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Impacts of Agricultural Trade Liberalisation on Households: The Case of Mexico

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Executive summary

The analysis of expenditures for different household categories within a CGE framework is a helpful instrument for economists and policy makers. This approach allows researchers to focus on the possible effects that macroeconomic changes and trade reforms might have on household categories, especially in developing countries.

This dissertation presents a new household expenditure estimation methodology and an application of it. The estimation is based on a complete household demand system, which is integrated into a household module. The complete demand system regarded in this approach is the one proposed by DEATON and MUELLBAUER (1980) the Almost Ideal Demand System in its linear version (LA/AIDS). The LA/AIDS contains a set of demand functions defining how households in function of prices and household preferences allocate commodities. The household module computes expenditure changes based on changes on prices from the GTAP model and on elasticities coming from the LA/AIDS for Mexican households.

The evaluation of household preferences shows that for non-poor households in Mexico, the decisions of purchase between food products and non-food products and services are independently made. Meanwhile, poor households try to first cover their food needs, and as a result of this, are delaying the acquisition of other goods and services.

This investigation then evaluates the effects of three different trade reforms on households' expenditures in Mexico. The results show that Mexico's efforts to reach a bilateral trade agreement with main trading partners pay off for households as prices of consumed commodities decrease driven by lower values of import commodities. Thus, the first scenario simulating 3 different Free Trade Agreements was identified as the most profitable trade setting for the poorest Mexican households because the price of staple foods decreases considerably. A restricted multilateral agreement considering a partial liberalisation (the second scenario simulating a possible outcome of the Doha Round), was found to be the most prudent and advantageous trade setting for the Mexican households as benefits will be distributed equally across more household categories. The third scenario evaluates a full trade liberalisation, and it was found to improve the performance of export sectors worldwide. The high prices brought about in Mexico might been compensated with gains for farm households, while urban households might lose. However, the inclusion of the income side is required to make conclusive statements on the real effects of a fully liberalised economy in Mexico.

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31. August 2009

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1 Introduction

1.1 Problem Statement

The current economic development in Mexico raises questions of growing concern among Mexican policy makers regarding the effects of agricultural trade policies on income and the distribution of welfare. It is important to analyse how upcoming agricultural trade agreements and national policies will affect households in Mexico. The effects of agricultural trade liberalisation on Mexican households are important, particularly when considering that in Mexico a third of households depend mostly upon the agricultural sector (INEGI, 2005a). This dependency is manifold and difficult to identify for agricultural wage earners, self consumers, net consumers and net producers. Households engaged in agricultural activities and self-consumption are not influenced directly by fluctuations in commodity market prices as households with different income sources are (RUBIO and SOLOAGA, 2004). However, for low-income households who do not produce but consume agricultural products, the price changes severely affect their budget expenditures (RUBIO and SOLOAGA, 2004). Households consuming and supplying in local markets represent a third case. Accordingly, the effects of fluctuations are variable and depend on other household characteristics. Some of these preferences will be investigated in household demand analysis.

Thus, the importance of identifying the impact of agricultural trade liberalisation on different household types is a critical issue, which must be accounted for in the design of trade policies, either to implement preventive measures within trade agreements such as the setting of sensitive products or to implement national strategies to support disadvantaged households.

It is also of particular interest to investigate to what extent agricultural trade liberalisation will promote or hinder the alleviation of poverty at the household level. Since nearly one third of the Mexican population is considered to be extremely poor, this question is especially important in Mexico (COMITÉ TÉCNICO PARA LA MEDICIÓN DE LA POBREZA, 2005). No upcoming economic policy should ignore the effects on this segment of the population in the final trade negotiations. Furthermore, there is a need for approaches that reliably forecast the effects of trade liberalisation on household expenditure patterns.

The study of the effects of trade liberalisation on different household types has not yet been completely explored. Research is either focused on the effects of trade liberalisation on macroeconomic factors or on the effects of domestic macroeconomic changes on different household types. However, research on the related effects of trade liberalisation on household expenditures and income levels is rather scarce. A key reason for this is the lack of

information related to household structures, especially how different households generate their income and expenditure patterns. Another reason is the lack of links relating household income- and expenditure structures with macroeconomic factors.

One possibility for overcoming the lack of information on household structures is to develop household demand systems. Further, the lack of linkages between household structures and macroeconomic factors is covered by the integration of the household parameters obtained from the household demand systems into Computable General Equilibrium (CGE) models (COCKBURN, 2001). CGE models are suitable instruments to analyse related effects because CGE models connect production factors within and between economic sectors. Further, these linkages can be extended to appraise interactions of markets and households through household demand systems.

The purpose of this study is to provide applied evidence on (a) whether household types in Mexico have different expenditure preferences according to their expenditure levels, (b) the integration of these expenditure preferences into a CGE model, and (c) the response of household expenditures to various scenarios simulating different agricultural trade liberalisation stages for Mexico.

These objectives are achieved first by estimating demand systems for ten household categories in Mexico. The household demand systems help us to understand household expenditure patterns. Household demand systems are calculated with time series containing information on household expenditure patterns and amounts consumed. Furthermore, these expenditure patterns are integrated into a household module. The household module adopts macroeconomic changes from a CGE model to deliver the effects on household types. The CGE model developed by the Global Trade Analysis Project (GTAP) is taken as a platform for this empirical methodology. The standard GTAP model analyses the effects of international economic changes on national economic structures. These effects are integrated into the household module to measure the changes in household expenditure patterns caused by trade liberalisation. The conception of the household module involves the integration of income, own and cross-price elasticities to obtain different reactions of households.

This research has been envisioned with the motivation of providing economists and policy makers an innovative methodology to assess interconnections between trade reforms and household reactions by measuring changes on expenditure patterns caused by the reforms. The validation of the methodology takes the case of Mexico as an example and explores the possible effects that further trade policies might have on private household categories.

1.2 Outline and Structure

The study is divided into 6 chapters. As this research focuses on the effects of trade liberalisation on Mexican households, after the introduction, Chapter 2 presents an overview of Mexico. Chapter 2 describes the main trends in agricultural production, the economy and the main characteristics of households in Mexico. These basic facts have to be explained to understand the existence and persistence of differences between household categories. The last section in Chapter 2 presents the Mexican agricultural trade liberalisation and synthesises the respective agricultural clauses of the trade agreements signed as of July 1, 2008. This last section serves as basis for ranking the importance of agricultural trade in the economic context of Mexico.

Chapter 3 turns to the theoretical basis for this study, and begins with the selection of the methodology to assess the effects of trade liberalisation on household categories coming forth from the selection of the GTAP model. Then, the GTAP framework as a methodological instrument for this research is described. Special emphasis is given to the modelling of the private household agent as a departing point to identify the important parameters for the household module. In Section 3.4, different methodologies to relate CGE models with household analysis are described and compared. This comparison gives important information on merits and caveats of recent research, which serves as introductory material for the proposed household module.

The household consumption preferences are related not only to expenditure level, but also to the share of other commodities consumed. With this purpose, Chapter 4 evaluates differences in expenditure patterns across different groups of households. The first section of the chapter underlines income and expenditure patterns in Mexico. Furthermore, the central point of Chapter 4 is the development of demand systems for household categories in Mexico. Also in this chapter, the required parameters for the construction of the GTAP module to analyse households are estimated, and the construction of the household module is finally presented in Section 4.4.

The coming Chapter 5 comprises the empirical part of this study. This chapter describes the GTAP data base version 6.2, the update of an Input Output Table (IOT) for Mexico, as well as the extensions in the GTAP model and its data base required for the implementation of the household module. Chapter 5 also includes the description of the scenarios assessing the effects of trade liberalisation on Mexican households. The presentation and interpretation of results comprise a major section of Chapter 5. The results focus comprehensively on Mexico and Mexican households. In order to check the robustness of these results, they are tested by a

triangular sensitivity analysis. This chapter concludes with the presentation of some qualifications and ideas for future improvements of the current approach. The final chapter draws the main conclusions of this study.

2 Mexico's Agricultural Sector, Trade Policy and Economic Situation

This chapter presents an introductory overview of the agricultural sector, agricultural trade policy and economic situation of Mexico. Mexico is selected mainly based on the widespread information available on households for Mexico and the country's open trade policy. These aspects are comprehensively described in this chapter. The first section describes agricultural production and trade in Mexico from 1980 to 2008. The second section depicts the economic situation of Mexico during the same period. The third section then describes the main characteristics of households in Mexico, and the last section reviews the main international trade agreements in which Mexico is involved.

2.1 Agricultural Production and Trade

Mexico, like most of the countries in Central and South America, underwent a critical debt crisis in 1982. This crisis led the Mexican government to conceive important economic reforms. In 1988, the new economic strategy reached the agricultural sector, resulting in an agricultural reform. From the 1960's to the end of the 1980's, the national economic strategy had been based on in-land protection of domestic industries and domestic agriculture through import tariffs and quotas. The protection of the agricultural sector included price supports for producers of staple crops and subsidies for agricultural inputs. Agricultural support was also given to producers in the form of credits and insurances through the State Rural Bank (Banrural) (HENRIQUES and PATEL, 2003). The government had also been giving priority to the processing of grains, oils and powders (milk) to support Mexican consumers by supplying cheap food through the National Company for Popular Subsistence (CONASUPO). CONASUPO was a state company that bought staples from producers at guaranteed prices. These products were either further commercialised or partially processed, also by CONASUPO, and sold to low-income households.

Starting in 1992, the agrarian laws were modified to reduce the number of import quotas and permits. Import tariffs were established as the main mechanism for trade regulation. The Mexican government reduced its support for consumers and producers by closing the CONASUPO. Another important modification introduced with the reform of the agrarian law was the decreasing number and amount of credits granted by the Rural Bank (Banrural) (YUNEZ-NAUNDE, 2003).

However, other programs of support conducted by the government in 1994 as a result of the new agricultural policies included the Program of Direct Payments to the Countryside (Programa de Apoyos Directos al Campo, PROCAMPO). PROCAMPO was introduced

simultaneously with the initiation of the tariff cut schedule planned as part of the North American Free Trade Agreement (NAFTA) in winter 1994 and envisaged to conclude in 2008.

PROCAMPO was conceived to establish a compensatory income transfer scheme targeted at basic crop producers. This programme also offered direct income transferred to farm households proportional to the area historically planted with one or more of the nine major staple crops. The programme's economic objective was to provide farmers and households with liquidity to adjust their income. The income of farmers was seriously affected by the agricultural reforms because of the decline of producer prices and rising prices of farm inputs. PROCAMPO also strove for other social goals such as stopping the spread of poverty in rural areas, as well as reducing population migration from rural to urban areas (GARICA-SALAZAR, 2001, MELLA and MERCADO, 2006). The nine major staple crops supported by PROCAMPO were maize, beans, soybeans, rice, wheat, sorghum, cotton, barley and cardamom. Since PROCAMPO was a direct payment based on cultivated areas, main beneficiaries of this program were major producers with large land areas (COLL-HURTADO and GODINEZ-CALDERON, 2003; HERRERA-RAMOS, 2002; SAUDOLET et al., 2001).

In 2008, a new phase in the Mexican economy began. This phase is driven mainly by two facts. First, the tariff elimination program under the North American Trade Agreement (NAFTA) scheme was completed, including the elimination of tariffs for sensitive products for Mexico, Canada and the USA. Second, the direct transfer program PROCAMPO came to an end.

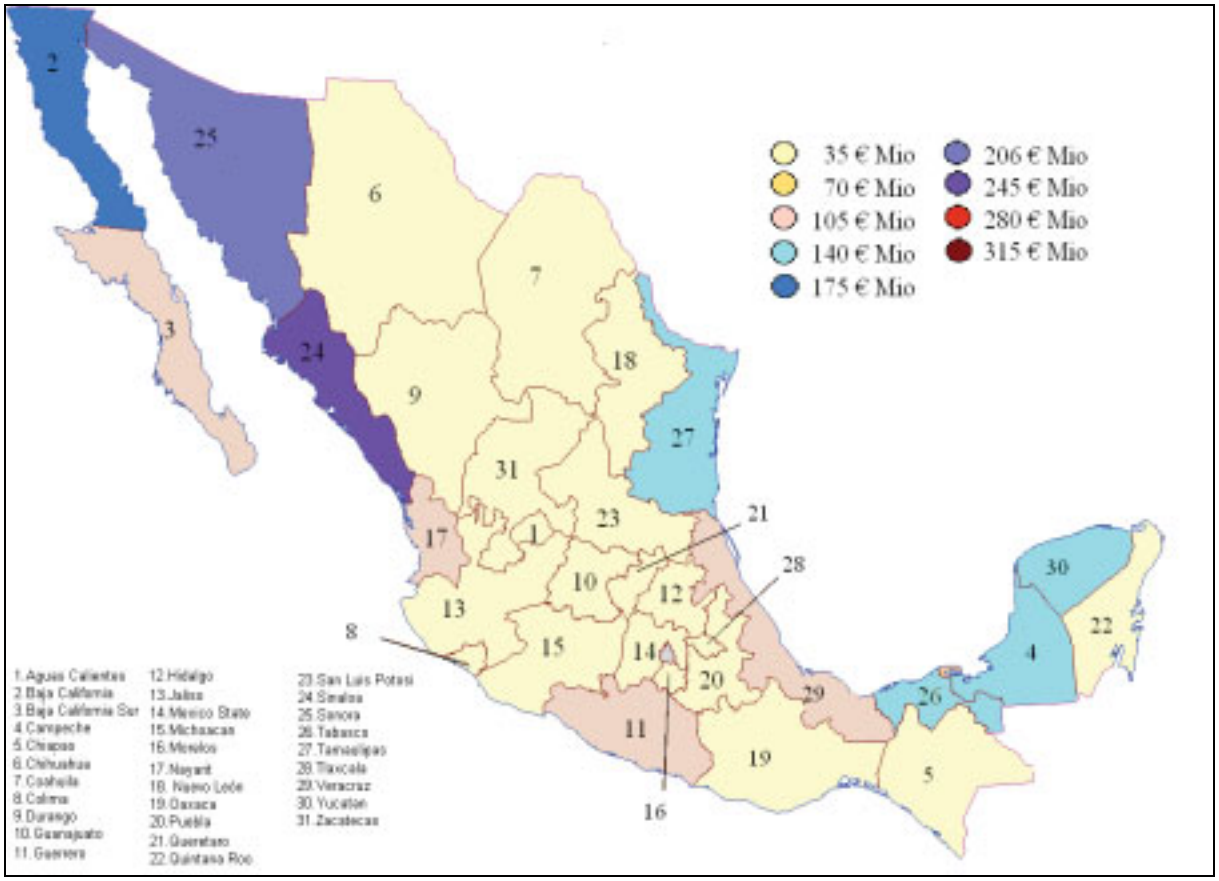
Having stated the economic situation confronting agriculture in Mexico in 2008, this chapter proceeds to deal with the agricultural sector and main changes observed in agricultural development from 1990 to 2005. The second section reviews the economic situation in Mexico. The third section describes the characteristics of households in Mexico, and the last section presents main international trade agreements that Mexico entered under bilateral and multilateral conditions by 2005. The objective of this chapter is provide a background to understand the differences of outcomes presented later on in this study and results obtained from other similar study cases.

2.1.1 Agricultural Production

The agricultural sector in Mexico employs approximately 20 percent of the economically active population and generates about 3.5 percent of the national gross domestic product (GDP) (INEGI, 2007). Generally, the arable land is owned by large land owners and

smallholders in equal proportions. Almost 50 percent of the agricultural land belongs to 26 000 *ejidatarios* (land owners), who possess 2.9 Mio *ejidos* (plots of shared land). The other half of the arable land belongs to smallholders possessing farms smaller than 5 hectares (SAGARPA, 2001). The agricultural production structure in Mexico is focused on traditional Mexican staple crops such as maize, rice and sorghum. From the 196 Mio hectares of total land area in Mexico, by 1950 nearly 10 percent (19 Mio ha) was being used for agricultural activities (COLL-HURTADO and GODINEZ-CALDERON, 2003). The agricultural land area has been reducing gradually: by 1990 it reached 31.1 Mio ha, and one decade later, in 2000, the land area decreased to 21.7 Mio ha. The extension of land surface devoted to agricultural activities is determined year by year as a function of natural factors, mainly climatic forecasting, as well as of national and international market conditions governing in previous years. Since the increase of the participation of Mexico in international trade in the mid-1980's, national and international conditions determine the extent of surface devoted to one or other crop. The Northeast region (Baja California, Baja California Sur, Sonora, and Sinaloa) as well as the Gulf region (Tabasco, Tamaulipas and Veracruz) contribute the highest values of agricultural production (see Figure 2-1).

Figure 2-1 Value of the agricultural production in Mexico (2003)



Source: Anuario Estadístico de la Producción Agrícola, SAGARPA (2005)

Compared with other sectors, the agricultural sector in Mexico has increased its production relatively slow. The average annual growth rate in the agricultural sector has been declining; it averaged 7.7 percent of the GDP in 1989-1991, then 6.2 percent in 1992-1994, and 5 years later dropped to 4.9 percent for the years 1997-1999 and then to 4.2 percent for the period 2000-2005 (SAGARPA, 2005).

A geospatial examination of crops harvested shows that cereals (maize, rice, sorghum and wheat) are the crops with the largest surface area cultivated in Mexico (9.5 Mio ha in 2000). Animal feed crops (mainly barley) represent the second largest group with 5.1 Mio ha; the third largest cultivated group are industrial crops such as cotton, agave and tobacco (SAGARPA, 2005). It is worth saying that surface area is not directly bound to economical value. Some crops, such as legumes, vegetables and fruits, require a relatively small surface area (3 percent of the national surface area cultivated), but, in economic terms, their harvest represents almost 20 percent of national agricultural production. Cereal crops have little economic importance, due to their predominant role as subsistence crops. Export-oriented crops, such as fruits in Michoacán or vegetables in Sinaloa, represent the highest economic value of agriculture in Mexico. Hemp is also cultivated illegally in Mexico, with 5.8 Mio ha by 2004 (USDOJ, 2006). Table 2-1 presents shares of land and production value of different crops by 2003. In this table, fruits and horticultural crops covered only 6 and 3 percent of the arable surface respectively. However, they represented 19 and 16 percent respectively of the total profits from agricultural production in the same year.

Table 2-1 Share of total surface and total value of agricultural production by crops (2003) (%)

Crops	Surface	Production value
Cereals	50.0	25.0
Animal feed crops	17.0	13.0
Legumes	12.0	6.0
Industrial crops	11.0	15.0
Fruits	6.0	19.0
Horticultural crops	3.0	16.0
Other crops	1.0	6.0
Total	100.0	100.0

Source: Anuario Estadístico de la Producción Agrícola, SAGARPA (2005)

Mexico has suitable conditions for the cultivation of fruits and horticultural products. The high diversity of microclimates and soil composition occurring in different regions of the territory makes it possible to harvest diverse horticultural crops during the entire year. Table 2-2 presents the main horticultural and fruit crops produced, as well as their economic value. The main horticultural products are potatoes, tomatoes, zucchini and pepper. These same crops are produced for domestic consumption and export-oriented crops as well (SILLER-

CEPEDA, 2003). The surface occupied by tomatoes and pepper represents a third of the surface devoted to horticultural products. Mexican tomatoes are an important export product (Table 2-2).

Mexico is a large producer of tropical and subtropical fruits. In 2003, more than 20 fruit species were cultivated. The most important crops are (in percent): coffee (41.6), oranges (17.4), coconut (9.4), mangoes (8.3), lemons (5.7), avocados (5.5), cacao (4.7) and bananas (3.9). Other important fruits are cucumbers, watermelons, sugar cane, peaches, apples, asparagus, tamarind and pears (Table 2-2).

Table 2-2 Main horticultural and fruit crops produced in Mexico (2003)

Product	Production (thousands of tonnes)	Value (thousands of USD)
Tomato	48.31	5917.19
Bell pepper	112.00	5433.10
Coffee	728.61	2892.66
Cucumber fresh or chilled	28.04	1390.37
Zucchini	10.84	49.92
Avocado	10.91	352.62
Mango	40.89	722.69
Asparagus	14.24	1300.36
Watermelon	35.41	1627.36
Tobacco	12.50	411.63
Orange	190.02	1491.05
Coconut	10.70	108.54
Cacao	80.90	845.41
Banana	40.66	1148.43

Source: Anuario Estadístico de la Producción Agrícola, SAGARPA (2005)

2.1.2 Level of Technology Applied in Agriculture

The level of technology applied by Mexican farmers is not homogeneous across the country and has profound differences. One group consists mostly of competitive export farmers who continuously adopt new technological developments from Canada and the USA. Another portion represents a considerably high share of farmers – mainly smallholders located in the Southern part of Mexico – whose technological development has been almost steady since 1910.

