TARIFF EQUIVALENCE OF AGRICULTURAL SUPPORT POLICIES

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** Authors are economists in the agricultural directorate of the OECD. Views expressed are their own and do not necessarily reflect those of the OECD Secretariat or its Member governments.
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Introduction

For the evaluation of trade policy to be effective and useful requires some means by which trade distorting policies may be measured and compared among countries, commodities and over time. The OECD publishes the Producer Support Estimate (PSE) and several derivative indicators that while not in themselves indicators of trade distortion are useful in tracking agricultural policy developments over time and making comparisons among countries. Two of the most relevant are the Nominal Assistance Coefficient (NAC) and the Nominal Protection Coefficient (NPC). The NAC is the ratio of total farm revenues, inclusive of support, to the total farm revenue obtained with the same farm output valued at world market prices. The Nominal Protection Coefficient (NPC) is the ratio of the average producer price and the corresponding world market price. The main distinction between these two indicators is that the NAC reflects all financial transfers from consumers and taxpayers to producers while the NPC reflects only those transfers from consumers and taxpayers that directly increase the producer price.

Discussing how to improve measures of support, Josling (1993) points out the inevitability of using economic models (implicitly or explicitly) in evaluating agricultural policy. He argues however, that models are most effective in analyses that begin by clearly defining the indicators of the specific policy effects, e.g. trade, income, environment, etc. which one wishes to measure. By emphasising definitions first, we shift the focus from the technique used to generate an indicator to that which the indicator is intended to measure. Starting with indicators of policy effects that have a clear and widely agreed upon interpretation leads to more productive discussion and debate about which methods of calculation or models are best suited to the job of measuring them. This is compared with measures that may have a well-known and agreed upon method of calculation but allow for many interpretations of what they mean. In Josling's view uniformity of approach to measuring an indicator is seen to be much less important than being specific and clear as to its meaning.

Anderson and Neary (1996) have proposed an indicator - the Trade Restrictiveness Index (TRI) defined as the uniform tariff that is equivalent in welfare terms to the protection provided by a set of trade policies. The TRI is an example of a Josling type "fixed definition" indicator, being explicitly a measure of a welfare-equivalent uniform tariff, a measure for which there are clearly alternative means of calculation. Anderson and others have used the TRI and its variations as an alternative to average tariff measures as well as a means of indexing domestic taxes and subsidies. Key virtues of the TRI are the clarity of its interpretation—a welfare-equivalent uniform tariff—and its respectability owing to its firm basis in welfare theory.

The analysis in this paper is an attempt to apply Josling's principle of fixed-definition measures, using the basic approach of the TRI, but applying it in the development of several different indicators of policy effects. Moreover, where in most previous applications the \`package´ of policy measures considered in calculating the TRI typically comprised both ad valorem tariffs and the ad valorem equivalents of specific tariffs and tariff rate quotas, here we use detailed PSE data classified into different support categories according to the way the associated policy is implemented. The analysis is undertaken using the OECD's Policy Evaluation Model (PEM), a partial equilibrium model of selected agricultural markets, designed to take into account both the level of transfers to producers and their composition in terms of policy categories. (OECD, 2001) Three different choices for the construction of a tariff-equivalent measure are explored: 1) producing equal farm household income 2) resulting in the same production level and 3) resulting in the same volume of net trade. The results are then compared with the PSE, the NAC and the NPC.

The indices constructed here reflect the effect of the current crop policy mix on incentive prices in the relevant output and input markets. As such, they do not reflect the other ways by which agricultural policies may affect producer decisions. For a discussion of some non-price impacts of policies reflective of OECD work on this subject currently underway, see OECD (2001b).

OECD measures of support to agriculture

Since the mid-1980s, measuring support provided by farm policies has been one of the flagship activities of OECD work on agriculture. The analytical backbone of this OECD activity is the Producer Support Estimate (PSE). OECD's annual update of PSEs for its Member countries (and some non-Member economies), published in the "Monitoring and Evaluation" series, is the only available source of internationally comparable information on support levels in agriculture. Measurement and publication of PSEs have created an unprecedented degree of transparency regarding the nature and incidence of agricultural policies, established a firm base for international policy dialogue on agriculture, and contributed significantly to the formulation of internationally binding commitments on domestic support in the WTO following the Agreement on Agriculture concluded in the Uruguay Round.

The PSE measures support arising from policies targeted at agriculture relative to a situation without such policies, *i.e.* one in which producers are subject only to general policies (including economic, social, environmental and tax policies) of the country. Although the PSE is measured net of producer contributions to help to finance a support policy (*e.g.* through a levy on production) it is fundamentally a gross concept because any costs incurred by individual producers associated with those policies are not deducted. It is also a measure of nominal assistance in the sense that increased costs associated with import duties on inputs are not deducted. The PSE includes both implicit and explicit payments, such as price gaps on outputs or inputs, tax exemptions and budgetary payments, including those for remunerating non-marketed goods and services. Although farm receipts (revenue) are increased (or farm expenditure reduced) by the amount of support, the PSE is not in itself an estimate of the impact on farm production or income. The PSE is composed of the annual monetary value of the following main components, categorized according to implementation criteria:

- **Market Price Support:** gross transfers from consumers and taxpayers[1] to agricultural producers arising from policy measures that create a gap between domestic market prices and border prices of a specific agricultural commodity, measured at the farm-gate level.
- **Payments based on output:** gross transfers from taxpayers to agricultural producers arising from policy measures based on current output of a specific agricultural commodity or a specific group of agricultural commodities.
- **Payments based on area planted/animal numbers:** gross transfers from taxpayers to agricultural producers arising from policy measures based on current plantings, or number of animals, in respect of a specific agricultural commodity or a specific group of agricultural commodities.
- **Payments based on historical entitlements:** gross transfers from taxpayers to agricultural producers arising from policy measures based on historical support, area, animal numbers or production of a specific agricultural commodity, or a specific group of agricultural commodities, without obligation to continue planting or producing such commodities.

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1. Transfers from taxpayers occur, for example, when subsidies are used to finance exports.

- **Payments based on input use:** gross transfers from taxpayers to agricultural producers arising from policy measures based on the use of a specific fixed or variable input, or a specific group of inputs or factors of production. Such payments may also include constraints on the use of inputs, to improve environmental performance, for example.

- **Payments based on overall farming income**: transfers from taxpayers to agricultural producers arising from policy measures based on overall farming income (or revenue), without constraints or conditions to produce specific commodities, or to use specific fixed or variable inputs.

- **Miscellaneous payments**: all transfers from taxpayers to agricultural producers that cannot be disaggregated and allocated to the other categories of transfers to producers.

The PSE by country and by commodity can be expressed in monetary terms (**PSE)**; as a ratio of the value of total gross farm receipts, measured by the value of total production (at farm-gate prices), plus budgetary support (%**PSE)**; a ratio between the value of total gross farm receipts including support, and production valued at world market prices without support (Nominal Assistance Coefficient, or **NAC**); or a ratio of the average price received by producers, including payments based on output (PO/tonne), and the border price (Nominal Protection Coefficient, or **NPC**). In algebraic form, these expressions can be written as follows:

$$\%PSE = \frac{PSE}{Q \cdot P_p + PP} \tag{1}$$

$$NAC = \frac{1}{1-\%PSE} = \frac{\%PSE}{1-\%PSE} + 1 = \frac{PSE}{Q \cdot P_b} + 1 \tag{2}$$

$$NPC = \frac{P_p + PO/tonne}{P_b} = \frac{(P_p - P_b) + PO/tonne}{P_b} + 1 \tag{3}$$

Where P_p is the producer price, inclusive of market price support measures, P_b is the border price, PP is payments other than market price support, and PO are payments based on output.

