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ABSTRACT

This paper calculates international income transfers which implement a Pareto optimal trade equilibrium in a world where many countries trade many goods.

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1. Introduction

The preamble to the General Agreement on Tariffs and Trade expresses the belief that a liberal and non-discriminatory world trading system will raise welfare. Consequently GATT has, ever since its inception in 1947, played several roles in the pursuit of global free trade: It has helped design rules for the conduct of international commerce, and it has helped enforce these rules. It has also periodically revisited them through rounds of multilateral trade negotiations.

In spite of its noble goal and many activities, GATT has in recent years been subjected to increasing criticism. It has been accused of being irrelevant, and of being a "General Agreement to Talk and Talk." It has even been accused of being dead. Signs of its diminishing role are already visible as even traditional "globalists," like the United States, are beginning to re-direct their political efforts towards "regional" integration.[1] It could

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[1] Unilateral and plurilateral initiatives can of course promote rather than hinder a liberal trading order. Thus a unilateral threat of tariffs by a large country can be used to pry open otherwise closed foreign markets, and preferential arrangements

be argued that these are just signs that the institution has outlived itself, and that it should be allowed to fade away. Against that goes that GATT remains a unique forum where nations can exchange trade policy concessions. The world remains ridden with policies aimed at distorting international trade, and threats of trade conflicts abound. It seems to us that trying to reform the institution holds far more promise for the world trading system.

One of GATT's problems is that much of the world's trade remains outside of its jurisdiction due to waivers, as prominently exemplified by agriculture and textiles, or due to a lack of rules, as exemplified by trade in services. A second difficulty is that GATT has shown itself unable to impose effective discipline on the use of non-tariff policies. In some cases, such as anti-dumping, GATT policy is too permissive, in other cases countries disguise their trade policy as domestic intervention.[2] A third problem is that it

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-- of which regional ones constitute one example -- certainly have the potential for being stepping stones to global free trade.

[2] The Dunkel Draft addresses both types of omissions. It attempts to bring agriculture and textiles back under GATT discipline, and it contains proposals on both TRIPs and TRIMs. It creates also a new body entitled the Multilateral Trade Organization whose members would accept not only the Dunkel Draft in its

appears to have become increasingly difficult to reform the system; in particular, it seems to have become harder to complete in timely and successful manner a trade negotiation round. The 1947 Geneva Round had 23 participants and lasted less than a year. The second to last round, the Tokyo Round, had 99 participants, took seven years to complete, and even then was not a complete success as it did not manage to get unanimous support for the important subsidies code.[3] The Uruguay Round, which was launched in September 1986, has more than one hundred participants and remains ongoing.[4] [5]

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entirety but also the Tokyo Round Subsidies Code, a new Disputes Settlement Understanding, and a Trade Policy Review Mechanism.

[3] Ten years after its completion only twenty-four countries had ratified the subsidies code. (See John Jackson (1989)).

[4] The Atlantic Council of the United States (1976) recommended in its GATT Plus proposal that assigning votes to contracting parties according to their role in world trade instead of the current system of one nation-one vote, would enable GATT to work faster and more effectively. Robert Baldwin (1992) has revisited the idea most recently.

[5] An additional problem with GATT's current emphasis on unanimity has been pointed out in Kowalczyk (1990), who shows, contrary to conventional wisdom, that a small country prefers a preferential trading arrangement to unilateral free

This paper investigates how adopting a financial mechanism funded by the member countries could help GATT become more effective in solidifying already obtained gains, as well as in further reforming the world trading system. It is quite likely that the informal give and take that goes on during a multilateral trade negotiation round involves promises or threats of changes in, for example, foreign aid. However, there is no tradition in GATT for encouraging or for channeling transfers of income in the context of a trade round. This stands in interesting contrast to recent practices in Europe where both the EC and EFTA have used international income transfers in connection with adjustments of trade policy. Thus the EC's budget is a channel for some income redistribution, as exemplified by the European Regional Development Fund. EFTA has also used income transfers to facilitate changes in trade policy. Its Nordic members extended a $14 million interest free loan to Iceland upon the latter's accession to EFTA in 1970, and when Portugal, one of the founders of EFTA, re-joined the organization in 1975, the other member countries agreed to establish a $100 million industrialization fund which would issue loans at 3% per year.[6]

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trade, and furthermore that it might prefer joining an exclusive customs union or free trade area to supporting a global effort at liberalizing trade.

[6] The European Free Trade Association (1987).

Most recently, the May 1992 Agreement on the European Economic Area between the EC and EFTA establishes a financial mechanism which transfers about 145 million ECUs per year over a period of five years from members of EFTA to members of the EC.[7] As percentages of income these transfers are quite insignificant.[8] Yet their existence and the apparent ease with which members of EFTA and members of the EC on several occasions have managed to negotiate major adjustments of trade policies suggest that the ability to use such payments could prove helpful in a negotiation.

