A Modeling Framework for Assessing the Trade Impact of SPS and TBT Regulations

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The quantification of the trade effect of Sanitary and Phytosanitary Standards (SPS) and other Technical Barriers to Trade (TBT) poses certain problems for trade policy analysts. That trade is impacted by such regulations is clear: what is in doubt is the magnitude of these trade impacts and the consequent effect on the gains from trade. Few studies have attempted to take the empirical leap into the arcane world of SPS and TBT to allow such quantification. Without such information it is unclear as to how significant they are as trade barriers, which regulations create the most impediment to trade, and how best to modify current rules in this area to reduce the unwanted trade impact. Unlike regular trade barriers their impact on international flows of goods is mainly indirect, through the additional cost of compliance which producers or traders face. Moreover, to the extent that these regulations have an impact on production functions and consumption decisions the import demand and export supply curves themselves can shift.

In general, considerably more information is needed to assess the trade impact of these regulatory trade barriers. The task of assessing the impact of these regulations on trade flows requires detailed knowledge of the regulations themselves, the process by which companies or individuals meet those regulations and the implications of not conforming to

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the rules. To put this technical information to use requires a framework of economic analysis. This framework should be simple and easily understood but at the same time be comprehensive enough to allow a satisfactory answer to a range of questions. The framework itself needs to include the classification of policy instruments at least to identify their main characteristics. It also requires a modeling framework into which to place empirical data for calculation of the trade impacts and welfare effects.

This note suggests such an modeling framework. It is based on a synthesis of the different approaches taken in five recent papers, each of which emphasizes one particular aspect of the issue. Considering these approaches as separate aspects of the variety of SPS/TBT barriers has the advantage of being able to combine them in any particular empirical case. The framework is intended to integrate these various approaches in a flexible and general model which can be customized to any specific measure. It is designed to build upon the current ERS work on the classification of SPS/TBT trade impediments (Roberts and DeRemer, 1997 and Thornsbury, *et al.* 1997). That work also emphasizes that SPS/TBT measures cannot simply be put in categories or pigeon holes: they are far too complex for that. They must be treated as bundles of characteristics, with the classification comprising the various combinations of these elements. In what follows the elements are modeled separately and in a way that can be combined in studying specific cases.

The contributions of the five recent approaches can be summarized as follows. Krissoff, Calvin and Gray (1997) examine the tariff and non-tariff barriers facing US apples in three different markets, Japan, Korea and Mexico, and calculate the tariff-equivalent of the non-tariff (phytosanitary) component. These estimates they then use to calculate how much trade is impeded by these and the regular tariff barriers. The model used is a static partial equilibrium analsis of the three apple markets. Although the authors acknowledge that the restrictions may be justified, the model does not include any impact on production in the importing country of removing the trade restriction. Sumner and Lee (1996) develop a model which is pitched primarily at the problem of Asian import regulations facing US vegetables. The emphasis of the paper is on the different ways in which the regulations can impose costs at different parts of the marketing chain. In a trade model this can have implications for the foreign and domestic price levels and the foreign exchange flows as well as quantities that are traded. Although they mention the possibility of shifts in the

curves they do not pursue the matter in their analytical model. Compliance costs are added like tariffs to the relevant supply curves in an otherwise conventional trade analysis.[1]

Shifts in the supply curve when trade introduces pests is at the heart of the justification for SPS-related trade barriers. Orden and Romano (1996) develop a model which focuses directly on the impact of imported diseases on domestic production costs. Referring to the US ban on avocado imports from Mexico (since partially rescinded) they model a market for avocados in the US where domestic supply shifts backwards/upwards when imports are allowed in to the country, as a result of pest infestation. As the ban has a consumer cost, the welfare impact of removing it is a combination of trade gains from cheaper avocados and resource losses as the cost of producing any given quantity of avocados at home increases. Compliance costs, such as border inspection do not play an active role in the model, and the consumer is assumed not to care whether or not he destroys the Californian avocado industry while enjoying cheap guacamole.

The consumer steps to the front in a model of information externalities by Thilmany and Barrett (1997). The emphasis is on the role of regulation of imports in giving consumers confidence in buying the product, thus avoiding the problem of "lemons" foist on the unsuspecting consumer by foreign producers who do not have to rely on reputation for repeat business. If the regulation is uninformative there is a welfare loss, but informative regulations can correct market failures and add to social welfare. The particular example chosen by the authors is the dairy trade between the US and Mexico.

