procures and sells domestic output and competes with the STE in the output market. Thus the STE has exclusive rights over imports but, depending on the size of n, the output market may be oligopolistic. The size of n will also determine the extent of oligopsony power exerted against domestic producers. But, in contrast to the previous case, neither the private firms nor the STE can price discriminate in the procurement market. In this case, the profit function for a representative private firm, i, is given by:

$$\pi_{hi} = (p_h - p_A)q_{hi} \tag{6}$$

and, for the STE, the profit component of the welfare function in (1) is given by:

$$\pi_m^{STE} = (p_m - p_w)Q_m^{STE} \tag{7}$$

Clearly, there are cases of STEs which may differ from the above two cases. For example, the STE may have sole rights in the procurement of imports but it has to compete with the private sector in the domestic procurement market. As an alternative, the private sector may also be responsible for procurement of imports either exclusively or in competition with the STE. While these variations can be dealt with readily in the proposed framework, we focus on the two cases above as these are the most transparent in terms of the analytics and are also readily applicable to the many examples of importing STEs currently being used.

Deriving the Tariff Equivalent Effect

The objective is to derive the tariff equivalent effect (t^e) in a framework that allows us to consider the issues discussed above. To proceed, we derive the first-order conditions for the private firm case inclusive of the implicit policy instruments and derive equilibrium quantities. Then, for a given characterisation of the STE and, accounting for the general welfare function given in equation (1), we derive its corresponding first-order conditions and the equilibrium quantities. We then set the equilibrium quantities in the *n* private firm

[8] The standard monopoly/monopsony case would arise only with $\alpha_p = \alpha_c = 0$.

benchmark and the STE to equal each other, and derive an explicit expression for the tariff equivalent.

Given that our aim is to derive explicit measures of the trade distortion, we assume a specific functional form.[9] Assume utility is given by:

$$U = m + u(Q_h, Q_m) \tag{8}$$

where m is the outside good and $u(Q_h, Q_m)$ is quadratic and is given by:

$$u(Q_h, Q_m) = a_1 Q_h + a_2 Q_m - 0.5(b_1 Q_h^2 + b_2^2 Q_m + 2\gamma Q_h Q_m)$$

The inverse demand functions that are derived from this utility function are given by:

$$p_h = a_1 - b_1 Q_h - \gamma Q_m \tag{9}$$

$$p_m = a_2 - b_2 Q_m - \gamma Q_h \tag{10}$$

where: subscripts h and m refer to the home produced and imported good respectively; $b_1 b_2 - \gamma^2 > 0$ implies that the goods are not perfect substitutes; $Q_h = nq_h$ and $Q_m = nq_m$ represent sales of the domestically produced and imported good respectively; q_h and q_m are the quantities of goods procured in home and imported, respectively, and sold in home by the typical firm; and n is the number of competing firms.

To capture the potential for market power to be exerted in the procurement market, we assume upward-sloping, inverse supply functions. For the domestically-procured commodity, this function is given by:

$$p_A = f + kQ_h \tag{11}$$

and for the imported good the function is:

$$p_w = F + KQ_m \tag{12}$$

If $K = 0$, we have the small country case and there is no potential for terms of trade effects in the purchase of imports. However, there may still be an effect on imports because the quantity procured domestically by the STE will differ from that of the private firms and, hence, will affect the quantity imported.

[9] Pursuing the approach with general functional forms does not develop the analysis to a stage that can be readily implemented. This is because we evaluate the domestic and trade effects on specific levels of imports, domestic procurement and domestic sales. In order to derive these for the STE cases that we investigate, explicit values for the volumes procured and sold need to be derived. Therefore, to avoid adding unnecessary algebra to the paper, we proceed directly to the case with a specific functional form.

