



NORTH-HOLLAND

The Gains From MERCOSUL: A General Equilibrium, Imperfect Competition Evaluation

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This paper presents general equilibrium evaluations of the MERCOSUL. Three scenarios are examined, varying from increased world regionalism to an optimistic multilateral situation. Welfare gains are significant for Uruguay, somewhat less for Argentina, and also present in Brazil. Uruguay is less vulnerable to the world environment; Argentina, on the contrary, profits much from the union and multilateralism. MERCOSUL exports rise for all sectors, and, under all scenarios, chemicals imports increase; the EU and NAFTA are equally important trade partners. Consumers gain even in sectors with modest trade diversion, though the number of firms decreases in all sectors but cars. Sensitivity analyses that raise results for Argentina depend on how Brazil engages in the integration. They also point that a “smaller Brazil” leaves everyone worse off. Complementarity, either for Argentina and Brazil or for Argentina and Uruguay, seems the likely outcome of MERCOSUL. Though the pattern of gains is clear for Uruguay, a deeper analysis is needed to identify, for Argentina and Brazil, other key areas. © *Society for Policy Modeling, 1997*

1. INTRODUCTION

Since the signature in March 1991 of the Assunción Treaty, macroeconomic problems—and particularly the stabilization issue—have received foremost attention in the majority of studies on the MERCOSUL. However, analysis of other questions of

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comparable relevance are sorely needed. Trade liberalization efforts in South America, with Chile often hailed as a model case, are happening at a fast pace, and analytic studies cannot wait longer.

This paper deals with the interaction between the Southern Cone integration and the world economy and its impact on different sectors in the four members. It provides several estimates and insights based on a static, multicountry, applied general equilibrium model with imperfect competition, increasing returns to scale at the firm level and product differentiation. Recent modeling experiments attribute to the imperfect competition features of the models much of the trade and welfare gains due to a unified market. Though not contradicting these findings, this work tries to concentrate on the consequences of different trade-policy scenarios.

The model developed for the MERCOSUL follows the lines of similar studies inspired by Harris' (1984) seminal paper: Burniaux and Waelbroeck (1992, 1994), Mercenier (1992, 1994), Gasiorek, Smith, and Venables (1992a, 1992b). The final structure is, however, closer to the last of these approaches.¹ Without necessarily implying a ranking of the options, this reflects the fact that GSV's framework was judged simpler and more suitable to the data available and to the questions to be formulated.

The simulations encompass three trade-policy alternatives, taking into account different actions of the other world regions.² As the form of competition in the imperfect markets and the magnitude of economies of scale are crucial factors for the possible gains, sensitivity analyses are also performed, in the lines proposed by Flôres and Mercenier (1992).

The paper is organized as follows. The idea and basic structure of the model are presented in Section 2, while Section 3 discusses the results. Sensitivity analyses are reported in Section 4, and the main conclusions are summarized in Section 5. A full description of the methodology, including the data problems, the model equations, and the calibration procedure may be found in the Appendix.

In principle, MERCOSUL will enable all its members, and foremost Uruguay, to take advantage from the integration. However, impacts are likely to be rather diversified across sectors and countries, and should be contrasted with more disaggregate partial exercises. This seems mandatory for Argentina and Brazil, as

¹From now on referred to as GSV. BW will stand for Burniaux and Waelbroeck's.

²For a discussion of some likely actions and/or reactions, see Flôres (1994).

the outcomes for the former will be tightly linked to the latter's reactions.

2. THE MODEL

2A. General Issues

The basic point common to all models in this area is that integration is seen as enabling consumers to profit from a decrease in the price-discriminating power of producers. In the full integration scenario, following the condition proposed by Smith and Venables (1988), firms are unable to discriminate and move to a single pricing rule: The difference between their price in each market and the associated trade and transportation costs is a constant, namely, the "price at the factory's gate." Consumers then benefit from both a reduction in average price-cost margins and the greater efficiency achieved through industry rationalization.

Recent evidences on the European integration process may cast some doubts on this mechanism. Depending on the number of players in a third market (i.e., countries/exporters within the union), it is not evident that more competitive behavior will take place, collusion among the few more powerful being a reasonable alternative. Even in the case of enhanced competition, the destructive effects of a tougher environment may go further—and at a faster pace—than portrayed by the models.

