Trade Negotiations, Distortions, and Welfare

by

Carsten Kowalczyk

The Fletcher School of Law and Diplomacy

Tufts University

Medford, MA 02155

USA

Telephone: 617.627.5603; Telefax: 617.627.3712

E-mail: CKOWALCZYK@Tufts.Edu

Prepared for December 1999 Seattle Conference: 'WTO and World Trade'

October 1999

Abstract

This paper analyzes unilateral and multilateral reform of *ad valorem* tariffs and subsidies. The paper shows that *radial* reform of *ad valorem* tariffs and subsidies reduces distortion if the subsidy rate exceeds the tariff rate, or if the tariff is so much higher than the subsidy that trade is substantially impeded. For intermediate rates, *radial* reform may raise distortion; but then reducing the tariff before or at a higher rate than the subsidy may reduce distortion. (79 words)

1.   Introduction

It is widely agreed that free trade realizes the largest gains from exchange between nations.   Yet the process of getting there has been a slow one.   Whether trade liberalization is unilateral or multilateral, it is rare to see trade distorting policies abruptly discontinued; more common is that such policies are phased out, sometimes over extended periods of time.[1]   Such gradualism presents an additional dimension to negotiating trade liberalization because, while free trade has the attractive property of creating large enough gains to make it possible -- if an appropriate income transfer mechanism exists -- to improve the well-being of everybody, there is no similarly strong proposition for a partial move in the direction of free trade. It may, therefore, matter for the welfare of nations, and for groups within them, which exact path of reform becomes the outcome of a negotiation of trade liberalization, whether such a negotiation is purely between domestic interest groups, or whether it is between nations in a multilateral round. The challenge to analysts and negotiators is to identify, among the many possible paths of rate reduction, those that do allow for expanded gains from trade along the reform path.[2]

---

[1]   Kowalczyk and Davis (1988) present the evidence on phase-outs for multilateral and preferential agreements.

[2]   I assume, throughout the paper, the existence of paths which allow for gains at every step of the reform. I assume also that the costs of identifying and negotiating such paths are not so large that nations would be better off pursuing simpler rules of rate reduction even if the latter raise distortions. Diewert, Turunen-Red, and Woodland (1989) demonstrate the existence of Pareto improving reform for a small country with no internal redistribution of income, and Turunen-Red and Woodland (1991) present a similar result for a

The notion that liberalization which does not eliminate fully all trade barriers or does not involve all trading partners might not realize added gains from trade has long been familiar to practitioners who, already when negotiating the International Trade Organization, were reluctant to provide for the type of preferential tariff reductions implied by the free trade areas and customs unions that became sanctioned under GATT Article XXIV. It is also an issue which has long been subjected to careful analytic scrutiny, leading to the path-breaking work by Viner (1950), Meade (1955), and Lipsey and Lancaster (1956) who provided the foundation for the theory of second best, and its associated theory of reform.[3]

In part in response to this general difficulty with gradual reform, attention was turned towards seeking particular rate cutting formulae which would yield gains along the implied reform paths for the main trade policy issue of the time: industrial tariffs. The effort yielded two types of reform: reducing extreme tariffs at every step (the *concertina* method), and reducing all tariff rates in the same proportion at every step (the *radial* method). Assuming that goods are substitutes and normal in consumption, Bertrand and Vanek (1971) and Hatta (1977a, b) derived the welfare properties of *concertina* reform for a small country, and Vanek (1964) showed that world welfare would increase if the

---

many country world. I assume, in contrast, that income transfers both within and between nations are feasible.

[3] Kowalczyk (1990, 1998) demonstrates how the problem of preferential trading arrangements should be analyzed by use of techniques from the theory of trade reform. Kowalczyk (1999) uses the theory of reform as an organizing framework for surveying the theory of integration.

concertina principle were applied to a multilateral tariff reduction. Under essentially similar assumptions, Bruno (1972) and Fukushima (1979) showed that *radial* reform of tariffs provides benefits along the reform path for a small open economy, and Hatta and Fukushima (1979) demonstrated formally that multilateral *radial* tariff reduction is also beneficial for world welfare along the adjustment path.[4] It is noteworthy that GATT practices are consistent with these results: It has been, and remains, a stated priority to eliminate "tariff peaks," and each of the Kennedy, Tokyo, and Uruguay Rounds led to equi-proportionate cuts in tariff rates with negotiations over exemptions to such across-the-board reductions.

Due to the Uruguay Round decision to subject agriculture to multilateral trade discipline, a Millennium Round would face the challenge of negotiating trade liberalization when both tariffs and subsidies co-exist. This is a problem which has received only scant attention in the literature. Thus, Kowalczyk (1989) shows that *radial* reform, under some standard conditions, may raise price distortions along a segment of the reform path if rates are *ad valorem*. Fukushima and Kim (1989) show that radial reform reduces distortions if rates are specific.

While a variety of instruments, including specific rates and non-standard ones such as variable levies, are used in the protection and subsidization of agriculture, world trade does display a preponderance of *ad valorem* rates, and an increasing one, as contracting

---

[4] López and Panagariya (1992) argue that importing inputs creates complementarities.

parties continue the process of "tariffication." Therefore, I explore further, in this paper, gradual reform of *ad valorem* tariffs and subsidies.