(i) Private Firm Benchmark

Given the profit function in (4), the first-order conditions for profit maximisation for a representative i firm are given by:

$$\begin{pmatrix} (b_1+k)(n+1) & \gamma(n+1) \\ \gamma(n+1) & (b_2+K)(n+1) \end{pmatrix}\begin{pmatrix} q_h \\ q_m \end{pmatrix} = \begin{pmatrix} a_1 - f) \\ a_2 - F - t^e \end{pmatrix} \tag{13}$$

Aggregating over n firms, equilibrium quantities are given by:

$$Q_h = nq_h = n\left\{\frac{\phi_2(a_1-f)-\gamma(n+1)(a_2-F-t^e)}{\phi_3}\right\} \tag{14}$$

$$Q_m = nq_m = \left\{\frac{\phi_1(a_2-F-t^e)-\gamma(n+1)(a_1-f)}{\phi_3}\right\} \tag{15}$$

where $\phi_1 = (b_1+k)(n+1)$, $\phi_2 = (b_2+K)(n+1)$ and $\phi_3 = \phi_1\phi_2 - \gamma^2(n+1)^2$.

(ii) STE with Joint Exclusive Rights

The STE maximises the weighted welfare function given in (1) with the profit component as given in (4). The first-order conditions for the STE are:

$$\begin{pmatrix} b_1(2-\alpha_c)+k(2-\alpha_p) & \gamma(2-\alpha_c) \\ \gamma(2-\alpha_c) & b_2(2-\alpha_c)+2K \end{pmatrix}\begin{pmatrix} Q_h^{STE} \\ Q_m^{STE} \end{pmatrix} = \begin{pmatrix} a_1 - f \\ a_2 - F \end{pmatrix} \tag{16}$$

Note that the relative weights on producer and consumer welfare are captured in these first-order conditions. It should also be noted that, if the STE were solely interested in maximising profits and acted like a private firm, then the left-hand side matrix of (16) would be identical with the left-hand side matrix in (13) for $n=1$. In this case, the implicit policy measure would be zero and there would be no difference between the STE and the private monopoly/monopsony. From equation (16), the corresponding equilibrium quantities procured and sold by the STE are given by:

$$Q_h^{STE} = \frac{\lambda_2(a_1-f)-\gamma(2-\alpha_c)(a_2-F)}{\lambda_3} \tag{17}$$

$$Q_m^{STE} = \frac{\lambda_1(a_2-F)-\gamma(2-\alpha_c)(a_1-f)}{\lambda_3} \tag{18}$$

where $\lambda_1 = b_1(2-\alpha_c)+k(2-\alpha_p)$, $\lambda_2 = b_2(2-\alpha_c)+2K$ and $\lambda_3 = \lambda_1\lambda_2 - \gamma^2(2-\alpha_c)^2$.

(iii) STE with Exclusive Rights to Import Only

In this case, the STE has sole rights to import, it is excluded from domestic procurement but has to compete for sales with the private sector that can only procure domestically. The first-order conditions in this case relate to the profit function for a representative firm given by (6) and the STE's welfare function by (1) but with the profit component given by (7). This gives:

$$\begin{pmatrix} b_2(2-\alpha_c)+2K & \gamma n(1-\alpha_c) \\ \gamma & (b_1+k)(n+1) \end{pmatrix} \begin{pmatrix} Q_m^{STE} \\ q_h \end{pmatrix} = \begin{pmatrix} a_2 - F \\ a_1 - f \end{pmatrix} \tag{19}$$

Aggregating over the *n* firms that can procure only domestically, the equilibrium quantities are given by:

$$Q_h^{'} = nq_h = n\left\{\frac{[b_2(2-\alpha_c)+2K](a_1-f)-\gamma(a_2-F)}{\lambda_4}\right\} \tag{20}$$

$$Q_m^{STE'} = \frac{\phi_1(a_2-F)-n\gamma(1-\alpha_c)(a_1-f)}{\lambda_4} \tag{21}$$

where $\lambda_4 = [b_2(2-\alpha_c)+2K]\phi_1 - n(1-\alpha_c)\gamma^2$ and where ϕ_1 is defined as above and with the prime distinguishing equilibrium quantities from the earlier two cases.

Given the equilibrium quantities derived above, we now can proceed to derive the explicit measures that identify the trade distorting effects of STEs. We do this for the two characterisations of the STEs.

(iv)Impact of an STE with Joint Exclusive Rights

To derive the tariff equivalent effect, using the definition in (3), set (18) equal to (15) and solve out for t^e, where the subscript (*JE*) refers to the joint exclusive rights case. This gives:

$$t_{JE}^e = \frac{(a_2-F)(n\lambda_3\phi_1-\phi_3\lambda_1)-(a_1-f)\gamma[n\lambda_3(n+1)-\phi_3(2-\alpha_c)]}{n\lambda_3\phi_1} \tag{22}$$

from which it can be concluded that the tariff equivalence is a function of n, α_p and α_c.

