NORTH-HOLLAND

Journal of Policy Modeling
24 (2002) 83–101

Journal of Policy Modeling

The revival of regional trade arrangements: a GE evaluation of the impact on small countries☆

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Received 1 March 2001; received in revised form 1 July 2001; accepted 1 October 2001

Abstract

In this paper we analyse the implications of various potential regional trade arrangements on the globe for small, medium, and large countries using a general equilibrium multi-region model of world trade. We show that the effects of regional trade arrangements on member and non-member countries are different for different equilibrium concept and the nature of agreements. In a traditional competitive equilibrium framework the welfare effects are small and non-member nations lose marginally due to a trade diversion. In a non-cooperative Nash equilibrium framework small non-member nations are worse affected. Since the larger regions can bring the terms of trade in their favor by retaliation, and hence could gain from retaliation, the growth of regional trade arrangements is a great cause of concern for the smaller regions. This concern becomes stronger if these trade arrangements are customs unions (CU). This makes small and medium size nations seeking trading arrangement with larger nations as a safe heaven strategy.

JEL classification: D5; F0; F1

Keywords: Trade retaliation; General equilibrium; Regional trade arrangements

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0161-8938/02/$ – see front matter © 2002 Society for Policy Modeling.
PII: S0161-8938(02)00100-X

1. Introduction

In recent years there has been an outburst of literature on the regional trade arrangements using general equilibrium models. Most of these modeling exercises display simulation results of various trade arrangements on the globe from a static competitive general equilibrium analysis and indicate very small effects from trade integration both on the member nations' and non-member nations' trade and welfare. The reason is that in most of these countries trade barriers are already at a low level due to unilateral, regional or multilateral under the GATT (WTO) tariff liberalizations that had taken place in the eighties and nineties. Even though the estimated effects of a trade integration on a non-member nation from these model simulations are very small, there has been widespread and growing concerns among the developing nations about the growth of regionalism. Why is this growing concern among small and medium size countries? The kind of analyses mentioned above cannot provide much light on the reasons behind the proliferation of regional trading arrangements. In this paper, we argue that a proper understanding of the reasons behind their concern about the growth of regionalism in many developing countries like India requires going beyond the traditional approach and by incorporating the potential cost of these arrangements in the event of a retaliatory trade regime. Here we use both the traditional models of comparative static competitive equilibrium in which tariffs are externally fixed and models of non-cooperative Nash (1950) equilibrium under which each country sets their optimal tariff subject to given tariff rates in other regions and a global equilibrium is reached when regional optimizing behaviors are mutually consistent across all regions. We find significant differences in the impacts of regional trade arrangements between these approaches.

We chose India as the single country and seven other aggregated regions in the model. Choice of India is because the author has access to data on India and it is one of the most vocal developing nation in the WTO. India, here, could be viewed as a representative small non-member nation. The model we use for evaluation of the impacts of various regional trade arrangements on India and other region is an enlarged version of the retaliatory Nash tariff and trade structure first set out in Gorman (1957) and Johnson (1953–1954), and subsequently expanded in Ghosh and Whalley (1997), Hamilton and Whalley (1983), Kennan and Riezman (1990), Markusen and Wigle (1989), and Perroni and Whalley (1996). Each region in the model has a fixed supply of one differentiated good. It captures trade, consumption, production as well as tariffs by region.

We compute global competitive equilibria in which tariff rates are exogenously specified and the effect of trade integration are simulated by changing the applicable tariff rates exogenously. We also compute global retaliatory Nash non-cooperative equilibria of a tariff game; tariff rates are thus endogenously determined. Implications for formation of trading arrangements are then analyzed under both the solution concepts.

We find that in a traditional competitive equilibrium framework the welfare effects of a regional trade arrangements are small and non-member nations lose marginally due to trade diversion while members gain. In a non-cooperative Nash equilibrium framework small non-member nations are worse affected. Since the larger regions can bring the terms of trade in their favor by retaliation, and hence could gain from retaliation, the growth of regional trade arrangements is a great cause of concern for the smaller regions. This concern becomes stronger if these trade arrangements are customs unions (CU) rather than free trade areas. The conclusion we draw is that the potential threat of a trade war rather than the gains or loss from ongoing trade arrangements as such are the primary reason of many developing nations seeking regional trade arrangements with larger nations.

2. A global trade model of regional trade arrangements

In this section we specify a general equilibrium global trade model consisting of eight regions, namely India (IND), Australia, New Zealand, and Japan aggregated as ANZ, Rich Asia (RIA), Poor Asia (POA), NAFTA (NAF), South America (SAM), European Union (EUR), and the Rest of the World (ROW).[1] We specify a model of a global competitive equilibria in which tariff rates are exogenously specified and also a Nash non-cooperative equilibrium structure in which each country sets their optimal tariffs; tariff rates are thus endogenously determined. Implications for the formation of trading arrangements are then analyzed using both these equilibrium structure for the member and non-member countries.

2.1. Production

Each region in the model has fixed supply of one differentiated good. Thus, the supply of exportable by each region is perfectly inelastic. This assumption could be relaxed by appropriate specification of the elasticity of supply. This means regional offer curves in the model are determined solely by endowments and preferences. This effectively gives a pure exchange formulation. Representative consumer in each economy consumes both the domestically produced and imported goods from outside the region.