I begin by demonstrating how changes in national welfare of a small open economy under standard assumptions is well-behaved in changes in price wedges, but not necessarily so in reductions of tariffs or subsidies.[5] I apply this framework to show that one version of the *concertina* result -- that raising the lowest import tariff raises welfare -- requires that every export good must be subsidized at a higher rate than the lowest import tariff, thus making it unlikely to be of policy relevance. I then demonstrate that a given prescription for rate reduction can have different effects on distortions depending on whether the rates are quoted on world or domestic prices. For certain rate configurations, radial reform of an *ad valorem* tariff and subsidy raises welfare if the absolute value of the subsidy exceeds the tariff. If the tariff exceeds the subsidy, then radial reform may increase a distortion somewhere along the path to free trade. I show, however, that in this case there exist alternative paths of rate reductions which do not increase distortions, and that these, in general, call for reducing the tariff at a faster rate than the subsidy.

I extend the analysis to a consideration of world welfare from reform in a two-country world. I show that changes in world welfare depends on the response of a weighted average of bilateral price wedges to the policy changes, and I derive results on how *radial* reform of *ad valorem* tariffs and subsidies affect distortions. These results are quite

---

[5] Foster and Sonnenschein (1970) present a general discussion of the relationship between distortion and welfare.

similar to those discussed for small country reform; in particular, they call, under some circumstances, for tariffs being phased out faster than subsidies.

Section 2 presents an expression for change in national welfare as relative price distortions change. Section 3 applies this framework to consider the effects on national welfare of *concertina* and *radial* reforms of tariffs and subsidies, and it derives an alternative reform path. Section 4 shows that changes in world welfare from reform depends on a weighted average of bilateral price wedges, and it derives world welfare improving paths of tariff and subsidy reform. Section 6 concludes.

2. Small Country Welfare and Price Distortions

Consider a small country inhabited by price-taking consumers and firms with constant returns to scale technologies. The country trades three goods at given world market prices p_i^e ($i = 0, 1, 2$); these prices are summarized by the column vector p^e. Due to *ad valorem* tariffs or subsidies, with the rate τ_i on good i ($i = 0, 1, 2$), each of these prices may differ from the corresponding domestic price p_i ($i = 0, 1, 2$) as given by $p_i = (1 + \tau_i)p_i^e$ ($i = 0, 1, 2$), and as summarized by the column vector p.

Denoting by u the utility level of the representative consumer, by v the vector of the country's factor endowments, which I assume to be fixed, and by m the net trade vector

(net imports as positive and net exports as negative entries), balanced trade at domestic prices requires that spending, as expressed by the expenditure function $e(p,u)$, equals the value of production, expressed by the revenue function $r(p,v)$, plus any tax revenue which I assume is redistributed in lump-sum manner to the consumer:

(1) $$e(p,u) = r(p,v) + (p - p^e)m.$$

Let $d\eta$ be the change in real income as given by $e_u du$. Since $m = m(p,u)$, and since the price derivative of the expenditure function, e_p, is compensated demand, and the price derivative of the revenue function, r_p, is supply, $m = e_p - r_p$. Differentiation of $m = m(p,u)$ therefore yields $dm = m_p dp + m_u du$, where m_p is the 3x3 symmetric substitution matrix with components m_{ij} (i, j = 0, 1, 2) expressing the change in compensated import demand for good i (i = 0, 1, 2) with respect to a change in the price of good (j = 0, 1, 2). If y denotes the country's income, equal to minimum expenditure, then $m_u = m_y e_u$. Define $I = 1 - \sum_{i=0}^{2} \tau_i p_i^e m_{iy}$, which is positive if no good is inferior in consumption or if a gift of real income raises utility, and define $d\vartheta = Id\eta$ to be the implied change in the country's welfare.[6] Expression (1) can then, after differentiation and after re-arranging terms, be written as

---

[6] See Bruno (1972).

$$(2) \qquad d\vartheta = \sum_{i=0}^{2} \tau_j p_i^e \left(\sum_{j=0}^{2} m_{ij} p_j \, d\tau_j \right).$$

Define the compensated price elasticity of import demand for good i with respect to a change in the price of good j as

$$(3) \qquad \varepsilon_{ij} = \frac{\partial m_i}{\delta p_j} \frac{p_j^e}{m_i}, \qquad\qquad i, j = 0, 1, 2,$$

where goods i and j are substitutes if $\varepsilon_{ij} > 0$.