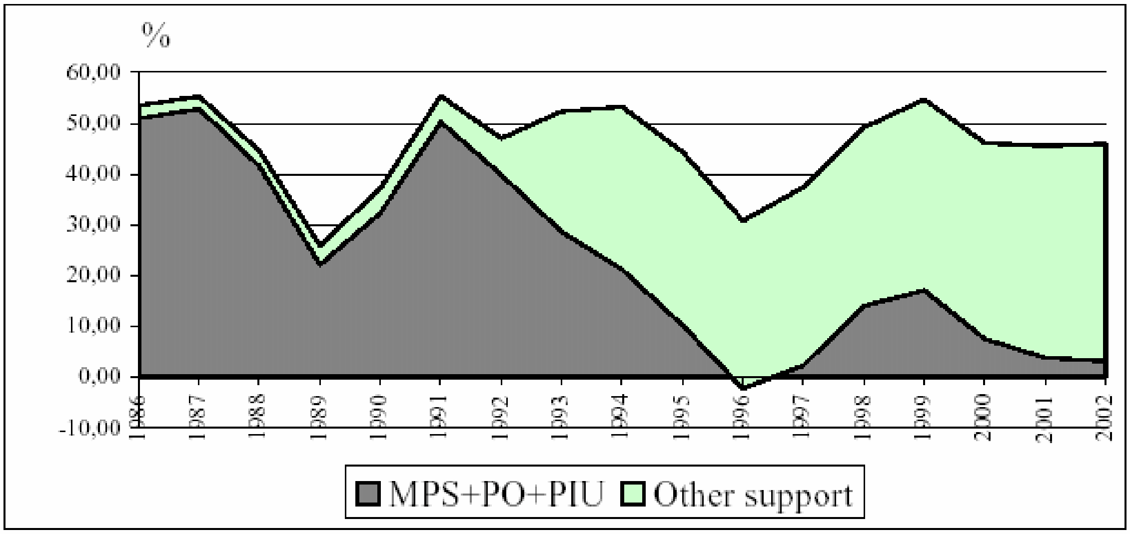
When the producer NAC is equal to one, gross farm receipts are entirely derived from the market without any support. The higher is the producer NAC, the lower the share of gross farm receipts derived from the market This can be seen as an indicator of market orientation, i.e. the degree of influence of market signals (relative to those from government intervention) on agricultural production decisions. In the case of the NPC, a value of 2 would show that the price received by farmers is twice the border price. The NPC can be seen, therefore, as an estimate of the nominal rate of market protection for producers.

It has been argued that the PSE does not properly reflect changes in agricultural policies and in particular their effects on production and trade. In this context, concern has been expressed in countries that have engaged in reforms of their agricultural policies, by changing the nature of the instruments used, that the PSE as a measure of total transfers to agriculture does not take the market and trade effects of such reforms of the policy mix sufficiently into account. To respond to this, the OECD has over time increasingly emphasized the composition of the PSE according to its various policy categories, and any changes that may have taken place in that composition. (OECD, 2004) To illustrate the point, Figure 1 shows the level and composition of support for wheat in the EU. The darker shaded area represents the three most production and trade distorting forms of support—market price support, output support, and input support—while the lighter shaded area represents other, less-distorting forms of support such as area payments and payments based on historical entitlements. Clearly, knowledge of the composition of support in the EU and elsewhere is important to understanding its potential impacts on world markets.

The analysis carried out in this paper integrates into a single measure the information contained in the level of the PSE as well as its composition. It does this by identifying what the equivalent level of the PSE would be with respect to policy effects of interest, were it composed entirely of market price support. It can be thought of equivalently as a "composition-adjusted" PSE or as a uniform tariff-equivalent in the TRI sense.[2]

[2] In making the case for fixed-definition indicators, Josling suggested using the *budget cost* of a lump-sum payment that leaves farm income unchanged. We prefer to use a tariff-based indicator rather than a budgetary one (although we could easily have done so) for the following reasons. First, such lump-sum payments do not exist in practice, and may be impossible to create (see OECD 2001b). Moreover, the policy rationale for such a transfer, directed at nothing in particular would be unclear. On the other hand, tariffs are readily understood and in many cases still make up a major portion of the composition of support to agriculture. The main drawback is that a tariff-equivalent measure does not do a good job at bringing to light the budgetary trade-offs of reform.

Figure 1 EU %PSE for wheat and its composition



Note: MPS=Market Price Support, PO= Payments based on output, PIU= Payments based on input use

Model

In order to calculate the equivalency of one measure with another, a model that captures the relevant market and policy details is required. In the case of the TRI, Anderson and Neary (1996) use and have made available a customized CGE model containing a great deal of detail on agricultural trade and tariffs but highly aggregated elsewhere. We use the PEM, a partial equilibrium model of selected agricultural commodities, containing explicit factor markets. (Appendix 1 shows the equation structure for a typical country module of the PEM. Full documentation can be found in OECD (2001a).) This model was designed by the OECD to be compatible with, and take advantage of, the PSE and the PSE composition to investigate the impacts of policies and policy reform. This design provides a key advantage to our analysis, as we are able to make use of the PSE in combination with an integrated model designed specifically to identify the different impacts of policies in each PSE category. The result of the analysis is not an alternative to the PSE, but rather a derivative of it that is obtained by applying a model that exploits the information contained in the PSE categorization.

The structure of the PEM is based directly on a partial equilibrium model of the farm sector elaborated in Gardner (1987). First developed by Hicks to study issues in labour economics, the same basic model has been widely applied in general economic policy analysis. An important precedent to its application in agricultural policy analysis was in an analysis of housing and urban land economics by Muth. The development of the model for analysis of agricultural price supports is generally credited to Floyd. Its application for the PEM follows most closely applications found in Atwood and Helmers (1998), Gunter *et al.* (1996), and in Hertel (1989).

The PEM provides a stylized representation of production, consumption, and trade of major cereal and oilseeds crops in six OECD countries: Canada, the European Union (treated as if it were one country), Japan, Mexico, Switzerland, and the United States. These country 'modules' were all developed according to a common structure. Crop supply is represented through a system of factor demand and factor supply equations. Excepting the rest of world module, there are equations representing demand and supply response and prices for at least four categories of inputs used to produce these crops in the study countries. The factor demand equations reflect the usual assumptions of profit maximisation constrained by the production relationship.

Crop supply response corresponding to a medium term adjustment horizon of three to five years is reflected in the values assumed for the price elasticities of factor supplies and the parameters measuring the substitutability of factors in production as well as the factor shares. No factor is assumed to be completely fixed in production of crops, but cropland and the other farm-owned factors are assumed to be relatively more fixed (have lower price elasticities of supply) than the purchased factors. Likewise, no factor is assumed freely mobile, but purchased inputs are assumed relatively more mobile (a higher elasticity of supply) than the farm-owned factors. Most supply parameters needed for the model come from systematic reviews of the empirical literature. (Abler 2000, Salhofer 2000)

Farm-gate demand for crop outputs, distinguished by food and feed uses, is represented in PEM using simple log-linear type demand equations parameterised with elasticities drawn from the literature. All crop outputs, but none of the production factors, are treated as tradable commodities in the model. In doing policy simulation experiments with the model the supply and demand behavioural relationships are combined with the equilibrium requirements that supply must equal demand to simultaneously clear all markets – global for commodities, domestic for factors.

Simulation procedure and the experiments

Each year OECD updates and publishes time series of annual estimates of the PSE and its main sub-components by commodity for each Member country. Here we use data covering the six PEM countries and crop commodities for the period 1990 to 2002. Overall, the most important sub-component of the PSE is market price support (MPS) which, for present purposes, may conveniently be viewed as resulting from a trade intervention in the form of a simple ad valorem tariff. (This ignores the wide variety of trade related interventions actually used and the associated measurement difficulties but helps keep the focus on main themes here.) The mix of non-MPS components making up the PSE may differ greatly among commodities, from one country to the next, and over time. The key analytical question motivating this analysis and guiding the setup of simulation experiments is *"how much does the mix (and changes in it over time) matter?"* In order to design the simulation experiments aimed at answering such a question we must first choose the policy effect with respect to which we want to see whether 'mix matters'. Here, we use three 'equivalency' indicators, one based on net trade, one on production and one on farm household income which we call respectively: Iso-trade, Iso-production and Iso-income.