Also, as integration does not change their behavior, consumers are treated in a rather passive way. Work by Hayes et al. (1992) shows that this is likely not to happen and may point toward feasible technical improvements in this direction.³

Moreover, although there are many reasons why a general equilibrium framework is most appropriate for dealing with the problem at hand, the introduction of imperfect competition still needs a clearer understanding. Partial equilibrium neglects the contribution of the components of variable costs (relative price changes in intermediate inputs will presumably affect the firms ratio of average to variable cost, i.e., the elasticity of scale economies) and assumes constant factor prices, but can be rigorously and clearly framed. Despite the pioneer work by Negishi (1961) and creative formulations introduced thereafter, such as Gabszewicz

³To the extent of our knowledge, this was first raised by Jean Waelbroeck; see also BW (1992).

and Vial (1972), general equilibrium systems with imperfect competition may be open to criticism. The treatment of intermediate demand and the proof that an optimal exists for the profit function are two examples of the difficulties facing a general formulation. Though, given the assumptions, most of the applied models are rigorous, it is not clear that their assumptions are realistic.

In this way, the structure to be described should be judged as an approximation that does not answer all the above questions.⁴

2B. Outline of Model Structure

We consider a static world model consisting of seven regions: Argentina, Brazil, Paraguay, Uruguay, NAFTA (=U.S.+Canada+Mexico), the EU, and the rest of the world (=ROW).⁵ All are fully endogenous and MERCOSUL countries have the same structure: nine sectors, of which four are perfectly competitive. The five imperfect competition sectors are *steel products (excluding non-ferrous)*, *machines and equipment*, *the car industry*, *other vehicles and related components*, and *chemicals*. Together with *agricultural and animal commodities*, *shoes and leather*, *dairy products*, and “*all the rest*,” they make up the nine sectors.

The industries operating in imperfectly competitive markets have increasing returns to scale, each firm producing a differentiated good. Variety is consequently measured by the number of (identical) firms in the sector.⁶ There are two production factors, labor and capital, both assumed mobile within each region. Wages are flexible and labor supply is determined by the base-year work force. The model focuses on induced external trade flows, on changes in the various welfare sources in the imperfectly competitive sectors, and on global welfare gains in each country. Time effects, such as those that Baldwin (1989, 1992) tried to capture, and other dynamic or uncertainty issues (Kehoe, 1993) are not accounted for.

⁴Flôres and Mercenier (1992) pointed out some of these issues in the MERCOSUL context, as well as important related problems, which cannot be addressed via these experiments.

⁵Actually, NAFTA has not been modeled internally, as the other regions: An econometric fit of its import/export relationships with MERCOSUL was used to disaggregate the results from a broader ROW.

⁶This is simpler than GSV's approach, who additionally allow a (constant) number of varieties per firm.

Sectors in general are denoted by j ; when distinction is needed, competitive sectors are denoted by s and noncompetitive ones by t . Countries are indexed by $i \in \{1, 2, \dots, 7\}$, with the MERCOSUL members characterized by $i \leq 4$.

The model shares the basic structure common to all computable general equilibrium (CGE) applications.⁷ In each region there is a representative consumer with a two-level utility tree. Faced with a price vector, the consumer first allocates his income among goods and next chooses their origin among the amount provided by each country.

The second stage utility for t sectors/goods is a CES, in the Dixit and Stiglitz (1977) fashion. For each sector, quantity aggregation at this stage uses a constant elasticity of substitution between goods of different origins, that is, final demand quantities $q_{i' t}$ or $q_{i' s}$.

At the first level, aggregation is performed via a Cobb–Douglas function, with coefficients α_t and α_s ($\sum_t \alpha_t + \sum_s \alpha_s = 1$) giving the expenditure shares in goods t and s , respectively.

Imports used in the intermediate consumption of each sector are also pooled into quantity aggregates of intermediate demand quantities $y_{i' j}$.

Domestic producers in perfectly competitive sectors are modeled in the traditional way. In each of the t sectors, firms have (the same) “increasing returns to scale” cost functions.

