Policy Measurement for Trade Negotiations and Domestic Reforms

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Abstract
The negotiation and enforcement of international agreements and domestic policy change requires the measurement of intervention levels. This paper reviews the principal techniques now available, and argues for the wider dissemination of aggregate tariff-equivalent measures based on observable budget data. The Canada-US FTA and then the Uruguay Round agreement pioneered the use of aggregate measures, as opposed to instrument-by-instrument negotiation. Further development of this approach could help make policies more transparent and facilitate further reforms. To help international agencies construct the most useful possible measures, we show that aggregation on a tariff-equivalent basis (i.e. expressing distortions relative to product reference prices) can guide policymakers towards resource allocations that are consistent with maximizing a social welfare function at the chosen reference prices, whereas using the same data in other formulas produces different rankings. We show the frequency of ranking reversals using a variety of data sources, and thereby demonstrate that tariff-equivalent formulas are more useful than previous measures in guiding policy debates towards welfare-enhancing reform.

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1. Introduction

Recent decades have seen dramatic improvements in economic modeling and policy analysis. With increasingly detailed data and increasingly sophisticated model structures, economists have developed increasingly precise analyses of a wide range of phenomena. But the complexity of these tools has prevented nonspecialists from using them, and the resulting "knowledge gap" between economists and government officials or voters could be a severe handicap on policymaking in many areas – most notably trade policy.

One way to help bridge the knowledge gap is to disseminate observations, independently of the theories or models that explain their significance. Observers will draw their own conclusions, based on their own informal models. But what to observe, and how to present those observations? At what scale should we report our observations, and how might we aggregate detailed observations into more useful ones? To generate useful conclusions our aggregation formulas must be guided by theory. But we would like the theory that guides measurement to be as broadly acceptable as possible, so that the data can be interpreted in similar ways by different people.

The purpose of this paper is to propose a simple principle for policy measurement, aimed at adding value to raw data by choosing an aggregation scheme that facilitates interpretation, making the data consistent with a broad class of models. We show that, in a standard traded-nontraded goods model, with constant shadow prices the marginal welfare changes associated with expanding two different activities can be ranked correctly by using input-output coefficients to construct aggregate "tariff-equivalent" price wedges, expressing distortions or shadow prices relative to product values. Standard measures which aggregate the same data using different formulas do not have this property.

The value of expressing aggregate measures in tariff-equivalent terms was first articulated in Masters (1993) and Masters and Winter-Nelson (1995), addressing the Producer Subsidy Equivalent (PSE) and Domestic Resource Cost (DRC) measures respectively. The PSE, when expressed in tariff-equivalent terms, is now known as the Nominal Assistance Coefficient (NAC) and is widely used in agricultural trade policy analyses (OECD 2002). The DRC, when expressed in tariff-equivalent terms, is a social cost-benefit ratio, and has also been adopted in the agricultural policy area (e.g. Liefert 2002, Beghin and Fang 2002).

Our goal in this paper is to provide a single model in which to demonstrate the analytical and practical advantages of using available data in tariff-equivalent form, as opposed to other types of aggregate protection measures such as domestic resource cost (DRC) ratios or producer subsidy equivalent (PSE) levels. The framework presented here is intended to clean up and unify the literature on these measures, which are widely used in practice but have attracted only sporadic attention from academic economists. Thus the paper's citations span several decades of academic and applied literature, aiming to bring it together and up to date in a unified approach.

2. Policy measurement and economic modeling

For trade policy analysis, where governments have multiple instruments and multiple objectives, data must be presented in a way that allows consistent comparisons across countries and sectors. A complete dataset can be used in a fully-specified model, with multiple equations producing cardinal measures of the magnitude with which a given policy change affects a given objective. Perhaps the most widely-used dataset in trade policy is maintained by the Global Trade Analysis Project (Hertel 1997), used in a wide variety of modeling applications.

It is possible to take a fully-specified model and derive from it a reduced-form equation, and thereby use a many-dimensional dataset to produce a one-dimensional ordinal rankings of policy change in terms of one key objective. The definitive approach here may be the Trade Restrictiveness Index of Anderson and Neary (1996), originally developed to compare policy changes in terms of welfare, but also applicable in terms of trade volumes or other targets (Anderson and Neary 1998). To maintain identical rankings as the larger model, the TRI requires an identical dataset.