Normally, the PEM contains equations corresponding to each of the three policy effects of interest. For each country by commodity pair, the equation determining production is the corresponding crop production function. The equations determining net trade are the associated market clearing identities. Likewise there are identity equations that track changes in farm household income. In setting up to do the simulation experiments the first step is to make one or another of the three policy outcomes of interest (farm income or output or net trade) in one of the study countries exogenous in the model and then set it at its base period value.

In the second step, the ad-valorem rates of market support for each crop, which are normally exogenous parameters in the model, are made endogenous meaning that the overall level of market price support is itself now endogenous. This sets the stage for the simulation experiments. They are all exactly the same regardless of the particular policy effect with respect to which 'equivalency' is being measured. In any given simulation experiment only one of the three is constrained, the other two remaining endogenous. The analysis proceeds by making one after the other of them exogenous in just one of the study countries continuing until the entire list of country by indicator experiments is completed.

In every case, the policy 'shock' imposed on the model is the elimination of all non-MPS support from the PSE. The key simulation result is what then happens to the endogenous level of market price support since in the experiment, market price support must adjust sufficiently to hold the policy outcome of interest at its base period value. This yields a new estimated total for the PSE composed entirely of market price support – the sum of the 'old' base period level and the 'new' part which has to be added in to replace the non-MPS components of the 'old' PSE. We call this the 'tariff equivalent' of all support measures. If the policy effect of interest is net trade or production we expect this new PSE to be smaller than its base period value if non-MPS support is less production and trade distorting than market price support. In reality, not all non-MPS support is less production and trade distorting than market price support but mostly it is. If the policy effect of interest is farm household income we might expect the new PSE to be greater than its base period value if market price support is less transfer efficient than other forms of support, which it usually is. (OECD, 2003)

In the case of quantity produced and volume of trade, the restriction that must be introduced into the model to 'endogenize' market price support is straightforward: the simulation outcome must equal the base period value for each country by crop combination. In the case of farm household income, some extra steps are required. Farm household income in the model accrues from returns to the inputs that are owned by the household. Specifically, the farm household is assumed to own a "farm-owned" factor, composed of the farmer's labour as well as capital such as machinery and buildings. The farm household is also assumed to own the land used for production[3]. In order to hold constant farm household income, equations representing the change in producer surplus for these two factors for each crop are introduced, and their total for each crop (with an adjustment for users of non-represented crops) held constant.[4]

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3 This includes the situation where if land is rented by a farmer, it is rented from another farm household.

4 Payments based on historical entitlements have a wider incidence than other land-based payments as they are paid regardless of the current use of the land. Thus, removing these payments eliminates a transfer to producers of other crops (who had produced an included crop during the reference period), and so an adjustment is made to take that into account.

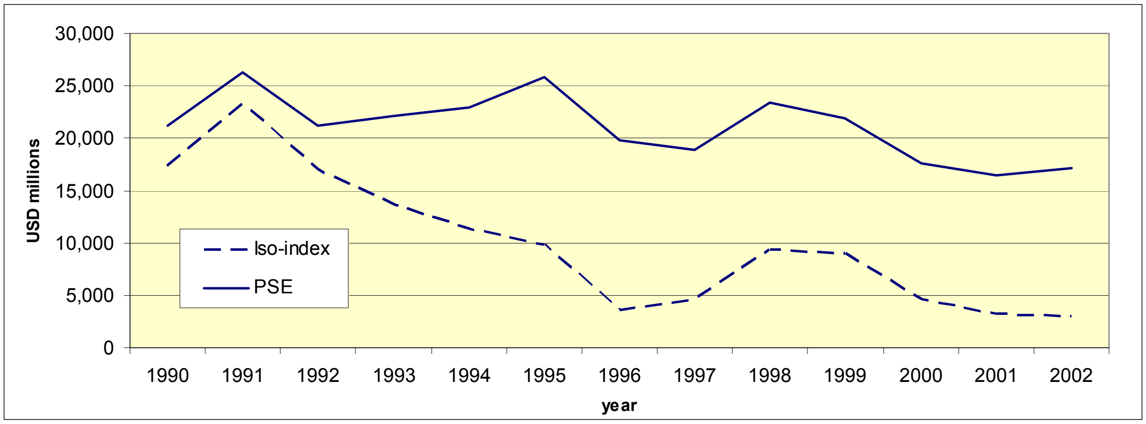
As noted above, this procedure, while occurring simultaneously in the model and thereby taking cross-effects into account, results in a separate rate of market price support for each crop category in the model. That is, the measure is uniform in the sense that there is only one policy variable remaining for each commodity, the rate of market price support, but this rate is different for each crop category included in the model. Since the resulting indicator for each crop category is in monetary units, they may be simply added together to arrive at the overall result for "crop production" as a whole.

Results

Constant trade volume

Appendix 2 contains results for all countries, crops and policy effects. Here in the text we concentrate on a few of the more interesting cases, starting with results for the EU. Prior to 1992, the main means of provision of support to agricultural producers in the EU was market price support. The McSharry reforms moved away from MPS as the primary tool of agricultural policy by introducing area and headage payments, to be paid to producers in compensation for reduced border measures. As calculated by the PSE, these reforms, and those that followed, did not have a major impact on total transfers to producers (though the PSE for the EU has trended downward slightly since the 1986-88 reference period), rather they shifted the source of these transfers from consumers to taxpayers. As direct payments of the type introduced by the McSharry reforms are recognized to be less distorting of trade compared with MPS, we expect that a measure of the MPS level that would result in the same observed trade volumes over the study period would have to be much less. Figure 2 shows the PSE level for the four crop categories considered, and the measure of the tariff-equivalent level calculated using the model. Recall that the Iso-trade index is the level of PSE that would have maintained the base period level of net trade if the PSE was composed entirely of market price support.

Figure 2 EU PSE level and Iso-trade index



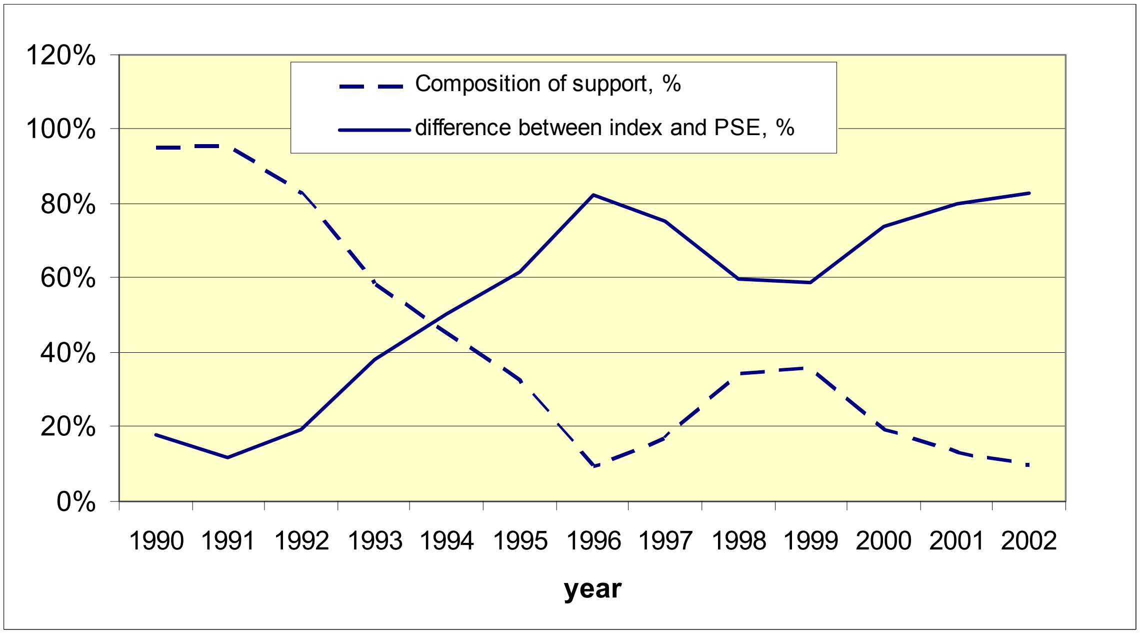
In the first two years of the study period, MPS made up 80% of total support as measured by the PSE. By 2002, that proportion was less than four percent. Payments based on output, another highly distorting form of support, were reduced in similar proportions. The Iso-trade index reflects these changes in the composition of the PSE, falling 82% over the study period[5], while by comparison the PSE fell only 25%. The Iso-trade index is effective at showing the impact of policy reform on trade distortion in a way that the PSE as a general measure of policy effort (as reflected by total transfers) does not.

