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MULTILATERAL TRADE RULES AND THE EXPECTED COST OF PROTECTION

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ABSTRACT

Multilateral Trade Rules and the Expected Cost of Protection*

Protection unconstrained by rules typically varies considerably over time. The policy disciplines introduced in the Uruguay Round in 'new' areas such as agricultural, services, and developing country industrial protection will constrain, but not eliminate, this variability. The effects of these constraints on the expected costs of protection are examined, taking into account their impacts on both the first and second moments of the distribution of protection. As an application, we examine Uruguay Round agricultural bindings, finding substantial reductions in the expected cost of protection even in some cases where the bindings are above previous protection levels.

JEL Classification: F11, F13
Keywords: expected protection, stochastic protection, trade liberalization, tariff bindings, trade rules, trade policy

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NON-TECHNICAL SUMMARY

Historically, rates of protection have varied substantially over time. In the case of protection of industrial products in developed countries, this variability has been greatly diminished as a result of the progressive lowering of multilaterally agreed tariffs. The stochastic nature of protection has remained strongly evident across sectors and instruments free from, or lightly constrained by, multilateral trade rules, however. Thus, protection rates have varied substantially in areas such as agriculture (in both developed and developing countries) and in industrial products in developing countries. When we look beyond bound tariffs on industrial goods, we find that a wide range of measures such as variable levies, import quotas, voluntary export restraints (VERs), import surcharges, and the various forms of contingent protection (such as balance of payments actions, anti-dumping and countervailing duties) has been used to generate time-varying rates of protection.

During the Uruguay Round, the coverage of multilateral trade rules was increased substantially. The coverage of tariff bindings was greatly expanded, with the coverage of bindings on agricultural commodities increasing to almost 100%. There were also large increases in the proportions of industrial product imports into developing countries covered by bindings. Completely new disciplines were introduced for trade in services and trade-related investment measures. While the range of trade covered by bindings has expanded, however, many of the new tariff bindings introduced by the Uruguay Round agreements represent relatively loose constraints on policy, being set at or above the currently applied rates of protection. Analytically, this requires techniques which have not been widely used by trade policy analysts.

Our objectives in this paper are twofold: to push our notion of protection and trade liberalization away from one based primarily on fixed policy instruments and closer to one that involves policy regimes subject to uncertainty and variability; and to offer a relatively simple approach to evaluating the benefits of rules-based commitments in this context. The importance of tariff bindings in a world of varying protection has long been recognized by trade negotiators, and the introduction of constraints on countries' trade policies is at the heart of the multilateral trading system. The very structure of market access commitments under the GATT is centred on the concept of bindings. During trade negotiations, negotiated credit is given even for tariff bindings at or above initial applied rates. Yet economists have given relatively little attention to formal evaluation of the benefits of tariff bindings and other rules-based commitments in the context of time-varying underlying protection processes.

As a basis for evaluating the liberalization of stochastically-varying protection, we develop a simple framework based on the expected cost of protection. For a single commodity, this cost depends on the second moment of protection about the origin (or, equivalently, the sum of the squared mean and the variance of protection) and the slope of the import demand function. This approach highlights the fact that the cost of protection rises with the square of the rate and the standard deviation of the rate of protection. Within this conceptual framework we can assess the relative impact of tariff bindings on the total costs of protection for individual commodities, through calculation of welfare-weighted costs of protection indexes.

As an illustration, we examine the effect of tariff bindings on imports of three important agricultural commodities: wheat, sugar and beef. Even though tariff bindings on these commodities were typically set at levels substantially higher than the average rates of protection previously applied, it seems likely that the introduction of tariff bindings will yield substantial reductions in the costs of protection on a broad range of these commodities.

I. Introduction

Historically, rates of protection have varied substantially over time. In the much-studied case of protection of industrial products in developed countries, this variability has been greatly diminished as a result of the progressive lowering of multilaterally agreed tariffs. However, the stochastic nature of protection has remained strongly evident across sectors and instruments free from, or lightly constrained by, multilateral trade rules. Thus, protection rates have varied substantially in areas such as agriculture (in both developed and developing countries) and in industrial products in developing countries. When we look beyond bound tariffs on industrial goods, we find that a wide range of measures such as variable levies, import quotas, voluntary export restraints (VERs), import surcharges, and the various forms of contingent protection (such as balance of payments actions, anti-dumping and countervailing duties) has been used to generate time-varying rates of protection.

During the Uruguay Round, the coverage of multilateral trade rules was increased substantially. The coverage of tariff bindings was greatly expanded, with the coverage of bindings on agricultural commodities increasing to almost 100 percent. There were also large increases in the proportions of industrial product imports into developing countries covered by bindings. Completely new disciplines were introduced for trade in services and trade-related investment measures. However, while the range of trade covered by bindings has expanded, many of the new tariff bindings introduced by the Uruguay Round agreements represent relatively loose constraints on policy, being set at or above the currently applied rates of protection. Analytically, this requires techniques which have not been widely used by trade policy analysts.

The importance of tariff bindings in a world of varying protection has long been recognized by trade negotiators, and the introduction of constraints on countries' trade policies is at the heart of the multilateral trading system. The very structure of market access commitments under the GATT is centered on the concept of bindings. During trade negotiations, negotiating credit is given even for tariff bindings at or above initial applied rates. Yet, economists have given relatively little attention to formal evaluation of the benefits of tariff bindings and other commitments in the context of time-varying underlying protection processes.[1] Our objectives in this paper are twofold: to push our notion of protection and trade liberalization away from one based primarily on fixed policy instruments and closer to one that involves policy regimes subject to uncertainty and variability; and to offer a relatively simple approach to evaluating the benefits of rules-based commitments in this context.

We start with a brief overview of the recent political economy literature on the determinants of protection. In our view, this literature provides a rather convincing rationale for treating the rate of protection as stochastic. We then examine the impact of policy rules on the first and second moments of the intertemporal distribution of rates of protection. This is followed by an evaluation of the consequences of changes in these moments for the expected costs of protection. A simple empirical application to the effects of agricultural bindings is also provided.

II. Characterizing the distribution of protection

A major thrust of trade policy research in recent decades has been the development of political economy models to represent the process of trade policy formulation. These models specify national trade policy measures as being determined by a set of time-varying explanatory variables operating through a political process which introduces a wide range of additional shocks to protection rates. While the emphasis of this literature has been on explaining the level of protection at any time, it seems clear that the models used imply that unrestrained protection will typically vary over time[2].