Using the homogeneity conditions,

$$(4) \qquad \sum_{j=0}^{2} m_{ij} p_j = 0, \qquad\qquad i = 0, 1, 2,$$

and denoting the rate of change of a variable by a circumflex ($\hat{z} \equiv dz / z$), it is possible to rewrite (2) as follows:

$$(5) \qquad d\vartheta = -(m_0 p_0^e)\varepsilon_{01}\left(\frac{p_1 - p_1^e}{p_1^e} - \frac{p_0 - p_0^e}{p_0^e} \right)\{\hat{p}_1 - \hat{p}_0\}$$

$$-(m_0 p_0^e)\varepsilon_{02}\left(\frac{p_2 - p_2^e}{p_2^e} - \frac{p_0 - p_0^e}{p_0^e} \right)\{\hat{p}_2 - \hat{p}_0\}$$

7

$$-(m_1 p_1^e)\varepsilon_{12}\left(\frac{p_2 - p_2^e}{p_2^e} - \frac{p_1 - p_1^e}{p_1^e}\right)\{\hat{p}_2 - \hat{p}_1\}.$$

This expression constitutes a useful framework for understanding how trade policy reform, which I define here in a general sense to mean a change in trade policy, affects welfare for a small open economy whose consumers and producers operate under perfect competition. Reform affects welfare through affecting a weighted sum of changes of price distortions.

A distortion exists between goods i and j if $\left(\frac{p_i - p_i^e}{p_i^e} - \frac{p_j - p_j^e}{p_j^e}\right)$ or, equivalently, $(\tau_i - \tau_j)$ is different from zero. The weight applied to any pair of goods i and j is the product of the non-negative value of trade of good j and the price elasticity of good i with respect to good j. If goods i and j are substitutes then moving the domestic prices p_i and p_j towards each other will contribute positively to welfare in the partial sense of closing the gap between them. Thus, if $(\tau_i - \tau_j)$ is positive, reducing p_i or raising p_j will have a positive partial effect on welfare, while if $(\tau_i - \tau_j)$ is negative, raising p_i or lowering p_j will. The effect is partial in the sense that, when many goods are considered, the change in a domestic price p_i affects welfare by either increasing or reducing the wedges relative to all other goods. As seen from expression (5), for two goods i and j, only if (a) there is no distortion, (b) there is no trade, or (c) the compensated cross-price elasticity is zero,

will changing the wedge between the two prices p_i and p_j have no partial welfare contribution.

Expression (5) generalizes in straightforward manner to the small country trading $(n+1)$ goods, indexed by $i = 0, 1, ..., n$. Define $\Omega_{ij} = -\frac{1}{2}(m_i p_i^e)\varepsilon_{ij}$ $(i, j = 0,1, ..., n)$, where the $\frac{1}{2}$ adjusts for the double-counting implied by the fact that the following expression, for a given pair of values of i and j, contains both $\Omega_{ij}\left(\dfrac{p_j - p_j^e}{p_j^e} - \dfrac{p_i - p_i^e}{p_i^e}\right)\{\hat{p}_j - \hat{p}_i\}$ and

$\Omega_{ji}\left(\dfrac{p_i - p_i^e}{p_i^e} - \dfrac{p_j - p_j^e}{p_j^e}\right)\{\hat{p}_i - \hat{p}_j\}$ which, due to symmetry of the substitution matrix, are identical terms. Then,

$$(6) \qquad d\vartheta = \Omega_{01}\left(\frac{p_1 - p_1^e}{p_1^e} - \frac{p_0 - p_0^e}{p_0^e}\right)\{\hat{p}_1 - \hat{p}_0\} \; + \; ... \; + \; \Omega_{0n}\left(\frac{p_n - p_n^e}{p_n^e} - \frac{p_0 - p_0^e}{p_0^e}\right)\{\hat{p}_n - \hat{p}_0\}$$

$$+$$

$$.$$
$$.$$
$$.$$

$$+ \; \Omega_{n0}\left(\frac{p_0 - p_0^e}{p_0^e} - \frac{p_n - p_n^e}{p_n^e}\right)\{\hat{p}_0 - \hat{p}_n\} \; + ... + \; \Omega_{nn-1}\left(\frac{p_{n-1} - p_{n-1}^e}{p_{n-1}^e} - \frac{p_n - p_n^e}{p_n^e}\right)\{\hat{p}_{n-1} - \hat{p}_n\}.$$

Expression (6) implies the following result:

Proposition 1. If all goods are net substitutes, a reform of tariffs and subsidies raises welfare if the weighted sum of reduced price distortions exceeds the weighted sum of increased price distortions where the weights are trade-weighted cross-price elasticities.

While expression (6) reveals a regularity -- and an appealing intuition -- for the relationship between change in welfare and changes in distortions, it also shows that, in general, much empirical work is required to determine the effect from reform: all trade values, all distortions (tariffs and tariff-equivalent quotas), and all cross price elasticities. I turn next to investigating two sets of reform which require less information if some strong assumptions on cross-price elasticities hold.

3. Reform of Tariffs and Subsidies, Distortions, and National Welfare

There are various statements and interpretations of the welfare from *concertina* reform. I propose defining the following versions of *concertina* reform and associated welfare statements:

Concertina Reform of Distortions: If an extreme good is a substitute for all other goods, reducing an extreme distortion raises welfare.

Concertina Reform of Tariffs: If an extreme good is a substitute for all other goods, lowering the highest tariff or raising the lowest tariff raises welfare.

Assume that initial *ad valorem* distortions are such that,

(7) $$\tau_0 \leq \tau_1 \leq ... \leq \tau_n.$$

The *Distortions Version* of the *concertina* rule follows immediately from expression (6): reducing τ_n lowers p_n which, in turn, reduces all distortions involving good n, while raising no distortions, as good n is assumed to be a net substitute relative to every other good. By similar reasoning, raising τ_0 raises p_0 and thus welfare, if good 0 is a net substitute relative to every other good.

