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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 that address the issue of trade liberalization, welfare effects are very small.1/ 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 international trade and industrial organization.2/ Although not as fast as the

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1/ See Shoven and Whalley [1984] for a literature survey on applied general equilibrium models.
2/ See Helpman and Krugman [1986].

theory, applied general equilibrium modelers have started to work in that direction.3/

This paper attempts to evaluate the effects that an eventual free trade agreement (FTA) between Mexico, Canada and United States would have on the Mexican economy, in the presence of scale economies and imperfect competition in the Mexican industry. The way of modeling economies of scale follows the lines of the Harris [1984] 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 advantage is not enough to explain the volume and direction of trade.4/

Likewise, it is convenient to mention that the results presented in this document refer to an scenario in which all trade barriers with North America are removed. Nonetheless, the way in which the model has been specified enables us to simulate not only different degrees of removal of trade barriers but also different ways in which the Mexican

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3/ See Harris [1984].
4/ On this point see, for instance, Casar et al [1990].

economy could react, that is, different closure rules. The realism of these different reactions, however, remains open to discussion.

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 presents some results. Section 3 comments on possible extensions of the model. Finally, Section 4 contains some concluding remarks.

1 TRADE POLICY AND INDUSTRIAL ORGANIZATION IN MEXICO

1.1 Trade Policy

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.5/

Unlike other Latin American countries, whose strategy was also to follow an "inward-oriented" policy based on high levels of tariffs, 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.6/

5/ 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]).

6/ 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.

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 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), and 100 percent in 1982.

Together with a policy of fix nominal exchange rate for over a period of 23 years and a growing public sector intervention, such a policy, although successful in achieving some degree of industrialization, did not take into consideration efficiency and opportunity costs. Indeed, this strategy led to a very distorted scenario in which prices no longer reflected opportunity costs, and the relative price structure of the 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. 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

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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]).

requirements 8/ and a reduction of the number of items covered by official prices.9/

The second stage is marked by Mexico joining the GATT in 1986, which strengthened the trade 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.

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. Thus, for instance, the trade weighted average tariff fell from 25

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.
9/ 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 commercial value. In 1986, for instance, duties on approximately 1,000 items were calculated on an official price.

percent in 1985 to 10 percent in 1990. Likewise, whereas in 1986 35 percent of Mexican import value were subject to the licensing requirement, in 1990 only 230 categories (out of nearly 12,000) were subject to this requirement.10/

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 the industrial structure behavior is far from being perfectly competitive, at least for some sectors.

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

As a whole, the industrial structure was the result of three decades of explosive growth since the volume of production duplicated every ten years.11/ The process,

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10/ These 230 controlled categories belong, basically, to a few sectors: agriculture, auto parts, pharmaceutical products, petrochemicals, apparel, wood and wood products.
11/ See Casar et al [1990].

however, resulted, in some cases, in sectors where a few large firms were dominant.12/

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 13/. 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 77 percent. The differentiated oligopolies contribute 12

12/ 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. Private national firms, in addition to collaborating with foreign firms, consolidated their position in the production of traditional goods, such as food, beverages, textiles, construction and, in a lesser extent, steel and chemicals.

13/ 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.

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 imperfectly competitive scenario where a few large firms produce the most sophisticated intermediate, capital, and durable consumer goods. It seems that the less sophisticated the commodity produced is, the larger the number of firms in a sector.

2 THE MODEL

2.1 Overview of the Model

The structure of the model is outlined in Table 1. With some exceptions, notably the introduction of economies of scale and imperfect competition, the assumptions of the model resemble very much 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 and imperfect competition. The more technical details are shown in Appendix A where the underlying equations of the model are presented.

The model is calibrated around a Social Accounting Matrix (SAM) of the Mexican economy for the year 1985. As mentioned in Table 1, domestic and imported commodities are assumed to be imperfect substitutes and modeled with the Armington assumption.14/ On the export side, domestic production and exports (both to North-America and rest of the world) are modeled with constant elasticity of transformation (CET) functions.15/ That is, we assume that the producer maximizes its income distributing output among the different markets (domestic and foreign). The obvious advantage of this

14/ See Armington [1969].
15/ For a derivation of this CET function see Appendix A.

TABLE 1
General Characteristics of the 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 are mobile between sectors (see Section 2.4 for the different closure rules adopted). It is assumed one consumer and three regions: Mexico, the rest of the world (ROW), and North-America (NA) (which includes US and Canada). It is important to stress that the model is not fully general equilibrium since only the Mexican economy is explicitly modeled (the other regions are modeled only in the sense that we postulate a demand for imports from NA and ROW as well as a demand for Mexican exports in the two regions).

3.- Production. All production activities combine intermediate inputs in fixed proportions but are allowed for some degree of substitution between domestic and foreign commodities. They also combine labor and capital by means of a Cobb-Douglas production function to generate net output which, in turn, combines in fixed proportions with intermediate inputs.