The level of adoption of new technologies at the farm level is directly bound to farm investment. Because of a lack of information, it is difficult to quantify the value of investments at the farm level. Farm investments can have three main sources: private or

farmers' investments, international investments and investments that are attributable to governmental transfers. Farmers and their families accrued farmers' investments from farming and off-farming activities. The direct international investments in agriculture come mainly from the USA (70 percent), followed by European countries (17 percent) (SAGARPA, 2005). Finally, governmental transfers reach farmers through official programs such as PROCAMPO and "*Alianza para el campo*", which are based on direct payments for investments in agricultural production.

The diversity in options for investments and the application of variable technologies lead to a broad panorama of agricultural possibilities in Mexico. Some farmers cultivate crops with high yields; these farmers are able to rotate their cultures depending on market needs. On the other extreme are farmers who have no access to investment capital or cannot purchase expensive inputs for their subsistence crops. These farmers produce only enough food to cover their own needs, and in rare cases when the harvest exceeds subsistence quantities, they sell the surpluses at the local market.

Investments, hence, lead to access to new technologies and the use of modern machinery, modified seeds, fertilisers, tractors, huller machines, threshing machines, etc. The extent of distribution of technology across the agricultural surface in Mexico is as highly unequal as income distribution across the country (GALINDO-GONZÁLEZ, 1996).

These facts cause the establishment of two fundamental types of agriculture in Mexico: commercial agriculture and subsistence agriculture. Subsistence agriculture is predominant across rural areas with indigenous populations, such as in the states of Guerrero, Oaxaca, Chiapas, Puebla, Estado de Mexico and Hidalgo. Farmers selling to national and international markets are found in Sonora, Sinaloa and the Pacific zone. Farmers who cater to export markets constitute 1 percent of the total national farmer population, while subsistence farmers represent about 60 percent. Approximately 1.5 Mio farmers focus on subsistence; their main crops are maize and beans.

The use of transgenic seeds is the one of the technological innovations introduced in Mexican agriculture in the early 2000's. Their adoption is a main topic of controversial discussions among farmers and environmental specialists because of its potential effects on biodiversity in the long term. Roughly 30 percent of the rural producers have access to this technology. States where its use has been broadly expanded are Baja California, Sonora and Sinaloa, and other Northern states (COLL-HURTADO and GODINEZ-CALDERON, 2003).

The use of chemical fertiliser is another important indicator of farmer investment potential. Some producers have access to chemical fertilisers, even though their yields are rather low. The use of chemical fertilisers differs widely around the country, with especially elevated use in Jalisco and Michoacán, where large scale production predominates. In the Southern part of Mexico, producers with small land parcels still consider manure the sole fertiliser.

Another important factor is the level of mechanisation, in particular the use of tractors. Because most of the farms in Mexico are smaller than 5 hectares, using tractors makes little sense to many farmers. Subsequently, only 37 percent of farms across Mexico are partially mechanised. The mechanised surface in Mexico is modest, and in some regions, such as the Yucatan Peninsula and the South Pacific zone, the use of tractors is even non-existent. In contrast, there are states such as Tlaxcala, where the level of mechanisation reaches 70 percent of the agricultural area. In non-mechanised areas, manual labour has not been substituted by technology, and the use of animals to facilitate the work is still widespread (COLL-HURTADO and GODINEZ-CALDERON, 2003).

Cultivation types might be classified as rain-fed crops and irrigation crops. Important irrigation systems have been built in the North and Central zones of Mexico in order to survive the climatic deficiencies. In fact, 60 percent of the total water storage capacity of the country is concentrated in the Northern region of the country: Sinaloa, Sonora, Tamaulipas, Chihuahua, Durango and Coahuila. The Central region is supplied with almost 8 percent of the total capacity, while regions such as the South Pacific only received less than 2 percent of the total capacity. Nowadays, nearly 25 percent of the cultivated surface is supplied by irrigation systems, and the rain-fed crops continue to be in the majority (GALINDO-GONZÁLEZ, 1996; SAGARPA, 2005).

2.1.3 Agricultural Trade

The import substitution model drove the economic national strategy between 1950 and 1982. The turning point for the Mexican economy came in 1984, when the government decided to move from a model based on price supports, producer subsidies and import substitution industrialization (ISI) to an export-competitive vision represented by the implementation of industrialization strategies towards an export-oriented industrialization model (EOI) (LEE HARRIS, 2001; HENRIQUES and PATEL, 2004; TAYLOR and YUNEZ-NAUNDE, 2001).

The adoption of the new export-oriented strategy led to important changes in trade policies. The government protection under the ISI model supported all sectors of the

economy, whereas in the EOI, specific firms with the potential to become exporters are subsidised by the government. This shift in policy affected fiscal discipline, price stability and balance of external accounts, and resulted in decreases in state involvement. For agriculture, many of these changes spurred support for the production of fruits and horticultural crops. Farmers dedicated to the production fruits and horticultural products are generally large farms. In contrast, farmers producing staple foods such as cereals are normally small farms. Thus, larger farms benefited the most by the implementation of the EOI while farmers participating in sectors of subsistence did not have high potential to become leading exporters. Subsistence sectors were (and still are) represented mainly by smallholders producing staple crops for self-subsistence (HENRIQUES and PATEL, 2004). The introduction of the export-oriented strategy in the Mexican economy was one of several international policies working towards trade liberalisation to international markets. Furthermore, the accession of Mexico to the World Trade Organization (WTO) in 1995 led to lower tariffs on all goods and the cut of import permit requirements for almost all agricultural commodities. After the consolidation of the export-oriented strategy, diverse trade agreements were negotiated (LEE HARRIS, 2001, HENRIQUES and PATEL, 2003).

One of the most notorious trade agreements is the one signed with Canada and the USA. Trade with the USA is of key importance to Mexico. Even before NAFTA was signed, 75 percent of Mexican exports went to the USA and 69 percent of Mexican imports came from the USA. Today 85 percent of Mexican trade is concentrated in exchange with the USA. Despite the later upcoming signed trade agreements, NAFTA holds the greatest policy-shaping power for Mexican trade (LEE HARRIS, 2001).

In Table 2-3 information on the importance of agriculture and processed food for the Mexican economy and other regions is compared from 1980 to 2005. By observing the dynamics followed by agricultural products, declining importance of agricultural products with respect to total imports and exports is registered for Mexico as well as for the selected areas. The share of agricultural exports in total Mexican exports fell from 1.4 percent in 1980-1985 to 0.5 percent in 2000-2005. The percentage of agricultural commodities in total imports decreased from 3.4 percent in 1980-1985 to 1.4 percent in 2000-2005. The food industry presented low relative changes in share of GDP in the national economy, but the share of food in total exports and total imports has decreased following international trends (Table 2-3). Thus, trends in Mexico and the selected areas point to a shift of trade from agricultural products to foods, beverages and tobacco.

Table 2-3 Economic importance of agricultural and food products for Mexico and other regions (1980-2005)

Period	OECD	Mexico	United States	Canada	Latin America and Caribbean
Agriculture, value added (% of GDP)					
1980-85	3.67	9.00	2.68	3.86	10.20
1985-90	3.03	8.93	2.18	3.20	9.95
1990-95	2.48	6.66	1.86	2.85	8.35
1995-00	2.07	5.30	1.48	2.67	7.44
2000-05	1.73	3.98	1.19	2.26	7.61
Agricultural raw materials exports (% of merchandise exports)					
1980-85	3.24	1.41	4.43	9.24	2.86
1985-90	3.21	1.47	4.36	9.67	2.73
1990-95	2.69	1.41	3.59	8.74	2.74
1995-00	2.11	0.91	2.57	7.45	2.45
2000-05	1.79	0.53	2.29	5.43	2.08
Agricultural raw materials imports (% of merchandise imports)					
1980-85	3.71	3.39	2.35	1.97	2.79
1985-90	3.53	4.63	2.08	1.75	3.74
1990-95	2.81	2.62	1.95	1.53	2.54
1995-00	2.34	1.81	1.81	1.43	1.88
2000-05	1.75	1.46	1.36	1.30	1.53
Food, beverages and tobacco (% of GDP)					
1980-85	n.a.	4.54	2.25	2.59	n.a.
1985-90	n.a.	4.92	2.38	2.62	n.a.
1990-95	n.a.	5.06	2.36	2.62	n.a.
1995-00	n.a.	5.33	2.16	2.55	n.a.
2000-05	n.a.	4.74	1.86	2.67	n.a.
Food exports (% of merchandise exports)					
1980-85	11.14	8.82	16.81	11.92	24.05
1985-90	9.57	12.40	11.92	9.05	23.65
1990-95	9.25	8.88	10.34	8.49	20.24
1995-00	7.93	6.13	8.63	7.57	18.43
2000-05	7.03	5.20	7.41	7.12	16.23
Food imports (% of merchandise imports)					
1980-85	10.36	15.08	7.64	6.94	12.99
1985-90	9.73	12.85	6.35	5.95	11.26
1990-95	9.14	9.56	5.44	6.16	9.79
1995-00	8.28	6.00	4.71	5.49	8.14
2000-05	7.29	5.94	4.39	5.71	7.42

Source: WORLD BANK (2007)

In Table 2-4, the agricultural balance for different Mexican products in 2007 is presented. The first row shows that cereals and grains (36.1 Mio tonnes) and animal feed crops (56.0 Mio tonnes) are the largest cultivated agricultural products in Mexico. Imports are dominated by cereals and grains, while imports of other crops are lower than 1 Mio tonne combined. The next row in this table shows agricultural exports by product, with the

exception of animal feed crops; other groups of agricultural products are exported. The Mexican exports are represented by horticultural products and fruits with 2.2 and 1.3 Mio tonnes respectively. The next row contains quantities of agricultural products consumed domestically. One can see that imported cereals and grains are required to fulfil the domestic consumption needs. The animal feed crops produced are entirely domestically consumed, while for the remaining agricultural products, consumption does not exceed domestic production. Thus, the most valuable agricultural products exclusively for export markets are horticultural products and tropical and sub-tropical fruits.

Table 2-4 Agricultural and food balance stock in Mexico[a] (2007) (Mio tonnes)

	Cereals and grains	Animal feed crops	Fruits	Horticultural crops	Industrial crops
Production	36.1	56.0	16.1	9.1	51.2
Importation	19.3	0.0	0.3	0.2	0.1
Exportation	0.9	0.0	2.9	2.6	1.0
Consumption	54.5	56.0	13.5	6.7	50.3

[a] estimated values

Source: INEGI (2008a)

Cereals and grains in Mexico have diverse destinations in the economy. The most important one is the role as the main pillar in the food patterns in Mexican households. To a lesser extent, cereals are commercialised for further processing in the food industry. Animal feed crops are cultivated to feed livestock. Animal feed crops are normally produced and consumed in the same farming region, thus assuring that the adequate supply of animal feed crops at the farm level covers the national demand. The same structure exists for industrial crops such as cotton, henequen and tobacco, among others (see Table 2-4).

The commercialisation and production of horticultural crops and fruits are the most important agro-economic activities at the national level in Mexico. Horticultural crops are strongly export driven. Mexico is the principal foreign supplier of fresh vegetables in the USA (65 percent of USA fresh vegetable import value in 2004) (INEGI, 2008a).

The production of fruits is mainly domestically oriented. Even though the climate conditions and production capacity within the country are suitable for higher production yields, a lack of effective commercialization chains hampers the export potential for fruits. Inefficient or non-existent preservation technologies hinder long storage periods of fresh products, such as apples, oranges, and lemons. Lack of research and development of breeding techniques and inefficient infrastructure of many types including transportation, water

storage, and distribution are some other factors that obstruct increases in production yields of fruits products for export markets (TAYLOR and YUNEZ-NAUNDE, 2001).

2.2 Economic Situation in Mexico

Mexico is the largest trading nation in Central and South America, and the eighth largest in the world. The Mexican economy is especially driven by oil production. Mexico is the main oil producer in Latin America and the fifth largest producer internationally. In 2006, the Mexican GDP sector ratios were composed as follows: 3.2 percent from agriculture, 8.3 percent from mining (mainly represented by the production of oil), 18.0 percent from industry and 70.5 percent from services (WORLD BANK, 2007). While in the north of Mexico the climate tends to be semi-arid, in South Mexico the climate is sub-tropical. These climatic differences cause changes in natural resource availability, which also drives the economy to different activities and products across regions. As a result, economic activities differ considerably among the geographic zones in Mexico.

Mexico has been divided into three main geographical zones and nine economic regions, each with particular production strengths derived from the economic and demographic conditions in each region. Table 2-5 presents the state classification by zone and region as well as the GDP contribution of each zone in 2004. The North zone is characterised by high industrial development, mainly in the basic metals branch; the foremost industries are automobiles, metallurgy and processed food. The agricultural activities in this region are mainly oriented to export products. Industry and services represent the main economic activities of the North zone. This zone comprises three economic regions: the north region (Chihuahua, Coahuila and Durango), the northeast (Baja California, Baja California Sur, Sonora and Sinaloa) and the northwest region (Tamaulipas and Nuevo Leon) which in total contribute 19.8 percent of the national GDP. A total of 22 percent of the national population lived in the North zone in 2004 (INEGI, 2007).

The Central zone of Mexico possesses particular importance since this region has produced a third of the national GDP between 1970 and 2000 (INEGI, 2007). This zone generates the highest income of the country, with greater economic growth than population growth. The Central zone comprises the North central region (Aguascalientes, Guanajuato, Querétaro, San Luis Potosí and Zacatecas), the West central region (Colima, Jalisco, Nayarit and Michoacán) and the Central region (Mexico State, Federal District, Hidalgo, Morelos, Puebla and Tlaxcala). It is characterised by its higher diversification in production, with industry and services the main economic activities. The Central region alone accounts for 39.3 percent of the national GDP, mainly concentrated in the service and industrial sectors.

The population living in urban areas of this zone represents 70 percent of the area's population (INEGI, 2007). Regions near the Central Mexican Valley benefited from the spill-over effects of the expansion of the Central region. Hence, the north central region has shown increases in its share of the GDP at the national level. This zone contributes 59.0 percent of the national GDP and concentrates 55 percent of the national population.

Table 2-5 Regional composition of GDP in Mexico (2004)

	Agriculture	**Mining**	**Industry**	**Services**	**Total**
Total national	3.74	8.65	18.03	69.58	100.00
North zone	0.79	1.04	3.52	14.46	19.81
Northwest region	0.55	0.49	1.19	6.34	8.57
Baja California	0.04	0.00	0.58	2.56	3.18
Baja California Sur	0.03	0.06	0.02	0.45	0.56
Sinaloa	0.30	0.00	0.15	1.65	2.10
Sonora	0.18	0.43	0.44	1.68	2.73
North region	0.50	0.86	2.28	5.64	9.28
Chihuahua	0.20	0.12	0.81	3.40	4.53
Coahuila	0.11	0.55	1.23	1.50	3.39
Durango	0.19	0.18	0.24	0.74	1.35
Northeast region	0.24	0.55	2.33	8.12	11.24
Nuevo León	0.10	0.25	1.68	5.77	7.79
Tamaulipas	0.14	0.31	0.65	2.35	3.45
Central zone	1.73	1.17	10.78	45.35	59.02
North central region	0.50	0.55	2.26	5.84	9.16
Aguascalientes	0.04	0.00	0.31	0.79	1.14
Guanajuato	0.17	0.06	0.95	2.51	3.70
Querétaro	0.06	0.06	0.52	1.12	1.76
San Luis Potosi	0.12	0.18	0.44	1.08	1.82
Zacatecas	0.11	0.25	0.04	0.33	0.73
West Central region	0.72	0.37	1.63	7.11	9.82
Colima	0.03	0.12	0.03	0.35	0.53
Jalisco	0.38	0.12	1.25	4.73	6.48
Michoacán	0.25	0.12	0.31	1.57	2.26
Nayarit	0.06	0.00	0.04	0.45	0.55
Central region	0.51	0.43	6.93	31.43	39.30
Federal District	0.01	0.06	2.70	19.83	22.60
Hidalgo	0.08	0.06	0.32	0.86	1.33
Mexico State	0.14	0.25	2.69	6.65	9.72
Morelos	0.11	0.00	0.26	1.05	1.42
Puebla	0.15	0.06	0.80	2.64	3.65
Tlaxcala	0.02	0.00	0.16	0.40	0.58

Cont. **Table 2-5**

	Agriculture	**Mining**	**Industry**	**Services**	**Total**
South zone	1.2	3.69	1.84	14.28	21.00
Gulf region	1.09	2.35	1.58	11.10	16.12
Tabasco	0.06	1.38	0.07	0.03	1.54
Veracruz	0.29	0.48	0.73	3.06	4.56
Pacific region	0.37	0.25	0.39	4.01	5.01
Chiapas	0.14	0.18	0.06	1.34	1.72
Guerrero	0.1	0.00	0.10	1.54	1.74
Oaxaca	0.13	0.06	0.23	1.13	1.55
Peninsular region	0.10	1.34	0.26	3.18	4.88
Quintana Roo	0.01	0.23	0.04	1.60	1.88
Yucatan	0.06	0.45	0.20	1.17	1.88
Campeche	0.03	0.66	0.02	0.41	1.12

Source: INEGI (2007)

Other contributing regions are the Gulf (Tabasco and Veracruz) and the Pacific region (Chiapas, Guerrero and Oaxaca). In this, the South zone, the most important economic activity is oil extraction and other mining activities. The South zone contributes 3.7 percent of the national GDP, mainly because of oil extraction. The main income source in the Peninsular region (Quintana Roo, Yucatan and Campeche) is tourism; however, this sector has presented slight decreases since 1999 because of hurricanes and other natural disasters. The contribution of these three regions to the national GDP amounts to 21.0 percent. In Figure 2-2, the geographical location of the economic zones and regions is visualised on a map.

Figure 2-2 Geographic zones in Mexico

Source: INEGI (2003)

2.2.1 Poverty in Mexico

According to the World Bank classification of countries ranked by income, Mexico is a middle-income country. In spite of the current macroeconomic conditions observed in the country, poverty is still present. Mexican poverty profiles show that the extremely poor, besides being located mostly in the rural areas, have the lowest level of educational and derive most of their earnings from self-employment and wage labour – mostly in agriculture and related activities (INEGI, 2005a). This section presents the poverty classification and the incidence of poverty in Mexico for different periods, as well as the main living conditions of poor people in Mexico.

Poverty Measurement

Currently, the official measurement of poverty in Mexico considers three types of poverty: (a) food poverty, (b) capacities poverty, and (c) assets poverty.

Persons living in *food poverty*, the first type, are unable to cover basic nourishment needs with their available income. The calculations suggest that these individuals earn an income per capita lower than 18.3 pesos per day (USD 1.2 in 2004) in rural areas, and 24.6

pesos (USD 1.6 in 2004) per day in urban areas. In 2004, 13.7 percent of the Mexican households earned less than the above mentioned amounts. This percent of households accounts for 17.3 percent of the total population. In the same year, Mexico had 104,243,700 inhabitants, meaning that 18,034,100 people experienced food poverty (COMITÉ TÉCNICO PARA LA MEDICIÓN DE LA POBREZA, 2005).

The second type is called *capacities poverty*. Persons living under poverty of capacity are considered to have insufficient income to cover food for basic nourishment, education and health. The income per capita estimated to overcome capacities poverty in 2004 was 21.7 pesos (USD 1.4) per day in rural areas and 30.3 pesos (USD 2.0) in urban areas. In the same year, poverty of capacity affected 19.8 percent of households and 24.6 percent of the total population, which translates to 25,654,000 people living under these conditions (COMITÉ TÉCNICO PARA LA MEDICIÓN DE LA POBREZA, 2005).

The third type, *assets poverty*, includes those individuals whose income is insufficient to cover altogether basic nourishment, health, wearing apparel, dwelling, and transport. These people earned fewer than 33.0 pesos (USD 2.2) per capita in rural areas and 49.6 pesos (USD 3.3) in urban areas in 2004. People living under these conditions in 2004 represented 47 percent of the total population, which accounts for 48,071,350 Mexicans living in poverty.

The distribution of poverty across different rural and urban areas, as well as the national average for different periods, has been assessed (LÓPEZ-ACEVEDO, 2005) and is presented in Table 2-6. At the national level, food poverty has been overcome by half of the population who lived under this critical condition in 1996 and dropped from 37.1 to 18.2 percent of the total population in nine years. Capacities poverty has also shown important improvements in this period, decreasing from 46.4 percent in 1996 to 24.7 percent in 2005. Levels of assets poverty in Mexico are still widespread at the national level and affect almost half of the total population in Mexico.