Figure 3 clarifies the relationship between the level and the composition of support and the Iso-trade index. There are two trend lines plotted in the Figure. The dashed line plots the evolution of the percent share of the three most distorting forms of support in the total PSE over the study period. The solid line plots the difference between the PSE and the Iso-trade index, also expressed as a percent of the PSE. It may be helpful to think of this as an indicator of how much the PSE *overstates* the 'tariff equivalent' of support. MPS as a proportion of support reached its

5 This is measured as one minus the ratio of the average value of the index for the first three and last three years of the study period.

nadir in 1996, followed by a brief spike in the amount of MPS provided in 1988 and 1989; the figure shows the index clearly picking up these movements.

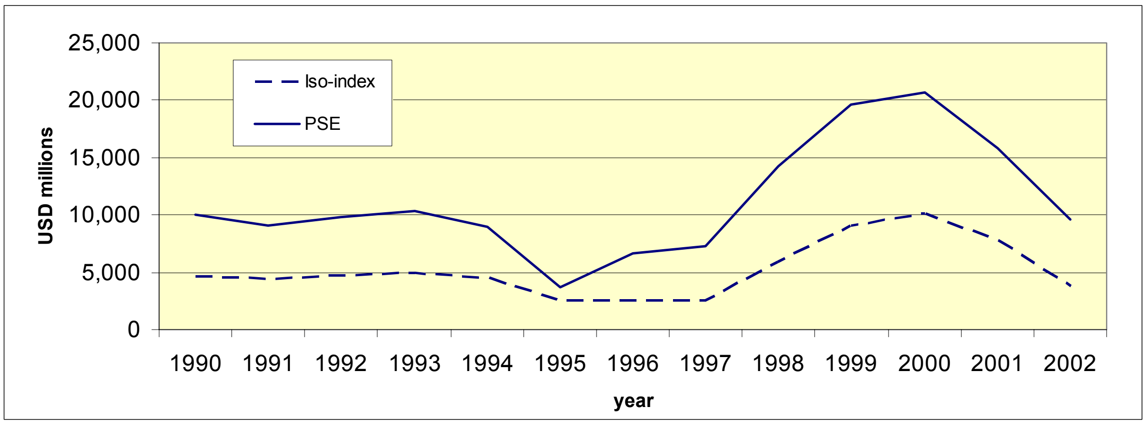
Figure 3 EU Composition of support and the relationship between the PSE and Iso-trade support index



The United States provides a similar level of support to crop producers as does the EU. However, reform to that support during the study period followed a different pattern. US support was never dominated by MPS to the same degree as in the EU, reaching a maximum of 22% of total support as measured by the PSE in 1991 and being mostly eliminated for the crop categories included in this study by 1995. On the contrary, support has been dominated by area payments for most of the study period. A major reform in 1996, the Freedom to Farm Act, introduced production flexibility contracts (PFCs), classified in the PSE as payments based on historical entitlements because of their basis on production in a reference period. This category of payments is one of the less distorting forms of support, and one would expect its predominance in the policy mix to drive a strong divergence between the PSE and the Iso-trade index of support.

However, for most of the years of their implementation in the study period, PFC payments were accompanied by exceptional payments, which were classified as payments based on output, a highly distorting form of support. As a result the relationship between the PSE and the Iso-trade index paints a decidedly mixed picture (Figure 4).

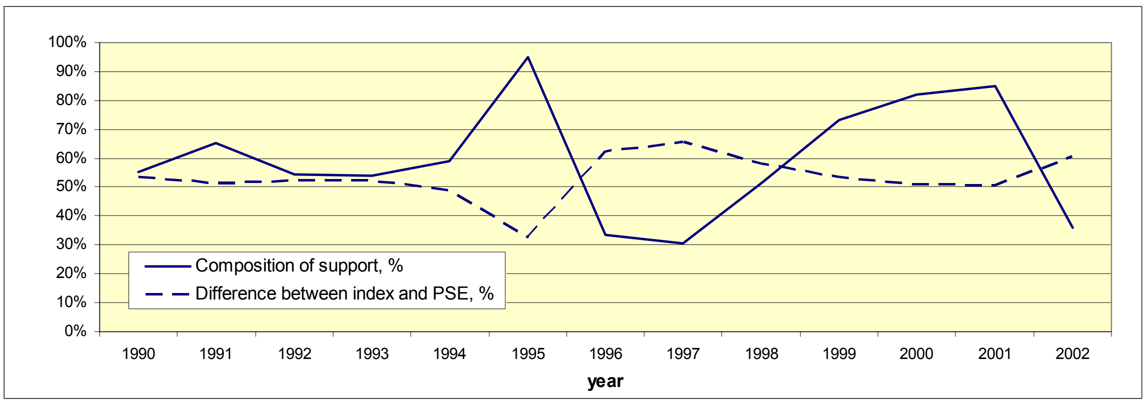
Figure 4 US PSE and Iso-trade index of support



For the 1990-1994 period, the composition of support remained stable, and the difference between the PSE and the Iso-trade index of support reflects mostly the relative level of distortion between direct payments (around 60% of the PSE) and MPS (the sole component of the Iso-trade index). That is, the Iso-trade index is about half of the PSE, indicating that the policy mix in that period was approximately half as trade distorting as MPS. High commodity prices in 1995 reduced the PSE significantly as fewer payments were triggered under the loan rate program. In the following year, the introduction of the FPC payments raised the PSE, but the Iso-trade index remains basically flat because of the low level of trade distortion of these payments. By 1998, however, payments based on output support (characterized as emergency or disaster payments) cause the Iso-trade index to begin to follow the PSE's upward trend.

Figure 5 shows the relationship between composition of support and the differential between the PSE and Iso-trade index for the US. The inverse relationship between composition and divergence of the PSE and Iso-trade index is less exact than was the case for the EU, as the changes that occurred in the composition of support are more complex. The Iso-trade index contains more information than is in the composition of support line, which simplifies support categories into "most distorting" and "other" only, and it also provides a better approach to summarising the changing composition of support in a single measure.