Prices in country i' , of sector j goods produced in country i (i can be equal to i') are denoted by $p_{i' j}$. The country i producer will receive $p_{i' j}(1 - \tau_{i' j})$, where $\tau_{i' j} = \tau_{i' j}^0 + \tau_{i' j}^1$ includes trade, $\tau_{i' j}^0$, and transportation costs, $\tau_{i' j}^1$, between the two countries, for the given sector. In the case of a t sector, there are n_{it} symmetric producers/differentiated goods in country i . For these producers, the strategic variable in final demand is assumed to be quantity. Considering one producer of t goods in region i' , the mark-up equation under a Cournot–Nash game is:

$$p_{i' t}(1 - \tau_{i' t}) \left(1 - \frac{1}{e_{i' t}}\right) = \frac{\partial c_{i' t}}{\partial x_{i' t}} \quad (1)$$

where $e_{i' t}$ is the perceived elasticity of demand, defined by

$$\frac{1}{e_{i' t}} = \frac{1}{\sigma_{it}} + \left(1 - \frac{1}{\sigma_{i' t}}\right) s_{i' t} \quad (2)$$

⁷ Readers less familiar with the CGE approach could look at Shoven and Whalley's (1992), for instance.

with $s_{i't}$ being the market share, in region i , of a sector t firm producing in country i' :

$$s_{i't} = \frac{P_{i't}q_{i't}}{\sum_{i^*=1}^7 n_{i^*} P_{i^*i't} q_{i^*i't}}$$

Prices of intermediate goods are set equal to final demand ones; moreover, the link between sectoral final demands domestically provided in a region and the corresponding intermediate demand composites is made via the input-output matrix. All this may be a considerable shortcut in the modeling of the derived effects of intermediate demand, though similar to procedures found in GSV and BW.

Summing up, the model computes, for each country/region:

- final and intermediate quantities demanded from each region, of each sector;
- all final demand prices;
- the total quantities of capital stock K_i , measured in value, and of the employed labor force L_i for generating the country's total output.

The main parameters needed for each country are:

- for each sector, the elasticity of substitution (in final demand) between goods of different origins;
- for each noncompetitive sector, the equivalent number of firms and the cost function parameters;
- the average capital remuneration rate (denoted r_i);
- input-output coefficients k_{ij} and $\alpha_{L_j,i}$ giving, respectively, the amount of capital and labor used by each sector j ;
- input-output coefficients relative to intermediate demand;
- estimates, for each sector, of trade and transportation costs regarding each other region in the model.

In equilibrium, the balance-of-payments nets out and total demand equals supply, for each sector and region. If $x_{i'j}$ is total sector production in country i' :

$$x_{i'j} = \sum_i x_{i'ij} = \sum_i (q_{i'ij} + y_{i'ij}) = q_{i'j} + y_{i'j}, \quad 1 \leq i \leq 7, 1 \leq j \leq 9. \quad (3)$$

Gross domestic product in region i is then measured as:

$$\text{GDP}_i = \text{payments to workers} + \text{payments to capital} + \\ \text{profits in the } t \text{ sectors} + \text{tariffs revenue} =$$

$$= \sum_{j \in \text{all sectors}} (w_i + r_i) x_{ij} + \sum_t \mathbb{1}_t + \sum_{j,i'} \tau_{i'ij}^o p_{i'ij} n_{i'ij} x_{i'ij}$$

with $n_{ij} = 1$ if $j = s$, and $\tau_{i'ij}^o = 0$

(4)

Finally, in the segmented markets version (see the next section), the total capital and labor inequalities for country i are:

$$\sum_{j \in \text{all sectors}} k_{ij} x_{ij} = K_i \leq K_i^* \quad (5)$$

$$\sum_{j \in \text{all sectors}} \alpha_{L,j,i} x_{ij} = L_i \leq L_i^* \quad (6)$$

The capital stock K_i^* used in the calibration is taken as the upper bound for capital in all experiments performed, while for labor the upper bound is equal to the total size of the labor force (employed and unemployed) in the base year.