One set of explanations for variations in rates of protection across industries and over time is inspired by the work of Olson (1965) and Stigler (1974), and focuses on factors such as the structure of the industry, its consequent costs of organization, and lobbying success. Another set of explanations surveyed by Dornbusch and Frankel (1987) emphasizes the role of macroeconomic shocks. A third set of models considers in more depth the nature of the political

[1] The literature on trade under uncertainty emphasizes stochastic disturbances in preferences or technology. See, for example, Helpman and Razin (1978) and Pomery (1984). With the notable recent exceptions of Stockman and Dellas (1986) and Barari and Lapan (1993), who examine asset markets under tariff uncertainty, the formal implications of stochastic tariff regimes has been largely ignored.

[2] See Rodrik (1986, 1994). Also see Nelson (1994).

decision making system which generates protection decisions (see Magee, Brock and Young, 1989) and introduces shocks from random political outcomes. Yet another approach emphasizes the role of past and present shocks to import levels. Finally, the choice of protective instrument will reflect the preferences of decision makers regarding the volatility of protection, and this choice will introduce an additional random element into the behavior of protection.

Anderson (1978, 1980) draws on the theoretical work of Olson and Stigler to explain differences in protection levels across industries in terms of a range of predetermined variables, including the number of firms, the size of the industry, the industry's net trade position, the labor intensity of the production process, and its geographical concentration (which influences its political strength). Gardner (1987) draws on similar literature to explain differences in agricultural protection both across industries and over time.

Dornbusch and Frankel (1987) offer models of protectionist pressures based on highly variable macroeconomic influences such as the real exchange rate, the real interest rate and the rate of unemployment. Other evidence linking protection to unemployment and recessions is provided by Ray (1987), Hanson (1990), and Bohara and Kaempfer (1991). The variables that generate changes in protection in these models are random, and are augmented by other random influences not captured in the models.

We also know that tariff levels are positively correlated with import levels (Leamer, 1988), which in turn are variable and subject to swings in exchange rates and macroeconomic conditions.[3] In terms of quotas, Bhagwati and Srinivasan (1976) offer a theoretical example where the level of imports in one period determines the probability of an import quota in the next. The threat of such protection reduces the (optimal) incentives for export from the point of view of the exporting country. One can imagine the level of import penetration, in various permutations of such a framework, as depending on exchange rate swings, the business cycle, or a number of other factors. The more recent theoretical literature (Baldwin 1989; Magee, Brock and Young, 1989; and Hillman, 1982) also links protection, in its various guises, with increased

[3] For example, the round of trade activism in trade-sensitive sectors in the United States in the mid 1980s, during a period with a soaring dollar and massive capital inflows, could be characterized as one of microeconomic triage for macroeconomic imbalances. The demand for protection can be responsive to swings in conditions well beyond those related to the immediate workings of particular sectors and their respective agents.

import penetration. In particular, increased penetration leads to intensified lobbying for protection. Trefler (1993) offers evidence that the application of NTBs in the United States is correlated with changes in the level of import penetration. In Trefler's results, it is changing (i.e. variable) market conditions, and not the level of import penetration *per se*, that leads to increases in protection.

The political processes highlighted in models emphasizing the political lobbying process (see, for example, Magee, Brock and Young, 1989) introduce additional sources of randomness into the determination of protection policies. Voters' views of protection vary through time, as does the extent to which politicians supply the trade policies they promise. The possibility of voter retribution in cases of nonperformance introduces further variability into the trade policy process.

The form of protection chosen may have an important impact on the variability of protection. While *ad valorem* tariffs maintain a fixed relativity between domestic and world prices, this is not the case with virtually any other form of protection. Specific tariffs can lead to very large changes in relative prices; Crucini (1994) finds that the use of specific tariffs was much more important than the Hawley-Smoot Act in raising US tariff rates during the 1930s. Protective instruments such as import quotas and variable import levies can have similarly dramatic impacts on relative prices for particular commodities. As emphasized by Vousden (1990, p70), the choice of protective instrument is not arbitrary. It is likely to be influenced by its impact on the mean and variability of the incomes of various groups. In turn, this choice will influence the variability of protection rates.

Intertemporal variability of protection is particularly marked in import monitoring and administered protection regimes such as those imposed where dumping is alleged. Winters (1994) finds that import surveillance, in the case of the European Union, can have a dampening effect on trade. Tollefsen (1994) notes that, as a group, VERs and monitoring mechanisms are the most common form of nontariff barrier (NTB) protection applied in the industrial countries. Both are a common outcome of threatened or suspended antidumping and countervailing duty actions.

While EC antidumping cases are more frequently settled by price undertakings and associated monitoring mechanisms (Hindley, 1990), U.S. practice in this area can take a similar tack, as evidenced by the U.S. export restraint arrangements on bearings from Japan and uranium from the FSU republics. Hindley postulates that, given the administrative uncertainly inherent in the U.S. system, there is an incentive for exporters to the United States to raise their prices on products not covered by antidumping duties, simply to reduce the probability of an investigation. Similar incentives exist to accept "voluntary" restraint arrangements under the threat of AD actions. In addition to administrative uncertainty, Feinberg (1989) links findings of dumping to swings in exchange rates, while Feinberg and Hirsch (1989) link such findings in downstream industries to the imposition of protection in upstream sectors.

Under the system of administrative reviews and revision to dumping duties used in the United States, existing dumping orders themselves serve as a type of monitoring mechanism. This mechanism may have a significant effect, even when bond requirements are below one percent. Boltuck, Francois, and Kaplan (1990) offer empirical evidence related to the outcome of administrative reviews. Because dumping duties in the United States are initially levied as bonds, with the actual duty rates determined long after the actual entry of imports, the *ex ante* variance in the duty-inclusive price of imports subject to bonding requirements can be quite large, introducing yet another stochastic component to the observed rate of protection.

Whichever model, or combination of models, is chosen to characterize the *ex ante* distribution of protection, it seems clear that protection rates for individual commodities should be characterized not merely by a single deterministic value, but as stochastic processes to be characterized by a mean value and one or more higher moments.

III. Rules as limits on protection

The multilateral trading system is a set of rules which governments can use to restrict the damage they impose through unbridled use of the range of policy instruments available to them. In most cases, multilateral trade rules do not prescribe precisely what countries must do. Rather, they tend to operate by imposing limits on the values and types of protection which are allowed. Tariffs are prohibited from varying across suppliers by most-favored-nation (MFN) requirements and their variation over time is limited by tariff bindings. The application of certain quotas is limited, or even prohibited, by the Uruguay Round Agreements. Contingent protection, through fair trade and safeguard actions, is in theory limited by related GATT disciplines as well. Other rules apply to balance-of-payments actions, licensing requirements, and trade-related investment measures. In the Uruguay Round, market access bindings were also introduced for the service sectors.