Our approach is to step back from the Anderson-Neary TRI, and ask how more limited data can be aggregated to retain consistency with more fully specified models. Our purpose is to select among the formulas available to manage one of the most common types of data currently available for comparisons across countries, products and years: the average prices and quantities entering production budgets. Averages are available from spot surveys as well as aggregate national accounts. Methods are not always consistent, but the data are in principle observable and verifiable by governments, making the resulting measures feasible as negotiating goals and enforcement mechanisms. In contrast, the parameters and model specifications required to derive the TRI are not directly observable, and are likely to remain contentious.

3. Alternative formulas for policy measurement

The tradition of using price comparisons in trade policy analysis dates to the origins of economics. In Book IV of *The Wealth of Nations*, Adam Smith (1776) evaluates the impact of the Corn Laws by comparing the price of wheat in Britain with its price on the continent. This measure, now generally known as the nominal protection coefficient, has been of widespread use in applied studies (e.g. Wiebelt et al. 1992). To introduce our notation we can define the NPC as:

$$NPC \equiv p'/p \qquad (1)$$

where *p’* refers to the domestic price observed in the presence of the policy in question, and *p* refers to a reference price observed elsewhere. The relevance of the NPC depends on the potential for competitive arbitrage to enforce the law of one price in the absence of policy, so the measure is useful only to the extent that the reference price includes all relevant transaction costs across space, time and product quality.

To aggregate the impacts of simultaneous policy changes affecting both products and inputs, the oldest measure is the effective protection coefficient (EPC) due to Barber (1955) and popularized by Johnson (1965), Corden (1966) and others. The EPC can be defined as the weighted average of NPCs on outputs and inputs, using the product of price and quantity vectors for outputs and inputs to compute the ratio of value added at domestic prices (*v’*) to value added at reference prices (*v*):

$$\begin{aligned} EPC &\equiv v'/v \\ &\equiv (\mathbf{p'_o} \bullet \mathbf{q_o} - \mathbf{p'_i} \bullet \mathbf{q_i}) / (\mathbf{p_o} \bullet \mathbf{q_o} - \mathbf{p_i} \bullet \mathbf{q_i}) \end{aligned} \qquad (2)$$

Like nominal protection, the relevance of effective protection depends on the relevance of the reference prices. It also depends on the input/output coefficients. A large literature addresses the interpretation of NPCs and EPCs: from Ethier (1972) we know that a given EPC’s effects on welfare, production or trade depend on input/output substitution possibilities. Bureau and Kalaitzondakes (1995) provide evidence for the magnitude of variation. Clearly, it is only when a fully-specified model cannot be constructed that the EPC or any other measure would be used. But even in this context the applicability of the EPC formula is limited to reporting distortions that affect a small share of total input costs. As the proportion of total costs included in the inputs vector increases, the denominator of the ratio shrinks to zero and can become negative, making the indicator increasingly sensitive to observational error.

At the same time as the EPC was popularized, Bruno (1965) and Krueger (1966) developed an alternative measure aimed at taking account of distortions in domestic factor markets. This was the resource cost ratio (DRCr), defined as:

$$\begin{aligned} DRCr &\equiv \mathbf{p_n} \bullet \mathbf{q_n} / v \\ &\equiv \mathbf{p_n} \bullet \mathbf{q_n} / (\mathbf{p_o} \bullet \mathbf{q_o} - \mathbf{p_i} \bullet \mathbf{q_i}) \end{aligned} \qquad (3)$$