There is a simple and compelling theoretical reason why income transfers would make a difference. Harry Johnson (1953) showed that a country might want to deviate from free trade even if its trade partner retaliates. Due to the assumed Pareto optimality of unimpeded trade the losing country would be willing and able to pay an amount up to its loss relative to global free trade if, in return, the partner would agree to re-establish free trade. Both countries would gain relative to the tariff-ridden situation.

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[7] The European Community (1992).

[8] Richard Baldwin (1992) estimates that the annual costs to EFTA from its transfer to the EC are less than one percent of EFTA's income in 1992.

The difficulty in this argument is not *conceptual* but rather *computational*. In a world where many countries trade many goods, who should pay whom, and how much, for Pareto optimal world trade to be implemented? Theoretical work on tariff reform and customs unions routinely assumes, for the purpose of discussing coalition welfare, the possibility of international income transfers. However, only two papers have explicitly dealt with international transfers of income in the context of trade policy: In a celebrated paper Murray Kemp and Henry Wan (1976) showed the existence of intra-club transfers that would raise welfare of all members of a customs union that otherwise set its external tariff such as to leave non-members indifferent. Earl Grinols (1981) made the transfers required for this result more transparent when showing that if each member receives or pays a transfer equal to its pre-change intra-club trade then no member will be hurt from the expansion of the club.

We construct an n-country world economy. Each country is inhabited by consumers and by a monopoly firm producing a single good. We assume that GATT's objective is to establish globally Pareto optimal international trade. However, a coalition of any size has the ability to block first best trade. We use the characteristic function from cooperative game theory to calculate payoffs as various coalitions form, and we derive the income transfer scheme that implements the Shapley value which, in our model, has

the important property of constituting a payoff vector that no coalition of countries would want to prevent.

Our model shares many features with Daniel Gros' (1987) analysis of tariffs in a Krugman-type model of monopolistic competition. The most important difference is that while Gros assumes that preferences are linear, which implies non-zero cross price effects, we assume quasi-linear preferences implying no cross price effects. We assume this form of preferences to ensure that a preferential trading club has no effect on bystanders. This is not an appealing property of our model. However, without it we would not be able to use the characteristic function approach to calculate coalition payoffs.

Section 2 presents the model. Section 3 introduces preferential trading clubs and derives some welfare properties from integration. Section 4 derives a financial mechanism which brings about Pareto optimal world trade. Section 5 shows when international sidepayments are needed for the global trading club to form. Section 6 concludes and stresses the limitations of the approach taken here. An Appendix derives expressions for consumer's surplus and profits as functions of underlying parameters.

2. The Model

We consider a world of n countries. In each country i there is a representative consumer who chooses a consumption vector c^i to maximize the quasi-linear preferences,

$$(1) \qquad \sum_{i \in K} \{ \bar{l}_0^i + \sum_{j \in N} S_j^i - \sum_{j \in K} \delta_j^i + \sum_{j \in K} \pi_j^i \};$$

$$0 < \theta_j^i < 1, i = 1,..., n,$$

where c_0^i is the consumption in country i of good zero, c_j^i is the consumption in country i of good j, and θ_j^i is a taste parameter.

Goods 1,..., n are produced, and they are traded internationally. The consumer in country i is endowed with $\bar{l}_0^i$ units of good zero. These can either be consumed, sold as input to the domestic firm, or used as a medium of international income transfer. If p_j^i denotes the domestic price of good j in country i, if good zero is chosen as numeraire, and if I^i denotes full income of the representative consumer in country i, the budget constraint can be written as,

$$(2) \qquad c_0^i + \sum_{j=1}^{n} p_j^i c_j^i = I^i; \qquad i = 1,..., n.$$

Equations (1) and (2) imply that demand in country i for each traded good j is given by the function,

$$(3) \qquad c_j^i = (p_j^i)^{1/(\theta_j^i - 1)} \quad ; \quad i, j = 1,..., n.$$

Given the assumed preferences, only the own price determines demand.[9] This feature is crucial since it will later enable us to introduce the characteristic function.

In each country i there is only one firm. It will sometimes be referred to as firm i, and it produces x^i units of good i with cost function,

$$(4) \qquad l_0^i = \beta^i x^i \quad ; \qquad i = 1, ..., n,$$

where l_0^i is its demand for good zero, and $\beta^i > 0$ is a constant cost parameter.

Firm i sells x_j^i units in market j. We assume that it declares on each unit not only where the product is made, but also for which market, and that

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9 Demand for good zero is found by substituting (3) into (2) for all traded goods, and then solving (2) for c_0^i.

penalties are sufficiently high to segment markets completely. The price charged by firm i in market j is denoted $(p^e)_i^j$, and its profits are given by,

$$\pi^i = \sum_{j=1}^{n} ((p^e)_i^j - \beta^i)\, x_j^i \quad ; \qquad i = 1,..., n. \tag{5}$$

In the absence of any policy restrictions, $(p^e)_i^j$ will be the monopoly price, as determined by the mark-up rule,

$$(p^e)_i^j = \frac{\beta^i}{\theta_i^j} \; ; \qquad i, j = 1, ..., n, \tag{6}$$

where we have used that the price elasticity of demand implied by (3) is $1/(1 - \theta_j^i)$.