Countries offering tariff bindings do not generally specify the tariff rate that they will actually apply. Instead, they commit themselves to tariff rates not exceeding the bound rate. Bindings are vital to the process of securing trade agreements. If an agreed tariff reduction could be unilaterally reversed, any Liberalization offer would have to be weighed against the probability of backsliding. Exporting firms, which provide much of the political support for multilateral trade Liberalization, are likely to be unenthusiastic about tariff cuts they expect to be short-lived. Bindings themselves are considered to be so important that countries agreeing to bind previously unbound tariffs are given "negotiating credit" for the decision. This is true even if the tariff is bound above the currently applied level.

Tariffs are not the only border protection measures that can be bound. For agricultural products, bindings include commitments on subsidies granted to exported products or to volumes exported with the aid of subsidies, and on internal support to agricultural producers. In the case of services, where obstacles to trade are not centered on border measures, countries have bound the level of market access and national treatment for sectors listed in their respective schedules, meaning that no new measures affecting entry and operation in the market may be imposed with respect to the four possible modes of supplying a service (cross-border, consumption abroad, commercial presence, and movement of personnel).

To ensure the credibility of these commitments, it is necessary to limit the remaining set of available instruments as well. Under GATT 1994, the limitations on industrial quotas accomplish part of this. The Uruguay Round Agreement on Safeguards requires the abolition of VERs, orderly marketing arrangements or any similar measures on the export or the import side, and places further limits on GATT-legal contingent protection. In theory, this includes notification requirements for the introduction of new quotas under the safeguards provisions (Article XIX). The Agreement also applies a "sunset clause" to all safeguard actions and sets out requirements for safeguard investigations. The Agreement on Implementation of Article VI (Anti-Dumping) clarifies many aspects of the rules governing the application of anti-dumping measures. Whether these rules actually constrain protection outcomes remains to be seen, however (See Finger, 1995).

IV. The effects of rules on the distribution of protection

In this section, we formally explore trade Liberalization through rules limiting the range of protection. Though we focus on tariff bindings, many other rules-based constraints on protection can be analyzed in a similar way.

We begin by representing the underlying distribution of protection in the absence of a tariff binding by a distribution such as that depicted in Figure 1. This distribution is based upon the stochastic determinants of protection discussed in the previous section. We assume that the expected level of the tariff is μ_0 in the absence of a binding on the tariff rate applied, and the distribution of protection can be characterized by a relatively small number of moments.

Now consider the introduction of a tariff binding at rate B. By definition, such a binding rules out all tariff rates above B. If the underlying probability distribution does not change, then all of the probability mass formerly associated with applied tariffs equal to or above B is mapped onto tariff rate B. The resulting distribution of tariffs is a winsorized distribution consisting of a truncated distribution of tariff rates up to the binding, and a "spike" at the bound rate, B. With the binding, the expected rate of protection will decline to a point like μ_1, and its variability will decrease. The effect of a binding at any given level above μ_0 on the mean of the protection process will be greater the larger is the variance of the protection process.

The effect of a tariff binding on the mean of the protection rate can be evaluated by calculating the expected tariff rate in the presence of a binding and comparing it with the mean of the unconstrained distribution of protection. Adapting the approach used by Martin and Urban (1984) to analyze the effects of support prices, we obtain the following expression for the mean tariff equivalent in the presence of the binding.

(1) $$\mu_1 = \int_0^B \tau . f(\tau) d\tau + \int_B^\infty B . f(\tau) d\tau$$

where μ_1 is the mean of the new distribution where tariffs are constrained by the binding; τ is the tariff rate; and f, which may be conditional on the exogenous factors suggested in the literature, is the density function of the tariff rate[4].

Because B is a constant, equation (1) may be simplified to:

(2) $$\mu_1 = \int_0^B \tau . f(\tau) d\tau + B(1 - F(B))$$

where $F(\tau)$ is the distribution (cumulative density) function of the tariff rate.

Turning to specific functional forms, if we assume that the distribution of the tariff rate can be approximated by a normal distribution, and that the distribution is invariant with respect to the imposition of a binding, then the mean of the tariff can be expressed in normalized form (μ_Z) as:

(3) $$\mu_Z = \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}(Z^*)^2} + Z^*(1 - F(Z^*))$$

where $Z = (\tau-\mu_0)/\sigma_0$, is the normalized tariff rate, defined by calculating the deviation of the tariff rate from its unbound mean and dividing by σ_0, the standard deviation of the original distribution; and $Z^* = (B-\mu_0)/\sigma_0$ is the value of the normalized tariff binding.

From equation (2) we can derive a simple, general expression for the long-run mean of the tariff following the introduction of a binding:

(4) $$\mu_1 = \mu_0 - \int_B^\infty (\tau - B) f(\tau) d\tau \ = \ \mu_0 - \int_B^\infty (\tau) f(\tau) d\tau + B \int_B^\infty f(\tau) d\tau$$

From the structure of the problem, it is clear that μ_1 must be less than the mean of the unbound tariff, μ_0. The relationship between the mean subject to binding (μ_1), and the unbound

[4]Alternative approaches for this type of problem have been suggested by Fraser (1988) who derived the mean price by mixing the two distributions, and by Bardsley and Cashin (1990), who applied option pricing theory.

mean (μ_0) is a nonlinear one, implying that the expected tariff cannot change one for one with the binding, as is frequently assumed. To explore this relationship further, it is useful to differentiate (4) with respect to B to obtain:

(5) $$\frac{\partial \mu_1}{\partial B} = \int_B^{\infty} f(\tau)d\tau = (1 - F(B))$$

This formulation makes it clear that a bound tariff rate well below the initial mean has the largest marginal impact on the expected future mean tariff rate. For B well below μ_0, F(B) will be relatively close to zero and so μ_1 will essentially decline one for one with reductions in the tariff binding. At higher bound rates, the marginal effect of a reduction in the tariff binding will be much less than unity. Importantly, however, the marginal effect of a change in a tariff binding does not change abruptly when the binding passes through the mean tariff rate, but rather declines monotonically with increases in the distribution function; this contrasts sharply with the deterministic case where changes in the binding have a unit impact below the applied rate and a zero impact at all values above the applied rate. For very high values of B, (1- F(B)) approaches zero, giving the common-sense conclusion that marginal changes in the binding about very high levels have essentially no effect on the expected value of the tariff.

Another way of interpreting equation (5) is in terms of the amount of probability mass accumulated at the binding. A marginal reduction in B has a one for one impact on the protection rate associated with the probability mass accumulated at that point. The impact of the change on the mean rate of protection will depend upon the amount of probability mass accumulated at the binding, that is on (1-F(B)).

