Policy Research Working Paper 5200

Formulas and Flexibility in Trade Negotiations

Sensitive Agricultural Products in the WTO's Doha Agenda

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The World Bank
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February 2010

Abstract

Many trade negotiations involve large cuts in high tariffs, with flexibilities allowing much smaller cuts for an agreed number of politically-sensitive products. The effects of these flexibilities on market access opportunities are difficult to predict, creating particular problems for developing countries in assessing whether to support a proposed agreement. Some widely-used *ad hoc* approaches to identifying likely sensitive products—such as the highest-bound-tariff rule—suggest that the impacts of a limited number of such exceptions on average tariffs and on market access are likely to be minor. This paper uses a rigorous specification based on the apparent objectives of policy makers in setting the pre-negotiation tariff. Applying this approach with detailed data allows the authors to assess the implications of sensitive-product provisions for average agricultural tariffs, economic welfare, and market access under the Doha negotiations. The authors conclude that highest-tariff rules are likely to seriously underestimate the impacts on average tariffs, and that treating even 2 percent of tariff lines as sensitive is likely to have a sharply adverse impact on economic welfare. The impacts on market access are also adverse, but much smaller, perhaps reflecting the mercantilist focus of the negotiating process.

This paper—a product of the Agriculture and Rural Development Team, Development Research Group—is part of a larger effort in the department to understand the implications of trade agreements for development. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. The author may be contacted at wmartin1@worldbank.org. This research was supported by the Multi-Donor Trust Fund for Trade.

Formulas and Flexibility in Trade Negotiations: Sensitive Agricultural Products in the WTO's Doha Agenda

by

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In recent years, a common feature of trade negotiations involving developing countries has been the use of a formula approach to tariff cutting, coupled with provisions for smaller, or zero, cuts in particular products. This approach follows a pattern observed in earlier WTO Rounds (Martin and Winters 1996) and regional agreements (Olarreaga and Soloaga 1998), where ambitious tariff reduction goals were combined with discretion for particular, politically-sensitive, products. One difference is that the specific products to be subjected to smaller cuts were typically directly negotiated in earlier agreements, while the Doha agenda "modalities" for agriculture specify the share of products allowed smaller cuts, leaving the choice of products to the discretion of the importer.

The approach being followed in the WTO agricultural negotiations (WTO 2004, 2008) specifies larger proportional cuts in higher bound tariffs but allows reduced cuts for "sensitive" products selected by members. Earlier work suggests this approach may make market access gains particularly susceptible to erosion through exclusion of a small number of goods, particularly in the industrial countries where the variance of agricultural tariffs is very high (Jean, Laborde and Martin 2006).

While discretion for smaller cuts on their own sensitive products is attractive to individual policy makers, it raises difficult questions for policy makers and for analysts making *ex ante* evaluations of proposed agreements. These problems are particularly acute for policy makers from small developing countries. While large traders may have the resources to estimate the direct impact of key partners' choices on their market access reasonably well, small developing countries frequently have difficulty doing so. Both groups remain vulnerable to importers changing their choice of products at the last moment. Analysts attempting to provide policy makers with *ex ante* assessments of proposed global agreements face a different and perhaps even more serious challenge—they need a consistent basis for assessing the use of these flexibilities in 153 WTO member countries.

One widely-used approach to *ex ante* assessment is to assume that flexibility will be used for the highest bound (Sharma 2006) or applied (WTO 2006) tariffs. These approaches lead to a sharp conclusion—that the impacts of flexibilities on cuts in average tariffs will be small. The highly variable, and frequently large, gaps between bound and applied agricultural tariffs (Jean, Laborde and Martin 2006) raise important questions—would products with high bound tariffs really be selected if the bound rate remains above the applied rate even after the bound rate is cut, and hence no reduction in applied rates is required? Even high applied rates may not be subject to cuts if the binding overhang on these products is sufficiently large. Further, these approaches ignore the importance of the product—high tariffs are frequently observed on very minor products.

To deal with these concerns, Jean, Laborde and Martin (2006) proposed a minimization-of-tariff-revenue-loss rule that takes into account the size of the cut in applied tariffs resulting from the formula and binding overhang, and the initial value of imports. This approach leads to a strikingly different conclusion—that even a small number of sensitive products can dramatically reduce the cuts in average agricultural tariffs. In this situation, it seems particularly desirable to have an approach with stronger behavioral foundations.

To estimate the effects of flexibilities requires a forecast of the products likely to be chosen, and an estimate of the effects of these choices on efficiency and market access. We first develop a simple, theoretically-well-grounded, model of the preferences of policy makers, and then use it to assess which agricultural products WTO members are likely to treat as sensitive. Our approach focuses on policy choices within a single country, building on the framework developed by Grossman and Helpman (1994) and others in the political-economy literature. It provides a much-needed *ex ante* assessment of the impact of policy choices on market access and welfare, and a basis for *ex post* testing should the current negotiations be successfully completed.

An important question for current and future negotiations is whether the combination of ambitious tariff-cutting formulas with flexibilities allowing small cuts on relatively high tariffs makes sense from economic or mercantilist perspectives. To shed light on this issue, we use the Anderson-Neary (2007) approach with the most disaggregated data available at the international level to assess the implications of flexibility for both welfare and market access.

We assume that the agricultural tariff prior to the negotiations results from maximization of a government objective function along the lines of the Grossman-Helpman (1994) model. This approach seems appropriate for agricultural tariffs in the current negotiations because they have not been effectively disciplined by multilateral agreements (Hathaway and Ingco 1996). We consider a liberalization agreement involving a tariff-reduction formula together with flexibility for sensitive products, and focus on the way policy makers use this flexibility at any given level of world prices. The combined effect of the decisions by all 153 members leads to changes in domestic and international prices that members must take into account in deciding whether to accept the agreement.

Our first step is to develop an objective function for government policy making. Then, in Section II, we use this function to assess the implications of changes in tariffs under alternative assumptions about the structure of preferences. In Section III, we discuss the data and tariff-cutting formulas on which we base our analysis. Section IV contains applications to real-world data designed to assess the likely outcomes for average tariffs; to provide comparisons with earlier approaches; and to examine the sensitivity of outcomes to different rules for sensitive products. In Section V, we examine the implications of sensitive products for economic welfare in the country utilizing the flexibility and for the market access opportunities of partner countries. Section VI concludes.

I. Representing Governments' Objective Functions

We begin by specifying an objective function for policy makers that takes into account the benefits to politicians from providing protection to particular sectors while considering the costs to consumers and taxpayers of providing this protection. Our political-economy objective function—based on Grossman and Helpman (1994, equation 5)—is expressed as:

$$G(\mathbf{p},u) = -z(\mathbf{p},u) + \mathbf{z_p}'(\mathbf{p}-\mathbf{p^*}) + \mathbf{h}'\mathbf{p} \quad (1)$$

Where $z(\mathbf{p},u)=e(\mathbf{p},u)-g(\mathbf{p})$ is the trade expenditure function, defined as the difference between the consumer expenditure function $e(\mathbf{p},u)$ defined over domestic prices, $\mathbf{p}$ and the utility level of the representative household, u, and a net revenue function, $g(\mathbf{p})$, defined over domestic prices for given factor endowments; $\mathbf{p^*}$ is the vector of world prices for traded goods, so that **(p-p*)** is a vector of specific tariff rates; $\mathbf{z_p} = \mathbf{e_p} - \mathbf{g}_p$ is a vector of net imports; $\mathbf{z_p}'\mathbf{(p-p^*)}$ is tariff revenues, assumed to be redistributed to the household; and the elements of **h** reflect the valuation by governments of changes in domestic prices, over and above their impact on general economic welfare. We consider only tariffs because domestic and export subsidies are dealt with under different "pillars" of the negotiations.

Like Grossman and Helpman (1994, proposition 2) and virtually all subsequent applications based on this model, we assume that importers and governments view import prices as fixed, so that changing tariffs from their initial level involves a reduction in the value of the government's objective function. For individual governments choosing their own protection levels on individual commodities, this seems reasonable for relatively homogenous agricultural products given that the estimated export supply elasticities for homogenous goods are five times as high as for other products (Broda, Limao and Weinstein 2008, p2033). It also seems consistent with the approach taken by agricultural policy makers dealing with product-specific issues such as the "tariffication" of non-tariff barriers (Hathaway and Ingco 1996).

