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Trade and Integration Policy Analyses for Mercosur: Methodologies of the CGE Modeling with Economies of Scale and Imperfect Competition*

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ABSTRACT

This paper addresses the approaches and methodologies used to construct the CGE model to evaluate trade and integration options for Mercosur. The model is a multi-region, multi-sector, comparative static CGE model with 25 sectors and 10 regions, benchmarked in 2001. We introduced several features in both database and modeling, which incorporates some elements of new trade theory beyond the standard neoclassical paradigm. First, in modeling scale economies, we follow the tradition of Smith and Venables (1988), Gasiorek, Smith and Venables (1990, 1992) and particularly Flores (1997). Instead of employing variable and fixed cost structures as in the majority of the models with scale economies, our model applies polynomial cost functional form, as presented in Flores. Second, the model assumes that firms in non-competitive sectors compete under the Cournot-Nash oligopolistic behavior. This enables us to analyze strategic interaction among firms at home and with foreign competitors. Third, the model is built on the new trade database, and the comprehensive hemispheric tariff database constructed from the FTAA database and the inclusion of numerous ALADI agreements. It incorporates all relevant trade agreements and preferential treatments in place in the Western Hemisphere with estimations of *ad valorem* equivalents of specific, compound tariffs plus TRQs. Finally, the market concentration for non-competitive industries in Mercosur is taken from the recent study, examining manufacturing competitiveness for large countries in Latin America, using the Herfindahl index of concentration in Brazil.

Key words: CGE model, Imperfect Competition and Economies of Scale, Cournot-Nash oligopoly, Herfindahl index, Mercosur

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1. INTRODUCTION

In the past, a number of applied general equilibrium (GE) models have examined the Mercosur integration processes, as the bloc liberalized its trade regime and has been engaged in external liberalization processes. Yet the majority has used the neo-classical standard framework: perfect competition and constant returns to scale. While some have endeavored to incorporate new features such as increasing returns to scale and imperfect competition or product differentiation in monopolistic competition, others have applied dynamic modeling.[1] However, many are already outdated. Besides, key parameters for these features are not estimated directly from actual industrial survey in Mercosur.

Today, the bloc revitalizes its integration agenda, and faces daunting challenges in multi-tier trade and integration initiatives: the South American Community of Nation, FTAA, integration with the European Union, and multilateral negotiations. Thus, there is an urgent need to assess the impact of these initiatives for Mercosur to prepare for the negotiations as well as for precise policy implications. In view of these situations, we are working to construct a new CGE model for Mercosur, built on updated benchmark data.

This paper addresses the approaches and methodologies of the Mercosur-tailored CGE model. The model is a comparative static CGE model, but has several innovations both in modeling and database. First, it incorporates economies of scale. We follow the tradition of Smith and Venables (1988), Gasiorek, Smith and Venables (1990, 1992) and particularly Flores (1997, 2003). Instead of employing variable and fixed cost structures as in standard models dealing with increasing returns, our model applies polynomial cost structure. Second, along with competitive sectors with constant returns to scale, the model has several imperfectly competitive sectors, which exhibits Cournot-Nash oligopolistic behavior. This enables us to analyze strategic interaction among firms at home and with foreign competitors. Third, the model is built on the comprehensive hemispheric tariff database based on the FTAA database, incorporating a number of ALADI agreements. It includes all relevant trade agreements and preferential treatments in

[1] The INTAL Journal of Integration and Trade No. 17 vol. 6 (2002) and No.18 vol. 7 document a series of policy-oriented studies, which examine the impact of trade and integration with focus on Latin America and the Caribbean. These studies also appear in the *Economie internationale* No. 94-95 (2003) by the CEPII.

place in the Western Hemisphere with estimations of *ad valorem* equivalents of specific, mixed tariffs plus TRQs. Fourth, scale economies are modeled on the basis of recent relevant studies (Oliveira-Martins, and Scarpetta, and Pilat, 1996a, 1996b) and engineering survey on minimum efficiency scale by Cline (1984) and Prattern (1988, 1991). Finally, market concentration of the imperfect competition sectors in key markets is estimated from the manufacturing data: the US Census Bureau (2001); Eurostat, (2001); and López-Córdova and Moreira (2004) for Mercosur. In short, the main features of the model that it incorporates economies of scale and imperfect competition—the core of industrial organization and new trade theory—with unique polynomial cost function, and is built on the most comprehensive tariff database for the Western Hemisphere and structural parameter estimations of the non-competitive sectors in Mercosur.

This paper is organized as follows. Section 2 documents the main model structures. It provides the block-by block specifications applied in the model. Section 3 presents sectors, regions, data sources and parameters for imperfectly competitive sectors. Section 4 details to some extent the calibration procedures for polynomial cost functions, the heart of the model. Finally the SAM-based accounting framework is briefed in Section 5.

2. THE MERCOSUR CGE MODEL

The Mercosur CGE model is a multi-region, multi-sector, comparative static model with 25 sectors and 10 regions. The model follows the lines of Smith and Venables (1988), Gasiorek, Smith and Venables (1990, 1992) and particularly the approaches by Flôres (1997, 2003). It is highly non-linear, simulates for a decentralized economy, and all regions are fully endogenized and linked through trade. The base year of the model is 2001. This section describes the structure of the model with focus on key elements and major assumptions.

2.1 Demand Structure

The model has two demand structures: final and intermediate demands. Final demand is constructed in a two-tier nested structure, and therefore derived from two-stage optimization

process.[2] At the upper level, consumer demands of the representative household, who has the Cobb-Douglas preferences, are derived from maximizing the utility subject to his budget constraint. Equation (1) defines consumer demands (*CD*), given a set composite prices inclusive of taxes. At the lower level, demand of composite goods (*QY*) is aggregated with the Armington–Dixit-Stiglitz CES structure, as specified in equation (2). The optimization procedure yields demand function of final goods (*Q*), originating from the respective regions and demanded by the household at home, as given in equation (3). The CES dual price index (*PY*) for the composite goods is defined in equation (4), in terms of the respective prices at destination.

$$CD_{ir} = cles_{ir} \cdot YHD_r / \left[PY_{ir} \cdot \left(1 + ctaxh_{ir}\right) \right] \tag{1}$$

$$QY_{is} = AY_{is} \cdot \left[\sum_r n_{ir} \cdot \delta_{irs}{}^{(1-\rho_{is})} \cdot Q_{irs}{}^{\rho_{is}} \right]^{\frac{1}{\rho_{is}}} \tag{2}$$

$$Q_{irs} = \delta_{irs} \cdot \left(\frac{PY_{is}}{P_{irs}} \right)^{\sigma_{is}} \cdot QY_{is} \tag{3}$$

$$PY_{is} = \left[\sum_r n_{ir} \cdot \delta_{irs} \cdot P_{irs}{}^{(1-\sigma_{is})} \right]^{\frac{1}{1-\sigma_{is}}} \qquad \left(\because \ \sigma_{ir} = \frac{1}{1-\rho_{ir}} \right) \tag{4}$$

where YHD denotes household disposable income and n is the equivalent number of symmetric firms for non-competitive sectors (unity for competitive sectors). AY is the shift parameter for final demand, $cles$ the fixed expenditure share of disposable income, $ctaxh$ sectoral commodity tax rate imposed on consumption goods, δ share parameter in CES function, σ elasticity of substitution for final demand, and ρ CES Armington exponent for final demand. Subscription i represents sectors and r regions.