The fifth study on which the suggested framework is based is that of Paarlberg and Lee (1997) who address the issue of foot and mouth disease and trade in beef from countries where the disease is endemic. Using the language of tariff theory, the authors calculate the "optimum tariff" which when placed differentially on imports from the infected country would maximize the difference between the gains from trade and the costs to the domestic industry from the spread of the disease. The costs are related to the number of outbreaks which in turn are related to the volume of imports. By using the concept of an optimum

[1] Josling (1994) laid out a similar model, using compliance costs differentiated by whether the producer was a domestic or a foreign supplier. The trade impacts were shown to be sensitive to the incidence of the relative costs of complance with regulations, and to be similar to the trade impacts of tariffs representing the difference between foreign and domestic compliance costs. However this model also allowed for no shifts in the supply curves, though there was provision for consumer gains from the information value of the regulation.

tariff the authors remind us that SPS and TBT issues involve a trade off between the commercial and the health and technical considerations. But in doing so they stray a little from policy realism: most countries would ban products from infected sources rather than merely tax them at the border.

The framework which follows includes three different but combinable components or sub-models. The **first** model component is the element of *regulatory protection*, a simple case of a regulation which has no function other than to give some rents to the domestic sector. This is in effect a special case, as will be seen later: most barriers have at the least some superficial justification. A variant of this model that could be called *compensatory protection* is one which assumes that a regulation similar to that faced by domestic producers is imposed on imports solely to keep the "playing field" level: the import regulation has no impact on the domestic supply and demand curves. This formulation differs from "pure" regulatory protection only in that it is tied to the cost of compliance with the domestic regulation.

The **second** component is a supply-shift model, for convenience referred to below as an SPS component, which focuses on the impact of imports on the domestic supply, together with the costs of enforcing compliance at the border (or in the supplying country) that will eliminate the threat of infestation. This element introduces the rationale for the trade barrier, though of course it does not follow that the particular SPS chosen is appropriate for the circumstances. The task of the model is to make that calculation.

The **third** component is a demand shift model which can be thought of as a TBT sub-model which assumes that the impact of the regulation on imports, in addition to the cost involved, is to impart information which has the potential of increasing the demand. The information can be related to quality (that the import meets a particular product standard) or to geographical origin (which gives consumers additional knowledge about expected characteristics).[2] Though more difficult to identify consumer benefits in such cases, one could also use the same approach where the TBT covers areas such as packaging which are presumably intended to lower the cost of distribution. A variant of the same model is useful for those cases where unregulated imports would have a negative impact on consumption, if

[2] The analysis in this paper assumes that the imported product sells for the same price as the domestic product on the importer's market. Thus the increase in demand for imports with the provision of information is not captured by an increase in the relative price of imports. The goods are perceived as perfect substitutes by the consumer once the information imparted by the regulation has been absorbed.

not through actual harm to consumers then through causing them to reevaluate their consumption patterns. The information imparted by the regulation causes consumers to increase demand for the preferred product, and incidentally reduce their demand for the identified inferior product, in essence differentiating the market for the good. At the extreme the government can ban imports of goods thought to have deleterious health consequences, even if some market demand would exist despite adequate information. This might be called the BSE model, though of course a full analysis of the BSE case would take us far beyond this simple didactic device.

The first of these sub-models describes a situation of regulatory capture, where social gains are subjugated to private profits by special interest groups. In this sense it is similar to the traditional analysis of tariffs where the tariff is assumed to have no other purpose than to protect producers at the expense of consumers. By contrast the second and third models allow for the regulation to have a beneficial impact, even if overdone at times and again capable of capture. After a brief description of the models some suggestions follow on implementation in empirical settings.

