A GENERAL EQUILIBRIUM ANALYSIS OF THE GAINS FROM TRADE FOR THE MEXICAN ECONOMY OF A NORTH AMERICAN FREE TRADE AGREEMENT

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0 INTRODUCTION

Applied general equilibrium models have become a widely used instrument for analyzing such issues as trade liberalization and fiscal reform since they capture the resulting resource allocation movements. In particular, trade liberalization has increasingly been analyzed in a general equilibrium context.

However, it would appear that it is now a common result that in most Walrasian applied general equilibrium models analyzing trade liberalization, welfare effects are very small. As a result of this, there seems to be concern as to whether such models might be misspecified in that, because of the assumption of constant returns to scale, they do not capture an important source of gains from trade arising from the presence of economies of scale and imperfect competition. This concern is reinforced by the increasing empirical evidence that countries with similar factor endowments have large volumes of trade. Moreover, on the theoretical side a growing literature has flourished focussing on the issue of trade and industrial organization (Helpman and Krugman [1986]).

Although not as fast as the theory, applied general equilibrium modelers have started to work in that direction

(see Harris and Cox [1986], for a model incorporating some sorts of scale economies for Canada).

This paper attempts to evaluate the effects that an eventual free trade agreement between Mexico, Canada and United States would have on the Mexican economy, in the presence of scale economies in the Mexican industry. The way of modeling economies of scale follows the lines of the Harris and Cox model for Canada and focuses in detail on the effects within the Mexican economy.

The choice of incorporating economies of scale for analyzing the Mexican economy responds not only to the recent movement away from Walrasian models mentioned above, but also to the fact that the empirical evidence in Mexico seems to confirm the idea that the theory of comparative advantages is not enough to explain the volume and direction of trade. (see Casar et al [1990]).

The exposition is organized as follows. Section 1 presents a brief review of trade policy in Mexico and some comments on the structure of industrial organization. Section 2 describes the model used and present some results. Section 3 comments on possible extensions of the model. Finally, Section 4 contains some concluding remarks.

It is important to mention that the results presented must be regarded as preliminary since it is still required to do some work both on the estimation of parameters and model specification. The hope is, however, that they will motivate the discussion.

1 HISTORICAL BACKGROUND

1.1 Trade Policy in Mexico

Mexico's economic modern history is not very long; the country started its industrialization process in the forties, particularly after the second world war when a period of import substitution began. Such period would not end until the eighties. During these five decades economic growth was essentially based on an "inward-oriented" strategy, characterized by a growing public sector intervention and high levels of protection.1/ This process, however, was not uniform, but went through different stages which are often identified by the degree of import

1/ During this period public sector expenditure increased permanently, particularly after 1970. Thus, for instance, the contribution of the public sector to GDP went from 14.6 percent in 1975 to 25.6 in 1983. As a result, while the public sector deficit as a proportion of GDP was kept at relatively low levels before 1970 (it averaged 1.4 percent from 1966 to 1971), after 1971 it increased sharply; it was 10 percent in 1975 and reached 15.4 percent in 1982. (IMF [1987]).

substitution reached by the country at different points in time.2/

While successful in that some degree of industrialization was achieved, such an strategy created huge economic imbalances which, at the beginning of the eighties, became unsustainable, thus leading the country to its worst economic crisis in modern history. In particular, the external disequilibrium became the main obstacle to economic growth.

Contrary to the "fiesta" of the second half of the seventies, which was the result of large revenues provided by oil exports and excessive foreign borrowing, the eighties characterized by a lack of economic growth and a continuous fall in the living standards of the population.

We shall not review here the characteristics of this process of economic growth both because it goes beyond the purposes of this paper and because is well documented

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2/ It has become almost a standard approach to identify three periods, each of them with its own peculiarities. A first period is broadly defined between 1940 and 1954, which is characterized by erratic economic growth rates, currency devaluations and price instability. A second period, lasting from 1955 to the end of the seventies, is known as the "stabilizing development" period and is characterized by low rates of inflation and high rates of economic growth. And finally, a third period, from the beginning of the seventies onwards, when many of the economic imbalances accumulated in the previous years started to become obstacles to the economic growth.

elsewhere.3/ Instead we will briefly comment on the characteristics of the trade policy that supported such strategy as well as the major changes that have been taking place in trade policy after 1982. At the end of this section we will also make some comments on the main features of the industrial organization that resulted from such a long period of protectionism.

1.1.1 1940-1982.

The evolution of commercial policy in Mexico can be analyzed with reference to the stages of the industrialization process. From the twenties until the mild forties trade policy was essentially used for tax collection purposes. During this period Mexico enjoyed a current account surplus and, therefore, balance of payments problems did not constitute an important element in the objectives of commercial policy.

However, by the forties, balance of payments considerations and industrial promotion started to play a role in the implementation of commercial policies. In 1947 several important modifications were carried out, among which the most important were the introduction of specific quotas and ad valorem duties, levied on the basis of

3/ See for instance Trejo [1987], Solis [1970], Ortiz Mena [1970] and Hansen [1971].

"official prices", that differed from the prices at which trade actually took place. While industrial promotion was gaining importance, during the forties and until the middle of the fifties balance of payments problems determined, to a great extent, the course of commercial policy. Such problems led to two currency devaluations.4/

From 1955 until the beginning of the seventies, however, commercial policy played a key role in promoting the industrialization of the country. This period coincided with the so-called "stabilizing development" period, and the role of trade policy was to create an environment for industrial growth, basically by providing an umbrella for domestic producers in an attempt to cover them against foreign competition.

Unlike other Latin American countries where a similar process took place, Mexico was to rely more heavily on the use of direct controls, particularly import permits, as opposed to tariffs, although, formally, commercial policy measures were made up of a combination of the two.

Indeed, from the forties direct controls in the form of import permits became the cornerstone of protection policy, and extended throughout the period to cover an increasing number of items. Thus, for instance, while in 1956 33

4/ In 1948 and 1954.

percent of import categories required import permits (28 percent in value terms), in 1973 the number of categories subject to licensing represented 80 percent (64 percent in value terms). This is shown in Table 1.

TABLE 1
Proportion of Import Categories Controlled

YEAR	1956	1962	1966	1970	1973	1975
Controlled (%)	33.0	44.0	60.0	65.0	80.0	100.0
Free (%)	67.0	56.0	40.0	35.0	20.0	0.0
YEAR	1977	1978	1979	1980	1981	1982
Controlled (%)	77.4	43.4	31.1	23.9	26.4	100.0
Free (%)	22.5	56.5	68.9	76.0	73.5	0.0

Source: Balassa [1983], p. 800, and Comercio Exterior [1987]

It is important to note that although trade policy in Mexico was formally based on a combination of tariffs and import permits, the fact that the latter was heavily used made tariffs superfluous, as far as the protection effect is concerned.

It is also interesting to consider that although 37 criteria had to be satisfied in order to grant an import licence, in practice, two criteria were the most relevant:

(a) Is the commodity produced in the country?

(b) Is it produced in sufficient amounts to supply national needs?5/

5/ See Kate and Wallace [1980], pp. 44-45.

These criteria, being the central ones, reveal the explicit emphasis placed on the idea of protecting domestic producers in order to achieve some degree of industrialization. It also suggests that those criteria concerned with efficiency and opportunity costs were most certainly not in the mind of policy makers.

As expected, the actual levels of protection were concentrated on manufactures. Table 2 shows an aggregated version of the effective rates of protection for the years 1960 and 1970.