4.- Foreign Trade. Each sector produces a share for domestic markets and export the remaining share to North-America and ROW. Exported commodities face a downward slopping demand curve which depends, among other things, on a price elasticity of demand. Production is split between these three possible destinations according to a constant elasticity of transformation (CET) function, which enables us to differentiate between domestic and exported commodities (in the present version an infinite elasticity of transformation is assumed). 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 numeraire is taken to be the consumer price index. (See Section 2.4 for different closure rules regarding balance of payments, exchange rate, and factor markets).

5.- Final Demand. There is a single representative consumer which demands goods according to a Cobb-Douglas utility function. The same assumption is adopted for government and investment expenditures.

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specification is that, by assigning different values to the elasticity of transformation, it is possible to differentiate commodities according to the market of destination. In the present version we assume that commodities sold in domestic markets and commodities exported are the same (infinite elasticity of substitution).16/

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 or value added combine in fix proportions.

The income received by factors of production, in the model, is divided, in fixed shares, between consumption, savings, and payment of taxes (both direct and indirect). There is only one representative consumer who takes two decisions; first, he decides the proportions to consume between domestic and foreign commodities and, as a second decision, he maximizes his utility level consuming composite commodities according to a Cobb-Douglas utility function. The same behavior is assumed for government expenditure. Domestic and foreign savings determine the level of

16/ The opposite extreme is zero, which amounts to assume that commodities sold in different markets are different commodities. Obviously, between these two extremes a whole range of elasticity values can be assumed depending on the degree of differentiation.

investment. Both factors of production, capital and labor, are perfectly mobile between sectors.17/

It is important to mention that, for the purposes of using the present model for analyzing the potential impact of an FTA between Mexico and North- America, the base benchmark equilibrium was calibrated using the level of tariffs of the year 1989 which, as we have seen, were substantially lower than the level of tariffs that prevailed in 1985, year for which the SAM was built.

2.2 Modeling Economies of Scale and Imperfect Competition

In modeling economies of scale we have followed the assumptions of the Harris [1984] model.18/ That is, we have assumed that some firms, in some industrial activities, behave as non competitive. Essentially, we have three types of industries: competitive, regulated, and non competitive. (See Table 2 to identify industry classification). In the competitive industries constant returns to scale are assumed. Insofar as the regulated industries, which in the present enquiry corresponds to the petroleum sector, we assume that the producer determines the price considering elements other than marginal costs which, for the purposes of the model, are exogenous. That is, both the quantity produced and the domestic price are fix and, therefore, the

17/ As it will be explained, in one version it will also be assumed that capital is mobile between countries.
18/ See also Harris [1986].

quantity exported is a residual once the domestic demand has been satisfied. Finally, in the case of non competitive industries we assume that firms, whose number is endogenous, use a fixed bundle of capital and labor, which can be interpreted as the costs involved in setting up a plant. A fixed cost is thus involved and, in the long run, average cost is declining everywhere. Thus, for a given level of output, X, total costs are

$$C = F(w,r) + V(P,w,r,)X \qquad (1)$$

where $F(\cdot)$ is fixed cost, which depends on the prices of labor and capital, and V is variable cost, being a function of prices of intermediates, P, as well as prices of labor and capital. Therefore, average cost is total cost divided by the level of output, X.

$$AC = F/X + V \qquad (2)$$

Thus, as the level of production increases, there is a gain in efficiency since average cost declines. As will be explained later, for each non competitive industry in the model, the degree of unexploited scale economies is measured as the ratio of marginal to average costs.

Following Harris [1984], two pricing behaviors are assumed. First, a modified Cournot-Chamberlain equilibrium

at the industry level is assumed, where firms set prices conditional on an elasticity of a perceived demand curve, according to the Lerner rule 19/

$$[(P-MC)/P] = 1/|n| \qquad (1)$$

where the degree of deviation between price and marginal cost is inversely related to the perceived elasticity of demand. Note that for this rule to be valid it is necessary that $|n| > 1$.

Freedom of entry and exit of firms guarantees zero economic profits in all industries so that price equals average cost. Naturally, for this adjustment to take place it is necessary to assume that there are no barriers to entry of firms, other than fix costs.

The second pricing rule attempts to capture the existence of an oligopolistic market which, as we saw, characterizes the industry in Mexico. This rule follows the Eastman-Stykolt model of protected oligopolies.20/ According to this model, domestic firms set prices in a collusive manner around a focal point price, which is determined as the international price plus the tariff. A removal of tariffs,

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19/ Notice that the model is not pure Cournot type since we assume that demand is evenly shared by all firms in the industry.
20/ See Eastman and Stykolt [1960].

therefore, leads to an immediate reduction of the domestic price. Naturally, the degree of collusion will determine the extent to which the domestic price falls. Therefore, as it will be explained, it will be necessary to define a particular value for this parameter. It is important to mention that, for the purposes of the present model, we considered North American prices as reference, rather than the prices of the rest of the world, thus recognizing that United States is, by and large, Mexico's main commercial partner which, no doubt, can be seen as a large economy compared to Mexico.

Together with the assumption of free entry and exit of firms, these two pricing behaviors make the adjustment of the economy very different from Walrasian models when trade liberalization takes place. Indeed, in the context of imperfect competition, an external change that causes the markup to be lower implies that some firms must leave the industry (since profits are negative) with the result that fewer firms serve a larger market at lower unitary costs. Compared to Walrasian models, thus, there is an additional efficiency gain.