3. Policy, Preferential Clubs, and Welfare

Taxes and tariffs will not be observed in the world economy specified here since they reduce both consumer surplus in i and monopoly profits in j. Consider instead a subsidy to imports from j which brings the price in i down to j's costs. Figure 1 illustrates that country i would not implement such a policy unilaterally since the subsidy bill, which equals area I + II +

III, exceeds the increase in consumer i's surplus, given by area I + II, causing country i to lose welfare equal to area III. An income transfer from country j, a reciprocal import subsidy on good i in country j, or both, would be required to induce i to subsidize imports from j. A transfer exists since foreign profits increase by an amount equal to area II + III which could be handed back to country i, leaving the monopoly firm as well off as before the subsidy while raising i 's welfare by triangle II.

For ease of exposition we cast the policy analysis in terms of price ceilings. A welfare maximizing government, say the one in country j, will always restrict its domestic firm to charge only marginal costs in its home market since this raises national welfare. As shown in figure 1, a ceiling on the export price by j to i reduces country j welfare by area I, but raises country i welfare by area I + II raising global welfare by II. Thus there exists a sidepayment from country i to country j that would trigger such an export price ceiling.[10] [11]

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[10] The assumption that governments always make their domestic firms charge only marginal costs in their home markets has the additional effect of preventing dumping.

[11] If, in this model, governments are allowed to restrict prices on imports then there is no room for cooperation since some governments will always use an

We define a *preferential trading club* to be an agreement between its members to price at costs in each other's markets. The *grand coalition* is then the agreement by all countries in the world to charge marginal costs in all markets. We define also an *increase in coalition welfare* to mean that if sidepayments within a coalition are possible then the gaining members of the coalition can compensate the losing members of the same coalition, and still be better off. An *increase in world welfare* is defined in analogous manner for the grand coalition.[12]

For all i and j define δ_j^i to be the increase in consumer surplus in country i from firm j reducing its price to marginal costs, and let π_i^j be the reduction

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import price ceiling and others will have no reason not to retaliate. The only equilibrium will be the non-cooperative, but Pareto optimal, one where all countries use import price ceilings. Since the objective of our analysis is to investigate how sidepayments can play a role in implementing Pareto optimal trade, we assume that countries cannot use import price ceilings. Only ceilings on export prices and on the prices charged in firms' domestic markets are available policy instruments.

[12] We do not require that the compensatory payments are actually executed. Thus the welfare criterion is that of a *potential* Pareto improvement.

in j's profits. We can then establish a number of welfare implications from trading clubs, including the grand coalition.

Proposition 1. *A preferential trading club raises coalition welfare of its members by an amount equal to the deadweight losses from their monopoly pricing on each other.*

Proof. Since δ_j^i equals area I + II in figure 1, and π_i^j equals area I, collective welfare increases by area II, which equals $(\delta_j^i - \pi_i^j)$. An analogous area equal to $(\delta_i^j - \pi_j^i)$ is gained from firm i reducing its price to marginal costs in market j, and the welfare increase for the pair is given by $[(\delta_j^i - \pi_i^j) + (\delta_i^j - \pi_j^i)]$. The increase in coalition welfare is finally found by adding these gains over all pairs of members of the coalition. Q.E.D.

Proposition 2. *The increase in coalition welfare is larger if country i joins* K' *than if it joins* K, *where all members of* K *are members of* K', *and i is not a member of either.*

Proof. Let $\{K' - K\}$ be the set of countries that are members of K' but not of K. By Proposition 1, for each agreement country i signs with a member, h, of this set, coalition welfare increases by $[(\delta_h^i - \pi_i^h) + (\delta_i^h -$

$\pi_h^i)$] which is positive for all h. For given i, adding these gains over all h yields the result. Q.E.D.

Kowalczyk and Ronald Wonnacott (1991) define as a *substitute* trading club one that leads to reduced import demand from the rest of the world, and as a *complement* trading club one leading to higher import demand from the rest of the world. We define here a trading club to be *neutral* if it does not affect its members' import demand from the rest of the world. For the present model we then have the following result:

Proposition 3. *Preferential trading clubs are neutral. They have no effect on non-members.*

Proof. By the earlier definition of a preferential trading club, its members do not change their policy relative to non-member countries. Although income increases among the club members, equation (3) implies that their demand for imports from non-member countries does not change. Higher club income raises consumption of non-traded good zero by club members. There is no effect on costs of production, and export prices remain constant. This establishes that trade volumes and prices between club members and non-members stay constant. It follows that non-members' welfare stays constant. Q.E.D.

It is an empirical question whether a trading club is substitute or complement (or neutral), and from that perspective it is not desirable that the model presented here allows only neutral clubs. However, from an analytical point of view it is essential that our model implies only neutral clubs. Indeed, the assumptions of quasi-linear preferences and constant costs were made with this very property in mind. The reason is, that in order to calculate sidepayments we need to introduce, in the next section, the *characteristic function*. This function measures the payoff that members of a coalition can guarantee among themselves. For the function to be defined it must, in particular, be the case that this payoff is independent of non-members' coalition choices. Neutral trading clubs guarantees that this requirement is satisfied.

