The Political Costs of Policy Reform

by

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Abstract

This paper provides simple, tractable approaches to estimate the political costs of reform when policies have been determined using political-support functions of the Grossman-Helpman type. The strength of policymakers' preference for particular sectors is inferred and used to develop political welfare functions that are then used to assess the political costs of particular reforms. Both short and long run measures of political welfare are developed and then explained using simple graphical techniques. Somewhat surprisingly, the differences between the short and long-run political costs of reform appear to be relatively small—suggesting a need for caution in assuming that opponents can be worn down and supporters strengthened by "staying the course" of policy reforms. The measures of political costs developed here complement existing measures of economic welfare and of benefits to negotiating partners, potentially providing useful guides to policy action when policymakers' political capital is limited. An application to tariff-cutting formulas for trade negotiations allows comparison of economic efficiency gains with political costs, and strongly favors simple tariff-cutting rules, such as the proportional-cut rule or, better, a proportional-cut in the power-of-the-tariff rule, over more aggressive approaches such as the Swiss formula or excessively lenient approaches like the average-cut rule.

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The Political Costs of Policy Reform

Economists have developed a formidable array of techniques for estimating the economic costs and benefits of reforms, and an equally formidable array of political economy models for analyzing and predicting the structure of price policy interventions (see, for example, Grossman and Helpman 1994). The political costs of reforms are typically regarded as something of mystery, akin to Churchill's famous description of the Soviet Union as "a riddle, wrapped in a mystery, inside an enigma"[1]. It would surely be desirable to have a key, like the key that Churchill believed he had found in Russian national interest. While surrounded by mystery and confusion, the imperative of minimizing the political costs of policy reform is as relevant to policy makers today as when Colbert described the art of taxation as "so plucking the goose as to obtain the largest amount of feathers with the smallest possible amount of hissing."

Clearly, it would be desirable to have a better understanding of the political costs of particular paths to reform. If the objective is to reform a trade regime so that the maximum amount of market access in partners' markets can be obtained with the minimum amount of domestic political cost, the measures defined in Anderson and Neary (2007) provide a guide to maximizing the market access gains and the efficiency gains—what remains is to obtain some idea of the political costs of undertaking different reforms. The potential importance of this issue is highlighted by the experience of the now-stalled Doha Round of negotiations in the WTO, where attempts to use economically-desirable tops-down tariff reform rules resulted in an intense focus on obtaining exceptions that compromised the goals of the negotiation, and particularly the efficiency objective (Falconer, 2008, paras 142-6; Jean, Laborde and Martin 2010).

Our paper builds on Anderson and Neary (2007), who note that there are very large numbers of distortions, for which suitable aggregates are needed to make informed decisions. They form aggregates for efficiency and for market access, and show that the behavior of these aggregates may differ considerably depending upon the nature of import demand and the approach to reform undertaken. In this paper, we seek to extend the set of aggregates to three by

[1] From a radio broadcast on 1 October 1939. The full quote from www.phrases.org.uk is "I cannot forecast to you the actions of Russia. It is a riddle, wrapped in a mystery, inside an enigma; but perhaps there is a key. That key is Russian national interest."

adding one for political costs. This, we hope, will provide a basis for normative approaches to reform subject to political-economy constraints.

In this paper, we show that the widely-used political-economy models such as Grossman and Helpman (1994) can be used to derive particularly simple methods of calculating the political costs of particular reforms. The Grossman-Helpman model transformed the literature of the political economy of protection and has been widely used to explain patterns of trade barriers. While the model is frequently seen as needing extension to deal with a range of issues, such as the impacts of protection on upstream and downstream industries, it still provides the basic underpinning for most models seeking to explain the political-economy determinants of policy (see, for example, Dutt and Mitra 2005; Anderson 2010). While the Grossman-Helpman model was developed for trade policy reform, its basic formulation of interest-group-driven differentials seems appropriate for other policy interventions involving finely-differentiated tax/subsidy rates—such as income tax regimes.

A key question, of course, is why policy makers would attempt to change policies away from a political-economy equilibrium which maximizes their economic welfare. We can see two potential answers to this question. One is the possibility that international negotiations might allow policy makers to obtain something not achievable within the domestic political-economy bargaining process. Another is that policy makers may seek to change the structure of the economy in a way that changes the strength of the political-economy forces confronting them, and hence lead to a different, locally optimal, political-economy equilibrium. In the applications presented in this paper, we focus on the first case, in which policy makers seek to obtain greater market access for their exports, and must make "sacrifices" relative to the domestic political-economy equilibrium.

We begin by adapting the Grossman-Helpman (1994) model to allow us to investigate the political-economy costs of reform. We then use a simple graphical model to provide some much-needed intuition into the nature of the results obtained. With this background, we then use this model to assess the political-economy costs of changes in tariff rates away from those chosen in the initial optimum. Finally, we present an application to tariff reform using formulas of the type frequently used in trade negotiations.

1. The Model

We begin with the canonical equation in Grossman and Helpman (1994, eqn 5):

$$G(\mathbf{p},u)=\sum_{i\in L}\mathrm{C}_i(\mathbf{p}) \quad + aW(\mathbf{p}) \tag{1}$$

Because tariff revenues are an important source of revenue for some developing country governments, and alternative taxes have a marginal cost of funds that may be substantially above unity (Anderson and Martin 2010), we also consider an extension[2] where tax revenues are at a premium for the government:

$$G(\mathbf{p},u)=\sum_{i\in L}\mathbf{C}_i(\mathbf{p}) \quad + aW(\mathbf{p})+\gamma TR(p)$$

where $\mathrm{C}_i(\mathbf{p})$ is the contribution function[3] of lobby group *i* organized to benefit those involved in commodity/sector *i* to the benefit of those involved in sector i; $W(\mathbf{p})$ is a measure of aggregate economic welfare that adds income from production, trade tax revenue and consumer surplus; *a* is the weight that politicians place on aggregate welfare relative to campaign contributions and other support provided directly to them; and γ is related to the marginal excess burden of alternative taxes. Evidence from estimation of the Grossman-Helpman model suggests that *a* is surprisingly large—and hence the gap between the value placed by policy makers on contributions and on the welfare of citizens is quite small. Estimates in the order of 50 by Goldberg and Maggi (1999) are broadly supported by estimates in other studies[4].

We modify the Grossman-Helpman equation by replacing the *W*(p) function with the Anderson-Neary (1992) Balance of Trade function, which represents exactly the same measure of aggregate economic welfare (Martin 1997) using a profit or revenue function for production revenues; an expenditure function (of opposite sign to the profit function) for the impact of price changes on consumer surplus; and a tariff or tax revenue function. Without loss of generality, we

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[2] An extension of this type is needed if the approach is to be applied to problems involving a revenue constraint.

[3] More recent applications of this model, such as Dutt and Mitra (2010) extend the focus beyond contributions alone, into influences such as ideology, inequality and democracy. Our use of the model is consistent with such broader interpretations of "contributions".

[4] Grossman and Helpman (1994, p838) show that *a* is equal to $a_2/(a_1-a_2)$ where $a_1$is the value placed on contributions and a_2 the value placed on welfare net of contributions. If, for instance, a_1 were twice a_2 then *a* would be below one. A value of 50 for *a* implies a value for a_1 only around 2 percent greater than a_2.

divide throughout by the scalar constant *a* to obtain a modified political-economy objective function (2) whose units are the same as those of aggregate economic welfare:

$$G^{*}(\mathbf{p},u)=\frac{1}{a}\iota'\mathbf{C}(\mathbf{p})+(-z(\mathbf{p},u)+\mathbf{z_p}'(\mathbf{p}-\mathbf{p^*})) \qquad (2)$$

With tariff revenue at a premium:

$$G^{*}(\mathbf{p},u)=\frac{1}{a}\iota'\mathbf{C}(\mathbf{p})+(-z(\mathbf{p},u)+\mathbf{z_p}'(\mathbf{p}-\mathbf{p^*}))+\gamma\mathbf{z_p}'(\mathbf{p}-\mathbf{p^*})$$

$$G^{*}(\mathbf{p},u)=\frac{1}{a}\iota'\mathbf{C}(\mathbf{p})+(-z(\mathbf{p},u)+(1+\gamma)\mathbf{z_p}'(\mathbf{p}-\mathbf{p^*}))$$

where **C(p)** is the vector of contribution functions; ι is a vector of ones; z(**p**,u)=e(**p**,u)-g(**p**) is the trade expenditure function, defined as the difference between the consumer expenditure function e(**p**,u) defined over domestic prices, **p** and the utility level of the representative household, *u*, and a net revenue function, g(**p**), defined over domestic prices for given factor endowments; **p*** is the vector of world prices for traded goods, so that **(p-p*)** is a vector of specific tariff rates; $\mathbf{z_p} = \mathbf{e_p} - \mathbf{g}_\mathrm{p}$ is a vector of net imports; $\mathbf{z_p}'$**(p-p*)** is tariff revenues, which are assumed to be redistributed to households; and γ=0 being our basic case. If the focus of the analysis were on domestic consumption taxes, or taxes on factors supplied by households, such as labor, then *z*(**p**,*u*) could be replaced by *e*(**p**,*u*) (see Anderson and Martin 2010).