(v) Impact of an STE with Exclusive Rights to Import Only

The same procedure as above can be used to derive the corresponding measures when the STE has exclusive rights to import only and it competes in the output market with the private sector that procures its output from the domestic agricultural sector. The

corresponding tariff equivalent measure is given below, where the subscript (*MO*) refers to the import only case:

$$t^{e}_{MO} = \frac{(a_2 - F)(\lambda_4 n\phi_1 - \phi_1\phi_3) - (a_1 - f)(\lambda_4 n\phi_1 - \phi_1\phi_3)}{n\lambda_4\phi_1} \tag{23}$$

from which it can be concluded that the tariff equivalence is no longer a function of α_p.

(vi) STEs and Other Government Policies

Of course, STEs are not the only instrument of government policy and they are seldom used in isolation. Rather, the manipulation of market structure often goes hand-in-hand with other government distortions aimed at re-distributing income. For example, a government may use price support to guarantee a minimum price to producers. In such cases, the important issue to address is the *marginal* effect of the STE, i.e., the nature of the transfers caused by the STE when other distortions are accounted for. The above framework can be readily adapted to deal with such cases. Consider, for example, the trade distorting effect that would arise in the case of the STE with joint exclusive rights. With a guaranteed farm level price, we can amend the inverse supply function to be given by $k = 0$ and $\bar{f}$ with the latter being set at the guaranteed price level. Re-writing (22) we have:

$$t^{e}_{JE} = \frac{(a_2 - F)(n\lambda_3\phi_1^{'} - \phi_3^{'}\lambda_1^{'}) - (a_1 - \bar{f})\gamma[n\lambda_3^{'}(n+1) - \phi_3(2-\alpha_c)]}{n\lambda_3^{'}\phi_3^{'}} \tag{22'}$$

where $\phi_1^{'} = b_1(n+1)$, $\phi_3^{'} = \phi_1^{'}\phi_2 - \gamma^2(n+1)^2$, $\lambda_1^{'} = b_1(2-\alpha_c)$ and $\lambda_3^{'} = \lambda_1^{'}\lambda_2 - \gamma^2(2-\alpha_c)$ with all other variables as given above. The tariff-equivalent effect is now a function of $\bar{f}$ as well as *n* and the policy weights.

Intuitively, the impact of the STE is changed in the presence of other instruments. Consider, for example, the role of the STE with no price support. Relative to an uncompetitive private sector, the STE corrects the distortion that would arise from too much buying power in the procurement market, with a producer-biased STE increasing procurement. As such, since for a producer-surplus maximising STE it is the average rather than the marginal outlay curve that matters, it increases domestic procurement, giving rise to a positive producer subsidy equivalent. But with a guaranteed price, the inverse supply and marginal outlay functions are flat (at least in a certain range) so that this distortion does

not need correcting to the same extent by the STE. The STE can only effectively exert its control on the market via its procurement of imports and the sale of domestic and imported commodities to consumers. Since the effect of the STE is now on exercising terms of trade effects and monopoly power in the domestic market, it may procure less than the $n > 1$ private firms. Given that an STE is essentially associated with manipulating market structure to achieve a given objective, the role of price support has already (partially) fulfilled this role and the marginal effect of the STE is reduced.

4. Case Study: Impact of STEs in the Wheat Sector in Japan

The theoretical model gives important insights into the key factors that likely determine the impact of STEs in importing countries[10]. However, following the tradition of the trade policy literature, the above model can be calibrated using price and quantity data and assumed values for the key elasticities. The calibration follows from the work of Dixit (1988). The important point to note is that the framework offers a potentially useful tool with which policy makers can improve the transparency of the trade effects of STEs that can arise in different environments. Irrespective of the specific results, we nevertheless show that the direction of the effects is consistent with the discussion provided above.