2.3 Parameter Values

Four set of parameter values are required to solve the model. They are, elasticities of substitution between

domestic and imported commodities (σ), export demand elasticities (β), inverse scale elasticities (δ), and the weight attached to the two pricing rules adopted in the model. Table 2 reports values for the first three sets of elasticities. It is important to mention that the values of σ and β are guess estimates.

TABLE 2
Elasticity Values

	σ	β	δ
Agriculture	3.0	2.0	competitive
Mining	0.5	2.0	competitive
Petroleum	0.5	3.0	regulated
Food	1.125	2.0	0.85
Beverages	1.125	2.0	0.71
Tobacco	-	2.0	0.72
Textiles	1.125	2.0	0.78
Wearing apparel	1.125	3.0	0.84
Leather	1.125	3.0	0.82
Wood	1.125	3.0	0.89
Paper	0.5	3.0	0.62
Chemicals	0.5	3.0	0.68
Rubber	0.5	3.0	0.71
Non-metallic prod	0.5	3.0	0.75
Iron and Steel	0.5	3.0	0.83
Non ferrous met	0.5	3.0	0.75
Metallic prods.	0.5	3.0	0.83
Non elect. mach.	0.375	3.0	0.98
Elect. mach.	0.375	3.0	0.55
Transp. equip.	0.375	3.0	0.66
Other manufac.	0.375	6.0	0.85
Construction	- -	2.0	competitive
Electricity	- -	2.0	competitive
Commerce, Hotels	- -	2.0	competitive
Transp. & comm.	- -	2.0	competitive
Financial serv.	- -	2.0	competitive
Other services	- -	2.0	competitive

σ = Elasticity of substitution (domestic-imported)
β = Export demand elasticity
δ = Inverse scale elasticity

Insofar as the values of inverse scale elasticities they were approached following calculations carried out by Hernandez [1985]. He estimated what he calls net scale economies at the industry level, which measures the extent to which economies of scale are exploited (see Chapter VIII).21/ Finally, a decision had to be taken as to what weight should be given to the two pricing rules. Unfortunately, there is nothing in the literature on this point. Therefore, we shall present results attaching a fifty percent weight to each rule 22/ and, at the end, we shall carry out some sensitivity analysis by changing the weights.

2.4 Results

The results presented in this section correspond to a bilateral 100 percent tariff reduction with North America. Table 3 shows the Mexican tariff levels used in the benchmark equilibrium.

21/ Estimations based on the 1975 industrial census.
22/ As Harris [1986] does.

TABLE 3
Benchmark Equilibrium Tariffs

Commodity	Tariff(%)
Agriculture	2.2
Mining	4.4
Petroleum	2.1
Food	7.8
Beverages	15.5
Textiles	12.7
Wearing apparel	19.9
Leather	17.9
Wood	15.3
Paper	3.5
Chemicals	8.3
Rubber	15.0
Prods. of non metallic minerals	15.0
Iron and steel	7.1
Non ferrous metals	6.8
Metallic products	15.7
Non electrical machinery	12.5
Electrical machinery	14.5
Transport equipment	14.8
Other manufactures	30.2

We present three different versions of the model changing in each version the closure rule. It is important to mention, however, that in all the three versions the assumption of perfect mobility of capital and labor between sectors is maintained. The main features of these three versions are briefly described as follows.

In version one we assume unemployment in the labor market and therefore the real wage is fixed. That is, the level of employment is endogenously determined. On the other hand, the quantity of capital is assumed to be fixed and hence, this factor market clears through movements of the price of capital. Thus, we assume full employment of capital. Insofar

as trade balance, the assumption in this first version is that it is fixed and therefore the real exchange rate adjusts to accommodate changes in domestic vs. foreign prices.

Version two is very similar to version one except for the fact that in this second version trade balance is allowed to change and therefore the real exchange rate is fixed. Note that the implicit assumption of this second version is that Mexico can borrow abroad without any restriction in order to finance any resulting deficit.23/

Finally, in version three we assume full employment in the labor market so that now the variable that clears the market is the wage. Insofar as capital is concerned we adopted the assumption that its price is fixed as the world rental rate.24/. Naturally, to justify this scenario it is necessary to assume that capital is mobile not only between sectors but also between countries. Notice that this assumption implies that Mexicans have a fix capital endowment and, therefore, if the level of economic activity expands, the additional capital is assumed to be owned by foreigners. It is important to mention that, in order to run this third version of the model, it was necessary to modify

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23/ Obviously, since the country can borrow abroad, requires that we formulate an intertemporal estimation at present value in the budget constraint.
24/ This assumption was originally adopted by Harris [1984].

the benchmark equilibrium since any surplus (deficit) in the current account balance was interpreted as a reduction (increase) in the capital endowment of Mexicans. To be consistent with this scenario we assumed a variable trade balance and a fix real exchange rate.