Figure 5 US Composition of support and the relationship between the PSE and Iso-trade support index



Perhaps the measure with the closest interpretation to the Iso-trade index is the NPC, as it represents the degree of market openness. For a group of commodities, an alternative calculation of the NPC may be obtained by dividing the value of production at domestic prices by the value of production at border prices for each commodity. This can be expressed as:

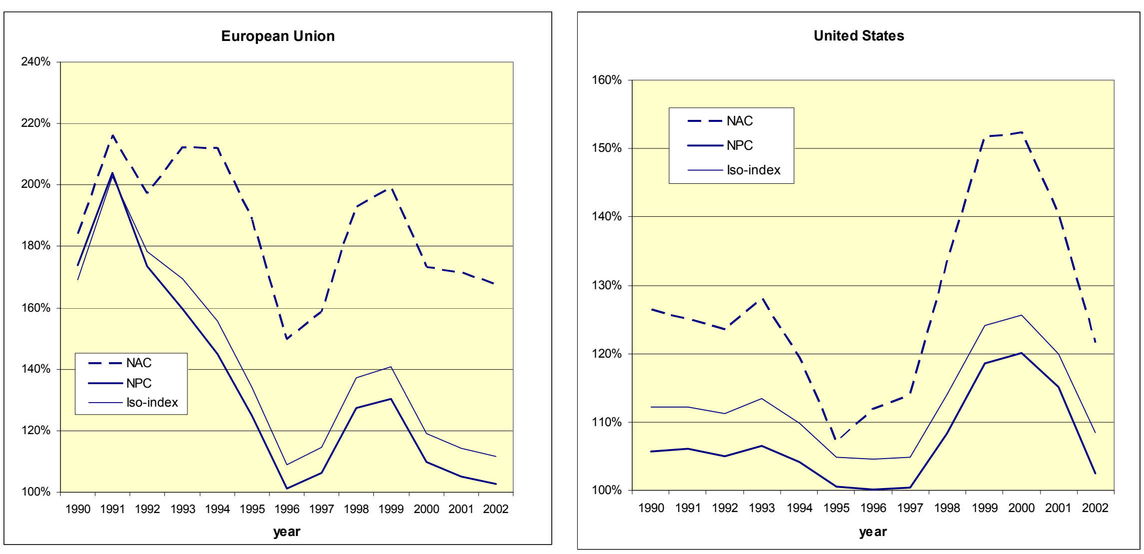
$$NPC = \frac{\sum_i Q_i P_i + MPS_i + PO_i}{\sum_i Q_i P_i} \tag{4}$$

for any aggregate of commodities, where P_i is the border price, Q_i is the level of production, and MPS_i and PO_i are transfers due to market price support and output support, respectively. The Iso-trade index can be converted into a comparable measure by expressing it in ad-valorem form:

$$Iso - trade_{av} = \frac{\sum_i Q_i P_i + index_i}{\sum_i Q_i P_i} \tag{5}$$

The resulting measures for the US and EU are shown in Figure 6, along with the NAC measure (which has a similar ad-valorem interpretation). As expected, the Iso-trade index falls between the NAC and the NPC. Why? The NPC includes only those policies which directly influence producer price. The NAC includes all policies, weighting them all equally. The Iso-trade index includes all policies, but assigns relative weightings to them according to how distortive they are of trade, and expressing the result using MPS, one of the most distorting forms of support. Therefore, the Iso-trade index should lie above the NPC as it contains additional policies that do have some impact on producer price (and therefore trade), and it should lie below the NAC because it weights these policies according to the degree to which they effect prices and trade. Also as expected, it shows the NPC to be a better measure of trade protection than the NAC.

Figure 6 NPC, NAC, and Iso-trade indices

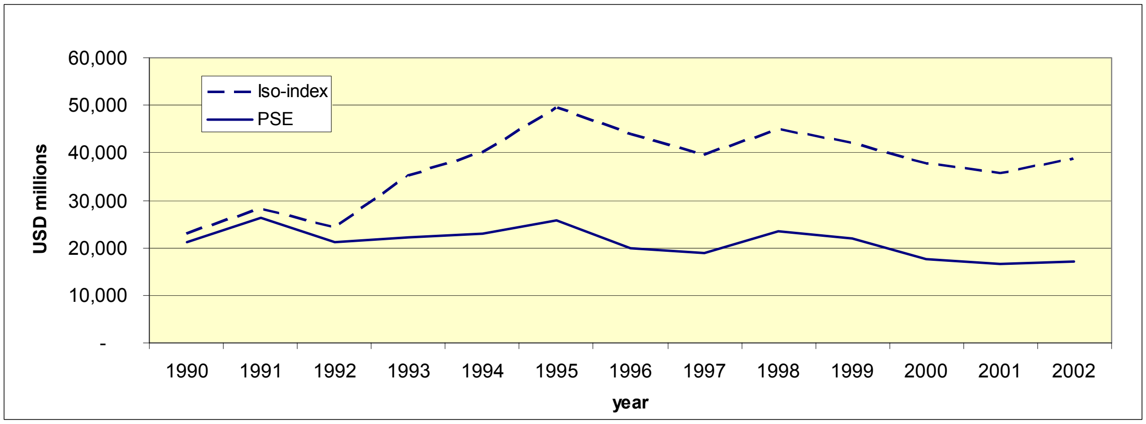


Constant farm household income

The PSE measures transfers to producers from consumers and taxpayers, but it is acknowledged that such transfers are not equally nor entirely effective at increasing the income of farm households. Suppliers can capture most of the benefits accruing from subsidies to inputs such as fuel or fertiliser, and in general the greater the production distortion caused by a policy, the less efficient is that policy in transferring income to producers. Previous work using the PEM model has indicated that this difference in efficiency can exceed a factor of two for commonly used agricultural policies, and in particular MPS (the numeraire policy chosen for the measure developed here) does a poor job at generating income for producers (OECD 2003).

In the case of the EU, the transition away from market price support to payments based on area or head of livestock increased the effectiveness of the policy mix in increasing farm household income (Figure 7). The Iso-income index shows that if EU policy consisted entirely of market price support, the level of support would have to double in order to provide the same income change as resulted from the McSharry reforms. Further, while transfers to producers as measured by the PSE has fallen over the study period, the fact that the Iso-income index is increasing indicates that the income benefits of support have increased, suggesting that producers in the EU have effectively received an increasing contribution to their income from government policy.

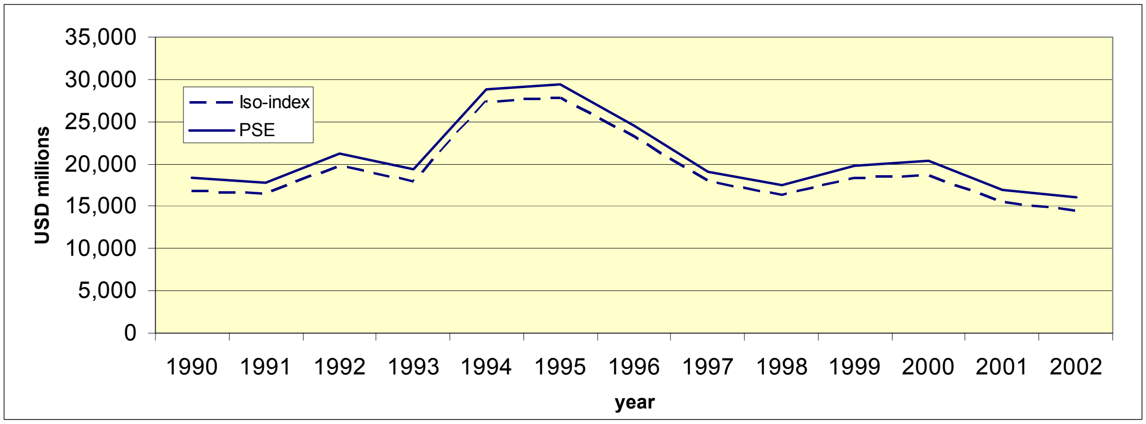
Figure 7 EU PSE and Iso-income index



Compare this with the Iso-trade index for the EU shown in Figure 2. MPS is **more** distorting of trade than most policies, so less support, if provided exclusively in the form of market price support, leads to the same degree of trade distortion as resulting from support provided in the actual policy mix. MPS is **less** effective at transferring income than most other policies, so the Iso-income index lies above the PSE in Figure 7, indicating more MPS is required to transfer the same amount of income to farm households.

Although market price support is generally seen to be more production distorting and less transfer efficient than other forms of support this is not always the case. Simulated results for Japan and Mexico illustrate this point. In the case of rice production in Japan, although most support provided to producers is in the form of MPS a significant part of the non-MPS component is made up of input support, the only category of support less efficient than MPS in transferring income to farm households. The upshot is that the Iso-income index actually lies below the PSE in this case (Figure 8). That is say, Japanese rice producers would have been slightly better off income-wise during the study period if the small amount of non-MPS support they received had been given in the form of more MPS and, of course, even better had this support – and MPS – been provided through less distortive policies.

