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MEASURING AND MODELLING NON-TARIFF DISTORTIONS WITH SPECIAL REFERENCE TO TRADE IN AGRICULTURAL COMMODITIES

by

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RESUMÉ

Ce document examine les problèmes provoqués par l'utilisation accrue des mesures non-tarifaires (MNT) devenues l'instrument favori des gouvernements pour intervenir sur les marchés des produits de base, en particulier celui des produits agricoles. Afin de comprendre les effets des MNT et de les comparer avec les tarifs, le document se réfère au concept standard de l'équivalence et de la non-équivalence avec les tarifs. Ce document établit et développe également une comparaison appelé quasi-équivalence entre deux instruments, comparaison particulièrement pertinente pour analyser les nombreuses différences existant entre les effets des mesures tarifaires et non tarifaires.

Ces différences entre les tarifs et les MNT ont plusieurs conséquences qu'une seule mesure ne saurait résumer de manière adéquate. Néanmoins, les effets sur les prix MNT peuveut être chiffrés soit en utilisant le taux réel d'assistance (TRA), soit les équivalents de subvention à la production (ESP). Si le calcul du pourcentage net du PSE est effectué en se basant sur les prix mondiaux et la prise en compte de la plus grande variation possible des prix des intrants, il est identique à la mesure TRA.

Dans le passé, pour représenter les effets des MNT, les auteurs les convertissaient généralement en "équivalences de tarif" ce qui suppose que les écarts entre les prix sont constants. Alternativement, ils utilisaient des équations de transmission de prix ce qui suppose un degré arbitraire de transmission. En fait, la seule façon de calculer correctement les effets des MNT (qui déséquilibrent gravement les marchés) est de les representer (modeler) directement. De nombreux exemples de représentation directe sont fournis dans ce document. Beaucoup de MNT ont sur le commerce international un impact sur les prix plus important que ne l'auraient des tarifs équivalents. Une augmentation de l'emploi des tarifs et une diminution de l'utilisation des MNT rendraient les distorsions commerciales plus transparentes et plus accessibles à la comparaison favorisant ainsi une réduction notable de l'instabilité sur les marchés mondiaux des denrées alimentaires.

SUMMARY

This paper examines issues which have arisen from the growth of non-tariff measures (NTM)s as the preferred instrument of government intervention in commodities markets, especially for agricultural commodities. In order to understand the effects of NTMs and to compare them with tariffs, the paper uses the standard concepts of equivalence and non-equivalence with tariffs . It also establishes and develops a comparison between two instruments called quasi-equivalence which is particularly useful in analysing various differences between the effects of tariffs and non-tariff measures.

These differences between tariffs and NTMs have several consequences which no single measure can adequately summarise. Nevertheless, the **price** effects of NTMs can be captured by using either effective rates of assistance (ERA) or producer

subsidy equivalents (PSE)s. When the net percentage form of the PSE is calculated using world prices and allowing for as many input price changes as possible, it is identical to the ERA measure.

To model the effects of NTMs, past authors have usually converted them to "tariff equivalents", which assume that the price wedges are constant, or they have used price transmission equations which assume an arbitrary degree of price transmission. The only way of capturing accurately the effects of NTMs which severely distort markets is to model them directly. A number of examples of direct modelling are provided.

Many NTMs have a greater impact on international trade than the price-equivalent tariffs would. Increasingly the use of tariffication and reversing the growth of NTMs would make trade distortions more comparable and transparent, thereby substantially reducing instability in world food markets.

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PREFACE

Within the framework of the Development Centre's 1990-1992 programme on Developing Country Agriculture and International Economic Trends, the Centre is analysing the implications for developing countries of agricultural trade liberalisation and alternative trade scenarios. A central element of the research is the analysis of agricultural protectionism and other distortions, using the Centre's Rural Urban North South (RUNS) global modelling instrument.

The measurement and modelling of market distortions presents a formidable challenge. This paper offers methodological and conceptual insights aimed at providing perspectives on measurement issues. It shows that non-tariff measures differ from tariffs in important ways, but that it is possible to derive equivalents for both these trade distortions. Given the difficulties associated with the measurement of non-tariff barriers, the paper makes a powerful argument for tariffication. This would make all trade measures more transparent and comparable and also eliminate the perverse effects of some non-tariff measures on production and trade, and it would reduce instability in world food markets.

The paper will be of interest to those engaged in the difficult task of measuring and modelling trade distortions, factors which in the OECD countries alone are estimated to cost in excess of $300 billion. It is more important than ever that the effects of trade interventions are accurately measured and modelled, providing the basis for constructing long-lasting and equitable policy reforms.

Louis Emmerij
President, OECD Development Centre
June 1991.

I. INTRODUCTION

This paper examines a number of closely related aspects of measuring and modelling non-tariff distortions of international trade. These aspects are relevant to the current development of quantitative measures for the surveillance of trade and industrial policies in the OECD and to the current discussions in the GATT, the EC and other international fora of ways of negotiating reductions in these measures.

The focus is on trade in agricultural commodities. Trade restrictions on international trade in many agricultural commodities are particularly severe. Some 38 per cent of the total value of OECD countries imports of agricultural products were subject to non-tariff measures in 1985 and the percentage has been increasing (OECD, 1990, p. 75). Nevertheless, it is important to recognise that the qualitative effects of using a particular instrument in the market for an agricultural commodity are the same as those of using the same instrument in the market for a non-agricultural commodity. There is nothing of importance to the analysis of the issues concerning assistance and trade that is peculiar to agricultural markets. Consequently, one must use the same methods of analysis for all tradeable commodities, although the relative frequency of instruments does vary among markets.

It is also important to bear in mind that border interventions may **increase** the aggregate quantity of goods traded in some instances, or they may change the distribution of the quantity traded on world markets among supplying countries, or increase the variability over time of world prices. Consequently, we refer to non-tariff **distortions** rather than non-tariff restrictions on international trade flows.

The analysis begins in Section 2 with a review of the notion of the equivalence or non-equivalence of a pair of instruments. The concept of equivalence, and its complement, non-equivalence, gives a precise interpretation to differences between instruments. A concept of quasi-equivalence is introduced to facilitate the comparison of alterative measures of support in the following sections. The problems of choosing an aggregate measure of support or assistance across commodity groups or industries are considered in Section 3. This section compares the two main contenders, the ERA and the PSE. Section 4 considers complications which stem from the fact that almost all measures of support which are actually calculated relate to a group of commodities, not to a single homogeneous commodity. The comparison of non-uniform rates within such groups is similar to that of ERAs across industries but it has received much less attention. In Section 5, we consider the desirability of modelling directly the effects of market intervention without recourse to any summary measures of support. This approach is especially appealing in the markets of agricultural and other commodities in which the instruments are either quantitative in nature or there is a multiplicity of instruments. Section 6 looks at the question of tariffication of NTMs and Section 7 states the main findings.

II EQUIVALENCE AND NON-EQUIVALENCE OF INSTRUMENTS

To make the comparison of two or more instruments precise it is customary to introduce the concept of non-equivalence. Several examples will be given and the concept will be extended to identify important differences between tariff and non-tariff measures.

This concept of non-equivalence dates back to the paper by Bhagwati (1969) though both the idea and the term are in Meade (1952). Bhagwati pointed out that a tariff and a quota which increase the domestic price by the same amount will restrict the quantity of imports to an unequal degree if there is a sole domestic producer or foreign supplier of the commodity or if the quota is held by a sole importer. Subsequently, non-equivalence between a tariff and a quota has been shown to hold under other conditions such as retaliation by the exporting country [see, especially, Rodriguez (1974)], rent-seeking [see Dinopoulos and Kreinen (1989) for a sample of the extensive literature on this topic] and uncertainty with respect to the product price [see, for example, Young (1979)].