2.2. Preferences

Demands in region *j* are determined by maximization of a double nested LES utility function subject to a regional budget constraint. The utility function of the representative agent in region *j* is given by

$$U^j = [\alpha_D^j (D_j - \overline{D}_j)^{\sigma_j - 1/\sigma_j} + \alpha_C^j (C_j - \overline{C}_j)^{\sigma_j - 1/\sigma_j}]^{\sigma_j/\sigma_j - 1}, \quad (j = 1, \ldots, K) \qquad (1)$$

[1] The details about the aggregation scheme followed are in Table 1.

where U^j defines utility, and D_j and C_j are quantities of the domestic (own region) good and the composite import good consumed by region j. α_D^j and α_C^j are share parameters in region j's preferences applying to the domestic and composite import good, and σ_j is the top level CES substitution elasticity in region j's preferences. $\overline{D}_j$ and $\overline{C}_j$ are LES shift parameters which can be interpreted as subsistence consumption requirements for domestic and composite foreign goods. The import composite for region j, C_j, is, in turn, treated as a CES aggregate over the imports M_i^j purchased by region j from region i, i.e.,

$$C_j = \left[\sum_{i \neq j} \beta_i^j M_i^{j^{\lambda_{j-1/}\lambda_j}} \right]^{\lambda_j/\lambda_j - 1}, \quad (j = 1, \ldots, K) \tag{2}$$

where β_i^j are CES share parameters on imports by region j from region i, and λ_j is the bottom level CES substitution elasticity parameter in region j. Earlier literature (Gorman, 1957; Johnson, 1953–1954; Kuga, 1973) used simple functional form viz, constant elasticity excess demand functions, in which optimal setting elicited no further response, and computation of Nash equilibria was trivial. Subsequent literature has used more conventional demand functions in which computation of Nash equilibrium requires repeated iteration. The difficulty of calculation increases rapidly with dimensionality (both in terms of goods and regions). Most other models use 2×2 or 3×3 formulations. We generalize the earlier approach by incorporating eight regions.

2.3. Income

Representative agent in each region (I^j) has two sources of income namely, tariff revenue (R^j) and endowments of production (S^j) which could be expressed by the following equation:

$$I^j = P_j \overline{S}^j + \sum_{i \neq j} R_j \tag{3}$$

where P_j is the domestic price in region j and R^j is expressed as

$$R_j = \sum_i t_i^j P_i M_i^j \tag{4}$$

where P_i is the output price (the world price) of good i (sold by region i to region j) and domestic demands in each region are

$$D_j = \frac{(\alpha_D^j)^{\sigma_j} (Y^j - P_j \overline{D}_j - P_j^M \overline{C}_j)}{[(\alpha_D^j)^{\sigma_j} P_j^{1-\sigma_j} + (\alpha_C^j)^{\sigma_j} (P_j^M)^{1-\sigma_j}] P_j^{\sigma_j}} + D^j \tag{5}$$

where P_j^M is the composite import price in region j, and given by

$$P_j^M = \left[\sum_{i\neq j}(\beta_i^j)^{\lambda_j}[(1+t_i^j)P_i]^{(1-\lambda_j)}\right]^{1/(1-\lambda_j)} \tag{6}$$

it follows that exports by region j, X_j, are given by

$$X_j = \overline{S}_j - D_j \tag{7}$$

The demand in region j for the regional import composite, C_j, is given by

$$C_j = \frac{(\alpha_c^j)^{\sigma_j}(Y^j - P_j\overline{D}_j - P_j^M\overline{C}_j)}{(P_j^M)^{\sigma_j}[(\alpha_D^j)^{\sigma_j}(P_j)^{(1-\sigma_j)} + (\alpha_c^j)^{\sigma_j}(P_j^M)^{(1-\sigma_j)}]} \tag{8}$$

and demands in region j for imports from region i are given as

$$M_i^j = \frac{(\beta_i^j)^{\lambda_j}(P_j^M C_j)}{((1+t_i^j)P_i)^{\lambda_j}\left[\sum_{i\neq j}(\beta_i^j)^{\lambda_j}[(1+t_i^j)P_i]^{(1-\lambda_j)}\right]} \tag{9}$$

The total demand for the exports of any region, l, is given by

$$Z_l = \sum_{j\neq l} M_l^j, \quad \forall l \tag{10}$$

and, in equilibrium,

$$Z_l = X_l, \quad \forall l \tag{11}$$

2.4. Competitive equilibria

For given tariff rates in all regions (and hence treated as exogenous), we compute global competitive equilibria for the model. These involve market clearing in each country specific product, government budget balance in each region, (K–1) relative goods prices, and K revenue levels in each country; with all of these endogenously determined in equilibrium.

2.5. Non-cooperative Nash equilibria

For computing non-cooperative Nash equilibria in global tariff game, we maximize (1), given tariff rates, t_j^k, in all other countries $k \neq j$, and the competitive equilibrium conditions (12) for each region j. This generates a set of endogenously determined optimal tariff rates, t_l^j, as a best response to the other region tariff rates, t_j^l, $l \neq j$. We represent these reaction functions as

$$\hat{t}_l^j = r(t_j^l), \quad l \neq j \tag{12}$$

In a non-cooperative Nash equilibrium, the conditions in which best response tariff rates generated by regional optimizing behavior are mutually consistent across all regions are given by

$$\hat{t}_l^j = r(\hat{t}_j^l), \quad l \neq j \, \forall l \tag{13}$$

This condition implies that optimal tariff rates are mutually consistent when no country has the incentive to change its tariff given other countries tariff rates.