In summary, then, we have three different versions of the model. Versions one and two attempt to determine the effects of an FTA in the presence of excess capacity in the labor market and a fix quantity of capital. Insofar as version three, the main purpose is to get an insight as to how an eventual capital inflow would influence the effects of an FTA. A common feature of the three scenarios, however, is the presence of economies of scale and imperfect competition in some industrial activities. Table 4 summarizes the main features of each version.

TABLE 4
CLOSURE RULES ADOPTED IN THE DIFFERENT VERSIONS OF THE MODEL

MODEL ASSUMPTIONS	VERSION ONE	VERSION TWO	VERSION THREE
CAPITAL STOCK	FIXED AND FULLY EMPLOYED		VARIABLE AND MOBILE BETWEEN COUNTRIES
EXCHANGE RATE	VARIABLE	F I X E D	
TRADE BALANCE	F I X E D	V A R I A B L E	
WAGE	F I X E D		VARIABLE

Moving now on to the analysis of results, it can be seen from Table 5 a summary of the main aggregate effects in each of the three versions. To keep the same order in the exposition we shall first make some comments on the results of version one.

TABLE 5
SUMMARY OF RESULTS
(Percent changes)

	VERSION 1	VERSION 2	VERSION 3
WELFARE	2.0	2.3	2.4
GDP	1.7	1.9	8.0
WAGE	0.0	0.0	16.2
EMPLOYMENT	5.1	5.8	0.0
RATE OF PROFITS	6.2	6.6	0.0
TRADE BALANCE	0.0	5.6	18.3
TRADE BALANCE (NA)	0.0	7.1	18.9
TRADE BALANCE (ROW)	0.0	2.1	17.1
EXCHANGE RATE (NA)	3.0	0.0	0.0
EXCHANGE RATE (ROW)	0.3	0.0	0.0

Starting with the first column of Table 5, it can be seen that in version one the welfare gain is 2.0 25/ percent, GDP goes up by 1.7 percent, employment raises 5.1 percent and, finally, the price of capital increases 6.2 percent. Since an initial condition in this version was to maintain the trade balance fixed, the real exchange rate becomes an adjusting variable; it depreciates 5.1 percent on average.

Table 6 shows much more detailed sectorial results of this first version. Looking at column two, it can be

25/ Welfare changes are computed with the so-called equivalent variation. That is, we compute income and prices in the benchmark equilibrium and calculate the income needed to reach the utility level of the solution equilibrium.

appreciated that, with the exception of petroleum, all production activities expand.

TABLE 6
VERSION ONE
SECTORIAL EFFECTS
(Percent changes)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Agriculture	3.4	1.5	3.2	-6.4	10.1	12.1	0.3	6.6
Mining	2.6	1.2	0.6	-5.3	4.5	3.7	-0.6	5.5
Petroleum	0.1	0.0	-2.5	0.7	0.4	0.8	-	0.0
Food	-3.9	2.2	8.5	-4.0	2.7	-2.6	1.2	7.5
Beverages	-7.7	2.4	12.7	-0.3	6.1	-6.9	0.9	7.2
Tobacco	2.7	2.1	21.9	-4.7	0.0	0.0	0.6	6.8
Textiles	-6.4	3.2	22.2	0.5	5.3	-5.0	1.2	7.5
Wearing app.	-6.2	3.5	59.4	2.9	12.5	-5.3	1.8	8.1
Leather	-0.9	2.6	40.6	3.1	6.8	-	0.4	6.7
Wood	-7.7	2.5	9.1	-3.5	6.2	-6.6	1.3	7.6
Paper	-1.6	1.9	13.1	1.5	1.1	0.8	0.3	6.6
Chemicals	-4.0	2.5	16.9	0.9	2.5	-0.1	1.0	7.3
Rubber	-7.5	2.6	38.6	0.2	3.9	-1.7	0.8	7.1
Non met. min.	-7.5	2.8	13.5	-3.9	3.9	-1.7	1.5	7.9
Iron & steel	-3.2	3.7	17.1	1.1	3.5	1.4	1.9	8.3
Non ferr. met.	-0.7	2.7	9.9	-5.0	4.6	2.6	1.3	7.6
Metallic prods	-7.8	2.9	18.6	-0.5	4.3	-1.7	0.9	7.2
Non elec.mach	-5.8	3.7	14.2	-2.2	3.6	0.1	1.9	8.2
Electr. mach	-6.8	5.1	24.9	3.1	3.7	-0.3	2.7	9.1
Transp. equip	-7.0	5.3	16.8	6.0	4.2	0.0	3.4	9.8
Other manuf	-14.8	3.6	14.0	-5.2	5.8	-5.9	2.4	8.8
Construction	-0.6	2.6	0.0	0.0	0.0	0.0	-1.3	4.7
Electricity	2.7	1.6	0.5	0.0	1.6	0.0	-0.4	5.7
Commerce	4.2	1.6	-2.2	0.0	2.1	0.0	0.4	6.7
Transport	3.1	1.7	0.0	0.0	1.9	0.0	0.0	6.2
Financial serv	4.1	1.5	-2.1	0.0	1.6	0.0	0.1	6.3
Other services	2.0	0.1	2.1	0.0	0.1	0.0	-3.1	2.9

Note: Columns are as follows. (1) = composite good price, (2) = gross output, (3) = exports to NA, (4) = exports to ROW, (5) = imports from NA, (6) = imports from ROW, (7) = capital, (8) = employment.