Since 1996, the classification of poverty by geographical region in Mexico shows that people living in rural areas have been afflicted with higher levels of poverty than those living in urban areas. In 1996, over half of the rural population was not able to cover basic nourishment needs (52.4 percent). In comparison, in 1996, food poverty affected 26.5 percent of the urban population (half of the estimate found for rural areas). Levels of poverty estimated in 2005 report important improvements compared to figures from 1996. In rural areas, 32.3 percent of the population still could not cover basic food needs, while in urban areas 9.9 percent still lived under food poverty (a third of the estimate found in rural areas) (Table 2-6).

Table 2-6 Share of population living under poverty (1996-2005) (%)

	1996	*1998*	*2000*	*2002*	*2005*
National					
Food Poverty	37.1	34.1	24.2	20.3	18.2
Capacities Poverty	46.4	42.8	32.0	27.4	24.7
Assets Poverty	69.0	64.3	53.8	50.6	47.0
Rural					
Food Poverty	52.4	52.5	72.4	34.8	32.3
Capacities Poverty	61.7	60.3	50.1	43.9	39.8
Assets Poverty	81.0	76.6	69.3	65.4	61.8
Urban					
Food Poverty	26.5	21.3	12.6	11.4	9.9
Capacities Poverty	35.9	30.7	20.3	17.4	15.8
Assets Poverty	60.7	55.8	43.8	41.5	38.3

Source: LÓPEZ-ACEVEDO (2005)

Other authors have related these differences to geographic characteristics. LÓPEZ-CALVA (2002) estimates poverty levels in 2000 in the North region accounting for 12 percent of Mexico's poor (LÓPEZ-CALVA, 2002). The Southeast region contained in the same year 5.3 percent of Mexico's population but 19 percent of national poverty (LÓPEZ-CALVA, 2002; BELLON et al., 2004). These facts support other estimates showing that the poverty levels in Mexico since 1996 are more broadly distributed in rural areas than in urban areas. Additionally, poverty incidence is higher in the Center, the South and the Southeast parts of Mexico (LÓPEZ RAMIREZ, 2005).

Other important aspects to be considered when analysing poverty are the characteristics of the head of the household. Table 2-7 shows in the upper part the level of education and in the lower part the occupation of the household head. The first four columns deliver estimates in four different periods for the average population in Mexico. The middle four columns contain the levels of education and occupations of heads of households living under food poverty for the same periods. Finally, the last four columns show similar information for households living under capacities poverty.

In 1989 the representative household was headed by an individual who attended primary school but did not complete primary education (31.0 percent). In 2005 the representative household was headed by an individual with some post-primary school attendance (28.0 percent).

The comparison of skill level of the household heads under food poverty implies an important increase of the level of education. The representative household under food poverty

from 1989 to 2004 was headed by an individual with some primary school attendance but no completion. However, the percentage of households headed by an individual with some post-primary education increased during the same period from 6.2 to 20.1 percent. In the case of poverty of capacities, the representative household is still headed by an individual who attended primary school but did not complete primary education. The values show a rise in the level of education in the population living under poverty of capacities. The percent of households headed by an individual either with some high school (from 0.8 to 8.0) or some advanced school (from 0.4 to 4.0) increased significantly during the same period.

Furthermore, the second branch of Table 2-7 classifies households by the occupation of the household head. By analysing this at the national level from 1989 to 2004, the percentage of households headed by rural workers decreased significantly from 25 to 12.5 percent. These workers have changed their occupations, probably to the industrial sector. The number of households whose head is occupied in the industrial sector increased from 22.0 to 34.1 percent in the same period. A possibly related fact is the fall in the percentage of households headed by rural workers under the food poverty line, which fell from 53.9 to 30.5 percent in the same period. The same increasing trend of industrial workers at the national level is observed in households under the food poverty line. Households headed by industrial workers have increased from 17.6 to 27.7 percent. The evolutionary trends of households under the capacities poverty line shows a fall in the number of households headed by a rural worker (44.9 to 24.0 percent), while the number of households headed by an industrial worker (21.0 to 30.0) or by an unclassified worker (1.7 to 10.0) has increased during the same period.

Table 2-7 Composition of poverty in Mexico (1989-2004) (%)

	Distribution of total population				Distribution of population under food poverty				Distribution of population under capacities poverty			
	1989	1992	1994	2004[a]	1989	1992	1994	2004[a]	1989	1992	1994	2004[a]
Education of household head												
Without formal education	21.7	18.7	20.4	8.0	36.0	34.0	36.6	13.6	38.2	26.2	30.1	12.0
Primary school not completed	31.0	31.6	29.0	21.0	41.3	44.0	41.4	33.2	42.0	40.2	37.8	28.0
Primary school completed	20.2	21.0	20.3	18.0	14.8	17.0	15.2	14.6	13.1	21.3	19.5	18.0
Some post-primary school	12.8	13.8	15.0	28.0	6.2	4.0	5.0	20.1	5.2	9.5	9.6	2.0
Some high school	5.7	6.2	6.2	12.0	0.7	1.0	1.0	6.5	0.8	2.2	1.8	8.0
Some advanced schooling	8.6	8.7	9.2	13.0	0.7	0.0	0.7	2.2	0.7	0.7	1.2	4.0
Occupation of household head												
Professional or technical	12.0	9.0	9.0	13.6	4.4	1.2	1.1	3.7	10.8	2.3	1.8	6.0
Rural workers	25.0	23.0	22.0	12.5	53.9	51.5	49.9	30.5	44.9	36.1	35.0	24.0
Industrial workers	22.0	26.0	24.0	34.1	17.6	23.5	20.4	27.7	21.0	27.8	25.8	30.0
Intermediate level workers	24.0	25.0	24.0	24.8	10.8	11.1	9.9	20.2	18.0	19.2	17.3	22.0
Household employees	3.0	4.0	5.0	4.8	2.7	3.2	4.5	10.3	5.3	3.7	5.2	8.0
Not classified	14.0	14.0	15.0	10.2	10.6	9.5	14.2	7.7	1.7	10.9	14.9	10.0

[a] Author's calculations from INEGI (2005b)

Source: LUSTIG and SZÉKELY (1997)

Other important demographic characteristics, such as the number of earners per household and the structural composition of households, are displayed in Table 2-8. The first column shows national trends. The following three columns show the composition of poor households, and the last column shows the trends for non-poor households.

The first branch of Table 2-8 lists the number of household members earning wages. At the national level, the share of households with only one person earning wages represents 50.5 percent of the total. Households with two wage earners represent a third of the households

while three or more earners represent 15.6 percent. Households with one wage earner (74.6 percent) are a considerable majority of the households under the food poverty line. Households suffering from capabilities and asset poverty also are mostly represented by households with one wage earner (71.7 and 65.4 percent). In contrast, households that have enough or more than enough money to cover their basic expenses tend to have one or two wage earners (41.0 and 35.5 percent respectively).

Additionally, one can see in Table 2-8 that poor households do have fewer members who are wage earners. For example, of the households under food poverty, 4.8 percent have three or more wage earners, while the same category in non-poor households covers 23.5 percent. Non-poor households have a higher number of household members earning wages than the poorest households. Thus, by 2004 well-being in Mexico was highly correlated with the number of household members earning labour wages.

Table 2-8 Member composition of households in Mexico (2004) (%)

	National Average	Population under food poverty	Population under capabilities poverty	Population under assets poverty	non-poor Population
Number of household earners					
1 wage earner	50.5	74.6	71.7	65.4	35.5
2 wage earners	34.3	20.6	23.2	27.6	41.0
3 wage earners or more	15.2	4.8	5.1	6.9	23.5
Household members					
1 adult	8.2	21.6	17.5	12.8	3.7
2 adults	13.1	21.1	18.8	16.0	10.1
3 adults	9.6	8.4	8.9	9.2	10.0
4 adults	7.8	3.2	3.8	5.2	10.3
5 to 7 adults	6.3	2.4	2.9	3.1	9.5
2 adults and 1 child	8.1	6.7	8.0	8.9	7.2
2 adults and 2 children	9.2	8.5	9.5	10.0	8.4
2 to 4 adults and 3 to 5 children	5.2	5.9	6.1	6.3	4.0
3 adults and 1 to 4 children	11.6	8.8	10.0	11.4	11.8
4 and 5 adults and 1 to 3 children	12.1	5.9	7.0	9.5	14.7
other combinations	8.8	7.8	7.4	7.5	10.2

Source: Author's calculations with data from INEGI (2005b)

The second branch of Table 2-8 contains the member composition of households. Households under the food and capabilities poverty lines are represented mostly by one- (21.6 and 17.5 percent respectively) and two-adult households (21.1 and 18.8 percent respectively). Households with three adults (8.4 and 8.9 percent respectively) or three adults and one to four children (8.8 and 10.5 percent respectively) are also highly represented. Households under the

assets poverty line are represented by households with two adults (16 percent) or households with one adult (12.8 percent).

Non-poor households are highly represented by households with (a) three adults and one to four children, (b) four to five adults and one to three children or (c) four adults. These classifications often have a dense population of children, which indicates that wealthier households have many members and tend to have more children than poor households.

2.2.2 Inequality in Mexico

Mexico presents a pattern often observed in other middle-income countries, especially in Central and South America (OECD, 2006). Most people in the middle class (Deciles V and VI) have an income that, on average, is closer to the bottom than to the top. In the last 20 years, inequality in Mexico has been marked by an increase in household income inequality. The wealthiest 10 percent of the population receives 42 percent of total national income, while the poorest 40 percent receives just over 11 percent (see Section 4.1; INEGI, 2005a).

Income inequality in Mexico has important urban versus rural connotations. The number of urban areas in the richer Northern states of the country is comparatively higher than the number of urban areas located in the poorer Southern states. Households in urban areas can count on a better infrastructure than households in rural areas (CORBACHO and SCHWARTZ, 2002). These differences have been assessed and attributed to differences in the level of returns for skills in rural and urban areas. The main drivers in these differences are the high share of agricultural labour and small business in rural areas and the low productivity of these activities (WORLD BANK, 2005). For example, one individual working in the manufacturing sector in urban areas earns a wage that is 30 percent higher than an individual with similar skills working in the agricultural sector in rural areas (WORLD BANK, 2005). Thus, the lower returns for skills in rural areas increase the likelihood of poverty compared to urban areas. Looking again at the poverty figures shown in Table 2-6, in 2005, 61.8 percent of people living in rural areas were under the assets poverty line. Similarly, in 2005, 38.3 percent of the population in urban areas lived under some kind of deprivation of basic assets.

The author's inequality calculations for 2004, using expenditure data from the Instituto Nacional de Estadística Geografía e Informática (INEGI 2005a) show important differences between regions in Mexico. Gini coefficients for urban and rural areas are 0.36 and 0.43, respectively. Thus, inequality is higher in rural than in urban areas. The rural and urban Gini coefficients differ substantially from the Gini coefficient calculated for the entire country, 0.46. Income inequality is also less pronounced for the country as a whole. These values show that the

situation observed ten years ago by PÁNUCO-LAGUETTE and SZÉKELY (1996) has not changed considerably. PÁNUCO-LAGUETTE and SZÉKELY show that inequality in living conditions between urban and rural areas is higher than inequality in income levels within one region. In 2005 the World Bank, using data from 1994, obtained Gini coefficients of 0.50 and 0.44 for urban and rural areas respectively, and a countrywide inequality of 0.54 (WORLD BANK, 2005). The comparison of values from the World Bank in 1994 and the author's calculations found in this study shows that inequality in rural areas has not changed significantly, while inequality at the national level and in urban areas has declined in ten years.

In 2005, SZÉKELY proposed a scheme to analyse the composition of individual income in Mexico, and therefore to determine factors involved in inequality. The first factor refers to the distribution of inherent attributes amongst individuals; the second element is the possibilities that the individual has to maximise the use of these given attributes; the third element is the market prices for these attributes; and the fourth element considers transferences and other income sources independent from the above mentioned attributes (SZÉKELY, 2005).

In the first element mentioned, the inherent attributes might be health, education, nutrition, land and capital. These attributes determine the productivity potential of an individual. The second element includes the possibilities that an individual has to offer his/her attributes. If someone has a special attribute, but lives in an isolated region, this attribute cannot be offered and therefore does not generate income. The third element is the price remunerating individual attributes: the higher the price, the higher the benefit for an individual will be. If an attribute is highly valued, individuals possessing it might take advantage of this. The fourth element depends on several factors, such as the presence of household members earning money from outside, governmental transfers, etc.

2.3 Mexican Households

Since the economic reforms in 1984, Mexico has experienced important macroeconomic changes, which have also been channelled to households through diverse pathways. The transmission pathways are mainly either via income sources or through changes in prices of purchased commodities creating changes in household income/expenditures. Households react to these changes by modifying their expenditure patterns, namely by reducing expenditures or substituting commodities. These economic reforms are thus expressed in a modification of consuming behaviour at the household level. Parallel to these economic changes, there are other social and demographic factors that have influenced household income in Mexico since the beginning of the 1980's. Some of these social factors are the fall of labour wages, the increase of the informal sector, and the rise of

the female labour force. Additional changes in demographic factors such as the drop of the annual birth rate and the effect of continuous migration flows, mainly to urban cities and to the USA, also affect household income.

This section presents an overview of the development of different socio-demographic factors that (together with the economic factors mentioned in Section 2.2) play an important role in the structure of expenditure patterns and income formation. These factors also provide a starting point for understanding the demographic and structural changes of Mexican households in the last 20 years.

2.3.1 Education

As remarked upon in preceding sections, the level of education is a critical factor for household welfare in Mexico. In 2005, the educational system in Mexico had 36.2 Mio students enrolled. Basic education in Mexico is subsidised by the state, although 10-12 percent of Mexican students attend private schools. The rising rate of students taking advantage of private education is the result of the increase in middle-class households and the perceived low quality of public education (OECD, 2007).

Around 78 percent of all students are enrolled in some level of basic education. Basic education is compulsory in Mexico and includes three levels:

Pre-primary school for children between 3 and 5 years.

Primary school for children between 6 and 12 years.

Low secondary school, which consists of three degrees, for students between 13 and 15 years.

In observing attendance of basic school in Mexico, some regional differences can be detected. Table 2-9 shows a relationship between regional economic differences and children's school attendance. The first column displays the percent share of GDP generated in each state, which serves as an indicator of the economic environment in each state. The second and third columns contain percent levels of children between 6 and 14 years who attended the school in the respective Mexican states in 1990 and 2000. The first row, containing the information for the entire country, shows that from 1990 to 2000 the average number of Mexican children attending school rose from 85.8 to 92.1 percent. Children living in poor states with low GDP rates and larger rural areas than urban areas, such as Oaxaca and Chiapas, have a lower rate of school attendance compared to those states with higher GDP

rates and larger urban areas than rural areas, such as the Federal District and Nuevo León (Table 2-9).

Table 2-9 Relationship between regional economic differences and children school attendance

State	share to National GDP	Percent of children in primary school between 6 and 14 years	
		1990	2000
Total National	100.00	85.81	92.08
Federal District	22.00	95.06	96.62
Nuevo León	7.49	92.66	95.81
Guerrero	1.70	79.97	89.19
Michoacán	2.23	77.28	88.43
Chiapas	1.71	71.28	84.39
Oaxaca	1.54	68.32	74.10

Source: adapted from AGUILAR (2001)

As seen in Section 2.2.1, in 2005, 47.0 percent of the Mexican population lived under assets poverty, and of those, 18.2 percent lived under extreme poverty. Most of these households are located in the southern states and in rural areas.

To increase household income, it is characteristic for poor households that children start to work at an earlier age in comparison to wealthier households. An early start by children in working activities has a negative effect on school attendance and completion but a positive effect on household income. This phenomenon has intergenerational dimensions; a poor household is forced to take children out of school to contribute to household income. In the long run, children do not complete school, and thus as adults, their only potential work is unskilled labour. The low wages in unskilled activities will not be enough to cover household expenses of the future household, so that their children will have to start to work at an early age, just as they did. Assets poverty is in this way transmitted from one generation to the next. This becomes evident in a comprehensive investigation of values comparing economic progress of different regions in Mexico with the enrolment rates in primary school in those regions (Table 2-9). Regions with low economic growth are represented by a high share of indigenous population living in rural areas, such as in the states of Chiapas, Michoacán and Oaxaca.

2.3.2 Changes in the Labour Market in Mexico

Table 2-10 presents modifications observed in the labour market in Mexican households from 1984 to 2005. The first row shows an increase in female-headed households for this period, from 16.2 to 23.0 percent of total households. Female-headed households might be linked to male migration or to female-sole-parent households in most of the cases. Most female-sole-parent households may earn only one wage, which is often less than men’s wages

(INEGI, 2005b). In many cases the female-sole-parent is also responsible for the housework and the household. Several phenomena might be causing the increasing number of female-sole-parent households, such as separation because of migration, divorce, unwed motherhood, a weaker religious and social culture, which tolerates women living alone, etc.

The second row in Table 2-10 shows the share of the Mexican population (individuals born in Mexico) who reside in the USA. Since the early 1980's, migration to the USA has profoundly affected the structure of Mexican households. Emigration rates have been rising steadily over time, and young adults register the highest rate. Between 1984 and 2005, the share of individuals born in Mexico who reside in the USA rose from 0.04 to 0.15 percent of the total population in the USA (HANSON, 2005). These numbers supports figures from the 2005 National Census in Mexico, which estimates that 10 percent (25.5 Mio) of the total Mexican population live in the USA (INEGI, 2005b).

Male migration is far more common than female migration; the share of men migrating from Mexico to the USA accounts for 70 percent of the total migrating population. At the household level, this phenomenon has important consequences, causing modifications in the role of household members. The traditional Mexican household used to be founded upon a division of activities, comprised of a male (the husband), a female (the wife) and their children. The husband is the principal wage-earner and the wife is the housekeeper. If a male migrates, his wife will start receiving transfers from him to contribute to household needs. In the most common case, where the received transfers do not cover the household expenditures, the wife must search for a job to cover household needs, frequently in the informal sector (see Section 2.3.3), and at the same time she must keep her role as housekeeper.

Table 2-10 Changes in the labour market observed in Mexican households (1984-2005)

Observed Factors	**1984**	**1989**	**1996**	**2000**	**2005**
Female-headed households	16.20	17.30	18.40	20.60	23.00
Share of population born in Mexico and living in the USA [a]	0.04	0.05	0.07	0.08	0.15
Informal sector(equivalent of % GDP)	12.10	16.30	16.00	26.40	33.00
Unemployment rate (%)	5.60	3.00	5.60	2.50	4.20

[a] taken from HANSON (2005)

Source: Author's calculations from the National Employment Survey (INEGI, 2005b) and data from the National Household Survey (INEGI, 2005a)

The informal sector has also increased almost three-fold during the same period, from 12.1 to 33.0 percent of the GDP. Due to the high importance of this economic activity for households in Mexico, it is presented comprehensively in the coming section. Finally, the last

row in Table 2-10 shows a decline in the unemployment rate over this period, which might be directly related to the increasing number of individuals in Mexico with earnings from the informal sector.

2.3.3 Informal Sector

An important factor to consider in the structure of Mexican households is the role of the informal sector. The informal sector is characterised by the use of basic and easily available technology, a scarcity of investments and capital – often there is no access to credit – and mostly unskilled labour. These activities are disregarded for the National Accounts of GDP of a country (RAMALES-OSORIO, and DÍAZ-OLEDO, 2005) as well as for unemployment statistic figures. In Mexico, official information on unemployment rates shows negative trends from 1984 to 2005, while levels of informal activities have increased (Table 2-10). This decrease of unemployment has not been achieved by increase of labour participating in formal economic activities (INEGI, 2005b).

Mexico has a large urban informal sector, the extent of which is unclear. Some estimates have ranged that approximately 40 percent of the labour force in some cities participates in informal activities (BRÚ and ROSAL, 2001). In 2005, of the total working force in the informal sector in Mexico, 36.9 percent were female and 63.1 percent male. The reasons for starting an informal business are mainly (a) to supplement household income, (b) to take advantage of the higher earnings in the informal sector compared to the industrial wages for unskilled labour, or (c) to participate in an alternative to unemployment (TOCKMAN, 1995). The informal sector is illegal in Mexico, and therefore, not included in the official National Accounts. The activities of the informal sector are classified in two categories: by the illegal nature of the activities performed and by the evasion of taxes in legal activities, also known as activities off the books (RAMALES-OSORIO, and DÍAZ-OLEDO, 2005).

Illegal activities are all those activities that are not permitted as an official income source in Mexico by the law. These activities are against the law because they cause injuries to the population (traffic of drugs and alcohol), the national economy (piracy), or the perpetrator (illegal prostitution). The classification of the informal sector is done in two main categories as shown in Table 2-11. The first group of activities is illegal activities such as smuggling, piracy and child labour. Activities off the books are legal and productive but deliberately hidden from the public authorities to avoid fiscal responsibilities (domestic labour) or complying with specific regulations (clandestine small factories). The inclusion of data providing information on the informal sector is not contemplated in official documents from the government, since these activities are not sanctioned by the law.