The consequences of non-equivalence between two instruments go beyond the magnitudes of the effects on the market variables. It is commonly supposed that any NTM which results in a positive price distortion (that is, the domestic price is greater than the foreign price) will have a market solution with the following qualitative properties by comparison with the market solution under free trade:

1. the quantity of domestic production is increased;

2. the quantity of imports is decreased for an importable commodity and the quantity of exports is increased for an exportable commodity;

3. the effect is felt on both an export commodity and an import commodity.

Counter examples can be found in which the sign of the change in the variables is the opposite to that predicted. A common example which contradicts the first is the effect of an import quota where there is a sole domestic supplier or a few domestic suppliers. In this case a quota may convert a market which was competitive because of import supplies into a local monopoly or oligopoly. An example which contradicts the second in the case of an exportable commodity is that of a support programme coupled with acreage controls (see Section 5 below). An example which contradicts the third is a subsidy on output set at a rate higher than the subsidy equivalent rate of a prohibitive tariff. If the commodity is tradeable, it will convert the commodity from an importable to an exportable and reverse the direction of trade. Similarly, the link between variable levies and tariff revenues on the one hand, and export restitutions on the other in the CAP, has converted many commodities which were once imported into exported commodities.

Although it is commonly supposed that agricultural commodity markets are competitive, the world grains markets have been characterised by Duncan (1990) as oligopolistic and some food processing markets are imperfectly competitive. In imperfectly competitive markets two different instruments may have different effects on the markets. Moreover, trade restrictions may themselves change the nature of competition in an industry [Goldberg and Ordover (1991) provide a survey of this literature].

It is also possible to find combinations of instruments which result in simultaneous exports and imports. Brander (1981), Brander and Krugman (1983) and others have recently constructed situations in which there is reciprocal dumping, that is two-way trade in a homogeneous commodity between two trading countries with both of them dumping the good in the foreign country. This situation can arise if there are national monopolies protected by trade barriers that allow the producers to price discriminate.

Instruments such as these which produce perverse effects have very different effects than tariffs. To compare the effects of NTMs we shall employ a set of three distinguishable equivalence-type concepts. These distinctions are based on the concept of a **market solution** which was introduced into the comparison of a tariff and a quota by Ohta (1978). A market solution is simply the set of solution values in a market of all endogenous variables; for example, the quantities of market production, consumption and imports, and the prices to consumers and producers, and the value of revenue collected from the instrument to the government.

Equivalence or non-equivalence of some form is a relation that holds between a pair of instruments.

Definition 1

One instrument is said to be **identical** to a second alterative instrument if both instruments, when set at appropriate levels, yield the same market solution.

Definition 2

One instrument is said to be **equivalent** to a second alternative instrument if both instruments, when set at appropriate levels, yield the same market solution except for the incomes of the agents.

Definition 3

One instrument is said to be **quasi-equivalent** to a second alternative instrument if both instruments, when set at appropriate levels, yield the same solution value for one of the endogenous variables.

The complement of Definition 2 is also defined.

Definition 4

Two instruments are said to be **non-equivalent** if they are not equivalent (in the sense of Definition 2).

In Definition 3 it may be that more than one endogenous variable takes on the same values but the possibility that all variables except the income variables take the same values is ruled out. Thus, Definitions 1, 2 and 3 are mutually exclusive. They are in decreasing order of the number of variables in the market which take the same values. Definition 4 is the complement of Definition 2. One could define the complements of Definitions 1 and 3, that is non-identical and non-quasi-equivalent instruments, in the same way if desired.

These distinctions are very helpful. The usefulness of Definition 1 is self-evident. Surprisingly, some pairs of instruments are identical which are not obviously so. An example is the identity of a set of uniform *ad valorem* tariffs and a quota for the commodity group which is specified in value terms and auctioned. The usefulness of Definition 2 is that it isolates the efficiency effects of instruments. These definitions are all partial equilibrium but they have general equilibrium analogues. In the general equilibrium version of the policy problems, two equivalent instruments may both be Pareto-efficient, that is, they yield production and consumption allocations which put the economy on the utility possibility frontier. Economic efficiency rules out the possibility of any slack in the economy in the sense of Pareto-improving reallocations.

Definition 3 is the most useful when one wants to compare the effects on some pre-selected variable. In the comparison of a tariff and a quota, Bhagwati's formulation was in terms of (quasi-) equivalence with respect to the price variable and he then noted that the two instruments had different effects on the quantity-of-imports variable. Shibata (1983) observed, in our terminology, that quasi-equivalence with respect to the quantity of domestic production was the crucial feature as the policy problem was conceived as one of protecting the domestic producers. One can usually compare two instruments by taking levels of the instrument (*ad valorem* tariff rates, values of quotas, etc.) which yield the same value of a variable, say, producer price or production and then compare the value of another variable, say, imports. This gives a precise measure of the difference between protective instruments which affect the volume of world trade differently; for example, for the same effect on prices received by US corn producers, subsidy payments increase the US aggregate supply and excess supply for trade on world markets whereas acreage controls reduce the aggregate and excess supplies (see Section 5 below). This type of comparison is the essential method used to analyse the effects of NTMs. The notion of quasi-equivalence has been implicit in these comparisons.

It is now well understood that any relation of equivalence or quasi-equivalence holds only under certain assumptions. Any modification of one of the critical assumptions will alter these rankings.

Two equivalent instruments may be compared in terms of their income effects. Thus, economists frequently argue that it is better to auction import quota rights to avoid the transfer of rents to quota-holders. The most important applications of this argument are the introduction of tendering for import quotas for motor vehicles and for clothing, textiles and footwear by the Australian Government in 1980 and 1982, and the tendering of import licenses in New Zealand a major feature of that country's import liberalisation programme begun in 1984. (The other reason in the New Zealand case was the desire to measure the degree of restrictiveness of quotas before converting them to tariffs.)

Two non-equivalent instruments may be compared and ranked in terms of their efficiency effects. Consider, for example, a non-prohibitive tariff and an output subsidy. Corden (1971) argued that a subsidy and a tariff are not equivalent and that a subsidy ranks above a tariff because, for an equal effect on price and production, the subsidy avoided the deadweight consumption loss of the tariff. In the absence of lumpsum sources of taxation, this is not true. One must then consider the consumption loss on the commodities which are taxed to raise the revenue for the subsidy or the deadweight loss on production of other commodities if production taxes are used. These deadweight losses will not be equal except by chance and the losses associated with the subsidy may be less than or greater than those of the tariff.

Some pairs of instruments are not quasi-equivalent. A simple example is a prohibitive tariff and a subsidy. Once it is raised to a prohibitive level, raising a tariff further can yield no more protective effect. However, a subsidy can be increased beyond the subsidy equivalent rate of the prohibitive tariff. As noted above, if the commodity is tradeable, it will convert the commodity from an importable to an exportable and reverse the direction of trade.

However, most non-identical pairs of instruments are quasi-equivalent. For example, a set of VERs and a set of import quotas are equivalent, provided they are both fixed in value or in volume terms and apply to all countries without discrimination or to the same subset of foreign countries and certain other conditions hold. If there is imperfect competition or uncertainty, or rent-seeking or retaliation, equivalence breaks down [see, for example, Brecher and Bhagwati (1987)] but quasi-equivalence remains.

Before the concept of quasi-equivalence can be used in a systematic way two choices must be made. One needs a standard instrument with which all others may be compared, and one must choose the variable of quasi-equivalence in order to fix the levels of the instruments.