The DRCr measure shares the same denominator as the EPC, but its numerator is the value at shadow prices (p_n) of the domestic factors (q_n) used in production. Bruno arrived at the DRC ratio as a project-appraisal indicator to evaluate the benefits of new activities, while Krueger developed it as a trade policy measure of the costs associated with maintaining inefficient activities in place. The two converged on the same ratio because they sought to take account of factor-market distortions in contexts where factor opportunity costs ($\mathbf{p_n}$) could be measured in domestic currency, and the opportunity costs of tradable products and inputs ($\mathbf{p_o}$, $\mathbf{p_i}$) can be measured in foreign currency. By separating the two types of goods, this ratio allows ranking of activities without knowing the shadow value of foreign exchange. A shadow exchange rate is still necessary to determine the cut-off between efficient and inefficient activities (or those that are protected and those disprotected). Following Pearson and Meyer (1974) most users of the DRC ratio present it in its unit-free normalized form. Defining the shadow exchange rate λ as the domestic currency premium per unit of foreign currency earned or saved, the normalized DRC is:

$$\begin{aligned} DRC &\equiv \boldsymbol{p_n} \bullet \boldsymbol{q_n} / \lambda v \\ &\equiv \boldsymbol{p_n} \bullet \boldsymbol{q_n} / \lambda(\boldsymbol{p_o} \bullet \boldsymbol{q_o} - \boldsymbol{p_i} \bullet \boldsymbol{q_i}) \end{aligned} \qquad (3')$$

Because of its versatility and intuitive interpretation, the DRC quickly became and remains the dominant indicator in general use. An extensive theoretical debate has clearly shown its limited value relative to more detailed models (e.g. Bhagwati and Srinivasan 1978, Warr 1983, Lucas 1984, Tower 1992, Fujita 1993), but an even larger body of applications has demonstrated its enduring practical appeal for international institutions documenting relative distortions across countries. It was a dominant tool used to guide World Bank-funded sectoral structural adjustment activities (e.g. World Bank 1991) and is often found in more general policy-analysis work such as studies for the FAO (Appleyard 1987), CIMMYT (Morris 1990), IFPRI (Gonzalez et al. 1993), OECD (Alpine and Pickett 1993; Barry, Stryker and Salinger 1991) and many others (e.g. Greenaway and Milner 1990, Sujimoto 1991, Weiss 1991).

While the DRC literature grew, a quite separate tradition of policy analysis developed to assess distortions in agricultural trade, where interventions often include direct payments from government to farmers alongside market mechanisms. To quantify the relative magnitudes of farm subsidies, Josling (1973) developed the producer subsidy equivalent (PSE) ratio, expressing total transfers as a proportion of farm revenue. Using the same notation as above, but adding transfers (t) as well as price supports or other divergences between market prices received (p') and reference prices (p):

$$PSE \equiv [t + (\boldsymbol{p'_o} - \boldsymbol{p_o}) \bullet \boldsymbol{q_o} - (\boldsymbol{p'_i} - \boldsymbol{p_i}) \bullet \boldsymbol{q_i} - (\boldsymbol{p'_n} - \boldsymbol{p_n}) \bullet \boldsymbol{q_n}] / (t + \boldsymbol{p'_o} \bullet \boldsymbol{q_o}) \qquad (4)$$

This formula is particularly attractive in the setting of policy negotiations because it can be defined and discussed without explicit mention of the reference prices – although of course they are implicit in the concept of price supports. This sleight-of-hand helped make the PSE very politically attractive: a PSE-type formula was used as a test of compliance in the Canada-U.S. Trade Agreement (GAO 1991). Large-scale programs of PSE measurement were instituted by the USDA (ERS, 1988) and the OECD (Cahill and Legg 1990) , and PSE findings have been seen as authoritative in the press (e.g. Carr 1992).

The many applications of PSEs and DRCs demonstrate the broad appeal of policy measures for policy debates and trade negotiations. Clearly there were compelling reasons for these measures to follow the forms in which they were developed and popularized, but it is not clear that those same forms are still the most appropriate. Our purpose in this paper is to distinguish among the available indicator formulas in terms of their ability to rank the welfare effects of policy change, testing each one against a standard model.