TABLE 2
Effective Protection. 1960 and 1970.
Effective Rates of Protection

SECTOR	1960	1970
Primary	2.7	-2.7
-Agriculture, livestock, forestry and fishing	3.0	-1.4
-Mining	-0.3	-12.3
Non-Durable consumer goods	21.6	31.6
Intermediate goods	13.2	16.8
Durable consumer and capital goods	64.6	77.2

Source: Kate and Wallace [1980], p. 135.
Note: Rates based on tariffs, not QRs.

One of the associated costs of these high levels of protection was a permanent loss of competitiveness in the export markets. Not surprisingly, during this period

manufactured exports rarely accounted for more than 25 percent of total exports. Likewise, export of primary commodities showed a very poor performance. Thus, for instance, while non-ferrous metals accounted for 15 percent of total exports in the period 1955-57, this proportion shrank to 4 percent in the period 1970-1972. More generally, primary exports increased, altogether, by only 2 percent during the sixties.

While during the "stabilizing development" period the primary concern of commercial policy was to protect the domestic industry, in the seventies balance of payments considerations regained importance, since, as has been suggested, the external disequilibrium accumulated during the previous years was becoming the main constraint to economic growth. Not surprisingly during the seventies commercial policy was very erratic.

Indeed, during the first half of the seventies the system of protection was reinforced. In 1975, import permits were extended to all import categories. After a devaluation of the currency in 1977 and the oil discoveries that took place in these years, however, an attempt was made to reduce the levels of protection since balance of payments problems were not a serious limitation any more, and somehow it was clear that some openness of the economy was necessary. In this event, the proportion of import categories subject to import

permits was reduced from 77.4 percent in 1977 to 34.1 percent in 1979. These changes were accompanied by a rise in tariffs, which were supposed to be temporary, so that eventually they would fall gradually. This, however, did not happened, mainly because of the overvaluation of the currency and the imminence of the economic crisis of the eighties. Thus, by 1982, all import categories were subject to the licensing mechanism once again (see Table 1).

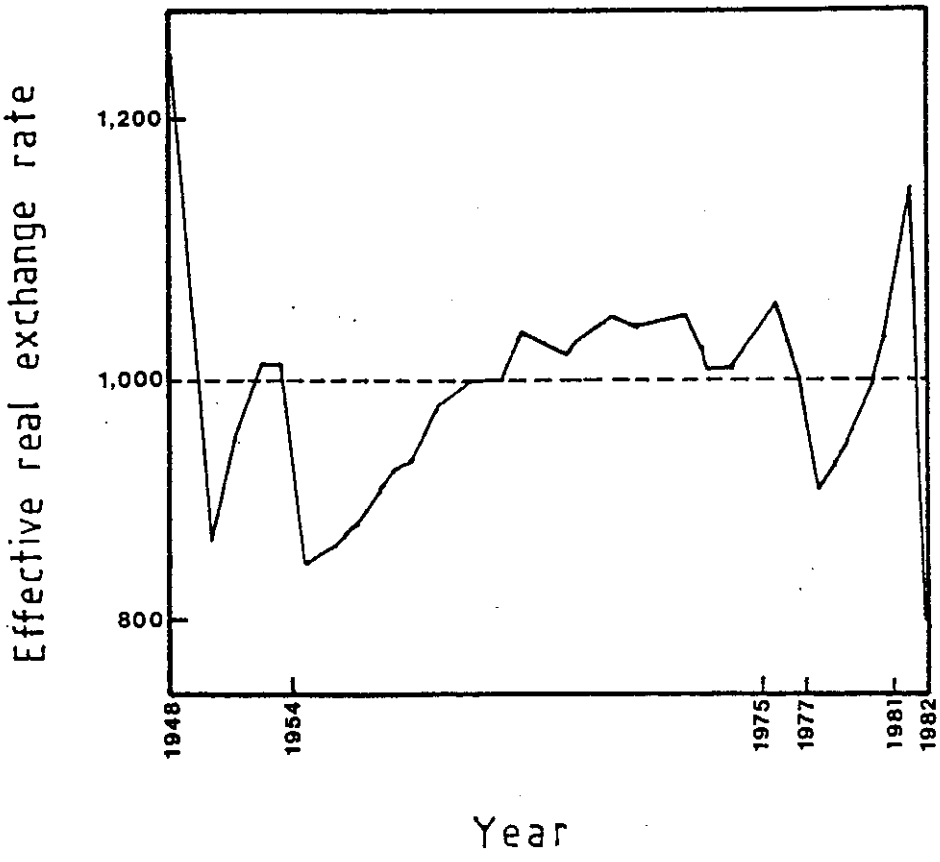
Before moving on to analyze the changes in trade policy that took place in the eighties, it is important to mention that a second major mechanism of protection, together with commercial policy, was the exchange rate.

Indeed, a very important mechanism of economic policy used to favour the industrialization of the economy was the exchange rate: the nominal exchange rate was kept fixed for a period of 23 years, from 1954 to 1976, at a parity of 12.5 pesos per dollar and then, from 1977 until 1981 its nominal value changed very little. Obviously, since inflation was permanently higher than in the United States, which is the country's main commercial partner, the result was a persistent appreciation of the Mexican peso in real terms.6/ Figure 1 shows the effective real exchange rate, defined as the ratio of domestic to foreign prices of main trade

6/ According to Balassa [1983], in the sixties and seventies wholesale prices rose by 32 percent in Mexico and by 10 percent in the United States.

Figure 1

EFFECTIVE REAL EXCHANGE RATE IN MEXICO. 1948-82



Source: Cardoso and Levy (1988).

partners, between 1948 and 1982. As can be seen, in twenty years between 1955 and 1975 the real exchange rate appreciated slowly but continuously.

This exchange rate policy clearly benefited some groups and damaged others. First, sectors which were traditionally generators of external resources in the first half of the century, such as agriculture and mining, were severely affected, suffering large reductions of their export volumes. This was particularly true of agriculture. Secondly, since imports become cheaper when the exchange rate overvalues, in the case of Mexico the most favored groups were those who imported intermediates and capital goods in large quantities. In contrast, imports of consumer goods were largely reduced by means of import permits and tariffs.

Therefore, the industrial sector not only benefited from the availability of cheap imported intermediates and capital goods, but also from protected domestic markets since competition from abroad was ruled out by the imposition of trade barriers, whenever domestic production existed.

In summary, the analysis of the economic growth of the Mexican economy over the past decades suggests that, although to some extent the country succeeded in achieving some degree of industrialization, efficiency and opportunity

costs were not taken into consideration. Such a set of policies, while successful in promoting industrial growth, led to a very distorted scenario in which prices no longer reflected opportunity costs and the relative price structure of the Mexican economy became a major source of micro and macroeconomic disequilibrium. Many economic imbalances were created during the past decades such as a very marked regional disequilibrium, a very concentrated income in relatively few hands and, more important, to the extent that it became the main obstacle to economic growth in the seventies, the external disequilibrium.

The picture in the eighties changed dramatically. With the second largest foreign debt in the developing world and most oil export revenues going to service this debt, Mexico embarked on a programme of economic reform in an attempt to remove domestic distortions and, more generally to liberalize the economy. This is the topic of the next sub-section.

1.1.2 1983-1990

In 1983 Mexico initiated a far reaching programme of economic reform in an attempt to modernize the economy. Essentially, the purpose has been to remove the many sources of distortions created in the previous years and to expose domestic producers to foreign competition. Such set of

reforms included not only changes in trade policy but, more generally, a reduction of the public sector intervention both direct and indirect.7/

Insofar as trade policy is concerned, the Mexican government implemented, after 1983, a deep trade liberalization set of measures that have taken the economy from one of the most protected economies in the seventies, to a one of the most opened economies by the nineties. Such measures were implemented in three stages.