Consider next the *Tariff Version* of the *concertina* rule. If the highest tariff good n is a net substitute to every other good then lowering τ_n lowers p_n and welfare increases. Obviously, yet importantly, this requires that good n in (7) above is an import; in particular, good n cannot be an export because, if it were, then lowering the highest tariff, which would now be on (n-1), would not imply lowering the highest rate in the economy. So the statement that lowering the highest tariff raises welfare requires also that no export good is subsidized at a higher *ad valorem* rate than the highest import tariff.

Consider the similar reasoning applied to the statement that raising the lowest tariff raises welfare: Raising the lowest tariff reduces price distortions relative to every other price only if good 0 in (7) is an import -- in particular, it cannot be an export because, if it were, then raising its tariff would further lower its price which would reduce welfare. But then the statement that raising the lowest tariff raises welfare requires that *every export*

11

good is subsidized at a higher ad valorem rate than the lowest import tariff. In a many-good world, this is a far less appealing restriction than the one required for the reduction of the highest tariff rate, suggesting that the "raising the lowest tariff rate raises welfare" part of the *Tariff Version* of the concertina result has little practical relevance.[7]

Proposition 2. If (a) the extreme goods are net substitutes relative to every other good, and (b) every export good is subsidized at a rate higher than the lowest *ad valorem* tariff rate but lower than the highest *ad valorem* tariff rate, then reducing the highest import tariff or raising the lowest import tariff will raise welfare.

I consider next reform involving the simultaneous reduction of tariffs and subsidies, and I assume, at the outset, that the small country trades only two goods, importing good 1 and exporting good 2. From (5), a reform of one or both of the policy rates affects welfare through

(8) $$d\vartheta = -B(\tau_2 - \tau_1)\{\hat{p}_2 - \hat{p}_1\},$$

where $B \equiv m_{12} p_1^e p_2^e > 0.$

For given p_1^e and p_2^e, define α to be an index of distortion given by,

---

[7] Neary (1998) reaches a similar conclusion through the very different route of assuming that there is a good which is neither taxed nor subsidized, an assumption which would make it impossible for the lowest taxed good to be the extreme good 0 in the string of inequalities in (7).

(9)
$$\alpha = \frac{p_2 / p_2^e}{p_1 / p_1^e},$$

Welfare is maximized when there is no distortion, i.e., when $\alpha = 1$. Welfare falls monotonically as α increases or falls away from unity.

Consider a proposal to reduce both the tariff and the subsidy rate by the same proportion, implying that

(10)
$$\hat{\tau}_1 = \hat{\tau}_2.$$

If rates are quoted as percentages of world market prices, then

(11)
$$\alpha = \frac{1 + \tau_2}{1 + \tau_1},$$

and any equi-proportionate rate reduction, regardless of the signs of τ_1 and τ_2, will move α monotonically towards one. Thus no paradox, in the sense that α moves away from one and hence welfare falls from a rate reduction, is possible for this configuration of rate quotations.

If, instead, the tax or subsidy on export good 1 is quoted as a percentage of the domestic price, then $(1 + v_1)p_1 = p_1^e$, where $v_1 > 0$ is an export tax, and $v_1 < 0$ is an export subsidy. In this case, (10) becomes

(12) $$\alpha = (1 + \tau_2)(1 + v_1).$$

This describes indifference curves in $(1 + \tau_2)(1 + v_1)$-space, each curve corresponding to a given value of α.[8] Figure 1 shows these curves as hyperbolae, with the maximum-valued one, denoted by CC, intersecting point $(1,1)$. Setting $\alpha = 1$, CC is described by,

(13) $$1 + \tau_2 = 1/1 + v_1.$$

A reform of equi-proportionate rate reductions, i.e., *radial* reform, implies a path of reform along a line from the point implied by the initial rates to point $(1,1)$. If both goods are taxed, or if both are subsidized, reducing rates by the same proportion raises welfare at every step of the reform path. This is also the case if the absolute value of the subsidy exceeds the tariff such as to bring the economy below KK, which is a line with slope negative one. However, if rates are such that the economy is above KK and below TT, where TT is the locus of tangency points between rays from the origin and indifference curves, then a *radial* reform path will traverse the area between CC and TT, and raise any price distortion.

---

[8] See Kowalczyk (1989).