For a small open economy, world prices **p*** are exogenous, and the changes in tariffs are synonymous with changes in domestic prices. Assuming that *G* is concave in prices, which may require stronger conditions than the concavity/convexity of the underlying expenditure/revenue functions, differentiating equation (2) with respect to **p** and equating it to zero yields the first-order conditions for maximization of a modified political welfare function:

$$\mathbf{d}G^{*}=\frac{\mathbf{d}G^{*}}{\mathbf{dp}}\mathbf{dp}=\left[\frac{1}{a}\iota'\frac{\partial\mathbf{C}}{\partial\mathbf{p}}+(\mathbf{p}-\mathbf{p^*})'\mathbf{z_{pp}})\right]\mathbf{dp}=\mathbf{0} \qquad (3)$$

With tariff revenue at a premium:

$$\mathbf{d}G^{*}=\frac{\mathbf{d}G^{*}}{\mathbf{dp}}\mathbf{dp}=\left[\frac{1}{a}\iota'\frac{\partial\mathbf{C}}{\partial\mathbf{p}}+(1+\gamma)(\mathbf{p}-\mathbf{p^*})'\mathbf{z_{pp}})+\gamma\mathbf{z_p}\right]\mathbf{dp}=\mathbf{0}$$

where $\frac{\partial \mathbf{C}}{\partial \mathbf{p}}$ is the matrix of derivatives of the contribution functions with respect to prices. The size and magnitude of these derivatives may reflect a number of political-economy features identified by authors such as Anderson and Hayami (1986), Cadot, de Melo and Olarreaga (2004), and Dutt and Mitra (2010) that influence how much protection a particular sector will receive. These include: (i) whether and, if so, how effectively the sector is organized; (ii) the leverage of own-output prices on returns to specific factors in the sector; (iii) adverse impacts on the costs of other politically-influential groups of protecting a particular sector; (iv) the possibility of log-rolling coalitions between different producer groups; (v) the ratio of imports to domestic consumption that determines the distribution of benefits between tariff revenues and transfers to producers, (vi) the degree of concentration in the sector and its influence on the cost of organization, and (vii) the extent to which the benefits of protection must be shared with new entrants (Hillman 1982)..

The matrix **C** is difficult to infer in the general case since it depends not only on tangible parameters such as the input-output and factor-market linkages examined in Cadot, de Melo and Olarreaga (2004), but also on the extent to which industry participants and politicians perceive the extent of these linkages[5]. However, if the initial situation is assumed to reflect a political-economy optimum, then the initial tariff structure can be used to characterize the column sums of **C**, which are the perceived net impacts of changes in the price of one product on contributions. Writing these column sums divided by *a* as a row vector **h**, and setting $\frac{dG}{dp} = 0$, yields a potentially observable expression for **h** at the initial domestic price vector[6]. The resulting equation reveals politicians' preferences at the margin by equating the marginal political benefits to politicians of providing protection with the marginal economic costs they are willing to incur in order to provide this support:

$$\mathbf{h} = -(\mathbf{p^0} - \mathbf{p^*})'\mathbf{z^0_{pp}} \qquad (4)$$

with tariff revenues receiving a premium, we have a "new" **h**

$$\mathbf{h} = -(1+\gamma)(\mathbf{p^0} - \mathbf{p^*})'\mathbf{z^0_{pp}} + \gamma\mathbf{z_p}$$

[5] It seems clear that some linkages—such as impacts of protection provided to producers of major inputs—are much more widely recognized than indirect impacts such as those operating through induced impacts on real exchange rates.

[6] While **h** may change in response to changes in economic structure, it is useful to focus on the short-run case where it is constant—an assumption that we relax later.

where $\mathbf{(p^0 - p^*)'z^0_{pp}}$ is the marginal welfare cost of tariff changes around $\mathbf{(p^0 - p^*)}$. 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}. Another important insight obtainable from equation (4) is that, for any given import demand elasticity, the value of h_i increases with import volume[7]. The importance of the import volume and elasticity terms means that the strength of political support for a commodity cannot be determined simply by the height of the tariff on that good—an error whose adverse consequences for inferences about policy reform are emphasized in Jean, Laborde and Martin (2010). Note also 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.

A key question is whether **h** is a constant, or whether it is endogenously determined, or at least pre-determined. The case where **h** is pre-determined turns out to be a particularly important one, corresponding to the short run in which incumbent firms respond to the impact of any policy reform that exogenously changes the value of distortions away from the initial political-economy optimum. The latter case is difficult to characterize in general, but can be given a very interesting and tractable interpretation using a simplified version of the Grossman-Helpman model discussed in detail by Baldwin and Robert-Nicoud (2006).

The simplified model, which Grossman and Helpman (1994, p846) described as Example 3, can be obtained by adapting equation (3) to take into account the fact that, in the truthful Nash equilibria on which they focus, the marginal impact of a policy change that increases the welfare of a lobby is an equal change in its contributions. Accompanying this with the assumption that the impact of a policy reform on the welfare of a lobby depends only on its impacts on the profits of its activity leads us to:

$$\mathbf{d}G^* = \frac{\mathbf{d}G^*}{\mathbf{dp}}\mathbf{dp} = \left[\frac{1}{a}\mathbf{g}'_{\mathbf{p}}\kappa + (\mathbf{p}-\mathbf{p}^*)'\mathbf{z}_{\mathbf{pp}})\right]\mathbf{dp} = \mathbf{0} \tag{5}$$

[7] This follows directly from the definition of the elasticity. The higher is the import volume, the higher z_{ii} must be to maintain a constant elasticity of import demand.

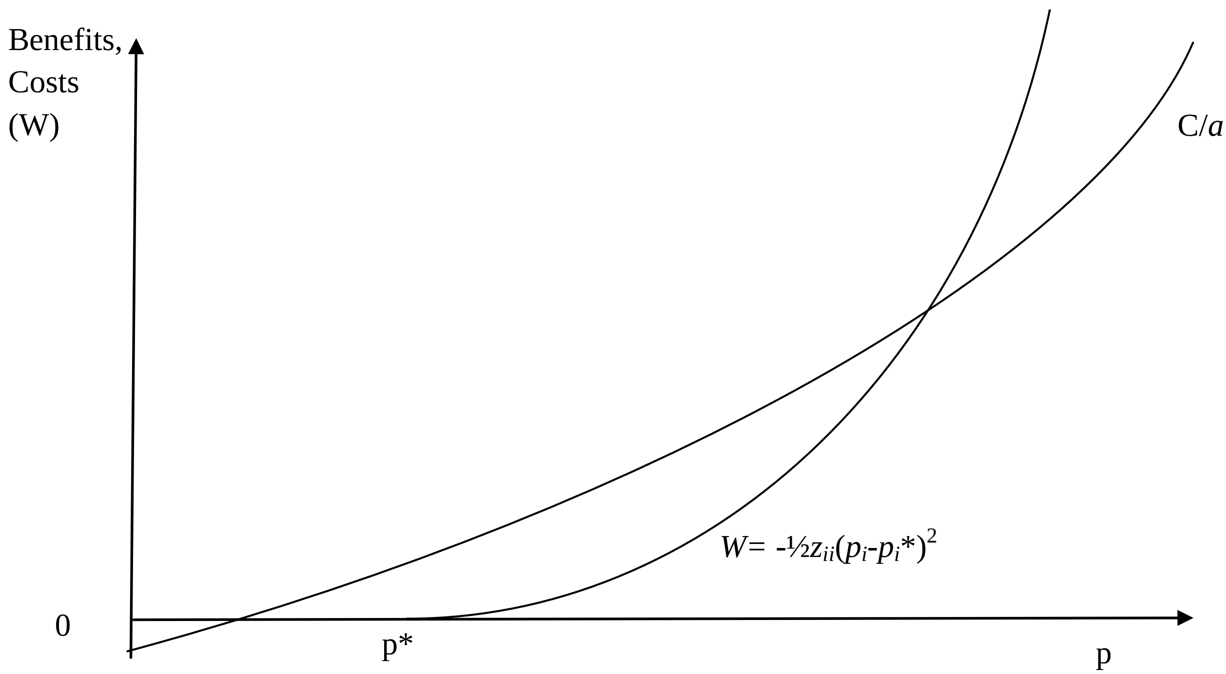
where κ is a diagonal matrix with ones for each organized sector, and zeroes otherwise. If we assume that all sectors with positive protection—and hence potentially subject to reform—are organized, then the matrix κ becomes an identity matrix and can be ignored.