Proposition 4. *The grand coalition is Pareto optimal.*

Proof. For any product, the grand coalition equalizes consumer prices across all countries and sets them equal to the costs of producing the good. Q.E.D.

It is a question of long standing in the theory of customs unions whether the formation or expansion of a particular preferential trading club raises or

lowers world welfare. The possibility that a trading club could reduce world welfare even in a competitive world economy was first demonstrated by Jacob Viner (1950). More than a quarter of a century later, Kemp and Wan (op. cit.) managed to calm these fears when showing that in a competitive world economy members of a trading club can always adjust their external tariffs in such a way that non-members remain indifferent while coalition welfare of the members increases. In recent work, however, Paul Krugman (1991) has revived Viner's concern by showing, in his model of monopolistic competition, that for reasonable assumptions on preferences world welfare is U-shaped in the number of trading clubs, with a minimum at three clubs.

A result similar to Krugman's does not hold in the present model. Rather, as shown in figure 2, propositions 2 and 4 imply that in our model world welfare increases monotonically -- at an increasing rate even -- as preferential trading clubs are expanded and the grand coalition approached. We hasten to add that our model is even more stylized, if not unrealistic, than is Krugman's, and that the trade policy we investigate is not tariffs.

Nevertheless, the analysis does have a bearing on the question "Is Bilateralism Bad?"[13]

4. Direction and Size of International Sidepayments

The agreement by all countries to charge marginal costs might not be incentive compatible since there may be countries that prefer to break away from such an arrangement and charge mark-up prices in some foreign markets. Assuming that GATT's objective is to implement the grand coalition of world-wide marginal cost pricing, we proceed by calculating the sidepayments that will permit the world's trading nations to exploit fully the gains from trade. We do so by applying cooperative game theory to our model economy. This requires that countries can negotiate, coordinate policies, and make binding commitments. It seems that these are all reasonable assumptions in the context of GATT negotiations.

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[13] Alan Deardorff and Robert Stern (1992) present an example where members of preferential clubs are chosen by random device. They show that under certain conditions expected world welfare is monotonically increasing as the number of blocs falls.

We denote the set of all *players* (i.e. the world's trading nations) by $N = \{1, ..., n\}$. A *coalition*, i.e. a preferential trading club, is a subset $K \subseteq N$, which has $|K| = k$ members. The *payoff* that coalition K can assure itself is given by the *characteristic function* $v(K)$, which, in a world where sidepayments are feasible, is a mapping from all permutations of the members in K (and non-members of K) into a real number; this number is also known as the *worth* of coalition K. The units of $v(K)$ are utils or, in our model, good zero. A game of this type is referred to as a *transferable utility game*.

The *core* of a transferable utility game is defined as the set of payoff vectors that will be blocked by no coalition of countries including coalitions containing only one country, where a vector of payoffs y is said to be *blocked* by some group of countries K if they can guarantee among

themselves a higher payoff, i.e. if $\sum_{i \in K} y_i < v(K)$. In many games the core is empty. We show next that this is not the case here.

Define the *marginal contribution* of country i to coalition K by $[v(K) - v(K \setminus \{i\})]$, where $v(K \setminus \{i\})$ denotes the worth of coalition K when i is

not a member.[14] A transferable utility game is said to be *convex* if, for $K \subseteq K'$, and $i \notin K$ and $i \notin K'$, the marginal contribution from i joining the larger coalition K' exceeds the marginal contribution form joining the smaller coalition K. Formally, that is if,

$$(7) \qquad v(K' \cup \{i\}) - v(K') \geq v(K \cup \{i\}) - v(K) .$$

Proposition 2 in the previous section established that this property holds in the economy analyzed here, and we can therefore rely on the following result:

Theorem 1. *In a convex transferable utility game the core is non-empty.*

Proof. See Lloyd Shapley (1971).

Investigating which allocations lie in the core and thus could be pursued by a consensus-seeking GATT could quickly become a large undertaking. The calculations could be involved, and in case the core contains several payoff vectors, some criterion for selecting between them might be needed. We follow instead a more direct approach of identifying one payoff vector

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[14] The marginal contribution can alternatively be defined as $v(K \cup \{i\}) - v(K)$.

which is known to be in the core, and we then assume that GATT strives to implement that particular vector. Admittedly, this does not address the problem of how to select between several core payoff vectors if such exist. However, we believe that this is relatively unimportant when compared to what we perceive as the immediate challenge faced by GATT: ridding the world of distortionary trade policies.

Theorem 2. *The Shapley value is the central point in the core of a convex game.*

Proof. See Lloyd Shapley (1971).