The locus *TT* is described by the equation

(14) $$(1 + \tau_2) = 1/(2 - 1/(1 + v_1)).$$

The condition that a point lies above *CC* and below *TT* is that

(15) $$1/1 + v_1 < (1 + \tau_2) < 1/(2 - 1/(1 + v_1)).$$

The following rates indicate that the region of paradox includes some realistic tariff and subsidy combinations:

v_1 percent:	10	25	100	200
τ_2 percent:	8-9	17-20	33-50	40-67

I investigate next radial reform in a world of three goods, and consider the special case where good 0 is neither taxed nor subsidized. It follows from (5) that the change in welfare is given by

(16) $$d\vartheta = -(m_0 p_0^e)\varepsilon_{01}\left(\frac{p_1 - p_1^e}{p_1^e}\right)\hat{p}_1$$

$$-(m_0 p_0^e)\varepsilon_{02}\left(\frac{p_2 - p_2^e}{p_2^e}\right)\hat{p}_2$$

$$-(m_1 p_1^e)\varepsilon_{12}\left(\frac{p_2 - p_2^e}{p_2^e} - \frac{p_1 - p_1^e}{p_1^e}\right)\{\hat{p}_2 - \hat{p}_1\}.$$

The first two terms capture the effects of the reform through the changes in the wedges

relative to good 0. Thus reducing the subsidy on good 1 lowers p_1 which, since $\dfrac{p_1 - p_1^e}{p_1^e}$

is positive, raises welfare by increasing the distortion relative to untaxed good 0. Since

$\dfrac{p_2 - p_2^e}{p_2^e}$ is positive, reducing the tariff on good 2, which reduces p_2 also raises welfare by

reducing the distortion relative to good 0. The last term captures the effect from the

reform on the distortion between goods 1 and 2. Assuming that $\left(\dfrac{p_2 - p_2^e}{p_2^e} - \dfrac{p_1 - p_1^e}{p_1^e}\right) > 0,$

reducing the tariff on good 2 reduces the distortion and raises welfare. However,

reducing the export subsidy on good 1, by raising p_1, expands this wedge and therefore

lowers welfare. This effect would be large, and the effects relative to good 0 small if the

value of trade in good 1 is large relative to the value of trade in good zero, and if goods 1

and 2 are highly substitutable.

The analysis can be summarized as follows:

Proposition 3. If a small country's *ad valorem* rates are quoted both in terms of world

market and domestic price then (i) if the subsidy rate exceeds the tariff rate, *radial* reform

reduces distortion; (ii) if the tariff rate exceeds the subsidy rate but the net effect is to

subsidize trade, *radial* reform can reduce distortion to zero from which point rates can be

reduced to maintain no distortion; (iii) if the tariff rate exceeds the subsidy rate but trade

is on net only slightly impeded, *radial* reform may raise distortion; reducing the tariff to its no-distortion level and then reducing both rates to maintain no distortion reduces distortion at every step during reform; (iv) if the tariff rate exceeds the subsidy rate and trade is heavily impeded, *radial* reform reduces distortion.

4.   World Welfare

I consider, finally, the welfare analysis of multilateral tariff reform, and I begin with the simplest case of two countries, with the home country, denoted by superscript H, importing good 1 from and exporting good 2 to the foreign country, denoted by superscript F.   The market clearing conditions provide two equations in home country utility, u^H, foreign country utility, u^F, and the relative world market price p_1^e / p_2^e:

$$(17) \qquad\qquad\qquad m_i^H + m_i^F = 0, \qquad\qquad\qquad i = 1, 2.$$

As is standard in this literature, I apply the potential Pareto criterion as the world welfare criterion by assuming that lump-sum income transfers can be used to fix foreign country utility at its initial level, u^F.   Equation (17) can then be solved for u^H and p_1^e / p_2^e. Dropping superscript H from u^H, world welfare is defined to have increased (fallen) if u has increased (fallen).

Let $p^k = p_1^k / p_2^k$ denote the relative price of good 1 in terms of good 2 in country k. Differentiation of (17), using the homogeneity conditions, yields

$$(18) \qquad\qquad du = -\tilde{B}(p^H - p^F)\{\hat{p}^H - \hat{p}^F\}$$

where $\tilde{B} = -(1/|A|)p^H m_{11}^H m_{11}^F > 0$, since $|A|$ is a negative-valued determinant of the matrix of the home country's utility and price derivatives, and m_{11}^k ($k = H, F$) is the negative-valued compensated own-price derivative of import demand for good 1.[9] This expression implies that, whether the initial wedge $(p^H - p^F)$ is positive or negative, i.e., whether trade is on net tax or subsidized initially, a reform raises world welfare if it reduces the gap between the domestic prices.

It follows from (18) that if both countries levy tariffs or both levy subsidies then an equi-proportionate reduction of both rates (*radial* reform), or the reduction of one of them, raises world welfare. If, however, one country subsidizes while the other one taxes trade, *radial* reform involving an equi-proportionate reduction of both rates may reduce world welfare along a segment of the reform path in analogous fashion to the earlier discussion of the single country.

This can be seen from figure 1 as it can be applied to this analysis by measuring $(1 + \tau_1^H)$ rather than $(1 + v_1)$ on the horizontal axis, and $(1 + \tau_2^F)$ on the vertical axis. By analogy to the earlier discussion of the small country, an equi-proportionate reduction of a

tariff and a subsidy defines a linear reform path connecting the initial tariff-subsidy point with global free trade (given by (1,1) in the figure). If the tariff and subsidy rates are such that the world economy is below *KK*, corresponding to the absolute value of the subsidy rate exceeding the tariff rate, then *radial* reform reduces distortions throughout the reform path. However, if the rates are above *KK* and below *TT*, where *TT* is now a locus connecting all the points of tangency between rays from the free trade point (defining *radial* reform paths) and world welfare indifference curves, then a radial reform path will traverse the area between *CC* and *TT* where distortions expand. In this region there are two opposing effects on world welfare: a tariff reduction which, for given subsidy, raises welfare, and a subsidy reduction which, for given tariff, lowers welfare. The overall effect on welfare depends, therefore, on which force is stronger as measured by whether the distance between the two countries' domestic prices expand or contract.