If we move beyond the Grossman-Helpman (1994) model, the **h** weights may also reflect a number of political-economy features identified by authors such as Anderson and Hayami (1986), Lindert (1991), Olarreaga and Soloaga (1998), Cadot, de Melo and Olarreaga (2004), and Dutt and Mitra (2010) that influence how much protection a particular agricultural sector will receive. These include: (i) how effectively the sector is organized; (ii) the impact of own-output prices on returns to specific factors in that sector; (iii) adverse impacts on the costs of other politically-influential groups of protecting a particular sector; and (iv) the ratio of imports to domestic consumption that determines the balance of benefits between tariff revenues and transfers to producers, and (v) the degree of concentration in the sector. In contrast with the studies above, our objective is not to explain the premium placed by policy makers on higher prices for particular goods. Rather, we use the observed policy choices to infer the elements of **h —** something that is feasible for highly disaggregated products.

Since we assume that the political-economy objective function is being maximized in the initial equilibrium, we can use the first order conditions to solve for **h**:

$$\mathbf{h} = -\mathbf{z}_{\mathbf{pp}}^{\mathbf{0}}(\mathbf{p}^{\mathbf{0}} - \mathbf{p}^{*}) \qquad (2)$$

where $-\mathbf{z}_{\mathbf{pp}}^{\mathbf{0}}\,(\mathbf{p}^{\mathbf{0}}-\mathbf{p}^{*})$ is the marginal welfare cost of tariff changes around $(\mathbf{p}-\mathbf{p}^{*})$, and the superscript ^{0} refers to values at the initial equilibrium (since world prices are assumed to be constant, $\mathbf{p}^{*\mathbf{0}} = \mathbf{p}^{*}$). The revealed value of **h** for product *i* clearly depends on the tariff for that sector. However, h_i depends also on the slope of the demand curve, z_{ii}, and the cross-price effects with other goods subject to tariffs, z_{ij}. In addition, for any given import demand elasticity, the value of h_i increases with import volume. Note that h_i for a good with a zero tariff will be negative if there are positive tariffs on its substitutes and none on any complements. Sectors that are organized will likely have positive values of h_i while unorganized sectors are expected to have negative values. Equations (1) and (2) together show the strong link between our approach and the Grossman-Helpman (1994) formulation.[1]

At any point where producers and consumers are making optimizing decisions relative to domestic prices, $\mathbf{z}_{\mathbf{pp}}\mathbf{p} = 0$. Equation (2) can thus be simplified to:

$$\mathbf{h} = \mathbf{z}_{\mathbf{pp}}^{\mathbf{0}}\mathbf{p}^{*} \qquad (2')$$

Equation (2′) includes all prices, and must yield exactly the same estimates as (2). It allows us to rewrite (1) in terms of potentially observable terms:

$$G = -z(\mathbf{p}, u) + \mathbf{z_p}(\mathbf{p} - \mathbf{p^*}) + \mathbf{p^{*\prime}} \mathbf{z^0_{pp}} \mathbf{p} \tag{1′}$$

Equation (1′) provides the basis for our subsequent analysis.

II. Implications of Tariff Changes for the Objective Function

A second-order Taylor-Series expansion of equation (1′) around the initial equilibrium provides insights into the implications of tariff changes that change **p** relative to **p***. We begin by taking the first and second derivatives of (1′) with respect to prices:

$$\frac{\partial G}{\partial \mathbf{p}} = \mathbf{p^{*\prime}} \mathbf{z^0_{pp}} + (\mathbf{p} - \mathbf{p^*})' \mathbf{z_{pp}} \quad \text{and} \quad \frac{\partial^2 G}{\partial \mathbf{p}^2} = \mathbf{z_{pp}} + \mathbf{z_{ppp}}(\mathbf{p} - \mathbf{p^*}) \tag{3}$$

For lack of information about the third derivatives of the trade expenditure function, we assume that the trade expenditure function can be adequately represented by a function such as the normalized quadratic introduced by Diewert and Ostensoe (1988) or the symmetric normalized quadratic used by Kohli (1993) to model import demand. As noted by these authors, these are flexible functional forms and hence can provide a second-order approximation at any point to any twice-differentiable functional form, such as the widely-used, but much less flexible, CES function. Given this assumption, the $\mathbf{z_{ppp}}$ term in equation (3) can be dropped and the implications of deviations in tariffs from the domestic political-economy optimum can be analyzed using the Taylor-Series expansion:

$$\Delta G = \frac{\partial G}{\partial \mathbf{p}} \Delta \mathbf{p} + \frac{1}{2} \Delta \mathbf{p}' \frac{\partial^2 G}{\partial \mathbf{p}^2} \Delta \mathbf{p} = \frac{1}{2} \Delta \mathbf{p}' \mathbf{z_{pp}} \Delta \mathbf{p} \tag{4}$$

Equation (4) is particularly simple because the initial equilibrium is an optimum from the point of view of the government acting unilaterally. It contains none of the interactions with existing distortions that complicate calculation of standard welfare effects (see Martin 1997). The quadratic nature of equation (4) immediately reveals a problem with the tariff-revenue-loss rule of Jean, Laborde and Martin (2006)—the impact of a reduction in the required tariff cut on the value of the government's objective function will depend not only on the size of the price increase allowed by sensitive product status, but also on the size of the initial cut required by the formula.

Further insights into the effects of particular tariff changes can be obtained by rearranging (4) into proportional change form:

$$\frac{\Delta G}{e} = \frac{1}{2}\begin{bmatrix}\hat{p}_1 & \hat{p}_2 & \dots & 0\end{bmatrix}\begin{bmatrix} s_1\eta_{11} & s_1\eta_{12} & \dots & s_1\eta_{1n} \\ s_2\eta_{21} & s_2\eta_{22} & & \\ \dots & & & \\ & & & \end{bmatrix}\begin{bmatrix}\hat{p}_1 \\ \hat{p}_2 \\ \dots \\ \end{bmatrix} \qquad (4')$$

where e is initial expenditure on <u>all</u> goods and services, including the non-distorted numeraire, n; s_i is the share of expenditure on good i; η_{ij} is the elasticity of demand for good i relative to the price of good j; and the vector $\hat{p}$ refers to proportional changes in domestic prices. Where the bound tariff equals the applied, $\hat{p}_i = \frac{-c_i t_i}{(1+t_i)}$ where c_i is the tariff cut required by the formula. The relationship is less direct, but still readily computable, when bound tariffs exceed applied rates. We express ΔG relative to e, without loss of generality, because this allows us to use value shares, rather than gross values, as weights on the elasticity matrix.

For simplicity and tractability, a product-by-product analysis can prove useful. This is possible based on (4´), since the impact of allowing sensitive-product treatment for product i on the government's objective function can be computed as the difference between the welfare loss with the formula applied to product *i*, $\frac{\Delta G}{e}|_{f(i)}$ and with sensitive-product treatment, $\frac{\Delta G}{e}|_{s(i)}$. If we let $\hat{p}_i$ represent the impact of the formula cut on p_i and the cut with flexibility be $(\hat{p}_i + \tilde{p}_i)$ where $\tilde{p}_i \geq 0$ is the increase in the price from the post-formula level as a proportion of its initial domestic price, we obtain, following the steps outlined in the Technical Appendix:

$$\left.\frac{\Delta G}{e}\right|_{s(i)} - \left.\frac{\Delta G}{e}\right|_{f(i)} = \frac{1}{2} s_i \tilde{p}_i [\eta_{ii} \tilde{p}_i + 2\sum_j \eta_{ij} \hat{p}_j] \tag{5}$$

A key insight from equation (5) not available from equation (4) is the potential importance of the size of the formula cuts on other goods for the selection of good i.

Unfortunately, we do not have the matrix of own and cross-price elasticities for over 5000 products included in equation (4'). If we use CES preferences to obtain local, theoretically-consistent, estimates of these elasticities, the own-price elasticities are given by $-(1-s_i).\sigma$, where σ is the elasticity of substitution, and the cross-price elasticities, η_{ij} are given by $\sigma.s_j$. As shown in the Technical Appendix, equations (4') and (5) can then be rewritten including cross-price effects as:

$$\frac{\Delta G}{e} = \frac{1}{2}\sigma \sum_j s_j \hat{p}_j \left(\sum_i \hat{p}_i s_i - \hat{p}_j \right) = -\frac{1}{2}\sigma . VAR(\hat{p}) \tag{4''}$$

with $VAR(\hat{p})$ the weighted (s_i) variance of price changes $\hat{p}_i$; and

$$\left.\frac{\Delta G}{e}\right|_{s(i)} - \left.\frac{\Delta G}{e}\right|_{f(i)} = \frac{1}{2}\sigma . s_i \tilde{p}_i [-(1-s_i)(\tilde{p}_i + 2\hat{p}_i) + 2\sum_{j \neq i} s_j \hat{p}_j] \tag{5'}$$

Note that in this CES framework the choice of sensitive products is independent of σ.