The term non-tariff measure itself suggests that these should be compared with tariffs. However, in practice, many countries use a variety of forms of tariffs — *ad valorem* duties, specific duties, composite duties (with a specific and an *ad valorem* component), sliding scale duties, variable levies, trigger price and minimum import price mechanisms, etc. Any pair of these will be non-equivalent and the differences may be significant. Consider, for example, a specific import duty which is a common and simple form of tariff. The *ad valorem* equivalent of a specific duty rises as the landed import price falls. If the world price varies or is uncertain, this has

the important consequence that a specific duty gives more downside protection than an *ad valorem* tariff. Falvey and Lloyd (1991) use this difference, and the difference between other pairs of instruments in terms of the price distributions in the presence of uncertainty, to explain why some instruments are preferred to others by policymakers. An *ad valorem* duty is the only form of duty which yields a constant percentage wedge between the domestic and world price. One should use this form as a standard and compare all other tariff forms as well as NTMs to an *ad valorem* tariff. Hereafter, when comparing two instruments, a tariff shall be taken to mean an *ad valorem* tariff.

The question now is which variable should one choose to fix the levels of the instruments being compared. The standard choice is the producer price variable. All of the standard measures such as the "tariff equivalent" or, the PSE except the CSE are some measure of the producer price variable. This choice is made because the focus is on measuring levels of "support" or "assistance" for producers. However, this is not necessarily the best choice. Bhagwati and Brecher (1989) discuss the relative virtues of "price equivalence" and "quantity equivalence" when making comparisons that entail instruments that are quantity-based. When the focus is on the effects which instruments have on imports and exports, Deardorff and Stern (1985, I, para. 20) have suggested we measure this import quantity effect. In the Uruguay Round discussions the Canadian and Nordic countries proposed an aggregate measure of policy effects on trade rather than on producer incomes. In a similar vein Gardner (1989, p. 7) proposed the use of the World Supply Effect (WSE).

There is a strong reason for preferring **price-equivalence** using a producer price-based measure. Prices are the signals to which all producers respond. This holds true even if the response of producers to a given price change depends on, say, whether they are a local monopolist or a competitive supplier. In most instances, two instruments which are producer-price-equivalent will yield the same effects on output[1] but there will be some exceptions when the nature of competition in the commodity market is itself dependent on the choice of instrument. One must recognise immediately that the effects on other variables, including the consumer price, may be different between two instruments even when they have the same effect on producer prices. If one wants to consider, say, the effects of quotas and other instruments on consumer welfare, there is no alternative but to measure the CSE directly.

There is, perhaps surprisingly, more than one way of measuring the effect of an instrument on producer prices(s). These are discussed in Section 3.

One systematic theme emerges in the literature[2] dealing with trade-based instruments. This is the difference between price-based instruments such as tariffs and subsidies on the one hand and quantity-based instruments such as quotas and prohibitions on the other. One example is the competition-reducing effects of quantity-based instruments noted above. A second example is the very different responses of the market variables when price uncertainty is introduced into the commodity market. In comparing tariffs and quotas under uncertainty, one early conclusion was that tariffs are the preferred instrument because they have greater flexibility in allowing the quantity of imports and hence the domestic price to respond to changes in costs and prices in the rest of the world. However, Fishelson and Flatters (1975) and Young

(1979) have shown that tariffs may in fact induce excessive flexibility in some circumstances.

A second theme is that NTMs are generally worse than tariffs in terms of their **trade** impact. This view can be reinforced by comparing a price-equivalent NTM with a tariff and considering the different effects on the quantities traded. The Bhagwati example of a quota which is quasi-equivalent (but not equivalent) to a tariff illustrates this feature. We have also noted the ability of some NTMs to change an importable commodity into an export commodity. Another aspect of the trade effects is the increase in price variability of NTMs which are designed to insulate domestic markets (see Section 6). These last two features are especially common in agricultural markets. NTMs such as VERs and export or import cartels also discriminate among trading countries. The notable exception to these adverse trade effects of NTMs is the output subsidy which has a lesser trade impact than a price-equivalent tariff because it avoids the consumption tax component of the tariff, provided the revenue to finance the subsidy payment is not raised by consumption taxes on importable commodities.

III PSES, CSES, ERAS AND OTHER MEASURES OF SUPPORT

For domestic and international surveillance of NTMs, there is a basic need for a single summary or index of the importance of each measure or of its "restrictiveness". Without such a measure, it is difficult to make comparisons of the importance of alternative measures.

A number of measures have been used or proposed. The oldest is the "tariff equivalent". This measures the magnitude of the producer price distortion or price wedge induced by some non-tariff instrument. (This "tariff equivalent" of an NTM is not to be confused with the equivalence between a tariff and some NTM. It is unfortunate that the same word equivalence has become accepted with two distinct but related meanings.) For example, at the level of commodities, the Australian Industry Assistance Commission (now called the Industry Commission) first converts subsidies, quotas and other NTMs into tariff equivalents at the lowest level of aggregation used and then averages them to calculate "nominal rates of assistance" which are simply the average tariff equivalents. Similarly, most applied general equilibrium modellers have measured the "price wedge" between the domestic and world prices, that is, the tariff equivalents of NTMs.

The OECD uses Producer Subsidy Equivalents supplemented by Consumer Subsidy Equivalents as an indicator to monitor a wide range of tariff and non-tariff policies in OECD countries. The US Department of Agriculture have suggested the use of Producer Subsidy Equivalents for negotiating purposes in GATT. The agreement reached at the April 1989 meeting of the GATT Trade Negotiations Committee approved the use of an "aggregate measure of support" as a part of the framework for the Uruguay Round negotiations. There is now a debate within the GATT over the choice of the appropriate "aggregate measure of support".

The Australian Government has recently proposed the use of Effective Rates of Assistance. The EC has proposed the Support Measurement Unit. There is a similar debate within the OECD Economic Policy Committee which is seeking quantitative indicators for multilateral surveillance of structural policies relating to industrial and agricultural commodities in Member countries. For this purpose a measure which covers tariffs and NTMs and domestic support policies is required.

The discussion of tariffs and NTMs in the previous section is directly relevant to this issue. This discussion has shown that tariffs are not equivalent, in general, to NTMs and two NTMs are not in general equivalent. The immediate implication is that there does not exist any single dimensional measure of the effects of border instruments which can be used to compare all effects of these instruments. This conclusion is not novel. For example, it has been expressed forcibly by Gardner (1989, p. 7) in his survey of agricultural trade liberalisation: "The search for an all-purpose scalar indicator of protection might be likened to aggregating blood pressure, cholesterol level, body weight and so forth to obtain an indicator of health. But the protection measurement indicator has a worse problem. It's like trying to find a scalar indicator of both your health and the fullness of your gas tank."

This conclusion does not quite mean that comparisons in terms of a single measure are meaningless. The single measures may still be useful provided one knows what one is measuring and one interprets the results accordingly. One may still use **one** variable of the market solution such as the price distortion or the quantity imported but these cannot predict the magnitude or even the direction of change of other variables. Section 2 concluded that the producer price variable was the best choice.

There are alternative ways of measuring the effect of an instrument on producer prices(s). There are a number of aspects to this choice including the choice of a gross or net (value added) price, the choice of reference price, the effects of product differentiation and the choice of level of aggregation. We shall now consider the merits and demerits of the two most frequently discussed measures, the PSE and the ERA. The questions of the level of aggregation are left to the next section.

1. The producer subsidy equivalent (PSE)

The producer subsidy equivalent is not a recent concept. It developed in the tariff debate of the 1960s and has been presented in textbooks since the 1970s; for example Corden (1971). In its original form it was proposed as a method of expressing the output subsidy effect of a single *ad valorem* tariff on a single commodity. When applied to another single instrument such as a subsidy, it yields the same measure of producer price distortion as the tariff equivalent, provided the subsidy is expressed as a percentage of the world price and not the domestic subsidy-inclusive price.