In the first stage, from 1983 to 1985, the De La Madrid administration started to gradually open the market to foreign participation, essentially by a simplification of the tariff schedule, a reduction of the import licensing requirements and a reduction of the number of items covered by official prices.8/ In this stage, the most significant measure was the removal of the import licensing requirement for a total of 2,000 categories on the Mexican tariff schedule. The second stage is marked by the adhesion of Mexico to GATT in 1986, which strengthened the trade

7/ In 1985 the government began a privatization programme to desincorporate its parastatal sector. By the end of July 1990, the number of Government-owned or controlled entities had fallen to 310 from 1,155 in 1982. (USITC [1991]).
8/ Official prices were a widely used instrument of the Mexican government to combat dumping or subsidized import competition. Essentially, this instrument permits the government to determine an "official" price that, usually, differs from the transaction value. In 1986, for instance, duties on approximately 1,000 items were calculated on an official price.

liberalization process by freeing more items from the import licensing requirements, reducing more the tariff level, and phasing out official prices. Indeed, by the end of 1987 the use of official prices was almost nonexistent and import tariffs were reduced from a 0 to 100 percent range in 1985, to a 0 to 20 percent range by the end of December 1987.(USITC [1990]).

As a result of these measures, in only three years the Mexican economy moved from a regime in which almost all imports were subject to import license to a regime in which only a few selected sectors required import permit.9/

Finally, in a third stage the government has attempted to consolidate these measures by further liberalizing some sectors and further reducing the level of tariffs. Let us review in more detail the dismantling of the protection system by commenting on the evolution of the three instruments of protection traditionally used by the Mexican government: import tariffs, import permits and official prices.

9/ Oil and oil derivatives, motor vehicles, pharmaceutical products, footwear, electronic equipment and agriculture.

1.1.2.1 Import Tariffs

It has been mentioned that in 1982 all import categories were subject to the import licensing requirement. That made the use of import tariffs irrelevant insofar as the protection effect is concerned. Nonetheless, after 1985 many import permits were removed and the authorities raised the level of tariffs so as to maintain an equivalent level of protection. In 1986, however, the Mexican government started a process of tariff reductions, immediately taking the maximum tariff level from 100 percent to 50 percent, and subsequent reductions set the maximum tariff level at 20 percent in 1989. Likewise, the trade weighted average tariff fell from 25 percent in 1985 to 10 percent in 1989.

1.1.2.2 Import Permits

As has already been pointed out, import permits were, by and large, the main instrument of protection used in Mexico throughout the industrialization period and until 1982. We have seen, for instance, that in 1982 a hundred percent of import categories were subject to the import licensing requirement. After 1985, however, import permits have been loosing importance in favor of tariffs. Thus, in July 1985 3,064 import items were liberalized from this requirement (from a total of 5,219 controlled categories). By 1986 licenses covered approximately 35 percent of Mexican import

value, and, currently, only 230 categories (out of nearly 12,000) are subject to permits.

These 230 controlled categories belong, basically, to a few sectors: agriculture, auto parts, pharmaceutical products, petrochemicals, apparel, and wood and wood products.10/

1.1.2.3 Official Prices

A third instrument in Mexico's commercial policy has been the use of official prices. In 1983, for instance, 1,353 items were subject to official prices, which accounted for 4.4 percent of total import value. After 1985, however, the use of official prices started to diminish so that by 1987 only 41 items had their price set with this mechanism and, by the end of this year official prices were eliminated.

1.2 Industrial Structure

As it has been mentioned, the industrialization process in Mexico has taken place in a relatively short period and, to a great extent, it was clearly an induced process. An important consequence, as we will try to explain, is that

10/ Some 60 percent of US agricultural exports to Mexico require import license.

the resulting industrial structure behaves in a very oligopolistic manner, at least for some sectors.

Indeed, the conformation of the industrial structure in Mexico might be easier to understand with reference to the evolution of the import substitution process.

The first stage, the import substitution of consumer goods, was roughly consolidated by the forties. By 1950, sectors such as food, beverages, tobacco, textiles, wearing apparel, leather, wood, printing and publishing, as well as some non metallic minerals, already covered more than 97 percent of the internal demand. (Ros y Vazquez [1980]).

In a second stage (middle of the fifties), a process of substitution of intermediates began, with huge investments in industries such as steel, metallic products, transport equipment (specially railroad equipment), paper products, and rubber products. A consequence of this was that, in the fifties, a drop in the ratio of imports to domestic demand, for these commodities, was registered. This process was strengthened during the sixties, particularly in the chemical industry, rubber, electrical and non electrical machinery, and the automotive industry. As a result, in only twenty years, the production of the manufacturing industry multiplied four times, and the sectors mentioned above,

altogether, multiplied their production levels by a factor of seven.

Whereas in the fifties and sixties the growth of the industrial sector was very stable, in the seventies the manufacturing industry registered large fluctuations reflecting balance of payments problems which, as it has been suggested, started to become the main obstacle to economic growth. To a great extent, the import substitution process itself, originated these balance of payments problems since, the more developed the industry was, the more dependent it was on sophisticated intermediates and capital goods.

In a very schematic way, it can be said that the Mexican industry concentrates in the production of consumer and some intermediate goods, whereas the production of sophisticated intermediate and capital goods is still incipient.

As a whole, the industrial structure was the result of three decades of explosive growth since the volume of production duplicated every ten years (see Casar et al [1990]). The process, however, resulted, in some cases, in sectors where a few large firms were dominant. Thus, for instance, in the fifties, large public enterprises were set up to produce steel, railroad equipment, and paper. On the other hand, private firms, often associated with foreign

firms, started to produce commodities such as electrical machinery, metallic products, and rubber products. By the end of the sixties foreign firms already participated with 30 percent and enjoyed a well established position in the automotive industry, chemicals, electrical and non electrical machinery. Insofar as private national firms, in addition to collaborate with foreign firms, they consolidated their position in the production traditional goods, such as food, beverages, textiles, construction and, in a lesser extent, steel and chemicals.

Casar et al [1990] characterize the Mexican industry, in 1980, as follows. They identify what they call (a) concentrated oligopolies, (b) concentrated and differentiated oligopolies, (c) differentiated oligopolies, (d) competitive oligopolies, and (d) competitive industries. The so called concentrated oligopolies are responsible for some 20 percent of value added in the manufacturing industry and produce intermediate and, to a lesser extent, capital goods. They characterize by high levels of concentration in the order of 75 percent 11/. The concentrated and differentiated oligopolies participate with 15 percent of value added in the manufacturing industry and produce mainly durable consumer goods and to a less degree, traditional consumer goods. The level of concentration is between 84 and

11/ Estimated as the value of the production of the four largest firms in the industry as a proportion of the total value of production in the industry.

77 percent. The differentiated oligopolies contribute with 12 percent of value added and have an average level of concentration of 40 percent. They produce mainly non durable consumer goods. The competitive oligopolies generate 30 percent of value added in manufacturing and have also a concentration level of 40 percent, concentrating on the production of light capital and intermediate goods (inputs for the agroindustry, food and textile industries as well as some non standard capital goods) Finally, the competitive industries participate with approximately 25 percent of value added and have a low level of concentration of 14 percent. They concentrate on the production of some intermediate inputs for agroindustries, construction materials as well as some basic consumer goods in the food, apparel, and shoe industries.

In summary, it can be said that the industrialization process in Mexico generated an oligopolistic scenario where few large firms produce the most sophisticated intermediate, capital, and durable consumer goods. It seems that the less sophisticated the commodity produced is, the number of firms in a sector increases (towards a more competitive behavior).

That is obviously a very superficial analysis but, nonetheless, gives us an idea of the characteristics of the industrial organization in Mexico.

