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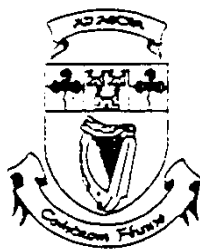
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Measuring the Restrictiveness of Trade Policy

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MEASURING THE RESTRICTIVENESS OF TRADE POLICY*

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MEASURING THE RESTRICTIVENESS OF TRADE POLICY

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MEASURING THE RESTRICTIVENESS OF TRADE POLICY

I Introduction

The orientation of a country's trade policy is widely agreed to be an important determinant of its economic well-being. Yet, the prior question of how trade restrictiveness should be measured has received very little attention in the past. Typically, this is done in practice using a variety of *ad hoc* measures such as the trade-weighted average tariff, the coefficient of variation of tariffs or the non-tariff-barrier coverage ratio. But all these measures lack any theoretical foundation and are subject to theoretical and practical drawbacks. Some researchers, such as Papageorgiou et al. (1991), have attempted to construct subjective measures of trade restrictiveness. These have the advantage of incorporating important local considerations but are inherently difficult to replicate for other countries or time periods. These problems are not so severe in the textbook world where trade barriers take a single and well-defined form. But in most real-world situations, especially in the developing world, actual systems of trade intervention are pervasive and highly complex. This poses a challenge for analysts and policy-makers alike. In the face of a bewildering array of tariffs and quantitative restrictions, it can be extremely difficult to assess the true orientation of a country's trade policy or to evaluate the thrust of a package of policy changes which encourage trade in some product lines but discourage it in others. Traditional analysis provides little guidance on how to aggregate restrictions across different markets. This makes it difficult to evaluate proposals for trade liberalisation which form part of a stabilization package or to assess the progress made in moving towards less restricted trade. It also poses problems of international comparability in multilateral negotiations. A further reason for seeking a framework within which trade policies can be compared consistently is of analytical as well as practical importance. Since ultimately the case for free trade is a scientific hypothesis, theoretically sound but potentially false, some measure of trade restrictiveness is necessary if satisfactory tests of the positive impact of trade on growth and economic performance are to be possible.¹

¹ Leamer (1988) and Edwards (1992) propose and implement tests along these lines, adopting the Heckscher-Ohlin explanation of trade patterns as a maintained hypothesis. Krishna (1991) and Pritchett (1991) review this and other approaches to measuring openness and trade restrictiveness.

This article describes an approach which has been developed and implemented by the authors with the objective of providing theoretically satisfactory yet practically implementable procedures for measuring the restrictiveness of trade policy. Two relatively recent developments have made this approach possible. At a theoretical level, the normative theory of international trade has been formalized in a systematic way and extended to take account of varieties of trade policy other than tariffs.² And, at a practical level, the rapid increase in availability of cheap computing power has made possible the implementation of models with a disaggregated structure which comes closer than ever before to the complexity of real-world protective structures. Later in the article, we describe how the approach we propose has been implemented on a personal computer. First, we examine the conceptual problem in more detail, show how different aspects of trade policy regimes can be incorporated into a single measure, the Trade Restrictiveness Index, and review some of the applications of the index which have been carried out.

II Measuring Trade Restrictiveness in the Presence of Tariffs

The simplest context in which measuring trade restrictiveness arises is when tariffs are the only form of trade policy. Panel (a) of Figure 1 illustrates the market for a single good whose world price (assumed given) is π_1^* and whose home import demand curve is $m_1(\pi_1)$. Domestic producers and consumers face a price which is raised by the tariff to π_1^0 . Adopting a partial equilibrium perspective for the moment, the resulting deadweight loss, or cost of protection, is measured by the Marshallian triangle DCE. As for the restrictiveness of trade policy, in this one-good context it can obviously and unambiguously be measured by the height of the tariff, the distance AB or CE.

Matters are not so simple, however, when tariffs apply to more than one good. In panel (b) of Figure 1 the import demand curve for good 2 is drawn: it is assumed to be less elastic in demand than good 1 and to be subject to a higher tariff.³ The total welfare loss from the two tariffs is the sum of the Marshallian triangles DCE and IHJ. But how should the "average" level of trade restrictiveness across these two markets be measured? The easiest approach, and the one typically adopted in practice, is to aggregate the two tariffs by

² Dixit (1986) and Anderson (1988 and 1993a) provide overviews of recent work in the field.

³ For ease of exposition, the world prices of the two goods are assumed to be equal.

weighting them by the import volumes of the two goods, AC and FH. However, this runs into difficulties immediately. Consider a change in trade policy which leads to the situation illustrated in Figure 2, where the same two import demand functions are illustrated but where the configuration of tariff levels is reversed: now, the correlation between demand elasticities and tariff levels is positive rather than negative. In panel (a), imports of the high-elasticity good 1 are almost eliminated, so its high tariff receives a very low weight in the average tariff. In panel (b), the low tariff on the low-elasticity good 2 receives a high weight. As a result, the calculated average tariff is low, considerably lower than that in Figure 1. Yet, it seems intuitively obvious that trade is more restricted in Figure 2 than in Figure 1. The standard index has thus moved in the wrong direction.

Another measure of trade restrictiveness which is often used in practice is the coefficient of variation of tariffs. This may be rationalised on the grounds that uniform tariffs minimise the welfare cost of meeting a given constraint on the value of imports, although on other grounds uniform tariffs are not necessarily desirable.⁴ But the coefficient of variation is no more satisfactory a measure of trade restrictiveness than is the trade-weighted average tariff. If the coefficient of variation is calculated with equal arithmetic weights, then its value does not change between Figures 1 and 2. Whereas, if import weights are used, then the coefficient of variation is higher in the case illustrated in Figure 2 than in that in Figure 1, but only because the average tariff has fallen.