Intermediate demand follows the structure of lower-stage final demand, but the composite intermediate demand (*QZ*) is specifically modeled in a standard non-nested CES formula, with the notion of national product differentiation, expressed in equation (5). Thus, industry demand from each region is imperfect substitute, implying that products are differentiated at national level due to region-specific attributes or different qualities. The optimal level of quantity (*ZD*) of

[2] In the model, final demand comprises consumer demand, government consumption and investment. However, it is assumed that only consumer demand determines final demand behavior, as other demand components (government

intermediate demand by industry from the respective regions is given in equation (6). Industry demand at destination is simply the product of the quantity of firm supply multiplied by the number of symmetric firms at origin, as expressed in equation (7). The CES dual price index (PZ) for the composite intermediate demand is given in equation (8).

$$QZ_{is} = AZ_{is} \cdot \left[\sum_{r} \gamma_{irs}^{\left(1-\rho z_{is}\right)} \cdot ZD_{irs}^{\rho z_{is}} \right]^{\frac{1}{\rho z_{is}}} \tag{5}$$

$$ZD_{irs} = \left(\frac{\gamma_{irs} \cdot PZ_{is}}{P_{irs}} \right)^{\sigma z_{is}} \cdot QZ_{is} \tag{6}$$

$$ZD_{irs} = n_{ir} \cdot Z_{irs} \tag{7}$$

$$PZ_{is} = \left[\sum_{r} \gamma_{irs}^{\sigma z_{is}} \cdot P_{irs}^{(1-\sigma z_{is})} \right]^{\frac{1}{1-\sigma z_{is}}} \qquad \left(\because \ \sigma_{ir} = \frac{1}{1-\rho_{ir}} \right) \tag{8}$$

where AZ denotes the shift parameter for intermediate demand, γ share parameter in intermediate CES function, σz elasticity of substitution for intermediate demand, and ρz CES Armington exponent for intermediate demand. Unlike Gasiorek, Smith and Venables (1990), who allow different prices between intermediate and final demands, we set prices are equal in intermediate demand and final demand for the same goods. However, the values of elasticity of substation for intermediate demand are differentiated from these of final demand.[3]

2.2 Cost and Supply Structure

Production uses three factors of production—land, capital and labor, endowed in each region—as primary inputs and intermediate inputs. For competitive sectors with constant returns to scale, cost function (*C*) for industry or sector is given by the aggregate of the primary factor costs plus the sum of fixed-coefficient (Leontief) intermediate inputs. The cost function for firms in non-competitive sectors with economies of scale, is defined in a polynomial functional form. Equation (9) defines the cost function for competitive sectors, and (10) for the non-competitive sectors. Primary factor unit cost (*PFUC*), used in the cost function for the non-competitive sectors, is specified by equation (11), inclusive of factor taxes (or subsidies) in each factor category. Differentiating cost function (10) with respect to output yields the marginal cost, as

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consumption and investment) are exogenously fixed, so that they do not play any role.

given in the equation (12). To be clear, primary factor inputs are expressed by value added times output for competitive sectors. For non-competitive sectors, they are specified as the product of the sum of the primary factor unit cost multiplied by the polynomial cost function coefficient, because the cost function is expressed in multiplicative form inclusive of factor taxes.

$$(1-tx_{ir})\cdot C_{ir} = \left(\sum_j \left(1+tcz_{jir}\right) IO_{jir}\cdot PZ_{jr} + PVA_{ir}\right)\cdot X_{ir} + \sum_f tf_{ifr}\cdot wdist_{ifr}\cdot WF_{fr}\cdot QF_{ifr} \quad (9)$$

$$(1-tx_{ir})\cdot C_{ir} = \left(a0_{ir} + a1_{ir}\cdot X_{ir} + a2\cdot X_{ir}^{b_{ir}}\right)\cdot\left(\sum_j \left(1+tcz_{jir}\right)\cdot IO_{jir}\cdot PZ_{jr} + \sum_f PFUC_{ifr}\right) \quad \left(a0, a1, a2 > 0 \quad 0<b<1\right) \quad (10)$$

$$PFUC_{ifr} = \frac{\left(1+tf_{ifr}\right)\cdot wdist_{ifr}\cdot WF_{fr}\cdot QF_{ifr}}{X_{ir}} \quad (11)$$

$$(1-tx_{ir})\cdot MC_{ir} = \left[a1_{ir} + a2_{ir}\cdot b_{ir}\cdot X_{ir}^{(b_{ir}-1)}\right]\cdot\left(\sum_j IO_{jir}\cdot PZ_{jr} + PVA_{ir}\right) + \sum_j tcz_{jir}\cdot IO_{jir}\cdot PZ_{jr} \quad (12)$$

$$\left(a2 = b = 0 \quad \text{for developing regions}\right)$$

where X denotes output, QF primary factor demand, PVA value added price, WF factor wages (land price, wage for labor, and rental return for capital). IO is input-output coefficients, $wdist$ factor return differential parameter, and tx, tcz, tf are respectively tax rates for output, intermediate inputs and factor payment. In addition, $a0$ is constant, while $a1$ and $a2$ are coefficients, b is exponent of the polynomial cost coefficient. In the model, cost function for non-competitive sectors are differentiated between developed and developing regions. Given the scarcity and inaccuracy in cost-related data in developing regions, the constant term $a2$ is set to zero for all developing regions including Mercosur; the cost function is then collapse to the linear functional form.

[3] The values of elasticity of demand for intermediate demand are set to be arbitrarily higher than those of final demand, assuming that firms are more indifferent from the origins of goods, and more sensitive to price changes than consumers.

The aggregate value added is defined in a CES function among three primary factors. Firm's profit-maximization decision requires that the marginal value product of each factor is equal to it factor return. This gives the optimal level of factor demands expressed in equation (13), and value added price in equation (14). In each region, however, factors are not necessarily receive uniform returns across sectors. Instead, the model allows factor market distortions or factor rigidities over sectors, imposed by the factor return differential parameters (*wdist*), which exogenously fix the ratios of the sectoral return relative to the economy-wide average return at benchmark. This implies that each country or region has its own structural rigidities, which are assumed not to change due to policy shocks: for instance, wage differentials among industries in the economy. In the base model, capital is assumed to be internationally mobile at a constant return as in Gasiorek, Smith and Venables (1992), while land and labor are freely and costlessly mobile over sectors, but immobile internationally. Land is used only in agriculture.

$$QF_{ifr} = \left(\delta p_{ifr} \cdot \frac{PVA_{ir}}{wdist_{ifr} \cdot WF_{fr}} \right)^{\sigma p_{ir}} \cdot \frac{X_{ir}}{AX_{ir}^{(1-\sigma p_{ir})}} \tag{13}$$

$$PVA_{ir} = \frac{1}{AX_{ir}} \cdot \left[\sum_{f} \delta p_{ifr}^{\sigma p_{ir}} \cdot \left(wdist_{ifr} \cdot WF_{fr} \right)^{1-\sigma p_{ir}} \right]^{\frac{1}{1-\sigma p_{ir}}} \tag{14}$$

where AX denotes production shift parameter, δp CES production share parameter, and σp elasticity of substitution among three factors of production.

2.3 Competition

The model has competitive and non-competitive sectors. Agriculture, many manufacturing industries, utilities and services are assumed to be perfectly competitive. However, some manufacturing industries are considered to be imperfectly competitive, due to market structures of the respective regions.[4] For these non-competitive sectors, each industry comprises a number of firms. For a particular industry in each region, all firms are symmetric, with the identical production and same sales patterns. The output from each firm is symmetrically sold for final and intermediate demands in the respective markets.

For the non-competitive industries, it is assumed that each firm competes under the Cournot-oligopolistic behavior. Each firm recognizes that its own decision on outputs affects prices, but the output decisions by any firms does not affect outputs of others. Thus, each firm decides its output level, taking sales from his rivals as given in each market. Outputs are the strategic variables interacting among the Cournot-oligopolistic firms.