The figure reveals that there are other reform paths which would raise welfare at every step. For points above *KK* and below *CC*, one such path would be radial reduction until *CC* is reached, and then reducing both rates along *CC*. For points above *CC*, reducing the tariff until *CC* is reached and then moving along *CC* would do likewise. The informational requirement for this path is hardly prohibitive -- it is *CC* which is the first-best relationship between rates as given by

(19)
$$1 + \tau_1^H = 1/1 + \tau_2^F .$$

---

[9] See Kowalczyk (1989) for further details.

I want to consider next what is the effect on the likelihood of this paradox from expanding the dimensionality of the commodity space. I introduce, therefore, an additional good which I denote 0. I make the additional assumption that it is neither taxed nor subsidized by either country. The corresponding market clearing conditions

(20) $$m_i^H + m_i^F = 0, \qquad\qquad i = 0, 1, 2,$$

determine u and the two relative prices, p_1^e / p_0^e and p_2^e / p_0^e.

Differentiation of (17) and extensive manipulation yields,

(21) $$du = [-B_{01}(p_1^H / p_0^H - p_1^F / p_0^F) - B_{12}(p_1^H / p_2^H - p_1^F / p_2^F)]\{\hat{p}_1^H - \hat{p}_1^F\}$$

$$[-B_{02}(p_2^H / p_0^H - p_2^F / p_0^F) - B_{21}(p_2^H / p_1^H - p_2^F / p_1^F)]\{\hat{p}_2^H - \hat{p}_2^F\}$$

where,

$$B_{01} = -\sum_k [m_{01}^k \sum_{\substack{i \\ j \neq l \neq i}} m_{ij}^{-k} m_{il}^{-k} p_i^{-k}] p_0^H p_0^F,$$

$$B_{12} = -\sum_k [m_{12}^k \sum_{\substack{i \\ j \neq l \neq i}} m_{ij}^{-k} m_{il}^{-k} p_i^{-k}] p_2^H p_2^F,$$

$$B_{02} = -\sum_k [m_{02}^k \sum_{\substack{i \\ j \neq l \neq i}} m_{ij}^{-k} m_{il}^{-k} p_i^{-k}] p_0^H p_0^F,$$

20

and
$$B_{21} = -\sum_{k}[m_{21}^{k}\sum_{\substack{i \\ j \neq l \neq i}}m_{ij}^{-k}m_{il}^{-k}p_{i}^{-k}]p_{1}^{H}p_{1}^{F}$$

are non-negative coefficients, when it is assumed that all goods are substitutes.

Consider the first line in (21) which captures the effect from the two countries changing their rates on good 1. As in the two-good case in (18), the relative change in the price wedge is weighted by the initial wedge. However, with three goods, the initial wedges between the countries' domestic prices of good 1 are now two, namely one wedge for the price of good 1 relative to good 0, and another wedge for the price of good 1 relative to good 2. Initial rates may imply the same or opposite signs of these wedges. The interpretation of the second line in (21), which captures the effect from the countries changing their rates on good 2, is analogous.

To investigate the scope for the tariff-subsidy paradox, I consider the simplest possible setting where the home country levies a tariff on its imports of good 1, i.e., $\tau_1^H > 0$, the foreign country subsidizes its imports of good 2, i.e., $\tau_2^F < 0$, and all other rates are zero, i.e., $\tau_2^H = \tau_0^H = \tau_1^F = \tau_0^F = 0$. These assumptions imply that $(p_1^H / p_0^H - p_1^F / p_0^F)$ and $(p_2^H / p_0^H - p_2^F / p_0^F)$ are both positive. The two remaining wedges, $(p_1^H / p_2^H - p_1^F / p_2^F)$ and $(p_2^H / p_1^H - p_2^F / p_1^F)$, are of opposite signs. To fix ideas, suppose that τ_1^H and τ_2^F are such that $(p_1^H / p_2^H - p_1^F / p_2^F) > 0$, i.e., the home country tariff on good 1 exceeds the foreign country subsidy on good 2 to the extent that the home country relative price of

good 1 exceeds that in the foreign country. It follows from (21) that a reduction in τ_1^H reduces the wedge between the home country's price of good 1 and the foreign country's price of good 1 regardless of whether these prices are measured relative to good 2 or relative to good 0. Reducing τ_1^H raises, therefore, world welfare. Expression (21) reveals further that reducing country F's import subsidy τ_2^F, which implies $\hat{p}_2^F > 0$, reduces the wedge between the home and foreign prices of good 2 as measured relative to good 0, which raises welfare, but raises the wedge between the prices of good 2 as measured relative to good 1, which reduces welfare.