The OECD defines the PSE for agricultural commodities as the "value of transfers to farmers generated by agricultural policy. These are paid either by consumers in the form of market price support or by taxpayers via direct payments and other support" [OECD (1990, p. 88)]. (See also Cahill and Legg, 1990.) It is calculated typically for a commodity on an annual basis. It is presented as a dollar total, or the dollars per unit of output, or as a percentage of total production valued at internal prices. In earlier calculations the OECD did not include the effects of any increases in the prices of intermediate inputs due to assistance provided to the upstream industries supplying these inputs in a form which increased the domestic market prices. In recent years, the OECD has made an adjustment for the one important example of government-induced increase in input prices, namely, additional costs of feed to livestock producers as a result of market price support on livestock feeds. This adjustment gives the "net" PSE measures for livestock products and eggs and poultry. [See OECD (1990) for recent discussion and estimates.] The USDA defines and calculates the measures in essentially the same way. [See, for example, Mabbs-Zeno and Dommen (1989).]

The OECD and USDA seem to regard the PSE as an adequate summary measure. The OECD uses PSEs to monitor changes in assistance to agriculture in OECD countries. The USDA regards it as a yardstick that measures the combined effects of different intervention policies, some of which affect prices directly and some of which involve direct payments to producers and some of which are input subsidies

to the producers of the commodities considered. It enables government to compare aggregate assistance across commodities ("apples and oranges") and countries (USDA, 1989). In the context of negotiations of the instruments included in the PSE calculations, USDA believes it has an advantage over the traditional rules approach: "An aggregate measure would allow GATT members to choose which kinds of agricultural assistance they would use and which they would discard as long as they met the targeted level [of reductions]" (Mabbs-Zeno and Dommen, 1989, pp. 2-3.) Tangermann, Josling and Pearson (1987) make the same argument in recommending the use of PSEs in GATT negotiations.

A money metric such as a PSE has appeal because it is readily understood. The measure has the further appeal that the dollar components which go into each measure can be simply added and over time the year-to-year changes in total support can be decomposed into the changes due to each component, that is, to changes in volume and changes in price support, direct payments, and other support and feed adjustment per unit of output [see OECD (1990, Annex II).] This is appropriate for a measure of the cost of transfers to the agricultural sector from agricultural policies. However, this appeal can be misleading. PSEs do not measure the effects of policy measures on production, trade and other variables. One is adding components which may have a very different effect on production or imports/exports or any variable other than farm prices because the component instruments are not equivalent. There are a number of conceptual difficulties with interpreting PSEs.

The first difficulty is that, in using internal prices which are higher than world prices for all assisted commodities, the PSE measure understates all of the percentage price movements. For example, OECD (1990, p. 92) estimates that the average net percentage PSE in 1989 for OECD agricultural production was 38 per cent but when the price increase is measured properly as the percentage change over the price excluding assistance, it is 54 per cent. However, this adjustment does not change the ordering among a set of PSE measures.

A second difficulty arises from the use of internal values to calculate the percentage measures. Peters (1988) noted that, when the PSE is expressed as a percentage of the value of production at producer prices, it is sensitive to the mix of policies which the country uses. He constructs an example in which dollar total of assistance is fixed but the measured percentage PSE can be changed from 59 per cent to 116 per cent by altering the mix of policies from price support to input subsidies. The former affects the domestic price while the latter does not. This feature stems from the use of the internal prices in the denominator. It is a question of presentation and can be overcome by expressing the PSE as a percentage of the value of production at world market prices, as Peters suggested. Indeed in its 1991 Monitoring and Outlook Report nominal assistance coefficients which express the PSE value as a percentage of world prices are given for each OECD country and commodity.

A third related difficulty arises from the different effects on variables other than producer prices when a PSE measure includes several different policy instruments. This too is a result of the non-equivalence of pairs of instruments. As a simple example, a tariff on an importable commodity has a greater effect on imports of the

commodity than an output subsidy which yields the same producer subsidy equivalent because the tariff also raises the price to consumers/users. This holds even if one uses world prices as the deflator of the percentage measure.

Many of the most highly assisted farm commodities are exported to world markets even though some exporting countries do not have a comparative advantage in these commodities. Assistance to farmers leads to exports in order to dispose of production which is surplus to national demand. Hertel (1989) has neatly illustrated some key differences between the groups of output and input subsidies, export subsidies and acreage controls instruments for exportable commodities. Consider, for example, the differences between subsidies based on output and subsidies based on inputs when the two subsidies yield an equal PSE to the producer. There are many differences in effects because a selective input subsidy distorts the relative price of inputs and will lead to substitution among inputs unless the technology has strictly fixed proportions. Thus the removal of an agricultural input subsidy will have a greater effect on (long-run) output (and hence exports and probably also farm labour employed) than the removal of an equal-PSE output subsidy when the input subsidy is a substitute for land, such as fertilizer. The logic of the proposition stems from the fixed supply of land which constrains output. On the other hand, the effects of these equal-PSE reductions on land values are the opposite. All forms of subsidies are partly capitalised in the value of land but a cut in the PSE resulting from a cut in the subsidy of an input which is a substitute for land will have a lesser effect on land values than a cut in an output subsidy. "This is because farm land becomes relatively more scarce as the mix of inputs moves away from land substitutes, thereby serving to bolster land values in the face of declining farm-support levels." (Hertel, 1989, p. 21).

Similar results follow from the comparison of output and export subsidies. "The impact on the farm sector of an export subsidy will generally exceed that of an output subsidy of equal cost." (Hertel, 1989, p. 19). In particular, an export subsidy will have a greater effect on farm output and exports of the commodity concerned than an output subsidy of equal cost. This is because the expenditure in the case of an export subsidy is based on exports which are the difference between farm output and domestic consumption. Hence the subsidy per unit and the price effect is higher. An export subsidy also raises the price to domestic buyers in order to equalise the returns to sales on the domestic and overseas markets. This non-equivalence between these two instruments can be understood in terms of another equivalence: an export subsidy is equivalent to the combination of an output subsidy and a consumption tax. In fact, this proposition relating to export subsidies is just the negative of the previous proposition relating to the differences between a tariff and an import subsidy for an importable commodity.

This comparison of output and export subsidies has several implications if PSEs are used in negotiations. As Hertel noted, replacing an export subsidy by an output subsidy of equal cost to the government would reduce exports to the benefit of competing countries and it would reduce consumer prices in the subsidising country. It also implies that the PSE of an export subsidy is a multiple of the cost to government of the subsidy, and part of the PSE is paid by consumers.

2. The effective rate of assistance (ERA)

The ERA is essentially a monitoring measure. It seeks to calculate the percentage change in the value added per unit of output (defined at some level of aggregation) under a regime with various government interventions compared to a regime with no interventions ("free trade"). When production processes are not fully integrated, the use of a net or value added measure reflects the fact that assistance to producers is assistance to the factors of production which add value at a particular stage of production. This is the fundamental insight of effective protection theory.

Under certain conditions, the ERA can be interpreted as the price of a physical unit of value added. Value added is, by conception, a monetary magnitude and has no natural units of value or of quantity measurement. The usual assumption is that material input proportions are all fixed. In this case, a production function in terms of the primary (non-produced) inputs defines the quantity of value added output and its dual unit cost function is the price of a unit of output. It is, however, not necessary to assume fixed input proportions in order to interpret value added per unit of output as the price of value added. This interpretation holds if the production function is weakly separable in the primary inputs. [This was proven by Bhagwati and Srinivasan (1973).] Under this condition the ERA is the appropriate measure of the price incentive to the value adding factors used to produce the commodity.

The ERAs do not measure resource movements. This is not the fault of the measure itself but rather a property of general equilibrium behaviour. In an economy with no intermediate input usage the effective rates of assistance are equal to the nominal rates of assistance. In such an economy, when there is assistance to only one industry, the final output of this commodity must increase from its free trade level. But when there is assistance to more than one commodity, it is no longer true that the output of the commodity with the highest rate of assistance must increase compared to free trade. The results depend on the substitutability/complementarity relationships among commodities. However, there is a general presumption that the output of commodities with high rates of assistance relative to the average will increase. These results carry over to effective rates of assistance in economies with intermediate inputs.

