PROPOSITIONS ON THE EFFECTS OF REGIONAL TRADE AGREEMENTS: BLENDING THEORY AND NUMERICAL SIMULATION[1]

Lisandro Abrego
University of Warwick

Raymond Riezman
University of Iowa

John Whalley
Universities of Warwick and Western Ontario and NBER

Abstract

This paper uses computational techniques to examine various propositions that have been advanced as plausible in the literature on regional trade agreements. Our aim is to establish the likelihood of their holding in particular cases. Examples of propositions we examine are whether membership of a regional trade agreement improves the welfare for all members, whether regional trade agreements result in higher tariffs both in member and non member countries, and whether regional trade agreements improve world welfare. We use a three country three good framework and evaluate these propositions relative to both a free trade outcome and 3 country non-cooperative Nash outcome in tariffs. To do this we use a Computable General Equilibrium approach which determines which of these propositions are true for various parametric specifications of a standard model. We use a finite grid defined over all possible parametric specifications to determine the probability of a proposition holding under various prior distributions over the parameter space. Some linking results emerge, not the least of which is changes in the direction of trade for well over 50% of cases between 3 country Nash equilibria and regional trade arrangement equilibria (theoretical work assumes the direction of trade is unchanged). Propositions hold in between 60 and 80% of the cases, with figures more sensitive to endowment pattern changes than preferences.

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1. INTRODUCTION

Literature on regional trade agreements (such as NAFTA or the European Union) goes back to Jacob Viner's pioneering book published in 1950. Despite nearly fifty years of subsequent research, no set of generally accepted propositions regarding the effects of regional trade agreements has emerged to guide policy makers and public officials. Whether individual countries necessarily gain by entering a customs union (CU) or free trade area (FTA) is unproven, and the use of alternative reference points, such as free trade or non cooperative Nash, only further clouds the picture. Whether world welfare is higher under a FTA or CU is also unknown, as is whether customs unions are associated with higher external tariffs compared to free trade areas. Other propositions are thought to be true, but without explicit confirmation; such as that CUs (or FTAs) generally improve the terms of trade of member countries; and that non-member countries prefer a free trade association to be formed against them than a customs union.

The idea behind this paper is to use a simple (few countries and commodities) numerical specifications of general equilibrium trade model and to use repeated model solutions to map out the sets of parameter for which each of a series of propositions is true. By determining the parameter space over which various results hold, the idea is to obtain an indication of which statements are more likely to be true and which are not. If we assume a uniform prior over the parameter space, the percentage of cases where results hold can be interpreted as the probability of their holding.

Specifically, we consider all possible combinations of model parameters lying on a grid that we can lay down within the parameter space for the model. This can be, for instance, all combinations of share parameters in preferences in a Cobb-Douglas case in all countries in the model from 0.1 to 0.9. Computing model outcomes allows us to assess whether or not propositions hold for particular parameterizations. In the process, we

compare, say, 3 country non-cooperative (Nash) outcomes to partial cooperation regional agreements where two countries form a regional agreement (either a CU or FTA) and play non-cooperatively against the third country.

A number of striking features emerge from model computations. The first is that non of the propositions we consider holds unambiguously. Some hold 80% of the time, others less. The proportions of cases in which propositions hold is little changed by altering preference weights, and more so by changing endowment patterns. The second is that in theoretical literature in this area (Lipsey (1957,60), Viner (1950), Lloyd (1979), Riezman (1979, 1997)) it is customary to assume that the direction of trade (by commodity, by country) is predetermined and invariant to the form of regional trade agreement. Computational work inevitably involves relaxing this assumption, and we experience directional changes in a large number of the cases we solve (well over 50% between free trade and 3 country Nash). These directional changes create computational problems for some of our specifications.

From these results, we conclude that numerical simulation can be an important and useful adjunct to theory. Where theory is unable to generate clear unambiguous results, numerical simulation, in turn, can throw up unanticipated insights highlighting the crucial role for seemingly innocuous assumptions (in this case, on the direction of trade). This form of interplay between theory and numerical simulation can, we believe, also yield benefits in other areas.

2. THEORETICAL BACKGROUND

There has recently been intense debate over whether regional trade agreements are desirable or not (Bhagwati and Panagariya (1996), Summers (1991), Riezman(1997)), but most of this debate is not new.