3. SCENARIOS AND RESULTS

In the segmented version, wages are flexible and capital mobile between sectors within a region. Integration allows capital mobility among the four members and supposes tariffs and implicit trade barriers⁸—but not transport costs—are zeroed in the MERCOSUL (as envisaged in the Assunção Treaty). This implies that, for those countries, Equations 5 are pooled into:

$$\sum_{i \leq 4} \sum_{j \in \text{all sectors}} k_{ij} x_{ij} \leq \sum_{i \leq 4} K_i^* \quad (5')$$

Moreover, the Smith–Venables condition is valid for all sectors j in MERCOSUL countries i , i' , and i^* :

$$p_{i'j} (1 - \tau_{i'ij}^1) = p_{i^*j} (1 - \tau_{i^*j}^1) \quad (7)$$

Three different trade-policy scenarios, under this integration setting, are examined:

- A: The “union case,” in which the MERCOSUL common external tariff per sector is equal to a weighted average of the 1990 members’ effective tariffs, and all the other regions’ tariffs are maintained at the base year level. This is the basic scenario for welfare evaluations.
- B: The “trade blocks case,” where NAFTA and the EU raise by 10 percent their tariffs for the steel industry, chemicals,

⁸ As reflected by the base-year calibration. See the Appendix.

Table 1: Changes (%) in Wages and GDP* in All Scenarios

Scenarios:	Wages			GDP		
	A	B	C	A	B	C
Argentina	1.5	1.3	2.6	1.8	1.3	2.6
Brazil	3.1	2.3	3.9	1.1	1.0	1.6
Uruguay	3.4	3.4	3.5	2.3	2.1	2.4

* Measured by compensating variation, as a percentage of base-year GDP.

and shoes and leather. MERCOSUL uses as common external tariffs the highest 1990 members' values.

- C: The “optimistic multilateralism case,” in which the EU lowers by 20 percent its tariffs on agricultural and animal commodities imports, and “world” tariffs fall by 10 percent in the other sectors. The common MERCOSUL external tariffs are set as in A.

Results are reported in Tables 1–3. We concentrate on the long-run solutions, in which there is free entry-exit of firms and profits in the t sectors go to zero.

Table 1 shows that welfare effects are unambiguously positive, especially for Argentina and Uruguay. The latter has more to gain under Scenario A, as its advantages in the perfectly competitive sectors enable it to expand its market share in Brazil, in spite of Argentinian competition. Moreover, as its exports outside the MERCOSUL are not very significant, it is not much affected either by the improvement or the stiffening of the international trade environment. The situation of Argentina is different, as that country is the most sensitive of the three to the world scene. Under the optimistic Scenario C outcome, due to its competitive exports of agricultural and animal commodities, it experiences a sizeable increase in GDP. Brazil, somewhat surprisingly, does not suffer much in Scenario B, as its losses are compensated by an increase in its MERCOSUL exports.

Real wages clearly increase in all countries, with significant variations for Argentina across the three scenarios. This must be judged remembering that the flexible wages in the model are market-determined at levels that ensure that the labor market clears. Though the result matches expectations (MERCOSUL is able to offer jobs to all its unemployed as well as to raise average

Table 2: Trade Flows Changes (Long-Run Results)

Sectors	MERCOSUL exports			MERCOSUL imports	
	Within	NAFTA	EC	NAFTA	EC
Scenario A:					
Agric. commod.	24.7	8.0	6.4	-6.2	-10.4
Shoes and leather	4.2	2.1	3.2	0.5	0.8
Dairy	16.6	5.3	0.6	-1.0	-3.9
Other	6.8	3.3	5.2	5.9	7.9
Steel	20.1	12.2	15.2	-5.3	2.6
Machines	3.3	1.3	2.6	1.7	4.9
Cars	18.3	1.5	0.9	-0.9	-1.5
Other vehicles	7.5	4.6	6.6	-1.4	1.1
Chemicals	1.8	0.9	0.8	2.6	4.6
Scenario B:					
Agric. commod.	28.2	4.9	5.3	-9.9	-13.9
Shoes and leather	4.6	0.8	2.3	-4.2	-3.9
Dairy	17.5	1.4	-0.1	-3.1	-4.4
Other	9.8	2.9	4.3	4.4	4.7
Steel	24.5	4.7	9.8	-6.5	0.9
Machines	5.0	1.4	2.1	-1.8	1.1
Cars	23.8	0.9	0.9	-1.1	-1.5
Other vehicles	12.9	3.9	5.6	-2.6	-1.7
Chemicals	2.5	0.6	0.8	2.4	3.8

wages), reductions in unemployment, due to labor market imperfections, should not be taken too seriously. Indeed, they should at least be checked under the assumption of *fixed number of firms* and *fixed real wages* (see Mercenier, 1992).