TABLE 7
VERSION TWO
SECTORIAL EFFECTS
(Percent changes)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Agriculture	3.4	1.0	-3.0	-7.2	20.7	13.2	-0.1	6.4
Mining	2.4	1.4	-5.4	-5.9	7.6	5.3	-0.5	5.9
Petroleum	-0.1	0.0	-2.2	0.0	2.1	1.1	0.0	0.0
Food	-3.9	2.2	2.1	-4.6	6.4	-2.1	1.1	7.7
Beverages	-7.6	2.6	6.1	-0.8	10.1	-6.3	1.0	7.7
Tobacco	2.7	2.4	14.7	-5.3	0.0	0.0	0.8	7.4
Textiles	-6.4	3.1	15.1	0.0	9.0	-4.6	1.0	7.6
Wearing app.	-6.3	3.3	45.6	2.0	16.7	-4.8	1.6	8.3
Leather	-9.0	2.8	28.4	2.2	10.8	0.0	0.4	7.8
Wood	-7.7	3.7	-0.5	-4.5	11.4	-5.0	2.4	9.1
Paper	-1.8	1.9	3.7	1.0	2.7	1.0	0.2	6.8
Chemicals	-4.2	2.5	7.1	0.3	4.4	0.3	0.9	7.6
Rubber	-7.6	2.8	26.8	-0.4	5.8	-1.2	0.9	7.5
Non met. min.	-7.5	4.1	3.6	-4.9	7.4	0.2	2.7	9.4
Iron & steel	-3.5	5.6	7.5	0.7	7.3	3.7	3.7	10.6
Non ferr. met.	-1.3	3.4	0.7	-5.6	7.1	3.6	1.9	8.6
Metallic prods	-8.1	4.0	8.6	-1.1	7.3	-0.2	1.9	8.6
Non elec.mach	-6.8	5.3	4.6	-2.8	7.6	3.0	3.3	10.1
Electr. mach	-7.1	5.3	14.5	2.7	6.8	1.4	2.9	9.7
Transp. equip	-7.4	5.1	7.4	5.8	7.0	1.6	3.1	9.8
Other manuf	-15.4	2.9	4.0	-6.1	8.3	-5.0	1.6	8.3
Construction	-0.6	6.4	0.0	0.0	0.0	0.0	2.9	8.8
Electricity	2.8	1.9	-5.4	0.0	0.0	0.0	-0.2	6.3
Commerce	4.3	1.4	-8.2	0.0	0.0	0.0	0.2	6.7
Transport	3.0	1.7	-6.0	0.0	0.0	0.0	-0.1	6.4
Financial serv	4.3	1.7	-8.1	0.0	0.0	0.0	0.2	6.8
Other services	2.0	0.2	-4.0	0.0	0.3	0.0	-3.2	3.1

Note: Columns are as follows. (1) = composite good price, (2) = gross output, (3) = exports to NA, (4) = exports to ROW, (5) = imports from NA, (6) = imports from ROW, (7) = capital, (8) = employment.

TABLE 8
VERSION THREE
SECTORIAL EFFECTS
(Percent changes)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Agriculture	1.6	3.6	0.5	-3.7	17.0	9.7	6.6	-8.2
Mining	2.7	16.1	-6.1	-6.6	28.0	25.2	21.7	4.7
Petroleum	-0.1	0.0	-8.9	0.0	5.4	4.3	0.0	0.0
Food	-3.9	3.3	5.3	-1.6	7.5	-1.2	5.9	-8.8
Beverages	-7.6	3.5	7.2	0.1	11.1	-5.5	7.3	-7.7
Tobacco	2.0	3.4	16.3	-4.0	0.0	0.0	7.5	-7.5
Textiles	-6.4	5.5	15.3	0.1	11.7	-2.2	10.6	-4.7
Wearing app.	-6.3	4.7	47.0	3.0	18.2	-3.5	9.0	-6.1
Leather	-9.0	4.3	27.1	1.2	12.6	0.0	10.2	-5.1
Wood	-7.7	17.2	3.5	-0.7	26.3	7.6	20.8	3.9
Paper	-1.8	6.9	4.2	1.5	7.8	6.0	11.2	-4.3
Chemicals	-4.2	7.9	8.1	1.2	10.1	5.8	11.8	-3.7
Rubber	-7.6	9.7	27.6	0.2	13.0	5.4	14.6	-1.3
Non met. min.	-7.5	20.5	6.1	-2.6	25.4	16.9	24.4	7.0
Iron & steel	-3.5	30.1	7.6	0.8	33.1	28.6	35.7	16.7
Non ferr. met.	-1.3	19.5	2.0	-4.4	24.2	20.4	23.7	6.4
Metallic prods	-8.1	19.4	8.1	-1.5	23.8	15.1	25.4	7.9
Non elec.mach	-6.8	30.5	4.7	-2.7	36.5	30.6	36.6	17.5
Electr. mach	-7.1	18.9	14.2	2.4	24.0	17.8	25.7	8.2
Transp. equip	-7.4	19.7	7.4	5.8	25.8	19.5	25.3	7.8
Other manuf	-15.4	11.1	8.0	-2.5	17.9	3.3	14.4	-1.5
Construction	2.8	38.4	0.0	0.0	0.0	0.0	52.8	31.4
Electricity	3.4	7.3	-6.6	0.0	0.0	0.0	13.0	-2.7
Commerce	2.8	6.6	-5.5	0.0	0.0	0.0	9.8	-5.5
Transport	3.0	5.6	-6.1	0.0	0.0	0.0	10.3	-5.1
Financial serv	3.5	3.6	-6.7	0.0	0.0	0.0	7.3	-7.6
Other services	6.5	0.0	-11.9	0.0	2.0	0.0	10.4	-4.9