Table 2-11 Classification of activities from the informal sector

Illegal Activities
Goods smuggling
Gambling
Traffic of drugs, tobacco and alcohol
Illegal prostitution
Piracy
Child labour
Activities off the books
Jobs not registered, paid in cash and without social security
Evasion of taxes
Moonlighting
Barter of goods and services (e.g. among neighbours)
Loans outside of the financial market (usually at higher return rates than official ones)
Transactions of goods and services underreported or not reported at all (second-hand automobiles, domestic work, etc)
Under- or over-turnovers of exports and imports

Source: RAMALES-OSORIO, and DÍAZ-OLEDO (2005)

The International Labour Organization (ILO) estimated that in 2000 the importance of the informal employees was especially high in sectors such as construction (61.0 percent), retail (68.0 percent), services (52.0 percent), transport (56.0 percent) and manufacturing (30.0 percent) (BRÚ and ROSAL, 2001).

2.3.4 Demographics

Other important factors determining household income are demographic changes in the country. Table 2-12 reviews some important changes in demographic characteristics of households in Mexico from 1984 to 2005. The first row presents as a parameter of reference the national average income. In the period from 1984 to 2005, average income per capita in Mexico increased from 1582.0 pesos (USD 130.0) to 2200.0 pesos (USD 160.0). During this period, the birth rate decreased across Mexican households from 4.2 to 2.5 births per female, leading to a decline in household size (from 5.1 to 4.0 members) and an increase in female labour (see Tables 2-10 and 2-12). The drop of the birth rate in this period can be also linked to the increase in the average number of household earners at the national level, which had increased systematically from 1.6 in 1984 to 2.0 in 2005. This rise in household earners is the effect of two main trends: (a) a higher number of household members of working age as a direct consequence of the fall in the mortality rate (CABRERA, 1990) and (b) an increase in the share of female labour force (CORTÉS, 2003).

Table 2-12 Changes in the demographic characteristics observed in Mexican households

Socio demographic characteristics	1984	1989	1996	2000	2005
Average income per capita[a]	1582.0	1550.0	1570.0	1919.0	2200.0
Birth rate	4.2	3.9	2.8	2.7	2.5
Household size	5.1	5.0	4.6	4.2	4.0
Average number of household members that are income earners	1.6	1.7	1.8	1.9	2.0

[a] HERNÁNDEZ LAOS (2000) in pesos from 1996

Source: Author's calculations from the National Household Survey (INEGI, 2005a) and data from LÓPEZ RAMIREZ (2005).

The interrelation of these facts might suggest a high correlation between the increases in the average income per capita within the household and the higher number of household members earning money, as well as the smaller number of household members (Table 2-12).

This phenomenon has been observed and extensively documented in developed countries (JEJEEBHOY, 1996; KILLINGSWORTH and HECKMAN, 1986, etc.), and is highly related to an increase in economical well-being for households. In Germany, England, Canada and the USA, the share of working women accounts for 40 percent of married women. Many household workers lead to more income for the whole household and more income per capita within the household, as well as better possibilities for an affordable education (e.g. private schools).

2.4 Bilateral and Multilateral Trade Agreements

In the previous sections of this chapter, the main characteristics of the Mexican economy, the structure of agricultural farms and main characteristics of households have been introduced. In this section, the bilateral and multilateral trade agreements and the respective agricultural chapters are reviewed.

In 2000 a program to promote trade and investment was initiated. The agenda was called "Program of International Trade and Investment Promotion 2001-2006" (OFFICIAL JOURNAL OF THE FEDERATION, 2004). The program underlines trade strategies for Mexico to be implemented in the coming years. According to the program, "The strategy of Mexico to confront and to optimise the benefits of globalisation is to focus on the definitive preferential access of Mexican products into main international markets." To achieve this goal, a selection of strategic regions had been defined: North America as the largest market worldwide is the first trade target of Mexican products. Latin America presents an attractive opportunity to expand trade by taking advantage of the geographical proximity. Finally, Europe and Japan

are especial trading partners with broad market possibilities for a diversification of Mexican exports.

By 2006, Mexico was the country with the largest network of Free Trade Agreements (FTAs) in the world. Mexico's network of FTAs with 43 countries is distributed over three different continents. According to the Mexican Ministry of Economy, Mexico's network of FTAs is formed as follows:

1992 – Mexico-Chile FTA: This treaty was Mexico's first FTA. The agreement contemplated from the beginning the elimination of export subsidies, and the elimination of tariffs for fresh and frozen fruits coming from Mexico. Since the January 1, 2006 apples coming from Chile have been free of tariffs in Mexico. By 2005, total trade between Mexico and Chile had increased twelve-fold since 1991, amounting to USD 2.2 Bil.

1994 – NAFTA among Mexico, USA and Canada: Specifications concerning the agricultural sector consider the following priorities: internal supports, reduction of prices, market access and subsidies for export products.

As a consequence of notorious differences in agricultural development between Mexico and its NAFTA partners, negative effects on production and employment in agricultural sectors in Mexico were expected after the implementation of NAFTA. In order to prevent these negative effects, the Mexican state tried to support competitiveness among farmers to increase export-driven growth. New policies to support financially producers[1] were initiated. In 2002, the state contributed about USD 9 billion to producers for agricultural support programmes. However, these economic supports do not compete with those implemented in trade partner countries. Farmers in the USA, in comparison, receive twice that amount in subsidies (HENRIQUES PATEL, 2003).

The last cuts to be removed as scheduled by NAFTA include sensitive products. For the USA, tariff abolishment for orange juice (frozen and fresh), watermelon, dried onion, dried garlic and peanuts started January 1, 2008. Sensitive products for Mexico that have been free of tariffs since the January 1, 2008, included maize, beans, sugar and sugar cane, and milk (FOREIGN TRADE INFORMATION SYSTEM, 2007).

[1] Some examples of such policies are the programmes PROCAMPO and Alianza para el Campo, which are programmes of direct payments for farmers.

Since the implementation of NAFTA in 1994, this agreement has been a key instrument in increasing trilateral trade. Between 1994 and 2005, total trade among the three countries grew by 128 percent to reach USD 772 Bil. In 2005, bilateral trade between Mexico and the USA reached over USD 288 Bil, while total trade during the same period between Mexico and Canada reached over USD 18 Bil (MINISTRY OF ECONOMY, 2006).

1995 – G3 FTA among Mexico, Venezuela and Colombia: On January 1, 2004, all import tariffs were eliminated for food commodities (FOREIGN TRADE INFORMATION SYSTEM, 2007). In 2004, Panama requested inclusion into the FTA (ALADI, 2005). In 2006, Venezuela formally withdrew from the FTA Since the January 1, 2005, export subsidies for food commodities were eliminated in Mexico and Colombia. Sensitive products such as sugar and sugar cane were removed from the agreement. Total trade under this agreement accounts for USD 3.3 Bil (FOREIGN TRADE INFORMATION SYSTEM, 2007).

1995 – Mexico-Costa Rica FTA: This agreement eliminates export subsidies in some food commodities. Total access to apples, pickles, chickpeas, plum, peaches, cherries, canned tomato and grape juice as main products is considered (FOREIGN TRADE INFORMATION SYSTEM, 2007).

Tariffs are cut gradually for beef, pork, roses, grains, oil seeds, oil, cacao and processed food. Sensitive products such as coffee, bananas, dairy products and poultry were excluded from this agreement (FOREIGN TRADE INFORMATION SYSTEM, 2007). Total trade in the region increased ten-fold between 1994 and 2005, and reached USD 1.2 Bil.

1995 – Mexico-Bolivia FTA: This agreement involved an immediate elimination of tariffs on products such as legumes, horticultural crops, asparagus, avocado, strawberries, beer, tequila, mescal, evaporated milk, chilli, onion, watermelon, melon, citric juices, papaya, apple and peach. Elimination of tariffs on maize and beans is planned for January 1, 2009 (FOREIGN TRADE INFORMATION SYSTEM, 2007).

Temporarily, some products such as beef, pork, poultry products, milk and sugar are exempted from the agreements. Total trade between Mexico and Bolivia increased by 130 percent between 1995 and 2005 (FOREIGN TRADE INFORMATION SYSTEM, 2007).

1998 – Mexico-Nicaragua FTA: On January 1, 2007, both countries eliminated export subsidies on all agricultural products. Immediately after this agreement came into force, 45 percent of Mexico’s total exports to Nicaragua entered duty free, while 77 percent of Nicaragua’s exports to Mexico entered duty free. By 2005, total trade between both countries had reached USD 465 Mio (FOREIGN TRADE INFORMATION SYSTEM, 2007).

2000 – Mexico-European Union (EU) FTA: This treaty created the first free-trade area between Europe and the American continent. The EU represents the second most important region after North America for trading relationships, absorbing 4 percent of total Mexican exports. Preferential access of 95 percent of Mexican products into the EU was granted. It considers the elimination of tariffs over a 10-year period, as well as the elimination of tariffs on coffee, chickpeas, tequila, beer, mangos, guavas and avocado, and a higher quota for orange juice. Since January 1, 2008, avocado, lemon and grapefruit have been exempt from import tariffs. In 2005, total trade between Mexico and the EU reached USD 34 Bil (FOREIGN TRADE INFORMATION SYSTEM, 2007).

2000 – Mexico-Israel FTA: This agreement permitted Mexico to increase trade with Israel. In 2005, Mexico achieved a total trade with Israel of USD 456 Mio (FOREIGN TRADE INFORMATION SYSTEM, 2007).

2001 – Mexico-European FTA: This treaty signed with Norway, Iceland, Switzerland and Liechtenstein was negotiated on the basis of the Mexico-EU FTA. In 2005, total trade between Mexico and EFTA countries reached USD 2.3 Bil (FOREIGN TRADE INFORMATION SYSTEM, 2007).

2001 – Mexico- North Triangle FTA between Mexico and El Salvador, Guatemala and Honduras: This agreement excludes products such as sugar, coffee and bananas. The schedule classified food commodities into three different categories. The first category includes 30 percent of the products, which were granted with immediate access. The second category includes 12 percent of the considered products and are to be liberalised in medium-term. The third category considers 41 percent to be liberalised in long-term. Since January 1, 2006, export subsidies have been eliminated for all food commodities. In 2005 total trade between Mexico and the North Triangle reached USD 1.8 Bil (FOREIGN TRADE INFORMATION SYSTEM, 2007).

2004 – Mexico - Uruguay FTA: This agreement pursues the consolidation of business opportunities for Mexico within Mercosur. In 2005 total trade between Mexico and Uruguay accounted for USD 900 Mio (FOREIGN TRADE INFORMATION SYSTEM, 2007).

2005 – Mexico - Japan Economic Partnership Agreement (EPA): The agreement represents a sizable advantage for both trading partners. For Mexico; Japan is the third most important trade partner after North America and the EU (FOREIGN TRADE INFORMATION SYSTEM, 2007). A comprehensive review of the FTAs signed by Mexico is extracted from the WTO (2008a) and presented in Table 2-13.

Table 2-13 Free-trade agreements (FTAs) signed by Mexico (1993-2006)

Agreement	*Effective date (signed)*	*Areas covered*
North American Free Trade Agreement (NAFTA) (with the United States of America and Canada)	January 1, 1994 (December 20, 1993)	National treatment and market access for goods; rules of origin; customs procedures; energy and basic petrochemicals; agricultural sector and sanitary and phytosanitary measures; emergency measures; standardization measures; government procurement; investment; cross-border trade in services; telecommunications; financial services; competition policy; temporary entry of business personnel; intellectual property; dispute settlement on anti-dumping and countervailing duties; institutional arrangements and dispute settlement.
G-3 FTA (with Columbia and Venezuela)[a]	January 1, 1995 (January 9, 1995)	Rules of origin; customs procedures; contingency measures; sanitary and phytosanitary measures; technical standards; services; telecommunications; financial services; temporary entry of business personnel; investment; government procurement; intellectual property and dispute settlement.
Mexico-Costa Rica FTA	January 1, 1995 (January 10, 1995)	Market access for goods; rules of origin and customs procedures; industrial sector and technical standards; agricultural sector and sanitary and phytosanitary measures; services; temporary entry of business personnel; investment; dispute settlement; institutional arrangements; government procurement and intellectual property.
Mexico-Bolivia FTA	January 1, 1995 (January 11, 1995)	Market access for goods; rules of origin and customs procedures; industrial sector and technical standards; agricultural sector and sanitary and phytosanitary measures; services; telecommunications; temporary entry of business personnel; financial services; investment; dispute settlement; government procurement; and intellectual property.
Mexico-Nicaragua FTA	January 1, 1998 (July 1, 1998)	Market access for goods; rules of origin; customs procedures; industrial sector and technical standards; agricultural sector and sanitary and phytosanitary measures; services; telecommunications; temporary entry of business personnel; financial services; investment, dispute settlement; institutions; government procurement; and intellectual property.
Mexico-Chile FTA	August 1, 1999 (July 28, 1999)	Market access for goods; rules of origin; technical regulations, sanitary and phytosanitary measures, safeguard measures; investments; cross-border trade in services; air transport; temporary entry of business personnel; telecommunications; competition policy; intellectual property and dispute settlement. In 2007, negotiations were completed on government procurement and negotiations began on financial services.
Mexico-EU-27 FTA	July 1, 2000 (June 26, 2000)	Market access for goods; rules of origin; technical regulations; sanitary and phytosanitary measures; safeguards; investments; trade in services; maritime transport; financial services; government procurement; competition policy; intellectual property; and dispute settlement.
Mexico-Israel FTA	July 1, 2000 (June 28, 2000)	Market access for goods; rules of origin; customs procedures; standards; safeguards; competition policy; government procurement and dispute settlement.
Mexico-Northern Triangle FTA (with El Salvador, Guatemala and Honduras)	March 15, 2001 with El Salvador and Guatemala, and June 1, 2001 with Honduras (March 14, 2001)	Market access for goods; customs procedures; rules of origin; technical standards, sanitary and phytosanitary measures, safeguards, trade in services; financial services; temporary entry of business personnel; telecommunications; investments; intellectual property and dispute settlement.
Mexico-European Free Trade Association FTA	July 1, 2001 (June 29, 2001)	Market access for goods; rules of origin; services and investment; competition; anti-dumping and subsidies; government procurement; intellectual property; institutional arrangements and dispute settlement.
Mexico-Uruguay FTA	July 15, 2004 (July 14, 2004)	Safeguards; unfair trade practices; competition policies; rules of origin; sanitary and phytosanitary measures, technical standards; intellectual property; investment; trade in services; cross-border trade in services; telecommunications; temporary entry of business personnel and dispute settlement. In 2006, negotiations began on financial services and government procurement.

Mexico-Japan Economic Association Agreement	April 1, 2005 (March 31, 2005)	Market access for goods; rules of origin; customs procedures; sanitary and phytosanitary standards; technical standards; safeguards; investment; services; financial services; temporary entry of business personnel; government procurement; competition; and dispute settlement. In addition, cooperation in areas such as trade and investment promotion, SMEs, support industry, science and technology, agriculture and tourism.

a) Since 2007 Venezuela resign from the FTA

Source: Adapted from WTO (2008a)

Mexico is also a member of multilateral trade organizations.

WTO: Mexico has been a member of the WTO since 1995. In the framework of the Doha Agenda, Mexico participates actively in negotiations supporting a conclusion of the Doha Round with favourable results for developing countries. Mexico negotiations are mostly focused on agriculture (as a member of the G-20[2]), market access for non-agricultural products, trade facilitation, trade rules, services and intellectual property (geographical indications) (WTO, 2008a).

Asia Pacific Economic Cooperation (APEC): One of APEC's main goals is to contribute to the development of the region, as well as to support a free international trade system. Mexico was APEC's 2002 chair, and hosted the "APEC's 14th Ministerial Meeting" and the "10th APEC Economic Leaders Meeting," both held in Los Cabos, Mexico, in October 2002.

Latin American Integration Association (ALADI): A member of this regional organization since 1980, Mexico pursues closer commercial integration within the region through the negotiation of partial-scope trade agreements with other members.

Organization for Economic Co-operation and Development (OECD): Provides a forum for analysis and co-operation and was created with the aim of expanding production, increasing jobs and promoting economic harmonisation. Mexico joined the OECD in 1994.

[2] The G-20 consists of Argentina, Bolivia, Brazil, Chile, China, Cuba, Ecuador, Egypt, Guatemala, India, Indonesia, Mexico, Nigeria, Pakistan, Paraguay, Peru, Philippines, South Africa, Thailand, the United Republic of Tanzania, Uruguay, Venezuela and Zimbabwe.

3 Theoretical Basis: The Global Trade Analysis Project (GTAP) Model

Computable General Equilibrium (CGE) models are constructed with a Social Account Matrix (SAM) as the basis. A SAM portrays all the transactions that occur in a national or regional economy during one reference year. One of the first pioneers in introducing a SAM to the construction of a CGE model was JOHANSEN (1960), who modelled the Norwegian economy, including 19 commodities, with data from 1950. Since then, the use of SAMs to build CGE models has increased. Moreover, CGE models have been used as a tool for both research and policy analysis (DEJAVARAN and ROBINSON, 2002).

Following JOHANSEN, economists such as SHOVEN and WHALLEY (1972) continued working with and expanding the CGE framework. Their approach is based on three steps: (a) developing the SAM data base, (b) calibrating the behavioural parameters with the data contained in the SAM, and (c) computing the counterfactual data base (SHOVEN and WHALLEY, 1984). The principles applied in these pioneer studies continue to serve as the platform of current CGE models (DERVIS, et al., 1982, DE MELO 1988 etc.). The use of CGE models has covered a broad range of topics, including among others international trade, environmental policy, agricultural policy, household analysis, income distribution and poverty.

The GTAP was established in 1992 at Purdue University, West Lafayette, USA. The model developed by the GTAP is a broadly used CGE model. The GTAP model is the result of a multi-institutional effort to produce a reliable economic model based on an up-to-date data base, a well documented and free bibliography containing detailed information on the econometric background behind the model, quantitative information on bilateral trade agreements among included regions, etc. A detailed description of the GTAP model can be found in HERTEL (1997). The GTAP model is a multiregional model linking data of production and trade for the countries and regions included in the data base. GTAP is a static model, because the element of time is not regarded as a variable. The model supposes perfect competition and constant returns to scales. The general equilibrium model is solved numerically by the software called General Equilibrium Modelling Package (GEMPACK) (HARRISON and PEARSON, 2002). Other models make use of the GTAP data base, i.e., LINKAGE[3], but applying other model frameworks.

[3] For further details of the LINKAGE model consult http://go.worldbank.org/7NP2KK1OH0.

This chapter brings forward the arguments for the methodology selection. In Section 3.2, the main element of the macroeconomic assessment of this study, the GTAP framework, is comprehensively described through a graphical presentation. The basic notation, equations and empirical background behind the GTAP model are also presented. Section 3.3 provides an overview of the accounting relationships underpinning the equilibrium system in the GTAP model. Finally, in order to identify possible contributions to the study of impacts of agricultural trade liberalisation on income distribution, Section 3.4 analyses the character, scope and achievements of existing studies that link CGE models with household analysis.

3.1 Justification of Methodology

This study proposes a methodology to evaluate the impact of agricultural trade reforms on household expenditures. Agricultural trade reforms in national economies are led by increasing international trade flows that modify structures in national markets. Since global markets are interconnected, it is necessary to employ a method permitting economists to outline linkages among national and international markets. Although these linkages are not necessarily obvious, it is important to consider them when analysing household welfare (WINTERS et al., 2004). The importance of these linkages in this study is addressed through the possible impact that commodity price changes might have on expenditure patterns at the household level. As a consequence, the approach must reflect changes in macroeconomic variables that might be responsible for changes observed in expenditure patterns and the composition of expenditures at the household level. With these key facts, the most suitable approach for this research is a general equilibrium model. The integration of household analysis into a CGE model can be a suitable method to assess international trade reforms and their possible effects on household welfare (IVANIC, 2004; HERTEL et al., 2007).

The general equilibrium model chosen as the platform for this study is the GTAP model. The main objective of this ambitious project was the development of a transparent, efficient instrument for economy-wide analysis of policy issues at low entry costs (HERTEL, 1997). The following aspects are of particular importance for the project:

- New users have the possibility of exploring the model structure and functions, since full model documentation is publicly available.
- GTAP is based on a standard modelling framework.
- Software has been developed to manipulate the data and extend the standard model in a user-friendly environment.

- The model can be improved by users, since full documentation is provided.
- GTAP has also created an Internet site for distributing software and data, exchanging model versions, networking among economists and other project-related items of interest.
- The project is led by a consortium of national and international agencies (HERTEL, 1997).