Formally price for goods *i* in region *s*, produced in region *r* is denoted by P_{irs}. Non-competitive firm in home market faces prices $P_{irs} \cdot (1-\tau_{irs})$, where τ_{irs} denotes the aggregate border protection and is expressed $\tau_{irs} = \tau 0_{irs} + \tau e_{irs} + \tau m_{irs}$; $\tau 0_{irs}, \tau e_{irs}, \tau m_{irs}$ are transport costs, export taxes (or subsidies), and import tariffs, respectively. For non-competitive industries, there are n equivalent number of symmetric firms in each region. Firm's optimizing decision yields that the marginal revenue is equal to the marginal cost, given downward slope of the perceived elasticity of demand, which depends on its market share in each market. From the Lerner formula, firm's optimal markup prices are given in equation (15), differentiating the prices in each segmented market.[5] The perceived elasticity of demand for the Cournot competition is given (16), and equation (17) defines the market share of the firm in each market for final demand. The profits of firms is given by the total sales of final and intermediate demands subtracting total cost, as expressed in equation (18).

Regarding market entry and exit, common caveat applies. In the short-run, the number of firms is fixed, due to barriers to entry, so that the incumbent firms earn non-zero profits (positive or negative), given in the previous equation. In the long-run, however, free market entry and exit force firm's profits to zero; technically firm's total sales is equalized with it cost, while the variable of the number of firm (*n*) is endogenized in the model.

$$P_{irs} \cdot (1-\tau_{irs}) \cdot \left(1 - \frac{1}{\varepsilon_{irs}}\right) = MC_{ir} \qquad (15)$$

[4] Criteria selecting non-competitive sectors is explained in the following section.

[5] Other alternative pricing is the *integrated market* hypothesis, applied by Smith and Venables (1988), Gasiorek, Smith and Venables (1990, 1992), and Flores (1997), where firms set the same prices for integrated market, $P_{irs} \cdot (1-\tau_{irs}) = P_{ir's} \cdot (1-\tau_{ir's})$. In more extreme case, firms charge the identical prices for all market, as in Francois and Roland-Holst (1997).

$$\frac{1}{\varepsilon_{irs}} = \frac{1}{\sigma_{is}} + \left(1 - \frac{1}{\sigma_{is}}\right) \cdot \varphi_{irs} \tag{16}$$

$$\varphi_{irs} = \frac{P_{irs} \cdot Q_{irs}}{\sum_{r'} n_{ir'} P_{ir's} \cdot Q_{ir's}} \tag{17}$$

$$\pi_{ir} = \sum_{s} P_{irs} \cdot (1 - \tau_{irs}) \cdot (Q_{irs} + Z_{irs}) - C_{ir} \tag{18}$$

2.4 Institutions

The institution has two agents: the single representative household and government. Production generates income from the factors of production, which is distributed to the respective agents of the institution. The household receives factor income from the production activities, pays taxed, consume, and save. Equation (19) specifies factor income (*YF*) by factor category, which is the sum of sectorally differentiated wages times factor demand in each sector, multiplied by the number of firms (unit value for competitive sectors). On income side, household income (*YH*) comprises factor income and transfer ($\overline{SUB}$) from government, as expressed in equation (20). Note that all domestic transfers are held fixed and multiplied by a price index (*CPI*) to ensure the homogeneity of the model. On expenditure side, equation (21) defines household savings, as the product of private marginal propensity of save (MPS) times after-tax household income. In the model, *MPS* is endogenized in order to guarantee the saving-investment balance in reach region. Equation (22) defines household disposable income (*HYD*), which is the net income after deducting taxes and savings from the aggregate household income, and will be spent for consumption of the household, who has the Cobb-Douglas preferences.

$$YF_{fr} = \sum_{i} n_{ir} \cdot wdist_{ifr} \cdot WF_{fr} \cdot QF_{ifr} \quad (n\text{=1 for competitive sectors}) \tag{19}$$

$$YH_{r} = \sum_{f} YF_{fr} + PXIDX_{r} \cdot \overline{SUB}_{r} \tag{20}$$

$$HSAV_{r} = MPS_{r} \cdot (1 - th_{r}) \cdot YH_{r} \tag{21}$$

$$YHD_{r} = (1 - MPS_{r}) \cdot (1 - th_{r}) \cdot YH_{r} \tag{22}$$

where *wdist* denotes factor return differential parameter and th direct household tax rate.

The government collects taxes, expends to purchase commodities for its consumption, transfers income to institution as subsidies, and the rest is used as government savings. Equation (23) expresses government revenues (*GR*), which consist of five tax categories. Equation (24) through (28) specifies output taxes, factor taxes, direct household taxes, export duties, and import tariffs. In the model, all taxes are at the *ad valorem* rates. Government saving (*GSAV*) is determined as residual between revenues and expenditures to insure the balanced budget, and is given in equation (29).

$$GR_r = OUTAX_r + FACTAX_r + HTAX_r + EXPTAX_r + TARIFF_r \tag{23}$$

$$OUTAX_r = \sum_i tx_{ir} \cdot C_{ir} \tag{24}$$

$$FACTAX_r = \sum_i \sum_f tf_{ifr} \cdot wdist_{ifr} \cdot WF_{fr} \cdot QF_{ifr} \tag{25}$$

$$HTAX_r = th_r \cdot YH_r \tag{26}$$

$$EXPTAX_r = \sum_s \sum_i \tau e_{irs} \cdot n_{ir} \cdot P_{irs} \cdot (Q_{irs} + Z_{irs}) \tag{27}$$

$$(n = 1 \quad \text{for competitive sectors})$$

$$TARIFF_s = \sum_r \sum_i \tau m_{irs} \cdot n_{ir} \cdot P_{irs} \cdot (Q_{irs} + Z_{irs}) \tag{28}$$

$$(n = 1 \quad \text{for competitive sectors})$$

$$GSAV_r = GR_r - \left(\sum_i PY_{ir} \cdot (1 + ctaxg_{ir}) \cdot GD_{ir} + PXIDX_{ir} \cdot \overline{SUB}_r \right) \tag{29}$$

where $OUTAX$ denotes output taxes, $FACTAX$ factor taxes, $HTAX$ household direct taxes, $EXPTAX$ export taxes, $TARIFF$ import tariffs, and *ctaxg* government consumption tax rates.

2.5 Market Equilibrium and Macroeconomic Closures

The model requires a set of balance conditions in product and factor markets and macroeconomic closures. Equation (30) gives commodity balance for final demand, which is the sum of household consumption, government consumption, and investment. In the model, government and investment demands are set exogenously fixed in real term at the benchmark. Equation (31)

defines balance in the composite intermediate demand, which is the sum of quantities demanded in each domestic industry under the Leontief fixed coefficients. Equation (32) relates to the supply-demand balance in commodity market. Domestic output is fully demanded by final and intermediate demands across regions; commodity markets are completely clear, and there is no excess supply and excess demand.

$$QY_{ir} = CD_{ir} + \overline{GD}_{ir} + \overline{ID}_{ir} \tag{30}$$

$$QZ_{ir} = \sum_{j} n_{jr} \cdot IO_{ijr} \cdot X_{jr} \quad (n = 1 \text{ for competitive sectors}) \tag{31}$$

$$X_{ir} = \sum_{s} \left(Q_{irs} + Z_{irs} \right) \tag{32}$$

Regarding factor markets (land, labor and capital), the model applies the combination of alternative equilibrium conditions. All factors are assumed to be perfectly and costlessly mobile across sectors. In the base model, capital is assumed to receive a constant return fixed at base year and internationally mobile. On the other hand, land and labor are immobile beyond regional border, and the full employment condition applies; the sum of sectoral demand exactly matches the factor supply in each region, as given in equation (33). The model also considers alternative labor closure, reflecting labor market situation in developing countries, where the level of unemployment is relatively high and underemployment in informal sectors prevail. To accommodate this labor market situation in developing regions, the fixed labor supply constraint is replaced by constant wage held at benchmark so that full employment condition is abandoned.

$$\begin{cases} FS_{fr} = \sum_{i} n_{ir} \cdot QF_{ifr} \\ WF_{fr} = \overline{WF}_{fr} \end{cases} \tag{33}$$

