SIMULTANEOUS REFORM OF TARIFFS AND QUOTAS*

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Abstract

This paper presents a general result for simultaneous reform of tariffs and quotas in a small open economy, where some of the quota rents do not accrue to domestic residents. Absent highly perverse income effects, welfare must rise following a uniform proportionate reduction in tariffs and a uniform proportionate relaxation of quotas, weighted by their rent-retention parameters. Previous results are shown to be special cases of this one, and its implications for practical policy advice and its relationship with the policy of "tariffication" of quotas are discussed.

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1 Introduction

The theory of piecemeal policy reform seeks rules of thumb for small policy changes which will guarantee an improvement in welfare, even when little detailed information on the structure of the economy is available. For changes in trade policy, the best-known result of this kind is that welfare must rise if all tariffs are reduced by the same proportion.[1] Falvey (1988) showed that this result also holds in the presence of "pure" quotas, where all the quota rents accrue to domestic residents. However, most real-world quantitative restrictions imply some loss of rents, typically mid-way between pure quotas and voluntary export restraints (VER's) where all rents accrue to foreign exporters and so are lost to the domestic economy. The theory has been extended to take account of such mixed cases by Anderson and Neary (1992), but they did not present any results for simultaneous reform of tariffs and quotas.[2]

This paper builds on the model of Anderson and Neary to derive a general result for simultaneous reform of all trade policies, when trade is distorted by quotas as well as tariffs and when quota-constrained imports differ in the share of rents retained by the importing country. Crucially, the result does not require any special assumptions about the structure of the economy. An alternative tradition derives results which hold under reasonable but nevertheless demanding restrictions on tastes and technology, for example, that some or all goods are general-equilibrium substitutes, as in Hatta (1977b) and Falvey (1988), or that tariff-constrained and quota-constrained goods are implicitly separable as in Anderson and Neary (1992). These results are of independent interest, but it is clearly very desirable to find results which hold more generally.

Section 2 describes the economy's equilibrium, using standard dual methods to model aggregate behaviour in the presence of tariffs and quotas. Section 3 derives expressions for the marginal welfare effects of changes in tariffs and quotas which generalise those of Anderson and Neary (1992). These are then used in Section 4 to derive the main result of the paper. This section also explains the intuitive basis for the result, shows that it nests many previous reform rules in the literature, and relates it to the policy of "tariffication" of quotas which was implemented in the Uruguay Round of trade liberalisation.

2 General Equilibrium in the Presence of Tariffs and Quotas

Consider a competitive small open economy, in which some imports are subject to tariffs and others are subject to quotas. Imports of tariff-constrained goods are denoted by a vector m, with domestic and world prices π and π^* respectively, which differ because of specific tariffs t, so $\pi = \pi^* + t$.[3] Imports of quota-constrained goods are denoted by a vector q, with domestic and world prices p and p^* respectively. It will be convenient to refer to the two groups of goods as the "t-goods" and the "q-goods", respectively. Finally, all other traded goods (including exports and unconstrained imports) can be grouped together as a composite numeraire good, with net imports m_0. The price of the numeraire, which is the same at home and abroad, is set equal to one (and omitted from the list of arguments of the behavioral functions for convenience).

Given these assumptions, the model's equilibrium condition can be written as follows:

$$\tilde{E}(\pi, q, u) + p'q = t'm + (p - p^*)'(I - \underline{\omega})q. \tag{1}$$

Consider first the left-hand side, which equals net spending by the private sector. Spending on the q-goods $p'q$ is effectively predetermined since I assume that the quotas are binding and that their domestic prices p are market-clearing. Net spending on all other goods is given by the distorted trade expenditure function $\tilde{E}(\pi, q, u)$, which depends on the prices of the t-goods, the quantities of the q-goods, and the utility of the representative consumer u.[4] The key properties of this function are given by the following two lemmas:

Lemma 1: The derivatives of $\tilde{E}$ with respect to π equal the compensated import demand functions for the t-goods conditional on the quotas: $\tilde{E}_\pi(\pi, q, u) = \tilde{m}^c(\pi, q, u)$. $\tilde{E}$ is concave in π, and so the matrix of price derivatives, $\tilde{m}^c_\pi$, which equals $\tilde{E}_{\pi\pi}$, is negative definite.[5]

Lemma 2: The derivatives of $\tilde{E}$ with respect to q equal minus the inverse demand functions for the q-goods, expressing their market-clearing prices as functions of the exogenous variables: $\tilde{E}_q(\pi, q, u) = -p(\pi, q, u)$. $\tilde{E}$ is convex in q, and so the matrix of derivatives of the inverse demand functions with respect to the quota levels, p_q, which equals $-\tilde{E}_{qq}$, is negative definite.

Lemma 1 is an application of Shephard's Lemma. Lemma 2 extends a result of Neary and Roberts (1980) from rationing theory. See Anderson and Neary (1992) for formal proofs. Heuristically, these lemmas imply that both the direct net import demand functions for the t-goods and the inverse demand functions for the q-goods slope downwards.

In equilibrium, private-sector spending less GDP, given by the left-hand side of (1), must equal transfers from the government, given by the right-hand side. It is standard to assume that all tariff revenue $t'm$ is redistributed in a lump-sum manner to the aggregate household. However, the same assumption is not plausible in the case of quota rents. Instead, I assume that a fraction ω_j of the quota rents on good j is lost to the domestic economy, so, for example, ω_j is zero in the case of a pure quota and one in the case of a VER. Total quota rents retained at home and redistributed to households therefore equal $\Sigma_j(1 - \omega_j)(p_j - p_j^*)q_j$, or, in matrix form, $(p - p^*)'(I - \underline{\omega})q$. (Here I is the identity matrix and an under-bar denotes a diagonalized vector, so $\underline{\omega}$ is a diagonal matrix with the rent-loss shares on the principal diagonal).

3 The Welfare Effects of Changes in Trade Policy

Equation (1) imposes equality between income and expenditure, and also expresses the level of utility as an implicit function of the policy variables t and q. Hence to derive the welfare effects of trade policy reform we totally differentiate it. (We simplify by using Lemmas 1 and 2 and the fact that $d\pi = dt$. We also assume for the present that the rent-loss parameters ω are constant.) This yields:

$$e_u du = t' dm + (p - p^*)'(I - \underline{\omega})dq - q'\underline{\omega}dp. \tag{2}$$

This equation does not give the full effect of changes in trade policy, because dm and dp are endogenous. Nevertheless, it is very helpful in providing intuition. The left-hand side is the change in utility times the marginal cost of utility, e_u. Consider in turn the three terms on the right-hand side. The first shows that, as in models where tariffs are the only distortion, welfare rises if the tariff-weighted volume of tariff-constrained imports increases, or, equivalently, if tariff revenue rises at the initial tariffs. The second shows that relaxing quotas raises welfare directly (except for VER's where $\omega_i = 1$, so all the rents are lost). Finally, the third term shows that welfare also rises when the domestic prices of quota-constrained goods fall, since (except for pure quotas where $\omega_i = 0$) this reduces total rents and hence reduces transfers to foreigners.

The next step is to use the differentials of $\tilde{E}_\pi$ and $\tilde{E}_q$ from Lemmas 1 and 2 to eliminate dm and dp from (2). This yields the basic equation for the welfare effects of changes in trade policy:

$$\mu^{-1} e_u du = \chi' dt + \rho' dq. \tag{3}$$

The coefficient of the change in real income $e_u du$ can be interpreted as the inverse of the shadow price of foreign exchange, μ, which measures the effect on welfare of a unit transfer of the numeraire good:[6]

$$\mu \equiv \frac{1}{1 - t'\tilde{m}_I + q'\underline{\omega}p_I}. \tag{4}$$

Any increase in real income has a multiplier effect which is greater than one to the extent that it raises demand for tariff-constrained imports. Offsetting this, when the rent-loss parameters ω_i are strictly positive, the multiplier effect is dampened to the extent that increases in demand for quota-constrained goods push up their domestic prices and so increase the amount of rents lost. Because of the combined effect of these influences, μ may be either greater or less than unity. In any case, we assume throughout that it is positive.[7]