The model is calibrated using data relating to the wheat market in Japan. This is an important case study for several reasons. First, Japan is a key player in the on-going Doha Round negotiations and is commonly seen as a country where there is limited market access for imported commodities, that the government's policy is strongly targeted at the interests of producers and away from consumers and where it has used state trading enterprises to manage the procurement of domestic and imported agricultural commodities and their subsequent domestic sale. Specifically, the Japan Food Agency in the past has been the dominant feature of the rice and wheat markets in Japan. Second, in recent years, the Japanese government has changed the exclusive rights that apply to the STE. In detail, the Japan Food Agency that prior to 2002 had exclusive rights to procure domestic and imported wheat for sale on the domestic market has now exclusive rights to import only and the private sector now procures domestically-grown wheat and competes with imported wheat in the output market. However, it should also be noted that the Japanese government also guaranteed prices to farmers with the Japan Food Agency procuring at government set

[10] For more detailed propositions that arise from this framework, see McCorriston and MacLaren (2011a).

prices. Coinciding with the changes to the exclusive rights that applied to the STE, the Japanese government also removed this price support with additional compensation now being given to farmers via the Income Stabilisation Fund. As such, the reform of the STE in Japan can be characterised as a move from the STE with joint exclusive rights co-existing with price support to an STE with rights to import only with no price support.[11]

We calibrate the parameters of the theoretical model based on price and quantity data for the Japanese wheat market in 2000. These data are shown in Table 1 along with assumed values for the key elasticities. However, as the previous discussion above shows, the impact of the STE is highly dependent on the bias in the welfare function which, in this case, likely reflects the overall bias in Japanese agricultural policy. To this end, we use the estimates of Lee and Kennedy (2006) who evaluate the relative weights on producer and consumer welfare that appear consistent with the wheat policies pursued by the Japanese government. Therefore, α_p and α_c are assumed to equal 1.25 and 0.75, respectively. We also set n=10 and, assume in the case where the STE has import rights only, the market comprises the same number of participants in the output market, i.e., n=9 plus the STE. The calibrated parameters are also shown in Table 1.

Based on the calibrated parameters, we can therefore evaluate the effects of the STE using (22), (22') and (23) above and highlight how the domestic and trade effects of the Japan Food Agency have changed following amendments to the nature of exclusive rights that apply. In considering how these effects relate to the change in exclusive rights, we assume that the bias in Japanese agricultural policy has remained unchanged. The results are reported in Table 2. We report three cases: first, where the Japan Food Agency with joint exclusive rights co-existed with domestic price support; second, assuming the joint exclusive rights were maintained but price support was removed; and third, where we have the Japan Food Department with import rights only and domestic price support has been removed.

There are two important insights that arise from these results. First, the Japan Food Agency did indeed cause a trade distortion, although the extent of it was significantly reduced following the change in exclusive rights that apply. When the STE had joint exclusive

[11] Since these payments are lump-sum in nature, they do not create any additional distortions and so are not modelled directly here.

rights, the tariff equivalent was around $517 per tonne – this amounts to around a 86 per cent of the world price. Following the change in the exclusive rights, this effect would have fallen to a tariff equivalent of $342 per tonne or 57 per cent *ad valorem*. Second, in the joint exclusive rights case, with the government guaranteeing prices, the inverse supply curve is flat and there is no oligopsony problem for the STE to correct. Nevertheless, on the consumer side the market is less competitive so overall sales go down. As a result, the STE procures less from domestic producers, less is sold to domestic consumers, imports are lower and so the trade distorting effect is positive. Note, however, that in the case where we have the STE with joint exclusive rights without domestic price support, the negative effects on market access also increase, the tariff equivalent is now $688 per tonne (115% *ad valorem*).

Table 1: Calibration Data and Parameters – Japanese Wheat Market, 2000

Parameter	Value	Calibrated Parameter	Value
Demand elasticity	0.25	b_1	0.001415626
Elasticity of substitution	5	b_2	0.000711467
Domestic retail price	$903/tonne	γ	0.000490279
Retail price of imported good	$1023/tonne	a_1	4515
Sales of domestically produced commodity	735000 tonnes	a_2	5115
Sales of imported good	5245000 tonnes	k	0.002864304
Export supply elasticity	5	f	-1305.26316
Domestic supply elasticity	0.25	K	2.27264E-05
Domestic producer price	$800/tonne	F	476.8
Import price	$596/tonne		

Data on domestic production, sales and imports comes from FAO. Import prices are calculated as unit values from import value and volume data from the FAO. Domestic producer and retail prices are sourced from USDA. No available studies produce demand and supply elasticities though the values chosen are broadly commensurate with elasticity data in other developed countries. Table 6 deals with sensitivity analyses with respect to these chosen parameters.