In addition, the model requires three macroeconomic closures; government balance, external balance, and saving-investment balance. Each has several alternative closures, depending largely upon macro-economic environments for the respective countries and regions under study, policy questions and options to address. For government balance, government savings, which are derived as residuals between revenues and expenditures, are adjusting variables to maintain balanced budget in public finance. Alternative closure is to endogenize one of the *ad valorem* tax

rates of the five tax components or to relax government transfer as adjusting variable, while fixing the government savings. For external balance, the closure is fixed trade balance, expressed in foreign currency; trade remains balanced for each region at benchmark. Lastly, for saving-investment balance, the model applies Johansen's investment-driven closure rule. Investment demand for each sector is held constant in real term at benchmark, and private saving rate in each region is allowed to adjust to generate the necessary amount of savings to finance the fixed real investment. The alternative is the neo-classical saving-driven closure, in which investment is determined by the amount of savings each region can generate. Under this alternative, private saving rate is fixed at benchmark, while the quantity of each sectoral investment demand is multiplied by a endogenous variable so as to guarantee that investment cost matches the saving amount.[6]

In general equilibrium framework, the model only determines equilibrium relative prices because of homogeneous degree of zero in all demand functions, so that the absolute price level must be set exogenously. In the model, the aggregate consumer price index of the competitive sectors in each region is held fixed, defining *numéraire*. With market equilibrium and macroeconomic closures above, however, the model is not square; the system of the model has one more equation than the number of variables. Yet Walras' law holds, because excess demand equations are not functionally independent of one another. Therefore, one equation can be technically eliminated; usually either external balance or saving-investment balance equation is the one to be dropped. However, the alternative approach is to add one more fictitious variable to the macroeconomic balance equations, instead of eliminating one equation, so as to make the system to be square; the number of equations is equal to that of endogenous variables. No equation is dropped from the system, and the absolute value of this variable should be zero with equilibrium solution.[7] This is the approach applied to the Mercosur model.

3. DATA SOURCES AND CALIBRATION FOR IMPERFECTLY COMPETITIVE SECTORS

[6] Refer to Lofgren, Harris and Robinson (2002) for discussions on the alternative macroeconomic closures.
[7] Due to high nonlinearity and the existence of scale economies in production activities, multiple equilibrium solutions will be possible, so that the model only guarantees locally optimal solution.

3.1 Major Data Sources

Following the broad GTAP database classifications, the model comprises 10 regions[8], and each region consists of 25 economic sectors[9]. It includes 6 agricultural sectors, 5 food-processing industries, 4 light manufacturing industries, 7 heavy manufacturing industries, identifying key industries based on the Mercosur's economic structure in production and trade as well as the perspectives of the forthcoming negotiations. In the model, Mercosur is modeled as a single region, along with four hemispheric partners. Out of 25 sectors, five sectors are considered as non-competitive industries, while the rest of 20 sectors are assumed to be perfectly competitive, including the aggregate of all the sectors in services. The criteria to identify the non-competitive sectors is that industries in which final demand accounts for more than 50 percent share in total demand across all regions are selected as imperfectly competitive sectors. Implicitly, this assumes that final demand, modeled by the Armington–Dixit-Stiglitz structure, is the source of imperfect competition.

The base year of the model is 2001. The primary data includes trade, protection, intermediate inputs, outputs, value added, final demand, all of which are required to be broken down or aggregated, following the sectoral classifications for all countries and regions in the model. For Mercosur, Argentine SAM (2000) and Brazilian IO (1996) table are the main data sources. These country tables are updated separately to the base year, and integrated to form Mercosur.[10] See the following section for some detail. For other regions, GTAP database[11] was extensively used. For the United States, and the European Union, key partners for Mercosur, the principal data sources are the Statistical Census of the U.S. (the U..S Census Bureau), and the EUROSTAT, respectively.

[8] The regions are composed of the United States, Mexico, the Andean Community, Mercosur, rest of the Western Hemisphere, the EU 25, Japan, China, Asia 10, and the rest of world.

[9] The sectors are: wheat, corn and other grains; vegetables and fruits ; oil seeds and soybeans; sugar; coffee, rice and other crops; other agricultural products; bovine meat; other meat; dairy products; beverages and tobaccos; vegetable oils and fats; minerals; energy products; textiles and apparel; leather, wood and paper; other light manufactures; chemical, and plastic products; ferrous metals; non-ferrous metals; motor vehicles; other transport equipment; electric equipment; machinery; utilities and construction; and trade and services.

[10] In terms of economic size, Argentina and Brazil constitute 96.8 percent of Mercosur's GDP, 96.5 percent of exports and 93.8 percent of imports in merchandise trade, respectively, so that they are nearly the proxy of the bloc.

[11] GTAP version 6 pre-release 5, with the base year 2001.

Other data includes International Financial Statistics (IMF) for national account, Government Finance Statistics (IMF) for public finance, Industrial Statistics (UNIDO) for industrial production, sectoral employment, and wages and salaries, Labor Statistics (ILO) for broad employment by economic activities. In addition, country specific data are also collected from central bank, statistics offices and other agencies, if needed. Table 3.1 displays the sectoral data for Mercosur.

<Table 3.1>

3.2 Trade and Protection

Trade and protection are the core of the database to evaluate trade and integration policies, in the application of the CGE models, dealing with the real side of the economy with no financial or monetary accounts in the model. This is because the former is the sole agent to transmit policy shock among partners, and the latter is the key policy variable the country or region under study can take. Thus, trade and protection data requires considerable care.

For merchandise trade, the COMTRADE is used to construct trade database. However, the initial aggregate of trade flows involves a fairly large number of incompatibilities between the country of origin and the country of destination at each sectoral level. To correct these irregularities, the following steps are applied. First, upper and lower limits are set to identify irregular trade flows, based on the aggregate bilateral trade flows. Second, bilateral export (FOB)-import (CIF) ratios are calculated at each sectoral level for all combination of bilateral trade, to differential normal and irregular trade flows. Third, the aggregate bilateral export-import ratios are estimated from the regular trade flows, and are applied to irregular trade flows. Finally, sectoral trade flows are adjusted so as to match both aggregate and sectoral trade with official statistics or to minimize discrepancies between reported exports at FOB and imports at CIF. For international trade in services treated as a single sector, the GTAP database is used, because it has bilateral flows over partners. But the aggregate trade in services is adjusted to match the official statistics. Note that for regions comprising a group of countries, trade presents trade flows exchanged with the

partners, as intra-regional trade is netted out.[12] Therefore, due care must be taken in comparing and evaluating the structure of trade such as trade share over production, sectoral composition, and dependencies. Table 3.2 shows the aggregate trade flows, after the above adjustments.

<Table 3.2>

For protection, we constructed the new database based on the FTAA database, while accommodating the ALADI agreements, to incorporate a number of trade agreements in place in the Western Hemisphere. They include intra-regional protection for five sub-regional blocs: the North American Free Trade Agreement (NAFTA), the Central America Common Market (CACM), the Caribbean Community and Common Market (CARICOM), the Andean Community (CAN), and the Southern Common Market (Mercosur). It also updates four bilateral agreements (Mercosur-Bolivia, Mercosur-Chile, Canada-Chile, Mexico-Chile), plus 11 FTAs, 10 Economic Complementation Agreements (ECA), and 6 Partial Scope Agreements (PCA), although the preferences under the ECAs and PCAs are marginal, and relatively shallow. In addition, the database also incorporates three key US preferential treatments for Latin America (the Andean Trade Preference Act, ATPA; the Caribbean Basin Initiative, CBI; and the Generalized System of Preference: GSP) from the USITC and Canada's General Preferential Tariff (GTP). Outside the Western Hemisphere, the European Union is included from the TRANIS data, including the GSP applied to Mercosur. All the Tariffs are constructed with the highest available disaggregation and in most cases at the HTS 8 digit levels, but some preferences are recorded at the HTS 6 digit.