For each of these sub-models we need to consider the situation from the viewpoint of both the exporter and the importer, and also take into account whether either can influence the world market price. This leads to a distinction between "small" and "large" countries, similar to that in tariff analysis. We also need to distinguish between those SPS and TBT that apply to all exporters (exporter-universal) and those that only apply to particular exporters (exporter-specific). To fill out the taxonomy we need to recognize those SPS and TBT that are applied only by one importer (importer-specific) and those which are generally applied (importer-universal). These distinctions essentially govern the incidence of the cost of compliance with the import regulations.[3]

A. The Regulatory Protection Model

The simple model of regulatory protection postulates a situation where the foreign supplier of the good is required to comply with some form of regulation as a condition of importation. This is essentially the model used by Krissoff, Calvin and Gray (henceforward

[3] Similar issues would be relevant in the case of export regulations, but these are not pursued here. In the models that follow, any regulation imposed by an exporter is merely a manifestation of the importer's regulation. The exporter authorities are acting in proxy for the importer authorities.

KCG). The compliance with this regulation is assumed to involve a cost. This cost acts like a tariff on the quantity of trade, but there is of course no tariff revenue.[4] As a result the importing country suffers a loss in the potential gain from trade. Domestic producers gain and consumers pay both for the producer gain and for the cost of the useless regulation. They also pay indirectly for the distortion in the consumption and production decisions, the traditional "welfare triangles". Exporters lose, as they would with any kind of protection.

Importer Perspective

The model is shown in Figure 1, as seen by an importer, with the left hand diagram representing the domestic market and the right hand diagram the world market. It is assumed that the regulation applies to all exports to this market (i.e. it is exporter-universal), that only this importer applies this regulation (it is importer-specific) and that the level of imports is small relative to the total world market (i.e. the small country case). A regulation on imports that was prohibitive would lead to a trade volume at M(0) (i.e. zero). Trade in the absence of the regulations would lead to trade volume M(1), with the usual gains from trade. With the non-prohibitive regulations imposed on imports, the price of those imports rises and trade shrinks to M(2), with a loss of the trade gain of the shaded area. Note that the loss is not just the small triangle familiar from tariff analysis but an area that depends on the total level of imports as well as the height of the regulatory cost. Thus we can say with reasonable certainty that the potential welfare losses from regulatory protection are many times the size of those from tariffs of the same height, which at least generate tariff revenue.

The trade effect of a ban on imports would be given by M(1) - M(0), the free trade quantity; the trade effect of the regulation would be M(1) - M(2), the loss of trade with the regulation in place. The regulation is of course less trade restrictive than the ban.

How should one measure the trade effects? Presumably the easiest way is to use the concept of a tariff equivalent (as chosen by KCG). This can be defined as the tariff that would restrict trade to the same extent as the regulatory protection. In the simple case given here the tariff equivalent is just the cost of compliance. This gives a fair indication of the volume

[4] In passing one should note that if the cost is in the form of a bribe to the customs officer the effect is much more like the tariff case.

effect of the regulation, but it should be remembered that the welfare impact can be many times as great as a tariff of the same height.[5]

Exporter Perspective

What does the situation look like from the viewpoint of the exporter? If the world market price is not impacted by the importer policy then exporters in general should not notice the loss. To be sure the world market has shrunk, but by an amount too small to change price: it is as if there are other importers only too willing to buy the displaced goods. But exporters do care when even small markets are denied, and KCG find the amount of trade that is retarded by the regulations to be significant. There are a number of reasons why the exporter might care. Either the exporter concern is political reality but an economic illusion. For each firm wishing to get into the market the barriers appear significant, even though the actual *ex post* impact on total export earnings may be statistically insignificant. Or the policy is discriminatory, aimed at US exporters rather than those from Australia. In this case the loss of market comes out of US exports rather than being shared by all exporters. The price will drop to the exporter, as the importers will continue to buy at the world price but the particular exporter that has to comply with the (specific) regulation will bear the cost of compliance. A third reason may be that the exporter is a large supplier, even though the importer is small. In this case although the price does not change perceptably the actual trade volume is concentrated on the large suppliers and hence may be noticable. The "large-country" case is treated seperately, below.

The model that illustrates these possibilities is shown in figure 2. In the left hand panel the exporter faces a fixed world price and sells the quantity X(0). The importer non-tariff barrier has no (measurable) impact on world prices and hence no (measurable) effect on the exporter. Bilateral trade flows are modified, and individual firms can be disadvantaged, but the aggregate impact is to small to show. If this indeed is a common phenomenon, one could conclude that the cost of such regulatory protection is borne by the importer, through a wasteful set of administrative trade measures which add to the real cost of imports without serving any purpose. The exporter may complain but if the alternative markets outlets exist there is little real economic cost to the exporting country.