Two features of equation (5') allow us to identify a potential simplified rule for selecting individual tariff lines: (i) since dutiable agricultural goods usually represent a small share of total expenditure, including goods that are not imported subject to tariffs, $\sum_{j \neq i} s_j \hat{p}_j$ is likely to be negligible in (5'); and (ii) with such a large number of sensitive products, it is likely that $\sum_{j \neq i} s_j \hat{p}_j$ is very similar for almost all choices of potential sensitive products, leaving the ranking of products unchanged even if $\sum_{j \neq i} s_j \hat{p}_j$ is nontrivial. With either or both of these assumptions, a simplified measure of the impact of designating product *i* as sensitive is:

$$\left.\frac{\Delta G}{e}\right|_{s(i)} - \left.\frac{\Delta G}{e}\right|_{f(i)} \approx -\frac{1}{2} s_i \sigma (1 - s_i)((\hat{p}_i + \tilde{p}_i)^2 - \hat{p}_i^{\,2}) \tag{6}$$

In the CES case, equation (6) provides a simple rule of thumb for selecting sensitive products that depends only on observable information on the expenditure share of the good in the presence of tariffs, s_i; the size of the price cut implied by the formula and any binding overhang; and the extent to which sensitive product selection allows a smaller cut in its price, $\tilde{p}_i$. The intuition of this measure is clear: it compares two triangles—formed by multiplying the elasticity of import demand $-(1-s_i)\sigma$ by a squared proportional change in prices— to measure the reduction in the loss of policy maker welfare when sensitive products are allowed.

The logic of the simplification involved in moving from equation (5') to equation (6) might also be used to justify a similar simplification of equation (5):

$$\left.\frac{\Delta G}{e}\right|_{s(i)} - \left.\frac{\Delta G}{e}\right|_{f(i)} \approx -\frac{1}{2} s_i \eta_{ii} ((\hat{p}_i + \tilde{p}_i)^2 - \hat{p}_i^{\,2}) \tag{7}$$

This approach follows Feenstra (1995) in using just the own-price terms to assess the implications of a tariff regime. It is particularly attractive since Kee, Nicita and

Olarreaga (2008) provide estimates of exactly the own-price elasticities required for this approach.[2]

III. Data and Tariff Formulas

We use the MAcMapHS6 v1.1 database (Bouët et al. 2008) on applied protection in the base year for the negotiations, 2001. This dataset includes key features such as the *ad valorem* equivalents of specific tariffs; an assessment of the impact of tariff-rate quotas (TRQs) on many key commodities; tariff preferences, and import values. The analysis is carried out at the finest level at which country classifications are internationally compatible: the six-digit level of the Harmonized System.[3] The protective effect of TRQs is represented by using the in-quota tariff when the quota is less than 90 percent filled; the out-of-quota tariff when the quota is filled; and their average in between. Adjustments were made for Korean corn and soybeans, where imports over high out-of-quota tariffs appear to be very large, but the TRQs are, in fact, expanded to meet demand. A pre-experiment introduced reforms that will proceed irrespective of the Doha outcome, including expansion of the European Union, the phase-in of remaining agricultural commitments by developing countries,[4] and reforms agreed by WTO accession countries.

The negotiations specify cuts in WTO bound tariffs, which are frequently well above applied rates. This binding overhang means that reductions in bound tariffs will not always bring about corresponding reductions in applied rates or increases in market access. A detailed dataset on bound duties (see Bchir et al. 2006) conformable with the MAcMapHS6 applied rate data was used to specify the cuts in bound rates. Applied rates were reduced to the extent that the new bound rate declined below the initial applied rate.

The analysis uses the tariff cut proposal that has shaped the negotiations—the proposal by the G-20 of a tiered formula with four bands and three inflexion points (G-20 2005). For the industrial countries, this involves proportional cuts in bound tariffs that increase through four tiers to reach 75 percent on tariffs above 75 percent. For developing countries, the cuts rise to 40 percent on tariffs above 130 percent. Tariffs are capped at 100 percent for developed countries and 150 percent for developing countries. Least-developed countries are not required to undertake any reduction commitments.

Bound tariffs on sensitive products can be cut by one third or two thirds of the formula cut, with increases in TRQs required to compensate trading partners for the resulting loss of market access (WTO 2008). We assume that the combined effect of the tariff cut and TRQ expansion for a sensitive product with a TRQ is one-half the formula cut.

IV. Experiments and Impacts on Average Tariffs

We used four different approaches to identifying sensitive products. The first was to solve equation (1') using nonlinear integer programming. However, we encountered multiple solutions using this nonlinear approach. We therefore turned to approaches based on the second-order approximations discussed in Section II. Our initial results were obtained by solving equation (4") using the SBB (Branch & Bound) GAMS® solver for Mixed Integer Nonlinear Programming (MINLP) (see GAMS 2010) with up to 2 percent of products allowed as sensitive. This was complemented by simple one-product-at-a-time selections using equation (6), and equation (7) with the own-price elasticities of Kee, Nicita and Olarreaga (2008).

The scenario against which we assess the impact of sensitive products applies the formulas to all products, without exception ("Formula" column in Table 1). We first compare these results against those using our three approaches to identifying two percent of sensitive products. We then compare these results with those from the three *ad hoc* approaches used in earlier studies— “highest bound”, “highest applied” and “tariff losses”. Next, we examine the potential sensitivity of our results to whether or not sensitive products include “sin” products, which might have high tariffs to discourage consumption rather than for political-economy reasons. Then, we consider the sensitivity of the results to the number of tariffs allowed sensitive treatment. Finally, we consider the implications of an alternative approach of basing the share of sensitive products on the percentage of imports, rather than a percentage of tariff lines.

Our results for the “Formula” scenario are given in the second column of Table 1. Even though the formulas more than halve average bound tariffs worldwide, the reductions in applied rates are smaller because of binding overhang. With no sensitive products, the average tariff for non-LDC WTO members is cut by 6 percentage points, from 14.6 percent to 8.6 percent (Table 1, column "Formula"). Among the main countries shown in Table 1, only Canada, the EU, EFTA, Japan and South Korea display more than a 5 percentage point cut in applied rates. Indeed liberalization appears to be overwhelmingly concentrated in Japan, EFTA and Korea, with very limited liberalization elsewhere.[5] For many countries, applied duties are hardly changed: 8 out of the 18 countries and groups shown in Table 1 experience a decline in applied duties of less than two percentage points. The formula considered narrows the binding overhang in many cases, without substantially changing applied rates.

Table 3 displays the products most frequently selected as sensitive by developed and developing countries when 2 percent of sensitive products are selected simultaneously using equation (4"). For comparison purposes, Appendix Table 1 compares these products with those selected using the highest-average tariff rules, and considers the coverage of agricultural imports for the different sets of products considered. This comparison shows that selecting products based on the highest tariffs leads to frequent inclusion of minor products, such as “foliage branches”, “maize stalks”, and “garlic” in the industrial countries and “other cereals”, with a share in agricultural imports of only one-hundredth of a percent in developing countries. A striking difference between the lists selected using equation (2´) and the highest-tariff rules is in the share of agricultural imports covered. Our political-economy approach results in a list of most-common sensitive products covering 80 (63) percent of agricultural imports into the industrial (developing) countries, while the highest bound tariff rule leads to a list covering only 5 (7) percent.

The resulting impacts for countries’ own weighted-average tariffs are presented in Table 1 (column "Sens 2"). Allowing 2 percent sensitive products, the cut in the world wide average applied duty drops from 6 percentage points to 3.1. Four relatively-highly-protected Harmonized System chapters, Meat and offal (02), Cereals (10), Fruits (08) and Sugar (17), accounting for 27 percent of total imports, contribute 67 percent of the tariff cut without exclusions, but 80 percent of the reduction in tariff cuts when sensitive products are introduced. For developing countries, four chapters (01-Meat, 10-Cereals, 12-Oilseeds and 24-Tobacco) cover 25 percent of total imports and contribute 51 percent of the basic cut but 64 percent of the reduction in the cut.