2. Some Intuition into the Nature of the Solution

To facilitate intuition, we consider the case of a single distorted product, *i*. We do this initially showing the total political benefits and costs relative to the output price, rather than to the tariff. The political benefit of higher prices is given by the curve labeled (C/a), which may be positive even at prices below the world market price, p*, because lobbies may feel the need to provide support in order to avoid the situation—all to familiar in developing-country agriculture (Anderson 2010)—where they are adversely affected by export taxes or import subsidies. The economic cost (EC) term, $z(p,u)$ $-z_p'(p,u)(p\text{-}p^*)$- $z(p^*,u)$, is zero when $p=p^*$and a convex function in the level of the tariff. Taking a second-order Taylor-Series expansion function about a zero tariff yields an estimate of the economic cost[8] of $W = -½z_{ii}(p_i\text{-}p_i^*)^2$. Note the absence of an intercept, because the cost is zero at a zero tariff, or of a linear term in (p-p*). Diagrammatically, these two functions can be represented as:

[8] To get this result we make the standard assumption in the theoretical literature that the third derivative expenditure function disappears (see Dixit 1975, p108), and hence that it can be approximated by a quadratic function.

Figure 1. Political Benefits and Economic Costs of a Tariff

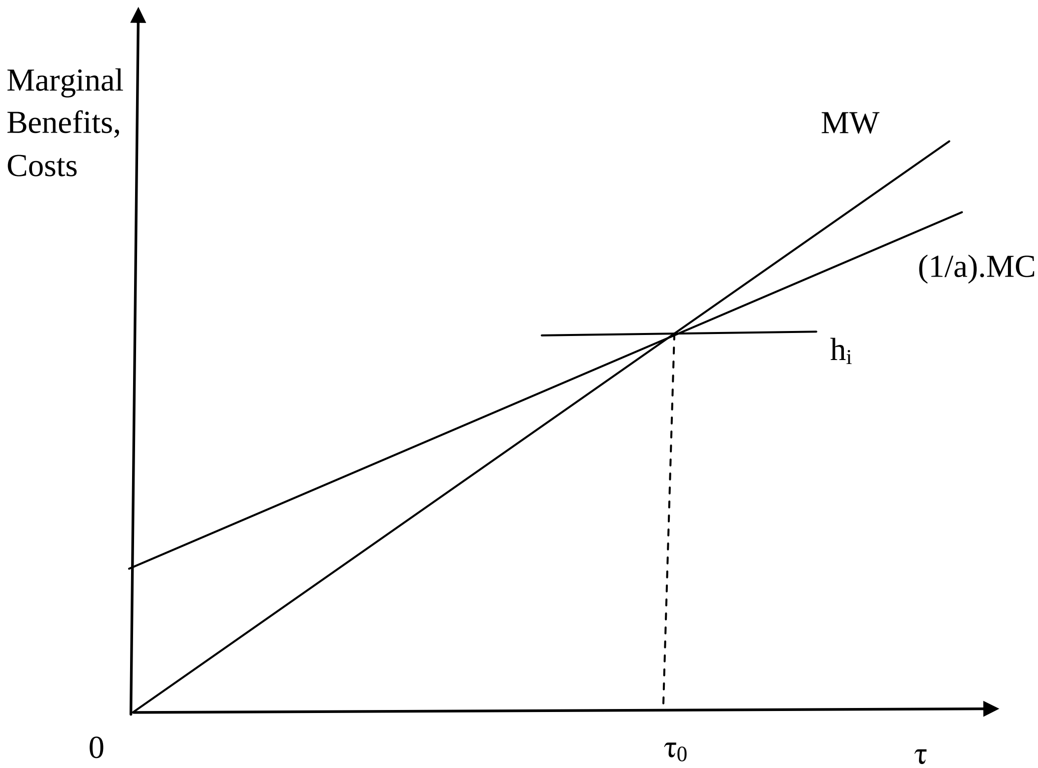


The politically-optimal tariff will be the one at which the slope of the benefit function equals the slope of the cost function. From examination of Figure 1, it is clear that the height of the tariff on any particular product (p^0 – p*) will depend on the shapes of the benefit and cost curves. The steeper and more convex is the benefit curve, the higher the equilibrium tariff will be, other things equal. And the steeper and more convex the welfare cost function, the higher the cost of providing a given level of protection, and hence the lower the tariff chosen for any given political benefit function.

Looking at the marginal impacts of changes in the tariff can provide important additional insights. To do this, it is useful to focus on the section of the x-axis that corresponds to a positive tariff. This yields Figure 2, in which the marginal efficiency cost of protection is given by the steeper line, MW. The marginal political benefit of higher protection (1/a.MC) is shown as an upward sloping line, reflecting the increase in output of the protected sectors as protection increases. This is very clear in the restricted model giving rise to equation (5), where the marginal impact on contributions is equal to the output level of the industry receiving protection. Even for more general models, it seems very likely that there will be a strong tendency for the marginal benefit to protected industries to rise with their output level. In the long run, the politically optimal tariff, τ_0 , is given by the intersection of the marginal political benefit schedule (1/a).MC and the marginal welfare cost MW. The marginal welfare costs of moving away from τ_0 are given by the vertical distance between the MW and (1/a)MC curves.

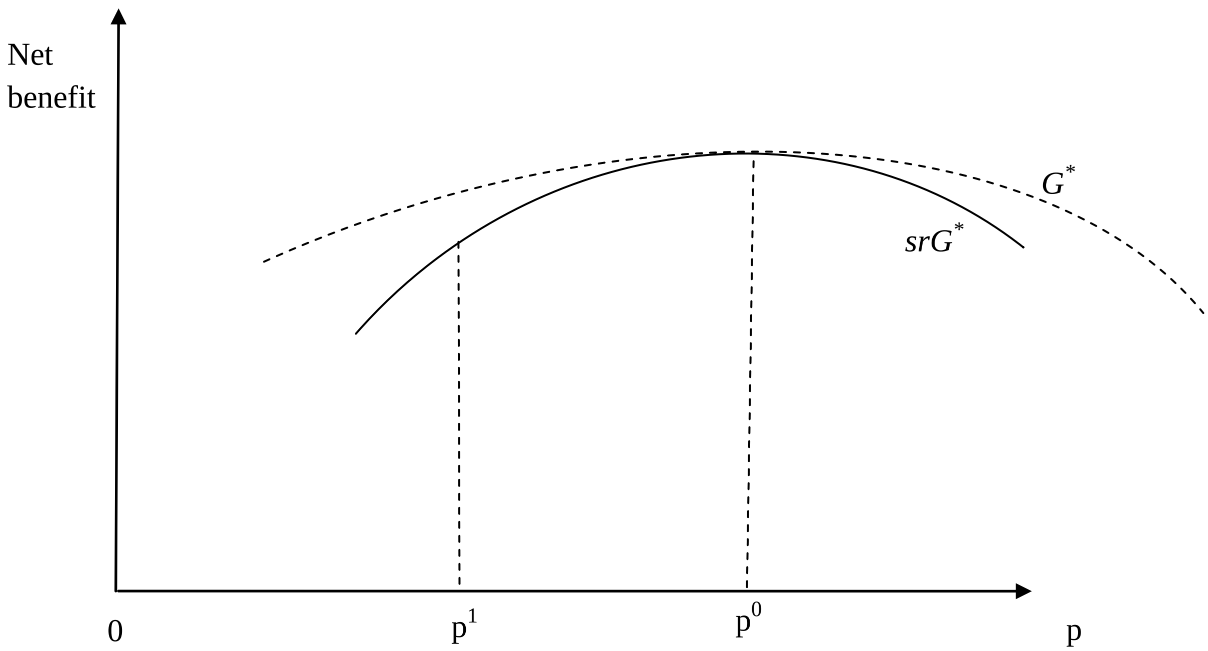
In the short run, the political economy forces are different. If protection is raised, incumbents are—as pointed out by Hillman (1982)—likely to reward governments based on their initial level of output rather than the final level of industry output because much of the benefit on new output is likely to accrue to new entrants. If protection is lowered, incumbents reduce their contributions based on the impact of the price change on their profits at their initial level of output, not the level of output to which they will subsequently adjust, if the tariff reduction is maintained. The short-run marginal impact on contributions to policy makers (1/a).MC is therefore represented by the horizontal line h_i corresponding to initial levels of output. Since policy makers need to survive the short run if they are to thrive in the long run, this short-run is likely to be critically important for them—as famously observed by J. M. Keynes "in the long run, we are all dead".