Note: Columns are as follows. (1) = composite good price, (2) = gross output, (3) = exports to NA, (4) = exports to ROW, (5) = imports from NA, (6) = imports from ROW, (7) = capital, (8) = employment.

The intersectorial factor movements are described in columns seven and eight in Table 6. It can be seen that all sectors use more labor, which is explained by the fact that its price is fixed so that a substitution of capital for labor may have taken place. Notice that the increase in the demand for labor is particularly strong in the manufacturing sectors. This is not surprising if we remember that these sectors have the opportunity of realizing economies of scale. Insofar as capital is concerned, although in aggregate the total quantity of capital remains unchanged, some capital shifts between sectors takes place. While in most sectors the demand for capital increases in some of them, such as mining, construction, electricity, and other services, the use of capital diminishes.

The evolution of trade is described in columns three to six in Table 6. Exports to North America are shown in column three whereas exports to the rest of the world appear in column four. As can be seen, in almost all of the so called traded commodities exports go up and, in particular, the increase in exports to North America in sectors such as leather, wearing apparel, electrical machinery, and rubber is very strong. With the exception of food processing and wood, in the remaining manufacturing activities the increases are of two digits. Exports to the rest of the world, although less pronounced, also register increases of considerable magnitude. It would appear that an important

element explaining the behavior of exports is the possibility of realizing economies of scale in the foreign markets.

The changes in the level of imports are less pronounced. The results may be suggesting some trade diversion in favor of North America. This could explain the fact that in some cases imports from the rest of the world fall. Obviously, in those cases where the elasticity of substitution between domestic and imported commodities is high, the substitution in favor of North America is higher. That seems to be the case of commodities such as food processing, beverages, textiles, wearing apparel, and some others.

Finally, column one of Table 6 shows the price changes of composite commodities, which, are the prices consumers face. It can be seen that price reductions, especially in the manufacturing sectors, are significant whereas in the case of the so called non traded commodities and in general in the competitive industries, prices go up.

The summary of results of version two are shown in column two of Table 5. This second version, as already explained, is very similar to version one, the only difference being that in this second version the trade balance is variable whereas the real exchange rate is assumed to be fixed. The results are, therefore, not very different. Welfare

increases by 2.3 percent while GDP goes up 1.9 percent. The level of employment rises 5.8 percent and the price of capital increases 6.6 percent. Thus, in general, the results are in the same direction as in version one although slightly greater in this second version.

Perhaps the only significant difference is that now the trade balance deteriorates 5.6 percent, which seems a reasonable result if we keep in mind that the average tariff level in Mexico is higher than North American tariffs on Mexican exports.

The sectorial results are shown in Table 7. It can be seen that the results are also very similar to version one although in this second version the increases in exports are less pronounced. Nonetheless, they still are of considerable magnitude.

The adjustment of the economy in the third version is, undoubtedly, of very different nature. This is so because of the specifications adopted in the factor markets. Indeed, looking at the third column of Table 5 it can be appreciated that whereas the welfare gain is close to the two previous versions (2.4%), the raise in GDP is considerably greater (8.0%).

The reason behind this result lies, obviously, on the assumption that the capital endowment of Mexicans is fixed so that, although the economy can easily expand because of the fact that the price of capital is fixed, the income generated by the use of additional capital goes to foreigners. Therefore, although Mexicans benefit from the expansion of the level of the economic activity, the additional income is not received by them.

Another interesting result is that the wage rate increases 16.2 percent whereas the trade balance registers a 18.3 percent deterioration.

The sectorial adjustment is also of very different nature when compared with the two previous versions. They are shown in Table 8. Several points deserve to be mentioned. First, as can be seen from column two, the expansion of the level of economic activity of the production sectors is stronger, particularly in the sectors where the capital-labor ratio is higher. This is the case, for instance, of sectors such as iron and steel, non electrical machinery, and construction.26/

26/ It is likely that these results may be overestimated because of data deficiencies. This is so because a common practice in collecting data for Mexican National Accounts is that, whenever a small business is run by a family whose members are not receiving an explicit salary, the implicit salary is registered as operating surplus. Unfortunately we have no empirical evidence of the magnitude of error.