The welfare effect of trade reform therefore depends on the coefficients of changes in the policy variables in (3), which we call the *marginal costs of tariffs* χ and the *shadow prices of quotas* ρ respectively:

$$\chi' = t'\tilde{m}^c_\pi - q'\underline{\omega}p_\pi \tag{5}$$

$$\rho' = t'\tilde{m}^c_q + (p - p^*)'(I - \underline{\omega}) - q'\underline{\omega}p_q \tag{6}$$

These formulae generalise the results of Anderson and Neary (1992) to allow for rent-loss parameters which differ across commodities. They are the central equations of the paper.

4 Simultaneous Trade Policy Reform

As explained in the introduction, we seek a rule for simultaneous changes in tariffs and quotas which guarantees a welfare improvement without the need to place restrictions on the structure of the economy. It transpires that such a rule can be devised by combining two results already in the literature. The first is the radial reduction in tariffs result, discussed in the introduction. The second is a result due to Anderson and Neary (1992, Theorem 2′, p. 68), who showed that, in the absence of tariffs, welfare must rise following a uniform relaxation of quotas weighted by their rent-loss parameters. Combining these results, provided both sets of distortions are relaxed at the *same* rate, a welfare improvement is assured.

We first state and prove the new result:

Proposition 1: Assume that the shadow price of foreign exchange is positive. Then a uniform proportionate reduction of tariffs, $dt = -td\alpha$, combined with a uniform proportionate relaxation of quotas weighted by the share of rents lost on each quota-constrained good, $dq = \underline{\omega}qd\alpha$, with both proportionate changes at the same rate (equal to the positive scalar $d\alpha$), must raise welfare.

Proof: Substituting the policy rule into (3), and using (5) and (6) to eliminate χ and ρ, yields:

$$\begin{aligned} \mu^{-1}e_u\frac{du}{d\alpha} &= -\chi't + \rho'\underline{\omega}q \\ &= -t'\tilde{m}^c_\pi t + (p - p^*)'(I - \underline{\omega})\underline{\omega}q - q'\underline{\omega}p_q\underline{\omega}q \end{aligned} \tag{7}$$

All three terms on the right-hand side of this expression are positive scalars, the second because all its individual terms are positive, and the first and third because they are minus quadratic forms in negative definite matrices, from Lemmas 1 and 2 respectively. Hence a welfare gain is guaranteed. Q.E.D.

While the proposition is not difficult to prove, providing intuition for it is more of a challenge. Consider first its mathematical underpinning. Recall from Lemmas 1 and 2 that the function $\widetilde{E}$ is concave in π (and hence, for given world prices, in t) and convex in q. This implies that the second-derivative matrices $\widetilde{E}_{\pi\pi}$ and $\widetilde{E}_{qq}$ are negative definite and positive definite respectively. Hence the expressions $t'\widetilde{E}_{\pi\pi}dt$ and $q'\underline{\omega}\widetilde{E}_{qq}dq$ are both positive when $dt = -td\alpha$ and $dq = \underline{\omega}qd\alpha$, since they are quadratic forms in the positive definite matrices $-\widetilde{E}_{\pi\pi}$ and $\widetilde{E}_{qq}$. Lemma 3 in the Appendix shows that this result can be extended to prove that for such a function the expression $x'\widetilde{E}_{xx}dx$ is also a positive quadratic form, where x is a vector formed by stacking the two vectors t and $\underline{\omega}q$, and dx is such that $dt = -td\alpha$ and $dq = \underline{\omega}qd\alpha$.