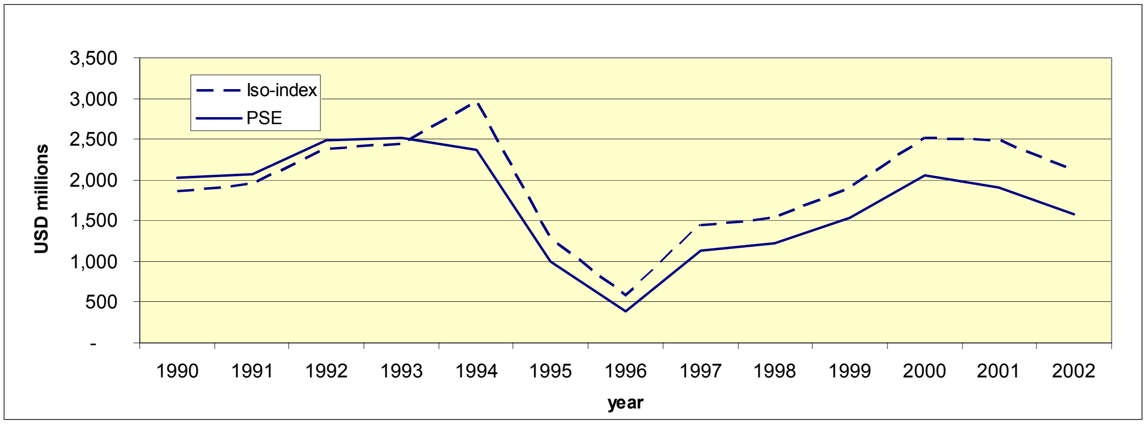
Figure 8 PSE and Iso-income index for Japan



A similar result is seen for the Iso-income index and PSE for the crop categories represented in the model for Mexico, shown in Figure 9. Support to crop producers in Mexico in the early 1990s was dominated by input support, and for that period the Iso-income index lies below the PSE. Policy reforms in 1994 that introduced the PROCAMPO program altered the composition of support with payments based on historical entitlements becoming the dominant component of the PSE, increasing the efficiency of the total policy package in transferring income, and resulting in an Iso-income index greater than the PSE after 1994. The large trough in support centred on 1996 reflect the impact of exchange rate movements related to the devaluation of the Peso on the level of support provided by MPS policies[6]. The continued importance of MPS in total support to agricultural producers in Mexico is reflected in the degree to which the two measures of support track each other.

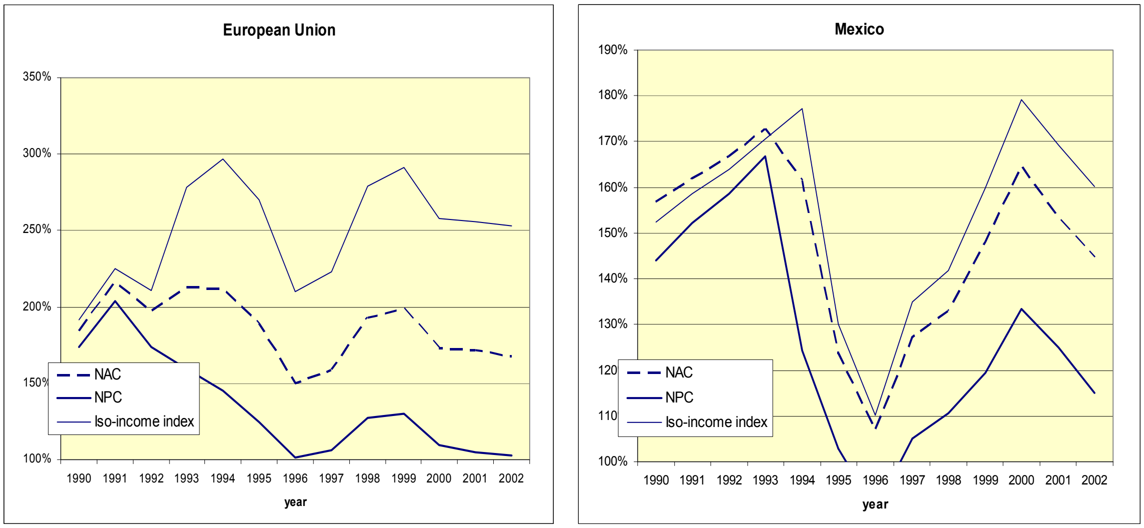
[6] In fact, devaluation caused MPS for crops in Mexico to be negative in 1996. The PSE remained positive as it also includes budgetary polices.

Figure 9 PSE and Iso-income index for Mexico



Putting the Iso-income index into ad-valorem form allows comparison again with the NPC and NAC. As shown in Figure 10, so long as payments based on input use do not form a significant portion of total support, the Iso-income index should lie above both the NPC and the NAC. This is again due to the fact that MPS, upon which the index is based, is one of the least efficient means of transferring income (second only to payments based on inputs), and so a greater amount is required to obtain the same level of income as the existing policy package. As Figure 10 indicates, the NAC is superior to the NPC in measuring the effectiveness of current policies at transferring income, although as seen in the case of the EU, its ability to cope with the impacts of significant reform is limited.

Figure 10 NPC, NAC, and Iso-income index

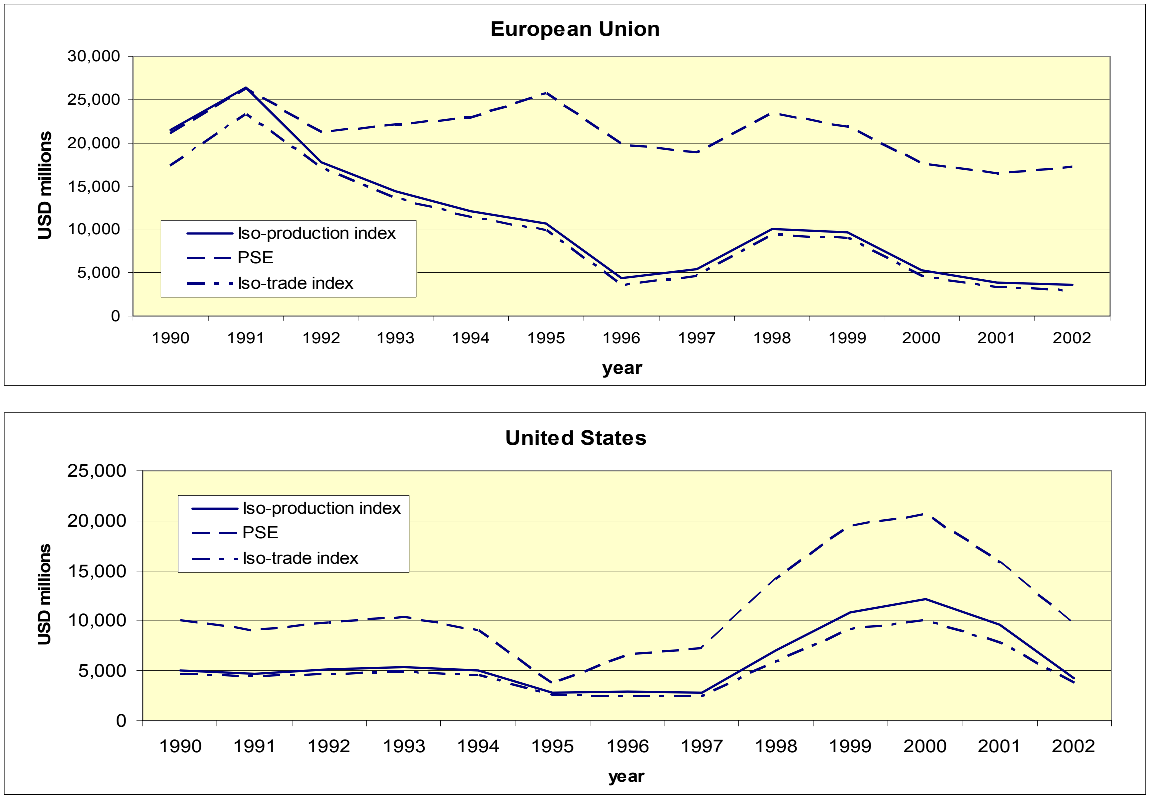


Constant level of production

The relative impact of a given policy on production or trade depends mainly on the way they impact domestic consumption. In particular, MPS and payments based on output have the same impact on producer prices for a given amount of transfer (from consumers or taxpayers, respectively). Unlike payments based on output, MPS also has the effect of increasing domestic prices paid by the consumer, and so dampens domestic consumption. As a result MPS is more trade-distorting than output support, though a given level of support provided by the two policies will have similar production effects.