If we take the average tariff rates on industrial products prior to the first post-war GATT Round as indicative of the underlying mean rate of tariffs on industrial products in developed countries, then this would imply an underlying average tariff rate of 40-50 percent (Preeg 1994). With average industrial tariffs in the developed countries reduced to only six percent after the Tokyo Round, it seems likely that $F(Z^*)$ was effectively zero from a policy viewpoint, implying that incremental reductions in the tariff bindings (which by then were virtually all equal to the applied rates) had essentially a unit impact on expected future tariff rates. This is consistent with the approach used in quantitative studies of the Tokyo Round (see, for example, Deardorff and Stern, 1986), where reductions in bindings were treated as leading to one-for-one reductions in protection. To extrapolate such an approach to Preeg's "brave new world" of the Uruguay Round agreement seems hazardous-- particularly since it involves bindings at or above previous levels of protection in many areas, and particularly in the agriculture agreement (Hathaway and Ingco, 1995).

The effect of a binding on the variance of the distribution can be evaluated using similar procedures to those adopted for the mean. We first write a general expression for the post-winsorization variance of a standardized variable:

$$(6) \qquad \sigma_z^2 = \int_{-\infty}^{Z^*} Z^2 . f(Z).dZ + \int_{Z^*}^{\infty} Z^{*2} . f(Z)dZ - \mu_Z^2$$

For the standardized normal, this has the explicit solution:

$$(7) \qquad \sigma_z^2 = F(Z^*) - Z^* . \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}Z^{*2}} + Z^{*2}(1 - F(Z^*)) - \mu_Z^2$$

The variance of the distribution of protection in the presence of a binding is then given by:

$$(8) \qquad \sigma_1^2 = \sigma_0^2 . \sigma_z^2$$

The marginal impact of a binding on the variance of protection can be derived in the same way as the impact of the binding on the mean. By differentiating equation (8) and rearranging the results, we find that:

$$(9) \qquad \frac{\partial \sigma_1^2}{\partial B} = 2(B - \mu_1)(1 - F(Z^*))$$

From equation (9), it is clear that the marginal impact of a change in a tariff binding on the variance may be considerably different from the impact on the mean given by equation (5). For values considerably above the underlying mean of the unfettered distribution, the impact of a change in the binding on the variance is very small for the same reason that the impact on the mean is small: because $(1-F(Z^*))$ approaches zero. This result reflects the intuition that small changes in bindings which are so high as to be irrelevant for practical policy purposes have very little impact on either the mean or the variability of the distribution. An important difference arises when we consider changes in bindings well below the underlying mean of the distribution. In this case, the binding approaches the mean of the winsorized distribution. Accordingly, $(B-\mu_l)$ approaches zero and the marginal impact of the binding on the variance of the distribution approaches zero -- even though the marginal impact on the mean is at its maximum in this situation. Here, virtually all of the probability distribution is collected at the binding and marginal reductions in the binding have very little further impact on the variance of protection.

V. The expected cost of protection

A convenient approach to evaluating the welfare impacts of protection in general equilibrium is the Balance of Trade function (Anderson and Neary, 1992; Martin 1995). Under this approach, a money measure of the change in welfare resulting from a tariff is obtained by evaluating the change in the balance of trade, at constant utility, resulting from the change in a tariff. A policy distortion which reduces domestic efficiency increases the costs of achieving a given level of utility, and requires an inflow of capital from the rest of the world to maintain that utility level. The balance of trade function for an economy subject only to trade distortions is defined as:

(10) $$B = e(p,u) - g(p,v) - (e_p - g_p)(p - p^*)$$

where $e(p,u)$ is the expenditure required to achieve the exogenously specified level of utility u at the vector of domestic, distorted prices p, and $g(p,v)$ is the gdp function indicating the maximum production revenue which can be generated with resource endowments v at domestic prices p. The vector of domestic demands for output is given by the first derivative of $e(p,u)$ with respect to p, while domestic supplies are represented by g_p. The gap between the domestic and the world price, $(p-p^*)$, is the tariff on imports, so that tariff revenues are given by $(e_p - g_p)(p - p^*)$. For notational simplicity, it is convenient to rewrite (10) in terms of the net revenue function $z(p,u,v)=e(p,u)-g(p,v)$ and its derivatives. Thus:

(11) $$B = z(p,u,v) - (z_p)(p - p^*)$$

To consider the effect of discrete changes in protection on the balance of trade function, it is convenient to use a second-order Taylor Series expansion. Assuming linearity of the excess demand curve, z_p , so that third derivatives vanish, this yields the following expression for the welfare effects of any change in a tariff:

(12) $$\Delta B = -z_{pp}(p - p^*)\Delta p - \frac{1}{2} z_{pp}(\Delta p)^2$$

To estimate the total costs of a single stochastic tariff, we evaluate (12) about a zero-tariff initial equilibrium, and take expectations to obtain:

(13) $$E(\Delta B) = -\frac{1}{2} z_{pp} E(\tau)^2 = -\frac{1}{2} z_{pp}\left[\mu_\tau^2 + \sigma_\tau^2\right]$$

where the first term on the right hand side of (12) disappears because the tariff was initially zero; Δp can be replaced by $\tau = (p - p^*)$ following the introduction of the tariff; and where μ_τ and σ_τ^2 are the mean and variance of the tariff.

From (13), we can see that the cost of protection on a particular good, relative to a free trade benchmark where $(p-p^*)=0$, is determined by the second moment of the tariff about the origin, $E(\tau)^2$, multiplied by 1/2 times the slope of the compensated import demand curve, z_{pp}. Since the second moment about the origin is equal to the sum of the mean squared and the variance, this implies that the expected cost of protection is given by the square of the mean tariff plus the variance of the tariff, all multiplied by one half the (absolute) slope of the compensated excess demand curve. Clearly, this implies that equiproportionate reductions in the variance of protection and in the mean-squared rate of protection have the same impact on the costs of protection.

This equation can be given a graphical interpretation using Figure 2, which depicts the compensated import demand curve, z_p. If we first consider the case of a deterministic tariff of $(p-p^*)$, the welfare cost is given by the Harberger triangle *cab* under the excess demand curve in Figure 2. This area is equal to $-1/2.z_{pp}(p-p^*)^2$. To illustrate the nature of the higher costs associated with variable protection, consider symmetric variations around this tariff level, with a higher tariff yielding a domestic price of p_h in one period, and a lower tariff yielding a lower domestic price, p_l in another time period. In Figure 2, the higher tariff has a welfare cost represented by area *cfg*, while the cost of the lower tariff is represented by area *cde*. Clearly, the average cost associated with the varying protection is greater than area *cab* associated with the same average rate of protection. This asymmetry is a manifestation of the convexity of equation (13) in the tariff rate.

Traditional analysis of the welfare effects of a tariff is based on the assumption that a tariff is fixed, such that the variance term in equation (13) is zero. Under this assumption, equation (13) collapses to:

$$(14) \qquad \Delta B = -\frac{1}{2} z_{pp} \tau^2 = -\frac{1}{2} z_{pp} \mu_\tau^2$$

Comparison of equations (13) and (14) makes it clear that the basic element missing under the assumption of a fixed rate of protection is the variance term, which maps directly into the welfare impact of protection.