This example suggests that, once we move away from the simple one-good case, the distinction between the welfare cost of protection and the restrictiveness of the protective structure cannot be rigidly maintained. Any satisfactory measure of trade restrictiveness must take account of the costs imposed on the economy by the pattern of tariffs, whereas purely statistical measures such as the trade-weighted average tariff or the coefficient of variation of tariffs bear no necessary relation to trade restrictiveness.

Further consideration of Figures 1 and 2 suggests a more satisfactory approach to comparing the trade policies in the two situations illustrated. This is to ask what is the *uniform* tariff which would be equivalent to the actual tariffs in each case, in the sense of yielding the same welfare loss.⁵ The answer to this question in Figure 1 is a tariff equal to

⁴ See Anderson (1988, Section 3.1) and Stern (1990).

⁵ Corden (1966) is an early exploration of this approach.

AR: by construction, the increase in the tariff on good 1 from AB to AR yields a welfare loss equal to the rectangle KCEL, which is equal to the welfare gain of HMNJ arising from the reduction in the tariff on good 2. The same applies in Figure 2 with appropriate modifications: the uniform tariff AR now implies a lowering of the tariff on good 1 and an increase in that on good 2. Evidently, the welfare-equivalent uniform tariff is lower in Figure 1 than in Figure 2, in accordance with the intuitive presumption that trade is less restricted in the former case than in the latter. A corollary is that, in both cases, the welfare-equivalent uniform tariff is closer to the actual tariff on the high-elasticity good 1: this accords with the intuition that a high tariff on that good is more restrictive than a high tariff on good 2.

Given that the welfare-equivalent uniform tariff appears to be a satisfactory measure of trade restrictiveness, the question naturally arises whether it can be extended to more general cases than the diagrammatic and partial equilibrium illustration in Figures 1 and 2. To do so, we make use of recent developments in the theory of trade policy, and especially of some technical tools introduced in Anderson and Neary (1992a and 1992b). Chief among these is the *balance of trade function*, which summarises in implicit form the general equilibrium of a multi-good economy. The value of this function, written as $B(\pi, u)$, is the amount of foreign exchange which is required to reach a level of aggregate national welfare, denoted by u , facing a given vector of domestic prices π .⁶ Implicit in the function are all the variables which characterise the general equilibrium of the economy, including taste and technology parameters, the balance of payments surplus or deficit, the level of world prices π^* and the price of the numeraire good. The requirement that the economy be in equilibrium is imposed by setting the value of the function equal to zero. Hence, if we wish to compare two situations, indexed by "0" and "1" respectively, the equilibrium conditions in each may be written as:

$$(2.1) \quad B(\pi^0, u^0) = B(\pi^1, u^1) = 0.$$

⁶ More precisely, the balance of trade function gives the excess of domestic expenditure, given by an expenditure function $e(\pi, u)$, over domestic income, which in turn is made up of GNP, given by a GNP function $g(\pi)$, tariff revenue, $(\pi - \pi^*)'m$, where imports m equal $e_\pi(\pi, u) - g_\pi(\pi)$, and the balance of payments deficit, β . Thus, in equilibrium:

$$(2.1a) \quad B(\pi, u) = e(\pi, u) - g(\pi) - (\pi - \pi^*)'m - \beta.$$



(In some applications, the new equilibrium may be identified with free trade, so that $\pi^1 = \pi^*$; but the techniques also allow for more general comparisons.)

In order to motivate the derivation of our welfare-equivalent uniform tariff measure using the B function, it is helpful to draw an analogy with the derivation of the true cost-of-living index for a consumer. This is typically defined as the scalar, ϕ , which equals the expenditure needed to attain the old utility level at the new prices, $e(\pi^1, u^0)$, scaled by expenditure in the initial period, $e(\pi^0, u^0)$:

$$(2.2) \quad \phi = e(\pi^1, u^0) / e(\pi^0, u^0).$$

Since the expenditure function $e(\pi, u)$ is homogeneous of degree zero in π , we can divide both sides of (2.2) by ϕ to rewrite it in a less conventional way:

$$(2.3) \quad \phi = [\phi: e(\pi^1/\phi, u^0) = e(\pi^0, u^0)].$$

This has the interpretation that the true cost-of-living index gives the uniform scaling factor by which period-1 prices must be deflated to compensate the consumer for the change in prices from π^0 to π^1 .

Now, by analogy with (2.3),⁷ we may define the *Trade Restrictiveness Index* or TRI as the uniform scaling factor Δ by which period-1 prices must be deflated to compensate the aggregate consumer for the change in prices from π^0 to π^1 :

$$(2.4) \quad \Delta = [\Delta: B(\pi^1/\Delta, u^0) = 0].$$

In the case where we consider a move all the way to free trade ($\pi^1 = \pi^*$), the inverse of Δ equals one plus the uniform tariff rate which compensates for the abolition of period-0 tariffs. More generally, the inverse of Δ is the proportionate change in domestic prices which implements this compensation. We call this the *uniform tariff surcharge factor*.