In 1950 it was Jacob Viner's book that first changed thinking about regional trade agreements. Viner pointed out that regional trade agreements do not necessarily result in trade gains even though some tariffs are eliminated. He developed what has become known as the trade creation-trade diversion approach to regional trade agreements. He considered cases where two countries, A and B, form a regional trade agreement and eliminate tariffs between them, and maintain tariffs against the third country, C, at levels the same as before the agreement. Suppose before the agreement county A imports clothing from country C, which is a low cost producer of clothing. Suppose as the result of the agreement, that A imports products from country B which it previously imported from country C. Even though B is a higher cost source of clothing this occurs because it has the advantage of tariff-free access to A's market. Trade into A is diverted from low cost producer C to high cost producer B and welfare is lowered. If A formed a union with C, A would import more from low cost producer C and less from high cost producer B; trade would be created and welfare increased. Thus, in the Vinerian view of the world trade creating regional agreements are good and trade diverting regional agreements are bad.

Viner's book launched a literature that subsequently tried to characterize general conditions under which regional trade agreements improve or worsen welfare based on trade creation-trade diversion considerations, and hence is relevant to this paper. But Meade (1955), Lipsey (1957) and other discovered that preference considerations also enter in trying to make such determinations. No general propositions seemed possible in the area (ultimately

leading to Lipsey and Lancaster's (1958) characterization of the general theory of the second best. Dissatisfaction with the trade creation-trade diversion approach thus grew and resulted in an alternative stream of literature involving Lipsey (1970), Riezman (1979, 1985), Kowalczyk (1989) and others who tried to find either approaches that would yield clear propositions. A new approach, known as the terms of trade-volume of trade approach, became the vogue in the literature and emphasized that the effects which follow from the formation of a regional trade agreement can be summarized in its effects on the terms of trade (prices) and trade volumes. The terms of trade-volume of trade approach uses general equilibrium instead of Vinerian partial equilibrium analysis, and emphasizes what individual countries do and why, instead of what happens to world welfare as integration occurs. However, the conclusion that there are no general results has persisted.

In more recent literature, strategic considerations underlying the formation of regional trade agreements have further clouded the picture. Older literature considered cases where countries forming a free trade area keep their existing trade barriers in place against third countries, or under a customs union in some way harmonize trade policy towards third countries. It is clear, however, that regional trade agreements are in part formed with strategic intent in mind. Documents from the mid 50's show that one objective behind the formation of the EU was to enhance joint country bargaining in the GATT with the US; Mercosur was, in part, an attempt by four countries (Brazil, Argentina, Uruguay, Paraguay) to strengthen their bargaining position for an eventual accession negotiation with NAFTA. Naturally, the terms of trade-volume of trade approach lead to research stressing countries as strategic players in a multi-country mixed cooperative – non-cooperative trade policy game. This is the approach taken by Kennan and Riezman (1990).

While the regional trade agreements literature has improved our understanding of the effects of regional trade agreements it still lacks a coherent set of general results that can

serve as a guide to policy makers, and surprisingly there are few, if any, general propositions that are true for all parameter values even in highly simplified models. Consider the conjecture: "In a three country, pure exchange economy any pair of countries can benefit from forming a regional trade agreement." In a world of countries that are the same size this conjecture is true, but Riezman (1997) shows that this conjecture fails to hold more generally. In a world with one large and two smaller countries, a regional trade agreement between the large country and either small country results in the large country doing worse than the initial equilibrium. In the initial equilibrium the large country benefits from its use of tariffs, against both countries, while the small countries lose. When the large country forms a customs union it shares some of these tariff advantages and forgoes the opportunity to play strategically against its small partner. Even in a simple model there are no thus general results.