Protection on commodities only covers tariffs, and does not include any non-tariff measures, and non-quantifiable barriers to trade. Specifically tariff includes *ad valorem*, and *ad valorem* equivalents of specific and compound tariffs plus TRQ, applied by the NAFTA and the European Union. For the United States, which imposes the largest number of applications of the non-*ad valorem* tariffs, the database uses the USITC official estimates. For Canada and Mexico, the *ad valorem* equivalent estimates are drawn from the database constructed by Jank, Fuchsloch, and

[12] In the model, this applies to the Andean Community, Mercosur, rest of the Western Hemisphere, the EU25, Asia 10, and the rest of world.

Krutas (2002). For the European Union, the UNCTAD data is used for the estimates of *ad valorem* equivalents of specific and compound tariffs, plus GSP applied to Latin America. On the other hand, the protection on services are set to zero, simply because there is very few studies and credible estimations, although it is widely acknowledged that services are far from protection-free, and barriers in services exists both in developed and developing countries.[13]

Tariffs are in principle estimated as a simple average from the HTS 8 digits for each sector and for the respective partners. This applies to the single countries or regions, which do not have peak tariffs. For region comprising several countries, which have considerably heterogeneous protection structures or peak tariffs, tariffs for this region are estimated as trade-weighted at each sectoral level, to avoid protection bias due to the existence of mega tariffs.[14] For other regions, the GTAP database is applied. Table 3.3 displays tariffs imposed on Mercosur by the trade partners, and MFN tariffs charge by Mercosur to its partners.

<Table 3.3>

3.3 Structural Parameters of the Imperfectly Competitive Sectors

A number of parameters are required to calibrate the model, which needs to generate the equilibrium solution, replicating the SAM as benchmark. While some parameters can be arbitrarily chosen, others are estimated from the observation of benchmark data. The former includes parameters from the literature or other similar studies or deriving them from econometric estimations. The most typical parameter in this category is the elasticity of substitution on trade. On the other hand, the remaining and the majority of the parameters needs to be calibrated from the point-estimate based on the benchmark SAM. They include IO technical coefficients, shift and share parameters, various tax rates, and other sectoral parameters. This process for estimating a set of parameters is called the calibration procedure. For models built under the

[13] Hoekman (2000) estimates the protection in services, and Brown, Deardorff and Stern (2002, 2003) apply this estimation for their CGE simulation exercises in evaluating the multilateral, regional and bilateral trade policy options.

[14] The rest of the Western Hemisphere is the typical case, which comprises Canada, Chile, CACM and CARICOM. Canada has peak tariffs plus specific and compound tariffs on sensitive agricultural products; the country imposes tariffs of higher than 100 percent of the *ad valorem* equivalents at the HTS 8 digit over 100 agricultural commodities with the highest of 540 percent (Jank, Fuchsloch, and Krutas; 2002). In the meantime, Chile applies 8 percent of uniform tariffs across sectors. As a result, the simple average results in tremendously high tariff estimations for some agricultural sectors, and distorts the overall protection more than the region potentially has.

standard and the neoclassical framework, this is relatively straightforward, and does not involve much difficulties.[15]

However, once the model framework departs from the standard neoclassical paradigm, the parameters must be calibrated with due caution. This is particularly the case, where models incorporate economies of scale and imperfect competition. These models incorporating the non-competitive industries need three set of parameters: elasticity of substitution, degree of economies of scale, and market concentration. However, for non-competitive firms to optimize their price-setting behavior, the Lener formula governs the following relation among these parameters:

$$\mu_0 = f(\sigma, n_0) \tag{34}$$

where μ_0 denotes benchmark markup, σ elasticity of substitution, and n_0 equivalent number of symmetric firms. Due to the above constraint, three parameters are not independent each other. Only two of three sets of parameters must be estimated exogenously, while the last is to be calibrated, following the Lener formula. Hence, three alternative calibration approaches are technically possible, as follows:

(i) Estimate μ_0 and n_0, and calibrate σ: Smith and Venables, 1988; Gasiorek, Smith and Venables, 1992a,1992b; Willenbockel, 1994; Flôres, 1997, 2003;

(ii) Estimate σ and n_0, and calibrate μ_0: Brown, Deardorff, and Sterns; 2002, 2003;

(iii) Estimate μ_0 and σ, and calibrate n_0: Devarajan and Rodrik, 1991.

The choice of these alternatives depends greatly on data availability and their accuracy. Taken these into account, the Mercosur model follows the first approach. Table 3.4 present the initial and calibrated values of these parameters at the benchmark, including the elasticity of substitution for the competitive sectors.

<Table 3.4>

[15] In some cases, however, the calibration procedure depends greatly on the structure of the model and the choice of functional forms of the behavioral equations such as production or cost functions, and demand system. If production,

Data sources and the calibration procedure for these parameter estimations are presented below in some detail.

(i) *Elasticity of substitution*. As presented in the previous section, the model has two demand systems: final and intermediate demands. Although the final demand is modeled in a two-tier nested tree, the composite final demand at lower stage and the composite intermediate are both modeled with a non-nested Armington CES function. Hence, there is no differentiation between domestic and imported goods, and the substitutability of the goods in demand systems is uniform among geographic origins. For competitive sectors, the model uses the estimation made by Hertel et al. (2004), because they econometrically estimate the elasticities of substitution from pooled data covering six major countries including all Mercosur countries (Argentina, Brazil, Chile, Paraguay, Uruguay and the United States).[16] For non-competitive industries, these parameter values are residually calibrated, following the Lerner formula with the exogenously estimated markups and the equivalent number of symmetric firms. The values of the elasticities of substitution for intermediate demand are set to be 50 percent larger than those of final demand, assuming that firms are irrespective of geographic origin, and more sensitive to prices.

(ii) Economies of Scale: The measurement of economies of scale takes several forms: cost disadvantage ratio (CDR), markup, or the changes in unit cost of the minimum efficiency scale (MES) of production[17], depending on the specifications of the production or cost function. Primarily we draw two sources. The first is the engineering estimates of the percentage change in unit cost at the MES. This includes Pratten (1988) for the European Union, and Cline (1984) and Pratten (1991) for the United States, essentially form the same original source. The other concerns Oliveira-Martin, Scarpetta and Pilat (1996a, 1996b) on the markups of the manufacturing industries in the OECD countries. These estimates are used for the United States, the European

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demand systems and trade are constructed in multi-tier nested structure for the multi-region models, the calibration procedure becomes complex. This also affects convergence of algorithm particularly in simulations.

[16] There are several studies econometrically estimating the elatiticities of substitution for individual countries. They include Gallaway, McDaniel, and Rivera (2003); Tourinho, Kume and Souza Pedroso (2002) for Brazil; and Karanauskas (2003) for Colombia. Compared with the estimation by Hertel et al., the estimated values of elasticity of substitution for these studies are fairly small, implying that even small economies have significant market power.

[17] In Pratten (1988), the MES is defined as the scale at which unit costs cease to fall.

Union and Japan. To reconcile the estimates from these sources, the familiar CDR form is used. With zero-profit assumption for the non-competitive industries, as applied in calibrating the parameters for the benchmark equilibrium solution, the markup is given by the following formula:

$$\mu_0 = \frac{1}{1 - CDR} \tag{35}$$

First, the CDR parameter values are estimated for the United States, the European Union, and Japan. Although Cline (1984) and Pratten (1991) measure the MES for the United States and the production for Latin America as a share of the US market, they do not estimate economies of scale for counties in Latin America. Therefore, as with the case in Harrison, Rutherford, and Tarr (1994), the average of the estimated CDR is used for other regions in the model, assuming that the magnitude of scale economies is industry-specific and are not much differentiated over regions.[18]

(iii) Market concentration: This measures the intensity of competition in industries, and is generally measured by the Herfindahl index of concentration. The inverse gives the equivalent number of symmetric firms in imperfectly competitive industries. For the United States and the European Union, the official statistics are used: the Concentration Ratios in Manufacturing for 1997 published by the US Census Bureau and the Annual Enterprise Statistics on Industry and Construction broken down by Size Classes, EUROSTAT. For Mercosur, the original data source is López-Córdova and Moreira (2004), examining the Brazilian competitiveness. The bloc's market concentration is then calculated from Brazil's Herfindahl index in proportion to the value of output in Mercosur.