To help further in getting an intuitive feel for the TRI, consider the effect on the value of Δ of a tariff change which causes a small change in period-1 prices, holding fixed the reference level of utility in period 0. Totally differentiating the equation on the right-hand side of (2.4) which defines Δ gives the following expression for the proportional change

⁷ Because of the presence of trade restrictions and the fact that there is a numeraire good implicit in the background, the balance of trade function is not homogeneous of degree zero in π , and so there is no step which is analogous to (2.2) in the general equilibrium derivation.

in Δ (denoted by a circumflex):

$$(2.5) \quad \hat{\Delta} = \Sigma \sigma_i \hat{\pi}_i.$$

This gives the change in the TRI as a weighted average of the changes in domestic prices caused by the tariff changes. The weights in turn are determined by the derivatives of the balance of trade function:

$$(2.6) \quad \sigma_i = B_i \pi_i / \Sigma_j B_j \pi_j,$$

which depend on the slopes of the general equilibrium import demand functions.⁸ This may be compared with the change in the trade-weighted average tariff: it is also a weighted average of domestic price changes, except that the weights are simply trade shares, $m_i \pi_i / \Sigma_j m_j \pi_j$. Hence, the superiority of the TRI is twofold: it derives from an explicitly specified model of the economy and has a firm basis in welfare economics, as opposed to the *ad hoc* aggregation of the trade-weighted average tariffs; and changes in the TRI depend on appropriate *marginal* trade shares rather than on simple *average* shares.

Having set up the theory of the TRI in a very general way, empirical implementation involves specifying more precisely the model of the economy which has so far been subsumed inside the black box of the B function.⁹ However, before proceeding with this, we must recognise that a great deal of protection in developing countries takes the form of quantitative restrictions rather than of tariffs. So the theory of the TRI must be extended to include such measures.

⁸ From equation (2.1a), the typical price derivative B_i equals $-\Sigma_j t_j \partial m_j / \partial p_i$.

⁹ For example, in the special case of linear demands illustrated in Figures 1 and 2, it is easier to work directly with the welfare function given by the sum of the Marshallian triangles rather than with the B function. For any domestic price vector π , the welfare cost is: $u = -\Sigma \beta_i (\pi_i - \pi_i^*)^2$, where β_i is the slope of the import demand curve for good i . Hence the welfare equivalent *ad valorem* tariff (equal to $\Delta^{-1} - 1$, with $\pi^1 = \pi^*$) equals the square root of: $\Sigma \beta_i (\pi_i - \pi_i^*)^2 / \Sigma \beta_i (\pi_i^*)^2$. Anderson (1992) shows that in general the TRI with tariffs only can be written as a function of a weighted average tariff and the generalised variance of tariffs. If all goods are substitutes the weights are non-negative; while if the trade expenditure function is Cobb-Douglas, the weights reduce to trade weights and the generalised variance collapses to the trade-weighted variance.

III Measuring Trade Restrictiveness with Quotas and Tariffs

The case where trade is restricted only by quotas lends itself easily to the development of a scalar index of trade restrictiveness. A natural way of posing the problem in this case is "What is the uniform proportionate change in the permitted import levels which would compensate for a given change in quotas?" This leads to an index which is defined over quantities rather than over prices.¹⁰ The technical development makes use of another function, the *distorted balance of trade function*, which is the analogue of the balance of trade function presented in the last section but modified to take account of quota distortions.¹¹ Written as $B^d(q,u)$, this is defined over the permitted import levels of the quota-constrained goods q and the level of utility u . As before, a great deal is hidden inside the black box, including now the world prices p^* of the quota-constrained goods. The quantity-based Trade Restrictiveness Index for quotas can now be defined as the proportionate change in period-1 quotas required to reach period-0 utility:

$$(3.1) \quad \Delta^q(q^1, u^0) \equiv [\Delta^q : B^d(\Delta^q q^1, u^0) = 0].$$

For the case of two goods, this is illustrated in Figure 3, drawn in quota space, where point A represents an arbitrary initial equilibrium and point D a new equilibrium (which may, but need not be, identified with free trade). The value of Δ^q is the distance OE/OD, where point E lies on the same iso-utility locus as A, and, once again, an increase in Δ^q (given A) represents an increase in restrictiveness: i.e., a move away from D in the direction of a more restrictive quota regime.

Finally we must consider the realistic case where trade is restricted by *both* tariffs and quotas. Two alternative approaches are now possible, differing in their intuitive appeal and in their data requirements. The first approach is simply to combine the individual indices already developed for the cases of tariffs and quotas alone, (2.4) and (3.1). This leads to a mixed quantity- and price-based index:

¹⁰ In this form the TRI is seen to descend from a family of "distance function" measures developed, among others, by Debreu (1951) and Deaton (1979). In our early work, which considered quota distortions only (Anderson and Neary (1990) and Anderson (1991)), we called our index the "coefficient of trade utilization," echoing Debreu's "coefficient of resource utilization."

¹¹ See Anderson and Neary (1992a and 1992b) for details.

$$(3.2) \quad \Delta^\lambda(q^1, \pi^1, u^0) \equiv [\Delta^\lambda : B^d(\Delta^\lambda q^1, \pi^1 / \Delta^\lambda, u^0) = 0].$$

The value of Δ^λ has the interpretation of the equal proportionate relaxation of all quota levels and reduction of all tariff-inclusive prices which would be equivalent in welfare terms to a given initial protective structure with an arbitrary pattern of quotas and tariffs. As before, a rise in Δ^λ corresponds to a move towards a new equilibrium with trade policy (q^1, π^1) which is more restrictive relative to the initial equilibrium with trade policy (q^0, π^0) .

The great advantage of the hybrid index (3.2) is computational: although the level of this index depends on world prices for quota-constrained goods, p^* , changes in the index between two distorted situations can be computed without the need to know such prices (data on which are notoriously difficult to obtain). On the other hand, the index has the disadvantage that it combines changes in quantities for quota-constrained goods with changes in prices for tariff-constrained goods. This is not a meaningless mixture, since the value of the index is a pure number. However, it makes the intuitive interpretation of the resulting index difficult, especially if we wish to compare the index across countries or time periods between which the mix of goods which are subject to tariffs and quota differs.