Using the simplified criterion in equation (6) ("Sens 2-simple") changes the aggregate results very little. This is reassuring, given that algorithms for simultaneous product selection are unlikely to be available to policy makers. The results based on equation (7) (“Sens 2-elas”) are somewhat higher than those for “Sens 2-simple”, reflecting the fact that the elasticity criterion used in their selection does not enter the calculation of the standard trade-weighted averages.[6]

An important question is how our results compare with the *ad-hoc* alternatives used in earlier policy analyses. Scenario "Sens 2-highest bound" uses Sharma’s (2006, p5) rule-of-thumb of selecting the products with the highest bound tariffs. This approach turns out to yield dramatically lower estimates of the impact of sensitive products on applied rates: the cut in the average applied tariff is found to decline by just over one percentage point when sensitive products are selected this way. If products with the highest applied tariffs ("Sens 2-highest applied") are chosen as sensitive (Martin and Wang 2004; WTO 2006), the impact on average tariffs is still much smaller. These two rules select many minor products with high tariffs.

Column (8), “Sens 2-tariff loss” selects sensitive products by minimizing tariff revenue losses. At the aggregate level, the results using this criterion differ little from those using our political-economy approach. At a disaggregated level, we find that our political-economy criteria pick some products—such as virgin olive oil for the European Union—that seem likely to be treated as exceptions, but are not identified using the tariff revenue loss criterion.

As is clear from Table 3, some of the WTO-agricultural products selected as “sensitive” are “sin” tax commodities such as cigarettes or alcohol. If high duties on these products are being used to raise revenues or to reduce externalities, countries may not follow a political-economy rule when choosing sensitive products. To guard against this, “Sens 2-sin” is derived using the same approach as “Sens 2” but excluding “sin” commodities such as alcohol and tobacco from the sensitive product category. This exclusion is found to lead to cuts in average tariffs that are similar to those without this exclusion. The increase in the cut with this exclusion is from 4.3 to 4.5 percent in the industrial countries, and from 1.2 to 1.6 percent in developing countries. This exclusion does change the composition of the products selected. In developed countries, preparations of meat and fish, and dairy products become more important, as do dairy products, fruits, meats and fats in developing countries.

While our analysis so far has focused on allowing 2 percent of tariff lines, many WTO members have sought much higher percentages of tariff lines.[7] We find that raising the number of sensitive products to 4 percent (“Sens 4”) using the political economy criterion in equation (4") has only a small impact, except in a few cases such as Japan and EFTA. Overall, the extent of delivered liberalization is only slightly reduced because sheltering just 2 percent of products is enough to greatly reduce the cut in average tariffs.

While the agricultural negotiations under the Doha Agenda have focused on restricting the number of sensitive products, constraints on the value of trade have been used in some other negotiations.[8] To shed light on the differences between constraints based on trade and those based on tariff lines, we compare the results for “Sens 2” and “Sens 4” with those where imports are constrained by import value—“Sens 2-trade” and “Sens 4-trade”. This comparison shows considerable differences. The global reduction in average tariffs is 4.8 percent under “Sens 2-trade”, as against 3.1 percent under “Sens 2”.

As compared to the "Formula" scenario, allowing 2 percent of imports as sensitive products based on trade causes the cut in world average tariffs to decline from 6.0 percent to 4.8 percent, with limited reductions in the resulting tariff cuts in most cases, in contrast with the dramatic and unpredictable reductions in disciplines associated with sensitive product limits based on tariff lines.

Figure 1 illustrates the relationship between the number of sensitive products and the final level of tariffs in a general way, by plotting the relationship between the number of sensitive products allowed, and the average level of applied protection. When the constraint is expressed in terms of number of products, the curve is indeed extremely steep near the y-axis: a very small share of sensitive products is enough to sweep out a significant part of the applied tariff cut. This is even clearer for developed countries than for developing countries. When defined as an import share, in contrast, changes in the number of sensitive products have a far less precipitous impact on tariff cuts. As far as developed countries are concerned, allowing 5 percent of initial imports to be defined as sensitive products reduces tariff cuts by approximately one third, 10 percent of imports would reduce them by almost two-thirds.

While trade is also an imperfect criterion—since highly-restricted products are likely to have small imports—it seems clear that its deficiencies as a basis for specifying sensitive products are less serious than those associated with the number of tariff lines. There is an important underlying reason for this better performance—external trade reflects the interests of the exporter rather than solely those of interest groups within the importing country.

Table 2 presents results corresponding to those in Table 1 for the case of 2 percent sensitive products but this time for the protection faced by each country. A sharp difference between the results for protection applied and protection faced is evident for developing countries. For most developing countries, allowing sensitive products reduces the extent of required own-liberalization very little because the cuts in their own applied rates in the absence of sensitive products are quite small. By contrast, allowing sensitive products results in a very substantial reduction in market access gains. The average reduction in tariffs facing developing countries declines by almost 3 percentage points—from 5.5 percent to 2.7 percent.

V. Implications for Welfare and Market Access

The average tariff measures reported in Tables 1 and 2 provide a broad—and widely understood—indication of the consequences of including flexibilities for the economic welfare and for market access. However, it is well known that the weighted average tariff is a flawed indicator of the efficiency or market access impacts of reform.

Anderson and Neary (2007) propose an integrating treatment of the problems of aggregation and the implications of trade reforms for welfare and market access. Their results provide a rigorous link between means and variances of tariff (specifically, generalized means and generalized variances that reflect substitution relationships between goods) and key policy outcomes including economic welfare and market access. For the special model in which the expenditure function over all goods (domestic and imported) takes the Constant-Elasticity of Substitution form, and domestic and imported goods are imperfect substitutes, the needed measures of the economy-wide generalized mean and variance can be calculated easily.

Using these estimates of the generalized means and variances, we can assess the implications of the flexibilities considered in this article for welfare in the importing countries, and for the market access available to their partners. A key finding of Anderson and Neary (2007) is that there are important differences in the impact of an increase in the variability of tariffs on welfare and on market access. Increases in the generalized variance of a tariff regime reduce welfare but will expand market access at a constant generalized mean (Anderson and Neary, 2007, p192, equation 16 and p193, equation 21). It seems likely that allowing sensitive products will increase the variance of the trade regime. Questions for policy makers therefore arise. Will a policy of allowing sensitive products have a less adverse impact on partners' market access than it has on the welfare of the country using the flexibility? And what are the magnitudes of these impacts?

A key issue is the impact of changes in the mean and variance of tariffs from allowing sensitive products for welfare and for market access. Figure 2(a) shows that the real income loss due to sensitive products is, in most countries, more a function of the rise in the tariff variance than of the mean tariff. By contrast, Figure 2(b) shows that the increased tariff variance associated with sensitive products substantially reduces the market-closing impacts of the increase in the mean. These findings are consistent with the demonstration by Kee (2007) and Kee, Nicita and Olarreaga (2008) that increases in the weighted variance raise the efficiency-oriented Trade Restrictiveness Index, while not affecting the mercantilist measure of trade restrictiveness. They highlight a reason that negotiators in a mercantilist forum like the WTO might choose deep tariff-cutting formulas combined with exceptions—the damage to market access is less than the damage to efficiency.

These results imply that it is important to look beyond average impacts when analyzing the impact of free trade on efficiency and market access. Reductions in tariffs resulting from the formula approach raise welfare both through the reduction in the generalized mean tariff and through reductions in the generalized variance. These results strongly reinforce the need to go beyond average impacts.

VI. Concluding Remarks

The impact of exceptions from tariff-cutting formulas in the Doha negotiations has been a major source of uncertainty and conflict. Some widely-used rules of thumb for their selection suggest that their overall impacts would be minor. We derive approaches to selection based on a political-economy framework applicable at a fine level of disaggregation, and estimate likely impacts on key outcomes from the negotiations.

We show that allowing even a limited number of products to be subjected to smaller cuts is likely to substantially reduce the extent of trade liberalization in the developed countries, while developing countries gain little in this mercantilist sense. In contrast, the costs to exporters are shared, and developing countries see their market access gains fall substantially with sensitive product exceptions.

We find that approaches to sensitive-product identification based only on the height of the tariff greatly underestimate their impact. However, we identify a simple approach using only readily-available information on the share of the product at domestic prices, the depth of the formula cut and the “relief” provided by flexibility that generates impacts consistent with our more complex models. The tariff-revenue-loss criterion used in our earlier work appears to track closely the overall impact of our full model results.

A problem for exporters associated with allowing a certain number of tariff lines to be sensitive is that this criterion does not take into account the importance of these tariff lines to the exporter. If we do this in a crude way by restricting the number of products on the basis of their share in total imports, we find a dramatic reduction in the damage to market access created by sensitive products.