2 THE MODEL

2.1 Overview of the Model

The structure of the model is outlined in Table 3. The equations underlying the model are presented in Appendix A. With some exceptions, notably the introduction of economies of scale, and some additional points, the assumptions of the model resemble very much with the conventional general equilibrium models and therefore in this section we will provide only a general overview of the model, and then proceed to comment on the question of economies of scale.

The model is calibrated around a Social Accounting Matrix (SAM) for the Mexican economy, for the year 1985. As mentioned in Table 3, domestic and imported commodities are assumed to be imperfect substitutes and modeled with the Armington assumption. On the export side, domestic production and exports (to both regions) are modeled with constant elasticity of transformation (CET) functions. In the present version we assume that commodities sold in domestic markets and the commodities exported are the same (infinite elasticity of substitution). The advantage of this CET specification, however, is that, by using different elasticity of transformation values, it enables us to model

TABLE 3
General Characteristics of the MEGA model

1.- Level of Aggregation. The model identifies 27 production sectors, each sector producing a single commodity. Of these 27 commodities, 21 belong to the category of the so called traded while the remaining 6 commodities are non traded. (See Appendix B).

2.- Dimensions. There are two factors of production, capital and labor, which, in principle, are assumed to be mobile between sectors. It is assumed one consumer, and three regions: Mexico, North-America (which includes US and Canada), and rest of the world. It is important to stress that the model is not fully general equilibrium in that only the Mexican economy is explicitly modeled (the other regions are modeled only in the sense that they buy our exports and sell to Mexico their exports).

3.- Production. All production activities combine intermediate inputs in fixed coefficients but are allowed for some degree of substitution between domestic and foreign commodities. At other level, they combine labor and capital by means of a Cobb-Douglas to generate net output which in turn combines in fixed coefficients with intermediate inputs. (this specification is modified for sectors in which economies of scale are assumed, as it is explained in the next sub-section).

4.- Foreign Trade. Each sector produces a share for the domestic market and exports the remaining share to North-America and ROW. Exported commodities face a downward slopping demand which depends, among other things, on a price elasticity of demand (see Appendix A). The model assumes Constant Elasticities of Transformation (CET) which enables us to differentiate between domestic and exported commodities. (in the version presented here it assumed an infinite elasticity of substitution). On the import side, the small country assumption is adopted, and domestic and foreign commodities are assumed to be imperfect substitutes (in the Armington manner). The exchange rate is assumed to be flexible, and the balance of payments deficit or surplus is assumed fixed. The numeraire is taken to be a basket of final consumption goods.

5.- Final Demand. Linear Expenditure System (because the parameters are still in the process of estimation, in the version presented here we assumed a Cobb-Douglas specification). Likewise, government and investment expenditures are specified in fixed quantity shares.

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some sort of price discrimination between domestic and foreign markets.

Producers buy composite commodities combining them in fixed coefficients while in the factor markets capital and labor combine in a Cobb-Douglas way. At a higher level intermediates and net output combine in fix proportions. Private consumers buy also composite goods and consume according to a Linear Expenditure System.12/

2.2 Modeling Economies of Scale and Imperfect Competition

In modeling economies of scale we followed the assumptions of the Harris and Cox [1986] model. That is, we assumed that some firms, in some industrial activities, behave as non competitive. Therefore, we have two types of industries. In the competitive industries constant returns to scale are assumed and factors of production are mobile. In the non competitive industries, firms, whose number is endogenous, use a fixed bundle of capital and labor. A fixed cost is thus involved and, in the long run, marginal cost is constant and average cost is declining everywhere. Therefore, as the level of production increases, there is a

12/ In the version presented here we assumed a Cobb-Douglas specification since the value of the parameters are still in process of estimation.

gain in efficiency since average costs decline (towards marginal costs). As it will be explained later in detail, the degree of unexploited economies of scale, is measured as the ratio of marginal to average costs

Following Harris and Cox [op. cit..], a modified Cournot-Chamberlain equilibrium at the industry level is assumed, where firms set prices conditional on an elasticity of a perceived demand curve, which determines a markup of price over marginal cost. Freedom of entry and exit guarantees zero economic profits in all industries so that price equals average cost.

2.3 Parameter Values

Three set of parameter values are required to solve the model. They are, elasticities of substitution between domestic and imported commodities (e), export demand elasticities (a), and the inverse scale elasticities (k). Table 4 reports these values, which, for the case of e and a two set of values are reported: high and low. The purpose of running the model with these two different sets is to carry out some sensitivity analysis.

It should be said that for the purposes of this paper, trade elasticities, as reported in Table 4, are guess estimates, since estimation of these parameters are still in process.

TABLE 4
Elasticity Values

	e		*a*		*k*
	Low	High	Low	High	
Agriculture	3.0	6.0	2.0	4.0	none
Mining	0.5	1.0	2.0	4.0	none
Petroleum	0.5	1.0	3.0	6.0	none
Food	1.125	2.5	2.0	4.0	0.84
Beverages	1.125	2.5	2.0	4.0	0.90
Tobacco	-	-	2.0	4.0	none
Textiles	1.125	2.5	2.0	4.0	none
Wearing apparel	1.125	2.5	3.0	6.0	none
Leather	1.125	2.5	3.0	6.0	none
Paper	0.5	1.0	3.0	6.0	0.84
Chemicals	0.5	1.0	3.0	6.0	0.84
Rubber	0.5	1.0	3.0	6.0	0.84
Non-metallic prod	0.5	1.0	3.0	6.0	0.73
Iron and Steel	0.5	1.0	3.0	6.0	0.84
Non ferrous met	0.5	1.0	3.0	6.0	0.73
Metallic prods.	0.5	1.0	3.0	6.0	0.84
Non elect. mach.	0.375	0.75	3.0	6.0	0.84
Elect. mach.	0.375	0.75	3.0	6.0	0.84
Transp. equip.	0.375	0.75	3.0	6.0	0.71
Other manufac.	0.375	0.75	3.0	6.0	0.95
Construction	-	-	2.0	4.0	none
Electricity	-	-	2.0	4.0	none
Commerce, Hotels	-	-	2.0	4.0	none
Transp. & comm.	-	-	2.0	4.0	none
Financial serv.	-	-	2.0	4.0	none
Other services	-	-	2.0	4.0	none

e = Elasticity of substitution (domestic-imported)
a = Export demand elasticity
k = inverse scale elasticit

Insofar as the values of inverse scale elasticities they were approached following calculations carried out by Casar et al [1990] for the Mexican industry. They estimated an index measuring the efficiency in the use of scale economies for the Mexican manufacturing sector for the year 1980.13/ This index measures the average size of a firm in relation to a minimum efficient size of a firm. Unfortunately their estimations were carried out at a different level of disaggregation than ours, so that it was necessary to establish a somewhat arbitrary mapping to get an idea of the degree of unexploited scale economies in the sectors identified in our model.

2.4 Results

In order to make the presentation as simple as possible, we simulated a 100 percent tariff reduction both unilateral and bilateral under different trade elasticity values, as reported in Table 4. Before commenting on the results, it is important to mention that a version of the model where all sectors are competitive was also run. We will not report on these results fully but, instead, during the course of the presentation we will refer them for purposes comparison.

13/ Based on the 1975 industrial census.

2.4.1 Unilateral trade liberalization

Our first policy experiment was to simulate a 100 percent tariff reduction on imports from North America. The results are reported in Tables 6 to 12. Table 6 summarizes the main aggregates while Tables 7 to 12 report detailed sectorial effects. As can be seen, in all this tables results are reported for the two sets of trade elasticity values: low and high. For presentation purposes we will comment here and in the next sub-section the results of trade liberalization both unilateral and bilateral for the case of low trade elasticities and then we will move on to make some comments on the issue of sensitivity analysis.