Next, to appreciate the economics underlying Proposition 1, consider the individual terms on the right-hand side of (7). From (2), the second term reflects the effects of the quota relaxation at given import volumes m and domestic prices p. Fixing m and p in this way rules out second-best complications, so any quota reform must raise welfare since it reduces the amount of rents lost. A quota reform of the type $dq = \underline{\omega}qd\alpha$ must strictly raise welfare provided that not all quotas have either zero ($\omega_i = 0$) or full ($\omega_i = 1$) rent loss.

As for the first and third terms on the right-hand side of (7), these reflect the direct effects of the tariff and quota reforms. The first term, $-t'\tilde{m}^c_\pi t$, reflects the welfare gain arising from the increase in imports of the t-goods following a uniform proportionate reduction in tariffs. The third term, $-q'\underline{\omega}p_q\underline{\omega}q$, reflects the welfare gain arising from the reduction in domestic prices p of the q-goods (with a consequent fall in rents lost) following a uniform proportionate relaxation of ω-weighted quotas. The fact that these direct effects on welfare are unambiguously positive is well-established in the literature.[8]

The trade reforms also have indirect effects, which might be expected to render their net impact on welfare ambiguous. These indirect effects are captured by two additional terms (not shown in equation (7)) which appear in the full expression for du, and which are indeterminate in sign : $t'\widetilde{m}^c_q\underline{\omega}q$ and $q'\underline{\omega}p_\pi t$. Fortunately, however, these two scalars cancel, because $\widetilde{m}^c_q$ (which equals $\widetilde{E}_{\pi q}$) is the transpose of $-p_\pi$ (which equals $\widetilde{E}_{q\pi}$). In words, the effect of the uniform quota relaxation on tariff revenue is exactly equal to the effect of the uniform tariff reduction on lost quota rents. Crucial for this result is the assumption that both types of trade distortion are relaxed at the *same* rate $d\alpha$. As a result the indirect effects play no role and the net effect of the trade reform on welfare is unambiguously positive.

With one exception, Proposition 1 encompasses as special cases all the results already in the literature for uniform proportionate relaxations of trade distortions in a small open economy.[9] These include the results of Hatta (1977a), Falvey (1988) and Neary (1995) that a uniform proportionate reduction in tariffs raises welfare either when quotas are absent or when all quota rents are retained. They also include the result of Anderson and Neary (1992) that, in the absence of tariffs, a uniform proportionate relaxation of quotas raises welfare with partial rent retention. All these results are corollaries of Proposition 1 which apply only in special cases when one set of trade policy instruments is either absent (no tariffs in the case of quota relaxations only) or benign (full rent retention in the case of tariff reductions only).

The one exceptional result which, strictly speaking, is not nested by Proposition 1, is the result of Corden and Falvey (1985), whereby welfare is raised by any quota reduction provided all rents are retained and there are no tariffs. In such a case the rule $dq = \underline{\omega} q d\alpha$ is clearly degenerate, since ω_i is zero for all i, and so Proposition 1 does not apply. As Corden and Falvey showed in this case, for arbitrary positive dq the change in welfare is proportional to $(p - p^*)' dq$ and so is positive. This shows in turn that, starting from an arbitrary initial distorted equilibrium, it is possible to follow a path of small changes, consisting of reforms of the kind specified in Proposition 1 for tariffs and quotas with partial or full rent-loss, and of the Corden-Falvey kind for quotas with all rents retained, which is guaranteed to raise welfare monotonically towards free trade.