Building on recent work by Anderson and Neary (2007), we show in addition that, since these exceptions increase the variance of tariffs relative to the formula outcome, their effects on economic welfare are much worse than their effects on market access. In this sense, the combination of steeply progressive tariff formulas and exceptions may be much more rational from a mercantilist point of view than when examined from the perspective of economic welfare and development.

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Table 1. Implications of Sensitive Products for Reductions in Countries' Average Applied Tariffs

	Base	Formula	Sens 2	Sens 2-simple	Sens 2-elas	Sens 2-highest bound	Sens2-highest applied	Sens 2-tariff losses	Sens 2-sin	Sens 4	Sens 2-trade
Country:	%					*percentage point cut*					
Industrial	14.9	8.5	4.3	4.4	4.7	7.4	7.2	4.3	4.5	3.8	6.8
Australia	3.1	1.0	0.5	0.5	0.6	1.0	1.0	0.5	0.8	0.5	0.8
Canada	9.8	5.0	1.5	1.5	1.9	4.8	4.8	1.5	1.5	1.0	3.8
EFTA	28.9	14.2	7.6	7.5	8.9	14.1	14.1	7.5	7.8	6.1	11.0
EU	13.4	7.5	4.4	4.4	4.4	6.4	5.9	4.4	4.4	4.0	6.3
Japan	35.6	22.4	11.2	11.3	12.2	19.1	19.1	11.0	11.2	9.9	18.0
USA	2.7	0.9	0.4	0.4	0.5	0.9	0.9	0.4	0.4	0.3	0.6
Developing	14.2	2.5	1.2	1.3	1.4	2.1	2.0	1.2	1.6	1.1	1.8
ASEAN	8.9	2.3	0.8	0.8	1.1	1.2	1.0	0.8	2.2	0.8	1.9
China	10.2	2.7	1.8	1.8	1.9	2.2	2.6	1.8	1.8	1.7	2.5
India	55.4	3.6	1.9	1.9	1.9	3.6	3.4	1.9	2.0	1.8	3.2
Korea	27.7	10.4	4.2	4.6	5.7	8.6	8.9	4.2	4.2	3.6	5.0
Maghreb	19.0	3.3	1.7	1.7	1.8	3.3	2.8	1.7	2.2	1.6	2.8
Mercosur	12.8	0.2	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.0	0.1
Mexico	9.5	0.9	0.2	0.2	0.2	0.9	0.9	0.2	0.3	0.2	0.8
Other SSA	25.3	2.0	0.9	0.9	1.0	2.0	1.1	0.9	1.5	0.8	1.9
Pakistan	31.3	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
SACU	12.6	0.6	0.3	0.3	0.2	0.6	0.5	0.3	0.3	0.3	0.4
Turkey	14.1	1.1	0.5	0.4	0.6	1.1	1.1	0.4	0.5	0.4	0.6
ROW	10.3	1.8	1.0	1.0	1.0	1.4	1.3	1.0	1.4	0.9	1.5
Non-LDC WTO	14.6	6.0	3.1	3.1	3.3	5.2	5.0	3.0	3.2	2.7	4.8

Notes: Numbers in first column are weighted average agricultural tariffs in 2001 for non-LDC WTO members, adjusted for agreed reductions. Numbers in subsequent columns are reductions in percentage points. Column headers name the scenarios: **Base**: 2001 applied tariffs; **Formula**: Applies the G20's tiered formula (TF), without sensitive products (SPs); **Sens 2**: TF with 2% SPs selected according to eq. (4"); **Sens 2-simple**: TF with 2% SPs, selected using eq. (6)**;** **Sens 2-elas**: TF with 2% SPs, selected using eq. (7); **Sens 2-highest bound**: TF with 2% SPs, selected by highest bound rates; **Sens 2-highest applied**: TF with 2% SPs selected by highest applied rates; **Sens 2-tariff losses**:TF with 2% SPs selected to minimize tariff loss; **Sens 2-sin**: Sens 2 TF with 4% SPs selected using eq. (4"); **Sens 2-trade**: TF with 2% SPs , selected using eq. (4").

Table 2. Implications of Sensitive Products for Reductions in Average Tariffs Faced

	Base	Formula	Sens 2	Sens 2-simple	Sens 2-elas	Sens 2-highest bound	Sens2-highest applied	Sens 2-tariff losses
Country:	%				*percentage point cut*			
Industrial ctries	15.3	6.5	3.4	3.3	3.7	5.8	5.8	3.3
Australia	19.1	9.6	4.4	4.4	4.9	8.3	8.5	4.2
Canada	9.6	4.5	2.0	2.0	2.2	4.4	4.5	2.0
EFTA	15.6	6.3	4.7	3.5	4.3	6.1	5.6	3.9
European Union	15.7	5.6	3.3	3.3	3.6	5.4	5.3	3.2
Japan	10.5	2.4	1.6	1.6	1.8	2.3	2.3	1.6
USA	16.3	7.5	3.6	3.6	4.0	6.3	6.3	3.6
Developing ctries	13.8	5.5	2.7	2.8	2.9	4.4	4.1	2.7
ASEAN	20.6	5.9	3.0	3.0	3.3	4.5	4.2	2.8
China	15.6	8.2	3.5	4.0	4.1	5.5	5.4	3.8
India	9.5	3.3	1.6	1.7	1.8	2.9	2.2	1.6
Korea	16.1	6.6	5.0	4.7	5.1	5.6	5.6	4.1
Maghreb	14.0	5.5	2.9	4.7	3.0	5.3	5.1	4.5
Mercosur	13.5	5.0	2.4	2.4	2.5	4.3	3.7	2.4
Mexico	3.8	1.6	0.8	1.0	1.1	1.5	1.4	0.8
Other SSA	10.5	5.2	2.3	2.3	2.3	3.3	2.8	2.2
Pakistan	14.3	6.0	3.2	3.2	3.7	5.8	4.0	3.1
SACU	18.1	7.2	4.5	4.4	4.3	6.9	6.3	4.4
Turkey	9.7	3.1	1.5	1.8	1.6	2.1	2.0	1.8
ROW	12.3	5.5	3.0	2.9	3.0	4.8	4.7	2.9
Non-LDC WTO	14.6	6.0	3.1	3.1	3.3	5.2	5.0	3.0

Notes: Numbers in first column are weighted average agricultural tariffs in 2001 faced by WTO members on WTO markets, adjusted for agreed reductions. Numbers in subsequent columns are reductions in percentage points. Column headers name the scenarios: **Base**: 2001 applied tariffs; **Formula**: Applies the G20's tiered formula (TF), without sensitive products (SPs); **Sens 2**: TF with 2% SPs selected according to eq. (4"); **Sens 2-simple**: TF with 2% SPs, selected using eq. (6)**; Sens 2-elas**: TF with 2% SPs, selected using eq. (7); **Sens 2-highest bound**: TF with 2% SPs, selected by highest bound rates; **Sens 2-highest applied**: TF with 2% SPs selected by highest applied rates; **Sens 2-tariff losses**:TF with 2% SPs selected to minimize tariff loss; **Sens 2-sin**: Sens 2 TF with 4% SPs selected using eq. (4"); **Sens 2-trade**: TF with 2% SPs , selected using eq. (4")..