Table 6 summarizes the main aggregate variables of both experiments and for the two sets of elasticity values. It can be seen that real income goes up in all cases in more than 3.0 percent as a proportion of GDP and reaches 4.09 percent in the extreme case of bilateral trade liberalization with high trade elasticities. Real wage increase varies between 4.70 and 6.10 percent while employment in the non competitive sectors moves from a 3.82 percent increase in the low-unilateral case to 5.62 percent increase in the high-bilateral scenario. Finally, the exchange rate depreciates in all cases with the rate of adjustment decreasing when liberalization is bilateral.

TABLE 5
AD VALOREM TARIFFS (%)
(BENCHMARK EQUILIBRIUM)

Sector	Tariff
AGRICULTURE	13.2
MINING	17.2
PETROLEUM	6.0
FOOD	32.7
BEVERAGES	85.4
TEXTILES	43.4
WEARING APPAREL	51.0
LEATHER	42.0
WOOD	42.1
PAPER	22.1
CHEMICALS	34.2
RUBBER	40.8
NON MET MINERALS	40.6
IRON AND STEEL	21.2
NON FER METALS	26.0
METALLIC PRODUCTS	38.9
NON ELEC MACH	31.6
ELECTRICAL MACH	42.4
TRANSPORT EQUI	41.3
OTHER MANUF	53.1

TABLE 6
CHANGES IN SOME IMPORTANT VARIABLES (%)

	UNILATERAL		BILATERAL	
	Low (1)	High (2)	Low (3)	High (4)
GDP AT FACTOR COST	3.43	3.79	3.66	4.09
REAL WAGE	4.70	5.70	5.10	6.10
RATE OF EXCHANGE WITH USA AND CANADA	5.60	4.30	4.50	3.40
RATE OF EXCHANGE WITH ROW	0.50	0.10	0.60	0.10
TOTAL EMPLOYMENT	0.63	0.73	0.73	0.92
EMPLOYMENT IN THE NON COMPETITIVE SECTORS	3.82	4.48	4.44	5.62

TABLE 7
CHANGES IN GDP (%)

	UNILATERAL		BILATERAL	
	Low (1)	High (2)	Low (3)	High (4)
AGRICULTURE	2.67	0.38	2.96	0.71
MINING	3.10	3.20	3.28	3.42
PETROLEUM	6.23	8.38	5.73	7.46
FOOD	3.64	3.04	4.15	3.91
BEVERAGES	4.02	3.60	4.47	4.28
TOBACCO	4.47	5.09	5.05	6.10
TEXTILES	2.90	1.31	4.07	3.75
WEARING APPAREL	2.98	1.26	4.67	5.28
LEATHER	3.90	3.92	4.70	5.48
WOOD	2.93	2.36	3.36	2.93
PAPER	2.75	2.67	2.99	3.01
CHEMICALS	2.61	1.80	3.15	2.78
RUBBER	3.42	3.37	4.00	4.48
NON MET MINERALS	3.87	5.29	4.82	7.09
IRON AND STEEL	3.18	4.15	3.79	5.09
NON FER METALS	2.04	1.12	2.66	2.23
METALLIC PRODUCTS	2.52	2.17	3.19	3.35
NON ELEC MACH	2.93	3.65	3.93	5.66
ELECTRICAL MACH	4.57	6.34	6.25	10.02
TRANSPORT EQUI	7.57	12.81	7.49	12.48
OTHER MANUF	2.21	0.53	3.77	3.97
CONSTRUCTION	2.72	4.04	3.26	4.55
ELECTRICITY	3.22	3.79	3.52	4.24
COMMERCE	4.75	5.80	4.79	5.73
TRANSPORT	4.44	5.38	4.53	5.39
FINANCIAL SERV	3.76	4.46	3.98	4.70
OTHER SERV	1.02	1.76	1.11	1.81

TABLE 8
CHANGES IN EXPORTS TO USA AND CANADA (%)

	UNILATERAL		BILATERAL	
	Low (1)	High (2)	Low (3)	High (4)
AGRICULTURE	10.32	15.41	12.82	21.42
MINING	9.81	13.95	8.12	11.12
PETROLEUM	15.87	24.32	13.72	20.79
FOOD	11.53	18.66	17.10	31.63
BEVERAGES	12.06	19.82	17.66	32.87
TOBACCO	10.35	15.38	30.98	63.50
TEXTILES	11.07	17.16	25.23	49.82
WEARING APPAREL	17.10	27.05	62.00	145.33
LEATHER	15.42	22.79	40.41	83.37
WOOD	16.42	25.49	17.63	29.28
PAPER	20.55	35.78	20.27	36.33
CHEMICALS	19.07	32.29	23.41	43.35
RUBBER	20.26	35.08	48.72	108.40
NON MET MINERALS	18.87	31.47	25.67	48.22
IRON AND STEEL	22.44	40.70	27.08	52.87
NON FER METALS	21.02	36.67	25.50	48.22
METALLIC PRODUCTS	21.66	38.57	29.92	59.39
NON ELEC MACH	24.49	45.52	30.34	60.87
ELECTRICAL MACH	21.58	38.21	31.67	63.52
TRANSPORT EQUI	26.80	51.40	25.15	48.75
OTHER MANUF	19.46	33.01	28.54	55.36
ELECTRICITY	8.83	11.84	6.51	7.74
COMMERCE	9.59	13.55	7.25	9.39
TRANSPORT	9.50	13.27	7.15	9.11
FINANCIAL SERV	9.13	12.42	6.77	8.25
OTHER SERV	7.41	8.09	4.95	3.82

TABLE 9
CHANGES IN EXPORTS TO ROW (%)

	UNILATERAL		BILATERAL	
	Low (1)	High (2)	Low (3)	High (4)
AGRICULTURE	0.10	-1.97	0.22	-1.93
MINING	-0.37	-3.20	-0.28	-3.25
PETROLEUM	0.14	-2.67	0.43	-2.46
FOOD	1.19	0.80	1.43	1.07
BEVERAGES	1.68	1.78	1.91	2.03
TOBACCO	0.13	-1.99	0.25	-1.96
TEXTILES	0.78	-0.48	0.92	-0.41
WEARING APPAREL	1.21	-0.53	1.42	-0.44
LEATHER	-0.25	-3.86	-0.10	-3.90
WOOD	0.62	-1.75	0.84	-1.63
PAPER	4.18	6.30	4.64	6.86
CHEMICALS	2.90	3.57	3.32	4.05
RUBBER	3.93	5.76	4.35	6.23
NON MET MINERALS	2.73	2.93	3.08	3.27
IRON AND STEEL	5.82	10.16	6.40	10.96
NON FER METALS	4.59	7.00	5.08	7.58
METALLIC PRODUCTS	5.14	8.49	5.64	9.13
NON ELEC MACH	7.59	13.93	8.17	14.73
ELECTRICAL MACH	5.08	8.21	5.53	8.76
TRANSPORT EQUI	9.58	18.53	10.19	19.40
OTHER MANUF	3.24	4.13	3.62	4.53

TABLE 10
CHANGES IN IMPORTS FROM USA AND CAN (%)