3. Data and parameterization of the model

For numerical implementation of the eight region global general equilibrium trade model described above, benchmark equilibrium data on production, consumption, trade and tariffs for the year 1992 are generated from the Global Trade Policy Analysis Project (GTAP) version 3 Data Base (see Hertel, 1997 and McDougall, 1997 for details). The aggregation scheme we follow is given in Table 1. We make necessary adjustments to the raw GTAP data to satisfy trade balance and other equilibrium conditions in the model including market clearing by product. Tables 2–4 report the base case data on production, value of elasticity parameters, bilateral trade and protection in terms of *ad valorem* equivalents. The *ad valorem* equivalent of protection includes tariffs and *ad valorem* equivalents of quotas and other policy interventions.

Table 1
Regional aggregation scheme used in constructing model base case data

Regions in the model		Countries in GTAP data base included in the region
1. ANJ	Australia, New Zealand and Japan	Australia, New Zealand and Japan
2. RIA	Rich Asia	Korea, Malaysia, Philippines, Singapore, Thailand and Hong Kong.
3. POA	Poor Asia	China, Indonesia, Taiwan and Rest of South Asia
4. IND	India	India
5. NAF	NAFTA	Canada, USA and Mexico
6. SAM	South America	Central American and Caribbean countries, Argentina, Brazil, Chile, rest of South America
7. EUR	Europe	European Union of the 12, Austria, Finland, Sweden, European Free Trade Area and Central European countries with EU Association Agreements
8. ROW	Rest of the World	Former Soviet Union, Middle East and North Africa, Sub-Saharan Africa and Rest of the World

Note: Author’s own classification.

Table 2
Base case (1992) production and elasticity parameters in global general equilibrium model

	Production ($ billion)	Uncompensated import demand elasticity
ANJ	3,452	−1.15
RIA	587	−1.12
POA	738	−0.95
IND	217	−0.85
NAF	6,099	−1.50
SAM	792	−0.85
EUR	7,159	−1.25
ROW	1,491	−0.85

Source: Basic data from GTAP version 3 Data Base, and elasticity values from Marquez (1990) and Stern, Francis and Schumacher (1976).

In terms of the GDP (production) in Table 2 we assume India to be a representative small developing country. Aggregated regions RIA, POA and SAM could be regarded as medium size countries and NAF and EUR considered to be large countries. ANJ lies somewhere between medium and large size countries. One important element in the data is that average tariff rates are higher in small developing countries and it tend to fall as we move on to large countries (Table 4).

The key behavioral parameters in the model are the elasticity parameters in two nests specified in the LES utility function and the income elasticity of demand. These parameter are very crucial because they determine the strengths of terms of trade effects across competitive equilibria. The uncompensated import demand elasticity of substitution data was taken from secondary sources including Marquez (1990) and Stern, Francis, and Schumacher (1976). As the estimates for the aggregated regions are not available, we chose those country estimates that approximately matches our block characteristics. Elasticity of substitution at the lower level, i.e., elasticity of substitution in imports from different origin is assumed to be 1.5 time the uncompensated import demand elasticity at the upper level.

Table 3
Benchmark (1992) trade flows ($ billion)

Exporting region	Importing region							
	ANJ	RIA	POA	IND	NAF	SAM	EUR	ROW
ANJ	–	71.96	65.69	2.57	115.57	12.14	92.24	27.55
RIA	59.79	–	39.79	2.26	60.84	6.30	58.45	18.30
POA	53.67	41.82	–	0.79	53.74	3.64	53.57	13.05
IND	3.66	2.34	1.94	–	4.13	0.17	7.59	3.59
NAF	114.73	48.10	43.27	2.97	–	41.11	202.68	42.79
SAM	12.49	4.71	4.65	0.33	36.97	–	41.73	6.41
EUR	85	54.30	52.70	8.88	187.28	37.63	–	181.55
ROW	58.38	22.47	12.24	5.62	37.13	6.30	151.09	–

Source: Basic data from GTAP version 3 Data Base.

Table 4
Benchmark (1992) tariff and tariff equivalents by region (%)

Exporting region	Importing region							
	ANJ	RIA	POA	IND	NAF	SAM	EUR	ROW
ANJ	–	16	19	46	19	22	13	21
RIA	8	–	25	45	9	21	9	23
POA	18	13	–	48	10	19	8	25
IND	4	13	18	–	10	20	10	18
NAF	21	16	18	40	–	14	6	13
SAM	12	10	11	30	10	–	16	13
EUR	9	11	17	36	6	15	–	16
ROW	4	8	15	16	3	7	6	–

Source: Basic data from GTAP version 3 Data Base.

The values of the elasticity parameters, reported in the Table 2 are largely in the neighborhood of one and are used in other modeling literature, reflect the range of estimated values that have been generated for over 40 years, going back to Orcutt's (1950) classic work on trade elasticities. However, trade economists often argue that these are implausibly low, and these in the present context are the source of strong inter-regional effects from trade policy changes in the model. We, therefore, conduct sensitivity tests to explore the implications of using alternative values of elasticities in the model for model solutions.

For other parameter values we use the calibration procedure elaborated in Mansur and Whalley (1984) and Shoven and Whalley (1992). Given equilibrium data, calibration in effect, imposes equilibrium as an identifying restriction on model specification and generates the parameter values. We make these and later model computations by using the Generalized Algebraic Modeling System (GAMS) Software due to Brooke, Kendrick, and Meeraus (1996).