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[5] This raises the question as to whether the tariff equivalent actually gives enough information to be used as a proxy for non-tariff barriers which involve real resource costs rather than financial transfers.

In the right hand panel of figure 2 the assumption is made that only this exporter is having to face the regulatory barrier. In this case the net price received from this market drops. One would expect the exporter to merely switch supply to other markets which did not require the same standards. Once again if the other markets are equally profitable then no economic loss accrues to the exporter. However it is also possible that others will target the exports from this country, in which case the net price is reduced on all exports. The exporter ends up by paying for the cost of compliance. Importers can simply buy from other exporting countries. An important implication of this is that one needs to know whether any particular trade barrier applies to all other exporters to one market, and whether other importers also use the same barriers. The incidence of the barrier will depend on these two aspects of universality and specificity.

B. The SPS Model

The characteristic of an SPS trade barrier is that it purports to protect the domestic farm and food sector from unwanted disease that might otherwise come with imports. Imagine initially a situation where an importing country maintains a ban on the importation of a good from countries on the grounds that a pathogen is endemic in those country. Its importation, along with the desired good, would lead (with 100 percent certainty) to the spread of the disease domestically. This is essentially the model used by Orden and Romano for exploring the avocado case. Assume for now that the importing country is a small player on the world market for the product (i.e. its trade volume will not affect the world price). Assume that there are no pathogen-free suppliers, but that by testing (or otherwise sorting) the product a safe product can be identified. The same regulations apply to all suppliers. Assume further that the impact on the domestic production of the pathogen is to make it more costly to produce (shift up the supply curve) or to cut production from a part of the country (shift back in the supply curve).[6] We now have the basis for a simple partial

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[6] The externalities arising from imports can be measured by the cost of avoiding the pathogen by domestic action (such as vaccination), rather than as the impact on production or demand of the domestic release of the pathogen per se. There may indeed be many alternative ways of intervening each of which should be analyzed separately. However in each case there will be a change in the relation between price and quantity supplied, i.e. it can be represented by a shift in the supply curve. Paarlberg and Lee decompose the relationship between imports and domestic supply into that between imports and outbreaks of aftosa and that between outbreaks and production loss. Such disaggregation is a useful way of formulating the technical information needed to estimate the relationship.

equilibrium open economy product market model from which to derive some basic propositions.

Importer Perspective

The market situation is shown in Figure 3. S(0) represents the supply curve in the absence of trade. The corresponding import demand curve is Dm. Opening up to trade (and not testing) will shift the supply curve up (or back) to S(1), corresponding to an import demand curve of Dm(1) and imports of M(1). The price level is P(1), the world price. There is an apparent gain from trade, but against this must be offset by the loss due to the pathogen which can be thought of as a negative externality which shifts the supply curve adversely.[7] Testing for the pathogen at the border removes this externality but at the cost of raising world price to P(2). This in essence corrects the externality, so that P(2) represents the world price for the product without the pathogen. Demand for imports is now Dm, reflecting the supply that obtains in the absence of the pathogen. This gives a gain from trade bounded by P(2) and Dm. (Note that the intersection of P(2) and Dm(1) has no meaning as an equilibrium as it cannot be maintained.)

We can now define the trade impacts of two potential SPS instruments:

(i) the original ban, which has a trade impact of M(1) - M(0), i.e. the impact on trade if the ban were removed but no action taken, or

(ii) border testing, which has a trade impact of M(1) - M(2), i.e. the impact of testing relative to no testing.

This illustrates an important point. We can list SPS measures by their impact on trade. In this case testing is less trade distorting than the ban. Trade only shrinks to M(2) rather than M(1). To quantify these effects, assuming we know the market parameters, we need to add two technical bits of information:

(a) the extent to which testing raises the cost of imports, and

(b) the extent to which the import of the pathogen would shift the domestic supply curve.

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[7] One could also imagine that the act of importing could have a positive impact on domestic supply, either by introducing some competition (i.e. removing x-inefficiency) or by the spread of technology or marketing ideas. In this case the regulatory barrier should perhaps be negative, i.e. an invitation to import rather than a restriction, which in itself indicates the limited practical nature of this variant.