Equation (13) provides an analytical basis for the concept of market security so much emphasized in qualitative analysis of trade policy. By combining the impacts of changes in bindings on both the mean and the variance of protection into a single measure of welfare change, it allows us to provide a quantitative estimate of the extent to which protection policy restrained by GATT-type disciplines is to be preferred over protection which is free to vary in an uncontrolled manner. Particularly early in the liberalization process, when tariff bindings are high relative to the underlying mean of the distribution of protection, the gains from subjecting protection to multilateral disciplines may be due more to reductions in variability than to reductions in the mean level of protection. This implies that the near-universal omission of the beneficial impacts of reductions in the variability of protection in studies of multilateral trade liberalization may have greatly understated the gains from this liberalization.

The formula for the cost of variable protection given in equation (13) provides us with a simple approach to estimate the relative reduction in the cost of protection associated with the introduction of a binding. One approach to undertaking this calculation is to estimate the mean and the standard deviation of protection before and after the new binding. Squaring these and adding them yields the second moment of the rate of protection, τ, about zero. Note that z_{pp} can be replaced by $M_0\,\varepsilon$ where M_0 is the free trade level of imports, ε is the (constant) import demand elasticity, and free trade prices are normalized to 1. Taking $-1/2.z_{pp}$ to be a constant, the proportional reduction in the second moment will give the proportional reduction in the cost of protection.

If we index the base cost of protection at I_o=100, then we can define a welfare-weighted index of the expected cost of protection as follows:

(15) $$I_1 = (E(\Delta B_1)/E(\Delta B_0)) \times 100 = (z_{pp}E(\Delta p_1)^2 / (z_{pp}E(\Delta p_0)^2) \times 100$$

Possible Generalizations

While the treatment above has considered only cases where the distribution of protection is invariant to changes in the tariff binding, it is straightforward in principle to generalize the analysis to cases where the distribution changes in response to changes in tariff bindings. In some cases, the mean level of protection might increase when the tariff binding is reduced, in an attempt to offset the effect of the reduction in the binding. In other cases, a reduction in a binding might reduce the profitability of rent-seeking behavior enough to lower the mean of the underlying distribution. We view the development of a suitable theoretical framework for evaluating such effects as beyond the scope of this paper, though we also consider it likely that in most cases these impacts will be small relative to those which are highlighted here.

In most of this paper we treat τ as a single tariff equivalent, applied in a single market. However, the basic point summarized by equations (12), (13), and (14) is more general: that the mean cost of protection is determined by the probability density function surrounding the protection term τ. One could also interpret τ as a vector of instruments applied over a set of markets, where the cost of protection then depends on the probability density function (including covariance terms) for the full vector of instruments. The binding term B can then be interpreted as a vector of instrument caps.

If we assume we are working with a vector of policy instruments, then the cost of protection measure becomes a multi-market measure, rather than a single market measure. Equation (10) is sufficiently general to allow for any number of trade distortions, and the expected cost of protection may be measured by a multivariate extension of equation (13). In the multivariate context, the cost of protection is given (to a second-order approximation) by a quadratic form in τ: Taking expectations of this quadratic form leads to the multivariate version of equation (13):

(16) $$E(\Delta B) = -\frac{1}{2}E(\tau' Z_{pp}\tau) = -\frac{1}{2}TR(Z_{pp}\Sigma)$$

where Z_{pp} is the matrix of compensated price effects contained in the behavioral model, and Σ is the variance-covariance matrix of second moments about the origin of the different protective instruments.

It is, in principle, possible to incorporate endogenous responses of the distribution of protection within a multi-market analysis. Such a fully general analysis would need to allow for the possibility of *instrument-switching* discussed by Martin and Francois (1995), where the impact of one instrument is offset by endogenously-determined changes in another. Undertaking a completely general, multi-market empirical evaluation of the impacts of bindings would be difficult to do reliably at this stage given the basic uncertainties which currently exist about which general class of political-economy models is the most appropriate for explaining the choice of particular policy instruments and we therefore view this task as beyond the scope of this exploratory paper. As a first step in gauging the order of magnitude of the effects under consideration we turn, in the next section, to a simple assessment for three major commodities of the impact of one of the most important areas of trade reform under the Uruguay Round, the introduction of tariff bindings on agricultural commodities.

VI. An illustrative application: Uruguay Round agricultural bindings

A typical operational approach to assessing the liberalizing effects of the introduction of a new binding, or a reduction in an existing binding, is to take the marginal impact of the binding to be zero if the final binding is above the initial applied rate, and to be unity if it is below the initial applied rate. It should now be clear that this approach completely ignores the effects of tariff bindings above the mean. Less obviously, it tends to overstate the marginal impact of reductions in bindings occurring at or below the initial applied rate. Our objective in this section is to highlight the implications of the concepts we have developed by application to agricultural bindings undertaken during the Uruguay Round.

Because of the complexities and uncertainties inherent in the full multivariate case, we elect to focus on individual commodities and countries in this application. Since we would normally expect bindings on one commodity to reduce the pressure for protection from related industries[5], we feel that the single-commodity analysis presented below will underestimate the gains associated with the extensive tariffication undertaken during the Uruguay Round. It will,

[5] This is particularly likely to be the case where goods are related vertically or horizontally in production. More generally, increases in protection to one industry tend to provide a positive signal to protectionist lobbies, and to stimulate protectionist pressures.

at the same time, raise the lower-bound estimate above that reached by current methods. In a global analysis, terms of trade and second-best effects of changes in world prices must also be considered; these are excluded in the present study in order to focus on the direct effects of primary interest, but could be included in a large scale numerical analysis.

Under the Uruguay Round agricultural agreement, developed countries are required to establish tariff bindings for previously unbound agricultural products with a protective effect equal to the combined effects of tariffs and nontariff barriers in a base period (1986-88), and to subsequently reduce them by an average of 36 percent in developed countries (24 percent in developing countries) and by at least 15 percent (10 percent in developing countries) for each tariff line. As detailed in Table 1, tariffication affected roughly 13 percent of agricultural trade by value, though it was concentrated in the most heavily protected sectors. Its implications for potential welfare effects are therefore greater than suggested by the trade weights. Sectors subject to tariffication include wheat, sugar, meat, and dairy products. The procedures used to estimate the protective effects of nontariff barriers allowed considerable scope for discretion[6]. As a result, many of the new tariff bindings in developed and developing countries for products subject to tariffication will be set above their levels in the reference period. This means that many of the tariff cuts in Table 1 are from elevated levels. Developing countries also had the option to set their tariff bindings even higher through the use of ceiling bindings (Hathaway and Ingco, 1995). Hence, even for sectors not subject to tariffication, developing countries often entered tariff bindings significantly above applied rates.