The differences between the ERA and the PSE concepts have sometimes been misunderstood and exaggerated. For the purpose of this comparison, it is best to compare the ERA with the net percentage form of the PSE. Both are price measures. Both seek to combine the effects of instruments which affect the producer through market prices for the outputs or direct payments or changes in input prices. They differ, however, in the following respects:

1. the ERA uses world prices rather than internal prices to calculate the percentage effect;

2. the ERA is expressed as a percentage change in the value added per unit of output;

3. the ERA seeks to take account of the direct effect of changes in the prices of all intermediate inputs;

4. the ERA is normally measured at the industry level whereas the PSE is normally measured at the commodity level.

These differences are minor differences in convention. The first could be overcome by using world prices in the percentage PSE measure. The second is basically a matter of interpretation. Consider, for example, agricultural activities. If all intermediate input price changes are included, the change in value added is equal to the change in income of the farm enterprise. This is what is measured by the PSE for agricultural commodities. If there is no outside labour hired, this is also equal to the income of the farm proprietor. The third difference is a matter of coverage. The last difference is a matter of practice. The ERA is a direct product of the theory of effective protection. In principle, the ERA is defined for a commodity, or more accurately an activity, which has a separate production process and which produces a single output. In practice, it is measured at the level of the industry or broad commodity group but it is possible to produce ERAs for individual commodities within industries. In Australia, which has the most disaggregated and detailed ERA calculations of all OECD countries, the Industry Assistance Commission has calculated ERAs for individual agricultural commodities and for commodities or commodity groups in other industries such as the textile and clothing industries.

The ERA is the preferable measure because it defines a percentage price change in the way which measures the change in activity prices to which producers respond and it seeks to include all input price changes. However, the net percentage PSE can be converted into the same measure by using the world price as the reference price and including all input price changes. Conversely, the ERA can be converted to a dollar measure of total assistance which is easily understood.

It is sometimes alleged that the ERA is deficient because it is a partial equilibrium measure, or because it assumes fixed coefficients of production or because it assumes perfect substitutability between imported and domestic goods. It is a partial equilibrium measure in that it measures only a price effect which, by itself, cannot predict the magnitude or even the direction of resource use. However, a set of measures of ERAs can be embedded in an applied general equilibrium model which will predict the changes in outputs, value added and all endogenous variables. Many countries have been modelled in this way by individuals, governments, and international bodies such as the World Bank and OECD.

The assumption that intermediate inputs are fixed is usual but it is not necessary. As noted previously, the ERA can be defined for a separable value added process. In the more general case, the calculation of the ERA would require knowledge of the whole cost function which is more demanding than knowledge of input-output coefficients.

The assumption that the imported inputs and outputs are perfectly substitutable for domestic goods is again usual but not necessary. The model of the economy can be extended to imperfect substitutes. For example, an Armington Model assumes the

final outputs of each country are imperfect substitutes. One can embed effective rates in an Armington-type model, the difference being that the solution will now depend on the Armington elasticities between imperfect substitutes within a group as well as on the other parameters of the model. The concept of an ERA is robust with respect of the assumptions concerning technologies and preferences in the economy.

The ERA concept is, however, like the PSE concept, deficient with regard to the treatment of NTMs. The standard method of treating NTMs for both outputs and input commodities in effective protection measures is to convert each to a tariff equivalent which is then put into the ERA formula. When ERAs are then compared or embedded in an applied general equilibrium model, all distortions are treated as if they are tariffs, the exception being in some cases that the consumer price effects are estimated separately. This method ignores entirely all non-equivalent effects. It is quite inadequate when dealing with quantity-based instruments and complex marketing arrangements of the kind which are common in agricultural trade. The only solution in such cases is to model these interventions directly (see Section 5 below).

The discussion so far relates to ERAs as a tool for policy surveillance. The ERA has been put forward recently by the Australian Government as a yardstick to be used in multilateral negotiations [see, for example, Australian Government (1988)] and this suggestion has been adopted by others [for example, Banks (1989)]. If ERAs were known for all commodities and all participating countries, they could in principle be cut individually or according to some formula in the same way as tariff rates. The use of ERAs for this purpose raises different issues.

A principal problem with using ERAs in any negotiations is the non-equivalence of tariffs and NTMs. Essentially, the problem is the same as with the use of PSEs. Consider two non-equivalent instruments which yield assistance to a producer. Choose the levels of each instrument so that they yield the same ERA, that is, they are equal-ERA instruments. They yield the same value added price effect but must have different effects on other variables. Consequently, reducing one ERA by some proportion will have a different effect on, say, producer output than reducing the other by the same proportion. For example, cutting an agricultural input subsidy will have a greater effect on output than cutting an equal-PSE agricultural output subsidy. Similarly, cutting an export subsidy will have a greater effect on exports than cutting an output subsidy with an equal PSE.

Non-equivalence also implies that it would be possible to cut ERAs and increase outputs or exports for an assisted exportable commodity (or not increase imports for an assisted importable commodity) by switching the mix of instruments. For example, a government could cut the ERA on some commodity or commodity group and maintain or even increase its output if, at the same time, it switched assistance from, say, output-based subsidies to input-based subsidies. Similarly, a government could cut the ERA and maintain or even increase exports if, at the same time, it substituted an export subsidy for an output subsidy. These trade implications would be of concern to trading partners in multilateral negotiations. As soon as one must consider the instruments which comprise ERA measures they lose their attractiveness as measures for exchanging "concessions" in negotiations.

These two objections, as with the same objection to PSEs, are important for small changes to the aggregate measures of support. However, if the cuts are large they will undoubtedly reduce the level of support for producers and reduce the distortions of world trade.

A greater problem is that any agreed cuts in ERAs would have to be translated into changes in the component instruments; for example a cut in variable levies or an increase in the import quotas. A related complication is that ERAs in practice are calculated only for a subset of instruments. Some instruments such as VERs and state trading are difficult to measure and some such as anti-dumping and countervailing duties are not considered normal assistance, but all such instruments may be part of the multilateral bargaining[3].

Another concern with using ERAs for negotiations is that they are usually measured at the level of an industry. This might encourage bargaining on an industry or sectoral basis. Such industry bargaining may be difficult and may limit trade-offs across industries.

IV AVERAGING ACROSS AND WITHIN INDUSTRIES

To interpret a set of ERA measures for an economy, there is a standard argument that it is the disparities among them rather than the absolute levels which are important. This argument is concerned with the resource allocation effects of government assistance and it follows because it is relative producer prices that determine resource allocation within an economy. (If there are non-tradeable commodities in the economy, the absolute levels of ERAs do matter as they affect the prices of tradeables relative to non-tradeables.) The usual device is to compare the ERA for some industry with the economy average and sometimes to measure the variation by some statistical measure such as the variance. An industry which has an ERA substantially above (below) the average has a larger (lesser) output than in the free trade situation. Consequently, it has used more (less) resources in the aggregate than in the free trade situation.

One can say more. The effects of a given structure of ERAs depend on the relationships of substitutability/complementarity in supply between all pairs of industries (commodities). This is a very complex matter. These relationships depend, in turn, on the factors used in each industry and the elasticities of supply of these factors. Industries which use similar factors will be closer substitutes in supply. Industries which use distinct factors will tend to be poorer substitutes in supply. In particular, agriculture which uses agriculture-specific resources such as land will be less affected in general by assistance to other industries. (Or, to put it the other way around, to effect a given resource transfer to agriculture from other sectors will require a higher rate of assistance.) On the other hand, resource mobility may, in some instances at least, be greater within industries than between industries. This could hold because of similarity of factor intensities, geographic proximity or superior within-industry information concerning jobs and rates of return. Much of the movement of resources induced by government interventions may occur within industries or sectors such as agriculture.