The approach that has been successful in generating results in models with specific parameterisations has been applied general equilibrium modelling. Since Miller and Spencer (1971), Shoven and Whalley (1974), Whalley (1985), researchers have used numerical equilibrium models to simulate the effects of regional trade agreements as well as to address a range of trade policy questions. They were used extensively in the Uruguay Round (see Francois, Nordstrom, and McDonald (1996)) as well as in the earlier Tokyo Round. They have also been used to explicitly model the effects of regional trade agreements, Hamilton and Whalley (1985), Perroni and Whalley, (1999). An advantage of this approach is that since models are richer (more countries, production, more commodities) one may have more faith that the results generated apply to actual policy situations. However, the models used are some distance from those used in pure theory; they use Armington product variety assumptions, more dimensions, and with the inherent lack of general results to guide them

produce results, lacking any general application to any situation other than the specific example under consideration.

The approach we offer in this paper is thus to combine the applied general equilibrium approach and terms of trade-volume of trade approaches. We use a model based on Kennan and Riezman (1990) and, examine various propositions regarding the effects of which follow from the creation of regional trade agreements. These are world welfare results, individual country results and results on prices, tariff levels and trade volumes and we evaluate these propositions with respect to the three country non-cooperative Nash equilibrium outcomes (not usually considered in the literature), free trade and a customs union between two countries. To begin we focus our attention on comparing Nash equilibrium with the customs union case. One can think of Nash equilibrium as being an initial equilibrium and then the question is what happens if, starting from there two countries decide to form a customs union.

Our list of propositions is:

1. Members of a customs union always benefit from the union.
2. Customs unions result in higher external tariffs.
3. Customs unions are a "stepping stone" to free trade.
4. Customs unions always improve the terms of trade for the member countries.
5. Customs unions result in more international trade for the member countries.
6. World welfare is higher under a customs union.

3. IMPLEMENTING PROPOSITIONAL ANALYSIS

To analyze the likelihood of the various theoretical propositions we list above holding we employ numerical general equilibrium analysis of a 3 country trade model. We specify functional forms and parameter values, and for each such specification compute a variety of equilibria; 3 country non-cooperative Nash; 2 country customs union playing Nash against a third country; and free trade equilibria. We use a procedure of specifying an integer grid over the potential range of parametric variations (see below), and in each case assess whether countries gain or lose (and other performance characteristics) in the appropriate comparison. Assuming a uniform prior over the parametric space, we can then compute the probability of a particular proposition holding.

Model Structure

We use a 3 good, 3 country pure exchange general equilibrium model to analyze the probability of the various propositions we listed earlier of holding. In this model, each country has a representative individual with endowments of three goods and a utility function of the form

$$U^i = U^i\left(X_1^i, X_2^1, X_3^i\right), \qquad (i = 1...3) \tag{1}$$

where X_1^i, X_2^i, X_3^i represent consumption of goods 1, 2 and 3 in country *i*, and U^i defines country *i*'s utility. Endowments are given by $\overline{E}_1^i, \overline{E}_2^i, \overline{E}_3^i$, where *i* denotes the country and 1, 2 and 3 denote the goods.

Because each country can impose tariffs at rate t_j^i on good *j* imported by country *i*, for any good *j*, we define the sellers prices (i.e. net of tariff prices) as P_j. This implies that internal gross of tariff prices in any country market are

$$P_j^i = \left(1 + t_j^i\right) P_j \tag{2}$$

As we note above, this presumes the direction of trade for any country in any commodity is known. In theoretical literature this is assumed to be given and unchanging as we move between alternative equilibria (free trade, 3 country Nash, with regional trade agreements). In the model we use, we assume nothing about the direction of trade, which is endogenously determined as part of the equilibrium structure. Tariffs are set to zero on any good exported by country *i.* Countries set optimal tariffs on all imported goods.

Tariff revenues collected by country *i*

$$T^i = \sum_{j=1}^{3} \max[0, t_j^i P_j (X_j^i - \overline{E}^i_j)] \tag{3}$$

The income of country *i* is thus given by

$$I^i = \sum_j P_j \overline{E}^i_j + T^i \tag{4}$$

It is easily shown that (4) implies that the balance of payments is zero.

We use constant elasticity of substitution (CES) (and in special cases Cobb-Douglas) preferences to represent the utility functions (1) for which utility maximizing demands are given by

$$X_j^i = \frac{\alpha_j^i I}{\left(P_j^i\right)^{\sigma_i} \sum_{j=i}^{3} \alpha_j^i P_j^{i(1-\sigma)}} \tag{5}$$

Equilibrium Solution Concepts

Using this structure we examine a number of different solution concepts, each of which is relevant to the investigation of the propositions we list above.