The GTAP model was envisaged to have global economic coverage. In this design, the most suitable assemblage was the introduction of a representative private household. This particularity makes the model unsuitable to investigate changes across different households within a region. This research presents an alternative method to obtain differentiated results for different household categories. The approach presented here permits users to apply the GTAP model to investigate changes of household expenditure within a region caused by trade reforms.

3.2 Graphical Overview of the Standard GTAP Model

This section describes the structure of the GTAP model. A complete understanding of the structure of the GTAP model will help the reader easier follow the design of the household module presented in Chapter 4 and the implications of the results on hand in Section 5.6. Because of the considerable complexity of the GTAP model's structure, it will be described graphically, starting with a simple representation of the model in Figure 3-1 and gradually including new elements to create the final appropriate representation of the model in Figure 3-3.

3.2.1 Closed Economy without Government Interventions

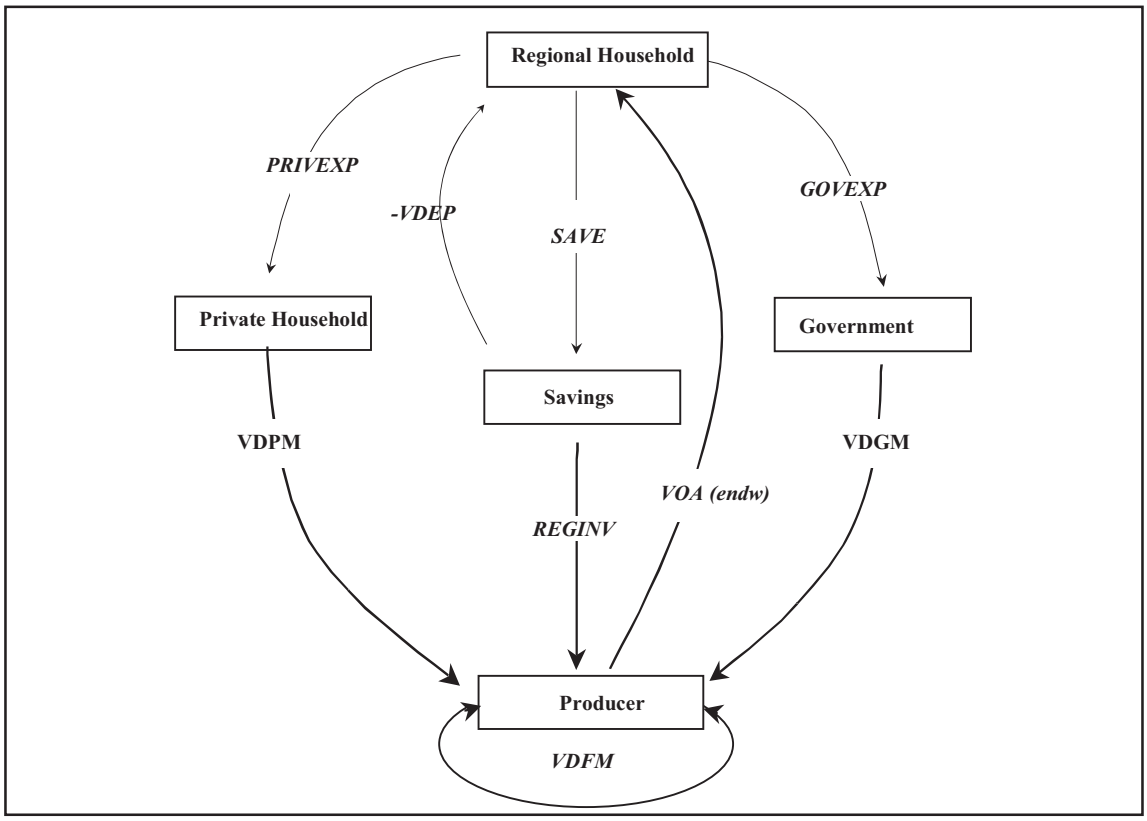
A single economy is represented in GTAP by a regional household for each country or region regarded in the model. The regional household embodies three basic elements: the government, the representative private household and regional savings (HERTEL, 1997; BROCKMEIER, 2003).

These final consumers are depicted in Figure 3-1. In this representation, regional income is allocated across the three final consumers: the private expenditure (PRIVEXP), the government expenditure (GOVEXP) and the savings (SAVE). In the standard closure of the model, the Cobb-Douglas function assures that the three final consumers receive constant budget shares. The closure can be modified to fix government purchases and savings, leaving

the private household to adjust as a direct function of the regional budget constraint (HERTEL, 1997; BROCKMEIER, 2003).

In this region, firms sell goods to private households (VDPM = Value of Domestic purchases by Private households at Market prices) and the government (VDGM = Value of Domestic purchases by Government at Market prices) and investments in the capital account (REGINV) and intermediate goods (VDFM = Value of Domestic purchases by Firms at Market prices) to other producers. The income flow is represented as VOA (endowments) which denotes Value of Outputs at Agent prices of endowment commodities: land, natural resources, capital and skilled and unskilled labour. The coefficient VOA represents the costs firms pay for the use of endowments (HERTEL, 1997; BROCKMEIER, 2003).

Figure 3-1 Closed economy without government interventions[a]



[a] See Appendix A for a description of the parameters and variables described here

Source: BROCKMEIER (2003)

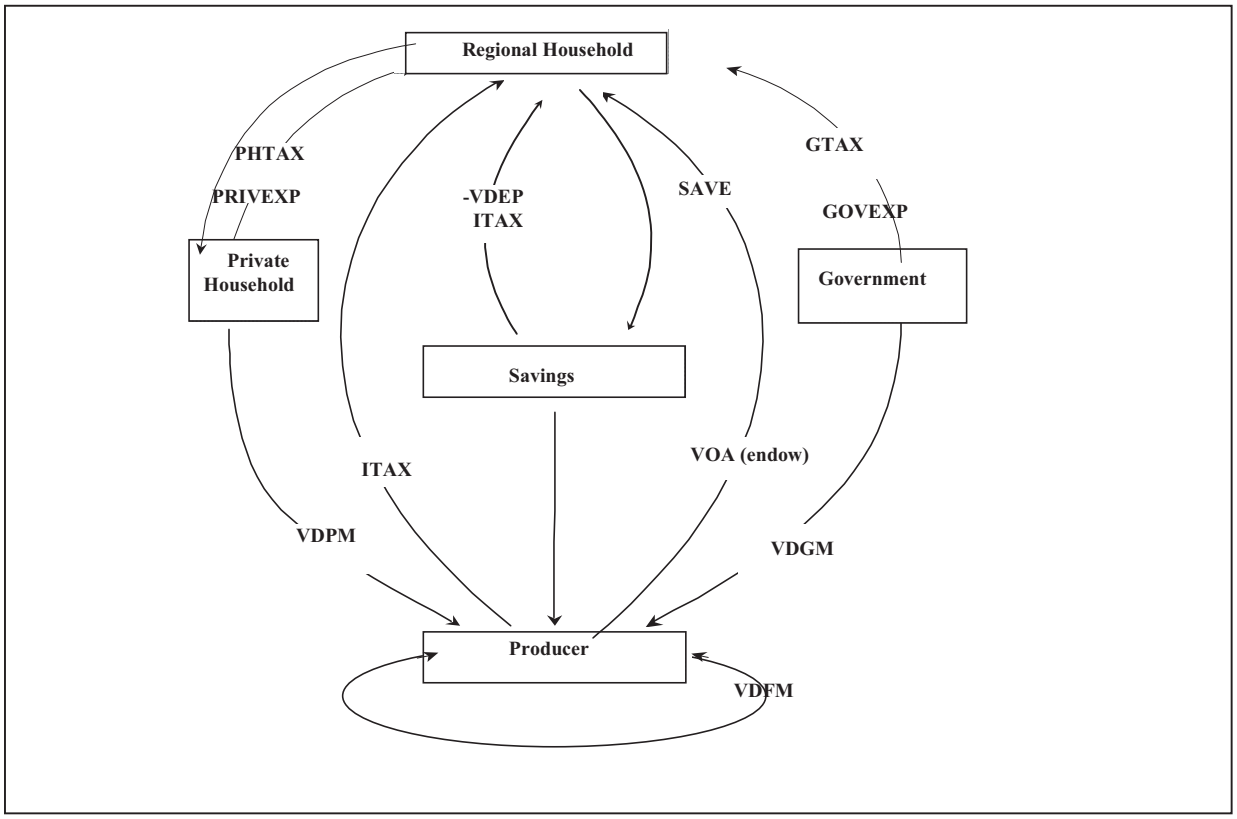
3.2.2 Closed Economy with Taxes

The next elements to be integrated are the government interventions, which in the case of the GTAP model are introduced in the form of tax flows. Figure 3-2 includes the additional flows arising from policy interventions.

The new integrated flows labelled, as TAX (e.g., PHTAX, ITAX, and GTAX) can be taxes, subsidies or the combination thereof. The flows do not represent single taxes or subsidies; rather, they represent the net flows – if the subsidy is higher in amount than the tax paid, the flow is depicted as positive (a net subsidy). Net subsidies are represented as deductions and net taxes as additions (HERTEL, 1997; BROCKMEIER, 2003).

Subsidies paid and taxes collected are calculated in GTAP as the difference between agent prices and market prices (HERTEL, 1997; BROCKMEIER, 2003).

Figure 3-2 Closed economy with taxes[a]



[a] See Appendix A for a description of the parameters and variables described here

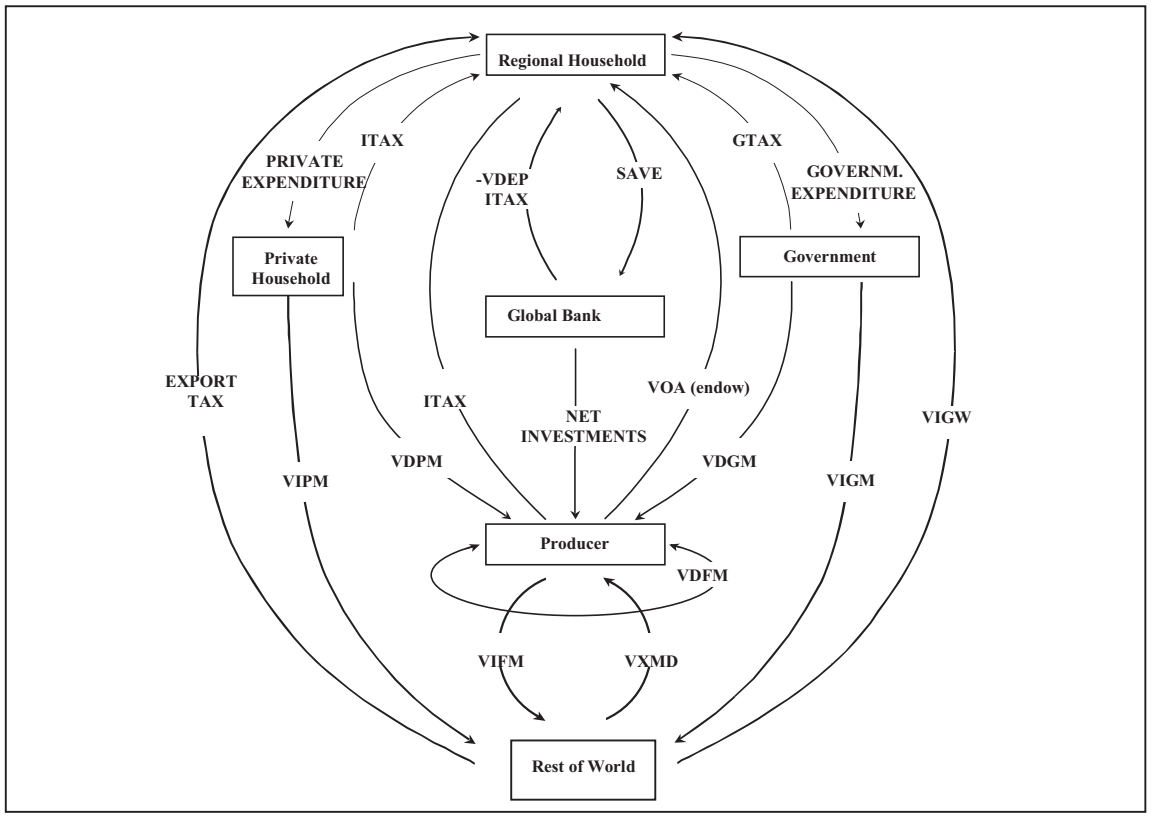
Source: BROCKMEIER (2003)

3.2.3 Open Economy with Taxes

The next step consists of the transformation to an open economy by the integration of a second region. Figure 3-3 shows the case of international trade by the integration of a new region, the rest of the world. This region has the same components as the domestic economy. The rest of the world produces domestic commodities, which might be exported to the regional household, and consumes import products from the regional household. Imports in the GTAP model are specified for each of the final domestic consumers, resulting in distinct import payments to ROW (Rest of the World) from private households (VIPM), government

budget (VGPM) and intermediaries purchased by firms (VIFM). These specific flows are important for the analysis of trade policy in regions where import values of the same commodity vary across uses (HERTEL, 1997; BROCKMEIER, 2003).

Figure 3-3 Open economy with taxes[a]



[a] See Appendix A for a description of the parameters and variables described here

Source: BROCKMEIER (2003)

3.3 Equation System of the GTAP Model

The GTAP model is a comparative static, general equilibrium model; therefore, an initial baseline setting the behaviour of all the elements included in the model must be provided (BROCKMEIER, 2003). For this purpose, behavioural equations characterise the role of elements in the economy. The model contains two different groups of equations. The first group of equations is a set of identity equations. These equations, called system constraint equations, define the equilibrium conditions of the model (e.g., supply and demand for every single market must be equal). The constraint equations are known as market clearing equations (BROCKMEIER, 2003) and support the equilibrium system of the GTAP model. The fundamental basis of market equilibrium is based on the Walras Law, which verifies that in each market, supply equals demand. The second group of equations describes the behaviour of single economic activities based on microeconomic theory (e.g., demand of private

households or supply from firms). This section describes both groups of equations, which model the assumptions of the GTAP model. The description presented here is a synthesis of descriptions provided by HERTEL (1997); BROCKMEIER (2003) and SCHUSCHNY, et al. (2007).

3.3.1 Walras Law in CGE Models

In a CGE model, the Walras coefficient is an entity obtained by adding up expenditure restrictions of all agents involved in the sales of each market. The principal conclusion of the Walras Law is the equilibrium of the *n-th* market when *n-1* markets are in equilibrium. In CGE models, a market is in equilibrium when the demand equals the supply (VARIAN, 2002). If all markets but the last one are in equilibrium, and the last market has a positive price, then this last market is in equilibrium as well. Thus, zero homogeneity in prices assures that relative prices can be calculated.

In order to verify this general equilibrium, a production function is taken as an example (CROUCH, 1972). This production function has a fixed price vector P. The total sum of demands by the *j-th* market is represented as:

$$P_1D_{1j} + P_2D_{2j} + P_3D_{3j} + P_4D_{4j} + ... + P_nD_{nj} = \sum_{i=1}^{n} P_iD_{ij} \qquad 3.1$$

where: P_1, P_2... P_n are the prices of the *n* traded goods and D_1, D_2... D_n are the demand quantities of those traded goods by the *j-th* market. In the same manner, the supply of the *j-th* market can be represented as:

$$P_1S_{1j} + P_2S_{2j} + P_3S_{3j} + P_4S_{4j} + ... + P_nS_{nj} = \sum_{i=1}^{n} P_iS_{ij} \qquad 3.2$$

where: S_1, S_2... S_n are the quantities of the *n* goods that the *j-th* market sells.

Since in equilibrium conditions all demanded goods by the *j-th* market must be equal to the total supply of the *j-th* market, this can be symbolised as:

$$\sum_{i=1}^{n} P_iD_{ij} = \sum_{i=1}^{n} P_iS_{ij} \qquad 3.3$$

Thus, the aggregate value of demand by all markets must be equal to the aggregate value of the quantities offered for sale by all markets. This is represented as the sum in Equation 3.3 over all *k* markets to get:

$$\sum_{j=1}^{k} \sum_{i=1}^{n} P_i D_{ij} = \sum_{j=1}^{k} \sum_{i=1}^{n} P_i S_{ij} \qquad 3.4$$

Separating the prices from each side of Equation 3.4:

$$\sum_{j=1}^{k} P_i * [\sum_{i=1}^{n} D_{ij}] = \sum_{j=1}^{k} P_i * [\sum_{i=1}^{n} S_{ij}] \qquad 3.5$$

In Equation 3.5, the expression in parentheses on the left hand side is the total market demand for the *i-th* good, because it is the sum of the individual transactors' demand for that commodity. This total market demand for the *i-th* commodity is also represented as D_i. The expression in parentheses on the right hand side is the total market supply of the *i-th* good, and is represented as S_i. These facts can be rewritten as:

$$\sum_{i=1}^{n} P_i D_i = \sum_{i=1}^{n} P_i S_i \qquad 3.6$$

Equation 3.6 is known as the Walras Identity (CROUCH, 1972). This equation states that the aggregate value of expenditures must be equal to the aggregate value of all market sales. The Walras Identity assumes that a set of prices different from zero has been established. Thus, demand equalises supply in each market except in the *n-th* market. Since all *n-1* markets are in equilibrium then:

$$D_1 = S_1, D_2 = S_2, \ldots, D_{n-1} = S_{n-1} \qquad 3.7$$

Including the vector price to bring these *n -1* markets in equilibrium, the following is obtained:

$$P_1 D_1 = P_1 S_1, P_2 D_2 = P_2 S_{2,\ldots,} P_{n-1} D_{n-1} = P_{n-1} S_{n-1} \qquad 3.8$$

Adding up:

$$\sum_{i=1}^{n-1} P_i D_i = \sum_{i=1}^{n-1} P_i S_i \qquad 3.9$$

Subtracting Equation 3.9 from the Walras Identity (Equation 3.6):

$$P_n D_n = P_n S_n \qquad 3.10$$

As the price is the same, Equation 3.10 implies that:

$$D_n = S_n \qquad 3.11$$

This equation means that the *n-th* market is also in equilibrium. This statement is of great importance in CGE models, because it allows modellers, when necessary, to skip the last equation, or to introduce an equation that permits modellers to cross-check the consistency of the model, since this last market is in equilibrium, as demonstrated here.

3.3.2 Behavioural Equations in the GTAP model

The preceding group of equations has been developed to describe the behaviour of all participants in the economy, e.g., firms, consumers, government and savings. In this section, equations representing price relationships in GTAP are presented; thereafter, behaviour of producers and final demand consumers is also introduced.

3.3.2.1 Price Equations

As explained above in Section 3.2.1, taxes and subsidies in GTAP are modelled as the difference between market and agent commodity prices. This difference represents the influence of diverse policies implemented by governments in each region. The regional policies implemented modify domestic prices through interventions in agent prices. Similarly, trade policies modify the relationship between regional market price and world market price. In this section, the introduction of these trade policies through different sets of prices is presented.

In the upcoming sections of this study, the notation used within the GTAP framework is followed, in which uppercase letters represent absolute values and lowercase letters represent percent changes of variables.

Differences in prices are represented mathematically as:

$$ppd_{ir} = tpd_{ir} + pm_{ir} \qquad 3.12$$

$$pgd_{ir} = tgd_{ir} + pm_{ir} \qquad 3.13$$

$$pfd_{ijr} = tfd_{ijr} + pm_{ir} \qquad 3.14$$

where:

ppd_{ir}	domestic price of domestic commodity i paid by private households in region r
pm_{ir}	market price of domestically produced commodity i in region r
pgd_{ir}	domestic price of domestic commodity i paid by government in region r

pfd_{ijr} domestic price of intermediate commodity i for firms producing j in region r

The variables tpd_{ir}, tgd_{ir}, and tfd_{ijr} are introduced in the model to define the implementation of agent-specific policies. In the GTAP model, these variables introduce a specific differentiation of prices paid by each consumer agent in the economy and the respective specifically targeted policies implemented at a national level.