It is desirable therefore to develop a second approach, leading to an index based on prices for both categories of goods. In the case of the quota-constrained goods, this involves using their *tariff equivalents*, and the resulting index is a *uniform tariff and tariff equivalent surcharge factor*: it equals the uniform proportionate change in the actual domestic prices (π) for tariff-constrained goods and the *virtual prices* (p^d) (i.e., world prices plus tariff equivalents) for quota-constrained goods which would compensate for the actual change in policy instruments from (q^0, π^0) to (q^1, π^1) .¹²

$$(3.3) \quad \Delta(q^1, \pi^1, u^0) \equiv [\Delta : B(p^d / \Delta, \pi^1 / \Delta, u^0) = 0].$$

In any application, the choice between the index (3.3) and the hybrid index (3.2) will depend on the quality of data available and on the type of comparative exercise being undertaken.

¹² The term "virtual prices" derives from the theory of rationing. (See Neary and Roberts (1980).) For theoretical consistency, the virtual prices, like the value of Δ itself, must be evaluated at the new instruments but the old level of welfare: (q^1, π^1, u^0) . See Anderson and Neary (1992b) for details.

IV Partial Equilibrium Applications of the TRI

The theoretical approach outlined in Sections II and III provides a framework for computing the TRI in a wide variety of applications. To operationalise the approach it is necessary to have a computable model of the economy under consideration. This raises a whole set of choices: the model may be partial or general equilibrium; it may be linearised around the initial equilibrium or explicitly non-linear; and it may be more or less disaggregated at the commodity level. In principle the TRI approach is consistent with any combination of choices from this menu. But, in practice, its focus on trade policy instruments pushes in the direction of taking a highly disaggregated approach which can encompass the fine detail of actual protective policies. This in turn makes it more natural to implement the TRI in either a partial equilibrium context or a general equilibrium model with a tightly specified productive structure.

The first set of applications of the TRI adopted a partial equilibrium perspective and considered quantitative restrictions on trade only, specifically in the context of imports of textiles and apparel to the U.S. under the Multi-Fibre Arrangement (MFA).¹³ A pilot study, reported in Anderson and Neary (1992b), considered exports from Hong Kong only. This has been extended to exports from six other countries, Bangladesh, India, Indonesia, South Korea, Mexico and Thailand, in Anderson and Neary (1992d). In each case the approach adopted was to estimate year-to-year changes in the quantity-based index (3.1). Such changes are, as in the tariff case, a weighted average of the changes in the instruments, where the weights are the contributions of each quota-constrained good to changes in the balance of trade. Specialising to the partial equilibrium context permits calculation of changes in the TRI using only readily-available information on elasticities. It is also straightforward to calculate separately the changes from the perspectives of the exporting and the importing countries.

A key issue which must be addressed in any empirical study of quantitative restrictions in international trade is the destiny of the resulting rents. If detailed information on the rent-distribution process in individual markets is available, it may be incorporated into the formulae for the shadow prices of tariffs and quotas which are needed to calculate the change in the TRI, using the general expressions of Anderson and Neary (1992a). Typically,

¹³ U.S. imports of cheese have also been considered by Anderson (1991).

however, such information is not available; indeed even data on export license prices are hard to come by, and in this study we were fortunate to have access to the estimates of Carl Hamilton. In the MFA study, we therefore assumed that all rents accrued to the exporting country, with one important exception: where the importing country imposes a tariff on a quota-constrained import, the tariff revenue amounts in effect to a transfer of part of the quota rents to the importing country. (Details are given in Anderson and Neary (1992b).)

Table 1 presents some representative results from the MFA study. These are from the perspective of the importing country, the U.S., and refer to imports from Hong Kong only. The first column of figures gives the changes in the TRI. The next two columns take account of a feature peculiar to quotas: unless they grow at the rate of growth of the economy as a whole, their severity increases. Hence, changes in the restrictiveness of quota policy should be evaluated relative to, not a *constant* quota policy, but a *neutral* quota policy in which all permitted import levels increase at the economy's rate of growth.¹⁴ This consideration gives rise to a "compensated" TRI, changes in which are given in the third column. These equal the uncompensated changes in the first column, reduced by the U.S. GDP growth rate given in the second. The final column of the table gives the change in the trade-weighted average equivalent tariff (using U.S. import shares as weights). It is clear that changes in this measure bear little relation to those in the TRI. While some of the assumptions made in calculating changes in the TRI are open to question, this case study demonstrates clearly that using it as a basis for evaluation of trade restrictiveness changes makes a substantial difference. The superior theoretical properties of the TRI imply that the increased restrictiveness of policy which it reveals (at least when real income growth is taken into account) is a more plausible summary of the change in trade policy over the period than the reduction in restrictiveness suggested by the cumulative fall in the average tariff equivalent.

V Measuring the Trade Restrictiveness of Domestic Policies

A very different application of the TRI is to evaluating the trade restrictiveness of *domestic* price policies. Such policies distort trade just as much as explicitly trade-focused policies, a fact which is increasingly recognised in trade negotiations: they have featured

¹⁴ For a rigorous justification of this procedure, see Anderson and Neary (1992b).

prominently for example in negotiations on farm subsidies in the Uruguay Round and in the Mexico-U.S. free trade area. They have also been extensively studied. But the measures used to date to evaluate their impact on trade (known as producer and consumer subsidy equivalent indices, or PSE's and CSE's) are just as crude as the trade-weighted average tariff measures discussed in earlier sections and are subject to the same drawbacks.

*The theoretical refinements to the TRI required to incorporate domestic policies are complicated in detail but straightforward in principle.*¹⁵ Take the simplest case, where the distortions occur in the markets for traded goods.¹⁶ If p and q represent the domestic producer and consumer prices respectively, we can once again write the balance of trade as a function of these prices and of the level of utility, $B(p,q,u)$. Now, in comparing two equilibria, the TRI is again defined as the uniform scaling factor which, when applied to *both* consumer and producer prices, would compensate for a policy change. Formally:

$$(5.1) \quad \Delta(p^1, q^1, u^0) \equiv [\Delta : B(p^1/\Delta, q^1/\Delta, u^0) = 0].$$

Once again, in the case where the new equilibrium is one of free trade ($p^1=q^1=p^*$), the TRI equals the inverse of one plus the uniform tariff which would have the same welfare effect as the initial structure of producer and consumer distortions.