Figure 2. Marginal Political Benefits and Economic Costs of a Tariff



As shown in Figure 3, the political net benefit, *G*, is assumed to be at its maximum at the initial tariff. Reductions in the tariff, yielding prices below p^0, imply a reduction in *G*, as do increases in the tariff above its optimal level. The important distinction between the short-run and long-run marginal political benefits allows us to develop two different relationships between the policy-makers' objective function and the tariff. In the long run, the dashed curve, *G*, reflects the implications of moving the tariff on the single protected good away from the initial political equilibrium at p_0. The short-run impact, shown by the solid curve *srG*, is tangent to the long run curve at the optimum, but everywhere else lies below the long-run curve, reflecting higher short-run political costs of deviating from the initial long-run equilibrium.

Figure 3. The political net benefit function with a single tariff, *G**



3. Implications of tariff changes for the objective function

With the framework developed in section 1 and illustrated in section 2, we are in a position to consider the effects on the objective function of arbitrary changes in tariff rates, and hence in **p** relative to **p***. Given our assumption that the initial equilibrium is a political economy optimum, the first derivative of G with respect to **p** is zero at this point. This is clearly appropriate given our assumption that the initial equilibrium is an optimum from the point of view of the politicians. As is the case with economic costs of distortions, the marginal impact of a change in protection is zero initially, but rises as the distortion increases. To capture the broad impact on political welfare of a discrete change in protection, we first take the second derivative about the initial equilibrium. Doing this in the simpler case of the short-run move from the political-economy equilibrium considered in equation (4), we obtain:

$$\frac{\partial^2 srG^*}{\partial \mathbf{p}^2} = \mathbf{z_{pp}} + \mathbf{z_{ppp}}(\mathbf{p} - \mathbf{p}^*) \qquad (6)$$

With a premium on tariff revenue:

$$= (1+2\gamma)\mathbf{z_{pp}} + (1+\gamma)\,\mathbf{z_{ppp}}\mathbf{(p - p^*)}$$

To be assured that the first order conditions for maximization of equation (1) lead to a welfare maximum, this function must be concave in prices. The fact that the trade expenditure function made explicit in equation (2) is necessarily concave in prices is not sufficient to ensure that G^* is concave—a fact that led to some difficulties in finding welfare maxima in Jean, Laborde and Martin (2010). As we will see, however, assuming that the trade expenditure function is quadratic is sufficient to ensure concavity of the policy objective function. It seems reasonable to assume that the trade expenditure function, *z*, 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 the assumption of a quadratic trade expenditure function, the $\mathbf{z_{ppp}}$ term in equation (6) can be dropped. Since the $\mathbf{z_{pp}}$ matrix is the Hessian of the trade expenditure function, we can be confident that it is negative definite, and hence that *G* is concave in prices. The implications of changes in tariffs from the domestic political-economy optimum can then be analyzed using the Taylor-Series expansion:

$$\Delta srG = \frac{\partial G}{\partial \mathbf{p}}\Delta\mathbf{p} + \frac{1}{2}\Delta\mathbf{p}'\frac{\partial^2 G}{\partial \mathbf{p}^2}\Delta\mathbf{p} \quad = \frac{1}{2}\Delta\mathbf{p}'\mathbf{z_{pp}}\Delta\mathbf{p} \qquad (7)$$

And in the case with a premium on tariff revenues:

$$= \frac{1}{2}(1+2\gamma)\Delta\mathbf{p}'\mathbf{z_{pp}}\Delta\mathbf{p}$$

Equation (7) is strikingly 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 economic welfare effects around a distorted equilibrium (see Martin 1997). It shows the political costs of deviations from the political-economy equilibrium to be a quadratic form in the deviations from the initial economically-but-not-politically distorted equilibrium. No political weights are required, and the political costs of deviations depend only the changes in prices and the slopes of the import demand functions.

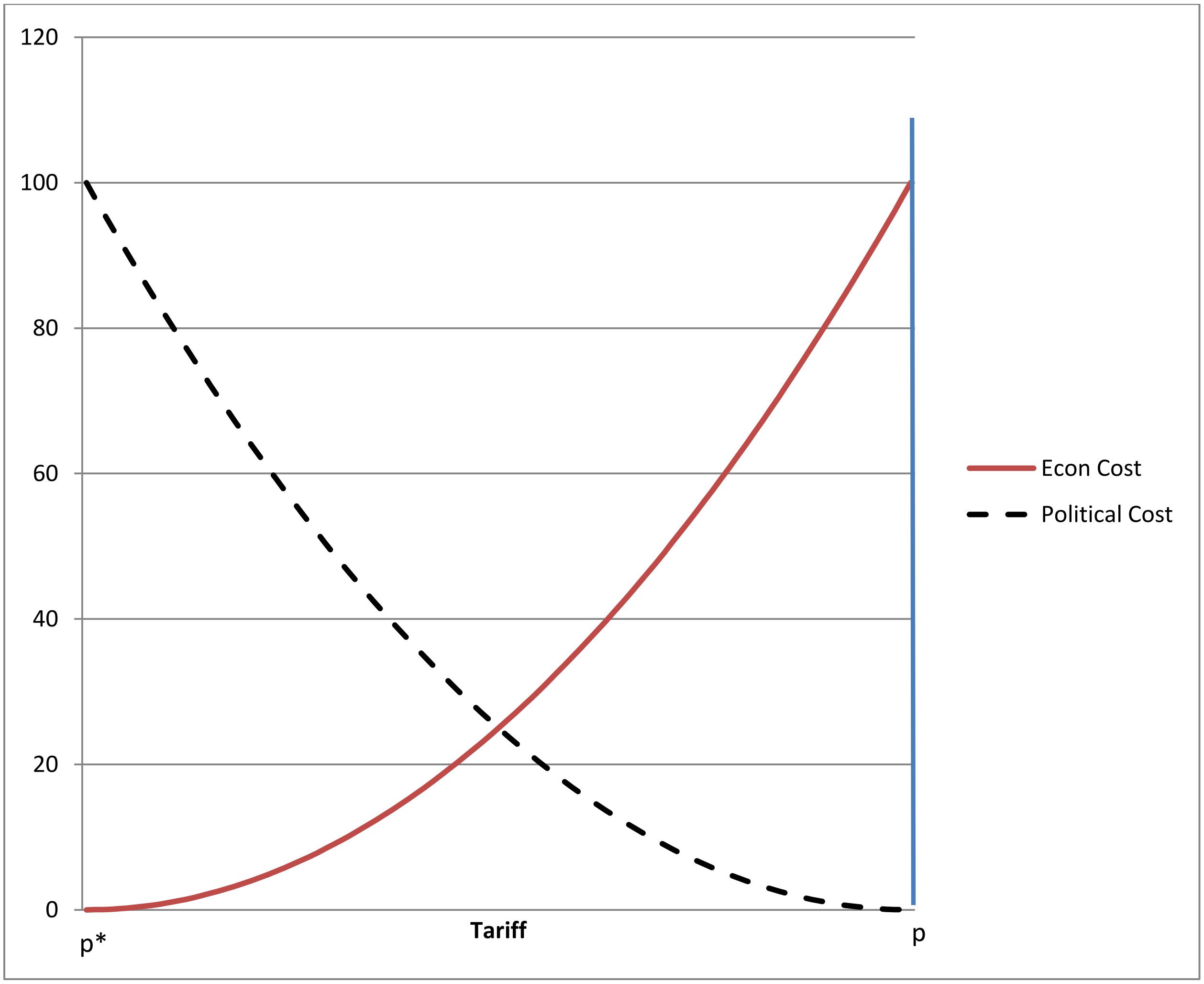
Moving to the longer-run analysis in which the size of the competing domestic industry changes, we follow a similar process beginning from equation (5). Assuming that all sectors with positive initial protection are organized, this yields:

$$\Delta G = \frac{1}{2}\Delta \mathbf{p}'\left[\frac{1}{a}\mathbf{g_{pp}} + \mathbf{z_{pp}}\right]\Delta \mathbf{p} \tag{8}$$