4. Results: evaluating the impacts of regional trade arrangements

To understand the implications of a small country such as India forming various regional trade arrangements under both the model solutions (comparative static competitive and non-cooperative Nash equilibrium) we run various probable and hypothetical counterfactual experiments and compute the changes in welfare compared to the base case in each region in terms of Hicksian equivalent variation. The comparative static competitive equilibria are computed to account for the changes in welfare due to formation of trade arrangements such as the CU and FTA without retaliation. By computation of Nash equilibria, we analyze the impact of the formation of CU and FTA in the presence of retaliation. We also compute Nash equilibria without regional trading arrangements.

Simulation results of India's joining various potential trade arrangements with different regions in the model both under competitive equilibria and Nash equilibria are reported in Table 5. Upper half of the table reports results under competitive model and lower half represents results under Nash computation. Gains (+) and losses (−) are reported in billion of US dollars. While computing Nash equilibria it is assumed that the ROW remains passive. This we assume because given the heterogeneity of interest and the level of well being among the countries in the rest of the world it is not possible for them to act as a single unit. This could also be treated as a representative region which remains passive in all regional trade arrangements.

Table 5 also reports the results of pair-wise bilateral tariff elimination both under FTA and CU agreements between India and other members in the model under the two model solution concepts. Simulation results of various bilateral trade arrangements by India with other regions in the model are reported in Table 5 (column 3–12; upper half indicating simulation results from competitive equilibria and lower half displays results from Nash equilibria).

A number of observations could be made from Table 5. First, the magnitude of gains and losses under simple competitive equilibria, due to bilateral tariff elimination between partners, are lower than that under Nash non-competitive equilibria. For example, a simple FTA arrangements with EU makes India marginally worse off (a loss of $0.4 billion) in the competitive equilibrium but brings a significant gain ($5.3 billion) under retaliatory tariff games when all regions are engaged in a tariff war. This is because under competitive equilibria only bilateral tariffs are eliminated and tariff rates vis-à-vis other regions remain unchanged but under non-cooperative Nash equilibria bilateral tariffs between India and Europe are eliminated but both Europe and India sets their optimal tariff vis-à-vis other regions. This result underscores the view that for a small country like India forming a trade arrangements with a bigger region like the EU is logical as it avoids retaliation with the partner in the worse case scenario. Pair-wise tariff liberalization by India with other regions in the model both under CU and FTA makes India better off compared to a situation of global retaliation with no trade arrangements except with the SAM. In this event though India lose marginally, joint welfare of India and SAM are higher than a Nash equilibrium in the absence of any regional regional trade arrangements. This implies that for an individual country there is always an incentive to go for regional trade arrangements particularly in the event of trade retaliation. Further results show that a welfare improvement under retaliation compared to base case (1992) occurs only when India forms a trade arrangement with the Europe (Table 5, columns 11 and 12). This result is quite obvious because Europe is the largest region in this model and India's largest trading partner too. A trading arrangement with Europe thus expands India's export markets in Europe though India's trade vis-à-vis others are reduced. The gains to importing countries from retaliation occur from driving up the prices of their own product against all other products in general, i.e., restricting their own trade in general for a country. Since every country retaliates, trade for each country falls and ultimate effect

Table 5
Equivalent variation under various regional trade arrangements: competitive equilibria and non-cooperative Nash equilibria

	NAG Nash[a]	IND, ANJ and FTA	IND, ANJ and CU	IND, RIA and FTA	IND, RIA and CU	IND, POA and FTA	IND, POA and CU	IND, NAF and FTA	IND, NAF and CU	IND, EUR and FTA	IND, EUR and CU	IND, SAM and FTA	IND, SAM and CU
Competitive equilibria (in $ billion)													
ANJ	–	+0.8	+18.2	−0.09	−1.4	−0.067	−3.4	−0.1	−9.5	−0.086	−2.1	−0.003	−0.5
RIA	–	−0.074	−1.9	+0.6	+5.3	−0.049	−0.6	−0.05	−0.2	−0.086	+0.2	−0.001	+0.2
POA	–	−0.041	−2.0	−0.081	−0.8	+0.2	+8.8	−0.02	−0.3	−0.038	−0.01	−0.001	+0.007
IND	–	−0.4	−1.8	−0.042	−1.1	+0.2	−0.5	+0.2	−0.8	−0.4	−0.8	−0.027	−0.9
NAF	–	−0.1	−6.3	−0.097	−0.4	−0.049	−0.8	+0.5	+18.0	−0.2	−0.052	−0.009	−0.3
SAM	–	−0.011	−0.5	−0.011	−0.1	−0.001	−0.04	−0.028	−0.6	−0.56	−0.2	−0.06	+3.7
EUR	–	−0.1	−2.9	−0.2	+0.3	−0.084	−0.2	−0.2	−0.7	+1.5	+5.0	−0.02	−1.0
ROW	–	−0.043	0.1	−0.083	−0.5	−0.037	−1.1	−0.09	−1.8	−0.5	−1.1	−0.006	−0.2
Non-cooperative Nash equilibria (in $ billion)													
ANJ	−106.8	−110.0	−107.0	−103.7	−108.7	−105.7	−107.9	−96.7	−107.4	−100.1	−91.9	−106.8	−106.8
RIA	−91.2	−89.0	−91.8	−93.4	−91.5	−90.4	−91.9	−88.0	−92.1	−87.2	−99.3	−91.1	−91.1
POA	−118.6	−116.4	−119.2	−116.2	−119.8	−119.6	−118.2	−115.3	−119.5	−113.0	−98.8	−118.6	−118.5
IND	−14.6	−8.4	−8.9	−9.0	−8.8	−12.0	−12.1	−0.2	−1.0	+5.3	+1.9	−14.8	−15.1
NAF	−89.2	−85.5	−90.3	−86.6	−90.4	−88.4	−89.8	−99.5	−95.9	−78.3	−97.5	−89.1	−89.5
SAM	−81.7	−81.3	−81.8	−81.4	−81.8	−81.7	−81.6	−77.1	−81.6	−75.7	−53.3	−81.4	−80.8
EUR	−27.6	−24.3	−29.2	−24.1	−29.5	−26.5	−29.0	−13.8	−28.6	−41.3	−35.3	−27.4	−28.4
ROW	−290.1	−289.2	−291.9	−289.0	291.9	−290.1	−290.4	−285.6	−293.6	−262.5	−142.8	−290.0	−289.9