The *Shapley value* for the transferable utility game (N, v) is the payoff vector $\Phi(N, v)$ which assigns to country i,

$$(8) \qquad \Phi^i(N, v) = \sum_{K \subseteq N} \frac{(|K| - 1)!\,(n - |K|)!}{n!} \left[v(K) - v(K \setminus \{i\}) \right];$$

$i = 1, \ldots n.$ $i = 1, \ldots n.$

Calculating the Shapley value directly by use of this definition is quite involved.[15] Instead, we use an approach recently proposed by Sergiu Hart and Andreu Mas-Colell (1989) who show that there exists a unique function which satisfies the criterion that for any coalition K the sum of the marginal contributions of all its members calculated according to this function add up to the worth of the coalition $v(K)$. They call it the *potential function*, and they denote it by $P(K)$. They show also that the vector of payoffs according to P coincides with the Shapley value of the game.

Let S_j^i be consumer surplus for good j in country i if country j charges only marginal costs on its exports to i. Then $(S_j^i - \delta_j^i)$ is consumer surplus in i from good j if firm j charges its monopoly price. It follows that we can express the characteristic function for coalition K as,

$$v(K) = \sum_{i \in K} \{ \bar{l}_0^i + \sum_{j \in N} S_j^i - \sum_{j \notin K} \delta_j^i + \sum_{j \notin K} \pi^j \} . \tag{9}$$

The first term is the coalition members' endowment of good zero. The second term is total consumer surplus for all members of K if the grand coalition forms. The third term is the loss in coalition K consumer surplus

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[15] For discussions of the Shapley value see, among others, James Friedman (1977), John Harsanyi (1977), and Martin Shubik (1984).

when some of the world's countries are not in preferential trading club K. (Thus the second and third terms together give actual consumer surplus.) Finally, the last term is total profits earned by firms in trading club K when selling in markets outside of K.

Theorem 3. *In the preferential trading club game (N, v) the Shapley value is given by*

$$(10) \qquad \Phi^i(N, v) = \bar{l}_0^i + \sum_{j=1}^{n} S_j^i + \frac{1}{2}\sum_{j=1}^{n}\left((\pi_j^i - \delta_j^i) - (\pi_i^j - \delta_i^j)\right);$$

$i = 1, \ldots, n$.

Proof. Assume that preferences are identical but not necessarily symmetric across countries, implying $\delta_j^i = \delta_j$ for all i, and $\pi_j^i = \pi^i$ for all j. For all $K \subseteq N$ define the function

$$(11) \quad P(K) = \sum_{i \in K} \bar{l}_0^i + \sum_{i \in K}\sum_{j \in N} S_j^i$$

$$+ \sum_{j \in K}\sum_{i \notin K}(\pi_i^j - \delta_i^j) + \frac{k-1}{2}\sum_{j \in K}(\pi_i^j - \delta_j^i).$$

We then have that i's marginal contribution to coalition K is,

(12) $P(K) - P(K \setminus \{i\}) =$

$$\bar{l}_0^i + \sum_{j \in N} S_j^i + \frac{1}{2} \sum_{j \in K} \left((\pi_j^i - \delta_j^i) - (\pi_i^j - \delta_i^j) \right) + \sum_{j \in K} (\pi_j^i - \delta_j^i) .$$

It is easy to check that for all $K \subseteq N$,

(13) $$\sum_{i \in K} [P(K) - P(K \setminus \{i\})] = v(K) ,$$

where $v(K)$ is given by (9).

This establishes that P is a *potential function* as defined by Hart and Mas-Colell (op. cit.). It follows, furthermore, from their Theorem A, that equation (12), when N is substituted for K, yields the Shapley value.
Q.E.D.

If the grand coalition forms, but no sidepayments take place, country i obtains,

(14) $$\bar{l}_0^i + \sum_{j=1}^{n} S_j^i ; \qquad i = 1, ..., n.$$

Subtracting (14) from (10) yields, finally, the transfer scheme that implements the Shapley value.

Proposition 5. *Forming the grand coalition, and implementing the vector of international sidepayments T(N,v) which assigns to country i the net transfer*

$$(15) \qquad T^i = \frac{1}{2}\sum_{j=1}^{n}\left((\pi_j^i - \delta_j^i) - (\pi_i^j - \delta_i^j)\right), \qquad i = 1, \ldots n,$$

brings GATT into the core.

For any country i, this formula determines i's overall net transfer by comparing i's welfare gains from not trading at costs with each of its partners j, with the welfare gains of each j from not trading at costs with i. The overall net transfer to or from i is then found by adding these differences over all i's partners. Thus $(\pi_j^i - \delta_j^i)$ is country i's net welfare gain from charging its mark-up price on country j and have j retaliate, while $(\pi_i^j - \delta_i^j)$ is j's net welfare gain from not trading preferentially with i.[16] For any bilateral comparison, equation (15) prescribes that the country with larger net gains from non-cooperation receives a transfer from the country with smaller net gains from non-cooperation. Alternatively, the country that gains more from cooperation pays a fee to the country gaining less from cooperation to induce a preferential trade arrangement. Country j gains more

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[16] Either of these net welfare gains can be positive, negative, or zero.

from cooperation with country i, (a) the less elastic is j's demand for good i, (b) the lower are i's costs, (c) the more elastic is i's demand for good j, and (d) the higher are j's costs. The effects in (a) and (b) raise δ_j^i, while those in (c) and (d) lower π^j. (We note for the sake of completeness that the mechanism is balanced: the sum of receipts equals the sum of payments.)