As noted following equation (2), $\mathbf{z_p} = \mathbf{e_p} - \mathbf{g_p}$. Since the diagonal elements of $\mathbf{g_{pp}}$ are weakly positive while those of $\mathbf{e_{pp}}$ are weakly negative, it is clear that the diagonal elements of the matrix expression in (8) must be negative and weakly smaller in absolute value than those of $\mathbf{z_{pp}}$. As long as all goods are substitutes in production and in consumption, the off-diagonal elements of this matrix must be positive and weakly smaller than those of $\mathbf{z_{pp}}$. The fact that 1/a is estimated (Goldberg and Maggi 1999) to be in the order of 0.02 suggests that the difference between the two formulations is likely to be very small in practice. As a result, we will focus in the remainder of the paper on specifications derived from equation (7).

A simple diagram for the case of a single tariff provides useful insights into the interpretation of the efficiency gains from reform relative to political-economy welfare costs. If we consider a tariff imposed at specific rate (p-p*), the economic efficiency costs of the tariff can be represented by a quadratic function rising from point p* in Figure 4. The political-economy costs associated with reducing protection so that the domestic price falls from p* towards p* can be represented by a mirror-image quadratic function rising from p.

Figure 4. Economic and Political Costs of Reforming a Single Tariff



As is clear from Figure 4, a reduction in a distortion from its original level causes political costs that are initially low, but rise exponentially with the extent of the reduction. Also evident is the fact that the economic costs of the distortion initially fall rapidly with a reduction in the tariff, but the rate of reduction in these costs falls as the reform proceeds. How far a policy maker is able to proceed down the reform path will depend upon the benefits obtainable from the value placed on the benefits—such as access to foreign markets—obtained as a broader part of the negotiating process. Where there are multiple distortions, the political costs will depend on how far the policy maker must move away from the political optimum in each product market, and on the strength of political support—as summarized by the h_i parameter for that product. As in the case of efficiency and market access considered by Anderson and Neary (2007), it seems likely that different approaches to tariff-cutting will generate different results for economic efficiency and political costs. It seems useful, therefore, to consider in more detail the implications of different patterns of reform in the case of multiple tariffs.

Further insights into the effects of particular tariff changes can be obtained by rearranging (7) into proportional change form:

$$\frac{\Delta G}{e} = \frac{1}{2}\begin{bmatrix}\hat{p}_1 & \hat{p}_2 & \ldots & 0\end{bmatrix}\begin{bmatrix} s_1\eta_{11} & s_1\eta_{12} & \ldots & s_1\eta_{1n} \\ s_2\eta_{21} & s_2\eta_{22} & & \\ \ldots & & & \\ & & & \end{bmatrix}\begin{bmatrix}\hat{p}_1 \\ \hat{p}_2 \\ \ldots \\ \end{bmatrix} \qquad (9)$$

where there is a premium on tariff revenue:

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

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 compensated elasticity of demand[9] for good i relative to the price of good j; and the vector $\hat{p}$ refers to proportional changes in domestic prices. 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. If we have available the matrix of elasticities, then equation (9) can be used to estimate the implications of any arbitrary change in prices from the initial equilibrium. It might also be used to choose a vector of price changes that minimizes the political opposition (or hissing) for a given increase in revenue (or feathers).

We will frequently not have available the complete matrix of own and cross-price elasticities needed for equation (8), especially if the problem involves tariffs, for which there are

[9] Here, we assume that imported goods are differentiated from domestic good so that all import demand and total demand are equivalent. If imported and domestic goods are perfect substitutes, then the net import demands should appear in equation (8).

over 5000 products at the finest level of internationally comparable statistics. In this situation, we can follow the lead of Anderson and Neary (2007) in using CES preferences to obtain local, theoretically-consistent, estimates of elasticities as a basis for exploring the properties of equation (8). With the CES, 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 $\sigma.s_j$. Equations (4') and (5) can then be rewritten including cross-price effects as:

$$\frac{\Delta G}{e} = \frac{1}{2}\sigma \sum_j s_j \hat{p}_j \left(\sum_i \hat{p}_i s_i - \hat{p}_j \right) = -\frac{1}{2}\sigma.VAR(\hat{p}) \tag{10}$$

where $VAR(\hat{p})$ is the weighted (s_i) variance of price changes $\hat{p}_i$ .from the political-economy equilibrium.

Like the measures based on weighted means and variances of tariffs used by Anderson and Neary (2007) to characterize the welfare and market access implications of a tariff regime, this result formalizes measures previously used without theoretical justification. Measures of the variance of tariff changes have sometimes been used (see, for example, Pincus (1977)) to characterize a tariff reform.

4. Applications

The general approach outlined in this paper is applicable to a wide range of problems in international trade, and with suitable adaptations, to a wide range of other reforms. Examples of such reforms would include attempts to restructure policies to achieve higher rates of economic growth and poverty reduction (as advocated in World Bank 1982) are likely to incur political costs either because of the public-good nature of many of their outcomes or because of a lack of clarity on these benefits. Attempts to change tax policies in order to achieve reductions in production of greenhouse gases are another example of a policy reform that seems likely to face strong political opposition even if the reforms advocated are part of a successful, co-ordinated attempt to mitigate the impacts of climate change. An example on which we focus in this section of the paper is the use of tariff-cutting rules to bring about negotiated reductions in trade barriers.

One important application, and the one on which we focus in this paper, is to the conduct of international trade negotiations. While early multilateral trade negotiations focused on bilateral exchanges of market access, the limitations of this approach quickly became evident (Baldwin 1986), and the Kennedy Round of 1964 to 1967 and all GATT/WTO negotiations since have used some sort of formula to allow participants to better identify the potential gains, and to better balance their offers with those of other participants.

One difficulty with using tariff-cutting formulas has been their *ad hoc* nature. Economic theory alone is sufficient to endorse only two multilateral tariff-cutting rules—(i) a concertina rule under which only the highest tariff is cut at each stage of the negotiations, or (ii) a proportional cut rule under which each tariff is cut proportionately (Turunen-Red and Woodland 1991). As noted by Anderson and Neary (2007), these do not correspond with the trade reforms considered in international negotiations or proposed by international organizations. Considerable attention has focused on devising alternative formulas that might better meet the needs of international negotiators (see, for example, Francois and Martin 2003; Anderson and Neary 2007, pp196-201). Within the set of available rules, negotiators have frequently seemed undecided about which rule best meets their needs. While the current Doha negotiations on agriculture have proceeded with high-political-cost rule that provides for larger cuts on higher tariffs, the resulting pressure for exceptions in developing countries led the Chairman of the negotiating group to canvass moving to a rule under which developing countries could choose the size of the cut on individual tariffs (Falconer 2008, para 145). Such a rule seems likely to lead to tariff cuts that are much less politically costly, but perhaps less effective in improving economic efficiency. But how should this choice be made?

To make progress towards identifying a good tariff-cutting rule, we assume that countries involved in the negotiations need to provide a certain amount of market access for their trading partners to be willing to conclude an agreement. Given the reciprocal nature of the negotiations, the commitments by their trading partners to reduce their trade barriers create a certain amount of political capital that they must use to bring about the politically difficult reductions in their own barriers. The amounts of market access provided and given need not be the same, with the balance depending on a wide range of factors, including the bargaining ability of each countries' negotiators, trade patterns, and views such as the principle of special and differential treatment in the WTO that involves smaller cuts in developing country tariffs than in the industrial countries. For any given amount of market access that a country must concede to its trading partners, we seek the tariff cutting rule that will yield the greatest efficiency gains per unit of political cost.