4. Index-number properties of alternative formulas in a benchmark model

Our context is the problem of a government choosing marginal projects or marginal changes in policy in pursuit of some unspecified objective function. To parallel the development of our policy measures, we wish to consider an economy with constraints on both the internal (resource) balance for nontraded goods and the external (foreign-exchange) balance for traded goods. Such models, in the tradition of Salter (1959) and Swan (1960), remain standard tools of cost-benefit analysis (e.g. Squire 1989, Fane 1991). Following Dornbusch, Fischer and Samuelson (1977) the distinction between traded and nontraded goods need not be predetermined, and can arise endogenously in the model. The government faces the following optimization problem:

maximize $U(c_t, c_n)$ (5)

subject to $c_n\, q_n - w_n \leq 0$ (6)

$p_t{\cdot}m_t - T = 0$ (7)

where c_n, c_t are quantities consumed of nontradables and tradables
p_t, m_t are border prices and net imports of tradables
q_n, w_n are quantities of nontradable inputs and endowments
T is a scalar of foreign-exchange transfers

The exogenous variables of our model are p_t w_n, and T. To solve for the endogenous variables we need to specify the production technology:

$$y_t = f(q_t, q_n) \qquad (8)$$

and the resulting market-clearing condition for tradables:

$$m_t = f(q_t, q_n) - q_t, + c_t \qquad (9)$$

With well-behaved functions the problem simplifies to maximizing the following Lagrangian expression:

$$₤= U(c_t, c_n) - \lambda[p_t \bullet \mathrm{F}(q_t , q_n) - p_t \bullet q_n - p_t \bullet q_t + T] + p_n \bullet [c_n + q_n - w_n] \qquad (10)$$

where λ is the Lagrange multiplier for the foreign exchange constraint, and
p_n is the vector of Lagrange multipliers for nontradable factors,

thereby recovering the notation of the policy measures presented in section 3.

The first-order conditions for optimal resource allocations have:

$$\partial £/\partial c_i = U_i - \lambda p_i = 0 , \forall i = 1, \dots , T \qquad (10')$$
$$\partial £/\partial c_j = U_j - p_j = 0 , \forall j = 1, \dots , N \qquad (10'')$$
$$\partial £/\partial q_i = \lambda p_t \bullet F_i - \lambda p_i = 0 , \forall i = 1, \dots , T \qquad (10''')$$
$$\partial £/\partial q_j = \lambda p_t \bullet F_j - p_j = 0 , \forall j = 1, \dots , N \qquad (10'''')$$

and combining the equations (10') and (10") we obtain the familiar optimality conditions:

$$\frac{U_i}{U_j} = \frac{p_t \cdot F_i}{p_t \cdot F_j} = \frac{\lambda p_i}{p_j}, \quad \forall\ i = 1, \dots , T \ , \quad \forall\ j = 1, \dots , N \qquad (11)$$

Against this benchmark we can test the optimality conditions reached by a government choosing activities according to each type of policy measure. We can begin with resource allocations achieved by pursuing the activities with the lowest DRCs:

$$\text{min. } DRC = \frac{p_n \cdot q_n}{\lambda p_t \cdot F(q_t, q_n) - \lambda p_t q_t} \qquad (12)$$

The first order conditions for this optimization problem are:

$$\frac{\partial DRC}{\partial q_i} = \frac{p_n \cdot q_n \lambda p_t F_i - p_n \cdot q_n \lambda p_i}{(\lambda p_t \cdot F(q_t, q_n) - \lambda p_t q_t)^2} = 0, \quad \forall\ i = 1, \dots , T \qquad (12')$$

$$\frac{\partial DRC}{\partial q_j} = \frac{p_j \lambda\ p_t \cdot F(q_t, q_n) - p_j \lambda\ p_t \cdot q_t - p_n \cdot q_n \lambda\ p \cdot F_j}{(\lambda p_t \cdot F(q_t, q_n) - \lambda p_t q_t)^2} = 0, \quad \forall\ j = 1, \dots , N$$

Combining (12') and (12") we obtain:

$$\frac{p_t \cdot F_i}{p_t \cdot F_j} = \left(\frac{p_n \cdot q_n}{\lambda p_t \cdot F(q_t, q_n) - \lambda p_t q_t} \right) \left(\frac{\lambda p_i}{p_j} \right) = DRC \left(\frac{\lambda p_i}{p_j} \right) \qquad (13)$$