	UNILATERAL		BILATERAL	
	Low (1)	High (2)	Low (3)	High (4)
AGRICULTURE	28.28	69.71	32.71	79.52
MINING	8.42	16.12	9.53	18.07
PETROLEUM	1.57	1.57	2.09	2.40
FOOD	33.62	75.85	35.55	79.91
BEVERAGES	94.96	273.67	97.77	282.22
TEXTILES	45.10	107.35	47.81	114.37
WEARING APPAREL	53.04	130.28	55.26	135.56
LEATHER	45.76	111.04	48.07	116.58
WOOD	43.66	105.48	45.94	110.62
PAPER	9.76	18.51	10.56	19.89
CHEMICALS	14.87	29.10	15.91	31.06
RUBBER	18.78	37.91	19.72	39.64
NON MET MINERALS	18.23	38.50	19.38	40.51
IRON AND STEEL	9.21	17.99	10.26	19.66
NON FER METALS	10.41	19.78	11.53	21.84
METALLIC PRODUCTS	16.20	32.77	17.24	34.56
NON ELEC MACH	7.91	14.98	8.71	16.02
ELECTRICAL MACH	13.36	26.34	14.27	27.80
TRANSPORT EQUI	12.91	25.27	13.61	26.24
OTHER MANUF	19.05	38.14	19.98	39.64
ELECTRICITY	3.22	3.79	3.52	4.24
COMMERCE	4.06	4.71	4.43	5.21
TRANSPORT	3.98	4.65	4.28	5.05
FINANCIAL SERV	3.68	4.35	3.94	4.65
OTHER SERV	0.88	1.62	1.03	1.76

TABLE 11
CHANGES IN IMPORTS FROM ROW (%)

	UNILATERAL		BILATERAL	
	Low (1)	High (2)	Low (3)	High (4)
AGRICULTURE	2.33	3.02	2.36	3.15
MINING	2.66	3.29	3.13	4.07
PETROLEUM	3.81	5.27	3.76	5.16
FOOD	2.66	1.98	2.84	2.22
BEVERAGES	2.83	2.14	3.01	2.35
TEXTILES	2.17	1.01	2.78	2.30
WEARING APPAREL	2.06	0.62	2.24	0.83
WOOD	2.28	2.32	2.60	2.75
PAPER	1.82	1.18	1.99	1.43
CHEMICALS	1.60	0.20	1.95	0.80
RUBBER	2.60	2.10	2.83	2.44
NON MET MINERALS	2.20	2.68	2.62	3.22
IRON AND STEEL	1.64	1.40	2.04	1.90
NON FER METALS	0.78	-0.98	1.23	-0.19
METALLIC PRODUCTS	1.03	-0.43	1.36	-0.01
NON ELEC MACH	-0.85	-3.52	-0.54	-3.31
ELECTRICAL MACH	1.11	-0.07	1.50	0.39
TRANSPORT EQUI	1.01	-0.34	1.21	-0.25
OTHER MANUF	-1.42	-6.02	-1.20	-5.86

TABLE 12

CHANGES IN PRICES OF THE COMPOSITE COMMODITY (%)

	UNILATERAL		BILATERAL	
	Low (1)	High (2)	Low (3)	High (4)
AGRICULTURE	0.1	0.0	0.1	0.0
MINING	-0.2	-0.2	-0.3	-0.2
PETROLEUM	0.8	0.7	0.7	0.7
FOOD	-0.8	-1.0	-0.8	-1.0
BEVERAGES	-0.8	-1.1	-0.9	-1.2
TOBACCO	0.5	0.6	0.5	0.6
TEXTILES	-0.8	-1.0	-0.8	-1.0
WEARING APPAREL	-1.4	-1.8	-1.4	-1.8
LEATHER	0.3	0.3	0.3	0.3
WOOD	-0.5	-0.7	-0.5	-0.7
PAPER	-2.0	-2.3	-2.2	-2.4
CHEMICALS	-2.5	-2.8	-2.6	-2.9
RUBBER	-2.3	-2.6	-2.4	-2.6
NON MET MINERALS	-1.1	-1.3	-1.2	-1.3
IRON AND STEEL	-2.6	-2.9	-2.7	-3.1
NON FER METALS	-4.7	-5.2	-4.9	-5.4
METALLIC PRODUCTS	-3.9	-4.4	-4.1	-4.5
NON ELEC MACH	-8.7	-9.5	-9.1	-9.8
ELECTRICAL MACH	-5.1	-5.6	-5.2	-5.7
TRANSPORT EQUI	-7.0	-7.6	-7.2	-7.8
OTHER MANUF	-8.9	-9.9	-9.1	-10.1
CONSTRUCTION	0.6	0.8	0.7	0.9
ELECTRICITY	1.2	1.4	1.2	1.4
COMMERCE	0.9	1.0	0.9	1.1
TRANSPORT	1.2	1.3	1.1	1.3
FINANCIAL SERV	1.1	1.3	1.1	1.3
OTHER SERV	1.9	2.3	2.0	2.4

Moving now to the sectorial results, it can be seen from Table 7 that all sectors expand, and the increase is particularly pronounced in activities such as transport equipment and petroleum. In looking at these results, it is important to have in mind that the policy experiment was simulated under the constraint that the current account balance is fixed so that, to a great extent, the adjustment comes from a depreciation of the real exchange rate (see Table 6).

The wage rate increases 4.7 percent which raises the capita-labor ratio in the competitive industries. In the non competitive industries, on the other hand, exit of firms occur which suggests that the remaining firms in the industry use capital more efficiently. Which firms do better within the manufacturing industries? It would appear that, other things equal, those industries with increasing returns to scale are capable of accessing more easily export markets. This can be corroborated by looking at column one in Table 8. Indeed, sectors such as iron and steel, non ferrous metals, metallic products, no electrical and electrical machinery and transport equipment register rates of export growth above 20 percent. The same story, although less pronounced, goes for exports to ROW (see Table 9). It would seem, then, that the presence of economies of scale contributes to soften the adjustment on the real exchange

rate necessary to maintain the current account (surplus) unchanged.

To complete the story, it is necessary to look at the structure of price reduction of the composite commodities (see Table 12). It is evident that the commodities whose main demand component is intermediate demand register an stronger drop in prices. This is the case of commodities such as non electrical machinery, transport equipment, other manufactures, and electrical machinery. In contrast, lower price reductions occur in those commodities whose main end use is final demand. This result is explained in part by the base solution structure of tariffs (see Table 5) but surely there is also an efficiency gain since the non competitive sectors are precisely those sectors producing intermediates in large volumes.

2.4.2 Bilateral trade liberalization

A second policy experiment was to simulate a bilateral reduction in tariffs, that is, 100 percent reduction in both domestic tariffs and North American tariffs. The reduction in North American tariffs was simulated as an increase in the world price of the corresponding commodity so that the demand for Mexican exports increase. As can be seen by comparing columns one and three of our report tables, moving from a unilateral to a bilateral scenario does not change

results significantly. With the exception of petroleum, exports increase and the adjustment of the exchange rate is also lower. It would appear that what really constraints the economy is mainly the domestic protection rather than the inability to get access to export markets. This suggestion, however, should be taken carefully since we are no explicitly considering possible quota restrictions to Mexican exports. We shall comment more on the issue of quotas in the last section.

2.4.3 Sensitivity Analysis

We carried out some sensitivity analysis basically by doubling trade elasticity values. Focusing on the unilateral liberalization scenario, the first point to notice is that composite commodity prices are naturally lower in the case of high trade elasticity values since there is more scope for substitution. This effect generates a further reduction in costs which, in some cases contributes to further expand activity levels. This picture, however is not general. Exporter sectors such as agriculture, textiles and wearing apparel suffer a relative contraction. In particular, GDP in agriculture moves from 2.67 percent increase in the low case scenario to a 0.38 percent in the high trade scenario. To some extent this result is explained by the relatively high level of import substitution elasticity in agriculture which shifts demand

towards imported agricultural goods. The remaining sectors, however do not seem to be very sensitive to the changes in trade elasticity values.