The theoretical measure defined in (5.1) has been applied in Anderson and Bannister (1992) to measuring the trade restrictiveness of changes in Mexican agricultural policy between 1985 and 1989 in a partial equilibrium context. This period was one of rapid change in policies, with some subsidies increasing and others falling. The first row of Table 2 shows the calculated changes in the TRI. The index shows a large increase in restrictiveness in 1986 and especially 1987 followed by major reductions in restrictiveness in 1988 and 1989. The cumulative effect of these changes is a 40.9% fall in trade restrictiveness over the four-year period. These changes may be decomposed into changes in the producer and consumer subsidy components of the TRI and this decomposition in turn may be compared with the conventional PSE and CSE measures. These comparisons are given in the remaining rows of the table, where Δ^p and Δ^q denote the "true" producer and

¹⁵ See Anderson and Neary (1992c) for details.

¹⁶ In Anderson and Neary (1992c), this is extended to distortions in the markets for both factors of production and non-traded goods.

consumer subsidy equivalent indexes, respectively;¹⁷ while "PSE" and "CSE" denote the *ad hoc* (i.e., average-share-weighted) indexes. As in Section IV, the table shows that there is little or no concordance between changes in the theoretically based and the *ad hoc* measures. Moreover, there is no acceptable procedure for combining the PSE and CSE to form an aggregate index, whereas this is precisely what the TRI is designed to do. Once again, it seems a much more satisfactory method of evaluating the effects of policies on international trade.

VI General Equilibrium Modelling with the TRI

So far, both the applications discussed have been partial equilibrium in character: though based on a theoretically consistent framework, the assumption of separability between the markets considered and the rest of the economy rules out interactions in factor markets and non-traded goods markets. This is unlikely to be a problem if trade policy changes in only a single sector or group of sectors are being considered. But it is obviously unsatisfactory in the case of a wide-ranging change in trade policy. At the same time, the focus of the TRI on the fine detail of the structure of protection makes it difficult to combine with most existing computable general equilibrium (CGE) models, which tend to be highly aggregated. To put this comparison in perspective, a typical CGE distinguishes about twenty or thirty sectors, whereas the applications discussed below accommodate over two thousand different traded commodities. The price of this disaggregation is the need to restrict significantly the structure of intercommodity and interfactor substitution.

With these considerations in mind, two different models have been developed in order to implement the TRI in a CGE context. The models differ in that the first involves linearisation around the initial equilibrium whereas the second uses exact functional forms to calculate global changes. In other respects, however, the models have much in common, sharing in particular a number of key assumptions. The first of these is the Armington (1969) assumption: every traded good produced at home is assumed to be an imperfect substitute for an imported good, and the structure of domestic consumption and production is of the

¹⁷ Thus, for example, the "true" producer subsidy equivalent index is defined, by analogy with (5.1), as follows:

$$(5.2) \quad \Delta^p(p^l, q^l, u^0) \equiv [\Delta^p : B(p^l/\Delta^p, q^l, u^0) = 0].$$

nested CES kind. This assumption greatly simplifies the substitution matrices. A second assumption is due to Jones (1974): we assume a single composite non-traded good, which is the *only* good that is both produced and consumed at home. Thus, no exports are domestically consumed and no imports are domestically produced. This greatly simplifies the models by eliminating many of the interactions between the consumption and production sides of the economy. It also has the great advantage that the relative price of the non-traded good can be interpreted as the real exchange rate. A final assumption concerns the destination of the rents which arise from quantitative restrictions on imports. In typical applications (by contrast with the MFA study discussed in Section IV above), data on quota premia are unlikely to be available. We therefore adopted the convenient simplification, following Krueger (1974), that all the quota rents are dissipated through competitive rent-seeking. In other respects, the models are very general: in particular, many different intermediate inputs are distinguished which may be subject to both tariff and quota restrictions. This highlights a further advantage of the TRI approach: it permits the consistent aggregation of trade restrictions on final and intermediate goods in a much more satisfactory way than the traditional effective rate of protection approach.

The first of the models of this type is presented in Anderson, Neary and Safadi (1992). It works directly with the expressions for changes in the TRI; i.e., with the differentials of equations (2.4), (3.1) and (3.2). This is equivalent to calculating the TRI by linearising the model of the economy embodied in the B function around the initial equilibrium. As with (2.5), the differential expressions required to calculate the change in Δ consist of weighted sums of changes in the trade policy instruments, where the weights are derived from the matrices of substitution effects in production and consumption. This first model constructs estimates of these weights using data on factor and expenditure shares and imposed values of certain key elasticities. Strong assumptions are made about the functional forms used to represent producer and consumer behaviour, with the result that the values of only a relatively small number of key parameters need to be imposed, while the remainder are implied by cross-equation constraints.¹⁸ Four kinds of traded goods are distinguished,

¹⁸ In empirical applications to date, the expenditure function has been assumed to be CES for the non-quota-constrained goods and Cobb-Douglas for the quota-constrained goods as well as between the two categories of goods; while on the production side, the aggregate profit function is assumed to be Cobb-Douglas. Analytical expressions for the shadow prices are

classified by whether they are final or intermediate and whether they are subject (at the margin) to tariff or quota constraints.¹⁹ As for domestic factor markets, a specific-factors structure (as in Jones (1971)) is assumed: each sector uses a specific type of capital while all draw on a pool of intersectorally mobile labour.