For this reason, we do not expect significant differences between the Iso-trade and Iso-production indices in most cases. The Iso-production index should lie above the Iso-trade index in most cases, and it should not correspond to the NPC quite as well as did the Iso-trade index. Figure 11 compares the Iso-production and Iso trade indices for the EU and the US verifying these points.

Figure 11 Iso-production and trade indices for EU and US



Conclusion

The OECD's PSE is frequently criticised for not revealing effects of farm support on indicators such as production, trade or farm household income. The PSE is an indicator of gross financial transfers from taxpayers and consumers to farmers resulting from farm policies. As such, it indeed does not directly reveal policy impacts on any other variable. However, it is possible, as we have demonstrated here, to use the PSE information as the basis for developing indicators of policy effects using a model. Following Josling, we began the analysis proposing three fixed-definition indicators, all based on the notion of the 'tariff-equivalent' level of support. That is, each of these three indicators measures the level of market price support that is equivalent to the current policy package either with respect to trade, production or farm household income.

Using these indicators to evaluate policy performance led us to conclude that, when evaluated relative to estimated effects on either trade or production, the tariff equivalent of support is generally below the observed PSE. This is because, in general but not always, the non-MPS part of the PSE is less production and trade distorting than market price support. Accordingly, where both the level of the overall PSE and the MPS share in the total are both declining over time the resulting downward trend in the Iso-trade, tariff-equivalent of support can substantially out-pace the downward trend in the PSE itself.

Our results also highlight the 'Tinbergen' principle, first used in establishing the essential one-to-one correspondence between policy targets and instruments. As here interpreted, we should also insist on a one to one correspondence between indicators and the policy effects to be measured by them. Findings with respect to our Iso-income measure illustrate the point. We found, for the EU for example, that both the total PSE and our Iso-trade indicator of the tariff-equivalent of support provided crop producers both declined during the study period. Yet, because of the particular changes in the 'mix' of support measures used over that period our Iso-income index suggests the income benefits of support were actually increasing.

References:

Abler, David (2000), *"Elasticities of substitution and factor supply in Canadian, Mexican, and US agriculture"*, *Consultant report to the OECD*, OECD, Paris.

Alston, J.M. (1991), "Research benefits in a multi-market setting: A Review", *Review of Marketing and Agricultural Economics*, vol. 1, no. 59, pp. 23-52.

Anderson, James (1995), "Effective Protection Redux", *Presentation to the European Economic Association meetings*, Prague.

Anderson, James, Geoffrey Bannister and J. Peter Neary (1995), "Domestic Distortions and International Trade" *International Economic Review*, vol. 36, No. 1, pp. 139-157.

Anderson, James and J. Peter Neary (1996), "A New Approach to Evaluating Trade Policy" *Review of Economic Studies*, vol 63 pp. 107-125

Anderson, Kym (1995), "On Measuring the Extent of Agricultural Policy Intervention: A Review of the PSE and related indicators", *Policy Discussion Paper No. 95/05, Centre for International Economic Studies*, University of Adelaide, Australia.

Gardner, B.L. (1990), *The Economics of Agricultural Policies*, New York, McGraw Hill.

Gunter, L.E., Ki Hong Jeong, and F.C. White (1966), "Multiple policy goals in a trade model with explicit factor markets", *American Journal of Agricultural Economics*, vol. 78, pp. 313-330.

Hertel, T.W. (1989), "Negotiating Reductions in Agricultural Support: Implications of Technology and Factor Mobility", *American Agricultural Economics Association Journal*, vol. 3, No. 71, pp. 559-573.

Josling, Tim (1993), "Of Models and Measures: Some Thoughts on the Use and Abuse of Policy Indicators", in Shane, Mathew and Harald Witzke (eds.). *The environment, government policies, and international trade : proceedings : papers presented at the Dec. 1990 annual meeting of the International Agricultural Trade Research Consortium (IATRC), San Diego, California.* Staff report no.AGES9314. Washington: U.S. Dept. of Agriculture Economic Research Service, 1993. 272 p.

Masters, William (1993), "Measuring Protection in Agriculture: the Producer Subsidy Equivalent Revisited", *Oxford Agrarian Studies*, vol. 21, No. 2, pp. 133-141.

OECD (2001a), *Market Effects of Crop Support Measures*, OECD, Paris.

OECD (2001b), *Decoupling: A conceptual overview*, OECD, Paris.

OECD (2002), *Methodology for the Measurement of Support and use in Policy Evaluation*, OECD, Paris.

OECD (2003), *Agricultural Policies in OECD Countries: Monitoring and Evaluation*, OECD, Paris.

OECD (2003), *Farm Household Income: Issues and Policy Responses,* OECD, Paris.

OECD (2004), *Is the Concept of the Producer Support Estimate in need of Revision?*, Internal document, OECD, Paris.

Salhofer, K. (2000) "Elasticities of substitution and factor supply elasticities in European agriculture: a review of past studies", *Consultant's report to the OECD*, OECD, Paris.

Schwartz, Nancy and Stephen Parker (1988) "Measuring Government Intervention in Agriculture for the GATT Negotiations" *American Journal of Agricultural Economics*, vol #, pp. 1137-1145

Appendix 1 Structure of the PEM for a representative country module

Endogenous variables	***Stands for***
q_i^d, q_i^s, q_i^t	percentage change in crop demand, supply and trade quantities
p_i^d, p_i^s, p_i^w	percentage change in domestic demand and supply prices and in world price of crops
x_j^d, x_j^s, x_{mi}^d	percentage change in input demand and supply quantities, and input demand for feed crops by dairy
r_j^d, r_j^s	percentage change in input demand and supply prices
k_i^d, k_i^t	ratios of domestic demand and trade to domestic supply
Policy variables	***Stands for percentage change in rate of***
m_i	market price support
o_i	output price support
a_i	area payment
h	historical entitlement payment
s_j	subsidy to variable inputs
Parameter symbol	***Stands for***
n_{ij}	elasticity of demand for crop i with respect to price of crop j
c_{ji}	cost share of input j used in producing crop i
σ_{ij}	elasticity of substitution between factor i and j
Equations	
$q_i^d = \sum_{j=1}^{4} n_{ij} p_i^d + x_{mi}^d$	domestic consumption demands for i=1 to 4 crops
$q_i^s = q_i^d * k_i^d + q_i^t * k_i^t$	domestic crop production for i=1 to 4 crops
$x_{j,i}^d = \sum_{j=1}^{m} c_{ji} \sigma_{ji} r_j^d + q_i^s$	input demands for j=1 to m inputs, i=1 to 4 crops
$p_i^s = \sum_{j=1}^{4} c_{ji} r_j^d$	zero profit conditions for i=1 to 4 crop supply prices (crop supply price equals unit average cost of production)
$x_j^s = \sum_{j=1}^{7} e_j r_j^s$	cropland supplies for j=1 to 7 categories of cropland (wheat, coarse grain, oilseed, rice, ‘other arable’, pasture, misc.).
$x_j^s = e_j r_j^s$	non-land input supplies for j=6 to m non-land inputs
$x_j^s = x_j^d$	input market clearing for j=1 to m inputs
$r_j^s = r_j^d + a_j + h$	cropland supply prices for j=1 to 5 categories of cropland
$r_j^s = r_j^d + s_j$	non-land supply prices for j=6 to m non-land inputs
$p_i^s = p_i^d + o_i$	crop supply prices for i=1 to 4 crops
$p_i^d = p_i^w + m_i$	crop demand prices for i=1 to 4 crops