With these bits of information one could assess the impact on trade of the instruments as well as the welfare gains and losses from each instrument. The concept of a tariff equivalent is however complicated in this case by the shift in the curve. In fact the total tariff equivalent can be broken down into that which is due to the regulation *per se* and that which is due to the externality, i.e. the event the regulation was to prevent.

Exporter Perspective

What of the exporter in this case? As before it all depends on whether the world price shifts and whether the SPS is specific or universal. The shift in domestic supply will not be enough to move the world price unless the country is a small trader but a large producer.[8] In the case discussed above the testing is assumed to be universal, so no one exporter faces all the costs. And it was assumed that the import market was small relative to the total world market. Therefore the impact on any (small) exporter is insignificant. The importer bears the costs, reaps the benefits and makes the calculations. The exporter rationally would just absorb the SPS as a quirk of this particular import market, much like a characteristic of consumer taste. Exporters would sell elsewhere if the cost of servicing this market got to be too large.[9]

If however the exporter were large in the market, and thus were to experience a price change, or if the SPS only effected this exporter then the calculation is different. The result would be a loss of the trade gains, as shown in the right panel of Figure 2.

C. The TBT Model

The analysis in the SPS model was based on the existence of a link between imports of a good and domestic supply conditions. Supposing instead that the link is between trade and the demand conditions, through the information imparted by the import regulation. The

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[8] This case may actually be fairly common. The largest countries tend to be fairly self-sufficient, and may therefore pass as "small countries" from the point of view of world markets. But a serious outbreak of disease in a crop or livestock herd could make a significant impact on world markets.

[9] This serves to emphasize an important aspect of the politics and political economy of SPS barriers. The exporter will in general be far less concerned about the health and safety of consumers in the importing country. This is not because they are likely to wish ill-effects on farmers in the importing country (though that might seem to be in the collective best interests of exporters) but simply because the situation in one import market usually has only a small impact on their profits. Of course if the SPS is specific to one exporter then the impact is immediately felt, even if that exporter can shift markets to avoid the effect.

demand will shift outward (as in Thilmany and Barrett) as consumers will get the benefit of knowing what to expect from the imported good. In effect the previous demand curve was assumed to have built into it limited information about foreign supplies.

In the TBT model the effect of not conforming with the requirement would be some consumer confusion and hence lower trade volumes. In these circumstances the measurement of externalities should presumably not focus on the trade impact of a ban. But there will usually be a "cost of conforming" to the regulations which will have much the same analytical effect as the "cost of testing" in the SPS case. Thus the trade effect of the trade regulation is a balance between the "good" effect of the information flow to the consumer and the "bad" impact of the cost of compliance. The informational effect can be very significant, and might spill over into the demand for the domestic good as well.

Importer Perspective

The model is illustrated in Figure 4. Trade in the absence of the informative regulation is given by M(1), corresponding to the import demand curve Dm, in turn derived from domestic demand D(0) and supply S. Enforcing the regulation raises the demand to D(1) and leads to trade of M(2) (which can be above or below M(1)). The domestic supply curve does not shift, as the imports do not change the cost of domestic production. The gains from trade are now much larger (represented by the shaded area), and for consumers there is a trade off between the cost of the information and its value. Producers at home gain, but on this occasion there is no presumption of distortion: the question is whether the consumer benefits from the information are greater than the cost of providing that information.

The assumption was made in the TBT case that information made the import more useful to the consumer. It is also possible that this information may work against at least some imports. Let us call this the BSE case, which requires a minor variant of the above model. In this case the demand curve will shift down when "unregulated" trade opens up, and up again (perhaps not to the same point) when the regulation is imposed. The trade impact will be different. Import demand would decline with trade as the impact was felt on consumption. The regulation "rescues" the situation by alerting consumers to the presence on the market of goods for which they have a disaffinity. The assumption is that the original demand curve was for the product as considered healthy by the consumer: the possible inferiority of certain imports was not built in to the original demand curve. The TBT and the BSE models are therefore formally similar. Whether one starts with a "naive" consumer who is easily duped by unscrupulous foreigners (or more accurately by profit seeking importing firms) or a suspicious consumer who needs the reassurance of government

regulations to rise above his xenophobia is probably a matter of modeling taste. Thus the analysis of regulations that relate to trade in agricultural products can take account of such consumer "scares" as alar on Washington apples, poisoned Chilean grapes, toxic Mexican strawberries as well as beef from mad British cows.[10]