Table 3. Products Most Frequently Selected as "Sensitive"

Industrial Countries

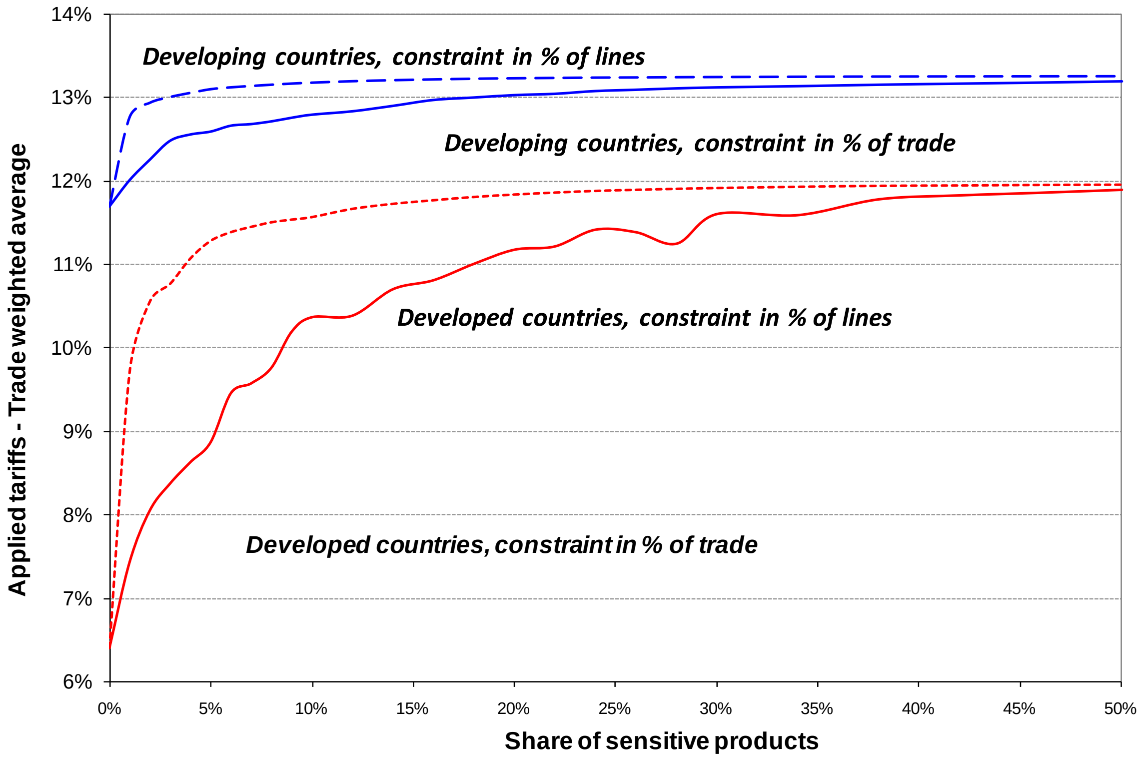
1	0201 30	Fresh or chilled bovine meat, boneless
2	0202 30	Frozen, boneless meat of bovine animals
3	0207 14	Frozen cuts and edible offal of fowls of the species *Gallus domesticus*
4	0406 90	Cheese
5	0603 10	Fresh cut flowers and flower buds, for bouquets or ornamental purposes
6	0702 00	Tomatoes, fresh or chilled
7	1001 90	Wheat and meslin (excl. durum wheat)
8	1701 11	Raw cane sugar (excl. added flavoring or coloring)
9	2106 90	Food preparations, n.e.s.
10	2202 90	Non-alcoholic beverages (excl. water, fruit or vegetable juices and milk)
11	2204 29	Grape juice (including grape must)
12	2402 20	Cigarettes containing tobacco

Developing Countries

1	2402 20	Cigarettes containing tobacco
2	2208 30	Whiskies
3	2203 00	Beer made from malt
4	1701 99	Cane or beet sugar
5	2204 21	Wine of fresh grapes, incl. fortified wines in bottles
6	2208 70	Liqueurs and cordials
7	2208 90	Ethyl alcohol < 80% vol, not denatured; spirits and other spirituous beverages
8	0207 14	Frozen cuts and edible offal of fowls of the species *Gallus domesticus*
9	2403 10	Smoking tobacco
10	2106 90	Food preparations, n.e.s.
11	2208 60	Grape juice
12	1006 30	Semi-milled or wholly milled rice, whether or not polished or glazed
13	1701 11	Raw cane sugar
14	1806 31	Chocolate and other preparations containing cocoa, in blocks, slabs or bars of <= 2 kg,
15	1806 90	Chocolate and other preparations containing cocoa

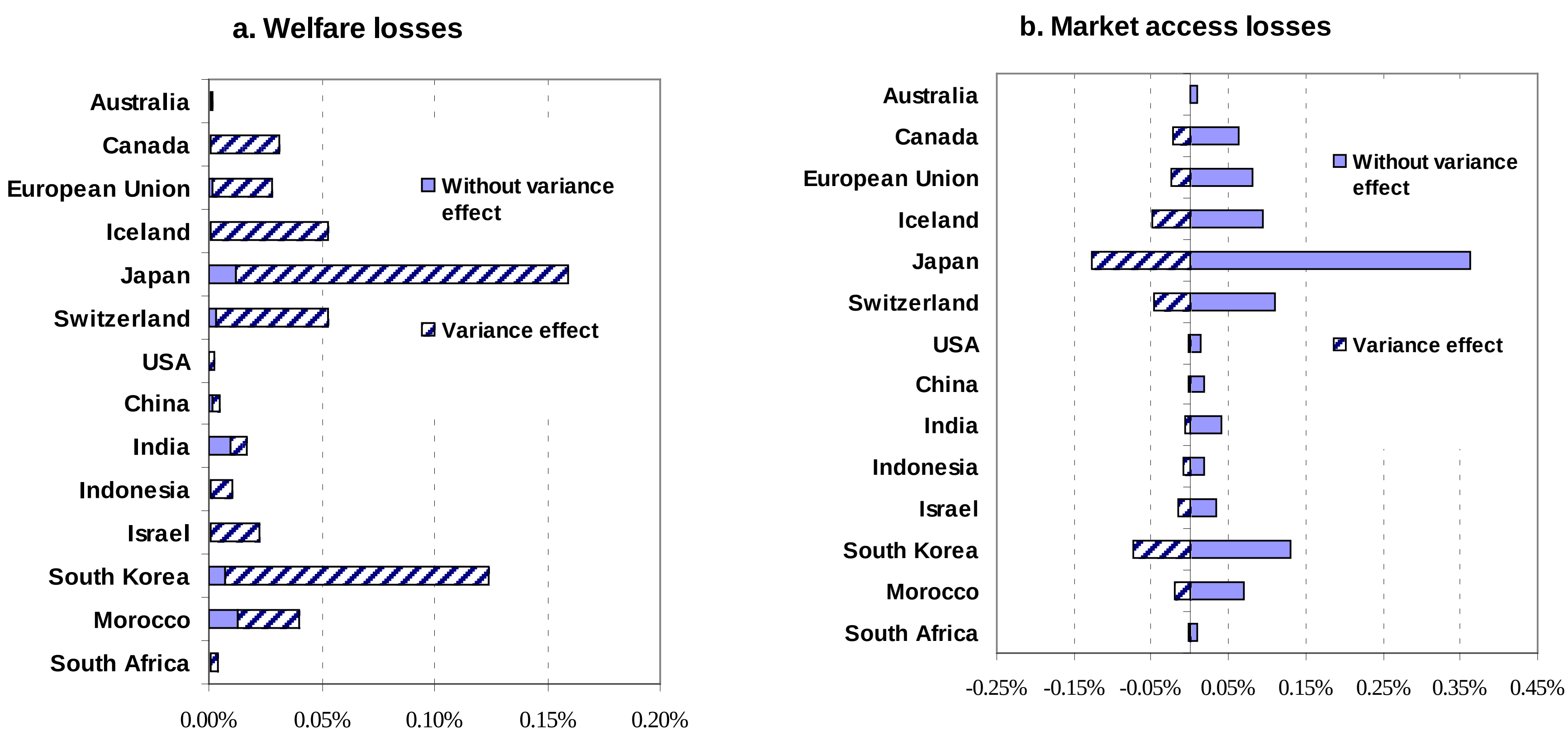
Note: fifteen products are included in the list for developing countries because the last four products were selected the same number of times.

Figure 1. Average applied tariffs resulting from the application of the tiered formula, depending on the criterion and threshold used to define sensitive products



Note: This graph plots the average applied protection level for non-LDC WTO members, once the G20 formula is applied. The share of sensitive products is reported on the x-axis. It is alternatively defined as a share in the number of agricultural products, or as a share in imports. Note that even sensitive products experience a cut in tariffs, although it is smaller than under the formula, so that the curves do not converge towards initial protection levels.

Figure 2. Welfare and market access losses from changes in generalized mean and variance of tariffs, 2% sensitive products



Note: Graphs are based on Anderson and Neary's (2007) equation 16 for social welfare and equation 21 for market access. Since generalized moments are equal to trade weighted ones, the welfare losses are proportional to income, and the market access impacts are proportional to total imports.