Anderson, Neary and Safadi apply this model to estimating the effects of trade reform in Columbia between 1988 and 1989. Table 3 gives the changes in Columbian trade policy between those two years, using some standard measures of trade restrictiveness. These show a confusing pattern. Average tariffs on all goods fell, though it should be recalled that a reduction in tariffs on quota-constrained goods is welfare-*worsening* since it lowers the share of quota rents retained at home. Associated with this was a greater dispersion of tariffs, as measured by the coefficient of variation, a significant reduction in the coverage of non-tariff barriers and an increase in the (unweighted) average level of quotas. Clearly, assessing the overall thrust of the trade policy changes is impossible without a consistent framework for aggregating these changes.

The TRI calculations in Table 4 attempt to provide just such an assessment. The first row gives the overall change in the TRI, the figure of -0.807 suggesting a modest liberalisation, equivalent in welfare terms to a uniform cut in tariffs and relaxation in quotas by 0.807% . The remaining rows decompose this change into the contributions attributable to different types of trade restriction. Clearly, the principal source of liberalisation is the change in quotas on final goods. Although quotas on intermediate goods were liberalised to a comparable extent as measured by the conventional statistics in Table 3, the weights which the quotas on final goods receive are much higher and so they contribute more to the overall index. As for tariff changes, they contribute tiny amounts of liberalisation; as Table 3 shows, the mean and variance of tariffs on both classes of goods move in opposite directions. Since in any case, the composition of quota- and tariff-constrained categories changes

also presented in Anderson, Neary and Safadi (1992) for the case where the expenditure function for non-quota-constrained goods and the aggregate profit function take the translog form. Naturally, implementing this more general specification would require much more detailed data.

¹⁹ If a good is subject to both a quota and a tariff and if the quota is binding, then the tariff is non-binding. In this case, as already noted in Section IV, the tariff serves merely to ensure that the fraction of total quota rents made up of tariff revenue is retained by the importing country.

between the two years, the standard indices are not truly comparable. The TRI solves this problem of comparability by aggregating in a manner which is fully compatible with the underlying theory.

The second CGE model developed for use with the TRI is presented in Anderson (1993b). It adopts many of the same assumptions as the model of Anderson, Neary and Safadi, including the specification of the functional forms of the key behavioural equations. The principal difference is that the functional forms are assumed to hold globally rather than merely serving as the basis for a linearisation around the initial equilibrium. This has the disadvantage that the effects of any misspecification are likely to be magnified for large changes in trade policy. On the other hand, it has the advantages of greater theoretical consistency and of permitting explicit calculation of the *level* of the TRI as well as of changes in it. This second model has also been implemented on a personal computer in a manner which can be readily accessed and we turn finally to review this.

VII Implementing the TRI on a Personal Computer

Anderson (1993b) gives a more complete description of the CGE model which has been implemented on an EXCEL spreadsheet and which can be applied easily to any detailed specification of trade policy. The user needs to input data on the domestic price, the tariff rate and the volume of imports of each commodity as well as two codes, one which indicates whether the commodity is for final or intermediate use and the other which indicates whether it is subject to a binding quantitative restriction or not. This information must be provided for two time periods. The spreadsheet program then calculates the change in the TRI between the two periods. In addition, the standard measures such as the trade-weighted average tariff and the non-tariff-barrier coverage ratio, are also calculated for purposes of comparison. Of course, the second of the two periods for which data are supplied may be a hypothetical one. For example, if data on world prices are available, the second period could be one in which all trade restrictions have been abolished. In this case, the program calculates the level of the TRI in the initial period.

As far as the underlying model of the economy is concerned, the program specifies default values of the key substitution parameters in production and consumption. These may be altered by the user, thus permitting an exploration of the sensitivity of the estimates of the TRI to changes in the underlying parameters. Table 5 illustrates some findings along these

lines. The data refer again to Columbia and give changes in the TRI under four different combinations of assumptions about the values of three key elasticities. The values assumed in the first row of the table are the same as those assumed in the linearised model of Anderson, Neary and Safadi, whose results were given in Table 4. In that model the estimated change in the TRI is -0.807% whereas Table 5 shows that in the non-linear model the corresponding estimate is -1.0% . This is an encouraging concordance of results and suggests that linearising the model may not appreciably affect its results. The remaining rows of Table 5 show the effects on the estimated change in the TRI of reductions in each of the three key elasticities. It can be seen that the TRI estimates appear to be relatively robust to these changes, and that all the estimates suggest a very different picture of changes in trade restrictiveness over the period than the standard measures of Table 3. This robustness has also been found in other applications of the TRI which have been carried out to date, though of course since it is only an empirical finding it needs to be replicated extensively on other data sets before it can be taken as typical.

The use of this computer program permits estimation of the degree of trade restrictiveness of a given trade policy in a consistent framework. Other applications of the approach are also possible. For example, the program can easily be adapted to calculate the utility cost of a given change in trade policy or the utility cost of an equiproportionate tariff change sufficient to raise a given amount of revenue. Since the program fits on a single 720KB disk and can be used on a portable computer, it permits an easy assessment of trade restrictiveness with minimal data and computing requirements.

VIII Conclusion

In this paper, we have outlined a new approach to measuring the restrictiveness of trade policy. The approach has the advantage of being firmly based in standard trade theory, so that it is easily related to the usual methodology for measuring the costs of protection. It thus avoids the *ad hoc* nature of the measures typically used in practice, such as the trade-weighted average tariff or the non-tariff-barrier coverage ratio. Our approach requires more data than these traditional measures. However, we have outlined some empirical procedures which we have developed for implementing the approach whose data requirements are likely to be met in most developing countries.