It is somewhat at odds with observed international income transfers, which show a tendency of going from richer to poorer countries, that the sidepayments implied by (15) are independent of nations' relative income levels.[17] The reason is that in our model transfers have the very specific, and narrow, function of being the price for obtaining a preferential trading arrangement, while actual income transfers serve additional purposes, including foreign aid's objective of making incomes more equal across countries. The financial mechanism derived in this paper would co-exist with other transfer schemes and it might not be of sufficient importance to raise substantially or reverse the direction of the transfers that we actually observe.[18]

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[17] Intra-EC payments, for example, tend to run from richer to poorer members countries.

[18] As an aside, if transfers according to (15) were applied within a sub-group of countries forming a preferential trading club, then no group of potential

The Appendix describes how consumer's surplus, profits, and income can be expressed as functions of the model's parameters. Drawing on these expressions, Table 1 presents some illustrative examples of the sidepayments implied by expression (15). We assume that a GATT negotiation round has 100 participants, and that they can be divided into four equal-sized groups where countries within a group are identical. We maintain the assumption that countries have identical, but not symmetric preferences. Moreover, we assume that demand for good 1 is relative inelastic, that demand for goods 2 and 3 is more elastic, and that demand for good 4 has the highest elasticity. The Table contains three sets of calculations. In the first set, the four groups are identical with respect to costs and endowment of good zero, as given by l. The Table shows that sidepayments go from each of the three groups producing the goods in relatively elastic demand to group 1 which produces the relatively inelastically demanded good. The next set of calculations shows the effect of raising costs of production in group 1. The net transfer to countries in group 1 falls to about one third of the transfer in the first calculation, and net payments by each of the other three groups fall; group 2 even becomes a

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members would want to bloc the coalition consisting of all the members of that sub-group. This has interesting implications for current problems in the EC.

net recipient. The final calculation illustrates how raising the endowment of good zero in each of the countries in group 1 raises income Y in group 1 but has no effect on transfers.

In all three cases, and independent of whether countries receive or pay, are the transfers less than two percent of national income Y. As discussed in the Introduction, this is the same order of magnitude as Richard Baldwin's (op. cit.) estimate of the EFTA countries' payments to the EC countries in connection with the European Economic Area. Table 1 reveals, furthermore, that the sidepayments can be a substantial fraction of a country's gains from trade as measured by $(Y - I)$. In all three sets of calculations payments are about ten percent of the gains from trade while receipts range from about two percent to a remarkable 96 percent. In fact, it is possible that a country receives transfers that exceed the size of its gains from trade.[19]

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[19] However, a country would never pay more than it gains if autarky is an option.

5. When Are International Sidepayments Needed?

Under which conditions can the global trading system -- as modeled in this paper -- reach a first best trading equilibrium without a financial mechanism? We stated in (14) that country i's surplus from the grand coalition equals

$\vec{l}_0^i + \sum_{j=1}^{n} S_j^i$ in the absence of international sidepayments. From equation (9) we can derive, furthermore, that when the grand coalition forms but no sidepayments take place the surplus to a group of countries K is,

$$v(K) = \sum_{i \in K} \{ \vec{l}_0^i + \sum_{j \in N} S_j^i \} . \tag{16}$$

The grand coalition without sidepayments is in the core if and only if for all $K \subseteq N$ the surplus from the grand coalition exceeds the surplus from any other preferential trading arrangement, that is, if the following inequality holds,

$$\sum_{i \in K} \{ \vec{l}_0^i + \sum_{j \in N} S_j^i \} \geq \sum_{i \in K} \{ \vec{l}_0^i + \sum_{j \in N} S_j^i - \sum_{j \notin K} \delta_j^i + \sum_{j \notin K} \pi_j^i \} \tag{17}$$

where the right hand side of the inequality is the characteristic value of coalition K as defined earlier by expression (9). It follows immediately that,

Proposition 6. *The grand coalition without sidepayments is in the core if and only if*

$$\sum_{i \in K} \sum_{j \notin K} \delta_j^i \geq \sum_{i \in K} \sum_{j \notin K} \pi^j \,. \tag{18}$$

This condition will not necessarily hold since it is possible that for some j, profits earned by members of K, which are given by the right hand side of this expression, exceed the loss in consumer's surplus in K from retaliation, which is the left hand side of the expression.

In the special case where all countries are identical with respect to tastes and costs, (18) reduces to

$$k(n-k)\,\delta \geq k(n-k)\,\pi \,, \tag{19}$$

which is always satisfied since $\delta \geq \pi$. Hence when countries are identical or almost identical there is no need to use sidepayments in a global trade negotiation.