Exporter Perspective

The introduction of information regulations which enhance the market will generally benefit the exporter. However the incidence of the cost is still relevant. If the import regulation is universal to all suppliers but specific to that market then the importer will tend to bear the cost and the larger market will be a bonus to exporters - though each one may be too small to notice the benefit. If the importer imposes the labeling regulation on just one exporter then that exporter will have to bear the cost. The small exporter will not be able to pass on these costs, though a large exporter will be able to charge some of the cost to the importer. Of course if the information encourages consumers to substitute away from the exports of particular countries then they will tend to be negatively impacted and will bear the full cost of the regulation.[11]

The analytical model for the exporter in the TBT case is similar to that of the SPS case, suitably reinterpreted, and therefore need not be repeated. A TBT that corrects for information deficiency will expand exports just as will the *absence* of an SPS. To the exporter it matters little (in terms of sales revenue) whether the firmer market price is due to stronger consumption due to consumer confidence or a reduction in production due to the spread of disease. In practice however the politics are likely to be very different, and the business strategies of individual firms will clearly differ in the two cases.

D. The World Price Effect

The models above assumed that no country was by itself large enough to influence world prices by its actions. If a country changes the world price by its decision as to what SPS instrument to use, or whether to introduce a TBT, a terms of trade impact must be included

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[10] Whether or not there was any credible scientific justification behind the consumer reaction, the demand for these products was certainly affected.

[11] The cost of the export ban on British beef as a result of the BSE scare thus falls on the UK as a relatively small player in the world beef market. In this case an export ban is analytically similar to a ban by all countries on imports from that country (i.e. importer-universal and exporter-specific.)

in the analysis. This would have a small impact on the gains from trade and have implications for other trading countries. The terms of trade effect can be thought of as apportioning the cost of compliance. This can be illustrated by means of Figure 5. Assume just a single importer facing a single exporter. The cost of compliance becomes a wedge between the price that the importer pays and the price that the exporter gets, net of compliance costs. The incidence is therefore simply determined by the ratio of the elasticities of excess supply and excess demand. The less flexible side of the market bears the largest part of the cost.

Does the large country case raise the possibility of strategic games to maximize welfare? It is always possible that a country might use its SPS in order to gain terms of trade advantage for the nation as a whole, as opposed to profits for protected sectors, though this seems unlikely. The Paarlberg and Lee case of FMD assumes a large country, as presumably appropriate for the US case which they explore. However they postulate the use of tariffs in place of bans for SPS purposes, rather than using the more common habit of using SPS barriers for commercial policy purposes. The crucial difference between tariffs and technical regulations is that the cost of the regulations involves a real resource outlay rather than a financial transfer. It is thus much less likely, though not impossible, for the terms of trade gain to offset the distortion loss, as this latter element is much larger than the efficiency loss "triangle" of tariff theory.

If the imposition of the TBT causes world price to change (i.e. the impact on demand is such as to shift world markets) then there might be some terms of trade impact in this case as well. In general the impact on world price of such TBTs as packaging regulations is likely to be small. This is not always going to be the case where consumer confidence, as opposed to marginal convenience is concerned. The BSE incident shows that considerable demand shifts are possible from consumer confidence swings, and that these could easily be enough to shift world prices.

E. Exporter and Importer Differentiation

In order to calculate the extent of the price rise of imports, and hence the full impact on the domestic market, we need also to know whether the regulation is importer-specific or whether other importers use similar regulations. A small importer acting alone will in effect pay the full cost of compliance. Otherwise no-one will sell to that market. If all importers impose the same regulation then the cost will be shared with exporters, who can no longer avoid it by selling to other markets. The compliance cost becomes incorporated into the

world price. Similarly if the importer is “large”, in the sense of influencing world prices then that importer can in effect get the exporter to pay for a part of the compliance cost.

It was suggested above that the impact of the import regulations on the exporter differed depending on whether they applied universally or specifically. If only one exporter is know to harbor the pathogen, and that country is not the dominant exporter in the market, there will be no net trade impact from imposing testing requirements on that exporter. Trade will take place at the world price level, and that exporter will have to bear the full cost if it wants to compete in this particular market. In most cases we would expect there to be other markets where the cost of entry (i.e. testing) is smaller. This implies that the conditions of competition on world markets are important.