The second point to notice is that, in the factor markets, the allocation of resources is also different. Labor, for instance, experiences strong intersectorial shifts whereas, on the other hand, the use of capital raises in all sectors. Naturally, given that the price of capital is fixed, some substitution of labor for capital takes place.

Finally, in relation to foreign trade, it can be seen that the evolution of exports follows a similar pattern to the behavior of exports in version two, where trade balance is also variable. In this third version, however, the increase in exports in most sectors is stronger.

In summary, depending on the assumptions adopted in regard to the behavior of factor markets, the adjustment of the economy can be very different. A common feature of the three versions, however, is that, as a result of trade liberalization, a fewer number of firms serve a larger market and use factors of production more efficiently. It would appear that sectors that do better are precisely those where the potential for realizing economies of scale is greater, particularly in the export markets.

2.4.3 Sensitivity Analysis

As it has already been mentioned, the results of the model are not very sensitive to the values of the elasticities of substitution between domestic and imported goods neither to the export demand elasticities. Although not reported here, we conducted the same set of experiments doubling the value of these parameters, and the results were not very different. A parameter which seems to influence the results considerably, however, is the weight attached to the Eastman-Stykolt pricing rule.

To get an idea of how sensible to this parameter the results are, we conducted some sensitivity analysis changing its value. A summary of these results is shown in Table 9. It should be mentioned that these results correspond to our third version and refer to four possible weights of the Eastman-Stykolt rule: 1.0, 0.5, 0.25 and 0.0.

TABLE 9
EASTMAN-STYKOLT WEIGHT
(Percent changes)

Eastman-Stykolt	GDP	Welfare
100	15.5	3.5
50	8.1	2.3
25	4.6	1.6
0	1.1	0.7

It can be seen that the results of the model are extremely sensible to the value of this parameter. For instance, when the weight is 1 GDP raises 15.5 percent and the welfare gain is 3.5 percent. In the opposite extreme, when the Eastman-Stykolt rule is not present GDP raises 1.1 percent and the corresponding welfare gain is 0.7 percent.

3. EXTENSIONS AND LIMITATIONS OF THE MODEL

Extensions to the present model are both, possible and desirable. Perhaps the most relevant extension is to incorporate the effects of non tariff barriers. Indeed, to the extent that the model is used to get some insight into the potential effects of an FTA, this extension becomes crucial, given the already low current level of tariffs on the three regions. It seems very likely that an FTA, if successful, will move in the direction of removing these trade barriers.

In terms of the model, a usual way out of it is to estimate the tariff equivalent level and then model the effects through the price mechanism. This option has the appeal that, once the tariff equivalent level has been estimated, it is very straightforward to model it. The obvious disadvantage is that, strictly speaking, non tariff barriers are essentially quantity rationing mechanisms. The other possibility is to explicitly incorporate this quantity rationing mechanism, thus recognizing that in the presence of QRs, a rent is generated, whose final destination is private producers.27/ This second option is not difficult to model as long as we keep the assumption that there is only one consumer in the model because, in this case, the problem

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27/ See Grais et al [1986] for an attempt to model QRs.

of allocation of rents does not exist. The only difficulty is then to estimate the tariff equivalent.

Another point is to get reliable values of parameters. Although the results do not seem to be very sensitive to these values, it nevertheless the task remains of running the model with elasticities estimated in the particular context to which the model is applied.

Finally, an intrinsic limitation of our approach is the static nature of the model. This, however, should not be seen as a limitation but, instead, as a delimitation of the analysis. That is, the main purpose of the present enquiry is to evaluate the static effects of an FTA in the presence of economies of scale and imperfect competition. No doubt a model that incorporated dynamic effects could produce very different results.

Insofar as the limitations of the model, there are many. We shall not, however, comment on the limitations of the general equilibrium approach since they are widely known in the literature. It will suffice to recognize that, on the issue of imperfect competition and scale economies, while the assumption of free entry and exit of firms may be appropriate for some industries, it is clearly not so in those industries where high entry barriers exist. The automotive industry provides a very good example of an

industry for which this assumption is not appropriate. In building highly disaggregated sectorial models, however, some realism has to be sacrificed. Whether or not the loss of realism is too much for the results to be reliable is an issue that ultimately has to be resolved on empirical grounds. Compared to a Walrasian model, however, it would appear that the present approach constitutes an step forward.

4 CONCLUDING REMARKS

The model presented here has attempted to incorporate a form of imperfect competition. The results suggest that, compared with the Walrasian general equilibrium models, additional gains from trade are present. We have seen that the magnitude of the results are, in some cases, very high.

The decision of incorporating economies of scale and imperfect competition obeys not only the recent theoretical approach focussing on these issues but also to the empirical evidence in Mexico, which suggests that the industrial sector is far from behaving as perfectly competitive.

Unfortunately the results of the model are quite sensitive to the weight attached to the two pricing rules adopted, but even in the case in which the Eastman-Stykolt assumption is not incorporated, the gains from trade are higher than the traditional general equilibrium model estimates.

Surely more sensitivity analysis is required both on issue of parameter values as well as model specification. That would give us more certainty as to how "accurate" the results are.