Over and above the specific models which we have developed, the TRI perspective

draws attention to a number of key general issues which should be borne in mind in any empirical study of trade policy. One of these is that simple averages of tariff rates are unlikely to be helpful guides to the true extent of trade restrictiveness. Another is that the destination of the rents which arise from quantitative restrictions is a crucial determinant of their welfare impact and their restrictiveness. And a final general issue is that the restrictiveness of quotas depends crucially on the environment in which they apply and hence on the values of exogenous variables determining the economy's equilibrium. Because they attempt to deal with these issues in a consistent framework, we claim that the methods described in this paper, however crude, represent a significant advance over any others hitherto available.

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	Change in TRI	Change in Real Income	Change in Compensated TRI	Change in Average Tariff Equivalent
1983	-2.8	3.9	1.1	84.4
1984	4.2	6.8	11.0	-8.1
1985	-1.7	3.2	1.5	-39.2
1986	-6.6	2.8	-3.8	42.2
1987	-1.0	2.9	1.9	12.0
1988	-0.9	4.5	3.6	-53.0
Cumulative	-8.8	26.6	15.7	-22.9

**Table 1: Changes in the Trade Restrictiveness Index:
U.S. Imports of Textiles and Apparel from Hong Kong, 1982-88**

All figures given are percentage changes

Source: Anderson and Neary (1992b)

	1986	1987	1988	1989	Cumulative
TRI:	7.5	40.2	-40.3	-34.3	-40.9
Comparison of True and <i>Ad Hoc</i> Sub-Indices:					
PSE	-7.4	2.4	-4.9	-5.9	-15.1
Δ^p	7.1	34.4	-31.6	-30.1	-31.2
CSE	-6.4	15.3	32.5	-31.0	-1.3
Δ^q	-79.8	-11.4	69.7	-7.9	-72.0

**Table 2: Changes in the TRI and its Components
for the Mexican Agricultural Sector, 1985-89**

All figures given are percentage changes.

Source: Anderson and Bannister (1992)



	1989	1990
Average Tariffs:		
final goods	0.230	0.166
tariff-constrained	0.092	0.100
quota-constrained	0.237	0.208
intermediate goods	0.185	0.151
tariff-constrained	0.125	0.125
quota-constrained	0.195	0.170
Coefficient of Variation of Tariffs:		
final goods	0.769	0.813
intermediate goods	0.596	0.625
NTB Coverage Ratio (%):		
final goods	90.8	57.3
intermediate goods	76.3	34.7
Average (Unweighted) Quota Change (%):		
final goods		12.0
intermediate goods		12.0

Table 3: Indices of Trade Reform in Columbia, 1989-90

Source: Anderson, Neary and Safadi (1992)

TRI:	-0.807
Decomposition by Type of Restriction:	
Tariffs on Final Goods	-4.327×10^{-6}
Quotas on Final Goods	-0.924
Tariffs on Intermediate Goods	-1.392×10^{-8}
Quotas on Intermediate Goods	-1.650×10^{-4}

Table 4: Changes in the TRI for Columbia, 1989-90

All figures given are percentage changes, 1989-90. Source: as Table 3

Elasticity of Final Demand	Elasticity of Intermediate Demand	Elasticity of Transformation	Change in TRI (%)
5.0	0.7	5.0	-1.0
2.0	0.7	5.0	-1.5
2.0	0.7	2.0	-2.1
5.0	0.5	5.0	-1.4

Table 5: Sensitivity Analysis of Change in TRI for Columbia, 1989-90

Source: Anderson (1993b)