Overall, it can be said that trade liberalization accompanied by the existence of some sort of economies of scale, increases real income and, more generally, it makes the economy, as a whole, more efficient. In particular, the assumption of economies of scale allows some sectors to realize economies of scale on the export markets.

It could of course be argued that the relatively important effects arise from the high level of tariffs in the benchmark equilibrium solution which, incidentally, were much higher than the current levels. Nonetheless, although not reported here, we conducted the same policy experiment in a Walrasian version of the model, and the results in terms of increase in GDP are very small.

It has also to be mentioned that another version of the present model was run incorporating the Eastman-Stykolt assumption that the Harris and Cox model adopt for the Canadian case. However, given the high level of tariffs that prevailed in the Mexican economy in 1985, the effects on almost all variables are very strong. We therefore decided, at least for this presentation, to concentrate on just one pricing behavior (Cournot-Chamberlain). Obviously we want to

incorporate and test this second pricing behavior for further policy experiments but it would be necessary to incorporate into our data the current levels of protection of the Mexican economy.

Finally, this presentation has concentrated, basically, on the results under the assumption that balance of payment (surplus) is maintained fixed. In doing that we assumed that, at least for the time being, the Mexican economy has no other feasible mechanism of adjustment since foreign borrowing in the past decade has practically been frozen. In the long run, however, additional sources, such as foreign investment might fill this gap. Fortunately different versions of our model can easily been handled and no doubt more simulations changing the model specification are needed to get more certainty as to how accurate the results are.

3 EXTENSIONS TO THE MODEL

The results presented here should of course be regarded as preliminary since more work is required both at the data level as well as the level of model specification.

Insofar as the data is concerned, the most immediate task is to adjust the levels of protection of our base year to the current protection levels. Fortunately this is not a serious problem. Perhaps more difficult is to get reliable

values of parameters, particularly trade elasticity values. On this particular point a research is already being conducted in Mexico and the estimations of the Department of Labor by Clinton R. Shiells will hopefully contribute to alleviate this problem. Finally, as could be appreciated the results presented do not incorporate the effects of non tariff restrictions. A usual way out of it is to estimate the tariff equivalent level and model the effects through the price mechanism. The other possibility is to explicitly incorporate the quantity rationing mechanism. Whatever method we choose will depend on how accurate we believe it is. The important thing, however, is to consider the effects of QRs since, at present, given the current low level of tariffs both in Mexico and North America, is very likely that an eventual free trade agreement will move in th direction of removing these barriers.

In relation to the issue of model specification it seems that more sensitivity analysis is required, particularly on the question of closure rules. Likewise it is desirable to do some sensitivity analysis incorporating the Eastman-Stykolt assumption which, as we already mentioned, was not presented in this paper because of the high level of tariffs in the year 1985. At the current levels, however, this assumption seem more sensible in the context of the Mexican economy.

The use of CET functions, which in this version were used with infinite elasticities of transformation, opens the possibility of modeling some sort of price discrimination between domestic and export markets.

Finally, and coming back to the question of QRs, one possibility to model them is impose a restriction on the quantity imported and to treat the difference between the price importers can buy at and the price the market is willing to pay, as a rent. That, of course, requires to calibrate the base year to estimate these rents. On the export side, QRs may be easier to model if one assumes that quotas are binding in which case export of commodities subject to a QRs should be fixed.

4 CONCLUDING REMARKS

The model presented here has attempted to incorporate a form of imperfect competition. The results, however preliminary, suggest that additional gains from trade are present. While the magnitudes are not very strong they are, nevertheless, more significant than the Walrasian models.

We followed the lines of the Harris and Cox model for Canada, although, in the version presented here, we presented results of only one form of imperfect competition.

Additional work both at the data level and model specification is required and therefore these results should be considered as points attempting to motivate the discussion.

APPENDIX A

MODEL EQUATIONS

A) PRICES

-Price of imports from United States (US)

$$PMEU_i = PEU_i \ (1+t_{meui}) \ TCEU \qquad (1)$$

where PEU_i is the price commodity i in dollars from US, t_{meui} is the tariff rate on the commodity i imported from US, and TCEU is the exchange rate between pesos and US dollars.

-Price of imports from the rest of the world (ROW)

$$PMRM_i = PRM_i \ (1+t_{mrmi}) \ TCRM \qquad (2)$$

where PRM_i is the price of commodity i in foreign exchange imported from ROW, t_{mrmi} is the tariff rate on commodity i imported from ROW, and TCRM is the exchange rate between pesos and foreign currency.

-Price of exports to US

$$PWEEU_i = PD_i/(1+t_{eeui}) \ TCEU \qquad (3)$$

where PD_i is the price of domestic commodity i, and t_{eeui} is the subsidy rate on exports to US.

—Price of exports to ROW

$$PWERM_i = PD_i/(1+t_{ermi}) \ TCRM \qquad (4)$$

where t_{ermi} is the subsidy rate on exports to ROW

-Price of the composite commodity

$$\begin{aligned} P_i = \delta_i^{-1/\sigma} \ \{ & PD_i[\alpha_i+\beta_i(\alpha_i \cdot PMEU_i/\beta_i \cdot PD_i)^{\sigma/(\sigma-1)} + \\ & + \tau_i(\alpha_i \cdot PMEU_i/\tau_i \cdot PD_i)^{\sigma/(\sigma-1)}]^{-1/\sigma} + \\ & + PMEU_i[\alpha_i(\beta_i \cdot PD_i/\alpha_i \cdot PMEU_i)^{\sigma/(\sigma-1)} + \beta_i + \\ & + \tau_i(\beta_i \cdot PMRM_i/\tau_i \cdot PMEU_i)^{\sigma/(\sigma-1)}]^{-1/\sigma} + \\ & + PMRM_i[\alpha_i(\tau_i \cdot PD_i/\alpha_i \cdot PMRM_i)^{\sigma/(\sigma-1)} + \\ & + \beta_i(\tau_i \cdot PMEU_i/\beta_i \cdot PMRM_i)^{\sigma/(\sigma-1)} + \tau_i]^{-1/\sigma} \ \} \end{aligned} \qquad (5)$$

where δ_i the scale parameter in the CES function from which the previous equation is obtained, and σ_i is defined as

$$\sigma_i = (1+ces_i)/ces_i \quad (6)$$

where ces_i is the elasticity of substitution, α_i, β_i and τ_i are the associated domestic, imported from US and imported from ROW parameters respectively, in the CES function.

-Price level

$$P = \Sigma\ \Omega_i P_i \quad (7)$$

-Net price equations (PN)

$$PN_i = PD_i(1-td_i) - \Sigma a_{ij} P_j \quad (8)$$

where td_i is a production tax on commodity i and a_{ij} the input-output coefficient.

B) PRODUCTION

-Value added functions

$$X_i = \phi_i[\pi_i L_i^{\epsilon i} + (1-\pi_i) K_i^{\epsilon i}]^{1/\epsilon i} \quad (9)$$

where L_i y K_i are the quantities of labor and capital respectively, in sector i, and ϵ_i is defined as

$$\epsilon_i = (\tau_i - 1)/\tau_i \quad (10)$$

where τ_i is the elasticity of substitution between capital and labor in sector i.

-Intermediate demand

$$II_{ij} = a_{ij}\ XO_i \quad (11)$$

where XO_i is gross product in sector i.

-Input aggregation functions

$$AI_j = \min\ (II_{ij}/a_{ij}) \quad (12)$$

-Gross product aggregation functions

$$XO_i = \min\ (AI_i\ ,\ X_i/v_i) \quad (13)$$

where v_i is the value added coefficient per produced commodity i.