[a] Results of retaliation in the absence of regional trade arrangements (NAG).

depends upon the net terms of trade effect. And in this game large countries/regions gain. In the event of a global retaliation, in the absence of any regional trading bloc, all the regions in the model lose including larger regions (Table 5, column 2). This implies that such event might not occur. The magnitude of loss as a percentage of GDP is, however, very small for the lager regions (0.4% for Europe) and large for smaller regions (7% for India). On the other hand, in the presence of regional trade arrangements retaliation bring gains to bloc members. Therefore, the probability of retaliation in the era of growing regionalism cannot be zero.

A comparison of results from various probable and hypothetical FTA and CU arrangements by India suggests that any kind of regional trade arrangement irrespective of the size of the region is good for India compared to case where no regional trade arrangements has taken place under Nash equilibria (column 1, lower half) in the event of a global trade war. For example, an FTA with ANJ reduces the loss from global trade war from \$14.6 billion to \$8.4 billion. ANJ, however, lose compared to base case marginally by forming FTA or CU with India. Therefore, it is argued that such an arrangement may not take place without a side payment by India.[2] Among the options elicited here, FTA and CU with bigger partners, i.e., EUR and NAF, are the best option for India. An FTA with EUR makes India better off and positive changes in level of welfare in the event of a global trade war. One may argue that EUR has no incentive in that arrangements as it lose but one cannot nullify the possibility of larger regional groupings where ANJ, RIA, POA, and NAF form a CU union arrangement and retaliate against others including EUR. Under such a situation EUR lose more than in a case without a regional trade arrangements (Table 6, column 7, upper half). A trade agreement with India may improve EUR's situation.

In Table 6 we report simulation results of the formation of various FTAs and CUs in which India is not a member to show the effects on non-participating small countries. Once again the effects are small in a competitive framework but huge effects from Nash non-cooperative outcome. These results should be compared with the results of Nash equilibria in the absence of any regional trade arrangements (Table 5, column 2, lower half). For instance, we compare the results of a FTA between ANJ and RIA under Nash equilibria (reported in Table 6, column 2, upper half) with no trade arrangements (NTA) Nash tariff war (Table 5, column 2, lower half). The results indicate that the effects are less severe in case of FTA arrangements. This indicates that FTAs are not necessarily bad for outside members in the event of global tariff retaliation. But CUs are bad in general. Compare the results of a CU between ANJ and RIA (Table 6, column 3, upper half and Table 5, column 2, lower half). Relative to NTA Nash retaliation, ANJ and RIA are better off when they are in CU as they could turn their terms of trade in a comparatively favorable position by setting their common external tariff. The increase in bloc size affects member countries positively and outsiders

[2] See Perroni and Whalley (1996) for a discussion on this.

Table 6
Equivalent variation under various regional trade arrangements: non-cooperatitive Nash equilibria and competitive equilibria

	ANJ and RIA		ANJ, RIA and POA		ANJ, RIA, POA and NAF		ANJ, RIA, POA, NAF and SAM		NAF and SAM		NAF and EUR	
	FTA	CU	FTA	CU	FTA	CU	FTA	CU	FTA	CU	FTA	CU
Non-cooperative Nash equilibria (in $ billion)												
ANJ	−94.8	−50.4	−94.7	−59.2	+6.8	+54.2	+3.9	+44.9	−75.0	−108.9	−31.5	−204.2
RIA	−58.5	−65.3	−53.0	−57.1	−16.9	−10.9	−17.7	−12.2	−81.0	−92.2	−57.6	−126.9
POA	−94.6	−149.5	−59.5	−47.0	−25.0	−9.4	−26.9	−13.9	−108.0	−119.5	−74.2	−180.4
IND	−13.1	−16.5	−12.7	−17.3	−10.2	−25.7	−10.3	−24.9	−13.7	−14.8	−7.4	−25.2
NAF	−57.6	−115.7	−43.7	−131.8	−90.0	−76.9	−85.6	−83.6	−121.5	−111.1	−6.8	+21.1
SAM	−76.7	−86.1	−75.6	−86.4	−50.1	−124.2	−27.2	−19.6	−12.9	−10.8	−37.4	−161.0
EUR	−4.7	−48.8	+7.8	−66.7	+74.5	−159.2	+83.0	−180.4	+11.6	−43.8	+38.1	+160.5
ROW	−275.0	−308.1	−273.0	−313.1	−240.7	−401.6	−241.3	−395.3	−278.8	−294.7	−170.3	−464.2
Competitive equilibria (in $ billion)												
ANJ	+7.6	+20.8	+8.0	+22.2	+20.0	+24.0	+20.0	+23.4	−0.7	−5.6	−2.2	−1.1
RIA	−0.4	−0.5	+3.9	+1.8	+4.5	+5.4	+4.8	+5.5	−0.2	−0.8	−1.1	−3.3
POA	−2.5	−2.4	+5.6	+3.2	+5.7	+5.0	+5.5	+4.7	−0.2	−1.5	−1.1	−1.4
IND	−0.1	+0.4	−0.3	+0.1	−0.6	+0.2	−0.6	−0.05	−0.02	−0.1	0.2	−0.4
NAF	−2.8	−5.8	−7.0	−9.8	+4.0	+0.8	+37	−0.2	+0.3	+11.8	+2.6	+10.8
SAM	−0.2	−0.7	−0.6	−1.1	−2.7	−3.2	+1.2	+4.0	+3.0	+5.5	−1.0	+0.8
EUR	−2.4	−6.9	−6.5	−9.0	−17.6	−15.4	−20.2	−18.4	−1.8	−3.8	+5.6	+0.8
ROW	−0.7	−0.4	−2.0	−0.9	−4.5	−4.5	−4.7	−5.2	+0.2	−1.6	−2.8	−0.6