Since there is no comparable statistics for other regions, the following steps are adopted. First, market size in terms of production or output is measured for large and small markets. The average of the gross value of the production of the United States and the European Union

[18] The study by Bchir et al. (2002) using the variance among three parameters (elasticity of substitution, economies of scale and industry concentration) generally confirms this assumption.

represents the former at each non-competitive industry, while Mercosur's output stands for the latter. Second, output per firm for each market, designated as reference output, is estimated by taking the average of the outputs per firm in the case of large market. Third, if the market size of some of the other regions falls within ± 50 percent of the size of either large or small market, the equivalent number of firms is directly calculated by dividing the gross output of these regions by the reference output. For instance, Mexico's gross output of bovine meat is 30 percent below that of Mercosur, so that the equivalent number of firms in Mexico is directly calculated by dividing its gross output by Mercosur's reference output per firm in that sector. Fourth, if the gross outputs for other regions do not fall within these ranges, the number of firms is estimated by dividing the gross output by the output per firm, which is linearly calculated from the sizes of the two reference markets.

4. CALIBRATION OF THE SPECIFIC FUNCTIONAL FORMS FOR COST FUNCTIONS

Keeping the same notation in the previous section, the cost function $C(x)$ is expressed in the following formula:

$$\begin{cases} C(x) = f(x) \cdot UC \\ f(x) = a_0 + a_1 \cdot x + a_2 \cdot x^b \qquad (a_0, a_1, a_2 > 0, \;\; 0<b<1) \\ UC = \sum IO \cdot PZ + PVA \end{cases} \tag{36}$$

where x stands for quantity or output, $f(x)$ denotes cost function coefficients, UC is unit cost, and PVA is value added price. For simplicity, subscriptions and tax components are omitted. By definition, average cost $AC(x)$ is given by $C(x)/x$, and the minimum efficiency scale (MES) is then expressed:

$$x^* = MES = arg\ min_x\ C(x)/x \tag{37}$$

Assuming that the cost function is continuously differentiable and the first derivatives are found, then the marginal cost $MC(x)$ is given by $C'(x)$. In the combination with the equation (35), this leads to the following relationship at $x^* = MES$:

$$C(x^*)/x = C'(x^*) \quad \text{or} \quad AC(x^*) \cong MC(x^*) \tag{38}$$

The above equality gives clues in setting the parameter values for the coefficients of a given specification. However, sometimes, it is valid only asymptotically. Usually , besides the value of x^*, a second point on the average cost curve, which can sometimes be used to extract a crude estimates of the tangent at x^*, is required. This is obtained from the relative increase in average (unit) cost, when output declines from the MES to a point, which is a fraction of x^*. This is precisely the estimates undertaken by Cline (1984), and Pratten (198, 1991).

The calibration procedures in estimating the parameters for the linear and polynomial forms used in the model are explained below.

(a) the linear function $f(x) = a_0 + a_1 \cdot x$, where a_0 denotes fixed cost and a_1 is constant marginal cost. In the case of $b = 0$ in the equation (34), the cost function collapse into the linear form. Because the equation (36) is only valid asymptotically, in practice the following approximation holds:

$$a_1 \approxeq a_1 + a_0/x^* \tag{39}$$

If the MES is known, this gives the restriction such that: $a_0 << x^*$;

If the average cost at the MES is also known, it can be used for the following approximation: $a_1 \approxeq AC(x^*)$.

(b) the polynomial function $f(x) = a_0 + a_1 \cdot x + a_2 \cdot x^b$, where a_0 again denotes fixed cost. As with the linear cost function, the average cost decreases asymptotically to a_1, so that:

if the MES is known, the following restrictions may be used:

$$a_2 << x^{*\,1-b} \quad \text{and} \quad a_0 << x^* \tag{40}$$

if the average cost at the MES is also known, it can provide a further restriction:

$$a_2 / x^{*\,1-b} + a_1 + a_0/x^* = AC(x^*) \tag{41}$$

As with the functional form of the linear cost coefficients, the following approximation also holds:

$$a_1 \approxeq AC(x^*) \tag{42}$$

The exponent b can be set by trial. Notice that, even under this specification, the marginal cost will be nearly constant at equilibrium level, if the scale is fully exploited, as expressed:

$$MC(x) = \left[a_1 + a_2 \cdot b \cdot x^{(1-b)} \right] \cdot UC \qquad (43)$$

5. SAM-BASED ACCOUNTING FRAMEWORK

The model is built on the basis of the Social Accounting Matrix (SAM), benchmarked in 2001 for each of the 12 countries and regions. The SAM displays a snapshot of the economy for each country and region identified in the model at the base year. Thus it enables us to analyze the economic structures in production, intermediate transactions, valued added, consumption, the composition and patters in trade with the respective partners, thus laying the ground *in priori* to evaluate the simulation results. Another advantage with the SAM-based general equilibrium modeling is its strict link between SAM accounting framework and underlining modeling. The fully specified model achieves benchmark equilibrium solution, which must replicate the benchmark SAM, so that this process can be used for diagnostic checking of the model. Table 3.3 displays the schematic SAM structure used for the model.

<Table 3.5>

Constructing the SAM requires numerous data, daunting tasks in data processing, as well as good knowledge and understanding on the economies under study. This is particularly the case with policy-oriented studies. Accurate database, which nearly matches corresponding official statistics and national account, is the core and the foundation for any policy simulations. The procedures to construct the balanced SAM for each country and region are as follows. For Mercosur, the Argentine SAM (64 sectors, 2000) and the Brazilian IO table (80 sectors, 1996) are used. First both tables are updated to year 2001, using the GDP indicators in each country. Based on the Brazilian IO table, the country SAM with the breakdown of 25 sectors is constructed, using fiscal and national tables. These individual SAMs are then combined to form the proxy for Mercosur, and adjusted to match it with the bloc's national account. This provisional SAM is examined with the recent GTAP database to examine the sectoral production, value added, final

demand, and other sectoral components. The GTAP database is primarily used to construct SAMs for other regions, supplementing fiscal data and national account from the official statistics. However, Trade flows and tariffs, explained in the previous section, are replaced with our newly construct database for all regions. Finally the RAS technique is applied to balance the SAM.