The actual tariff-cutting experiments that we consider are given in Table 1. These experiments include (1) the proportional tariff cut endorsed by economic theory; (2) the Swiss formula used in the Tokyo Round of the WTO and the negotiations on non-agricultural market access under the Doha agenda; (3) an absolute cut in tariffs of the type considered by Anderson and Neary (2007, p198); (4) a proportional cut in the power of the tariff that should minimize the variance of price changes; (5) an extended Swiss formula of the type considered by Francois and Martin (2003); (6) an absolute-cut formula with a non-negativity constraint to avoid negative tariffs (import subsidies); (7) an absolute cut in the power of the tariff subject to a similar non-negativity constraint, and (8) a regime where countries can choose the cuts in their individual tariffs subject in order to minimize the political pain.

As an initial step, we first compared the effects of each of these tariff-cutting rules in a context where each country provides a five-percent increase in market access. In this situation, we first estimated the parameter needed to achieve the increase in market access, and then the implications for economic welfare and for political costs. Following Anderson and Neary (2007), we assumed that preferences can be approximated in the neighborhood of the initial equilibrium using a CES function because this formulation leads allows us to obtain theoretically-consistent results that take advantage of the available information on expenditure shares and the magnitude of distortions[10]. Eight different types of potential reform are outlined in Table 2. Key results for an experiment requiring countries to generate an increase of five percent in the amount of market access they offer are presented in Table 3 for all but the family of extended Swiss formulas.

[10] The particular CES function used in this application had an elasticity of substitution of 4, although this parameter is unlikely to determine the results. As previously noted we assume throughout that the trade expenditure function is quadratic in prices in order to confirm that G^* is concave in prices. Because this functional form is fully flexible, it provides a second-order approximation to any preference structure—including the much less flexible CES function—at the initial equilibrium.

Table 1 Illustrative Tariff Cutting Formulas

Formula	Label	Expression
1	Proportional cut	$t_f = \boldsymbol{c} \times t_0$, c>0 and c <1
2	Swiss Formula	$t_f = \frac{\boldsymbol{a} \times t_0}{\boldsymbol{a}+t_0}$, a.>0
3	Absolute cut in tariffs	$t_f = t_0 - d$, d>0
4	Proportional cut in the power of tariff	$t_f = \boldsymbol{k}(1+t_0) - 1$, k >0 and k<1
5	Extended Swiss formula	$t_f = \frac{\boldsymbol{f} \times t_0}{\boldsymbol{fg}+t_0}$, f>0 and g>0
6	Absolute tariff cut with non-negativity constraint	$t_f = Max(t_0 - d, 0)$, d>0
7	Proportional cut in the power of the tariff with non-negativity constraint	$t_f = Max(\boldsymbol{k}(1+t_0) - 1, 0)$, k >0 & k<1
8	Political-economy cost minimization	$t_f = \boldsymbol{r} \times t_0$, r>0 and r<1 and r different for each product

Notes: t_f is the post-formula tariff, t_0 is the ex-ante proportional tariff, in **bold** formula coefficients. The extended Swiss formula is defined in Francois and Martin (2003).

These particular formulas were selected for a number of reasons. Formulas (1), the proportional-cut rule, has been widely used in tariff negotiations, and is supported by theoretical analysis seeking approaches that provide economic welfare gains to all participants in trade negotiations. The emphasis of the Swiss formula on cutting the highest tariffs by the most seems consistent with the concertina rule supported by economic theory. As shown in the Appendix, the absolute cut in (proportional) tariffs (formula 3) is consistent with our political-economy cost-minimization approach for tariffs as long as no tariffs become negative, while formula 4 is similarly consistent with the Anderson-Neary formulation. As shown by Francois and Martin (2003), the extended Swiss formula allows choice over a wide range of formulas with curvature varying continuously between the polar cases of the Swiss formula and the proportional cut formula. Formulas 6 and 7 introduce non-negativity constraints to rule out cases where tariffs become negative, and require the introduction of import subsidies. Formula 8 examines the case where tariffs cuts are chosen simultaneously in order to minimize the political-economy cost achieving the required increase in market access. Because it allow great freedom to each country in choosing its cuts on individual tariffs Formula 8 has much in common with the average-cut approach used for agriculture[11] in the Uruguay Round (see Martin and Winters 1995).

[11] The average-cut approach is usually complemented by a minimum cut on each tariff, which would likely increase its political cost relative to our formulation.

Results are presented in Table 2 for a range of important economies at different stages of economic development and with different tariff profiles. For each of these countries, we assume that imports at the six-digit level of the Harmonized System substitute between themselves and with a domestic good by preferences that can be characterized using Constant-Elasticity of Substitution preferences. We rely on the 2004 applied MFN rates from MAcMapHS6-v2 by Boumellassa, Laborde and Mitaritonna (2009) for data on applied tariffs and on imports. Values for domestic consumption on goods and services, and imports of services are drawn from the GTAP 7.2 database (Narayanan and Wamlsey, 2008).

Table 2. Economic Efficiency Relative to Political Cost

Formula		Brazil	Canada	China	EU	Indonesia	India	USA
1	Proportional	8.62	1.31	5.53	4.12	3.76	14.66	1.59
2	Swiss	6.55	1.25	5.49	2.20	2.27	5.32	1.30
3	Absolute cut	8.38	0.68	5.52	3.48	3.32	14.41	1.12
4	Prop. Cut in Power	9.06	1.56	5.53	4.48	4.05	16.25	1.49
6	Abs. cut, non-negative	8.66	1.66	5.52	4.04	3.75	14.51	1.77
7	Prop. Cut in power, non-negative	8.94	2.00	5.53	4.76	4.11	16.05	1.86
8	Political-Economy	8.15	1.10	5.00	3.32	3.41	13.77	1.62
	Proportional Coeff.	0.79	0.13	0.69	0.61	0.58	0.87	0.23

Note: The final row of the table refers to the proportional cut coefficient required to bring about the five percent expansion in market access used in this baseline experiment. Where tariffs are relatively high, as in India, only a relatively large coefficient is sufficient. Where they are very low, as in Canada or the United States, a very small coefficient—and hence a very large cut—is required. na. means could not be successfully calculated.

The results in Table 2 provide a number of important insights. When only a small cut in tariffs from their initial levels is required, as in India or Brazil, then the political costs of reform tend to be small relative to the efficiency gains. By contrast, when large cuts from initial levels are required, as in Canada or the USA, then the economic efficiency gains from reform tend to be much lower relative to the political costs. These results are consistent with Figure 1, where deeper cuts from initial protection levels involved a decline in benefits relative to political costs.

Comparisons between the different formulas in Table 2 are also extremely revealing. One striking comparison is between the proportional cut and the Swiss formula. In every case, the ratio of economic benefits to political costs is much higher for the proportional cut formula than for the Swiss formula. While both of these approaches are broadly endorsed by economic theory, these results suggest an important note of caution in the use of aggressive tops-down approaches to tariff cutting such as the Swiss formula or the tiered-formula used in the Doha negotiations in agriculture (Jean, Laborde and Martin 2005). From an economic point of view, the Swiss formula is highly desirable because the highest tariffs involve the highest economic costs. Our results, however, suggest that once the constraint of limited political capital is factored in it is likely that the economic gains from a less-ambitious proportional-cut formula will be greater.

Another striking result emerges from comparison of the proportional cut approach with the pure political-economy approach to liberalization in Formula 8. The free-form approach where countries can choose the extent to which they cut their tariffs is found to yield economic benefits that are typically much lower, relative to the political costs incurred, than other approaches such as the proportional cut formula. This suggests a need for caution in using approaches such as the average-cut formula, where countries can choose the extent to which they cut individual tariffs.

Another striking comparison is between the proportional cut formula and approaches using a constant cut, or a constant proportional cut, in the tariff. While Formulas 3 and 4, that impose a constant absolute cut in tariffs (or the power of the tariff) or a proportional cut in the power of the tariff, are interesting from analytical point of view, they seem of little policy relevance as they involve replacing low tariffs with negative tariffs. Since countries seem unlikely to commit to introducing such import subsidies as part of a trade negotiation, it seems sensible to focus on cases like Formulas 6 and 7 that avoid this problem by truncating tariffs that would otherwise be reduced below zero at a minimum of zero.