In this situation, simple approaches to evaluating the liberalizing effects of agricultural tariff bindings are likely to tell us very little. If the tariff bindings are simply compared with the previously applied rates of protection, it may even appear that the agreement has resulted in an increase in protection. A standard approach is to compare applied rate to bindings, and assume changes occur only if the new bindings are below old applied rates. (see, for example, Francois *et al,* 1995). Under this approach, the estimated extent of liberalization is likely to be extremely small, as is evident from Hathaway and Ingco's (1995) analysis.

[6] The tariff equivalents were generally to be calculated at the 4-digit level of the Harmonized System, while tariffs are applied at the individual national tariff line level, which may involve 10 or 12 digits.

The approach we take here is to estimate the mean and variance of the underlying distribution of protection, and to evaluate the impact of bindings on the mean level and cost of protection. Comparison of the mean level of protection with the mean of the data during the sample period provides an initial indication of the extent of expected liberalization. We use data calculated by the OECD for the annual *ad valorem* equivalents of agricultural trade barriers in OECD countries (OECD 1994) made available on diskette by the Agriculture Directorate of the OECD. These data are available over the period 1979-93, providing a sample large enough to make a rough estimate of the standard deviation of protection for each commodity under the policy regime applying during this period. For illustrative purposes, our calculations are based on the assumption that the mean and variance of protection over the 1979-93 period would continue to apply in the future in the absence of a tariff binding.[7] Where Uruguay Round tariff bindings were made in specific terms, they have been converted to *ad valorem* equivalents using World Bank commodity price projections.

We take the world price of the good as exogenous to each individual country, and the rate of protection as distributed independently of this world price. In a short run context of sticky internal prices, it is clear that the protection rate is not completely independent of the world price on a year to year basis. In fact, once the domestic price is set for a season under arrangements such as the European Union's variable levy system, the protection rate and the world price are perfectly negatively correlated. Over the longer term, however, there is evidence that domestic prices tend to follow world prices of agricultural products, except for a randomly determined margin term which includes the effects of protection policy (Mundlak and Larson, 1992). Mundlak and Larson also provide evidence that the elasticity of price transmission is

[7]This assumption is clearly important. If protection rates are increasing, then this assumption may understate the degree of liberalization which has been achieved. Importantly, we also assume that the balance between those seeking and resisting protection will be unchanged by the presence of a binding. If, however, both parties are fully rational in their understanding of the system, it is possible that the suppliers and demanders of protection would understand that a higher level of protection during unbound periods is required to achieve any given level of average protection. In this super-rational case, our results may overstate the degree of Liberalization actually achieved.

very close to unity, implying that domestic prices move proportionately with world prices in the long run.[8]

We assume that the moments of the process generating the distribution of protection remain constant after the introduction of bindings. That is, we assume that the fundamental determinants of the supply of and demand for protection do not change because of the introduction of tariff bindings, and that basically the same instruments continue to be used to determine the rate of protection below the constraint imposed by the binding. In some important cases, such as EU agricultural policy, it appears that the same general instruments for border protection will continue in effect subject to the constraint imposed by the GATT tariff bindings (Josling and Tangermann, 1994). Even if the specific instruments utilized do change, it seems reasonable to assume, as a general rule, that protection will still vary in similar ways, since the fundamental stochastic determinants of protection remain in place.

Importantly, we assume that the mean of the distribution of protection rates will not merely be increased to fully compensate for the introduction of a binding. While possible, such a reaction would seem to require more knowledge of the system, and a greater degree of co-ordination between suppliers and demanders of protection than would seem generally likely. If individual industries were able to counter GATT rules so easily, then presumably they could block the entire GATT process of protection reduction, an assumption contradicted by the success experienced by the GATT in lowering protection rates on the goods which it has systematically covered -- manufactured goods imported by industrial countries.

We provide an illustrative application for three important agricultural commodities (wheat, sugar, and beef) in seven OECD countries for which *ad valorem measures* of the final tariff bindings resulting from the Uruguay Round are available from analysis undertaken by

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[8] As a check on the robustness of our results, we calculated the correlation between the world price and the protection rate using our sample. In general, these correlations were very small, suggesting that the lack of independence between the world price and the protection rate would not significantly affect the estimate of the variance. Had the correlations been significant, we could very simply have adjusted our procedures to obtain an estimate of the variance of the protection rate conditional on our projection of the world price. Given a predicted value for the world price, the conditional variance of the protection rate is: $\sigma_{\tau|p}{}^2 = \sigma_\tau^2(1-\rho^2)$, where ρ is the correlation between the world price and the protection rate (Freund and Walpole 1980). If the mean over the forecast period were expected to deviate from its underlying mean, then and adjustment to the conditional mean of the distribution of protection would also be required before the impact of the binding on protection could be evaluated.

Ingco (1994). In most cases, the tariff commitments have been made in specific terms, and these *ad valorem* equivalents have been calculated using 1989-93 average prices as an indicator of likely future prices. An exception is the protection estimates for Wheat and Sugar in the EU and Japan, where the *ad valorem* bindings are based on World Bank commodity price projections for the year 2000. We discuss all of the protection measures in terms of import protection, even for exporting countries, since import restrictions are an essential backstop for export subsidy programs.

In Table 2, we provide estimates of the mean and the standard deviation of protection prior to the Round in the first and second columns. In the third column, we show the estimated *ad valorem* equivalent of the tariff binding. Then, in the fourth and fifth columns, we provide estimates of the mean and standard deviation of (bound) protection applying after the Round. The final column shows the relative reduction in the expected cost of protection resulting from the introduction of the binding, calculated using equation (13).

The results for wheat presented in the first section of Table 2 highlight the very substantial variation across regions and across time in the rates of border protection applying to wheat. Further, it is clear that the final bindings are above the average rates of protection applying in the pre-Round era, despite the commitment in the Round to lower protection relative to previous average levels. Does this imply that the Uruguay Round "liberalization" actually resulted in increases in protection rates? Clearly not. When we look at the mean protection rates in the final column of the table, it is clear that even these generally high bindings can be expected to lead to some liberalization in some major markets. This liberalization is particularly important in Japan, where the expected cost of protection declines by 287 percentage points from the 1979-93 average.

Another important feature of the results for wheat is the decline in the standard deviation of protection resulting from the introduction of tariff bindings. In the EU, the proportional reduction in the variability of protection is greater than in the mean, implying that most of the gains are derived from the reduction in variability, rather than from the reduction in the average rate of protection. In the case of the United States, the mean falls by much more than the standard deviation of protection falls, implying that the reduction in average protection is more important than the reduction in the variability of protection. In other cases, such as Japan, the proportional reduction in the standard deviation is much larger than that in the mean, implying that the reduction in the variability of protection is the dominant influence in reducing the welfare costs of protection. In this case, so much of the probability mass is concentrated at the binding that it effectively becomes a deterministic rate of protection.