Similarly, at a domestic level, variables representing government intervention in prices for the same three agents are introduced. These variables describe the relationships between import price and the corresponding prices for imported goods paid by each agent:

$$ppm_{ir} = tpm_{ir} + pim_{ir} \quad 3.15$$

$$pgm_{ir} = tgm_{ir} + pim_{ir} \quad 3.16$$

$$pfm_{ijr} = tfm_{ijr} + pim_{ir} \quad 3.17$$

where:

ppm_{ir} domestic price of imported commodity i paid by private households in region r

pim_{ir} market price of imported commodity i in region r

pgm_{ir} domestic price of imported commodity i paid by government in region r

pfm_{ijr} domestic price of imported intermediate commodity i paid by firms producing j in region r

Governmental interventions exist in production factors, as well. Taxes or subsidies on production factors are depicted in GTAP by the variable tf_{ijr}. Equation 3.18 represents the mathematical relationship of mobile primary factors and agent prices. Mobile primary factors in GTAP are endowment commodities with full mobility across markets within a region. The value of mobile endowment commodities increases proportionally with the returns to markets.

$$pfe_{ijr} = tf_{ijr} + pm_{ir} \quad 3.18$$

where:

pfe_{ijr} price of mobile endowment commodity i used by sector j in region r ($\forall i \in ENDWM\_COMM$)[4]

For immobile or sluggish commodities, Equation 3.19 presents their adjustments as a function of market prices and tf_{ijr}.

$$pfe_{ijr} = tf_{ijr} + pmes_{ijr} \qquad 3.19$$

where:

pfe_{ijr} price of sluggish endowment commodity i used by sector j in region r ($\forall i \in ENDWS\_COMM$)

$pmes_{ijr}$ market price of sluggish endowment i used by sector j in region r

The GTAP model also integrates a representation of governmental interventions in produced commodities. Equation 3.20 reflects the relationship between market and agent prices through an output tax:

$$ps_{ir} = to_{ir} + pm_{ir} \qquad 3.20$$

where:

ps_{ir} supply price of commodity i in region r

to_{ir} tax levied on output of commodity i in region r

The next equation brings into the model the influence of interventions on imported good i in region r coming from region s:

$$pms_{irs} = tm_{is} + tms_{irs} + pcif_{irs} \qquad 3.21$$

where:

pms_{irs} domestic price for good i supplied from region r to region s

tm_{is} source-generic tax on imports of i coming into region s

tms_{irs} source-generic tax on imports of i from region r into region s (levied in region s)

$pcif_{irs}$ source-generic CIF world price of commodity i supplied from region r to region s

[4]ENDWM_COMM is a set of endowment commodities. For a complete list of sets and other abbreviations, consult Appendix A.

Additionally $pcif_{irs}$ is calculated based on import and transport quantities:

$$pcif_{irs} = FOBSHR_{irs} * pfob_{irs} + TRNSHR_{irs} * [pt - atr_{irs}] \quad 3.22$$

where:

pt changes in price of transport

atr_{irs} technological change in shipping commodity i from region r to region s

$FOBSHR_{irs}$ FOB share in value of imports calculated as total costs of imports of commodity i from region r to region s

$TRNSHR_{irs}$ Transport share in value of imports calculated as total costs of imports of commodity i from region r to region s

FOB prices are modelled in Equation 3.23 with a similar structure to CIF prices. FOB prices depend not only on market prices in the origin region, but also on two kinds of taxes (subsidies) on exports: one of generic destination (tx_{ir}) and the other specifying a particular destination (txs_{irs}):

$$pfob_{irs} = pm_{ir} - tx_{ir} - txs_{irs} \quad 3.23$$

where:

$pfob_{irs}$ FOB world price of commodity i supplied from region r to region s

tx_{ir} destination-generic subsidy on exports of commodity i from region r

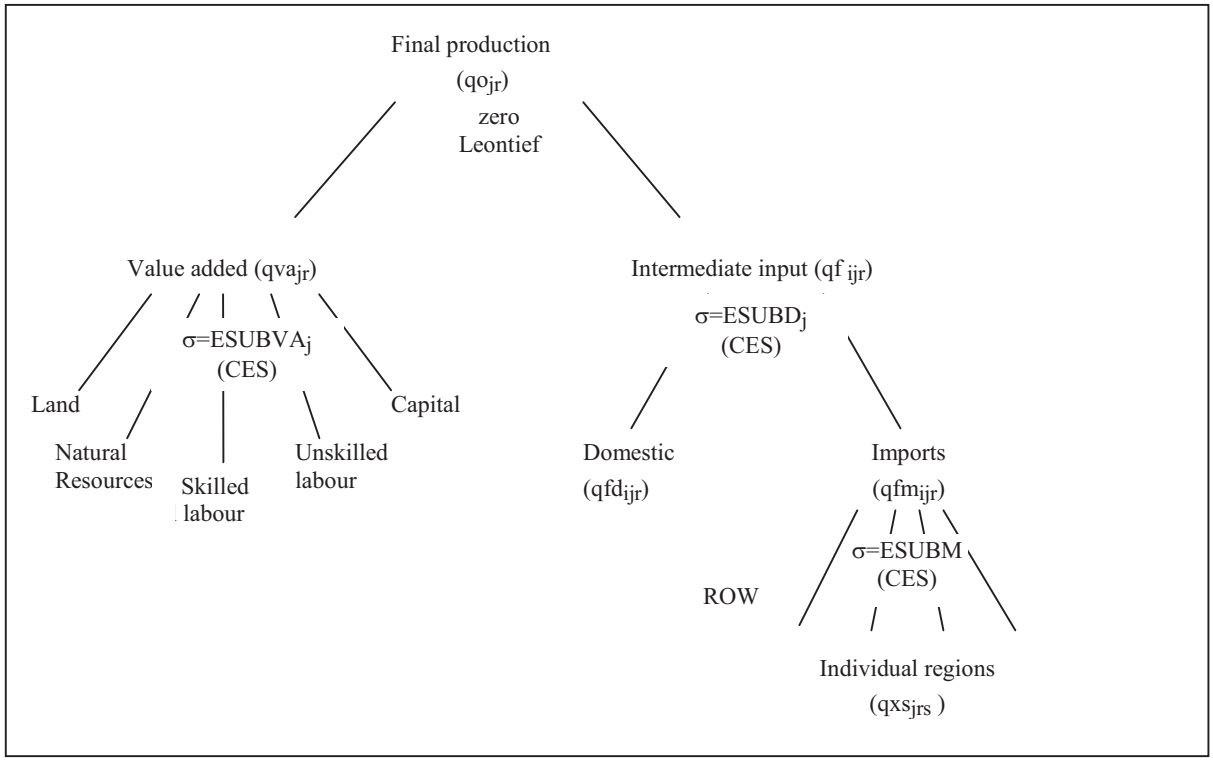
txs_{irs} destination specific subsidy on exports of commodity i from region r to region s (levied in region r)

3.3.2.2 Producers

The behaviour of producers in the GTAP model differentiates between the demand of primary factors and intermediate products. This differentiation assumes separability. The assumption of separability allows multi-staged decision-making in the model. Therefore, modifications occurring in one production nest do not affect other nests. The separability of producer decisions in the GTAP model is represented as a “production tree”, as shown in Figure 3-4. In the upper part of the figure, a Leontief production function models the

producers' output based on primary factors and intermediate goods used. The assumption of separability introduces the particularity in the model that firms can fix an optimal combination of primary factors independent from prices of intermediate goods. Neither of these two components of production (production factors and intermediate goods) is a substitute for the other. The next two branches of the production tree in Figure 3-4 show a structure of production functions of the CES form modelling demand for production factors (land, unskilled labour, skilled labour, capital, natural resources) and demand for intermediate commodities (domestic and import) required to produce final commodities. The system assumes that intermediates from different origins are different. Thus, the intermediates are demanded either from the domestic market or from imported suppliers. The distinction of their origin is comprised of imported intermediates.

Figure 3-4 Graphic representation of production in GTAP



Source: SCHUSCHNY et al. (2007)

The final production is based on a Leontief production function assuming constant return to scale:

$$QO_{jr} = \min(\upsilon_{jr} * QVA_{jr}, \psi_{ijr} * QF_{ijr}) \qquad 3.24$$

where:

QO_{jr} quantity output of commodity j in region r

QVA_{jr} quantity of production factor j in region r

QF_{ijr} intermediate use of commodity j by production of i in region r

ψ_{ijr} share of intermediate aggregate i for the production of j in region r

υ_{jr} share of value added for the production of j in region r

The parameters ψ_{ijr} and υ_{jr} correspond to technical coefficient coming from Input Output Tables (IOT).

In Figure 3-4, the first and second branch after the Leontief function represent the demand function of endowments and intermediates. Their respective percentage variation are:

$$QVA_{jr} \frac{1}{\nu_{jr}} QO_{jr}, \rightarrow qva_{jr} = qo_{jr} - ao_{jr} - ava_{jr} \qquad 3.25$$

$$QF_{ijr} = \frac{1}{\varphi_{ijr}} * QO_{jr}, \rightarrow qf_{ijr} = qo_{jr} - ao_{jr} - af_{ijr} \qquad 3.26$$

Once the demand for inlays for production (endowments and intermediate commodities) has been fixed, demand for each endowment (represented in the first branch of Figure 3-4) and demand for each intermediate good (domestic or imported) are then allocated. This allocation takes place according to Constant Elasticity of Substitution (CES) functions. These two proportions are modelled as CES functions:

$$qfe_{ijr} + afe_{ijr} = qva_{jr} - ESUBVA_j * [pfe_{ijr} - afe_{ijr} - pva_{jr}] \qquad 3.27$$

The price of value added is determined by share-weighted prices as:

$$pva_{jr} = \sum_{i \in ENDW} SVA_{ijr} * [pfe_{ijr} - afe_{ijr})] \qquad 3.28$$

where:

qfe_{ijr} demand for endowment i by sector j in region r $(\forall i \in ENDW\_COMM)$

$ESUBVA_j$ substitution parameter between endowment commodities in the production of commodity j

afe_{ijr} primary factor i augmenting technological change by sector j in region r

pva_{ijr} firms' price of value added in industry j of region r

SVA_{ijr} share of i in total value added in production of j in region r

Shares of domestic and import intermediaries are allocated according to Armington's assumption of differences between domestic and imported products. The demand of domestic products is calculated as:

$$qfd_{ijr} = qf_{ijr} - ESUBD_i * [pfd_{ijr} - pf_{ijr}] \quad 3.29$$

and demands of import distinguish products according to their origin:

$$qfm_{ijr} = qf_{ijr} - ESUBD_i * [pfm_{ijr} - pf_{ijr}] \quad 3.30$$

where:

qfd_{ijr} demand for domestic good i by industry j in region r

qfm_{ijr} demand for import commodity i by industry j in region s

qf_{ijr} intermediate demand for commodity i for use in sector j in region r

$ESUBD_i$ region-generic elasticity of substitution between domestic and imported commodity i

pf_{ijr} firms' price of intermediates i by sector j in region r

3.3.2.3 Regional Household and Final Demand

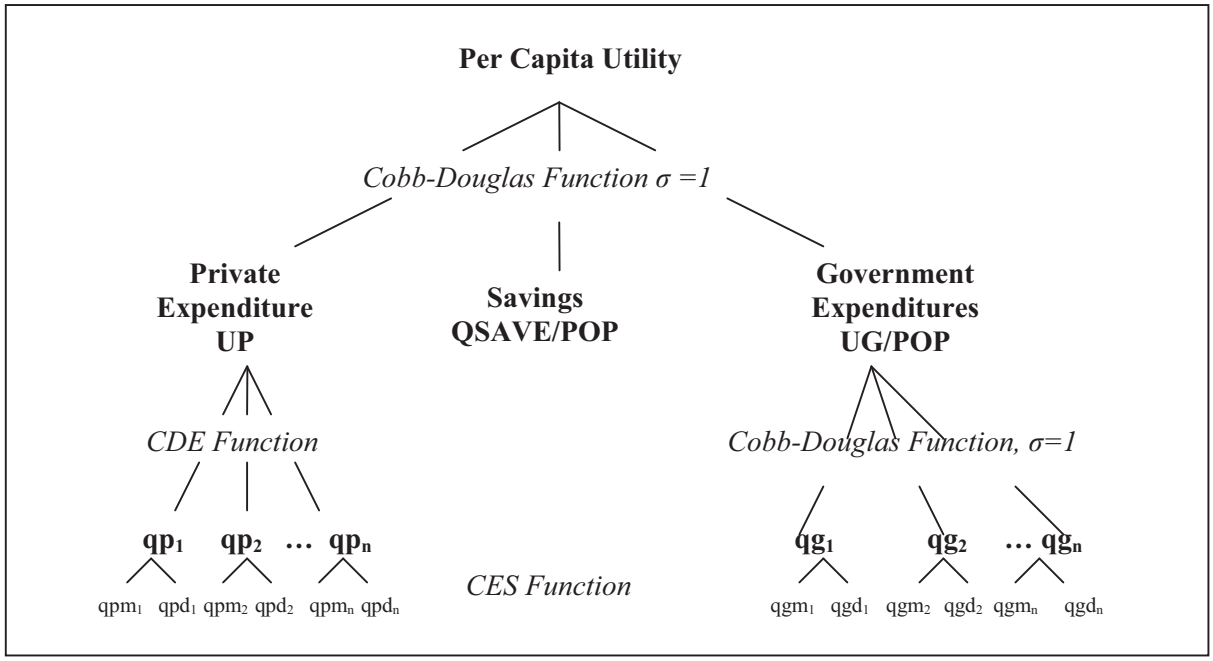
The assumption of separability is not limited to the production structure, but rather also plays a role in consumption. The assumption of separability is a practical way to introduce a utility tree in which each stage of consumption is independent from other stages. One particularity of the GTAP model is the introduction of the concept of "regional household". The regional household collects income and taxes and provides subsidies. The regional utility is represented as a per capita Cobb-Douglas utility function, as in Equation 3.31. This equation allocates the levels of expenditure in constant shares for private consumption, governmental expenditures and savings.

$$U_r = UP_r^{\frac{PRIVEXP_r}{INCOME_r}} * \left(\frac{UG_r}{POP_r}\right)^{\frac{GOVEXP_r}{INCOME_r}} * \left(\frac{QSAVE_r}{POP_r}\right)^{\frac{SAVE_r}{INCOME_r}} \quad 3.31$$

Regional utility is a function of the utility and expenditure shares of the three final consumers (private, government, and savings). The regional utility function in region r also considers the population rate (pop_r) and the final income in region r.

The comparative static GTAP model, does not contemplate intertemporal mechanisms for determination of savings. The procedure to model savings in this static framework introduces a scheme in which savings are introduced in the utility function, and treated as an equivalent to a temporal maximization problem. Thus, the GTAP model determines savings as specific shares of income. This representation eliminates the relationship between expenditures of the government and income generated from taxes. For this reason, the GTAP model is not appropriate to measure governmental behaviour in a function of exogenous changes in the structure.

Figure 3-5 Graphic representation of final demand in GTAP



Source: HERTEL (1997)

Private Demand in GTAP

The mathematical representation of the non-homothetic preferences of private households is handled in this part. The private utility basis is represented in the model on a per capita. This feature permits users to introduce regional population growth. The change in expenditures is dictated by the Constant Difference of Elasticities (CDE) system which is adopted by the GTAP model to define preferences of the private representative household.

The CDE expenditure function was introduced by HANOCH (1975), who discussed models more general than the CES but less general than a flexible functional form, for example, the translog. The CDE is based on the assumption of implicit additivity for goods broadly defined which, in the case of N commodities, constrains the symmetric $N \times N$ matrix of elasticities of substitution. The CDE also allows for non-homotheticity by introducing N "expansion parameters" one for each good, as well as for non-constancy of elasticity substitution through N

"substitution parameters" one for each good (HANOCH, 1975). The CDE implicit expenditure function is given by:

$$\sum B_{ir} UP_r^{(\beta_{ir},\gamma_{ir})} * \left[\frac{PP_{ir}}{E(PP_{ir}, UP_r)} \right]^{\beta_{ir}} \equiv 1 \qquad 3.32$$

In this equation, $E[PP_r, UP_r]$ represents the minimum expenditure to satisfy a pre-specified level of private utility UP_r; the vector of prices paid by private households in a given region r is represented by PP_{ir}. Parameters designated by β_i are the *N* "substitution parameters" among commodities for consumption (SUBPAR in GTAP); those designated by γ_i are *N* "expansion parameters", which appear because of non-homotheticity in consumption in region r (INCPAR in GTAP). Both type of parameters – β and γ – are initially calculated through a calibration to replicate the pre-specified vectors of compensated own-price elasticities of demand and income elasticities of demand. Terms B_{ir} are scale parameters necessary to specify the function containing information on the specific budget share; the linearized form of these preferences is represented in the model as $CONSHR_{ir}$.

The specification of the expenditure function in this form presents two advantages: first, the CDE system is based on a "per capita maximization"; through this approach, non-homothetic preferences are modelled. Secondly, calibration might be performed with previous information on income and price elasticities. In this case, calibration of consumption consists of suitably electing consistent values of β to reproduce known demand elasticities and then choosing γ to adjust for income elasticities. The general form of the expenditure function might be represented as a function of prices and utility:

$$YP_r = f(PP_{ir}, UP_{ir}) \qquad 3.33$$

The linearized representation of Equation 3.33 is:

$$dYP_r = \left(\frac{\partial YP_r}{\partial PP_{ir}} \right) * dPP_{ir} + \left(\frac{\partial YP_r}{\partial UP_r} \right) * dUP_r \qquad 3.34$$

Equation 3.34 is divided by YP_r; elements on the right side of the equation are multiplied by PP_{ir}/PP_{ir} and UP_{ir}/UP_{ir}, respectively, yielding:

$$yp_r = \left(\frac{\partial YP_r}{\partial PP_{ir}} \right) * \frac{PP_{ir}}{YP_r} * pp_{ir} + \left(\frac{\partial YP_r}{\partial UP_r} \right) * \frac{UP_r}{YP_r} * up_r \qquad 3.35$$

As shown by HANOCH (1975), the elasticity of expenditure in the utility function is equivalent to the multiplication of expansion parameters of the CDE function and consumption shares. Additionally, following Shepard's Lemma, the derivative vector of the expenditure function with respect to prices is the demand function. As regional expenditures are a function of regional population, the term pop_r represents changes in the regional population:

$$yp_r = \sum_{i \in TRAD} (CONSHR_{ir} * pp_{ir}) + \sum_{i \in TRAD} (CONSHR_{ir} * INCPAR_{ir} * up_r) + pop_r \qquad 3.36$$

where $CONSHR_{ir}$ represents B_{ir} in the linearized version of Equation 3.32. A similar procedure is developed to obtain the quantities demanded (qp_{ir}), which are in function of prices and total expenditures:

$$QP_{ir} = f(PP_{ir} * YP_{ir}) \qquad 3.37$$

The total derivative of 3.37 is:

$$dQP_{ir} = \frac{\partial QP_{ir}}{\partial PP_{ir}} + dPP_{ir} + \frac{\partial QP_{ir}}{\partial YP_{ir}} * dYP_{ir} \qquad 3.38$$

By dividing both sides through QP_{ir} and including PP_{ir}/PP_{ir} and YP_{ir}/YP_{ir} in both terms of the right side, respectively, the per capita demand function for each commodity (or its percentage change with respect to the equilibrium in the baseline) is:

$$qp_{ir} = \sum_{i \in TRAD} EP_{ikr} * pp_{kr} + EY_{ir} * [yp_r - pop_r] + pop_r \qquad 3.39$$

In the GTAP model, a CDE function is achieved by calibration of the income and expansion parameters (INCPAR and SUBPAR). In Equation 3.39, EP_{ikr} and EY_{ir} are price and income elasticities, respectively, and pp_{kr} is the percent of price variation of commodities k.