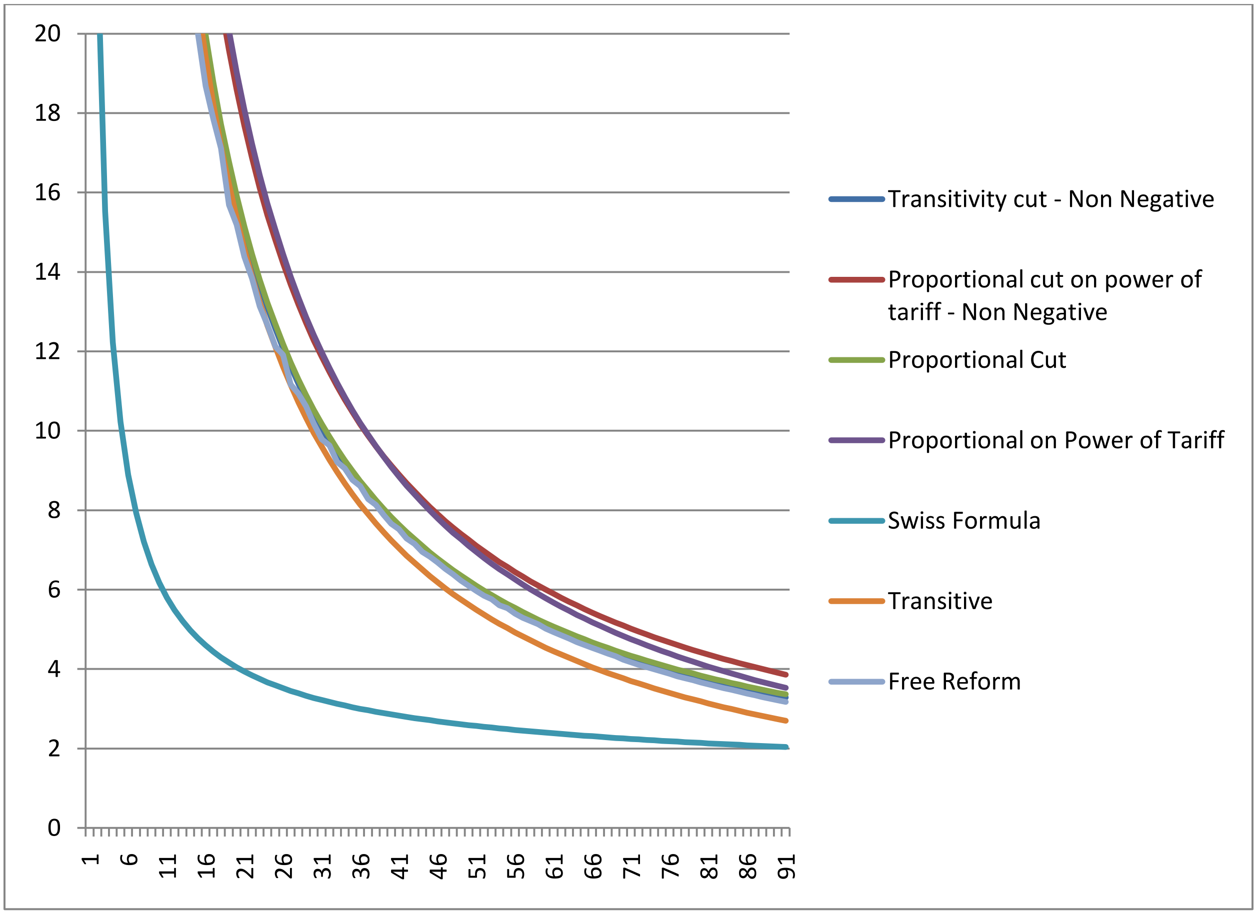
Formula 6, which cuts tariffs by a constant absolute amount, is dominated by Formula 7, which cuts the power of the tariff by a constant proportional amount. Relative to a proportional cut rule, it tilts the tariff cutting schedule towards higher cuts in lower tariffs. A ten-percent tariff cut would, for instance, reduce a tariff of 11 percent to zero while reducing a tariff of 100 percent by 20 percentage points. By contrast, a 10 percent proportional cut would reduce the 11 percent tariff by 1.1 percent, while reducing the 100 percent tariff by 10 percent. From the point of view of economic efficiency, this tendency to cut lower tariffs by more than higher tariffs is less desirable than a rule that imposes higher cuts on higher tariffs—such as the proportional cut rule or the Swiss formula.

However, the cut in the power of the tariff rule has advantages from the point of view of political costs and market access. This formula maintains the relative prices of all goods that remain protected after the tariff cut. This elimination of within-group variability reduces the variance of prices that is shown in equation (10) to be a strong positive influence on the political-economy cost of protection. The proportional cut in the power of the tariff rule is formula is also likely to be more successful than the proportional-cut rule in achieving expansion of market access, since it sharply reduces tariffs on some goods with already-low tariffs that are likely to be associated with relatively large volumes of imports. This reinforces the finding of Anderson and Neary (2007) that increases in the generalized variance of tariffs are good for market access.

The combination of better performance in increasing market access and in reducing political-economy welfare costs leads the proportional-cut in the power-of-the-tariff rule to be the best of the feasible tariff-cutting rules in achieving economic welfare gains for any given amount of available political capital.

To check that the results are not specific to the level of market access (5 percent) considered in our initial experiment, we have examined for the European Union the economic efficiency/political cost ratio for a range of levels of market access expansion. The results of this experiment are presented in Figure 5. The results show two clear and interesting findings. The first is confirmation of our results for a specific (5 percent) increase in market access regarding the superiority of the power-cut formula over other formulas such as the proportional cut and, particularly, the Swiss formula. The second is to confirm our earlier finding for a single tariff cut that the further the liberalization proceeds, the smaller are the economic welfare gains relative to the political costs.

Figure 5. The efficiency ratio at different levels of market access, EU



5. Conclusions

In this paper, we show that the political costs of policy reform can be evaluated using the Grossman-Helpman model of trade policy determination. The analysis builds on and extends the approach used by Jean, Laborde and Martin (2010) for the selection of sensitive products in trade negotiations. Under very weak conditions about the determinants of political contributions, we show that the political-economy costs of policy reform can be expressed very simply in terms of the squared deviations of domestic prices from their levels in the initial political-economy equilibrium/optimum. Slightly more restrictive formulations are required for analysis of longer run impacts, but the qualitative results remain the same. We also extend the model to the case—

important for many developing countries—where trade tax revenues are at a premium. Interestingly the expressions for political costs are quite simple, and do not depend upon knowledge of political preferences, except as summarized in a single parameter routinely estimated in applications of the Grossman-Helpman model.

The analysis suggests that the differences between the short and long run political-economy costs of reform are likely to be small. This suggests a need for caution in assuming that trade reform away from a stable political-economy equilibrium will "wear down" its opponents and energize its supporters.

The model is applied to compare the effectiveness of different tariff-cut rules in achieving gains in economic efficiency for any given amount of political capital derived, for instance, from gains in market access in trading partners. This formulation appears much more likely to be successful in identifying the best tariff-cutting formula for negotiations than past approaches that have focused solely on the efficiency properties of these formulas. A range of tariff-cutting formulas is considered, including those that have been applied in past multilateral negotiations, together with approaches based on changes in the power of the tariff suggested by the analysis in this paper. A stylized application to tariff reform in eight important WTO members finds a new and surprising ranking of tariff-cutting rules. Free-form approaches modeled on the average-cut rule used in the Uruguay Round negotiations on agriculture give consistently poor results. Equally strikingly, the much-vaunted Swiss formula produces results that are inferior in terms of efficiency gains per unit of political capital to a simple proportional-cut rule. A new rule suggested by our analysis- the proportional-cut in the power-of-the-tariff rule consistently produces better results in terms of the efficiency achieved per unit of political capital expended.