The optimality condition associated with choosing activities to minimize their DRC (equation 13) coincides with that of maximizing welfare (equation 11) only when the resulting minimum DRC is unity – that is, that all activities are equally optimal at shadow prices, and hence resource allocations mimic those of a competitive market economy. This familiar result of the early DRC literature (Bhagwati and Srinivasan 1978) is of little practical value in most contexts, where DRCs are used to evaluate new projects which embody innovations or to assess existing distorted activities, and hence DRC levels vary widely and are often far from unity (Tower 1992, p. 32). In the normal context, where the lowest-DRC activity has a DRC below unity, pursuing the lowest-DRC activity (following equation 13) involves a marginal rate of substitution between tradable and nontradable inputs that is lower than optimal: such an activity uses more tradable inputs and less nontradable inputs than the optimal one.

Figure 1 gives a graphical representation of the difference between the optimality conditions obtained when choosing among innovations by the DRC criterion, and those obtained from the general model. In Figure 1, an existing optimal activity (A) is to be replaced by an innovation from a set of new technologies represented by the dotted isoquant. Assuming the change is economically small we hold shadow prices constant. Technique (B) is economically optimal in the context of the full model (following equation 12), but technique (C) would be chosen by following the minimum-DRC criterion. In general, the path of technical change guided by DRCs will be more input-intensive (less factor-intensive) than that guided by the full model.

In the absence of the data required to estimate a fully-specified model, is it possible to use observable data in a formula that would be consistent with the model? The exact same data as the DRC can be used in an alternative unit-free ratio, constructed just like the DRC but with total benefits rather than value added in the denominator. This is, of course, a simple cost-benefit ratio. Such a measure was mentioned by Bhagwati and Srinivasan (1978) who call it a "gross DRC" but they dismiss its importance, on the grounds that "none of the DRC practitioners have used gross measures" (p. 105). It is of course true that the form of the ratio does not affect its performance as a cost-benefit criterion, but it does affect the ranking of alternative activities and the selection of optimal ones.

Tower (1991) notes that DRCs are just one of many possible cost-benefit ratios, and argues that specific ratios are needed for specific purposes. If the objective is the policymaker's utility function in equation (5), however, we might want to consider the pursuit of activities with the lowest general social cost-benefit (SCB) ratio:

$$\text{min.}\, SCB = \frac{\lambda p_t q_t + p_n \cdot q_n}{\lambda p_t \cdot F(q_t, q_n)} \qquad (14)$$

The first-order optimality conditions of this problem, proceeding as above (for equation 12), reduce to:

$$\frac{p_t \cdot F_i}{p_t \cdot F_j} = \left(\frac{\lambda p_i}{p_j} \right) \qquad (15)$$

which is the same relative-price condition as for the full model (equation 11). To obtain this result we aggregate distortions relative to the reference value of the product, just as Adam Smith did in deriving what is now the nominal protection coefficient. We term this a "tariff-equivalent" approach because it measures total distortions as a fraction of reference prices. The effects on production, trade and welfare of a given tariff-equivalent degree of protection will, of course, depend on the context and the mix instruments used, but the factor-intensity of optimal activities will follow equation 15 and hence be consistent with the full model (equation 11).

If tariff-equivalence is a useful property for a cost-benefit ratio, perhaps it is also useful for an aggregate protection indicator. The percentage PSE, as defined in equation (4), is not a tariff-equivalent ratio: it is expressed relative to market prices rather than reference values. But we can construct a ratio using the exact same data as the PSE in tariff-equivalent form; indeed such a measure was proposed by Scott R. Pearson in a different context (Monke and Pearson 1989), who called it the Subsidy Ratio to Producers (SRP). Defining the SRP in the same terms as the PSE we have:

$$SRP \equiv [t + (\mathbf{p'_o} - \mathbf{p_o}) \bullet \mathbf{q_o} - (\mathbf{p'_i} - \mathbf{p_i}) \bullet \mathbf{q_i} - (\mathbf{p'_n} - \mathbf{p_n}) \bullet \mathbf{q_n}] / (\mathbf{p_o} \bullet \mathbf{q_o}) \qquad (16)$$

and using analogous notation we can define it in the same terms as the SCB:

$$SRP \equiv \frac{t + (p'_t - \lambda p_t) \cdot F(q_t, q_n) + (p'_t - \lambda p_t) q_t + (p'_n - p_n) \cdot q_n}{\lambda p_t \cdot F(q_t, q_n)} \qquad (16')$$