If one thinks of the world market in Armingtonian terms then each supplier has a monopoly on selling a particular differentiated product. Consumers in the importing country will be more affected by import regulations. If all suppliers compete in a homogeneous market at a “world” price then the cost is borne by the supplier who has to meet the importers standards.

TBTs are more likely to apply to all suppliers, though sometimes the cost of compliance could differ among exporting countries. Discriminatory TBT models are therefore less likely to be relevant. However, one could introduce into customs union models TBTs that operate only on goods coming from outside the preferential area. This would allow an assessment of mutual recognition agreements

F. Customizing the Model

Several additional aspects can be incorporated in these basic SPS and TBT models to make them more specific to particular examples. Only two such aspects will be mentioned here: the location of testing and the issue of risk assessment.

Location of Testing

One aspect of the modeling framework which can have an impact on the incidence of the burden of these non-tariff barriers is the location of testing.[12] If the testing were done at the level of the foreign producer rather than at the border (essentially requiring the foreign

[12] This issue is not unrelated to that of the “equivalency” issue (whether a production or processing method regulation can substitute for a product standard) and the question of “mutual recognition of testing methods” (whereby regulatory authorities accept the results of each other’s tests).

producer to adapt all production not just the amount exported) then the foreign consumer would be affected as well. They would not be able to "escape" the testing costs on output retained at home. This would not have any impact in the small country case but would influence the exporters excess supply curve, and hence have a modifying impact on the terms of trade change in the case that the importer is "large". The cost of the testing will ultimately end up being absorbed largely by the consumer. However the point at which the cost is imposed has an impact of foreign exchange flows. (A main point of the Sumner and Lee paper is modeling of the incidence of the burden of the regulations.) If the cost is borne by the importer the foreign exchange cost of the imports is less than if the exporter has to bear the costs. The cost of meeting TBTs would seem likely always to fall on the overseas supplier. The foreign exchange price will therefore tend to include it.

Probabilities and risk assessment

Most situations of pest control involve probabilities of infestation rather than certainties. Paarlberg and Lee illustrate the way in which such probabilities can be handled in their study of FMD. Uncertainty about an outcome makes it necessary to couch the analysis in terms of expected values. In cases where the risks of producer or consumer impacts are slight the shifts in the demand curves can be reinterpreted as "worst case scenarios" and the calculations need to take into account that in many instances the impacts will be nil. The costs and benefits from the various SPS instruments can then be expressed as means and variances rather than as simple point estimates. Much of the skill in modeling SPS barriers will be in the translation of scientific knowledge of animal and plant health effects into probabilities of loss and valuations of that loss.

G. Conclusion

Where does this leave the potential model-builder wishing to estimate the effect of SPS and TBTs on trade? The following list of questions serve as a useful checklist.

- What is the nature of the SPS or TBT? Is it related to plant and animal health, consumer safety, packaging requirements, or other technical standards? This gives an early indication as to the model to use, though many regulations will have multiple objectives (Roberts and DeRemer, 1997).
- What instruments are used in the policy? Testing, prohibitions, labeling requirements, certification of origin? The translation of instruments into variables, equations and constraints in models requires imagination and experimentation.

- What would happen to domestic supply if the regulation were not in force? Would the domestic supply curve be shifted at all by the importation of unregulated goods? What would this do to domestic costs? How could the infestation be controlled, and at what cost? Technical information needs to be put in a form usable in the model.
- Would there be implications for consumer behavior in the absence of regulations on imports? Would consumers lose confidence in the product if not held to specific standards? Would consumers be able to recognize qualities of products without the help of regulations? What is the net effect of the regulations on the consumer demand curve? This entails estimation which may be even more difficult than in the case of supply shifting regulations.
- Are the regulations common to all importers, implying that there is no unregulated market available to exporters? Do the regulations apply to all exporters or is there differentiation by source? Ideally this requires knowledge of the regulations of all countries: in practice it implies that some indication of the behavior of competitors is needed to be able to estimate the incidence of the burden of complying with regulations.
- Does either the importer or the exporter have any market power? Is the market characterized by competition or are there dominant players which could influence the world price through their action? This requires some indication of the world market for the commodity in question, so as one can impute the terms of trade impact of the regulations under study.

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