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Appendix

Minimizing the Political Cost of Achieving a Given Level of Market Access Expansion

In this section, we seek to identify a rule-of-thumb approach that would correspond to minimizing the political cost of a given market access expansion. We first do this using the approach outlined this paper. We then undertake the same exercise using the approach suggested by Anderson and Neary (2007). Because of different assumptions about what parameters are held constant, we find results that differ in ways that shed light into the nature of the solution. To avoid tariffs that become negative—requiring governments to pay import subsidies—we rule out such reductions through a complementary slackness condition.

Using the approach of this paper

Like Anderson and Neary (2007), we assume that market access concessions can be characterized by the ensuing increase in net imports, valued at given world prices. For a given utility level, prices influence imports as follows:

$$\frac{\partial M}{\partial \mathbf{p}} = \mathbf{p}^{*}{}'\mathbf{z}_{\mathbf{pp}} \tag{A.1}$$

Where M stands for imports valued at (constant) world prices. Based on a first order approximation, the market access concessions inherent to a given change in tariffs (and therefore in domestic prices) can thus be evaluated as

$$\Delta M = \mathbf{p}^{*}{}'\mathbf{z}_{\mathbf{pp}}\Delta\mathbf{p} \tag{A.2}$$

We assume that policy makers analyze the political economy costs of reform based on the second order Taylor series expansion used in equation (7):

$$\Delta srG^{*} = \frac{1}{2}\Delta\mathbf{p}'\mathbf{z}_{\mathbf{pp}}\Delta\mathbf{p} \tag{A.3}$$

To minimize the political-economy cost of granting given market access concessions (corresponding, say, to an increase in imports by an amount ΔB), policy makers must thus solve the following problem:

$$\begin{array}{l} \min_{\mathbf{p}} \ \Delta srG = \frac{1}{2}\Delta\mathbf{p}'\mathbf{z_{pp}}\Delta\mathbf{p} \\ s.t. \ \begin{cases} \Delta B - \mathbf{p}^{*}{}'\mathbf{z_{pp}}\left(\mathbf{p}-\mathbf{p^0}\right) \le 0 \\ p_i^{*} - p_i \le 0, \quad \forall i = 1,\ldots,n \end{cases} \end{array} \tag{A.4}$$

The first constraint makes sure market access concessions match the country's need to contribute to the negotiations. The subsequent n constraints reflect the fact that tariffs are not allowed to take negative values. For convenience, the problem is written using domestic prices as control variables, which is strictly equivalent in our framework to using tariffs. Ignoring as before changes in z_{pp}, the vector of partial derivatives of the Lagrangian with respect to prices may be written:

$$\frac{\partial L}{\partial \mathbf{p}} = \mathbf{z_{pp}}\Delta\mathbf{p} - \lambda_0 z_{pp} p^{*} - \boldsymbol{\lambda} \tag{A.5}$$

Where λ_0 is the Lagrange multiplier associated with the market access constraint, and $\boldsymbol{\lambda}$ is an *n* x 1 vector including Lagrange multipliers ($\lambda_1,\ldots,\lambda_n$) associated with the constraints of non-negativity of tariffs. For some products, the constraint of non-negative tariffs may be binding. When this is the case, the corresponding multiplier λ_i is positive. As soon as the non-negativity constraint is not binding, however, λ_i is necessarily equal to zero. As a consequence, for any product for which the resulting final tariff is not zero, the multiplier λ_i is zero, and the FOC can be written:

$$\Delta p_i - \lambda_0 p_i^{*} = 0 \tag{A.6}$$

In terms of changes in specific tariffs, this condition may be written $\Delta t_i = \lambda_0 p_i^{*}$. Or, denoting by τ the ad valorem-equivalent tariff, $\Delta\tau_i = \lambda_0$: the liberalization formula that minimizes political costs is therefore an absolute-cut formula under which *ad valorem*-equivalent tariffs are lowered by the same absolute amount irrespective of their initial level, subject to the non-negativity constraint. For an initial *ad-valorem* equivalent τ_i^0, the resulting tariff is thus defined as

$$\tau_i = \max(0; \tau_i^0 - \lambda_0) \tag{A.7}$$

Using the Anderson-Neary Approach

Anderson and Neary (2007) introduce a matrix of substitution effects normalised by domestic prices (eq 4), defined in our notations as:

$$\mathbf{S} \equiv -\bar{s}^{-1}\underline{\mathbf{p}}\,\mathbf{z_{pp}}\,\underline{\mathbf{p}}, \text{ with } \bar{s} = -\mathbf{p}'\mathbf{z_{pp}}\,\mathbf{p} \qquad \text{(A.8)}$$

where $\underline{x}$ denotes a diagonal matrix with the elements of the vector x on the principal diagonal. S is thus an n by n matrix, while $\bar{s}$ is a scalar (the factor of normalization).

By construction S is a symmetric n-by-n positive definite matrix whose elements sum to one. The matrix S is assumed constant in Anderson-Neary (2007) when computing changes in the average tariff (see eq 11).

In our case let's start from the small-change equivalent of equation (A.3) above:

$$dsrG = \frac{1}{2}\mathbf{dp}'\,\mathbf{z_{pp}}\mathbf{dp} \qquad \text{(A.9)}$$

Given that dp = $\underline{\text{p}}$ dT, this can be re-written as

$$dsrG^{*} = -\bar{s}\,\mathbf{dT}'\,\mathbf{S}\,\mathbf{dT} \qquad \text{(A.10)}$$

Likewise,

$$\begin{aligned} dM &= \mathbf{p}^{*\prime}\,\mathbf{z_{pp}}\mathbf{dp} \\ &= (\boldsymbol{\iota} - \mathbf{T})'\underline{\mathbf{p}}\,\mathbf{z_{pp}}\,\underline{\mathbf{p}}\,\mathbf{dT} \\ &= -\bar{s}\,(\boldsymbol{\iota} - \mathbf{T})'\mathbf{S}\,\mathbf{dT} \end{aligned} \qquad \text{(A.11)}$$

The minimization problem can thus be written as

$$\begin{aligned} &\min_{\mathbf{p}}\ \Delta srG^{*} = -\bar{s}\,\Delta\mathbf{T}'\mathbf{S}\,\Delta\mathbf{T} \\ &s.t.\ \begin{cases} \Delta B + \bar{s}\,(\boldsymbol{\iota} - \mathbf{T})'\mathbf{S}\,\Delta\mathbf{T} \le 0 \\ p_i^{*} - p_i \le 0, \quad \forall i = 1,\ldots,n \end{cases} \end{aligned} \qquad \text{(A.12)}$$

Hence the differentiated Lagrangian is (recall that $\mathbf{\Delta T} = \mathbf{T} - \mathbf{T_0}$):

$$\begin{aligned} \frac{\partial L}{\partial \mathbf{T}} &= -2\bar{s}\,S\,\Delta\mathbf{T} - \lambda_0\bar{s}\,\mathbf{S}(\boldsymbol{\iota} - \mathbf{T}) + \lambda_0\bar{s}\,\mathbf{S}\,\Delta\mathbf{T} + \underline{\boldsymbol{\lambda}} \\ &= \bar{s}\,S\left[-2\Delta\mathbf{T} + \lambda_0\left(2\Delta\mathbf{T} - \boldsymbol{\iota} + \mathbf{T}_0\right)\right] \end{aligned} \qquad \text{(A.13)}$$

And minimization is obtained for any non-zero tariff at:

$$\Delta\mathbf{T} = \frac{\lambda_0}{2(\lambda_0 - 1)}(\mathbf{\iota} - \mathbf{T}_0) \tag{A.14}$$

This shows that the pure political-welfare minimizing solution is a proportional cut in each tariff defined on the domestic price base. If we define α= λ/(2(λ-1), this yields, at the product level:

$$T_i - T_i^0 = \alpha\left(1 - T_i^0\right) \tag{A.15}$$

Expressed in terms of domestic prices, $T_i = \frac{t_i}{\pi_i} = \frac{\pi_i - \pi_i^*}{\pi_i} = 1 - \frac{\pi_i^*}{\pi_i}$

So (A.15) can be re-written

$$\frac{\pi_i^*}{\pi_i^0} - \frac{\pi_i^*}{\pi_i} = \alpha\left(\frac{\pi_i^*}{\pi_i^0}\right) \tag{A.16}$$

That is:

$$\pi_i - \pi_i^0 = \alpha\pi_i \tag{A.17}$$

or

$$\pi_i = \frac{1}{1-\alpha}\pi_i^0 \tag{A.18}$$