Elasticities EP_{ikr} and EY_{ir} are not constant; rather, they vary in function of relative prices and consumption shares. The formulas for the uncompensated price and income elasticities of demand EP_{ikr} and EY_{ir} are used to compute parameter values to be used in the system of equations representing the model. The first of these equations defines a parameter, α, that is equal to 1 minus the CDE substitution parameter.

$$\alpha_{ir} = [1 - \beta_{ir}] \qquad 3.40$$

Formulas 3.41 and 3.42 compute the own- and cross-price Allen partial elasticities of substitution in consumption values of β =0, creating preferences of the Cobb-Douglas type. When pre-multiplied by $CONSHR_{ir}$, Equation 3.42 yields the compensated, own-price elasticity of demand for commodity i. Once these elasticities have been specified, this linear system of equations may be solved for the "calibrated" values of α and β via 3.40:

$$APE_{ikr} = \alpha_{ir} + \alpha_{kr} - \sum_{m \in TRAD} [CONSHR_{mr} * \alpha_{mr})] \qquad 3.41$$

$$APE_{iir} = 2.0 * \alpha_{ir} - \sum_{m \in TRAD} [CONSHR_{mr} * \alpha_{mr}] - \frac{\alpha_{ir}}{CONSHR_{ir}} \qquad 3.42$$

Income elasticities of demand are also computed as a function of consumption shares; the income and expansion parameters are designated by γ and α. Thus, calibration of the own-price elasticities of demand (Equation 3.42) must precede calibration of the income elasticities.

$$EY_{ir} = [\sum_{m \in TRAD} CONSHR_{mr} * \gamma_{mr}^{-1} * \gamma_{mr} * [1.0 - \alpha_{ir}] + \sum_{m \in TRAD} CONSHR_{mr} * \gamma_{mr} * \alpha_{mr} + \left\{ \alpha_{ir} - \sum_{m \in TRAD} [CONSHR_{mr} * \alpha_{mr}] \right\} \qquad 3.43$$

Finally, to calculate uncompensated elasticities, both income and Allen elasticities are combined as in Equation 3.44:

$$EP_{ikr} = [APE_{ikr} - EY_{ir}] * CONSHR_{ir} \qquad 3.44$$

As seen in Figure 3-5, first the quantities of commodities consumed by households (qp_{ir}) are determined through a CDE function. Then, import and domestic quantities are calculated through a CES utility function. As mentioned before, the GTAP model distinguishes commodities by origin. Thus, consumers differentiate between domestic and imported commodities (ARMINGTON, 1969). This theory, proposed by Armington, introduces in the GTAP model trade flows of a commodity in two directions: a given good can be exported and imported simultaneously. Another advantage of this assumption is that it makes import commodities imperfect substitutes for domestic goods. The quantity of domestic commodity i consumed by the private household is:

$$QPD_{ir} = QP_{ir} * PMSHR_{ir} * \left(\frac{PPD_{ir}}{PP_{ir}} \right)^{-ESUBD_i} \qquad 3.45$$

where:

QPD_{ir} domestic quantity of commodity i consumed by private households in region r

QP_{ir} composite quantity of commodity i consumed by private households in region r

$ESUBD_i$ substitution parameter between domestic and composite imported commodities i

with $PMSHR_{ir} = \frac{VIPA_{ir}}{VPA_{ir}}$ 3.46

Equation 3.46 depicts the relationship between values of imported commodity and total available commodity at agent prices. The representation of 3.46 in percent changes is given by:

$$qpd_{ir} = qp_{ir} + ESUBD_i * [pp_{ir} - ppd_{ir}] \quad 3.47$$

and quantities of imported commodity from other regions for private consumption:

$$QPM_{ir} = QP_{ir} * PMSHR_{ir} * \left(\frac{PPM_{ir}}{PP_{ir}} \right)^{-ESUBD_i} \quad 3.48$$

where:

QPM_{ir} imported quantity of commodity i consumed by private households in region r

or in percentage change:

$$qpm_{ir} = qp_{ir} + ESUBD_i * [pp_{ir} - ppm_{ir}] \quad 3.49$$

Quantities purchased coming from either domestic $[QPD_{ir}]$ or import markets $[QPM_{ir}]$ will be driven by market price $[PM_{ir}]$, domestic price $[PPD_{ir}]$ and import price $[PPM_{ir}]$ of commodities. If prices of domestic goods are lower than the prices of imported goods, the private household will purchase a higher quantity of the domestic commodity as a function of the elasticity of substitution $ESUBD_i$ between domestic and imported goods. The mathematical representation is given by:

$$PP_{ir} = (PMSHR_{ir} * (PPD_{ir}^{1-ESUBD_i}) + (1 - PMSHR_{ir}) * (PPD_{ir}^{1-ESUBD_i})^{\frac{1}{1-ESUBD_i}} \quad 3.50$$

where:

PP_{ir} private consumption price for composite commodity i in region r.

The linearized version of Equation 3.50 is:

$$pp_{ir} = PMSHR_{ir} * ppm_{ir} + [1 - PMSHR_{ir}] * ppd_{ir} \qquad 3.51$$

The composite quantities are a function of prices and demand. The first element of Equations 3.47 and 3.49 shows the expansive effect of demand. If total demand of a good increases (ceteris paribus), domestic and import demand will increase. The second term of the same equations represents the substitution effect, which depends on changes in prices of domestic and import commodities with respect to private households' consumption price of composite commodities pp_{ir}.

Government Demand in GTAP

Once the percentage of change in real government spending with respect to the baseline has been determined, this must be distributed across composite goods. The GTAP model allocates the governmental expenditure with the help of a Cobb-Douglas function. As observed in Figure 3-5, the allocation of composite commodities from different origins takes place under the assumption of a CES utility function:

$$ug_r = y_r - pgov_r - govslack_r \qquad 3.52$$

In Equation 3.52, government utility varies as a function of income at the regional level and price paid by the government. Thus, a rise in regional income implies an increase in government utility, while an increase in prices depreciates government utility. The percentage of price paid by the government is an average of percentage variations of prices paid by the government for commodities, weighted by the share of expenditure for commodity i (VGA_{ir}) in total expenditure ($GOVEXP_r$):

$$pgov_r = \sum_{i \in TRAD} \left(\frac{VGA_{ir}}{GOVEXP_r} \right) * pg_{ir} \qquad 3.53$$

The variable $govslack_r$ in 3.52 is a slack variable introduced to achieve the numeric convergence at the equilibrium state. In the standard closure of the model, when equilibrium is reached in the model, all markets are cleared and $govslack_r$ must be equal to zero[5]. The

[5] The complete description of the standard closure of the GTAP model is to be found in HERTEL (1997).

value of $govslack_r$ ensures that the results are feasible according to the Walras Law (Section 3.3.1). Hence, the level of variation of the demand function for each commodity is:

$$qg_{ir} = ug_r - [pg_{ir} - pgov_r] + pop_r \qquad 3.54$$

As in the case for private consumption, domestic and imported quantities are determined through Armington elasticities based on utility functions with constant elasticities of imported and domestic commodities. The percentage of variation of commodity i produced in the domestic market and consumed by the government is:

$$qgd_{ir} = qg_{ir} + ESUBD_i * [pg_{ir} - pgd_{ir}] \qquad 3.55$$

and the imported quantity consumed is:

$$qgm_{ir} = qg_{ir} + ESUBD_i * [pg_{ir} - pgm_{ir}] \qquad 3.56$$

where the price paid by the government for each commodity i (pg_{ir}) is led by domestic and imported prices:

$$pg_{ir} = GMSHR_{ir} * pm_{ir} + (1 + GMSHR_{ir} * pgd_{ir}) \qquad 3.57$$

with

$$GMSHR_{ir} = \frac{VIGA_{ir}}{VGA_{ir}} \qquad 3.58$$

A complete description of the variable nomenclature is provided in Appendix A.

3.3.2.4 Global Investments

This section describes how investments are collected. Investment in the GTAP model is determined by two different components. The first component calculates investments as a function of regional rates of return on capital. The second component is based on the assumption that regional composition of global capital stock is allocated in fixed shares of the stocks[6]. The option chosen will determine the closure of the model.

Investment will be adjusted through the Global Bank, which operates as a global collector of the *cgds* capital good. Each sector produces commodities that are sold and traded, and also produces a certain quantity of capital good *cgds*. Production of a capital good is integrated into the model in the same way as other commodities, except that its production requires only intermediate goods, without making use of the endowment commodities.

[6] For a comprehensive description of these two procedures consult BROCKMEIER (2003) and HERTEL (1997).

Investments are aggregated at the global level in GLOBINV from net regional investments – that is, gross investment less capital depreciations:

$$GLOBINV = \sum_{r \in REG} NETINV_r \qquad 3.59$$

with:

$$NETINV_r = REGINV_r - VDEP_r \qquad 3.60$$

where:

$NETINV_r$ net investments in region r

$VDEP_r$ value of depreciation in region r

$REGINV_r$ gross investment in region r

$$REGINV_r \equiv VOA_{cgdsr} \qquad 3.61$$

and

$$VDEP_r \equiv pcgds_r * kb_r \qquad 3.62$$

where:

VOA_{cgdrs} value of output of capital good *cgds*

kb_r capital stock in region r at the beginning of the period

$pcgds_r$ change in price of capital commodity in region r

Hereafter, this good is offered to regional households to satisfy their saving demands:

$$SAVE_r = psave_r * qsave_r \qquad 3.63$$

As GTAP is a static model, investments do not directly influence domestic production. The value of capital stock of the baseline is updated as a function of regional investments minus depreciation.

$$VKE_r = VKB_r * (1 + DEPR_r + REGINV_r) \qquad 3.64$$

where:

VKE_r value of capital stock at the end of the period in region r

VKB_r value of capital stock at the beginning of the period in region r

$DEPR_r$ depreciation rate in region r

In version 6.2 of the GTAP model[7], price of a demanded commodity is adjusted at the same rate as the price of the regional investment in that good cgds, plus the equilibrium between saving levels and investment levels at regional level ($psaveslack_r$):

$$psave_r = pcgds_r + \sum_{s \in REG} \frac{NETINCV_s - SAVE_s}{GLOBINV} * pcgds_s + psaveslack_r \quad 3.65$$

In other words, the price of $pcgds_r$ depends on the price variations of produced commodities (ps_{ir}) and on the ratio of production and regional investment (VOA_{ir} / $REGINV_r$)

$$pcgds_r = \sum_{i \in CGDS} \frac{VOA_{ir}}{REGINV_r} * ps_{ir} \quad 3.66$$

The Global Bank acquires the capital good from all regions and sells it to regional households to satisfy savings and investment demands as shown in Equation 3.60. As saving and investments are considered in GTAP to be the last market, and considering the Walras Law again (if all other markets are in equilibrium, this last market must be also in equilibrium), this last market must always be in equilibrium. In other words, in the standard closure of the GTAP model, the condition of clearance is S-I = 0, and therefore this equation can be omitted from the system.

3.3.2.5 Global Transportation

Transportation in the GTAP model is conceived as a global sector. Differences between the FOB price of an exporting country and the CIF price of an importing country represent the cost of transport. The "quantity" of transport available for a region behaves as a Cobb-Douglas production function, depending on the total variation of services (expansion effect) and the difference between changes in global and regional price indices (substitution effect). The index of prices is obtained as the sum of transport services for one single good aggregated across regions. As a global sector, the value of transportation from one region to another represents a share of the total transportation available globally. The value of transport supplied is expressed as:

$$VT = QT * PT \quad 3.67$$

[7] The version of the GTAP model refers to the specific version of the TABLO file used to run the model. Periodically the TABLO file of the standard model is updated and released as a new version of the GTAP model.

and

$$QT = \sum_{i \in TRAD} \sum_{r \in REG} \sum_{s \in REG} QST_{irs} \qquad 3.68$$

where:

VT international supply of transport

QT international usage of transport

PT price of transport

QST_{irs} demand for regional supply of global transportation service for traded commodity i from region r to region s

$$qst_{ir} = qt + [pt - pm_{ir}] \qquad 3.69$$

Equation 3.69 calculates changes in the international transport sectors as a function of demand for regional supplies of transportation services. The price of the transport demanded at the international level is given by:

$$pt = \sum_{i \in TRAD} \sum_{r \in REG} \frac{VST_{ir}}{VT} * pm_{ir} \qquad 3.70$$

As mentioned above, each region demands a certain "value of transport". This has fixed proportions for each volume of transported commodity through a given route (defined by origin and destination):

$$QXS_{irs} = ATR_{irs} * QST_{irs}; \text{and}: qst_{irs} = qxs_{irs} - atr_{irs} \qquad 3.71$$

where:

QXS_{irs} export sales of commodity i from r to region s

ATR_{irs} technical coefficient (indicating commodity/route specificity)

ATR_{irs} is an exogenous parameter representing a technical rate of change particular to each commodity, source and destination.

3.3.3 Macroeconomic Closure

The macroeconomic closure in the GTAP model, as in every CGE model, consists in the definition of exogenous variables and endogenous variables. The sets of variables selected as exogenous and endogenous defines the conditions needed to reach the equilibrium. Closures are classified, according to the kinds of variables that are selected to be exogenous,

and the implicit policies assumed in the given economy. In a neoclassical closure thus, there is an exogenous variable fixing the quantity available for each production factor, while prices adjust to the quantities. In a Keynesian closure, the price of production factors is set as exogenous. A model with a Keynesian closure achieves the equilibrium by changing the quantity of the required production factor.

In the standard version of the GTAP model, all prices are endogenous, perfect competition is assumed (costs equal sales). Thus, the implications of this closure are (a) the assumption of full employment, (b) full mobility within regions. In the standard version, investment is a function of return rates. Thus, the model possesses a "neoclassical closure" in which all markets reach equilibrium by adjusting prices to the quantities available.

3.4 Representation of Private Households in Other CGE Models

3.4.1 CGE Models and Household Analysis

Computable General Equilibrium (CGE) models constitute one of the quantitative instruments available for economists seeking to assess the impact of macroeconomic policies on microeconomic changes in overall income distribution and welfare. Most of the research done in a CGE framework bases conclusions on equivalent variation (EV) or compensating variation (CV), rather than including household categories (DEATON, 1997; COCKBURN and DECALUWÉ, 2006). More recently, other approaches have achieved the construction of an integrated household analysis in a CGE framework. The most common objective of this methodology is the analysis of expenditure and income patterns with their consequent implications in household welfare. Furthermore, for economists interested in studies on changes in income distribution, poverty and inequality, CGE models are only useful if they contain detailed information on household income formation and consumption patterns. This detailed information involves the integration of several categories of households with their corresponding links to macroeconomic variables. The main objective of this detailed household analysis is the link between macroeconomic reforms and their effects on poverty levels. The modelling of household analyses in CGE models is based generally on different techniques and data sources. Some studies are certainly more meticulous in the description either of the income side or of the expenditure side. This decision is strongly influenced by the objectives pursued by each study (e.g., study of labour factors or market prices), as well as the availability of information. Pioneer research considering the integration of consumption and income patterns in CGE models is represented by ADELMAN and ROBINSON (1978) and

DERVIS et al. (1982) amongst others specified a lognormal function to assess group income distribution in an approach with a unique representative agent. Later studies from KYEREME and THORBECKE (1991); DE JANVRY et al. (1991); and BOURGUIGNON et al. (1991) evaluate the effect of diverse policy adjustments on income distribution over different household groups.

Econometric models applied to link macroeconomic reforms with household analyses might be classified into two types of analyses. The first approach integrates household categories into the CGE framework by regarding commodity prices and factor remuneration as dependent on macroeconomic equilibrium (DECALUWÉ et al., 1999; COCKBURN, 2001; BOCCANFUSSO et al., 2003; CORORATON and COCKBURN, 2007; RUTHERFORD et al., 2005). The second approach requires the adaptation of two different models in a sequential process. The first model is used to reproduce macroeconomic conditions; its output is then fed into the second model, which assesses conditions at the household level. This latter approach is also known as macro-micro simulation (CRANFIELD et al., 2002; BOURGUIGNON et al., 2003; DAVIES, 2004; CHEMINGNI and THABET, 2005; CORONG, 2005; FERRAIRA and HORRIDGE, 2004; HERTEL et al., 2005). One application of both approaches is the evaluation of income distribution and poverty levels.

The remaining part of this section evaluates studies integrating household analysis into a CGE framework. The purpose of this section is to compare different modelling procedures applied to the study of differences caused by macroeconomic policies at the household level. Furthermore, the coverage of different ways of integrating household analysis is comprehensively studied in order to draw and compare main scopes, advantages and limitations from the different analyses. This section also describes the current state of CGE modelling linked to household analysis, enlightening possible future extensions in this field.

3.4.2 CGE Models with Several Household Categories

The main idea behind the construction of a CGE model with several groups of households is the assessment of different household categories as actual economic transactors. The differences in the participation of the household categories in economic activities determine the differentiation among impacts caused by economic policies on expenditure allocation and remuneration. In this approach, it is assumed that households in one category have a homogeneous behaviour. The first studies integrating household differentiation in a CGE model managed to integrate a small number of households; since then, the number of household categories has increased. Some authors have achieved the integration of as many

households as are available in household surveys (COCKBURN, 2001; RUTHERFORD et al., 2005).

The partition of the household agent into different household groups was performed in the earliest studies by different sources and levels of income and expenditure but the same wage and expenditure elasticities in the model. One example of this approach is the study by DECALUWÉ et al. (1999), who used a SAM to generate results based on the principle of a representative household agent. Modifications caused by shocks in the SAM are updated through a multiplier matrix M_a. Changes at the household level are calculated as:

$$y_n = M_a x \qquad 3.72$$

where y_n represents the different sources of household income (production factors, government transfers etc.), M_a is the multiplier matrix, and x is the initial value of y_n. Subsequently, the updated SAM is used to calibrate a CGE model representing the archetype economy of an African developing country. The CGE model developed by DECALUWÉ et al. (1999) contains six different households (workers, small land-owners and large land-owners in rural areas; and low education, high education and capitalist for urban households). The equation modelling household income is:

$$YH_n = wnq\,\lambda_n^{nq} * \sum_i LN_i + wq\,\lambda_n^{q} * \sum_i LQ_i + \lambda_n^{k}\left(\sum_{in} r_{in} KD_{in} + \sum_{ag} r_{ag} KD_{ag}\right) + \lambda_n^{t} \sum rt_{ag} * \overline{LAND_{ag}} + \overline{TGH_h} \qquad 3.73$$

where:

YH_n	household income
wnq and wq	unskilled and skilled wage rate, respectively
$\lambda_n^{nq}, \lambda_n^{q}, \lambda_n^{k}$ and λ_n^{t}	share of income household from unskilled labour, skilled labour, capital and land, respectively
LQ_i and LN_i	demand of skilled and unskilled labour, respectively
KD_{in} and KD_{ag}	composite capital for non-agricultural and agricultural activities, respectively

r_{in}, r_{ag} and rt_{ag} rate of return on capital, agricultural capital and land capital, respectively

$\overline{LAND_{ag}}$ agricultural land

$\overline{TGH_{h}}$ government transfer payments to household

DECALUWÉ's approach introduced a new feature in the model by endogenizing a poverty line (a basic consumption basket is defined and updated according to new prices) and the resulting poverty incidence for each of the household types (DECALUWÉ et al., 1999).

The next improvement in the inclusion of household categories in a CGE model was presented in 2000 by COGNEAU and ROBILLIARD, whose study covers the behaviour of 4,508 households. The model includes different categories of skilled labour, labour preferences and consumption preferences at the individual and the household level, while allowing for an endogenous determination of relative prices between sectors. COGNEAU and ROBILLIARD's model represents labour markets based on the specification of a constant elasticity of transformation (CET) for each household activity. The production function makes a distinction between production for the local market or for export. The formal sector account is an aggregate of private and public formal activities accounts. This matrix summarises the model accounts, which include 4,508 households, of which approximately 3,500 are agricultural producers (COGNEAU and ROBILLIARD, 2000).

The model developed by COGNEAU and ROBILLIARD (2000) contains a detailed structured of the expenditure behaviour. The consumption model is based on a linear expenditure system (LES):

$$X_{hi} = \min_{hi} + \beta_{hi}^{C} * \frac{(CTH_{hj} - \sum_{j} PC_{j} * \min_{hj})}{PC_{i}} \qquad 3.74$$

where:

X_{hi} consumption of good i

$\min_{hi}$ minimum subsistence consumption of commodity i (or good j)

β_{hi}^{C} marginal share of good i in its consumption

CTH_{hj} total consumption

PC_j the composite price of commodity j

The expenditure function LES was calibrated for each household according to budget shares from the household survey and the SAM. This calibration process yields income and price elasticities as well as Frisch parameters[8] for each household (COGNEAU and ROBILLIARD, 2000).

A similar approach presented in 2001 by COCKBURN adapts a standard CGE model to explicitly integrate over 3,000 households. COCKBURN (2001) uses data of household income sources and consumption patterns from household surveys. The model approach presented by COCKBURN integrates Nepalese Survey Data into a CGE based model. This research simultaneously matches and balances the national SAM with the gradual integration of the 3,000 households. This step involves the development of special software, which funnels the integration, balancing and consistency of the SAM. Household consumption is modelled using a LES function, while household income from wages is modelled by a CET function through the combination of different activities.

The two former approaches both integrate households reported in the household survey into the CGE model. The main difference between them lies in the process undertaken to achieve this integration. COGNEAU and ROBILLIARD (2000) constructed the SAM with 4,508 households from the beginning, while COCKBURN (2001) integrated households gradually into the CGE patterns, making it easy to extrapolate this approach for other countries.

The study of fiscal measurements and government support has also been dealt with using CGE models including several household categories. For example, in 2002 THURLOW and VAN SEVENTER published a study including twelve households. This paper reports the construction and testing of a CGE model developed by the International Food Policy Research Institute (IFPRI) for South Africa. The CGE model for South Africa is used to simulate the economy-wide impact of a range of hypothetical policy measures, including increased government spending, the elimination of tariff barriers and government support for improvement in total factor productivity. For this purpose, a SAM as of 1998 was compiled for South Africa using national accounts information and recently released IOT. Labour

[8] The Frisch parameter is the marginal utility of income with respect to income or elasticity of labour demand. In CGE models it is applied to introduce in the model the willingness to substitute one product for another (consumption side) or the decision-making process of working versus leisure (income side).

provided for commodity production is modelled as a CES function; private consumption is also modelled as a CES Armington function.