Table 2: Domestic and Trade Effects of the Japan Food Agency in the Wheat Market (US$ per tonne)

	Tariff Equivalent
Joint Exclusive Rights with domestic price support	517 (86%)
Joint Exclusive Rights with no domestic price support	688 (115%)
Import Only	342 (57%)

Table 3 reports the results from a sensitivity analysis of the initial calibration. The first row reports the results from the initial calibration and the assumptions associated with it. Throughout the remainder of the table, we report how the tariff equivalent effects vary when the underlying assumptions are changed. In the case where joint exclusive (*JE*) rights applied, the impact on trade, the competitiveness of the underlying benchmark and the assumption about the domestic demand elasticity matter most. When the STE can import only (*MO*), the tariff equivalent measure is particularly sensitive to the underlying competitiveness of the market.

Finally, it should be noted that the exercise reported here is not intended as a definitive evaluation of the effects of the STE that applies in Japan. Rather, and drawing from the theoretical model outlined above, the important point is that a theoretically-consistent framework can be used to evaluate the effects of STEs that arise in different environments. For example, by changing the relative weights in the objective function, we can capture the likely bias of policy in developing countries, and by capturing explicitly the exclusive rights that apply, the model can be applied using observable data to increase the transparency of the likely effects of STEs and, in turn, inform policymakers of the trade effects of these STEs.

Table 3: Domestic and Trade Effects of the Japan Food Agency-Sensitivity Analysis (US$ per tonne)

	Tariff Equivalent	
	JE_{nps}	MO
Benchmark Case[a]	688	342
More Competitive Domestic Market[b]	933	617
Weaker Terms of Trade Effects[c]	627	279
More Elastic Domestic Demand[d]	345	217

Note: JE_{ps} and JE_{nps} refer to the cases where the STE has joint exclusive rights but with and without domestic price support respectively. *MO* refers to the case where the STE has exclusive rights to import only. [a] In the benchmark case, we use the calibrated data presented in Table 1. We also assume n=10 and $\alpha_p = 1.25$ and $\alpha_c = 0.75$. We vary the underlying benchmark with the same calibrated parameters or keep the same number of private firms and re-calibrate the model to allow for different values for the elasticity data. [b] Number, n, of firms in benchmark set equal to 50. [c] Elasticity of import supply set equal to 20. [d] The elasticity of demand is increased from 0.25 to 0.75.

5. Summary and Future Research Issues

The principal aim of this paper was to outline the challenges in addressing state trading enterprises as non-tariff measures. STEs indeed have the potential to restrict market access and therefore act as a non-tariff barrier to trade. However, this does not necessarily arise only because an STE has single desk status. To put it bluntly, to assume that the STE issue is solely to do with the number of participants in the market, as in the treatment of STEs in the MAST programme, is overly simplistic. There are many factors that contribute to the trade-distorting outcome of STEs. The aim of this paper has been to outline the several challenges in analysing the trade effects of STEs and to present a framework that can incorporate these various challenges. Importantly for policy analysis, the framework lends itself to a single and transparent tariff-equivalent measure that can be applied to markets in which state enterprises are to be found. Even if there are different perceptions regarding what the non-STE market may look like, the framework outlined here can nevertheless accommodate these perceptions as well as accommodating other features of the market that also impact in assessing the trade-distorting aspect of STEs, e.g., the presence of domestic price support measures, and the 'small' versus 'large' country assumption.

There are remaining issues to address on STEs. One obvious and topical one is the extent to which STEs dissipate the impact of price volatility that arises on domestic and world markets. Aspects of market structure may have an important bearing, not just on the levels of welfare and the trade distorting effects that arise from the government manipulating market structure but also the extent to which domestic producers and consumers are exposed to volatility and commodity price spikes. In this context, there may be a trade-off between the level of welfare and the variance in the presence of commodity market fluctuations. Related to this is whether the pay-off functions of STEs (see equation (1)) should represent some role for risk, given recent events on world markets and increasing concerns about food security? Countries may be less willing to reduce the role of STEs in managing imports in a more volatile commodity environment.

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