A striking feature of the results is just how large are the reductions in the costs of protection resulting from the introduction of bindings on wheat, despite the frequently substantial slippage in the settings of the bindings relative to the objectives of the Round. The size of these reductions highlights the very large gains associated with initial reductions in rates of protection, and the importance of measuring the effects on both the mean and the variability of protection. To illustrate this point, Figure 3 presents a decomposition of the source of estimated reductions in the cost of protection, into the share attributable to mean reduction, and the share attributable to variance reduction. As suggested by Table 2, the relative importance of mean and variance reduction varies by country. Measures of protection which are based on methods like equation (14), and which therefore focus only on the reduction in observed protection, will only capture reductions related to the mean rate. As is evident from Figure 3 (particularly Canada, Australia and the United States), such an approach can miss important liberalizing aspects of rules limiting the rate of protection.

The estimates of the impact of sugar market liberalization in the central section of Table 2 present a somewhat more diverse pattern than the results for wheat. In Japan, the binding itself virtually determines the expected rate of protection after the Round. The final binding is so far to the left of the underlying mean rate of protection that virtually all of the probability mass is collected at the bound rate. The cost of protecting sugar in Japan is reduced by 94 percent because of the sharp reduction in both the mean and the variability of protection. The reduction in the standard deviation of protection is almost twenty-fold and contributes much more than the reduction in average protection to the overall reduction in costs. The binding offered by the USA, at 91 percent, reduces the average rate of protection and the standard deviation by broadly similar amounts. Even though the tariff binding is only seven percentage points below the underlying average tariff rate, the mean tariff is reduced by 32 percentage points, and the standard deviation of protection is almost halved, with the costs of protection falling by 60 percent. In the EU, the cost of protection is reduced by an estimated 43 percent even though the binding is above the previous mean level of protection.

The case of beef is quite different from that of sugar and wheat, primarily because the standard deviation of protection is much lower for this commodity than for wheat or sugar. In part because of this, and in part because of the setting of the protection rates, bindings above the average tariff rate do not have a substantial liberalizing effect in any country other than Japan. In Japan, the binding is below the average rate of protection and reduces both the mean and the standard deviation of protection substantially. Since the proportional reduction in the variability of protection is larger, this reduction contributes most of the 60 percent reduction in the costs of protection observed in this case.

VII. Summary and Conclusions

A key feature of the Uruguay Round was the introduction of tariff bindings which constrain the range and variability of protection rates. While tariff bindings allow tariff rates to vary below the level of the binding, they reduce both the average applied tariff and the variability of the applied rate of protection. Drawing on the extensive literature on the political economy of protection for support, we argue that protection rates vary in response to a wide range of pressures for protection, and that these pressures are likely to continue to generate varying rates of protection even after the introduction of new tariff bindings. Accordingly, we represent trade policy in the presence of a tariff binding as generating varying rates of protection subject to the limit imposed by the binding. Under this assumption, we assess the effect of a tariff binding on the mean and the standard deviation of protection.

As a basis for evaluating the liberalization of stochastically varying protection, we develop a simple framework based on the expected cost of protection. For a single commodity, this cost depends on the second moment of protection about the origin (or, equivalently, the sum of the squared mean and the variance of protection) and the slope of the import demand function. This approach highlights the fact that the cost of protection rises with the square of the rate and the standard deviation of the rate of protection. Within this conceptual framework, we are able to assess the relative impact of tariff bindings on the total costs of protection for individual commodities, through calculation of welfare-weighted cost of protection indexes.

We have provided illustrative examples, based on such indexes, for the effect of tariff bindings on imports of three important commodities: wheat, sugar and beef. Even though tariff bindings on these commodities were typically set at levels substantially higher than the average rates of protection previously applied, it seems likely that the introduction of tariff bindings will yield substantial reductions in the costs of protection on a broad range of these commodities.

A basic objective of this paper has been to shift the notion of protection from one based primarily on fixed policy instruments, to one that involves policy regimes subject to uncertainty and variability. While the importance of the security and certainty of market access has long been recognized in the policy process, little attention has been devoted to these issues in the formal economics literature. As the present exercise has demonstrated, the stochastic aspect of policy variables can have important implications for the welfare effects of negotiated bindings and rules-based policy constraints, beyond those suggested in frameworks built around fixed policy regimes.

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Figure 1.

The implications of a tariff binding for the applied rate of protection

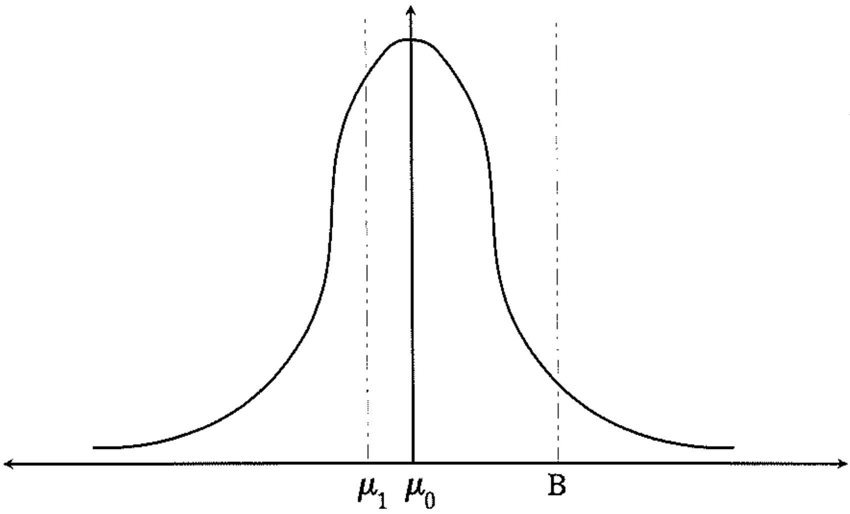

Figure 2.