The possibility of **intra-industry** distortions implies the need to measure ERAs for individual commodities or activities within industries. Ideally, one should use a model of industry behaviour to yield the correct set of weights. The weighting system will vary from industry to industry depending on the structure of the industry in terms of the relationship of the production of commodities in the industry to each other. The industry average should then be expressible as a weighted average of the commodity rates. The usual method of calculating the industry average is to weight differential tariff or tariff equivalent rates on outputs by the unassisted value of output shares of each commodity, and to weight the differential rates on inputs by shares of the unassisted values of these inputs in the whole industry. This is approximately equivalent to weighting the effective rates of commodities by the shares of value added.

ERAs will not be a reliable predictor of output change in cases where the assistance is due to an NTM which has a perverse effect on the output of the commodity or commodities assisted. Similarly one must use nominal rates of assistance or, in cases in which the nominal or gross assistance is not wholly due to an increase in the market price, the CSE in order to predict the pattern of change in demand.

V MODELLING NTBS

Surveillance should not be confined to measuring the price effects of tariffs and NTMs. For NTMs which alter the direction of change of output or imports or other variables this is especially important. In such cases we must model the effects of these instruments.

The simplest and most common assumption in models with respect to NTMs is to assume a constant *ad valorem* price wedge between the domestic and the international market and to estimate the average wedge in some year or sample period. This may be called the "tariff equivalent" approach. It can be extended to allow different consumer and producer wedges. Yet, it is plainly inadequate as it treats as constants price differentials which vary greatly over time as world prices fluctuate and government policies change. For example, the estimates of percentage PSEs for agricultural commodities of OECD countries which are calculated annually in the report on *Agricultural Policies, Markets and Trade* show considerable year-to-year variation. A second major disadvantage of this method is that it ignores all of the non-equivalent effects of non-tariff measures on domestic production, imports and other variables. This method does, however, have the advantage that the rates are easily changed to reflect in a crude way changes in policy.

Another method commonly used in the modelling of agricultural markets is the use of price transmission equations. This might be called the "statistical" method. It was introduced by Bredahl *et al.* (1979) and is used, for example, in the RUNS model [Burniaux and van der Mensbrugghe (1990)] and in Anderson-Tyers multi-commodity model of world food markets [this work is reviewed in Tyers and Anderson (1991)]. Under this method, a net export or import equation is derived from the difference between the domestic supply equation and the domestic demand equation. These equations are functions of domestic producer and consumer prices. These domestic producer and consumer prices are then related to the world prices through a price transmission equation or equations.

In the RUNS model this price transmission equation for a commodity expresses the domestic price as a linear function of the world price of the commodity and the price of non-agricultural commodities:

$$ppr = [\phi ppu + (1-\phi)pw](1+\tau^o)$$

where *ppr*, *ppu*, and *pw* are the domestic price, the price of other non-agricultural commodities and the world price respectively. ϕ is the pass through coefficient and is τ^o benchmark value of the nominal rate of protection (see Burniaux and van der Mensbrugghe, 1990, p. 35). ϕ is in the interval [0, 1] and determines the extent to which changes in world prices flow through to domestic prices. If $2\phi = o$, $ppr = pw(1+\tau^o)$ and there is a constant wedge between the domestic and world price. If $\phi = 1$, $ppr = ppu(1+\tau^o)$ and the domestic market price is completely insulated from the world price. This assumption is adopted because domestic prices for agricultural commodities are frequently fixed to protect farmers or to fix the prices of staple

products for the benefit of urban consumers. For all cases of ϕ other than 0, the constant wedge limit case, the implicit (nominal) rate of protection varies with the world price. This is the opposite to the fixed wedge assumption.

Anderson and Tyers use a more complex variant of the price transmission model to capture the protection and stabilisation components of agricultural policies. There are separate transmission equations for consumer and producer prices. It is assumed that there is, in association with any border price for a commodity, a "target" domestic price. Actual prices move towards the target price according to a Nerlovian partial adjustment equation. This gives rise to distinct short-run and long-run price equation, each of which is a constant elasticity form. Thus, the "static" or long-run price transmission equation for the producer price of commodity i, p_i^P, for some period and country is given by

$$p_i^P = \rho_i^p \, \bar{P}_i^B (P_i/P_{io})^{\phi i}$$

where $\bar{P}_i^B$, P_i, and P_{io} are the actual border prices in the country, and the international indicator price on world markets in the current period and in the base period respectively. ρ_i^p is the target nominal protection coefficient. It is equivalent to $(1+\tau_i)$ where τ_i is expressed in terms of an *ad valorem* rate of protection. ϕ is the price transmission elasticity coefficient. This is in the interval [0, 1] but in this model 0 is the limit case of complete insulation and 1 is the opposite limit case of a fixed percentage wedge between the domestic and border price. The dynamic version is estimated econometrically. There are corresponding equations for the consumer prices of each commodity in each market.

The finding is that "In general, the long-run price transmission elasticities are less than unity reflecting the prevalence of non-tariff protection instruments in food markets. In the face of volatile and declining real prices in international commodity markets, governments limit the extent to which both the long-run trend and the short-run changes in domestic prices follow those of international prices." (Anderson and Tyers, 1990, p. 49).

These transmission equation models are flexible in allowing a wide range of domestic policies to assist producers, subsidise or tax consumers, and to stabilise commodity market prices. However, they have some disadvantages. The implied interventions which create the differences between domestic and world prices are restricted in form. RUNS assumes that all assistance comes from either a domestic market price above the world price or an input subsidy. Consequently, there are no direct transfers and the distortion of the consumer price is equal to that of producer prices for all commodities apart from that component which comes from input assistance. By contrast, Anderson and Tyers, in estimating the transmission equations independently for consumers and producers, make the opposite assumption that there is no link between producers and consumer prices by means of tariffs, quotas, variable levies or other instruments which raise domestic prices for both producers and consumers.

A second disadvantage is that it is difficult to find single instruments which would yield the fixed degree of pass-through that is modelled. Most instruments yield either complete or zero pass-through for prices at the borders. Instruments such as

tariffs, subsidies and export subsidies and other price-based interventions yield complete pass-through (unless they imply nominal rates of protection which are prohibitive). Instruments such as import or export prohibition, prohibitive tariffs, quotas and variable levies yield complete insulation of the domestic market prices from world market prices. (One needs to distinguish here between prices at the border and at the farm gate for a commodity.) Farm gate prices may be partly insulated from border prices inclusive of all tariffs, variable levies and other domestic interventions because of a variable mark-up between the farmgate and local markets.

The fundamental deficiency of the transmission price approach is that the transmission equations combine and bury the effects of a multiplicity of interventions in individual markets and then aggregate across the commodities with different interventions within the broad aggregates which are usually defined in these models. They are a statistical summary measure but we do not know what interventions they are summarising in each commodity group. The finding by Roe, Shane and Vo (1986) that these elasticities of price transmission are stable over time is a small comfort.

The corollary of the averaging of multiple interventions is that we cannot simulate proposed changes to the individual instruments which cause divergence between domestic and world prices. For example, in the RUNS model simulations of changes in protection are made by varying the pass-through coefficient but this coefficient measures the degree of insulation rather than the level of assistance, though the two are related. Alternatively, one could vary the benchmark parameter but this would not capture reductions in instruments such as the removal of quotas, variable levies and marketing arrangements which insulated the domestic market from the world market. However, one can simulate complete free trade in these models by substituting complete pass-through values for the pass-through coefficient and zero values for the protection coefficient. One can also simulate the somewhat less radical reform proposal of complete tariffication of all border intervention measures for any group of markets in these models. The United States first proposed the conversion of all food import barriers to tariffs to the GATT Committee on Trade in Agriculture in February 1985. Other tariffication proposals have been made subsequently.

If one is to model the effects of individual instruments of policy which affect international trade or to model the effects of multilateral reforms of one group of instruments, one must model the effects of these instruments directly. There is no escape from this course as the inadequacies of the "tariff equivalent" and the "statistical" approaches have shown. It is a direct consequence of the non-equivalence of tariffs and NTMs. This view has also been advocated by Hertel (1990, p. 31) and Whalley and Wigle (1990).