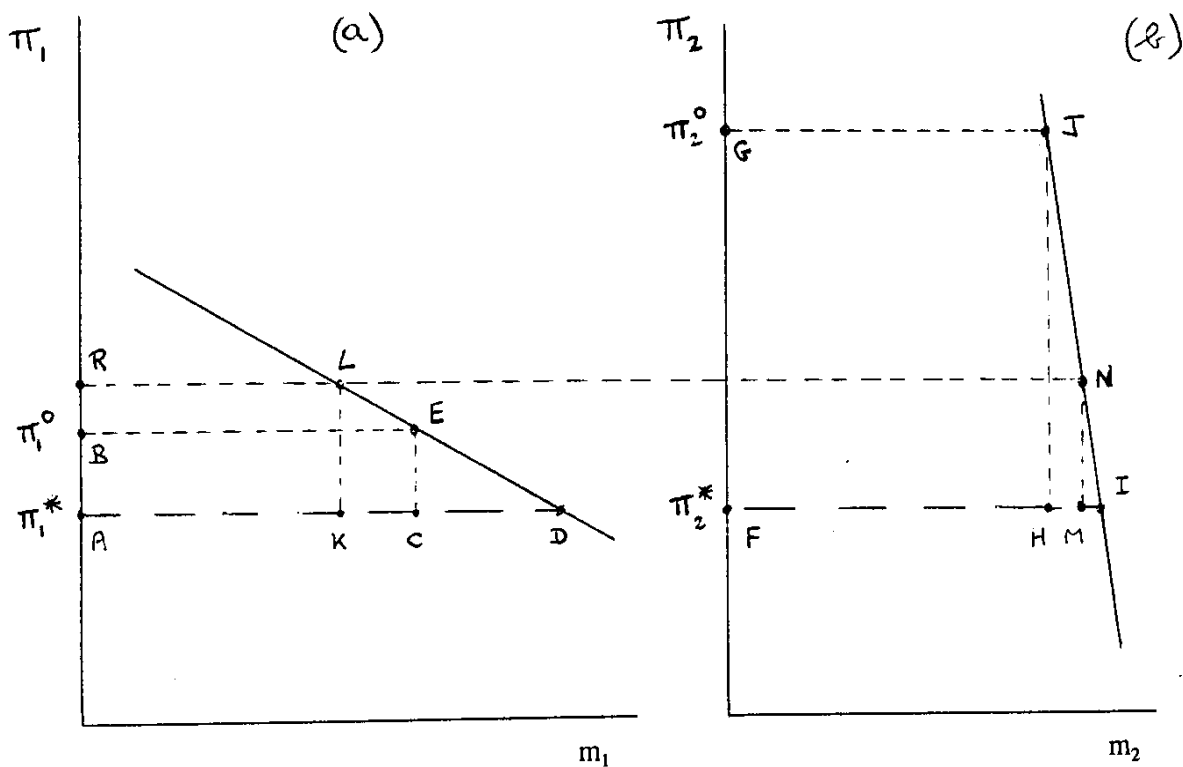


Figure 1: Measuring Trade Restrictiveness in the Presence of Tariffs

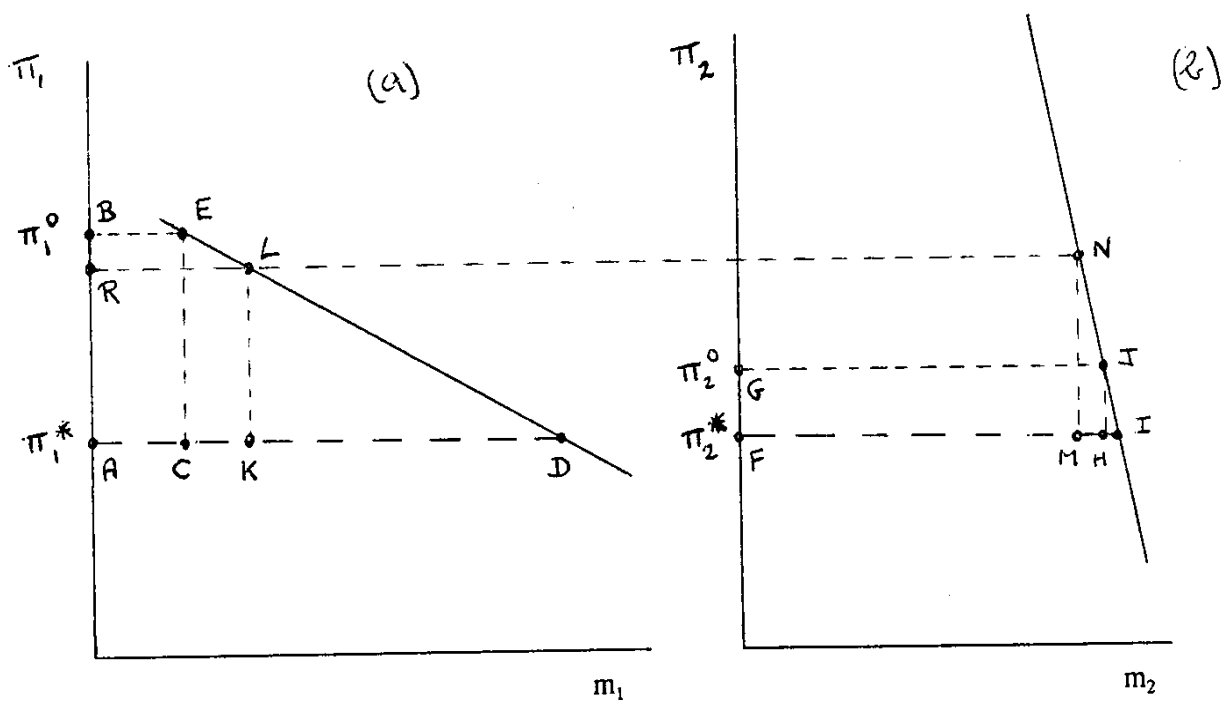


Figure 2: Measuring Trade Restrictiveness in the Presence of Tariffs

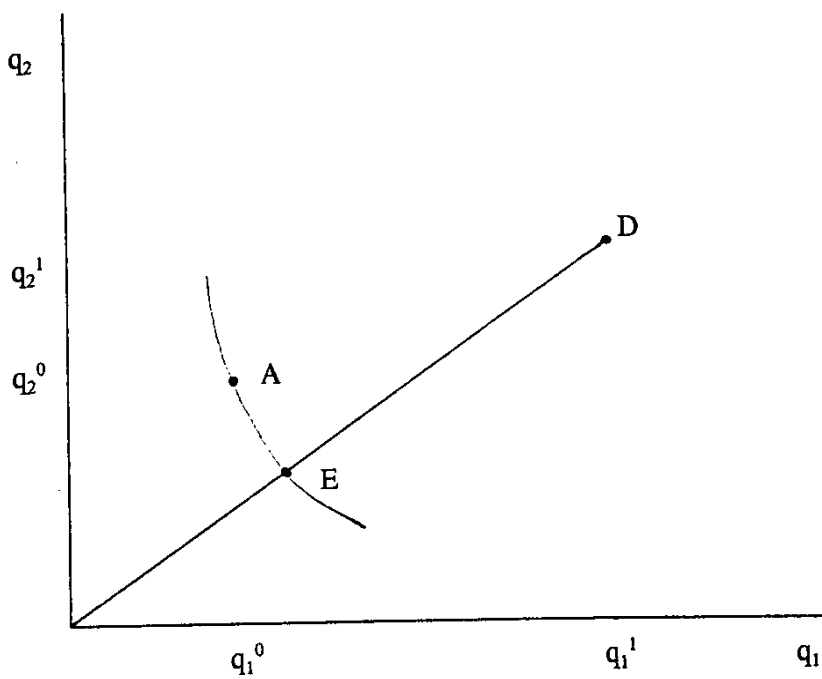


Figure 3: The Trade Restrictiveness Index with Quotas