The welfare impact of varying tariff rates

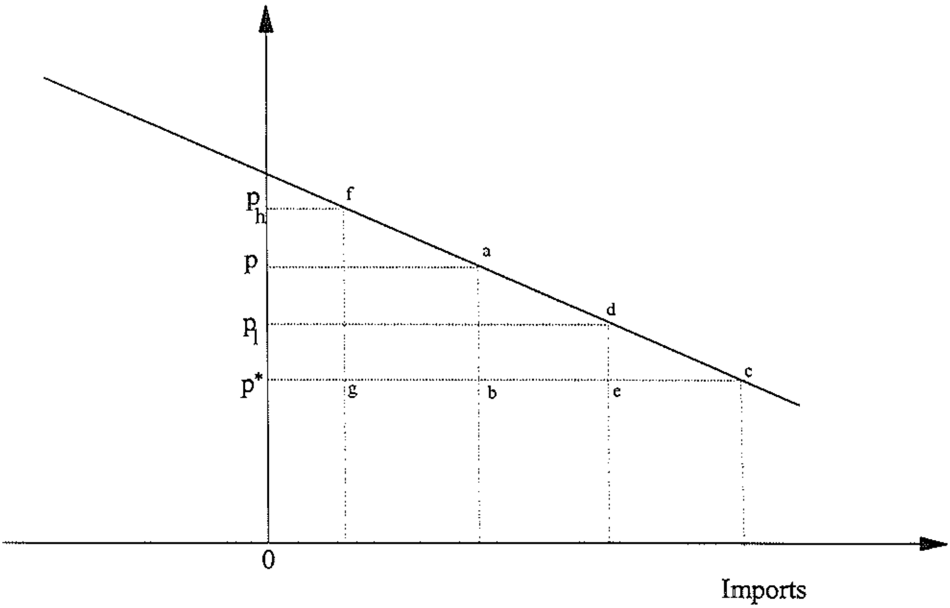

Figure 3
The Expected Cost of Protection for Wheat
(percentage reductions)

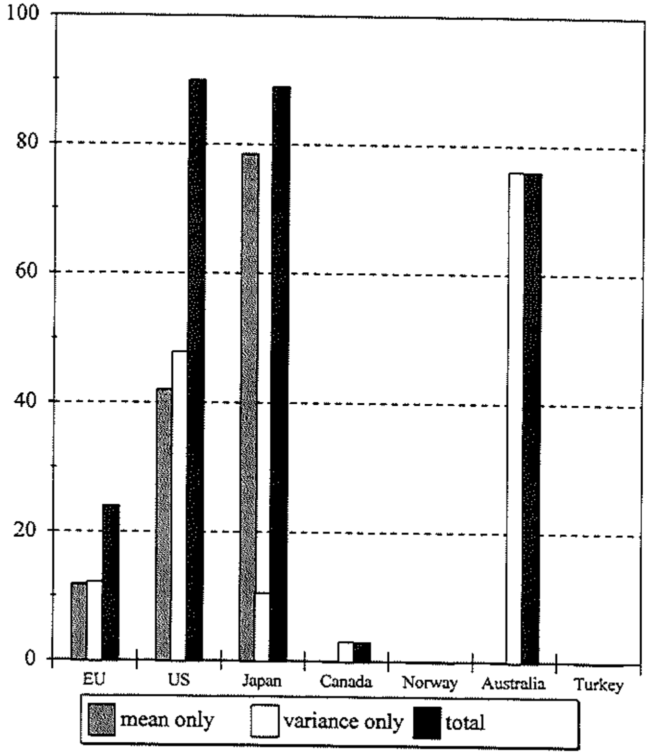

Table 1. Bindings, tariff reductions, and tariffications in the Uruguay Round agriculture agreement (imports in millions of dollars)

Reporter country	Total imports	Scope of bindings		Profile of Tariff Reductions						Scope of Tariffication
		Pre-Round	Post-Round	0.0%	0.1-9.9%	10.0 - 14.9%	15.0 - 24%	24.1 - 36%	> 36%	
Australia	1,009	474	1,009	0	0	0	213	59	599	83
Austria	864	648	864	0	0	0	146	240	304	108
Brazil	888	320	888	327	17	271	50	62	109	0
Canada	2,065	2,024	2,065	0	0	0	298	439	295	239
Czech Republic	1,278	1,266	1,278	15	0	24	224	32	342	92
European Union	32,728	29,455	32,728	0	0	0	4,759	6,874	5,697	6,100
Finland	588	494	588	0	0	9	128	67	235	105
Hong Kong	8,419	253	8,419	0	0	0	0	0	0	0
Hungary	751	308	751	0	0	0	211	250	108	377
India	1,630	326	1,630	1,221	0	0	0	101	38	0
Indonesia	1,313	906	1,313	0	0	996	195	45	77	68
Jamaica	192	0	192	105	0	0	0	0	0	0
Japan	25,970	15,582	25,970	8	6	1,420	6,736	485	5,973	1,868
Korea Rep.	4,598	1,103	4,598	1	2	1,450	260	272	2,604	850
Macao	232	0	232	0	0	0	0	0	0	0
Malaysia	932	37	932	53	0	123	207	240	128	34
Mexico	2,740	2,740	2,740	0	137	1,911	22	532	88	743
New Zealand	293	225	293	0	0	0	16	43	97	0
Norway	512	476	512	0	0	0	68	187	43	252
Philippines	1,079	313	1,079	7	0	130	64	290	588	251
Poland	1,490	0	1,490	0	0	0	86	502	706	694
Romania	871	200	871	0	2	200	368	52	249	59
Singapore	2,103	21	2,103	0	0	0	449	23	1,612	0
Slovak Rep.	1,278	1,266	1,278	15	0	24	224	32	342	92
Sri Lanka	522	78	522	80	0	0	442	0	0	0
Sweden	1,194	1,015	1,194	0	0	0	185	114	117	299
Switzerland	1,351	972	1,351	0	12	27	298	420	304	484
Thailand	1,048	189	1,048	0	0	825	15	58	119	189
Tunisia	616	0	616	0	0	1	296	255	64	290
Turkey	1,093	109	1,093	0	0	497	360	18	218	0
United States	17,555	16,501	17,555	410	212	1,628	3,119	2,265	4,426	1,052
Venezuela	646	646	646	0	21	446	127	0	52	507
Total	117,848	77,948	117,848	2,241	410	9,982	19,568	13,956	25,531	14,835
Shares	1.00	0.66	1.00	0.02	0.00	0.08	0.17	0.12	0.22	0.13

Source: GATT/WTO secretariat. Data are for Harmonized System (HS6) participants.

Table 2 **Implications of Uruguay Round agricultural bindings**

	Mean 79-93 %	Std Deviation %	Final Binding %	New Mean %	New Std Dev. %	Cost Reduction %
Wheat						
EU	56	37	82	51	30	24
US	12	14	4	1	6	90
Japan	438	153	152	151	14	89
Canada	22	18	58	22	18	3
Norway	170	126	495	170	126	0
Australia	0	1	0	0	1	76
Turkey	13	29	200	13	29	0
Sugar						
EU	149	80	152	118	48	43
US	98	70	91	66	39	60
Japan	227	74	58	58	4	94
Canada	8	3	35	8	3	2
Norway	0	0	211	0	0	0
Australia	7	7	52	7	7	0
Turkey	17	30	150	17	30	0
Beef						
EU	84	16	125	84	16	0
US	2	2	31	2	2	0
Japan	54	21	39	36	7	61
Canada	2	2	38	2	2	0
Norway	146	25	405	146	25	0
Australia	0	0	0	0	0	0
Turkey	28	29	250	28	29	0

Note: numbers have been rounded to the nearest percent.