Some examples of direct modelling are now presented.

Example 1: Non ad valorem tariffs

It was observed in Section 2 that many tariffs are not of the *ad valorem* form and that such tariffs are not equivalent to an *ad valorem* tariff.

As an example, consider a **specific duty**, say $\$\bar{T}_i$ per unit of the commodity i imported in some country. A bar denotes a fixed rate of duty. In this case the wedge between the domestic duty-paid price and the border price (p_i^*), expressed in percentage terms, is given by the function

$$d_i(\bar{T}_i,\ p_i) = [(p_i^* + \bar{T}_i) - p_i^*]/p_i^*$$

$$= \bar{T}_i/p_i^*$$

d_i measures the distortion from border prices for commodities subject to such duties. In the absence of any other distortion, and assuming the domestic product and the import are perfect substitutes and the rate of duty is not prohibitive, the domestic price will exceed the border price by this margin. There will be a single domestic price for both producers and consumers alike.

At any time p_{it}^* is known and one can compute the *ad valorem* tariff equivalent. It is (T_i/p_{it}^*). The problem is that p_{it}^* varies over time and consequently so too does this *ad valorem* equivalent. One can construct an ***ad valorem* equivalent function** which expresses the *ad valorem* equivalent function as a function of p_i^*, given the rate of duty, for this form of duty (see Figure 1). This shows that the *ad valorem* equivalent or a fixed specific duty is a strictly decreasing function of the border price. Or, reversing the direction of price change, the (nominal) *ad valorem* equivalent rises as the price falls. This illustrates the property that a fixed specific duty gives more downside protection than a fixed *ad valorem* duty.

Consider a **variable levy** such that the duty is varied to ensure that the duty-paid price is equal to some specified target price, (p_i^b)

viz. $T_i = p_i^b - p_i^*$ *if* $p_i^b > p_i^*$ and 0 otherwise.

T_i is here the duty paid.

The rate of distortion with this duty is a function of p_i^b and p_i^* as given by the function

$$d_i(p_i^b,\ p_i^*) = (p_i^b/p_i^* - 1) \quad \textit{if} \quad p_i^* < p_i^b$$

$$= 0 \qquad \textit{otherwise}.$$

The *ad valorem* equivalent function for this duty is also plotted in Figure 1. This duty yields even more downside protection than a specific duty.

This case of a variable levy is closely related to the case of a quota fixed in quantity terms, viz. $q_i < \bar{q}_i$ where q denotes quantities and $\bar{q}_i$ is the maximum import quota. If the country imposing the quota is a price-taker and the only market variability is in the world price rather than in the domestic demand and supply equations, a quota has the same effects on the market solution as a variable levy. For all prices below some level it maintains a constant domestic price and for higher prices above this level it is not binding.

p_i^b can be interpreted now as the fixed domestic price when the quota is binding.

Consider instead a **minimum price tariff** such that a supplementary duty is paid when the price falls below a specified minimum price, p_i^a. If the basic duty, *ti*, and the additional duty, τ_i, are levied at *ad valorem* rates, the implied *ad valorem* equivalent rate resulting from the tariff is

$$d_i(p_i^*, t_i, p_i^a) = t_i \text{ if } p_i^* \geq p_i^a$$

$$= t_i + \tau_i \text{ if } p_i^* < p_i^a$$

The *ad valorem* equivalent function is given in Figure 1. It is a two-part tariff.

All of these forms of duty are common, either as individual duties or as parts of more complex marketing arrangements, or with the variable levies in the CAP of the EC. They can all be modelled in an applied general equilibrium model or a partial equilibrium model merely by substituting the tariff equivalent function for the fixed tariff equivalent.

Example 2: Output subsidies

Subsidies which are based on output are easily modelled. Most output-based subsidies are fixed in terms of the local currency, say, $\bar{S}_i$ per unit of output, i.e. they are specific rates. These rates can be converted to *ad valorem* equivalents by dividing by the price which the producer received from the market, $s_i = (\bar{S}_i/p_i)$. The consumer price is equal to the market price and is thus less than the subsidy-inclusive producer price.

Many forms of output-based assistance are, in fact, conditional on the price being below some specified target level; for example, deficiency payments. The *ad valorem* subsidy equivalent is then a function of market price and the price level which triggers government payments. This can be modelled in the same way as the variable levy in Example 1.

The subsidy equivalents calculated by the OECD distinguish between the producer subsidy equivalents and the consumer subsidy equivalents except that the percentage rates are expressed as a percentage of the subsidy-inclusive price and treated as constant wedges.

Example 3: Export subsidies

Subsidies based on exports are usually either *ad valorem* or specific in form. They can be modelled in precisely the same way as tariffs since an export subsidy is merely a negative export tax. Export subsidies raise prices to both domestic producers and domestic consumers/users as the local price will be increased by arbitrage until it equals the subsidy-inclusive price on sales.

In cases where the amount of subsidy is linked to some source of revenue or variable, as with export restitutions in the CAP, this link must be modelled specifically.

Example 4: Import quotas

An import quota fixed in terms of the **volume** of imports can be modelled directly or, if it is a binding constraint, it can be modelled as the equivalent variable levy which yields the same quantity of imports.

The equivalence with a variable levy is illustrated in Figure 2. Suppose the quota is fixed at AB. The market clearing price is p_i. If the landed price of imports is p_1^* the implicit levy is $(p_i - p_1^*)$. If the landed price of imports is instead p_2^*, the implicit levy is $(p_i - p_2^*)$. The quota has the same effect on the domestic price, production and consumption as a levy system which fixes a domestic price target, p_i^b, and imposes a levy on imports to maintain this price. With a quota the revenue effect will be zero, assuming that the quota is not auctioned, as is usually the case. The revenue is passed to the quota-holder as a rent or, alternatively, one might suppose it is dissipated in rent-seeking costs in order to obtain the quota entitlement. In some instances a tariff is combined with a quota with the consequence that some of the income accrues to the government and some to the quota-holders.

If a quota category includes a number of commodities which sell at distinctly different prices, the quota is equivalent (apart from the income effect) to a set of equal specific duties on these commodities or the corresponding variable levies so long as it is a binding constraint on the level of imports.

An import quota fixed in terms of the maximum **value** of imports is equivalent to a set of equal *ad valorem* rates of duty on the commodities included in the quota category. Value-based quotas are frequently used when the commodities in the category are measured in different units.

Examples 1-4 are cases in which the modelling is restricted to specifying a function to model the price effects. In other cases it may be necessary to model the commodity market in a way which captures other complexities of NTMs.

Example 5: Acreage controls

Because the effect of subsidies on agricultural outputs, inputs and exports is to boost production, several OECD countries have introduced controls on production or inputs used in production in an attempt to control production. As an example, acreage controls have been used to control production of grains (in the United States, Canada and Japan) and cotton (in the United States). Acreage controls reduce long-run output and exports if the commodity is exportable, and raise land values, other things being equal.

Modelling acreage controls requires two modifications. First, as they are an input control, one must explicitly model the production process. A supply equation is not sufficient. Second, acreage controls are used in association with output subsidies

and other interventions. These combinations of instruments cannot be represented adequately by PSEs or tariff equivalents. They should be modelled directly.

This has been done in the case of the US wheat production by Whalley and Wigle (1988, 1990). Whalley and Wigle model directly the US wheat production within a global computable general equilibrium model. Their results are of special interest in the present context because they compare the predicted effects of unilateral US and world wheat trade liberalisation when the market interventions are modelled directly with the predictions under the usual fixed producer price wedge (PSE) method.

In the US wheat producers receive a combination of deficiency payments and subsidised loans if they agree to participate in the support programme. A condition of receiving support is that they set aside some of the acreage previously used to produce wheat. The decision of individual farmers to participate or not is modelled, using the profit function dual to CES technology with two inputs, the land which may be subject to set-asides and other inputs.