The SRP measure aggregates distortions, and the SCB measure aggregates social costs, but since they share the same denominator we may suspect they share the same desirable property of ranking two or more activities by the same criterion as the full model (equations 15 and 11). This is strictly true only if the data account for all distortions between social costs and market prices, and if the zero-profit condition holds at market prices so that revenue including transfers exhausts total costs:

$$t + \mathbf{p'_o} \bullet \mathbf{q_o} = \mathbf{p'_i} \bullet \mathbf{q_i} - \mathbf{p'_n} \bullet \mathbf{q_n} \qquad (17)$$

Substituting equations (17) into (16') and rearranging terms we obtain:

$$\begin{aligned} SRP &= \frac{\lambda p_t q_t + p_n \cdot q_n}{\lambda p_t \cdot F(q_t, q_n)} - 1 \\ &= SCB - 1 \end{aligned} \qquad (18)$$

As data collection advances towards complete enumeration of all distortions (in the SRP) and all costs (in the SCB), the two measures converge to the same tariff-equivalent concept, with the SRP presented in percentage form as a *rate* of protection, and the SCB presented like the NPC or EPC as a *coefficient* of protection, with the two measures giving identical activity rankings.

5. Empirical performance of alternative formulas

Does the theoretical distinction between measures have any practical importance? Having determined that rankings obtained with tariff-equivalent measures have desirable properties in the context of a standard model, do these rankings actually differ from those generated with traditional measures derived for other reasons? Here we compare first DRC and SCB results, and then PSE and SRP results

Typical sets of DRC data used in agricultural policy analysis are those reported by Masters (1994) for Zimbabwe and Pearson and Monke (1996) for Kenya. Both sets of data were compiled in collaborative projects with the host-country government, aimed at guiding a range of policy instruments including public-sector investments and extension advice to those farming activities perceived to be most economically efficient. In Tables 1 and 2 we report all of the DRCs calculated in those studies, along with the exact same data reported in SCB form. Activities are ranked by DRC level, to reveal ranking reversals when using the SCB. Note that ranking reversals are counted as any pair of activities ranked differently by the two measures: in the sample of 16 Zimbabwean activities for which budgets are reported, there are 120 (16x15/2) possible pairings. Of the possible pairings, 2.5 percent are reversed in the Zimbabwe data, and 14 percent are reversed in the Kenya data. As predicted by the model, the reversals occur where a relatively input-intensive technique is compared with a relatively factor-intensive one.

Table 1. DRC and SCB estimates for Zimbabwe, 1990 harvest

Crop and technique	DRC	SCB
Groundnuts-Large scale	0.42	0.53
Cotton-Large scale	0.43	0.56
Soya-Large scale	0.48	0.61
Groundnuts-Low potential	0.52	0.57
Maize-Low potential	0.52	0.59
Maize-High potential	0.53	0.62
Maize-Large scale	0.63	0.75
Wheat-Large scale	0.65	0.74
Cotton-High potential	0.72	0.77
Groundnuts-High potential	0.89	0.90
Sunflwr-Low potential	0.98	0.99
Sunflwr-High potential	1.06	1.05
Fin.Millet-High potential	1.20	1.17
Fin.Millet-Low potential	1.20	1.18
Sorghum-Low potential	2.63	2.29
Prl.Millet-Low potential	4.41	2.81

Note: There are 16 crop-and-technique observations, for 120 possible rankings of which 3 or 2.5 percent are reversed when using the SCB.
Source: Calculated from data reported in Masters (1994)

For example, in the Zimbabwe data, comparing two of the most common techniques for producing oilseeds using the DRC suggests that large-scale production of soyabeans uses fewer resources than smallholder production of groundnuts in low-potential areas (a DRC of 0.48 for soyabeans versus 0.52 for groundnuts), but the social cost-benefit ratio of the groundnuts is lower (0.57 for groundnuts versus 0.61 for soyabeans). This arises because tradable inputs account for a much larger fraction of total costs for the soyabeans than for the groundnuts (cost shares of 25 percent versus 10 percent respectively).