Appendix Table 1. Products most commonly selected using political economy and highest-tariff rules

	With Political Economy criterion		Rank	With highest Bound tariff		Rank	With highest applied tariff		Rank
Industrial countries	020130	FRESH BOVINE MEAT BONELESS	*1*	020230	BONELESS FROZEN MEAT OF BOVINE AN	*1*	020230	BONELESS FROZEN MEAT OF BOVINE ANIMALS	*1*
Industrial countries	020230	BONELESS FROZEN MEAT OF BOVINE AN	*2*	040590	FATS AND OILS DERIVED FROM MILK	*2*	100630	SEMI MILLED OR WHOLLY MILLED RICE	*2*
Industrial countries	020714	FROZEN CUTS & EDIBLE OFFAL OF FOWLS	*3*	060491	FOLIAGE BRANCHES & PARTS OF PLANTS	*3*	240399	CHEWING TOBACCO SNUFF	*3*
Industrial countries	040690	CHEESE EXCL. FRESH CHEESE	*4*	070320	GARLIC FRESH OR CHILLED	*4*	040590	FATS AND OILS DERIVED FROM MILK AND DEH	*4*
Industrial countries	060310	FRESH CUT FLOWERS AND FLOWER BUDS	*5*	100620	HUSKED OR BROWN RICE	*5*	060491	FOLIAGE BRANCHES AND OTHER PARTS OF PLA	*5*
Industrial countries	070200	TOMATOES FRESH OR CHILLED	*6*	100630	SEMI MILLED OR WHOLLY MILLED RICE	*6*	070320	GARLIC FRESH OR CHILLED	*6*
Industrial countries	100190	WHEAT AND MESLIN	*7*	100640	BROKEN RICE	*7*	100620	HUSKED OR BROWN RICE	*7*
Industrial countries	170111	RAW CANE SUGAR	*8*	170111	RAW CANE SUGAR EXCL. ADDED FLAVOUR	*8*	100640	BROKEN RICE	*8*
Industrial countries	210690	FOOD PREPARATIONS N.E.S.	*9*	230890	MAIZE STALKS MAIZE LEAVES	*9*	170111	RAW CANE SUGAR EXCL. ADDED FLAVOURING	*9*
Industrial countries	220290	NON ALCOHOLIC BEVERAGES	*10*	240220	CIGARETTES CONTAINING TOBACCO	*10*	170199	CANE OR BEET SUGAR	*10*
Industrial countries	220429	WINE OF FRESH GRAPES	*11*	240399	CHEWING TOBACCO SNUFF	*11*	220830	WHISKIES	*11*
Industrial countries	240220	CIGARETTES CONTAINING TOBACCO	*12*	010111	PURE BRED BREEDING HORSES	*12*	220840	RUM AND TAFFIA	*12*
Industrial countries	020319	FRESH OR CHILLED MEAT OF SWINE	*13*	020130	FRESH OR CHILLED BOVINE MEAT BONEL	*13*	220850	GIN AND GENEVA	*13*
Industrial countries	020329	FROZEN MEAT OF SWINE EXCL. CARC	*14*	020319	FRESH OR CHILLED MEAT OF SWINE	*14*	220860	VODKA	*14*
Industrial countries	020713	FRESH OR CHILLED CUTS & EDIBLE OFFAL	*15*	020322	FROZEN HAMS		220870	LIQUEURS AND CORDIALS	*15*
% of Agricultural imports		**80**			**5**			**8**	
Developing countries	240220	CIGARETTES CONTAINING TOBACCO	*1*	220710	UNDENATURED ETHYL ALCOHOL	*1*	240220	CIGARETTES CONTAINING TOBACCO	*1*
Developing countries	220830	WHISKIES	*2*	220300	BEER MADE FROM MALT	*2*	220300	BEER MADE FROM MALT	*2*
Developing countries	220300	BEER MADE FROM MALT	*3*	220860	VODKA	*3*	220830	WHISKIES	*3*
Developing countries	170199	CANE OR BEET SUGAR	*4*	240110	TOBACCO NOT STEMMED OR STRIPPED	*4*	240310	SMOKING TOBACCO	*4*
Developing countries	220421	WINE OF FRESH GRAPES INCL. FORT	*5*	240120	TOBACCO PARTLY OR WHOLLY STEMMED	*5*	220890	ETHYL ALCOHOL	*5*
Developing countries	220870	LIQUEURS AND CORDIALS	*6*	240220	CIGARETTES CONTAINING TOBACCO	*6*	220850	GIN AND GENEVA	*6*
Developing countries	220890	ETHYL ALCOHOL	*7*	020230	BONELESS FROZEN MEAT OF BOVINE AN	*7*	240399	CHEWING TOBACCO SNUFF A	*7*
Developing countries	020714	FROZEN CUTS AND EDIBLE OFFAL OF FOWL	*8*	020629	FROZEN EDIBLE BOVINE OFFAL	*8*	220429	WINE OF FRESH GRAPES INCL. FORTIFIED WI	*8*
Developing countries	220860	VODKA	*9*	040690	CHEESE EXCL. FRESH CHEESE	*9*	220710	UNDENATURED ETHYL ALCOHOL	*9*
Developing countries	240310	SMOKING TOBACCO	*10*	100300	BARLEY	*10*	220820	SPIRITS OBTAINED BY DISTILLING GRAPE WIN	*10*
Developing countries	210690	FOOD PREPARATIONS N.E.S.	*11*	100620	HUSKED OR BROWN RICE	*11*	220860	VODKA	*11*
Developing countries	100630	SEMI MILLED OR WHOLLY MILLED RICE	*12*	100630	SEMI MILLED OR WHOLLY MILLED RICE	*12*	220870	LIQUEURS AND CORDIALS	*12*
Developing countries	170111	RAW CANE SUGAR	*13*	100890	CEREALS EXCL. WHEAT AND MESLIN	*13*	240120	TOBACCO PARTLY OR WHOLLY STEMMED OR STR	*13*
Developing countries	180631	CHOCOLATE AND OTHER PREPARATIONS	*14*	120220	SHELLED GROUND NUTS	*14*	170199	CANE OR BEET SUGAR AND CHEMICALLY PURE S	*14*
Developing countries	180690	CHOCOLATE AND OTHER PREPARATIONS	*15*	020322	FROZEN HAMS SHOULDERS AND CUTS	*15*	220421	WINE OF FRESH GRAPES INCL. FORTIFIED WI	*15*
% of Agricultural imports		**63**			**7**			**22**	

Note: A list of up to 2% of agricultural tariff lines is selected for each country using equation (6), and the frequency table is generated from these lists. Shares of agricultural imports are calculated for industrial and developing country groups by expressing the value of imports sheltered by sensitive product treatment relative to total imports for the group.

Technical Appendix

This appendix sets out the intermediate steps in the derivation of equations (4''), (5) and (5').

Our starting point is equation (4'), describing the change in the political-economy objective function resulting from price changes:

$$\frac{\Delta G}{e} = \frac{1}{2}\begin{bmatrix}\hat{p}_1 & \hat{p}_2 & \ldots & 0\end{bmatrix}\begin{bmatrix} s_1\eta_{11} & s_1\eta_{12} & \ldots & s_1\eta_{1n} \\ s_2\eta_{21} & s_2\eta_{22} & & \\ \ldots & & & \\ & & & \end{bmatrix}\begin{bmatrix}\hat{p}_1 \\ \hat{p}_2 \\ \ldots \\ \end{bmatrix} \qquad (4')$$

With $\hat{p}_i$ being the relative change in domestic price of good *i*, η_{ij} the compensated cross price elasticity of good *i* relative to the price of *j* (η_{ii} is the compensated own price elasticity of good *i*), and s_i the share of good *i* in total expenditure.

Moreover we assume that:

The price change is $\hat{p}_i$ if product *i* is not sensitive, and as such subject to the full formula cut, and $(\hat{p}_i + \tilde{p}_i)$ if product *i* is sensitive, and as such subject to a smaller cut ($\hat{p}_i \leq \hat{p}_i + \tilde{p}_i \leq 0$).