These findings are consistent with earlier work. Raymond Riezman (1985) presents a three-country example where a single country blocks global free

trade even though the other countries respond by forming a customs union which sets its optimal external tariff. In an analysis of the role of country size in blocking global free trade John Kennan and Riezman (1988) argue, in a two-country exchange economy, that the larger country, due to its relatively more elastic offer curve, is the likely beneficiary from a tariff war.[20] They extend that analysis to three countries in Kennan and Riezman (1990), and present, among other examples, one where global free trade is upset by a pair of countries forming a customs union (or a free trade area).

6. Conclusion

This paper has shown that international transfers of income can be helpful in establishing a Pareto optimal global trading environment. In particular, international income transfers can be used to induce countries, who might otherwise prevent Pareto optimal trade from being realized, to refrain from using their blocking ability.

The paper calculates exact values of transfers that will do the job in a world where a large number of countries produce and trade a similarly large

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[20] See also Richard Jensen and Marie Thursby (1980).

number of goods. The formula for the transfers confirms the interpretation of the role of an international income transfer mechanism as one of reigning in stronger nations: in order to establish a globally Pareto optimal trading order it may be necessary to tax those who have much to gain from it, and subsidize those who do not. While perhaps unappealing at first glance, such transfers have the attractive feature of inducing nations with large positive externalities on other countries to take part in the global process.

The model used to derive the international transfer schema is highly stylized. It has the unusual feature that global free trade is not Pareto optimal. It implies also that countries will not use tariffs; rather, the policy game between nations that is stressed in this paper -- although not the only one implied by the model -- is essentially one of regulation. These idiosyncrasies are a consequence of our forcing the problem of global policy coordination with international sidepayments into one to which the characteristic function approach applies. We do not consider them appealing. However, they might not be unacceptable costs for obtaining an explicit formula for international transfers in a world of many countries and many goods. Furthermore, situations where laissez-faire fails to be Pareto optimal are becoming increasingly urgent: just witness the need for international cooperation on environmental issues which, we believe, is

another area where a transfer mechanism of the sort derived here could be applicable.

In conclusion, we consider this to be a first attempt at analyzing a financial mechanism for GATT. To the extent preferential trading clubs are not neutral, our mechanism cannot be implemented. However, it could be considered revising article XXIV on customs unions and free trade areas to require that these always set the compensating external tariffs discussed by Kemp and Wan. This would guarantee that clubs would be neutral, and a mechanism of the sort analyzed in this paper could become relevant.

Appendix

From equation (3) in the text the inverse demand function in country i for good j is,

(A1) $$p_j^i = c_j^{i\,(\theta_j^i - 1)},$$

which implies that the area under the demand curve is given by,

(A2) $$\int_0^{c^*} p_j^i \, dc_j^i = \frac{1}{\theta_j^i} c_j^{i\theta_j^i},$$

where c^* is a limit of integration. If good j is obtained at cost, then $p_j^i = \beta^j$, and $c_j^i = \beta^{j\frac{1}{\theta_j^i - 1}}$. Substituting this demand into (A2) and subtracting from the resulting expression total spending by consumer i on good j, which equals,

(A3) $$p_j^i c_j^i = \beta^{j\frac{\theta_j^i}{\theta_j^i - 1}},$$

yields consumer i's surplus when j is purchased at cost, S_j^i,

(A4) $$S_j^i = \left(\frac{1 - \theta_j^i}{\theta_j^i}\right) \beta^{j\,\frac{\theta_j^i}{\theta_j^i - 1}} .$$

If good j is purchased instead at the monopoly price $p_j^i = \frac{\beta^j}{\theta_j^i}$ then $c_j^i = \left(\frac{\beta^j}{\theta_j^i}\right)^{\frac{1}{\theta_j^i - 1}}$, and i's spending on good j equals,

(A5) $$S_j^i = \left(\frac{1 - \theta_j^i}{\theta_j^i}\right) \beta^{j\,\frac{\theta_j^i}{\theta_j^i - 1}}$$

Let $(S_j^i)'$ be consumer's surplus in i if j is purchased at the monopoly price. Substituting the corresponding demand into (A2), and subtracting (A5), then gives,

(A6) $$(S_j^i)' = \left(\frac{1 - \theta_j^i}{\theta_j^i}\right) \left(\frac{\beta^j}{\theta_j^i}\right)^{\frac{\theta_j^i}{\theta_j^i - 1}} .$$

Defining $\delta_j^i = S_j^i - (S_j^i)'$, and subtracting (A6) from (A4), gives the increase in consumer's surplus from reducing the price of j to marginal costs as,

(A7) $$\delta_j^i = \left(\frac{1 - \theta_j^i}{\theta_j^i}\right) \left(1 - \theta_j^{i\,\frac{\theta_j^i}{1 - \theta_j^i}}\right) \beta^{j\,\frac{\theta_j^i}{\theta_j^i - 1}} .$$