Reversals are more frequent in the Kenya data than in the Zimbabwe data, as the DRCs are more similar and the factor intensities more disparate. A typical example from the Kenya data would be a comparison of wheat and maize production on commercial farms in Nakuru district. Wheat has a lower DRC (0.23 versus 0.35) but a higher SCB (0.54 versus 0.43), due to a much higher share of costs in tradable inputs (64 percent versus 28 percent).

Table 2. DRC and SCB estimates for Kenya, 1990 harvest

Crop – technique	**DRC**	**SCB**	**Crop – technique**	**DRC**	**SCB**
Oranges	0.10	0.22	Maize-tractor	0.35	0.43
Tomato-irrigated	0.12	0.20	Maize+beans2	0.36	0.40
Wheat-large scale	0.12	0.45	Tea	0.37	0.43
French beans	0.14	0.20	Maize+Beans5	0.38	0.47
Canning tomato	0.15	0.23	Tomato-rainfed	0.39	0.47
Maize+beans	0.19	0.24	Pyrethrum	0.40	0.41
Tomato-improved	0.21	0.31	Potato-irrigated	0.40	0.64
Wheat2	0.23	0.54	Pyrethrum2	0.42	0.42
Wheat	0.25	0.37	Tomato-rainfed2	0.44	0.60
Cabbage-irrigated	0.25	0.43	Pyrethrum3	0.52	0.52
Potato-rainfed	0.29	0.49	Maize-oxplow	0.53	0.58
Maize+beans4	0.32	0.41	Potato-rainfed2	0.56	0.62
Coffee	0.33	0.33	Sorghum-improved	0.59	0.62
Cotton	0.33	0.35	Coffee-estate	0.59	0.82
Maize+beans3	0.34	0.40	Tea	0.78	0.82
Maize	0.34	0.41			

Note: There are 29 crop-and-technique observations, for 615 possible rankings of which 86 or 14 percent are reversed when using the SCB.
Source: Calculated from data in Pearson and Monke (1996).

Clearly, the choice of denominator matters, in a politically important way: using the DRC to guide resource allocation points to an inefficiently input-intensive development path. Following cost-benefit ratios would lead to a more labor- and land-intensive set of techniques, that is more consistent with the government's goals as reflected in whatever shadow prices are used in the study.

The DRC measure is used mainly in policy debates within developing countries. In trade negotiations between countries the PSE is the dominant measure. During the Uruguay

Round negotiations the USDA assembled a worldwide PSE database, and the OECD continues to maintain such as database for its member countries.

The USDA database covers the principal crops in each of 33 countries for the 1983-89 period. Using period averages, Table 3 reports some examples of PSE and SRP ranking reversals in those data. Table 4 reports similar examples using the OECD database.

Table 3. Example PSE and SRP comparisons in USDA data (1983-89 averages)

		PSE	SRP
Comparisons across countries			
Milk	EC-12	71%	249%
	Canada	114%	134%
Wheat	US	41%	70%
	Mexico	43%	53%
Mutton/lamb	EC-12	54%	119%
	New Zealand	72%	72%
Comparisons across crops			
United States	Barley	36%	79%
	Wheat	41%	70%
Mexico	Soyabeans	57%	88%
	Maize	59%	62%
India	Maize	-43%	-14%
	Sorghum	-27%	-20%

Note: The sample size is 250 crop-and-country observations, producing 31, 125 (250x249/2) possible pairings, of which 1,572 (5.1 percent) are ranked differently using the SRP than using the PSE.
Source: calculated from data in ERS, 1988.

In the USDA data reported above, for example, milk appears by the PSE criterion to have been far more protected in Canada than in Europe, whereas the SRP criterion shows the opposite. Across crops, in India where agriculture was taxed rather than subsidized, the PSE suggests that maize is more heavily taxed than sorghum, whereas the SRP shows the opposite. In both cases the difference is due to the mix of policies, as the PSE allows price-raising policies to increase the denominator as well as the numerator, so support offered that way results in lower PSE estimates than interventions using other instruments.