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Table 3.1 Sectoral Data for Mercosur

Sectors	Market Structure*	Sectoral Composition (%)					Ratio (%)		Factor composition in Value Added (%)			
		Output	Value Added	Final Demand	Exports	Imports	Exports/ Output	Imports/ Absorption	Land	Labor	Capital	Total
1 Wheat, Corn and Other Grains	PC	0.6	0.7	0.0	2.5	0.0	26.9	0.4	24.3	39.9	35.8	100.0
2 Vegetables and Fruits	PC	0.4	0.5	0.4	1.4	0.3	22.3	5.0	23.8	39.0	37.1	100.0
3 Oil seeds and Soybeans	PC	1.0	1.0	0.0	5.6	0.0	38.5	0.1	21.0	33.6	45.4	100.0
4 Sugar	PC	0.7	0.4	0.2	2.3	0.0	20.9	0.0	11.3	39.1	49.6	100.0
5 Coffee, Rice and Other Crops	PC	1.0	1.1	0.5	3.4	0.2	23.2	1.7	17.1	28.3	54.6	100.0
6 Other Agricultural Products	PC	5.0	3.5	4.2	5.1	1.3	6.9	1.8	10.0	41.6	48.5	100.0
7 Bovine Meat	IMC	1.3	0.4	1.7	1.5	0.0	7.5	0.1		48.7	51.3	100.0
8 Other Meat	IMC	0.5	0.2	0.6	2.5	0.0	31.6	0.5		45.5	54.5	100.0
9 Dairy Products	PC	1.3	0.8	1.3	0.3	0.1	1.6	0.5	10.0	37.8	52.2	100.0
10 Beverages and Tobaccos	IMC	1.0	0.5	1.8	0.3	0.5	2.3	3.0		55.4	44.6	100.0
11 Vegetable Oils and Fats	PC	1.2	0.2	0.4	8.3	0.2	47.5	0.9		37.7	62.3	100.0
12 Minerals	PC	2.0	1.4	0.2	6.0	1.4	20.2	4.6	5.6	51.5	42.9	100.0
13 Energy Products	PC	2.8	1.6	2.1	3.7	4.4	9.1	10.0	31.3	32.1	36.6	100.0
14 Textiles and Apparel	PC	2.0	1.1	2.0	1.5	2.1	5.0	6.8		54.9	45.1	100.0
15 Leather, Wood and Paper	PC	3.5	2.2	1.8	9.5	2.6	18.2	4.9		67.2	32.8	100.0
16 Other Light Manufactures	PC	1.2	0.9	1.3	0.3	0.9	1.7	4.7		55.7	44.3	100.0
17 Chemical, and Plastic Products	PC	4.7	2.8	2.4	5.1	17.8	7.3	20.6		46.0	54.0	100.0
18 Ferrous metals	PC	1.6	0.5	0.0	4.5	1.0	18.6	4.2		49.5	50.5	100.0
19 Non-ferrous Metals	PC	2.1	1.1	0.3	3.4	3.1	10.9	9.1		65.6	34.4	100.0
20 Motor Vehicles	IMC	1.8	0.8	3.2	5.8	5.4	21.1	16.4		42.2	57.8	100.0
21 Other Transport Equipment	IMC	1.2	0.7	0.4	4.1	3.9	22.9	18.0		62.6	37.4	100.0
22 Electric Equipment	PC	1.1	0.6	2.4	2.5	11.3	15.6	40.3		36.7	63.3	100.0
23 Machinery	PC	2.4	1.7	3.9	4.8	19.5	13.4	34.5		51.2	48.8	100.0
24 Utilities and Construction	PC	9.7	9.8	12.0	0.0	0.0	0.0	0.0		30.7	69.3	100.0
25 Trade and Services	PC	49.9	65.4	57.0	15.6	24.0	2.1	3.3		63.4	36.6	100.0
Total		100.0	100.0	100.0	100.0	100.0	6.7	6.5	1.7	56.1	42.1	100.0

Note: * PC denotes perfect competition, and IMC imperfect competition.

Table 3.2 Direction of Aggregate Trade Flows by Partner

Exports

(percent)

From \ To	United States	Mexico	Andean Community	Mercosur	Rest of WH	EU 25	Japan	China	Asia 10	Rest of World	Total	Value ($bilion)
United States		11.37	1.57	2.45	19.99	30.60	8.10	2.76	11.12	12.05	100.00	882.0
Mexico	83.48		0.96	0.75	3.92	6.17	1.00	0.41	1.24	2.07	100.00	169.4
Andean Community	48.61	1.90		3.45	9.68	18.22	2.93	1.59	2.73	10.89	100.00	49.3
Mercosur	22.06	3.11	4.73		8.32	32.28	4.16	4.23	5.98	15.14	100.00	86.3
Rest of WH	69.87	1.64	1.00	1.08		13.19	3.82	1.63	3.09	4.69	100.00	341.4
EU 25	29.31	2.26	0.99	2.90	4.77		7.55	4.29	12.94	35.00	100.00	1,081.8
Japan	28.30	1.41	0.51	0.97	3.11	19.19		8.40	26.41	11.70	100.00	439.0
China	23.91	0.90	0.39	0.82	2.44	19.42	14.80		27.35	9.97	100.00	287.5
Asia 10	27.33	1.59	0.43	1.22	2.66	26.81	14.01	13.72		12.22	100.00	516.6
Rest of World	19.33	0.88	0.42	1.36	2.45	48.51	9.80	5.71	11.55		100.00	777.7

Imports

(percent)

To \ From	United States	Mexico	Andean Community	Mercosur	Rest of WH	EU 25	Japan	China	Asia 10	Rest of World	Total	Value ($bilion)
United States		10.76	1.86	1.45	18.64	23.91	10.24	7.87	13.92	11.34	100.00	1,353.7
Mexico	64.46		0.53	1.65	3.37	13.61	3.98	2.28	6.35	3.76	100.00	183.8
Andean Community	32.53	4.20		9.52	7.81	23.65	5.32	3.61	5.97	7.38	100.00	45.6
Mercosur	25.25	1.56	1.96		4.42	35.25	5.45	4.01	9.05	13.06	100.00	90.1
Rest of WH	58.04	2.32	1.57	2.46		16.76	4.56	2.83	5.10	6.36	100.00	312.1
EU 25	25.88	1.03	0.84	2.69	4.22		7.95	6.48	15.35	35.56	100.00	1,089.3
Japan	18.35	0.49	0.35	0.87	3.20	19.27		15.58	23.02	18.86	100.00	429.4
China	11.06	0.30	0.35	1.62	2.34	16.73	15.52		33.92	18.17	100.00	281.4
Asia 10	17.84	0.38	0.24	0.93	1.89	24.70	20.83	16.43		16.76	100.00	579.3
Rest of World	15.80	0.52	0.80	1.96	2.35	56.06	7.69	4.80	10.02		100.00	692.6

Source: Mercosur SAM Database.

Note: The value of trade for region of group of countries does not match official trade statistics, because trade in these regions are netted out in the model, although it is reconciled with the official trade data.

Table 3.3 Tariff Structure imposed on and by Mercosur

(percent)

Sectors	Tariffs imposed on Mercosur									Mercosur (MFN)
	United States	Mexico	Andean Community	Rest of WH	EU 25	Japan	China	Asia 10	Rest of World	
1 Wheat, Corn and Other Grains	0.56	57.20	8.75	3.77	34.20	32.97	1.05	256.45	8.12	6.28
2 Vegetables and Fruits	2.56	20.86	11.65	4.19	6.58	13.20	20.30	8.62	15.94	10.93
3 Oil seeds and Soybeans	17.07	3.20	8.03	1.30	0.00	0.56	0.14	71.70	29.00	5.67
4 Sugar	11.16	14.30	13.72	10.05	40.39	283.28	20.71	28.94	25.07	16.72
5 Coffee, Rice and Other Crops	11.51	13.06	8.15	2.67	14.26	6.65	18.34	29.06	14.72	9.27
6 Other Agricultural Products	4.87	29.12	14.21	5.59	73.44	40.75	22.52	2.31	29.95	11.60
7 Bovine Meat	1.60	21.10	15.69	34.31	21.51	29.66	11.90	1.12	15.35	13.46
8 Other Meat	20.52	34.27	15.28	18.46	71.17	64.36	13.80	8.48	12.04	19.12
9 Dairy Products	14.04	34.28	13.86	7.14	6.65	34.31	20.65	28.11	22.57	19.85
10 Beverages and Tobaccos	3.03	19.79	12.46	6.42	12.52	0.95	7.71	1.95	23.37	11.88
11 Vegetable Oils and Fats	5.56	18.72	12.43	6.73	14.58	14.56	17.41	23.65	15.40	12.43
12 Minerals	1.89	16.06	8.60	1.98	1.21	0.01	0.80	1.42	5.74	10.68
13 Energy Products	0.38	9.88	5.57	2.37	0.65	1.10	1.51	3.60	10.82	0.81
14 Textiles and Apparel	9.76	15.95	15.08	4.75	7.23	8.17	20.01	6.66	11.80	19.68
15 Leather, Wood and Paper	3.76	17.35	11.38	3.58	3.01	2.74	6.40	2.56	11.86	14.40
16 Other Light Manufactures	0.73	21.58	11.99	3.86	0.75	0.30	18.82	6.62	9.41	19.30
17 Chemical, and Plastic Products	0.83	11.56	6.58	1.92	2.49	0.30	10.94	5.97	9.93	10.13
18 Ferrous metals	1.40	12.78	7.25	1.78	0.79	0.22	4.81	4.54	10.41	13.93
19 Non-ferrous Metals	0.54	16.97	9.12	2.39	1.40	0.21	7.52	3.25	4.79	14.69
20 Motor Vehicles	1.53	17.08	11.37	4.56	4.85	0.00	29.92	24.70	20.76	23.62
21 Other Transport Equipment	0.95	15.12	8.94	2.54	1.67	0.00	8.77	3.35	0.49	11.70
22 Electric Equipment	0.79	15.67	7.92	1.50	2.52	0.00	9.94	3.93	6.81	14.37
23 Machinery	0.62	14.33	8.31	2.03	0.32	0.00	10.23	4.94	9.01	14.31
24 Utilities and Construction	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25 Trade and Services	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Source: USITC for the United States, FTAA database for other countries and regions in the Western Hemisphere, TRAINS for the EU25, and the GTAP database for the rest of the regions.