When modelled as constant *ad valorem* price wedges, the US support programme has the standard subsidy effect of increasing wheat farm incomes and total wheat production. When modelled directly and taking account of the acreage control component, the support programme is seen to have a positive effect on producer incomes but a negative effect on total production. This arises because the output-reducing effect of acreage controls more than offsets the output-increasing effect of higher prices. (Another way of viewing this is that the combination of higher prices and acreage controls causes an upward shift of the supply function as well as a movement along it.) Reversing the level of support has the opposite effect of lowering incomes and **increasing** outputs. Moreover, the effects on some other endogenous variables in the market solutions are of opposite sign. Direct modelling predicts that reducing the support programme will lower the world price whereas the naive use of *ad valorem* equivalents predicts the opposite. This is an outstanding example of the non-equivalence of instruments and the benefits of modelling them directly.

Another example of direct modelling is the evaluation by Brown and Richards (1990) of the price and trade effects of the CAP and interventions by other major industrialised countries in the markets of some 25 agricultural products. The CAP is a particularly complex policy which combines tariffs, variable levies and quotas on imports, output subsides, output controls and export subsidies. For some commodities, there is a hierarchy of support prices — a target price, threshold price, intervention price and export price. [See also BAE (1985) and ABARE (1990, Chapter 5) for an analysis of CAP.] In some markets, the EC is both an exporter and an importer because of product differentiation (for example, wheat) and it is necessary to model the differentiated product markets separately. A series of models is constructed and various liberalisation scenarios are simulated with rich results.

The gains from direct modelling may be considerable, as the examples illustrate. The cost is the increased modelling required. This is not difficult by state-of-the-arts modelling technologies, even in the case of combinations of instruments. Enough detail must be specified to capture the main features of each market in each

country and of the government interventions. This will require some disaggregation by both commodity and country as one should not lump together markets with different structures or countries which use different instruments in a market.

There is a difficulty in that data required for some NTM instruments is not available, especially in developing countries. In those instances where the assistance comes wholly or predominantly from a single instrument such as an import prohibition or a regime of quantitative import restrictions, the data can be obtained and the intervention can be modelled directly. Initially it may be desirable to model the intervention for some industries directly and to continue for the time being to use some other summary measure for other interventions.

VI TARIFFICATION

The complex effects of NTMs and the difficulties of measuring and comparing them have led to proposals to convert them to tariffs. In this context tariffication usually means the substitution of the NTMs by *ad valorem* tariffs or, in case of measures which assist export commodities, by *ad valorem* export subsidies. In the Uruguay Round the United States suggested in 1985 that NTMs be converted to tariffs.

The substitution of tariffs for NTMs has a number of advantages. The advantages which are usually stressed are that it would increase the transparency of assistance measures and that it would increase the comparability of trade measures and thereby facilitate trade negotiations and the surveillance of trade policies. These are very real advantages. Tariffs would also eliminate the rents which accrue to some traders, such as import quota holders or those who have the rights to export under VERs, when NTMs are used. In the light of the discussion of non-equivalence above, a policy of tariffication would also eliminate some of the perverse effects of NTMs on production and the direction of trade. In cases where the use of NTMs as instruments of trade policy has created monopolies or reduced the degree of competition in local markets, the substitution of tariffs would have the additional benefit of increasing the degree of competition.

One objection to the substitution of *ad valorem* tariffs is that it would increase the instability of domestic markets because the instability in world prices would be transmitted directly to domestic markets and amplified by the *ad valorem* form of tariffs. Suppose the instrument of assistance for some commodity, commodity i, in some country is an *ad valorem* tariff ($\bar{t}_i$) and the world price is a random variable, $\tilde{p}_i^*$. A tilde is used to denote a random variable. In this situation the domestic price is also a random variable, $\tilde{p}_i = \tilde{p}_i^* (1 + \bar{t}_i)$, making the usual assumption that the domestic and imported products are perfect substitutes. The variance of the domestic price is $Var\ (\tilde{p}_i) = (1+\bar{t}_i)^2\ Var\ (\tilde{p}_i^*)$. That is, the variance of the foreign price is fully transmitted and amplified by the *ad valorem* tariff.

This analysis is, however, a partial analysis which treats each importing country as small and assumes that the disturbance originates in the Rest of the World. It is impossible for all countries in the world to be small. (Indeed, it can be shown that it is, strictly speaking, impossible for any country to be small unless it demands or supplies an infinitesimal part of the world market.) And random shocks have to originate in the demand or supply of some countries in the market.

The true relationship between domestic and "world" market instability is quite different. Trade among nations reduces the average stability of markets across the world because trade pools the risks among the markets. When countries insulate their national markets from the rest of the world, this transfers instability in the national market to the rest of the world and **increases** the instability in the rest of the world. Johnson (1975) emphasized that the effect of schemes which fix a domestic price for a tradeable commodity is to reduce the price elasticity of excess demand for imports or supply of exports to zero. Hence all of the price variations which are required absorb random shifts in demand and supply are forced on to the rest of the world.

Reversing this process by tariffication connects the national markets and reduces the instability in world markets. From the point of view of the world as a whole, the *ad valorem* tariff is the instrument which, for a given average level of assistance, minimises the instability precisely because it transmits fully and proportionately all price variation from one trading nation to another. The empirical work of Tyers and Anderson (1991, Chapter 7) predicts that tariffication in agricultural markets would substantially reduce the price variability in world food markets and in markets which are less insulated with only a moderate increase in price variability in the more insulated markets. The high degree of instability in world markets due to the use of NTMs designed to insulated domestic markets is another illustration of the additional problems created in world trade by the increasing substitution of NTMs for tariffs.

VI CONCLUSION

NTMs differ from tariffs in a number of ways. These differences have been expressed in terms of the effects which each instrument has on prices and the quantities supplied, demanded and traded in each commodity market. Several examples have been given of such instruments which are not equivalent to *ad valorem* tariffs.

The producer price effects of both tariffs and NTMs may, nevertheless, be measured. The paper shows that producer subsidy equivalents and effective rates of assistance are virtually identical measures of the net producer price effects, provided they both value output at world prices and take into account the same input price changes. Given a set of measures of the net producer price effects, one can determine in broad terms the resource movements induced by these measures.

For some NTMs which are not equivalent to tariffs we can measure the producer price effects by means of a tariff equivalent function. In other cases, an understanding of the effects of NTMs on the market variables can only be obtained by modelling them directly.

This analysis allows us to indicate the ways in which the proliferation of NTMs in place of tariffs have been bad for international trade. First, the non-transparency of the measures obscured for some time the extent of these measures. Secondly, when measures of the price distortions implied by NTMs became increasingly available as a result of empirical work in individual countries and international organisations such as the OECD, the distortions were revealed to be much higher than those now resulting from tariffs. This is especially true of assistance to agricultural producers. Third, many NTMs have a greater impact on trade flows than the price-equivalent tariffs.

Tariffication would make all border measures more transparent and comparable. It would also eliminate the perverse effects of some NTMs on production and trade and it would reduce the instability in world food markets.

NOTES

1. In a computable general equilibrium model which specified the behaviour of all consumer and producer agents, one could compare **utility** - equivalent measures. That is, one could take an NTM and a tariff which yielded the same real incomes to the producers who are assisted and then solve the model to obtain the values of all other variables including trade flows and the utilities of other agents in the protecting country and in other countries.

2. This difference between price-based and quantity-based instruments arises in other fields of policymaking; for example, in comparing administrative controls on pollution externalities such as ambient air quality standards with pollution charges. The standard reference is Weitzman (1974).

3. One may note that for some countries a significant amount of assistance to domestic producers of tradeable commodities is provided by an exchange rate which is maintained above the purchasing power parity. A real exchange rate depreciation gives a uniform rate of assistance to all imports and exports *vis-à-vis* non-tradeable commodities. Such "exchange rate protection" appears to be a deliberate strategy of some countries, though it may also result from a current account surplus.

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