In the OECD data of Table 4, we have fewer countries but a longer and more recent time period.

Table 4. Example PSE and SRP comparisons in OECD data

		PSE	SRP
Comparisons across countries			
Sorghum in 1980	Canada	18%	22%
	Mexico	21%	18%
Large scale oilseeds in 1991	Sweden	64%	185%
	EU	67%	175%
Wheat in 1994	Finland	79%	343%
	Switzerland	81%	318%
Comparisons across crops			
Turkey in 1991	Milk	49%	108%
	Wheat	53%	91%
USA in 1994	Rice	34%	52%
	Wheat	34%	47%
Japan in 1995	Rice	97%	615%
	Othgrain	99%	566%
Comparisons over time			
Large scale oilseeds in Austria	1986	85%	481%
	1987	84%	535%
Pigmeat in Finland	1989	52%	157%
	1990	51%	170%
Eggs in Sweden	1992	69%	280%
	1993	71%	233%

Notes: The sample size is 2,984 observations.

For comparisons across countries (within one product and one year), there are 14,011 possible rankings of which 359 (2.6%) were reversed; for comparisons across products (within one country and one year), there are 24,756 possible rankings of which 742 (3.0%) were reversed; for comparisons over time (within one product and one country), there are 19,966 possible rankings of which 635 (3.2%) were reversed.

Source: Calculated from data in OECD, 1997.

Table 4 reports data from individual years allowing comparisons over time: for example, with eggs in Sweden the PSE measure suggests that protection increased from 1992 to 1993, whereas the SRP indicator shows that it declined. Again, this is because the mix of instruments changed away from price-raising policies, towards input subsidies and payments to factors.

6. Conclusions

Fully-specified models are needed to say how much production, trade or welfare would be changed by reform. But the structure and parameters of such models cannot be observed directly, and are therefore of limited use in trade negotiations and policy debates. On the other hand, observable prices and quantities can be aggregated in a policy measure to guide negotiations and serve as an enforcement mechanism, just like any tariff formula or market access agreement.

A policy measure based entirely on observed data cannot be given cardinal meaning without further assumptions, but it can be used in an ordinal sense to rank activities and guide policy towards particular resource allocations. Whether a measure is useful and guides policy towards desirable resource allocations depends first on the quality of the data, but also on the aggregation formula.

For a given set of data—prices and quantities—any policy measure will be interpreted by each observer using their own implicit or explicit model. But the *general* usefulness of the measure depends on it having common significance in one or more standard models. In this paper we demonstrate that the popular Domestic Resource Cost (DRC) ratio and percentage Producer Subsidy Equivalent (PSE) measures do *not* systematically guide policy towards socially optimal levels in a conventional tradable-nontradable goods model.

Relative to the results of the standard model, a given set of prices and quantities in the DRC formula would guide resource allocations towards activities that are excessively intensive users of tradable inputs, while the percentage PSE guides decisionmakers towards policies that excessively alter product prices.. However, the optimality conditions of the standard model are achieved when policy is guided by tariff-equivalent measures, such as the SCB and SRP, and those two measures are identical when the zero-profit condition holds at market prices.

The data presented here show that using observable budget data in a tariff-equivalent ratio reverses the results obtained with conventional DRC ratios or percentage PSEs in a significant fraction (2.5 to 14.0 percent) of pairwise comparisons across products, among countries or over time. These ranking reversals occur using identical data, simply expressing them as a fraction of the reference value of the product (as in a tariff) as opposed to value added (in the DRC) or market revenues (in the PSE).

We conclude that, for any given set of prices and quantities which policy makers observe and accept, expressing those data as an aggregate tariff-equivalent is preferable to expressing them as DRCs or PSEs. Using such measures to negotiate and enforce trade agreements or domestic reforms should be politically possible, building on the experience of the Canada-US Free Trade Agreement and the Uruguay Round to help guide future policy debates towards mutually desirable outcomes.

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Figure 1. Optimality conditions for new projects using the DRC