Appendix 2: Complete results by country

United States

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
PSE	10,062	9,077	9,838	10,383	9,012	3,736	6,626	7,295	14,193	19,582	20,625	15,875	9,615
Iso-production index	5,021	4,675	5,080	5,340	5,030	2,807	2,862	2,844	6,998	10,844	12,142	9,593	4,291
Iso-trade index	4,654	4,418	4,699	4,938	4,586	2,522	2,503	2,510	5,932	9,119	10,096	7,843	3,773
Iso-welfare index	17,077	14,281	17,784	16,949	15,709	4,411	11,379	13,226	27,033	37,248	38,529	28,375	16,751
%PSE	21%	20%	19%	22%	16%	7%	11%	12%	25%	34%	34%	29%	18%
NAC	126%	125%	124%	128%	119%	107%	112%	114%	133%	152%	152%	141%	122%
NPC	106%	106%	105%	106%	104%	101%	100%	100%	108%	119%	120%	115%	102%
ad-valorem													
iso-production index	113%	113%	112%	114%	111%	105%	105%	105%	117%	129%	131%	124%	110%
Iso-trade index	112%	112%	111%	113%	110%	105%	105%	105%	114%	124%	126%	120%	108%
Iso-welfare index	145%	139%	143%	146%	134%	108%	121%	125%	164%	198%	198%	172%	138%
Composition*	55%	65%	55%	54%	59%	95%	33%	30%	52%	73%	82%	85%	36%

* (%MPS, PO, PIU)

European Union

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
PSE	21,145	26,298	21,184	22,159	22,930	25,793	19,840	18,898	23,386	21,898	17,618	16,488	17,189
Iso-production index	21,478	26,414	17,729	14,398	12,148	10,733	4,389	5,366	10,095	9,681	5,264	3,913	3,597
Iso-trade index	17,339	23,255	17,062	13,686	11,405	9,896	3,541	4,643	9,378	9,015	4,611	3,292	2,959
Iso-welfare index	23,072	28,263	24,178	35,127	40,188	49,457	43,919	39,595	45,061	42,172	37,907	35,826	38,909
%PSE	46%	54%	49%	53%	53%	47%	33%	37%	48%	50%	42%	42%	40%
NAC	184%	216%	197%	212%	212%	189%	150%	159%	193%	199%	173%	172%	168%
NPC	174%	204%	174%	160%	145%	125%	101%	106%	127%	130%	110%	105%	103%
ad-valorem													
iso-production index	185%	217%	181%	173%	159%	137%	111%	117%	140%	144%	122%	117%	114%
Iso-trade index	169%	203%	178%	169%	156%	134%	109%	114%	137%	141%	119%	114%	112%
Iso-welfare index	192%	225%	211%	278%	296%	270%	210%	223%	279%	291%	258%	255%	253%
Composition*	95%	96%	83%	59%	45%	33%	9%	17%	34%	36%	19%	13%	10%

* (%MPS, PO, PIU)

Canada

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
PSE	2553	2871	1947	1240	779	1092	978	276	274	317	806	804	679
Iso-production index	2345	1607	1220	989	734	365	388	271	234	260	337	343	297
Iso-trade index	2293	1550	1180	959	711	336	360	246	211	234	294	302	262
Iso-welfare index	2777	3711	2416	1408	808	1497	1309	280	301	358	1095	1072	886
%PSE	39%	36%	28%	18%	11%	11%	11%	4%	4%	5%	13%	14%	12%
NAC	165%	157%	139%	122%	113%	113%	113%	104%	104%	106%	115%	116%	114%
NPC	148%	118%	116%	112%	108%	101%	101%	101%	101%	102%	102%	102%	101%
ad-valorem													
iso-production index	160%	132%	125%	118%	112%	104%	105%	104%	104%	105%	106%	107%	106%
Iso-trade index	158%	131%	124%	117%	112%	104%	105%	104%	103%	104%	105%	106%	105%
Iso-welfare index	171%	174%	149%	125%	113%	117%	117%	104%	105%	106%	120%	122%	118%
Composition*	83%	41%	48%	66%	82%	20%	26%	69%	57%	57%	26%	26%	21%

* (%MPS, PO, PIU)

Switzerland

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
PSE	697	717	698	685	654	727	569	507	513	421	374	251	319
Iso-production index	571	601	580	569	526	602	430	380	394	298	257	152	204
Iso-trade index	557	584	566	557	516	592	421	372	384	289	248	143	193
Iso-welfare index	818	838	842	795	748	805	635	577	586	429	383	220	291
%PSE	73%	74%	73%	73%	70%	68%	59%	64%	66%	71%	66%	59%	61%
NAC	369%	380%	373%	370%	334%	316%	243%	275%	294%	342%	292%	242%	258%
NPC	311%	325%	309%	307%	273%	266%	197%	218%	234%	254%	219%	173%	189%
ad-valorem													
iso-production index	320%	335%	327%	324%	288%	279%	208%	231%	249%	271%	232%	186%	201%
Iso-trade index	315%	328%	322%	319%	284%	276%	206%	228%	245%	266%	227%	181%	196%
Iso-welfare index	416%	428%	430%	413%	367%	339%	260%	299%	321%	346%	297%	224%	245%
Composition*	81%	83%	80%	80%	77%	80%	72%	71%	73%	68%	66%	58%	62%

* (%MPS, PO, PIU)

Mexico

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
PSE	2021	2067	2493	2521	2362	1003	393	1131	1220	1528	2053	1911	1572
Iso-production index	2192	2190	2612	2602	1362	387	-173	423	552	808	1270	1208	755
Iso-trade index	2045	2103	2527	2568	1296	326	-243	390	529	774	1234	1009	582
Iso-welfare index	1864	1956	2385	2447	2962	1277	582	1443	1539	1912	2520	2484	2118
%PSE	36%	38%	40%	42%	38%	19%	6%	21%	25%	32%	39%	35%	31%
NAC	157%	162%	167%	173%	162%	124%	107%	127%	133%	148%	165%	153%	145%
NPC	144%	152%	158%	167%	124%	103%	89%	105%	111%	119%	133%	125%	115%
ad-valorem													
iso-production index	162%	166%	170%	175%	136%	109%	97%	110%	115%	125%	140%	134%	121%
Iso-trade index	158%	163%	168%	174%	134%	108%	96%	109%	114%	124%	139%	128%	117%
Iso-welfare index	152%	159%	164%	171%	177%	130%	110%	135%	142%	160%	179%	169%	160%
Composition*	100%	100%	100%	100%	50%	28%	-85%	28%	38%	47%	57%	55%	40%

* (%MPS, PO, PIU)

Japan

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
PSE	18301	17831	21236	19352	28900	29410	24598	19070	17448	19770	20362	16996	16009
Iso-production index	17495	17181	20620	18788	28413	29108	24252	18699	17091	19245	19738	16413	15265
Iso-trade index	16603	16198	19601	17374	27460	27774	23312	17692	16199	18173	18513	15351	14391
Iso-welfare index	16803	16477	19780	17866	27366	27890	23286	17863	16339	18364	18694	15517	14440
%PSE	80%	80%	82%	86%	83%	85%	81%	78%	84%	87%	88%	87%	85%
NAC	506%	501%	570%	734%	574%	668%	513%	456%	627%	789%	849%	776%	665%
NPC	491%	485%	551%	705%	557%	645%	497%	440%	604%	759%	811%	741%	636%
ad-valorem													
iso-production index	489%	486%	556%	716%	566%	662%	508%	449%	616%	771%	826%	753%	639%
Iso-trade index	476%	471%	542%	686%	556%	646%	497%	437%	599%	748%	798%	727%	620%
Iso-welfare index	479%	476%	544%	697%	555%	647%	497%	439%	601%	752%	802%	731%	621%
Composition*	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

* (%MPS, PO, PIU)