Table 7
Equivalent variation (in $ billion) under various regional trade arrangements: bottom and upper level elasticity parameters are increased by 25%

	NAG Nash[a]	IND, ANJ and FTA	IND, ANJ and CU	IND, RIA and FTA	IND, RIA and CU	IND, POA and FTA	IND, POA and CU	IND, NAF and FTA	IND, NAF and CU	IND, EUR and FTA	IND, EUR and CU	IND, SAM and FTA	IND, SAM and CU
Competitive equilibria (in $ billion)													
ANJ	–	+0.8	+17.4	−0.09	−1.3	−0.07	−3.5	−0.1	−8.1	−0.09	−2.0	−0.0	−0.5
RIA	–	−0.08	−1.8	+0.6	+5.1	−0.05	−0.6	−0.05	−0.2	−0.09	+0.2	−0.0	+0.1
POA	–	−0.04	−1.8	−0.09	−0.7	+0.2	+8.6	−0.03	−0.3	−0.04	−0.02	+0.03	+0.0
IND	–	−0.4	−1.4	−0.02	−0.7	+0.2	−0.2	+0.2	−0.4	−0.03	−0.4	−0.03	−0.6
NAF	–	−0.1	−5.5	−0.1	−0.4	−0.05	−0.7	+0.5	−17.6	−0.2	−0.01	−0.0	−0.3
SAM	–	−0.01	−0.5	−0.01	−0.09	−0.01	−0.04	−0.03	−0.5	−0.05	−0.1	+0.06	+3.5
EUR	–	−0.1	−2.6	−0.2	+0.2	−0.08	−0.2	−0.2	−0.6	+1.5	+4.8	−0.02	−0.8
ROW	–	−0.05	+0.03	−0.08	−0.5	−0.04	−1.0	−0.09	−1.6	−0.5	−1.0	−0.0	−0.2
Non-cooperative Nash equilibria (in $ billion)													
ANJ	−61.5	−63.0	−61.1	−59.8	−62.5	−60.9	−62.1	−56.5	−61.9	−58.7	−62.2	−61.5	−61.5
RIA	−61.3	−60.1	−61.8	−62.6	−61.1	−60.9	−61.8	−59.5	−61.9	−59.4	−62.0	−61.3	−61.3
POA	−74.1	−73.0	−74.5	−72.7	−74.7	−74.6	−73.5	−72.5	−74.5	−71.9	−74.6	−74.0	−74.0
IND	−8.9	−5.1	−5.4	−5.4	−5.4	−7.2	−7.3	+0.05	−0.4	+2.8	+0.9	−8.9	−9.1
NAF	−54.9	−52.9	−55.6	−53.5	−55.6	−54.5	−55.2	−60.5	−58.6	−50.0	−55.8	−54.8	−55.1
SAM	−46.9	−46.7	−46.9	−46.7	−46.9	−46.9	−46.9	−44.9	−46.8	−44.7	−46.9	−46.7	−46.3
EUR	−22.5	−20.8	−23.6	−20.7	−23.7	−21.9	−23.2	−15.8	−23.5	−29.0	−23.4	−22.4	−23.0
ROW	−174.4	−173.8	−175.6	−173.7	−175.5	−174.4	−174.7	−172.2	−176.1	−163.8	−176.6	−174.4	−174.4

[a] Results of retaliation in the absence of regional trade arrangements (NAG).

Table 8
Equivalent variation (in $ billion) under various regional trade arrangements: bottom and upper level elasticity parameters are increased by 25%