This analysis is complemented by Table 2, displaying what happens to the trade flows. The union drastically raises the level of

Table 3: MERCOSUL: Breakdown (in %) of Welfare Gains for the Imperfect Competition Sectors, Scenario A

	Direct	Compet.	Variety	Diversion	Exp.	Imp.
Steel	45.2	71.2	-9.2	-3.1	-5.0	0.9
Machines	28.5	82.2	-1.2	-0.4	-9.4	0.3
Cars	48.5	69.5	0.0	-11.3	-7.2	0.5
Other vehicles	50.5	78.1	-2.3	-8.8	-18.0	0.5
Chemicals	37.5	73.2	-1.0	-4.4	-6.8	1.5

trade between its members, especially in agriculture, dairy products, steel, and cars; increases are also noticeable in the transport equipment and “others” sectors. The moderate values for machines and chemicals draw attention to interesting points. The former has already a significant trade flow, thanks to the previous bilateral agreements between Argentina, Brazil, and Uruguay. The latter is a sector where no member is strong, all being heavily dependent on foreign imports.

The positive pattern is reproduced in the exports to NAFTA and the EU, making both stand as competing export targets. There are expected decreases in the imports of agricultural and dairy products from both regions, as well as in steel imports from NAFTA. Cars and transport equipment imports also decrease in the NAFTA flows, the same being true of cars from the EU. These two sectors account for a sizeable part of the welfare gains for Argentina and, especially, Brazil. Indeed, under the adverse Scenario B, they experience an even higher growth within the union and partially explain why welfare does not suffer much from the trade restrictions. Import increases are noticeable precisely for machines and chemicals.

All sectors show higher trade creation under Scenario B, though from a Scenario A perspective exports flows do not fall much. However, imports suffer considerably, maybe slightly more in the NAFTA region. An interesting point is that chemicals continue almost unaltered, signaling the strategic role of this sector in the union. As said, its present industrial structure in the MERCOSUL is unable to supply the products needed for a growth context.

The role of the noncompetitive sectors can be better understood with the aid of Table 3, which breaks down the welfare gains into six components:

- a direct effect (*Direct*), due to the reduction in trade costs $\tau_{i'.i}$
- a competition effect (*Compet.*), related to the reduction in the price/cost margin;
- a diversity factor (*Variety*), due to the change in the number of firms;
- trade diversion (*Diversión*); and
- the two changes in the terms of trade (*Exp., Imp.*), as it is an intra-industry trade situation.⁹

⁹For a more-detailed description of these six effects, see GSV (1992b).

The largest gains are due to the competition effect, followed by those due to the reduction in trade costs (direct). It is significant that, even in sectors like steel and, especially, machines, with modest trade diversion and average direct gains, considerable reductions in margins can be achieved, suggesting that in spite of the previous bilateral agreements, which boosted the flow of these goods in the Southern Cone, the MERCOSUL market is still quite segmented. In accordance with this, the highest reduction in variety is for steel, showing that considerable concentration is likely to take place there, probably with exit of Brazilian firms. Variety decreases for all sectors but cars. This goes against some expectations that the Brazilian industry would crush the Argentinian one.¹⁰ Firms in this already concentrated sector will apparently “join forces” across the borders and become stronger, as supported by the trade diversion figures.

All export terms of trade decrease, while imports increase, with the net result that welfare will be exported and MERCOSUL goods will become more competitive in international markets. The figure for machines (Exp.), though higher than could be expected, stresses some of the points raised above.

4. SENSITIVITY OF THE RESULTS

Sensitivity analyses were performed, in the three scenarios, by varying in ± 15 percent the equivalent number of firms n_{ij} and, in ± 30 percent, the scale economies.¹¹

Beyond this numerical exercise, all scenarios were evaluated under a second mode, which assumes that labor in the three perfectly competitive sectors (agricultural and animal commodities, shoes and leather, and dairy products) is mobile within MERCOSUL. Calling J' the set of these three sectors, Equation 6 is then changed in the following way, for MERCOSUL members:

$$\sum_{i \leq 4} \sum_{j \in J'} \alpha_{L_j, i} X_{ij} \leq L_{J'} \\ \sum_{j \in J-J'} \alpha_{L_j, i} X_{ij} \leq L_i^* - L_{iJ'} \quad , i \leq 4 \quad (6')$$

where $L_{J'}$, was calculated by multiplying, in each member, the proportion of the employed in the base year in set J' by total labor force and adding up these products (i.e., the $L_{iJ'}$'s).