Finally, Proposition 1 highlights the importance in trade policy reform of taking account of the rents lost to the domestic economy. While some authors have argued that this consideration also applies to tariffs (see in particular the discussion of "revenue seeking" by Bhagwati and Srinivasan (1980)), it seems most serious in the case of quotas. This suggests that the model should have implications for the issue of "tariffication": abolishing quantitative restrictions and replacing them by their equivalent tariffs. This policy switch was applied to agricultural trade in the Uruguay Round for example. In the present model, it is equivalent to a combination of two policies: first, a switch from the economy described by equation (1) where behaviour is summarised in terms of the distorted trade expenditure function to an otherwise identical economy expressed in terms of the undistorted trade expenditure function (recall footnote 4); and second, a reduction in the rent-loss parameters ω. The first change is neutral in itself. To see the effects of the second, return to equation (1) and totally differentiate it with respect to ω, which yields:

$$\mu^{-1} e_u du = -\left(p - p^*\right)' \underline{q} d\omega \tag{8}$$

The right-hand side is positive provided $d\omega$ is negative. Reducing the rent-loss parameters in any way (not necessarily proportionally) thus unambiguously lowers the amount of rents lost and raises welfare. After the tariffication process is carried out, so q rather than p adjusts, the welfare effect of changes in ω is also given by (8), except that the shadow price of foreign exchange takes a slightly different form.[10] Thus tariffication of quotas, to the extent that it reduces infra-marginal rent loss, is unambiguously welfare-improving.

5 Conclusion

This paper has presented a new result on simultaneous reform of tariffs and quotas in a distorted small open economy. The policy rule of Proposition 1 involves a uniform proportionate relaxation of all distortions. For practical advice, it has the convenient implication that both tariffs and quotas should be relaxed at the same rate, even though they are measured in different units. It also has the intuitively plausible property that quotas which lose the most rent for the domestic economy should be relaxed fastest. Combining these policy reform rules ensures that second-best problems are avoided and so a welfare gain is guaranteed.

As far as the practical applicability of our results is concerned, uniform proportionate reductions in tariffs and related tariff-cutting formulae have been widely used in previous GATT trade rounds and are a central topic in current WTO negotiations. (See Francois and Martin (2003) for discussion.) Uniform proportionate relaxations of quotas have also been adopted in individual sectors, for example in the Agreement on Textiles and Clothing which formed part of the 1995 Uruguay Round agreement. (See WTO (1996) for a summary and Francois and Woerz (2005) for a review of how the Agreement has operated in practice.) However, these types of reform have not been combined in the past. This highlights one of the key features of the trade reform rule in Proposition 1, namely that it requires all trade policy instruments to be altered at once. On the other hand, it has minimal informational requirements: no parameters of the home economy need be known, and the only assumption which must be made is that the interactions between initial distortions and income effects are not sufficiently perverse that the shadow price of foreign exchange is negative. Though it may not be directly applicable in a particular application, the result provides a benchmark with which actual liberalisation plans can be compared.

Appendix

As noted in the text, the formal underpinnings of Proposition 1 can be expressed as follows:

Lemma 3: Consider a function $F(x)$ where the vector x is partitioned in two and the vector y is a simple transformation of x:

$$x = \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} \qquad \text{and} \qquad y = \begin{bmatrix} -x_1 \\ x_2 \end{bmatrix} \tag{9}$$

If F is strictly concave in x_1 and strictly convex in x_2, then $x' F_{xx} y$ is strictly positive.

Proof: The proof is immediate:

$$
\begin{aligned}
x'F_{xx}y &= x_1'F_{11}y_1 + x_1'F_{12}y_2 + x_2'F_{21}y_1 + x_2'F_{22}y_2 \\
&= -x_1'F_{11}x_1 + x_1'F_{12}x_2 - x_2'F_{21}x_1 + x_2'F_{22}x_2 \\
&= -x_1'F_{11}x_1 + x_2'F_{22}x_2 > 0 \qquad (10)
\end{aligned}
$$

In the last line, $x_1'F_{11}x_1$ is negative because F is strictly concave in x_1 and $x_2'F_{22}x_2$ is positive because F is strictly convex in x_2. Hence the whole expression is strictly positive. Q.E.D.