Without any flexibility for sensitive products, Equation (4´) could be rewritten as:

$$\frac{\Delta G}{e} = \frac{1}{2}\sum_j \hat{p}_j s_j \sum_i \hat{p}_i \eta_{ji}$$

A. From Equation (4´) to Equation (5):

Looking at the change in policy makers' objective function resulting from using flexibility to reduce the cut in tariffs, we have:

$$\left.\frac{\Delta G}{e}\right|_{\hat{p}+\tilde{p}} - \left.\frac{\Delta G}{e}\right|_{\hat{p}} = \frac{1}{2}\sum_j (\hat{p}_j + \tilde{p}_j) s_j \sum_k (\hat{p}_k + \tilde{p}_k)\eta_{jk} - \frac{1}{2}\sum_j \hat{p}_j s_j \sum_k \hat{p}_k \eta_{jk}$$

$$= \frac{1}{2}\sum_j (\hat{p}_j + \tilde{p}_j) s_j \sum_k \tilde{p}_k \eta_{jk} + \frac{1}{2}\sum_j (\hat{p}_j + \tilde{p}_j) s_j \sum_k \hat{p}_k \eta_{jk} - \frac{1}{2}\sum_j \hat{p}_j s_j \sum_k \hat{p}_k \eta_{jk}$$

$$= \frac{1}{2}\sum_j \hat{p}_j s_j \sum_k \hat{p}_k \eta_{jk} + \frac{1}{2}\sum_j \tilde{p}_j s_j \sum_k \hat{p}_k \eta_{jk} + \frac{1}{2}\sum_j \tilde{p}_j s_j \sum_k \tilde{p}_k \eta_{jk} + \frac{1}{2}\sum_j \hat{p}_j s_j \sum_k \tilde{p}_k \eta_{jk} - \frac{1}{2}\sum_j \hat{p}_j s_j \sum_k \hat{p}_k \eta_{jk}$$

$$= \frac{1}{2}\sum_j \tilde{p}_j s_j \sum_k \hat{p}_k \eta_{jk} + \frac{1}{2}\sum_j \tilde{p}_j s_j \sum_k \tilde{p}_k \eta_{jk} + \frac{1}{2}\sum_j \hat{p}_j s_j \sum_k \tilde{p}_k \eta_{jk}$$

Assuming that only product *i*, is sensitive, we have $\tilde{p}_k = 0, \forall k \neq i$ and

$$\left.\frac{\Delta G}{e}\right|_{s(i)} - \left.\frac{\Delta G}{e}\right|_{f(i)} = \frac{1}{2}\left[\tilde{p}_i s_i \sum_k \hat{p}_k \eta_{ik} + \tilde{p}_i s_i \tilde{p}_i \eta_{ii} + \tilde{p}_i \sum_j \hat{p}_j s_j \eta_{ji}\right]$$

$$= \frac{1}{2}\tilde{p}_i\left[\sum_k \hat{p}_k s_i \eta_{ik} + \sum_j \hat{p}_j s_j \eta_{ji} + \tilde{p}_i s_i \eta_{ii}\right]$$

Due to the symmetry of the second order derivatives of the expenditure function (*Clairaut's / Schwarz's theorem*), $s_j \eta_{ji} = s_i \eta_{ij}$. Substituting in the second term of the previous expression:

$$\left.\frac{\Delta G}{e}\right|_{s(i)} - \left.\frac{\Delta G}{e}\right|_{f(i)} = \frac{1}{2}\tilde{p}_i\left[s_i \sum_k \hat{p}_k \eta_{ik} + \sum_j \hat{p}_j s_i \eta_{ij} + \tilde{p}_i s_i \eta_{ii}\right]$$

$$= \frac{1}{2} s_i \tilde{p}_i \left[\eta_{ii}\tilde{p}_i + 2\sum_j \eta_{ij}\hat{p}_j\right] \qquad (5)$$

B. From Equation (5) to Equation (5'):

Now, under the CES assumption: $\eta_{ij} = s_j \sigma, \forall\, j \neq i$ and $\eta_{ii} = -(1 - s_i)\sigma$ with σ the elasticity of substitution.

$$\left.\frac{\Delta G}{e}\right|_{s(i)} - \left.\frac{\Delta G}{e}\right|_{f(i)} = \frac{1}{2} s_i \tilde{p}_i \left[-(1-s_i)\tilde{p}_i\sigma + 2\sum_j \hat{p}_j s_j \sigma - 2\hat{p}_i s_i \sigma - 2(1-s_i)\hat{p}_i\sigma \right]$$

$$= \frac{1}{2}\sigma s_i \tilde{p}_i \left[-(1-s_i)\tilde{p}_i - 2\hat{p}_i + 2\sum_j s_j \hat{p}_j \right]$$

$$= \frac{1}{2}\sigma s_i \tilde{p}_i \left[-(1-s_i)\tilde{p}_i - 2(\hat{p}_i + s_i\hat{p}_i) + 2\sum_{j\neq i} s_j \hat{p}_j \right]$$

$$= \frac{1}{2}\sigma s_i \tilde{p}_i [-(1-s_i)(\tilde{p}_i + 2\hat{p}_i) + 2\sum_{j\neq i} s_j \hat{p}_j]$$

C. <u>From Equation (4') to Equation (4''):</u>

$$\frac{\Delta G}{e} = \frac{1}{2}\sum_j \hat{p}_j s_j \sum_i \hat{p}_i \eta_{ji}$$

$$= \frac{1}{2}\sigma\sum_j \hat{p}_j s_j \left(\sum_{i\neq j} \hat{p}_i s_i - \hat{p}_j (1-s_j) \right)$$

$$= \frac{1}{2}\sigma\sum_j \hat{p}_j s_j \left(\sum_{i\neq j} \hat{p}_i s_i + \hat{p}_j s_j - \hat{p}_j \right)$$

$$= \frac{1}{2}\sigma\sum_j \hat{p}_j s_j \left(\sum_i \hat{p}_i s_i - \hat{p}_j \right)$$

Let's define $\overline{p}$ as the average price change, i.e. $\overline{p} = \sum_i \hat{p}_i s_i$. Then

$$\frac{\Delta G}{e} = \frac{1}{2}\sigma\sum_j s_j \hat{p}_j (\overline{p} - \hat{p}_j)$$

$$= \frac{1}{2}\sigma\left(\overline{p}^2 - \sum_j s_j \hat{p}_j^{\,2} \right)$$

$$= -\frac{1}{2}\sigma VAR(\hat{p})$$

Endnotes

[1] Using the model and notation of Grossman and Helpman (1994, equation 15), h_i is given by $\frac{\partial W}{\partial p_j} = (p_j - p_j^*)m_j'$ where W is economic welfare and m_j' is the slope of the import demand function. From their equation (5), h_j equals $\frac{1}{a}\frac{\partial \sum C_i(p_i)}{\partial p_j}$ where a is the value placed by policy makers on general economic welfare relative to political contributions and C_j is the contribution schedule of sector i.

[2] Alternative estimates of import elasticities of substitution provided by Hummels (2001) and by Broda and Weinstein (2006) would allow us to take into account cross-price effects, but these studies focus on substitution between products from different suppliers, rather than on the responses of aggregate imports which are our focus in this paper.

[3] In an earlier assessment of the impact of flexibilities, Martin and Wang (2004) found little difference between results obtained using tariff-line level and six-digit data for the impacts on overall protection considered in this paper. While policy makers undoubtedly view some products at finer levels as strongly differentiated, many countries have notified their tariffs to the WTO at the six-digit level, and few have notified beyond the eight-digit level.

[4] Developing countries had 10 years from 1994 to implement their Uruguay Round commitments, as did developed countries for a few products.

[5] Assessment of tariff-cutting formulae is complicated in the case of Japan and Korea by the existence of large tariff-rate quotas with prohibitive out-of-quota tariffs, the ad valorem-equivalent of which is difficult to gauge. Assessments based on tariffs and on observed price differentials were used to compute meaningful *ad valorem* tariff equivalents for rice in Japan and for rice and corn in Korea.

[6] As well as using the conventional trade-weighted averages, we estimated the Trade Restrictiveness Index (TRI) and the Mercantilist Trade Restrictiveness Index (Anderson and Neary, 2003) using the approach of Kee, Nicita and Olarreaga (2008). In the TRI case, the estimated cuts in tariffs are slightly larger when the elasticity-based selection criterion is used. In most cases, the MTRI is cut by slightly less when using this criterion. This is related to the correlation between the aggregator used and components of our selection criterion (trade value, elasticity, and the square of the tariff). Our key result—that the size of the cut in tariffs is greatly reduced when a theoretically-consistent approach to product selection is used—proved robust to the choice of aggregator.

[7] While 2 and 4 percent of tariff lines have been the most widely discussed proposals for sensitive products, the EU earlier proposed allowing 8 percent of tariff lines in the industrial countries. WTO (2008) would allow developing countries one-third more than the industrial countries. In addition, many developing countries have sought flexibility for an additional 20 percent of "Special Products" subject also to criteria such as food security and livelihood security.

[8] The "substantially all trade" criterion for Free Trade Areas under GATT Article XXIV is frequently interpreted as limiting exceptions under these agreements to no more than 10 percent of trade. The Doha negotiations on non-agricultural products restrict flexibilities using both trade and tariff lines.