¹⁰ As these countries are the only ones to be present in this sector.

¹¹ For all sectors and regions where these limits made sense.

Table 4: MERCOSUL: Size Discrepancies, 1990

	GDP¹	Population (millions)	Per capita GDP¹ (US\$bn)	Exports (US\$bn)	Imports (US\$bn)
Argentina	124	32	3,875	12.4	3.7
Brazil	478	145	3,297	31.4	20.4
Paraguay	10	4	2,500	1.3	1.4
Uruguay	11	3	3,667	1.6	1.3

¹ in current US\$ bn, evaluated through an average annual dollar rate.

The results for Brazil and Uruguay have proved themselves fairly robust to the different combinations tried. In the case of Argentina, the variability begins to be relevant. Global welfare gains, under Scenario A, range from 1.2 percent to 2.8 percent, depending on less- or more-favorable combinations of the parameters; the latter referring to fewer firms and smaller scales in Brazil and the reverse in Argentina. This raises the issue that outcomes for Argentina will be heavily conditioned on how she and Brazil actually engage in the integration.

The freer movement of labor hypothesis did not change the results too much, broadly confirming the general belief that gains are mainly due to the imperfect competition structure. However, again for Argentina, in the optimistic scenario, additional welfare increases of around 0.2 points take place,¹² signaling that the higher export demand for agricultural commodities needs labor from the other members to be fully matched.

Another related question—and a point frequently raised in MERCOSUL discussions—is size. Brazil is by far the largest member of the planned common market, occupying a very special position in the Southern Cone (see Table 4). As shown in many experiments with similar methodologies, Venables (1990), size matters for the final results and this should be taken into consideration when analyzing the findings in the previous section. However, it is also generally agreed that not the whole of Brazil will be engaged in the new market, the northern and the northeastern parts being much less involved than the rest. As an attempt to reflect this fact—in a preliminary way—the calibrated scaling parameters in the Brazilian demand functions¹³ were reduced to 3/4 in all sectors. In this instance, welfare gains decrease *in all*

¹² Almost uniformly over the different numerical possibilities discussed above.

¹³ See the corresponding equations in the Appendix.

members as compared with the values in Table 1, the biggest loser being Uruguay.

5. CONCLUSIONS

This paper has provided a first general equilibrium evaluation of some effects of the completion of the MERCOSUL. In the model used, imperfectly competitive firms are initially assumed to take advantage of the monopoly power conferred to them in each country by the tariffs and market imperfections allowed for by the “non-integration.” The move towards a single market is interpreted as eliminating their ability to behave as price-discriminating monopolists. Within this framework results are favorable to the integration and, more strongly so, if the follow-up of the Uruguay Round decisions tends to greater trade liberalization.

In spite of the sector aggregation level, some important strategic findings are revealed. Firstly, complementarity rather than a devastating struggle is likely to take place in the car and transport sectors, enabling *both* Argentina and Brazil to take advantage of the integration in this area. Traditional and less-protected industries, like machines and steel, will also benefit, becoming much more competitive. On the other hand, the union will be more than ever dependent on chemicals imports, which highlights the investment possibilities in this sector. Gains in the perfectly competitive sectors accrue mainly to Uruguay and Argentina. There are no signs that Argentina will skim off Uruguay’s gains; indeed, Uruguay itself experiences the highest welfare increases.

Employment effects are also expected to be relevant and, if multilateralism prevails after the GATT Round, there is scope for labor force mobility within the union, at least as far as the perfect competition sectors are concerned.

Gains are clearly more significant for Uruguay. For Argentina and Brazil, a deeper analysis is needed to identify key subgroups of the aggregates used, but, whatever happens, the Argentinian outcomes will be tightly linked to the Brazilian reactions.

APPENDIX: DATA, EQUATIONS, AND CALIBRATION

A1. The Data Set: Some Background Issues

The database includes bilateral trade flows among the seven regions, input-output tables with imports and final demand disaggregation,¹⁴ and estimates of imperfect competition parameters.