	ANJ and RIA		ANJ, RIA and POA		ANJ, RIA, POA and NAF		ANJ, RIA, POA, NAF and SAM		NAF and EUR		NAF and EUR	
	FTA	CU	FTA	CU	FTA	CU	FTA	CU	FTA	CU	FTA	CU
Non-cooperatitive Nash equilibria												
ANJ	−52.3	−24.3	−52.8	−30.0	+14.3	+45.8	+12.3	+40.2	−44.4	−63.5	−18.7	−111.1
RIA	−38.3	−42.7	−33.9	−36.2	−8.4	−3.6	−9.0	−4.3	−55.3	−62.2	−41.0	−82.8
POA	−60.1	−94.5	−33.4	−24.9	−11.5	+0.8	−12.7	−2.0	−68.3	−74.7	−49.9	−103.9
IND	−8.1	−10.4	−7.8	−10.6	−6.4	−14.9	−6.5	−14.6	−8.4	−8.9	−5.2	−13.5
NAF	−36.4	−72.3	−27.8	−84.3	−54.8	−44.4	−51.8	−47.4	−73.1	−66.2	−2.2	+13.4
SAM	−44.4	−49.3	−43.6	−49.9	−30.2	−68.4	−14.2	−8.3	−4.3	−3.2	−24.3	−82.0
EUR	−9.6	−35.8	−2.2	−48.9	−36.7	−102.8	+41.6	−118.7	−2.4	−33.8	+26.2	+94.3
ROW	−166.0	−185.9	−164.3	−190.7	−147.4	−234.9	−147.4	−234.1	−168.7	−176.2	−116.0	−252.7
Competitive equilibria												
ANJ	+7.3	+20.4	+7.7	+21.6	+20.2	+24.0	+20.2	+23.5	−0.7	−4.8	−2.1	−0.4
RIA	+0.4	−0.4	+3.9	+2.0	+4.7	+5.7	+5.0	+5.8	−0.2	−0.8	−1.0	−3.2
POA	+2.4	−2.2	+5.8	+3.8	+5.9	+5.6	+5.8	+5.3	−0.2	−1.4	−1.0	−1.3
IND	−0.1	+0.04	−0.3	+0.08	−0.6	+0.1	−0.6	+0.01	−0.02	−0.1	−0.2	−0.3
NAF	−2.8	−4.9	−6.8	−8.8	+4.9	+1.9	+4.7	+1.1	+0.4	+11.4	+2.4	+11.0
SAM	−0.2	−0.6	−0.5	−1.1	−2.5	−3.0	+1.3	+4.0	+2.8	+5.5	−0.9	+0.8
EUR	−2.3	−6.3	−6.2	−8.4	−16.7	−14.3	−19.1	−16.9	−1.7	−3.3	+5.3	+1.1
ROW	−0.7	−0.5	−2.0	−1.1	−4.5	−4.4	−4.7	−5.0	−0.2	−1.4	−2.6	−0.4

Table 9
Equivalent variation (in $ billion) under various regional trade arrangements: bottom level elasticity parameters are reduced by 25%

	NAG Nash[a]	IND, ANJ and FTA	IND, ANJ and CU	IND, RIA and FTA	IND, RIA and CU	IND, POA and FTA	IND, POA and CU	IND, NAF and FTA	IND, NAF and CU	IND, EUR and FTA	IND, EUR and CU	IND, SAM and FTA	IND, SAM and CU
Competitive equilibria (in $ billion)													
ANJ	–	+0.7	+17.8	−0.05	−1.3	−0.05	−4.3	−0.05	−10.8	–	–	–	–
RIA	–	−0.04	−1.6	+0.6	+5.2	−0.04	−0.3	−0.03	+0.3	–	–	–	–
POA	–	−0.02	−1.6	−0.05	−0.8	+0.1	+8.8	−0.01	+0.3	–	–	–	–
IND	–	−0.5	−2.6	−0.1	−1.8	+0.2	−1.0	+0.06	−1.6	–	–	–	–
NAF	–	−0.05	−7.0	−0.07	−0.09	−0.04	−0.4	+0.3	+17.0	–	–	–	–
SAM	–	−0.01	−0.4	−0.01	−0.09	−0.0	−0.02	−0.02	−0.3	–	–	–	–
EUR	–	−0.06	−2.5	−0.1	+0.6	−0.06	+0.1	−0.1	+0.6	–	–	–	–
ROW	–	−0.01	−0.5	−0.06	−0.4	−0.03	−1.1	−0.06	−1.5	–	–	–	–
Non-cooperative Nash equilibria (in $ billion)													
ANJ	−273.2	−218.0	−214.1	−206.4	−215.8	−210.6	−213.6	−188.7	−214.3	–	–	–	–
RIA	−174.9	−144.4	−148.6	−151.7	−149.6	−147.0	−148.8	−141.2	−149.8	–	–	–	–
POA	−261.2	−208.1	−212.5	−207.8	−214.0	−213.1	−211.5	−203.5	−215.0	–	–	–	–
IND	−39.8	−20.3	−20.6	−21.0	−20.4	−25.6	−25.9	−7.1	−8.0	–	–	–	–
NAF	−200.2	−153.9	−161.2	−155.4	−162.2	−158.7	−160.8	−178.1	−174.1	–	–	–	–
SAM	−198.7	−153.4	−154.1	−153.6	−154.5	−153.9	−153.5	−142.2	−155.3	–	–	–	–
EUR	−117.9	−76.8	−85.7	−76.6	−86.7	−82.3	−85.9	−48.9	−82.9	–	–	–	–
ROW	−640.8	−509.6	−512.0	−509.0	−512.9	−509.6	−508.8	−500.2	−522.6	–	–	–	–

[a] Results of retaliation in the absence of regional trade arrangements (NAG).

Note: Simulation results in the last 4 columns are not reported, as these counterfactuals were numerically difficult to solve.