Compared to the two-good analysis, adding another good, and, in particular, assuming that the added good is neither taxed nor subsidized thus introduces additional wedges which, in particular, have the effect that any rate reduction, whether of a tariff or a subsidy, by being a move towards zero -- which is also the rate on good zero -- raises welfare. Adding untaxed goods thus amounts to adding potentially positive welfare effects which, in turn, reduces the likelihood of parameter constellations which will yield an overall negative welfare effect from a *radial* reduction of tariffs and subsidies. Adding instead goods which are taxed or subsidized would also imply additional wedges but possibly of different signs which could make it more rather than less likely that parameter values would support a paradox from *radial* reform.

Finally, and just as for the two-good case, there exist for the three-good case alternatives to the *radial* reform path which would raise world welfare at every step. One such reform path would be to reduce τ_1^H until $(p_1^H / p_2^H - p_1^F / p_2^F)$ and $(p_2^H / p_1^H - p_2^F / p_1^F)$

in (21) are zero, and then to reduce τ_1^H and raise τ_2^F (which reduces the subsidy) while maintaining the equality of the two countries' relative prices.

By analogy to the small country analysis, we have for multilateral reform:

Proposition 4. If two countries levy *ad valorem* tariffs and subsidies then (i) if the subsidy rate exceeds the tariff rate, *radial* reform reduces distortion; (ii) if the tariff rate exceeds the subsidy rate but the net effect is to subsidize trade, *radial* reform can reduce distortion to zero from which point rates can be reduced to maintain no distortion; (iii) if the tariff rate exceeds the subsidy rate but trade is on net only slightly impeded, *radial* reform may raise distortion; reducing the tariff to its no-distortion level, and then reducing both rates to maintain no distortion reduces distortion at every step during reform; (iv) if the tariff rate exceeds the subsidy rate and trade is heavily impeded *radial* reform reduces distortion.

5.   Conclusion

This paper has demonstrated how tariff reform affects national and world welfare through changes in relevant price wedges.

The paper has sharpened the notion of *concertina* reform by stressing the difference between extreme rates and extreme distortions, and it has argued that any proposition that raising an import tariff is welfare improving, whether considered in its national or multilateral version, requires that initial trade is extensively subsidized. It is shown, for

example, that the single country version of that proposition requires that *all* exports of a nation are subsidized at a higher rate than the lowest tariff rate.

The paper has also shown that, while *radial* reform which reduces simultaneously tariffs and subsidies has the potential to expand some price wedges, a larger number of goods and limited initial subsidization could combine to reduce the significance of this issue. Indeed, the simplicity and apparent "fairness" of *radial* reform (both parties change policies simultaneously, with change in a rate being larger the further is that rate from free trade) may outweigh any difficulties and costs associated with identifying and negotiating alternative, more complicated rules. This paper has not considered such difficulties or costs. Yet, while recognizing that simple rules of reform are hard to come by, the analysis does suggest that, if trade is initially impeded, cutting tariffs by relatively more than subsidies, at least at the early stages of reform, may prove fruitful as compared to more conventional *radial* reform.

REFERENCES

Bertrand, Trent and Jaroslav Vanek (1972): "The Theory of Tariffs, Taxes and Subsidies: Some Aspects of the Second Best," *American Economic Review* 61, 925-931.

Diewert, W. Edwin, Arja H. Turunen-Red, and Alan D. Woodland (1989): "Productivity and Pareto-Improving Changes in Taxes and Tariffs," *Review of Economic Studies* 56, 199-215.

Foster, Edward and Hugo Sonnenschein (1970): "Price Distortion and Economic Welfare," *Econometrica* 38, 281-297.

Fukushima, Tatsuhiro (1979): "Tariff Structure, Nontraded Goods and Theory of Piecemeal Policy Recommendations," *International Economic Review* 20, 427-435.

Fukushima, Tatsuhiro and Namdoo Kim (1989): "Welfare Improving Tariff Changes: A Case of Many Countries and Many Goods," *Journal of International Economics* 26, 383-388.

Hatta, Tatsuo (1977a): "A Theory of Piecemeal Policy Recommendations," *Review of Economic Studies* 44, 1-21.

Hatta, Tatsuo (1977b): "A Recommendation for a Better Tariff Structure," *Econometrica* 45, 1859-1869.

Hatta, Tatsuo and Takashi Fukushima (1979): "The Welfare Effect of Tariff Rate Reductions in a Many Country World," *Journal of International Economics* 9, 503-511.

Kowalczyk, Carsten (1989): "Trade Negotiations and World Welfare," *American Economic Review* 79, 552-559.

Kowalczyk, Carsten (1990): "Welfare and Customs Unions," National Bureau of Economic Research Working Paper No. 3476.

Kowalczyk, Carsten (1992): "Paradoxes in Integration Theory," *Open Economies Review* 3, 51-59.

Kowalczyk, Carsten (1998): "Welfare and Integration," *International Economic Review*, forthcoming.

Kowalczyk, Carsten (1999): "Introduction," in Carsten Kowalczyk (ed.): *Economic Integration and International Trade*. International Library of Critical Writings in Economics. Cheltenham, U.K.: Edward Elgar Publishing Ltd., forthcoming.