Lemma 3 does not yield Proposition 1 immediately. It applies directly to the first and third terms in the expression for du in (7). They can be written as $x'F_{xx}y$, where $F = \tilde{E}$, $y_1 = -x_1 d\alpha$ and $y_2 = x_2 d\alpha$, representing a uniform proportionate decrease in x_1 and a uniform proportionate increase in x_2 at the same rate. The additional term in the expression for $du/d\alpha$, $(p - p^*)'(I - \underline{\omega})\underline{\omega}q$, is not covered by the Lemma. Fortunately, all the elements of this term are non-negative, so it does not reverse the result.

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Endnotes

1. Foster and Sonnenschein (1970) provided the first formal proof of the equiproportionate tariff reduction result, assuming that all goods are normal; Bruno (1972) showed that this assumption could be replaced by the much weaker assumption that the shadow price of foreign exchange is positive (see Section 3 below for details); and Hatta (1977a) provided a simple proof using the expenditure function.

2. Other papers which extend the theory of trade liberalization to take account of quotas (or of non-traded goods, which are formally equivalent to prohibitive quotas), include Hatta (1977b), Fukushima (1979), Corden and Falvey (1985), Neary (1995) and Lahiri and Raimondos (1996).

3. The paper uses the following notational conventions: all vectors are column vectors; a prime ($'$) denotes a transpose; and subscripts denote partial derivatives.

4. The distorted trade expenditure function is defined as $\tilde{E}(\pi, q, u) \equiv \min_p[E(\pi, p, u) - p'q]$, where $E(\pi, p, u)$ is the undistorted trade expenditure function. The latter is defined in turn as the difference between the expenditure function $e(\pi, p, u)$ and the GDP function $g(\pi, p)$.

5. Negative definiteness, as opposed to merely semi-definiteness, of the matrix of price derivatives, $\widetilde{m}_\pi^c$, requires some substitutability in excess demand between the different groups of goods. I make this mild assumption throughout, without repeating the qualification.

6. To derive the expression for μ in (4), express the cross-derivatives of $\tilde{E}$ with respect to prices and utility in terms of the derivatives of the distorted Marshallian import demand and virtual price functions with respect to income: $\tilde{E}_{\pi u} = \tilde{m}_I e_u$ and $\tilde{E}_{qu} = -p_I e_u$.

7. A positive value for μ may be rationalised on stability grounds or by invoking a minimal degree of rationality of government policy. Alternatively, we can look for sufficient conditions to sign the individual terms. The term in μ which does not appear in the absence of quotas is $q'\underline{\omega}p_I$. This can be shown to equal $-q'\underline{\omega}E_{pp}^{-1}q_I$. Alternative sufficient conditions for this to be positive are: (a) from Hatta (1977a), that the q-goods are normal in demand and net substitutes; and (b) from Anderson and Neary (1992), that ω_i is the same for all goods and that the q-goods are homothetic in demand and have uniform import shares (so that $q_I = \alpha q/I$, where α is the common import share).

8. Hatta (1977b) and Fukushima (1979) showed that a uniform proportionate reduction in tariffs must raise welfare in the presence of non-traded goods, provided all goods are net substitutes. Falvey (1988)

extended this result to tariff reductions in the presence of quotas with full retention, and Neary (1995) showed that the qualification of net substitutability is unnecessary. As for a uniform proportionate relaxation of ω-weighted quotas, as already noted Anderson and Neary (1992) showed that this must raise welfare in the absence of tariffs.

9. However, it does not encompass the case of unilateral reform of tariffs and quotas in a large economy, as in Neary (1995), nor that of multilateral reforms of tariffs and quotas by a group of countries, as in Woodland and Turunen-Red (2000).

10. To derive the welfare effect of changes in ω after tariffication is carried out, differentiate (1), with the left-hand side equal to the undistorted trade expenditure function, and with m and q equal by Shephard's Lemma to its derivatives with respect to π and p respectively. This yields: $(\mu')^{-1} e_u du = -(p - p^*)' \underline{q} d\omega$, where $\mu' = \left[1 - t' m_I - (p - p^*)' (I - \underline{\omega}) q_I\right]^{-1}$.