Firm i's profits from sales to j are found by substituting equations (6) and (3) of the text (the latter properly re-labeled) into equation (5) of the text:

$$\pi_j^i = (1 - \theta_i^j)\left(\frac{\beta^i}{\theta_i^j}\right)^{\frac{\theta_i^j}{\theta_i^j - 1}} . \tag{A8}$$

Finally, income in country i, when the grand coalition forms, is given by,

$$Y^i = \bar{l}_0^i + \sum_{j=1}^{n} S_j^i . \tag{A9}$$

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θ1	θ2	θ3	θ4		Y	T	T/Y(%)	T/(Y-l) (%)
0.3	0.5	0.7	0.9	for country 1	1018.78	18.03	1.77	95.98
β1	β2	β3	β4	for country 30	1037.57	-3.54	-0.34	-9.42
10	10	10	10	for country 60	1075.14	-7.20	-0.67	-9.59
l1	l2	l3	l4	for country 95	1056.35	-7.29	-0.69	-12.93
1000	1000	1000	1000					
θ1	θ2	θ3	θ4					
0.3	0.5	0.7	0.9	for country 1	1008.20	6.12	0.61	74.61
β1	β2	β3	β4	for country 30	1016.40	0.43	0.04	2.63
100	10	10	10	for country 60	1024.60	-3.23	-0.32	-13.14
l1	l2	l3	l4	for country 95	1032.81	-3.32	-0.32	-10.12
1000	1000	1000	1000					
θ1	θ2	θ3	θ4					
0.3	0.5	0.7	0.9	for country 1	5008.20	6.12	0.12	74.61
β1	β2	β3	β4	for country 30	1016.40	0.43	0.04	2.63
100	10	10	10	for country 60	1024.60	-3.23	-0.32	-13.14
l1	l2	l3	l4	for country 95	1032.81	-3.32	-0.32	-10.12
5000	1000	1000	1000					

Table 1

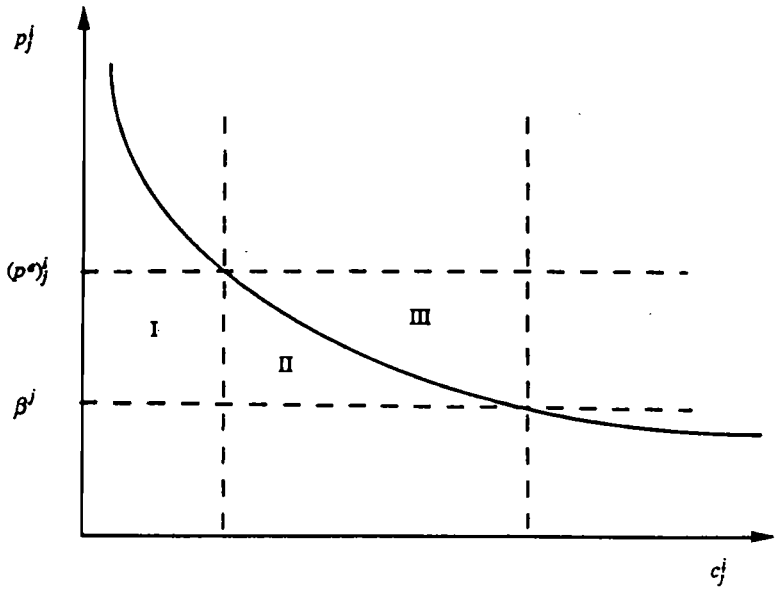

Figure 1

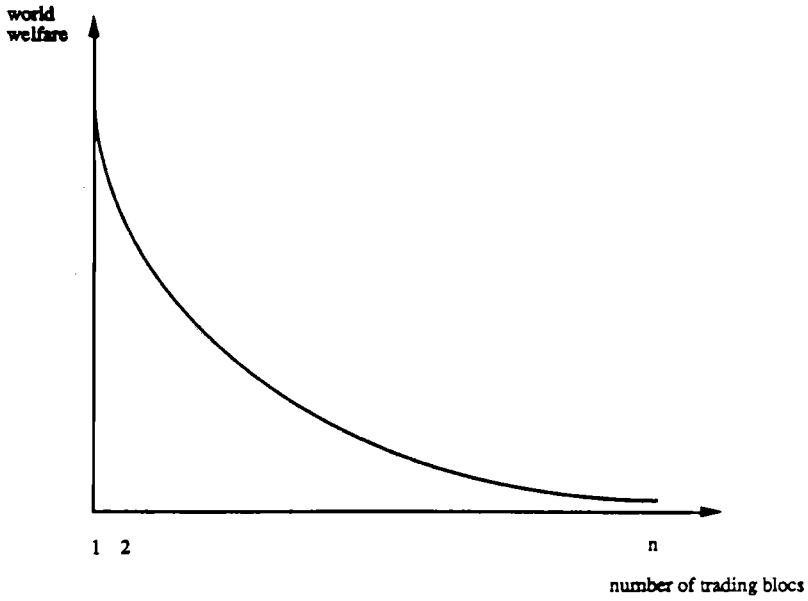

Figure 2