Free Trade Competitive Equilibria

In free trade, tariff rates are all zero on all products in all countries. Equilibrium prices clear markets globally, i.e. equilibrium prices are $\left(P_1^*, P_2^*, P_3^*\right)$ are determined such that

$$\sum_{j=1}^{3} X_j^i\left(P_1^*, P_2^*, P_3^*\right) - \sum_{j=1}^{3} \overline{E}_j^i = 0 \qquad (6)$$

i.e.. global excess demands are all zero. Given that only relative prices matter in such a structure, we can normalize prices to sum to unity i.e. $\sum_{j=1}^{3} P_j = 1; \quad P_j \geq 0$.

Three Country Non-Cooperative Nash Equilibria

We also compute three country non-cooperative Nash equilibria in which each country takes other countries' tariffs as parametrically given and compute their own optimal tariffs. In Nash equilibria, country computations of optimal tariffs are mutually consistent.

Specifically, each country determines their own optimal tariff vector $\left(t_j^i\right)^*$ by maximizing U^i subject to the constraint that the balance of payments equals zero. Equilibrium occurs when there is a tariff vector such that global markets clear and each country charges an optimal tariff given the tariffs of other countries. Unlike the competitive equilibrium case, t_j^i are thus endogenously determined for country *i*.

Since tariff revenues enter this version of the model, T^i are endogenously determined and affect demands since they are assumed redistributed to the country's representative consumer in lump sum fashion. In equilibrium, optimising behaviour on tariffs, market clearing and government budget balance in each country define equilibria. Thus, for each country *i* we

$$\max U^i$$

$$\text{subject to } I^i = \sum_j P_j \overline{E}^i_j + T^i \qquad (7)$$

In the optimization problem (7), t^k_j for $k \neq i$ are taken as given and denoted by $\hat{t}^k_j$. In a Nash equilibrium optimal tariff rates t^{i*}_j are such that

$$t^{i*}_j = \hat{t}^i_j \text{ for all } i, j \text{ and markets clear}$$

$$\sum_{j=1}^{3} X^j_i\left(P_1, P_2, P_3, T^1, T^2, T^3\right) - \sum_{j=1}^{3} \overline{E}^j_i = 0 \quad \forall i \qquad (8)$$

An important feature of this model is that the direction of trade can change between, say, competitive free trade equilibria and Nash equilibria. We capture such directional changes in our computational analysis since we first assume trade directions to be given, and then modify these assumptions on the basis of what computed equilibria reveal. As we comment below, our results show a substantial number of trade direction changes between free trade and Nash equilibria, and also cases of non-convergent cycling where directional changes in both directions alternatively occur.

Customs Union Equilibria

We also compute customs union equilibria. In these, we assume that country 1 and country 2 form a customs union with zero tariffs between them, and set a common external tariff against country 3. Thus Countries 1 and 2 jointly set an optimal tariff against country 3, and country 3 sets an optimal tariff against the two other countries.

In this mixed cooperative, non-cooperative structure, countries 1 and 2 set zero tariffs against each other, i.e.

$t_j^1 = t_j^2 = 0$ if the supplying country is 1 or 2. (9)

This requires the bilateral trade flows to be accounted for in the model, unlike the free trade and Nash equilibrium cases. We do this by taking bilateral flows to be given by the difference in the sum of country 1 and 2 imports of good *j* and the exports of good *j* by country 3. Such a calculation is only necessary for the goods that country 3 exports, and such goods at any point in our model calculations are given by the directional assumption in force at that point.

Optimizing behaviour in the non co-operative Nash part of this model involves country 1 and 2 jointly setting optimal tariff vector against country 3, and 3 playing optimally against 1 and 2. Countries 1 and 2 may have a conflict of interest over their joint external tariff. How they resolve this conflict is a difficult problem deserving of its own analysis. However, for our purposes we choose to solve that problem in a relatively simple but ad hoc way. We assume that the joint external tariff is set to maximise the sum of country 1 and 2's utilities. In subsequent sensitivity analysis we use different weights on country utility in the joint sum.