Perhaps the most general and important conclusion of the present study is that economies of scale matter. Indeed, a common result in all the versions presented is that, as a result of trade liberalization, a fewer number of firms will end up serving a larger market and using factors of production more efficiently.

Finally, it is important to mention that the simulations carried out here are quite arbitrary since we assumed a total removal of tariffs. No doubt the results will be very different once we get an idea of the possible direction of an FTA both in terms of which sectors are going to be liberalized as well as the magnitude of such liberalization. That will provide us with better information in order to carry out more sensible simulations.

Appendix A
Model Equations

A) PRICES

-Prices of Imports from North America (NA).

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

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

-Prices 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 in foreign currency of commodity i imported from ROW, t_{mrmi} is the corresponding tariff rate, and TCRM is the exchange rate between pesos and the currencies from ROW.

-Price of Exports to NA

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

where PD_i is the price of domestic commodity i and t_{eeui} is the corresponding subsidy on exports to NA.

-Price of Exports to ROW.

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

where t_{ermi} is the subsidy 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 is the scale parameter associated to a CES function from which the last 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 parameters associated with the commodities domestic, imported from NA and imported from ROW, 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 the tax rate on the production of commodity i and a_{ij} is 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 and K_i are the quantities of labor and capital respectively used 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 Input Demands

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

where XO_i is the gross domestic product of sector i.

-Functions for Aggregation of Inputs.

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

-Gross Output Functions

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

where v_i is a value added coefficient indicating the value added requirements by unit of production of commodity i.

C) FACTOR MARKETS

-Labor Demand

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

where r and w are the prices of capital and labor respectively.

-Labor Supply

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

-Demand for Capital by Sector

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

-Supply of Capital

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

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 income tax rate.

-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 of commodity i from NA and ROW respectively, and EEU_i and ERM_i are exports to NA and ROW.

E) INVESTMENT EQUATIONS

-Savings - Investment equality.

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

where sp and sg are the private and public income proportions devoted to savings, and FEU and FRM are foreign savings from NA and ROW respectively, 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 on total investment demand.

F) CONSUMPTION EQUATIONS

-Private Consumption of Commodity i.

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

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

-Government Consumption of Commodity i.

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

where $parg_i$ is the parameter associated to commodity i in the Cobb-Douglas utility function.

G) INTERMEDIATE DEMAND

-Intermediate Demand.

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

H) EXTERNAL SECTOR

-Function for Exports to NA

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

where $EEUF_i$ is the demand in NA for the domestically produced commodity i when prices in NA equal the prices of Mexican exports, $elaeu_i$ is the price elasticity of demand for exports to NA.

-Function for Exports to ROW

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

where $ERMF_i$ is the demand of the ROW for commodity i when the prices of our Mexican exports equal the prices in ROW.

-Functions for Imports from NA

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

where D_i is the internal demand for domestic commodities.

-Functions for Imports from ROW.

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

I) DEMAND EQUATIONS

-Demand for Domestic Commodities

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

where RU_i is the ratio of domestic use to total demand for composite commodity i. It is obtained from

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

-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 NA

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

-External Equilibrium with ROW

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

DERIVATION OF THE CET FUNCTION

Formally, it will be assumed that producers distribute their output in three markets, i, (i = 1,2,3) corresponding to the domestic, NA, and ROW markets respectively, according to a constant elasticity of transformation (CET) function, of the following form

$$Q_j^{\phi} = \Sigma\ \theta\ Q_{ji} \tag{37}$$

where θ is a distribution parameter which represents the proportions in which the commodity i is distributed within the different markets i, and the elasticity of transformation, E, is given by $[1/(1-\phi_j)]$. Thus, the problem for the producer of commodity i is to maximize its total income, $\Sigma P_i Q_{ji}$, subject to (37). That is, the problem is to maximize

$$\Sigma\ P_i Q_{ji} + \mu[Q_j^{\phi} - \Sigma\theta Q_{ji}^{\phi}\ ] \tag{38}$$

differentiating with respect to Q_{ji} gives

$$P_i = \mu\phi\theta_i\ Q_{ji}^{(\phi-1)} \tag{39}$$

and multiplying by Q_{ji}, and remembering that total income of the producer is P_jQ_j

$$\Sigma\ Q_{ji}P_j = \mu\phi\Sigma\theta_i Q_{ji}^{\phi} = \mu\phi Q_j^{\phi} = P_jQ_j \tag{40}$$

then, from (39)

$$P_i = (P_jQ_j/Q_j^{\phi})\ \theta_i Q_{ji}^{(\phi-1)} \tag{41}$$

and

$$P_i = \theta_i P_j (Q_{ji}/Q_j)^{(\phi-1)} \tag{42}$$

hence,

$$\Sigma\theta_i[P_i/P_j\theta_i]^{[\phi/(\phi-1)]} = \Sigma\theta_i(Q_{ji}/Q_j)^{\phi} = 1 \tag{43}$$

finally, solving for P_j and remembering that $E=1/(1-\phi)$

$$P_j^{(1-E)} = \Sigma\ \theta_i^{E}\ P_i^{(1-E)} \tag{44}$$

Note that if E tends to infinite the price is independent of the market in which the commodity is sold.

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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