Kowalczyk, Carsten and Donald Davis (1998): "Tariff Phase-Outs: Theory and Evidence from GATT and NAFTA," in Jeffrey A. Frankel (ed.): *The Regionalization of the World Economy*, Chicago: The University of Chicago Press.

Lipsey, Richard G. and R. Kelvin Lancaster (1956): "The General Theory of Second Best," *Review of Economic Studies* 24, 11-32.

López, Ramón and Arvind Panagariya (1992): "On the Theory of Piecemeal Reform: The Case of Pure Imported Intermediate Inputs," *American Economic Review* 82, 615-625.

Meade, James (1955): *Trade and Welfare*, London: Oxford University Press.

Neary, J. Peter (1998): "Pitfalls in the Theory of International Trade Policy: Concertina Reforms of Tariffs, and Subsidies to High-Technology Industries," *Scandinavian Journal of Economics* 100, 187-206.

Turunen-Red, Arja H. and Alan Woodland (1991): "Strict Pareto-Improving Multilateral Reforms of Tariffs," *Econometrica* 59, 1127-1152.

Vanek, Jaroslav (1964): "Unilateral Trade Liberalization and Global World Income," *Quarterly Journal of Economics* 78, 139-147.

Viner, Jacob (1950): *The Customs Union Issue*, New York: Carnegie Endowment for International Peace.
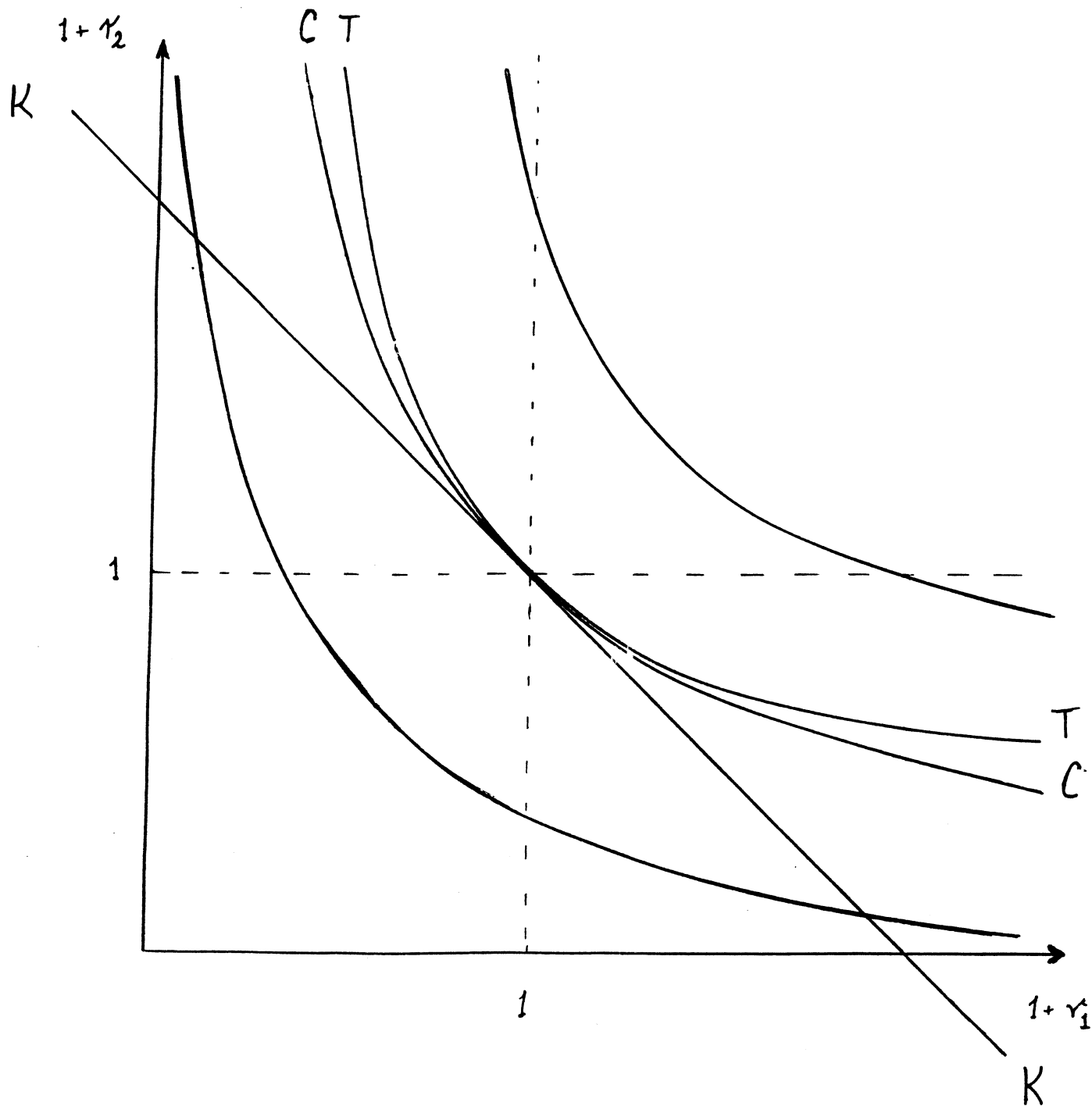
Figure 1