This optimisation problem is given by

$$\max U^1 + U^2$$

subject to $I^i = \sum_j P_j \overline{E}_j^i + T^i$ for $i = 1,2$

Implicit is the assumption that members of the Union receive back the tariff revenues collected from their own imports.

Implementing the Approach

To implement our approach to investigating the probability that the propositions we list above hold, we adopt a procedure of exhaustive search across equilibria associated with

parametric specifications of the model given by a lattice grid of points in the parameter space. To keep this procedure simple, we first restrict ourselves to a case in which there are three countries and three goods, and Cobb-Douglas preference function parameters that are symmetric and identical across countries. Later when we do our sensitivity analysis we allow for different preferences across goods and we allow for general CES utility functions with varying elasticities of substitution. Table 1 outlines our central case.

Table 1

Implementing Propositional Analysis in the Central Case

Dimensionality:	3 countries, 3 goods
Preferences:	Cobb-Douglas—symmetric identical preferences across countries, with shares equal to 1/3 for each good.
Endowments:	Lattice grid of model specifications, with a cross country endowment for each good of 1, and 0.1 intervals in the lattice grid for country own endowment of each good. Off diagonal elements are treated as symmetric. Thus, each specification is represented by a vector, for which an array of endowments is generated (see array below).
Number of cases:	We consider 769 different model specifications of this form.
Equilibria computed for each case:	Competitive equilibria, 3 country Nash equilibria, Customs Union equilibria (the sum of member utilities is maximized).

Table 1 also details the parametric variations we make over the endowment parameter space. We assume that the global endowment of each good is 1 by choice of units, and consider own country endowments of goods that range between .1 and .9. We consider off diagonal elements of the endowment array to be symmetric, and thus as Table 1 indicates, a case in our specification of (0.1, 0.3, 0.4) translates into an endowment array of

	Goods		
Country	1	2	3
1	0.10	0.35	0.3

2	0.45	0.30	0.30
3	0.45	0.35	0.40

We consider all possible cases with single digit decimals across the 3 countries; a total of 769 cases. Some cases are symmetric by construction (eg. (0.2, 0.4, 0.6) gives the same equilibria as (0.4, 0.2, 0.6)), and this enables us to check accuracy of code to ensure that symmetric solutions result.

We then compute free trade, three country Nash, and customs union equilibria and compare across these equilibrium solutions to assess whether or not the propositions we list above hold in the cases we consider. Assuming a uniform prior, we can cumulate cases into a probabilistic statement as to whether or not any particular proposition holds.

4. RESULTS

In this section we use the methodology developed earlier to evaluate the likelihood that the various propositions in the theoretical literature on customs unions we list earlier hold. As we note above, a problem, usually ignored in the theoretical literature, is that for a given endowment matrix, there can be different trade patterns in different equilibria. The usual assumption is that the same trade pattern will hold for free trade, Nash equilibrium, and for any possible customs union equilibrium. Our results indicate that such an assumption will be incorrect much of the time. In over 40% (41.1%) of the cases that we have looked at and been able to solve for our central case specification the trade pattern changes between Nash equilibrium and Free Trade. Between Free Trade and Customs Union equilibrium, there are directional changes nearly 60% of the time (59.6% of the cases); and between Customs Union and Nash equilibrium over 50% of the time (50.3% of the cases) the trade pattern changes.

These changes in direction of trade clearly imply that the assumptions on trade directions usually made in theoretical analysis are unjustified for the model specifications we consider. They also create a computational problem. We find that in a significant number of cases[2] that the pattern of trade may not converge. This can preclude the determination of meaningful equilibria for the model.

Such cases occur for 17% of our model parameterisations for the base case, and we discard such cases in determining our prepositional analysis outcomes.

Table 2 presents our results for the model central case. Some propositions hold in nearly 100% of computed cases (that a CU improves the members terms of trade); others are less frequent. A Customs Union, for instance, only improves world welfare relative to a Nash equilibrium in 64% of computed cases. Customs Unions result in higher external tariffs for member countries in 79% of cases. Both members benefit from forming a customs union in over 80% of the cases. Customs unions lead to more international trade for member countries 91.4% of the time. One result that is a bit

[2] Such cases occur for 17% of our model parameterisations for the base case, and we discard such cases in determining our prepositional analysis outcomes.

surprising is that in over 20% of the cases customs unions are a "stepping stone" to free trade. We discuss each of these results individually.