C) FACTOR MARKETS

-Labor demand by sector

$$L_i=(X_i/\phi_i)\{\pi_i+[1-\pi_i][\pi_i r/(w-w\pi_i)]^{\epsilon/(\epsilon-1)}\}^{-1/\epsilon} \quad (14)$$

where r y w are prices of capital and labor respectively

-Labor supply

$$L = L \quad (15)$$

-Capital demand by sector

$$K_i=(X_i/\phi_i)\{(1-\pi_i)+\pi_i[(w-w\pi_i)/r\pi_i]^{\epsilon/(\epsilon-1)}\}^{-1/\epsilon} \quad (16)$$

-Capital supply

$$K = K \quad (17)$$

D) INCOME EQUATIONS

-Net private income

$$RP = (\Sigma\ L_i\cdot w + \Sigma\ K_i\cdot r)(1-dir) \quad (18)$$

where -dir- is the tax rate on income

-Net government income

$$\begin{aligned} RG = {} & (\Sigma L_i\cdot w + \Sigma K_i\cdot r)\cdot dir + \Sigma PEU_i\cdot t_{meui}\cdot TCEU\cdot MEU_i + \\ & + \Sigma PRM_i\cdot t_{mrmi}\cdot TCRM\cdot MRM_i - \Sigma PD_i\cdot t_{eeui}\cdot TCEU\cdot EEU_i - \\ & - \Sigma PD_i\cdot t_{ermi}\cdot TCRM\cdot ERM_i + \Sigma PD_i\cdot td_i\cdot XO_i \end{aligned} \quad (19)$$

where MEU_i and MRM_i are imports from US and ROW respectively, and EEU_i and ERM_i are exports to US and ROW respectively.

E) INVESTMENT EQUATIONS

-Equality between savings and investment

$$TINV = sp\cdot RP + sg\cdot RG + FEU\cdot TCEU + FRM\cdot TCRM \quad (20)$$

where sp y sg are the income shares that households and government save, FEU and FRM are the US and ROW external savings, expressed in dollars.

-Investment by sector of destination

$$Y_i = par_i\cdot TINV \quad (21)$$

where par_i is the share of sector i in total investment demand.

F) CONSUMPTION EQUATIONS

-Private consumption of commodity i

$$CP_i = parp_i \cdot (1-sp) \cdot RP/P_i \quad (22)$$

where $parp_i$ is the parameter associated to commodity i in the utility function.

-Government consumption of commodity i

$$CG_i = parg_i \cdot (1-sg) \cdot RG/P_i \quad (23)$$

where $parg_i$ is the parameter associated to commodity i in the government consumption function.

G) INTERMEDIATE DEMAND

-Intermediate demand

$$V_i = \Sigma\, a_{ij} \cdot XO_j \quad (24)$$

H) EXTERNAL SECTOR

-Export demand functions to US

$$EEU_i = EEUF_i\ (PEU_i/PWEEU)^{elaeui} \quad (25)$$

where $EEUF_i$ is US demand for commodity i if US and Mexican export prices were equal, and $elaeu_i$ is the US price elasticity of demand for commodity i produced domestically.

-Export demand functions to ROW

$$ERM_i = ERMF_i\ (PRM_i/PWERM_i)^{elarmi} \quad (26)$$

where $ERMF_i$ is ROW demand for commodity i if ROW and Mexican export prices were equal, and $elarm_i$ is the ROW price elasticity of demand for commodity i produced domestically.

-Demand functions for imports from US

$$MEU_i = [(\beta_i \cdot PD_i)/(\alpha_i \cdot PMEU_i)]^{\sigma-1} \cdot D_i \quad (27)$$

where D_i is the internal demand for domestic commodity i.

-Demand Functions for imports from ROW

$$MRM_i = [(\tau_i \cdot PD_i)/(\alpha_i \cdot PMRM_i)]^{\sigma-1} \cdot D_i \quad (28)$$

I) DEMAND EQUATIONS

-Internal demand for domestic commodity i

$$D_i = RU_i(Y_i + CP_i + CG_i + V_i) \tag{29}$$

where RU_i is the ratio of domestic use. It indicates the share of domestic demand of composite commodity i in total demand of composite commodity i.

$$RU_i = \delta_i^{-1/\sigma}[\alpha_i + \beta_i(\alpha_i \cdot PMEU_i/\beta_i \cdot PD_i)^{\sigma/(\sigma-1)} + \tau_i(\alpha_i \cdot PMRM_i/\tau_i \cdot PD_i)^{\sigma i/(\sigma i-1)}]^{-1/\sigma i} \tag{30}$$

-Total demand for domestic commodities

$$XD_i = D_i + EEU_i + ERM_i \tag{31}$$

J) EQUILIBRIUM CONDITIONS

-Equilibrium in the labor market

$$L = \Sigma L_i \tag{32}$$

-Equilibrium in the capital market

$$K = \Sigma K_i \tag{33}$$

-Equilibrium in the commodity markets

$$XO_i = XD_i \tag{34}$$

-External equilibrium with US

$$FEU = \Sigma PEU_i \cdot MEU_i - \Sigma PWEEU_i \cdot EEU_i \tag{35}$$

-External equilibrium with ROW

$$FRM = \Sigma PRM_i \cdot MRM_i - \Sigma PWERM_i \cdot ERM_i \tag{36}$$

APPENDIX B

1. AGRICULTURE

   Agriculture
   Livestock
   Forestry
   Fishing and hunting

2. MINING

   Coal products
   Metal ore mining
   Other mining
   Quarrying
   Other metal ore mining

3. PETROLEUM

   Petroleum extraction & natural gas
   Petroleum products
   Basic petrochemicals

4. FOOD PROCESSING

   Meat and dairy products
   Processed fruits and vegetables
   Milling of wheat and their products
   Milling of corn and their products
   Processing of coffee
   Sugar and products
   Oils and fats
   Food for animals
   Other processed food

5. BEVERAGES

   Alcoholic beverages
   Beer
   Soft beverages

6. TOBACCO

   Tobacco and products

7. TEXTILES

   Soft fiber textiles
   Hard fiber textiles
   Other textiles

8. WEARING APPAREL

Wearing apparel

9. LEATHER

Leather and products

10. WOOD

Manufacturing wood
Other wood industries

11. PAPER

Paper products
Printing and publishing

12. CHEMICALS

Basic chemicals
Fertilizers
Synthetic fibers
Drugs and medicines
Soaps and detergents
Other chemical industries

13. RUBBER

Rubber products
Plastic products

14. NON METALLIC MINERAL PRODUCTS

Glass products
Cement
Other non metallic mineral products

15. IRON AND STEEL

Steel mills

16. NON FERROUS METALS

Non ferrous basic industries

17. METALLIC PRODUCTS

Metallic furniture
Metallic structures
Other metallic products

18. NON ELECTRICAL MACHINERY

Machinery and non electrical equipment

19. ELECTRICAL MACHINERY

Electrical machinery
Electrical appliances
Electronic equipment
Other electrical products

20. TRANSPORT EQUIPMENT

Motor vehicles
Motor parts
Other transport equipment

21. OTHER MANUFACTURES

Other manufacturing industries

22. CONSTRUCTION

Construction

23. ELECTRICITY

Electricity, gas and water

24. COMMERCE, RESTAURANTS AND HOTELS

Commerce
Restaurants and hotels

25. TRANSPORT AND COMMUNICATIONS

Transport
Communications

26. FINANCIAL SERVICES AND INSURANCE SERVICES

Financial services
Dwellings

27. OTHER SERVICES

Professional services
Educational services
Medical services
Recreational and cultural services
Other services.

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