¹⁴ According to consumers and capital formation.

The choice of sectors took into account the structure of the four economies and the importance of the industries from a trade and a (domestic) market power viewpoint. The adoption of an imperfect competition structure should be regarded as an approximation, the accuracy of which varies among the five selected industries. It is definitely less valid in the chemicals sector, which is very diversified. In some first experiments, textiles were also included in this group, due to their importance for most members. However, they can almost be divided into a perfect and an imperfect competitive subset, each with a different importance in the member countries. Statistical inaccuracy of the tried separations, as well as computing limitations, eventually led us to abandon this disaggregation.

The choice was also influenced by previous work based on simplified partial equilibrium models described in Flôres (1994). These showed reasonably significant Armington effects¹⁵ for chemicals and the car and transport equipment industries. Fuels, ores, and mineral goods also revealed to be important for the MERCOSUL countries, but this sector was not specifically analyzed in the present model, not only because of its diversity¹⁶ but mainly because the flow of these goods among the four members is small. However, if the union expands to include a net energy exporter like Peru or Venezuela, this will become a crucial sector in any modeling experiment.

In spite of their aggregate character, the input-output tables related to this classification are more adequate to the cases of Brazil and Argentina. Paraguay has a rather simple industrial structure and its IO matrix was “framed” in the best possible way into this classification.

Matching the trade data to the nine sectors classification was not an easy job. Detailed flow statistics are available from the United Nations, and quite aggregate though harmonized sets are produced by CEPAL and ALALC. With the exception of Uruguay, the U.N. set shows striking discrepancies between the same flow when recorded as an export and an import. The situation is worse in the case of Paraguay, and most discrepancies are hard to explain by the fob/cif difference. The other two sources present more consistent information, but their sectors did not exactly

¹⁵That is, geographic shifts in the demand for imported goods, following the classical paper by Armington (1969).

¹⁶As an example, Argentina and Brazil differ in the proportions of the domestic supply of oil and natural gas, while Uruguay is totally dependent on imports for both.

match ours. The final trade-flows matrices were the result of an analysis of the three sets plus some adjustment of the discrepancies in the lines of usual CGE practices. As a broad evaluation we would venture that misclassifications are more likely to be present in *agricultural and animal commodities* and in *chemicals*.

The imperfect competition parameters are the estimates of the equivalent number of firms and of the economies of scale. The former was estimated according to Smith and Venables (1988); for the latter, two approaches were used. For the EU, NAFTA, and “rest of the world,” a set of values was taken from the standard sources, while estimates were produced for MERCOSUL countries.

A2. Equations: A Formal Description of the Model

Keeping the notation used in the paper, we describe first the demand side. At the second, disaggregate level of the utility tree, sector quantity aggregates are given by:

$$U_{i't} = Q_{i't} = \left[\sum_{i=1}^7 n_{ii} a_{ii't}^{1/\sigma_{i't}} q_{ii't}^{(\sigma_{i't}-1)/\sigma_{i't}} \right]^{\sigma_{i't}/(\sigma_{i't}-1)} \quad (\text{A1})$$

where $\sigma_{i't}$ is the elasticity of substitution between goods of different origins, $q_{ii't}$ are the quantities purchased and the $a_{ii't}$ are scale coefficients. For each competitive sector s , a similar formula is valid, without the number of firms parameter n_{ii} .

Equation A1 can be seen as a quantity aggregator dual to which there is a price index:

$$p_{i't} = \left[\sum_{i=1}^7 n_{ii} a_{ii't} p_{ii't}^{(1-\sigma_{i't})} \right]^{1/(1-\sigma_{i't})} \quad (\text{A2})$$

At the first level, aggregation of the $Q_{i't}$ is made via a Cobb–Douglas function, with coefficients α_t and α_s ($\sum_t \alpha_t + \sum_s \alpha_s = 1$), giving the expenditure shares in goods t and s , respectively:

$$\alpha_t = \frac{Q_{i't}}{\sum_{i'} Q_{i't} + \sum_s Q_{i's}}$$

Demand functions are then expressed by:

$$q_{ii't} = p_{ii't}^{-\sigma_{i't}} a_{ii't} Q_{i't} P_{i't}^{\sigma_{i't}} \quad (\text{A3})$$

Imports used in the intermediate consumption of each sector are similarly pooled into quantity aggregates $I_{i'j}$ of intermediate demands $y_{ii'j}$, with duals $R_{i'j}$ related to prices $z_{ii'j}$.