Table 2

Central Case: Analysis of Customs Unions Propositions

Proposition	Percentage of Computed Model Parameterizations for which the Proposition is True
1. Both Members Benefit from a Customs Union	81.6
2. Customs Union Results in Higher External Tariffs for Member Countries	79.1
3. Customs Unions are a "Stepping Stone" to Free Trade (i.e. members are better off in CU relative to Nash, and members gain on free trade)	23.9
4. Customs Union Improves Member Countries' Terms of Trade	98.5
5. Customs Union Increases Member Countries' Volume of Trade	91.4
6. Customs Union Increases World Welfare relative to a 3 country Nash equilibrium	64.1

Interpreting the Results

The first result suggests that both members benefit from a customs union about 80% of the time. *Questions*; Do both members ever lose? Are the cases in which they lose related to the cases in which the union lowers its tariffs or when union members trade volume declines? Hypothesis: In the 20% of cases in which one member loses from a customs union the intra-customs union terms of trade turns against the member who experiences the welfare loss.

More than 20% of the time customs unions lower tariff rates. For example, in Krugman's 1991 paper he shows that customs unions always increase tariffs. This is not generally true. What is

the intuition for why customs unions lower tariffs 20% of the time? Syropoulos (1999) argues that when two countries form a customs union there are two effects working against each other in determining the optimal external tariff. First, there is a tariff reduction effect due to the fact that the customs unions members have eliminated tariffs between them. Second, there is a tariff increasing effect as the customs union solves the tariff externality that occurs when members import the same good. Using this intuition suggests that the customs union's external tariffs fall when this tariff externality isn't important, i.e. when the customs union members do not import very much of the same good.

The stepping stone result is surprising. To begin we start with the 81.6% of the cases where both members benefit from a customs union. The result then implies that in approximately 30% of these cases both member countries of a customs union would benefit from a further move to free trade. This suggests that these are cases in which the terms of trade gain from the customs union are not too large. *Hypothesis*: These cases are ones in which the customs union is relatively small. Intuition--Since they don't have much market power the move to free trade actually benefits them.

Customs unions have improved terms of trade virtually in all situations. This is a bit surprising. The sensitivity analysis suggests that this is highly variable so it might pay to examine the asymmetric preferences case. There the customs union's terms of trade only improve 86 % of the time. Theory suggests that the customs union's external terms of trade deteriorates when the customs union is small relative to the third country. *Hypothesis*: Customs unions member's terms of trade improve except in cases where the customs union is small relative to the third country.

Customs unions result in more trade for the members more than 90% of the time. The theory is that the volume of internal trade goes up while external trade falls. So, this could be a case of the external trade falling more than the internal trade is increasing. This could be associated with trade pattern changes. So, suppose two countries who trade with each other form a customs union. As a result of the union the trade pattern changes and results in less external trade then it seems likely that the member's volume of trade falls as a result of the union.

Finally, the world welfare results suggest there is only a mild bias in favor of customs unions when one looks at world welfare. Theoretically, we are comparing two distorted equilibria. Moving

from Nash equilibrium to a customs union we get some tariff reduction, but also we get member country's co-ordinating their tariffs which tends to lead to more protection. The results indicate that from the world's point of view the benefits of reduction outweigh the costs of tariff co-ordination slightly more than half the time.

5. Sensitivity Analysis

Table 3 reports on some sensitivity analysis around the central case. We present these to give some idea of how our results vary with standard variations in basic assumptions. The results indicate quite a bit variability in the numbers but the patterns of the numbers appear to be quite stable.

Table 3

Sensitivity Analysis on Customs Union Propositional Analysis

Proposition	Percentage of Computed Model Parameterizations For which the Proposition is True				
	Central Case	Asymmetric Preferences*	CES Preferences (σ=1.50)**	Asymmetric off Diagonal Endowments	Weighted Sum of Utilities for CU***
1. Both members benefit from a CU	81.6	85.8	84.2	83.3	84.0
2. CU results in higher external tariff	79.1	83.7	81.5	72.1	77.8
3. CU are a stepping stone to free trade	23.9	21.3	24.8	14.1	29.7
4. CU improves members' terms of trade	98.1	86.1	99.5	92.9	90.0
5. CU increases members' trade volume	91.5	94.9	92.0	89.7	81.2
6. CU increases world welfare	64.1	63.7	64.8	70.3	52.1

* Shares are different across goods but the same across countries (shares are 0.5, 0.3 and 0.2 for goods 1, 2 and 3 respectively).
** σ is the elasticity of substitution in preferences.
*** Weights are given by the share of the value of each country's endowment in the value of world endowment.