Note: (1) Tariffs include *ad valorem* , and the estimations of the *ad valorem* equivalents of specific and compound tariffs, plus TRQ. In the estimation of the *ad valorem* equivalents for Canada and Mexico, the estimation made by Jank, Fuchsloch, and Krutas (2002) was applied.

(2) The principal estimation is the simple average from the HTS 8 digit for each sectoral category. Trade-weighted average is also used for the regions comprising a group of countries, which have considerably heterogeneous protection structures over sectors or peak tariffs.

Table 3.4 Sectoral Parameters

Sectors	United States	Mexico	Andean Community	Mercosur	Rest of WH	EU 25	Japan	China	Asia 10	Rest of World
Elasticity of Substitution for Final Demand										
Wheat, Corn and Other Grains	6.33	6.33	6.33	6.33	6.33	6.33	6.33	6.33	6.33	6.33
Vegetables and Fruits	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70
Oil seeds and Soybeans	4.90	4.90	4.90	4.90	4.90	4.90	4.90	4.90	4.90	4.90
Sugar	5.40	5.40	5.40	5.40	5.40	5.40	5.40	5.40	5.40	5.40
Coffee, Rice and Other Crops	5.23	5.23	5.23	5.23	5.23	5.23	5.23	5.23	5.23	5.23
Other Agricultural Products	3.96	3.96	3.96	3.96	3.96	3.96	3.96	3.96	3.96	3.96
Bovine Meat	9.76	7.78	9.59	7.03	7.46	7.06	3.68	7.31	7.79	6.45
Other Meat	9.35	6.18	6.99	7.62	6.34	5.91	3.45	6.27	6.14	5.83
Dairy Products	6.40	6.40	6.40	6.40	6.40	6.40	6.40	6.40	6.40	6.40
Beverages and Tobaccos	2.69	2.71	2.77	2.74	2.70	2.78	2.86	2.75	2.73	2.74
Vegetable Oils and Fats	6.60	6.60	6.60	6.60	6.60	6.60	6.60	6.60	6.60	6.60
Minerals	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80
Energy Products	6.28	6.28	6.28	6.28	6.28	6.28	6.28	6.28	6.28	6.28
Textiles and Apparel	7.45	7.45	7.45	7.45	7.45	7.45	7.45	7.45	7.45	7.45
Leather, Wood and Paper	6.93	6.93	6.93	6.93	6.93	6.93	6.93	6.93	6.93	6.93
Other Light Manufactures	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50
Chemical, and Plastic Products	6.60	6.60	6.60	6.60	6.60	6.60	6.60	6.60	6.60	6.60
Ferrous metals	5.90	5.90	5.90	5.90	5.90	5.90	5.90	5.90	5.90	5.90
Non-ferrous Metals	7.95	7.95	7.95	7.95	7.95	7.95	7.95	7.95	7.95	7.95
Motor Vehicles	9.05	8.27	9.42	9.12	8.06	9.02	10.49	9.15	8.88	8.63
Other Transport Equipment	5.28	4.75	5.22	4.41	4.32	4.94	4.47	4.46	4.25	4.34
Electric Equipment	8.80	8.80	8.80	8.80	8.80	8.80	8.80	8.80	8.80	8.80
Machinery	8.10	8.10	8.10	8.10	8.10	8.10	8.10	8.10	8.10	8.10
Utilities and Construction	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00
Trade and Services	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00
Mark-up Ratio										
Bovine Meat	1.05	1.13	1.13	1.13	1.13	1.12	1.32	1.13	1.13	1.13
Other Meat	1.05	1.13	1.13	1.13	1.13	1.12	1.32	1.13	1.13	1.13
Beverages and Tobaccos	1.48	1.46	1.46	1.46	1.46	1.45	1.43	1.46	1.46	1.46
Motor Vehicles	1.09	1.13	1.13	1.13	1.13	1.12	1.17	1.13	1.13	1.13
Other Transport Equipment	1.26	1.32	1.32	1.32	1.32	1.27	1.32	1.32	1.32	1.32
Equivalent Number of Symmetric Firms										
Bovine Meat	26.9	12.0	10.0	17.0	13.6	18.5	13.8	6.4	11.3	20.9
Other Meat	31.6	25.8	7.2	14.0	21.6	49.6	16.5	24.6	25.5	35.4
Beverages and Tobaccos	39.0	64.2	32.8	43.2	59.8	41.8	42.6	42.7	42.8	42.6
Motor Vehicles	36.5	35.4	23.4	31.6	37.1	41.0	24.2	35.4	36.8	37.7
Other Transport Equipment	32.2	16.6	10.4	36.1	33.7	33.2	32.9	33.3	46.8	32.4

Sources: Elasticities of substitution for competitive sectors are drawn from Hertel et.al. (2004),
while those of imperfectly competitive sectors are calibrated, cited in the text.
For Markup ratios, Pratten (1998,1991) and Oliveira-Martin, Scarpetta and Pilat (1996a, 1996b).

Table 3.5 Structure of the Social Accounting Matrix for Mercosur CGE Model

		Activities	Commodities	Factors	Households	Government	Saving-Investment	Taxes					Rest of World	Total
								Factor Taxes	Com. Taxes	SS Taxes	Ex. Duties	Tariffs		
Activities			Domestic Sales										Exports	Gross Outputs
Commodities		Intermediate Inputs			Private Consumption	Public Consumption	Investment							Total Demand
Factors		Factor Payment												Factor Payment
Households				Factor Income		Household Subsidies								Household Income
Government		Output Taxes			Household Direct Taxes			Factor Taxes	Commodity Taxes	Social Security Taxes	Export Duties	Tariffs		Government Receipt
Saving-Investment					Household Savings	Government Savings							Foreign Savings	Total Savings
Taxes	Factor Taxes	Factor Taxes												Factor Taxes
	Commodity Taxes	Commodity Taxes			Commodity Taxes	Commodity Taxes	Commodity Taxes							Commodity Taxes
	Social Security Taxes				Household SS Taxes									Social Security Taxes
	Export Duties													Export Duties
	Tariffs		Tariffs											Tariffs
Rest of World			Imports											Imports
Total		Gross Inputs	Total Supplies	Factor Income	Household Expenditures	Government Expenditures	Total Investment	Factor Taxes	Commodity Taxes	Social Security Taxes	Export Duties	Tariffs	Foreign Exchange Inflow	