In the production side, perfectly competitive sectors are modeled in the traditional way. For the t sectors, each firm has the same cost function. Calling

$$x_{i't} = \sum_i x_{i'it} = \sum_i (q_{i'it} + y_{i'it}) = q_{i't} + y_{i't} \quad (\text{A4})$$

total firm output, the cost is given by:

$$c_{i't} = f_i(x_{i't}) [\sum_{j \in \text{all sectors}} \beta_{j,i'} R_{ij} + w_{i'} + r_{i'}]$$

where $f_i(x_{i't})$ is such that:

$$\begin{aligned} \text{i) } & \frac{f_i}{x_{i't}} \text{ is decreasing} \\ \text{ii) } & \frac{d^2 f_i}{dx_{i't}^2} \leq 0 \text{ or a constant} \end{aligned} \quad (\text{A5})$$

The $\beta_{j,i'}$, coefficients come from input-output matrices, and $w_{i'}$, and $r_{i'}$, are, respectively, the country-specific wage and capital remuneration rates. Functions f_i are sector-specific; however, in the model, two functional forms were used: an affine one, that is, constant marginal costs, for the MERCOSUL members and the ROW, and a decreasing marginal costs polynomial for the developed regions, to account for the technological differences between these two groups.

For the noncompetitive producers, as said in Section 2, the strategic variable is quantity, and the key pricing equation—also called the Lerner or Amoroso+Robinson condition—was introduced there.

When solving the model, prices of intermediate goods, $z_{i'ij}$, are set equal to $p_{i'ij}$. The link between sectoral final demands domestically provided in a region—that is, for instance, the $q_{i't's}$ and $n_{i'} q_{i't'i}$ —and the composites $I_{i's}$ and $I_{i't}$ is made via the input-output matrix. Associated quantities at the firm level follow from the demand relationships which, similarly to Equation 3, will be a function of the composites and a substitution elasticity.

The closing general equilibrium identities or inequalities have already been presented in Section 2 and, beyond the standard balance-of-payments equilibrium condition, they are Equations 3, 5, and 6.

A3. Calibration

The calibration was performed for two different base years: 1985 and 1990. A rather complete data set is available for 1985 but as it was an import contraction year, the results were checked against a second, more recent base.

The most important parameters in the model are probably the substitution elasticities σ_{it} . Mercenier (1994) assumes they are known from exogenous sources and uses their value to compute a consistent set of equilibrium prices and marginal to average cost ratios in the base year; BW and GSV calibrate them from the base-year data, using the economies of scale estimates. Both Mercenier (1992, 1994) and GSV assume a long-run equilibrium in the base year, while BW use smarter though more data demanding assumptions. We have also calibrated the substitution elasticities from the base-year data set, but did not impose the zero profits condition as this—especially in the years actually used—would be a farfetched hypothesis. The equations used are the Lerner Equation 5 for all countries exporting to i . The calibration then yields the values of σ_{it} and of the τ_{iit} (τ_{iit} is set equal to zero). Given the set of effective tariffs, τ_{iit}^0 , transport costs are evaluated as $\tau_{iit}^1 = \tau_{iit} - \tau_{iit}^0$. All τ_{iit}^1 values obtained by the calibration were higher than the corresponding τ_{iit}^0 and produced sensible transport costs estimates.

Substitution elasticities in intermediate demand were arbitrarily set at high values, as in GSV.

The scale parameters were used to calibrate the cost-function coefficients. Two specifications were tried out for the f_i functions:

$$f_i = \beta_0 + \beta_1 x_i$$

$$f_i = \beta_0 + \beta_1 x_i + \beta_2 x_i^\alpha, \quad \beta_2 > 0, 1 > \alpha > 0.$$

The first is a somewhat oversimplified specification, as marginal cost becomes constant. However, given the paucity of information for the MERCOSUL countries, it was thought dangerous to use the second option in this context. The second form was used for the other regions.

The calibrated scale elasticities are in fair agreement with independent estimates derived from census data for Argentina and Brazil (and with previous work on the subject). This acted as an ultimate check of the calibration.

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