Table 10
Equivalent variation (in $ billion) under various regional trade arrangements: bottom level elasticity parameters are reduced by 25%

	ANJ and RIA		ANJ, RIA and POA		ANJ, RIA, POA and NAF		ANJ,RIA, POA, NAF and SAM		NAF and SAM		NAF and EUR	
	FTA	CU	FTA	CU	FTA	CU	FTA	CU	FTA	CU	FTA	CU
Non-cooperative Nash equilibria (in $ billion)												
ANJ	−187.8	−138.7	−186.3	−147.7	−32.5	+6.7	−36.0	−9.2	−153.5	−215.6	−61.4	–
RIA	−111.0	−118.7	−101.3	−107.1	−42.4	−46.9	−43.4	−49.3	−131.8	−151.4	−87.1	–
POA	−169.2	−238.5	−128.1	−113.1	−63.4	−66.0	−66.9	−74.7	−193.1	−219.5	−121.7	–
IND	−26.1	−31.5	−25.5	−31.9	−19.6	−51.2	−20.0	−48.3	−27.1	−32.0	−12.1	–
NAF	−105.3	−180.6	−80.6	−181.5	−149.2	−153.5	−143.3	−164.0	−209.8	−206.2	−38.0	–
SAM	−142.5	−158.0	−141.8	−157.2	−90.7	−231.6	−61.7	−71.5	−52.7	−53.5	−59.0	–
EUR	−36.0	−108.1	−10.7	−115.3	+119.9	−261.3	+139.2	−234.0	+1.2	−91.0	+22.7	–
ROW	−481.3	−523.2	−482.9	−525.7	−415.1	−713.1	−421.4	−596.7	−495.6	−548.9	−259.2	–
Competitive equilibria (in $ billion)												
ANJ	+18.2	+6.8	+6.7	+20.1	+16.6	+20.5	+16.7	+20.1	−0.5	−6.1	−1.3	–
RIA	−0.7	−0.2	+3.4	+1.8	+5.0	+5.9	+5.3	+6.1	−0.2	−0.6	−0.7	–
POA	−1.7	−2.0	+4.4	+1.8	+5.3	+4.1	+5.2	+3.9	−0.2	−1.3	−0.7	–
IND	+0.1	−0.1	−0.2	+0.2	−0.5	+0.3	−0.5	+0.0	−0.1	−0.2	−0.1	–
NAF	−6.1	−2.0	−5.1	−8.9	+0.5	−1.6	+0.08	−2.4	−0.04	+11.2	+1.3	–
SAM	−0.5	−0.2	−0.5	−1.0	−2.0	−2.6	+1.0	+3.5	+2.5	+4.8	−0.6	–
EUR	−5.8	−2.0	−5.1	−7.3	−12.3	−11.1	−14.0	−13.7	−1.2	−2.7	+4.1	–
ROW	+0.1	−0.5	−1.7	−0.09	−3.6	−3.4	−3.8	−3.9	−0.2	−1.3	−1.7	–

are worse off. This result is true for all other cases also, e.g., the formation of a CU between ANJ, RIA, and POA. The worst outcome for a non-member could be when all others are within a CU. In our model, among the simulation exercises undertaken, the worst for the non-members appears to be the event when the two largest region, i.e., NAF and EUR forms a CU and retaliate against the rests. The magnitude of welfare loss is 5–6% of their respective GNP while the members could end up with positive changes in the level of welfare. This explains the reasons for the concern of the developing countries for the rise in regional trading arrangements particularly CU agreements like the EU. These analyses could thus explain why small countries would like to remain within a regional trading arrangements.

4.1. Sensitivity of model results

The results of the several sensitivity tests are reported in Tables 7–10. The results reveal the role of the values of elasticity parameters in welfare effects. The higher the elasticity parameter the greater the transmission of price changes and lower the effect of the terms of trade. The lower the elasticity of substitution in preferences the higher the terms of trade effect. The results reported in Tables 7 and 8 (with both bottom and upper level elasticities increased by 25% compared to base case shown in Tables 5 and 6) indicate a lower welfare effect compared to base case and Tables 9 and 10 (with bottom level elasticities reduced by 25%) indicate a higher welfare effect. This is in accordance with what the theory suggests.

5. Conclusion

In search for an explanation for the growing surge for regional trade arrangements and the consequent concerns of many small and medium size countries who are not its participants, in this paper we perform simulation exercises using a eight region computable general equilibrium model of world trade. We compute the effects of regional trade arrangements on member and non-member nations using both competitive equilibrium structures in which regional trade arrangements take the form of tariff reductions within members and keeping tariffs with other nations constant and a non-cooperative Nash equilibrium structure in which tariff retaliation with non-member nations takes place. In a competitive equilibrium, the effects of regional trade arrangements are small in terms of benefits accruing to member nations and the loss to the non-members. This result is quite obvious as the tariff base in many of these nations are already at a low level due to tariff reductions undertaken in successive GATT (WTO) rounds and unilateral attempts in many countries. Using standard CGE modeling tools, thus, cannot provide adequate explanation for the growth and concerns for regionalism.

Using a somewhat non-standard approach, a non-cooperative Nash equilibrium framework, we show that regional trade arrangements yield larger gains for the bigger nations while smaller regions lose dramatically. In the absence of regional trade arrangements trade retaliation does not bring any benefit rather loss to every country. Therefore, a trade war in absence of regional trading arrangements might not occur. Given the fact that larger regions can bring the terms of trade in their favor by retaliation, and hence could gain from retaliation, the growth of regional trade arrangements could be a great cause of concern for the smaller regions. Our analyses show that this concern becomes stronger if these trade arrangements are CUs. This makes smaller countries seek trading arrangement with larger nations as a safe heaven strategy. The formation of FTA is not bad, in general, compared to CU. Finally, for a small country like India regional trading arrangements with larger nations might be beneficial in the longer run.

Acknowledgements

I am grateful to John Whalley, Manmohan Agarwal and the disanant and participants of the Canadian Economic Association mettings, June 2000 for useful comments.

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