In order to do comprehensive sensitivity analysis we employ Monte Carlo simulation. In particular, what we do is a Monte Carlo simulation in which we use CES preferences, but allow them to be asymmetric across goods, different between countries, and to take on different values of the elasticity of substitution. Endowments are unconstrained and selected randomly. We let the program choose values for all of these variables and compute the resulting equilibria. At the end we report what percentage of the cases the six propositions we examine hold true. This reflects the view that we regard variations in all these variables as being generated by a uniform distribution.

6. CONCLUSION

To follow.

References

Bhagwati, J. and A. Panagariya, 1996, "Preferential trading areas and multilateralism: strangers, friends or foes?" In J. Bhagwati and A. Panagariya (eds.), *Free Trade Areas or Free Trade? The Economics of Preferential Trading Agreements.* Washington, D. C.: AEI Press.

Francois, J. F., B. MacDonald and H. Nordstrom (1996), "The Uruguay Round: A Numerically Based Qualitative Assessment." In Martin, W. And A. Winters (eds.), *The Uruguay Round and the developing countries*. Cambridge; New York and Melbourne: Cambridge University Press.

Hamilton, R. And J. Whalley (1985), "Geographically Discriminatory Trade Arrangements." *Review of Economics and Statistics* 67: 446-55.

Kennan, J., and R. Riezman (1990), "Optimal tariff equilibria with customs unions." *Canadian Journal of Economics* 90: 70-83

Kowalczyk, C. (1989), "Trade Negotiations and World Welfare." *American Economic Review* 79: 552-59.

Kowalczyk, C (1999) Welfare and customs unions, forthcoming *International Economic Review.*

Lipsey, R. G. (1957), "The Theory of Customs Unions: Trade Diversion and Welfare." *Economica* 24: 40-46.

Lipsey, R. G. (1960), "The Theory of Customs Unions: A General Survey." *Economic Journal* 70: 498-513.

Lipsey, R.G. (1970), *The Theory of Customs Unions: A General Equilibrium Analysis*. London: Weidenfeld and Nicholson.

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

Lloyd, P. J. (1982), "A 3 x 3 Theory of Customs Unions." *Journal of International Economics* 12: 41-63.

Meade, J. E. (1955), *The Theory of Customs Unions*. Amsterdam: North-Holland.

Miller, M. H. and Spencer, J. E. (1971), "The Static Economic Effects of the UK Joining the EEC: A General Equilibrium Approach." *Review of Economic Studies* 44: 71-93.

Perroni, C. and J. Whalley (1994), "The New Regionalism: Trade Liberalization or Insurance?" NBER Working Paper # 4626. Forthcoming in *Canadian Journal of Economics*.

Perroni, C. and J. Whalley (1996), "How Severe Is Global Retaliation Risk under Increasing Regionalism?" *American Economic Review* 86: 57-61.

Riezman, R. (1979), "A 3X3 Model of Customs Unions." *Journal of International Economics* 9, 341-354.

Riezman, R. (1985), "Customs unions and the core." *Journal of International Economics* 19: 355-365.

Riezman, R. (1999), "Can Bilateral Agreements Help Induce Free Trade?" *Canadian Journal of Economics* 32: 751-766.

Shoven, J. B. and J. Whalley (1974), "On the Computation of Competitive Equilibrium on International Markets with Tariffs." *Journal of International Economics* 4 : 341-54.

Summers, L. (1991), "Regionalism and the World Trading System." *Federal Reserve Bank of Kansas City* (Policy Implications of Trade and Currency Zones), 295-301.

Syropoulos, C. (1999), "Customs Unions and Comparative Advantage," forthcoming *Oxford Economic Papers.*

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

Whalley (1985)