A remarkable global effort to assess income distribution across households is presented by the Poverty and Economic Policy Network (PEP). The Exterplus model has been developed as a part of the activities supported by the PEP at the University of Laval in Canada. The Exterplus model is a CGE model computed in GAMS[9]. This model has been broadly used to create country extensions containing household categories for different countries (COCKBURN and CLOUTIER, 2002).

An example of the application of the Exterplus model to Tunisia was developed by BIBI and CHATTI (2006). The dynamic model developed by BIBI and CHATTI possesses a Keynesian closure. Thus, quantities are exogenous and prices are determined endogenously. The changes in income are the result of the updated utility. Changes in utility are estimated by assuming an equivalent income to the utility in the baseline. The update of the equivalent income after the simulation yields values of household utility, as shown in Equation 3.75. The indirect utility for each household is obtained in the form of a Cobb-Douglas function:

$$v(\xi_{it}, Y_t^{hm}) = \frac{1}{(1+g_t^h) * Y_0^{hm}} * \sum_{i=1}^{I} (\xi_{it})^{s_i^{hm}} \qquad 3.75$$

where

$v(\cdot)$	indirect utility function
ξ_{it}	price of good i at the period t
Y_t^{hm}	income of household h within the group m at the period t
Y_0^{hm}	income of household h within the group m at the beginning
g_t^h	nominal income growth rate of household h at the period t
s_i^{hm}	budget share devoted to the good i by the household h within the group m

The results are then applied to assess the change in real income of each household group, using a sample from a household survey. Other case countries analysed with the

[9] For further information on the structure and scope of the Externplus model, consult COCKBURN and CLOUTIER (2002).

Externplus model include Tanzania, Philippines, Ghana, Benin, Senegal, Sri Lanka, Kenya, Vietnam etc[10].

Other methodology to integrate a large number of households into a CGE was presented by RUTHERFORD et al. (2005). Their model incorporates all 55,000 households from the Russian Household Budget Survey as "real" households in the model. In the first step, they employed a CGE comparative static model of the Russian economy to assess the impact of accession to the WTO on income distribution and the poor. Then, the real households were integrated into the CGE model by the development of a new algorithm for solving general equilibrium models with a large number of agents. Household labour is modelled as a Cobb-Douglas function and classified as skilled or unskilled labour. The consumption process takes place in two stages. In the first stage, households allocate consumption among 35 composite commodities, maximizing cost as in a Cobb-Douglas utility function. In the second stage, households fulfil commodity needs with imports and domestic supplies, modelled by a CES function. Another new feature provided by RUTHERFORD et al.'s research is the inclusion of foreign direct investment and endogenous productivity effects in trade and poverty analysis.

So far, the models described have been focused on the assessment of one model for the CGE scope as well as for the household analysis. Another successfully applied methodology utilises two models. This methodology is known as macro-micro simulation. The first model shows macroeconomic conditions of one or several regions, whereas the second model analyses the effects at the household level.

3.4.3 Macro-Micro Simulation

The harmonisation of the two models to transmit results from one model to the next model is known as macro-micro simulation. The macro-micro simulation is performed in two steps. In the first step, a CGE model is used to simulate the specific market reforms in the form of a shock to obtain changes in commodity prices and factor remuneration. These changes are the result of macroeconomic reforms. In the second step, or post-simulation analysis, a microeconomic model based on a household survey is used to monitor how these changes influence the household income and expenditure patterns. The macro-micro simulation might or might not contain feedback from the micro-simulation model to the macro-simulation model. A methodology with feedback is constituted by both models involved in an iterative process until both models reach equilibrium. The second possibility is

[10] For more information on the PEP Network, consult www.pep-net.org.

also known as *top-down*, implying the unidirectional dynamics of changes in both models. The macro-micro simulation carries over regional reforms to household structures. These changes are transported to a micro model that still conserves the flexible framework for household categories in terms of specific behavioural characteristics of household categories (SAVARD, 2005).

An example of a macro-simulation covering several countries is presented by HERTEL et al. (2003). In their study, HERTEL et al. (2003) conducted a comparative study in seven developing countries (Brazil, Chile, Indonesia, the Philippines, Thailand, Uganda and Zambia), simulating the possible results of full trade liberalisation. The first step involves the use of the model developed by the GTAP for the simulation of complete elimination of merchandise tariffs in all traded goods as well as the elimination of export subsidies on agricultural and textile and apparel products. Modifications in the standard closure of the GTAP model were made to fix government spending and tax revenues to the net national income. This new closure permits public transfers to move in proportion to the change in per capita income (HERTEL et al. 2003).

The second step of HERTEL et al.'s methodology stratifies households according to primary sources of income (95 percent or more of their income): agricultural enterprises, non-agricultural enterprises, wage/salary labour or transfers. All other households are classified as diversified, and therefore less likely to be vulnerable to trade shocks (HERTEL et al., 2003).

Another point of view is presented by BOURGUIGNON et al. (2003), who compare results of a representative household agent to several household categories. BOURGUIGNON et al. (2003) developed a macro-micro simulation approach to evaluate effects of fiscal reforms on Indonesian households. The micro model in their research tackles within-household heterogeneity by modelling households according to the number of working members. Another characteristic of the model is the evaluation of impacts through changes in real income in households located in different regions in Indonesia. Variables taken into account for the approach of within-household heterogeneity are the area of residence, age and schooling of the household head and number of household members. The income is modelled as:

$$\log wa_{mi} = \alpha_{g(mi)} + \varsigma_{mi} * \beta_{g(mi)} + \varpi_{mi} \qquad 3.76$$

where:

$\alpha_{g(mi)}$ gender of the household head

$\beta_{g(mi)}$ school level

wa_{mi} household member of working age i in household m

ς_{mi} personal characteristics of member i from household m

ϖ_{mi} unobserved earning determinants of member i from household m

The study of income and expenditure patterns of households in Morocco is assessed by RAVALLION and LOKSHIN (2004). RAVALLION and LOKSHIN built a CGE model capable of transmitting changes in prices of factor production and commodities to a micro-simulation model. The microeconomic model generates a set of changes in welfare for producer and consumer households in Morocco. The main focus of RAVALLION and LOKSHIN is household utility and welfare according to the position of each household in the economy (net consumer or net producer).

Changes in household utility are obtained from the equation:

$$g_i = \frac{\partial U_i}{v_{\Pi i}} = \sum_{j=n}^{m} pri^s_{ij} q^s_{ij} * \frac{dpri^s_{ij}}{pri^s_{ij}} - pri^d_{ij} q^d_{ij} * \frac{dpri^d_{ij}}{pri^d_{ij}} + \sum_{s=1}^{n} \left(wr_k L^s_{ik} * \frac{dwr_k}{wr_k} \right) \quad 3.77$$

where:

g_i utility function

$v_{\Pi i}$ marginal utility of income for household i

L^s_{ik} household's "external" labour supply to activity k

pri^s_{ij} price of supplied commodity j of household i

q^s_{ij} quantity of supplied commodity j of household i

pri^d_{ij} price of demanded commodity j of household i

q^d_{ij} quantity of demanded commodity j of household i

wr_k wage rate earned in activity k

The effects of the Doha Round on households have also concerned several scholars. In 2005, BENTO DE SOUZA FERREIRA and HORRIDGE studied the effect of the Doha Round on Brazilian households. The GTAP model was applied to the generation of price changes, which were then used in a micro-simulation model. The GTAP model simulated changes in import prices and export demands and excluded effects of Brazil's own tariff reductions. Thus, the results from the GTAP model are used to update wages and worked hours in a micro-simulation model. The micro simulation contains a broader aggregation than previous models presented in this literature review. The model maps 42 industries, 52 commodities, 10 households and 10 labour occupations, all of which vary by 27 regions within Brazil; the year of analysis was 2001. The micro-simulation model adapts changes in production factors followed by relocated jobs according to the changes in labour demand. The model follows a process of relocation (called quantum weights method) based on the weight of each worker on the labour market.

The effects of the Doha Round on Mexican households were evaluated by NICITA (2005) with a macro-micro simulation. In the first phase, NICITA simulated the effects on prices caused by the implementation of the Doha development agenda. The simulation was estimated using the GTAP model, and the micro simulation was performed by mapping results into the welfare function using household survey data. The households were classified 1) as urban or rural, 2) as extremely poor or moderately poor and 3) according to their geographic location (North, South, Centre, Mexico City, and Borders). NICITA thus did a spatial study of the effects of trade liberalisation on different locations in Mexico. As main results, NICITA obtained different patterns in the perception of prices by households: those in the northern part of the country were more susceptible to price changes from imports than households in the South.

3.4.4 Applications: Poverty Levels

The household analysis coupled with CGE models has a wide variety of possible applications; one of the most investigated is the relationship of macroeconomic reforms to poverty levels. Literature discussing poverty and macroeconomic reforms ranges from inland fiscal reforms and their effects on household poverty (RUTHERFORD et al., 2005) to multilateral trade liberalisation and poverty (BOURGUIGNON et al., 2003; CHEMINGNI and THABET, 2005; CORONG, 2005; DAVIES, 2004; FERRAIRA and HORRIDGE, 2004; HERTEL et al., 2005).

In their study, DE JANVRY et al. (1991) present an application of a CGE model for Ecuador. This study analyses the alternative approaches to financial stabilization induced by foreign direct investment. The CGE model is based on a SAM containing different income sources (skilled, unskilled and agricultural labour) and seven household classes (small, medium-size and large farmers for the agricultural sector and urban households with low, medium and high levels of education). The CGE model includes real income and imputed benefits from the use of public goods as they affect household utility and thus poverty levels (DE JANVRY et al., 1991).

In a study in 2001, COCKBURN assessed the impacts of trade liberalisation on individual households and how these impacts feed back into the general equilibrium of the national economy. As the model estimates income for each household, the author generates all the data required to carry out standard income-based poverty and income distribution analysis. According to COCKBURN's study, liberalisation in Nepal favours urban households as opposed to households in fertile plains. Urban poverty falls and rural poverty increases, particularly among the moderately poor as opposed to the very poorest. In his results, the absolute impact of trade liberalisation, whether it is positive (in the urban areas) or negative (in the rural areas), generally increases with the level of income.

HERTEL et al. (2003) used an empirical application of their model to simulate effects of trade reforms on household categories. The main results of this research show that the aggregate measure of poverty is reduced in Indonesia, the Philippines, Thailand, Uganda and Zambia, while it is increased in Brazil and Chile. The largest percentage reduction in poverty occurs among agriculturally specialised households in Brazil and Chile (more than 30 percent reduction). Poverty also falls between 7 percent and 9 percent for the agriculturally specialised households in the Philippines and Thailand and for wage labour households in Indonesia and the Philippines, while poverty increases range from 5 percent to 11 percent among the self-employed, non-agricultural households in Indonesia and the labour-specialised households in Brazil and Chile (HERTEL et al., 2003).

3.4.5 Qualifications for Future Studies of CGE Models with Household Analysis

This section focussed on the description of approaches linking CGE models with household analysis. The studies presented might be classified into two main methodologies. The first approach integrates household categories into a CGE model. A notable advantage of this approach is the direct link between macroeconomic factors and patterns of the household categories. One main caveat of these models is the assumption of equal distribution of

changes across households (following the behaviour of the original representative household category). The second approach involves the employment of two economic models. Here, a macroeconomic model is plugged to a microeconomic model, known also as a macro-micro simulation. The macro-micro simulation presents some advantages over the CGE models with several household categories. The most notorious of these advantages is the possibility of expanding or condensing the macroeconomic model framework without affecting the structure of the microeconomic model and vice versa, making this a flexible methodology suited to being adapted according to the research goals. On the other hand, in most cases this flexibility limits the feedback to the macro model.

After detailed comparison of these studies, it becomes evident that almost all focus on single regions. The assessment of poverty in multi-country studies is only addressed by HERTEL et al. (2005) and COCKBURN et al. (2006). However, HERTEL et al.'s and COCKBURN et al.'s studies monitor the income side, and changes at expenditure level cannot be tracked back to single household categories. Another observation arising in this section is the low number of studies estimating changes in household expenditures in detail and with utility functions more flexible than the LES or CES.

The consumption side of households is seen in this study as a priority and a more reliable measure of welfare for several reasons. Household consumption patterns are more stable than income patterns, which tend to be especially volatile for poor households relying on informal or temporal income sources (DEATON, 1997). The methodology developed in Chapter 4 and applied in Chapter 5 follows the criteria of a micro-macro simulation. In this case, the results generated with the standard version of the GTAP model are used to analyse the changes in the patterns of consumption of deciles in Mexico according to their expenditures and cross-price elasticities.

The methodology proposed in this research and tested for Mexico permits economists to assess welfare impacts through changes in expenditures for different household categories and for different countries simultaneously, when information is available (see Section 4.4). Similarly, to HERTEL et al. (2005), the changes in commodity prices generated with GTAP are taken as input for an estimated Linear Almost Ideal Demand System (LA/AIDS) for household categories in Mexico. However, this study splits households according to expenditure patterns to obtain impacts on single household categories, complementing in this sense the approach suggested by HERTEL et al. (2005).

4 The Demand Behaviour of Household Deciles in Mexico

As discussed in Chapter 2, Mexico has a high-income disparity across different population groups. Thus, each group (in this case household decile) presents different inherent characteristics and thereof different income sources. As a result of all these differences, household deciles have heterogeneous patterns of needs which must be satisfied subject also to their heterogeneous budget constraints. The budget constraint and the preferences of each household decile determine what commodities the household decile consumes and at which proportions relative to income level.

In order to identify consumption preferences by deciles, it is necessary to have expenditure and cross-price elasticities as parameters to integrate into a CGE model. This Section describes the complete demand system developed to estimate expenditure and cross-price elasticities by decile in Mexico. The demand system is carried out for household deciles (ten household categories) in Mexico following the methodology proposed by DEATON and MUELLBAUER (1980). Commodities are aggregated in the following categories: cereals, vegetables, meat, other food, energy, dwellings manufactures, housing services and services. The first section introduces principal characteristics of households in Mexico. The second section describes the criteria considered to choose the most appropriate demand system model for the empirical analysis of Mexican household demands. Also in the second section the data and the variables required are described. The third section contains the results and interpretation of parameters obtained by the LA/AIDS. The last section discusses the basic premises and the theoretical basis for the further integration of household categories into the GTAP model by creating a household module within the GTAP framework.

4.1 Income- and Expenditure Patterns of Households in Mexico

4.1.1 Household Income Sources

Households in Mexico are split in ten different groups, each group representing ten percent of the households (deciles). The categorization criteria to split the deciles, is the income level; having in decile I the ten percent of households in Mexico with the lowest income. Households in decile X represent the ten percent of households with the highest income in Mexico.

Income in Mexico is classified according to the INEGI as monetary and non-monetary. Households combine diverse sources of income (both monetary and non-monetary) to accrue total household income. Monetary income sources cover all those activities, which are

compensated with money. Official statistics classified monetary income activities in: wages, industrial profits, trade profits, agricultural profits, service profits, capital profits, other profits and other monetary income sources (such as remittances and government subsidies). Non-monetary income sources are: self-consumption, income in kind, imputed rent and negative savings.

Table 4-1 contains information on the sources and composition of income for deciles in Mexico. The first column synthesises the income pattern of the average Mexican household. The remaining columns each represent a household decile. From the first column it can be seen that the main source of monetary income in Mexico is wages. For households with lower income, wages (in decile I, 30 percent) and transfers (in decile I, 20 percent) are the most important monetary income sources. For wealthier households, income is dependent mostly on wages (in decile X, 42 percent), then the contributions of other monetary sources of income in a similar range are: rental income, capital profit and agricultural profit (in decile X approximately 10 percent each) (Table 4-1). Thus, income sources of wealthier households are more varied than income formation of poor households, which rely mostly on wages and transfers.

According to the National Household Income and Expenditures Survey (Encuesta Nacional de Ingresos y Gastos de los Hogares, ENIGH) in 2005, at the national level, wages are regarded as the most important source of income for all deciles (INEGI, 2005a). The main source of non-monetary income is the imputed rent. Imputed rent represents an imputation for the net rental income of the own-occupied housing. It is calculated as if the property owner who at the same time is the tenant would be different actors in the rental business. The tenant rents the house in which he/she lives to him/herself. Imputed rent is the rent received by a property owner owning a real estate of the same value in the same geographical region, and it is calculated via a hedonic approach (DEATON and MUELLBAUER, 1980).

Table 4-1 Income distribution per household decile in Mexico (%)

Activity	*Average* [a]	*I*	*II*	*III*	*IV*	*V*	*VI*	*VII*	*VIII*	*IX*	*X*
Wages	48.93	29.90	42.93	50.62	51.78	53.88	54.05	57.10	56.50	52.83	42.10
Industrial Profit	1.34	2.99	2.36	2.53	2.26	2.42	1.94	1.52	1.36	1.30	0.65
Trade Profit	2.65	3.73	3.86	2.83	3.57	3.38	3.60	3.12	3.32	3.81	1.29
Service Profit	2.99	2.88	2.75	3.47	4.16	4.11	5.16	3.07	3.72	2.95	2.01
Agricultural Profit	6.93	3.69	2.36	3.17	3.12	2.70	4.27	3.65	4.79	6.88	10.86
Capital Profit	5.22	2.19	1.86	1.76	1.97	1.84	1.89	2.54	2.64	3.30	9.71
Other Profits	0.20	0.96	0.36	0.72	0.24	0.22	0.13	0.14	0.30	0.22	0.10
Rental Income	5.17	0.60	0.49	0.43	0.73	0.78	0.53	1.03	1.35	2.19	11.68
Transfers	8.12	20.39	17.29	12.60	11.00	10.48	9.29	7.96	7.44	8.21	5.72
Other Income Sources	0.04	0.04	0.02	0.02	0.00	0.02	0.03	0.01	0.00	0.02	0.08
Self-consumption	0.69	2.65	1.24	0.99	1.07	0.85	0.74	0.79	0.76	0.84	0.34
Income in kind	1.32	0.53	0.33	0.65	0.94	0.95	0.98	1.48	1.57	1.51	1.48
Negative savings	5.32	12.27	10.45	7.79	7.06	6.69	5.80	5.74	4.80	4.85	4.11
Imputed Rent	11.08	17.19	13.71	12.41	12.10	11.67	11.60	11.84	11.45	11.09	9.88

[a] Percentage of the total income per household

Source: INEGI (2005a), Author's calculations

For decile I imputed rent represents 17.2 percent of the total income. This value decreases across the deciles until it reaches 9.9 percent of total income for the richest households classified in decile X. Household deciles with the lowest income have a higher income share coming from self-consumption than households with higher income. Transfers although they might be either monetary or non-monetary, refer to all kind of subsidies received by households, such as government subsidies, remittances, seeds, food, medications etc. Transfers are just as an important source of income as wages, especially for the first deciles. The income of poor households relies more strongly on remittances than is the case for richer households. Transfers decline rapidly across the income deciles. Household profits (e.g., industrial profits, trade profits, services profits, capital profits, agricultural profits and other profits), are important sources of income, accounting for 19.3 percent of the national income (table 4-1). Another important source of income for households (mainly for poor households) is the receipt of negative savings. As it might be seen in Table 4-1, negative savings represent 12.27 percent of the total income for decile I while for decile X it only constitutes 4.1 percent of total income. The dependency of households on negative savings has important consequences on the intertemporal allocation of expenditures, as these debts

have to be covered at some time. In addition, these facts have important implications for the intertemporal possibility for poor households to overcome the poverty line.

4.1.2 Households Expenditures

In Table 4-2 the disaggregated structure of consumption patterns for households in Mexico for 2005 is shown. The average Mexican household consumes, on a per capita basis, about USD 250.9 per month, of which nearly a quarter (28.9 percent) is reserved for food, a quarter for manufactures (25.2 percent), and approximately the half (45.8 percent) is spent on services.

When analysing the expenditure structure of food items across households, important differences are exposed between food consumption patterns. According to the ENIGH in 2005, the poorest decile allocates a comparatively higher share of expenditure in cereals (paddy rice, wheat and other cereals) and vegetables (9.6 and 6.9 percent respectively). Richer households rely more on expensive foods such as meat (bovine meat, meat products and fishing) and processed food, namely 3.1 and 10.7 percent respectively. Households from deciles I to VII spend on average a higher share on cereals than on meat. Deciles VIII to X spend a higher share of income on meat than on cereals. One third of expenditures in decile I correspond to cereals, vegetables meat and processed food, while households in decile X allocate only 15 percent of their expenditures for the same items (INEGI, 2005a, Table 4-2).

Comparatively poor households devote a higher share of their expenditures to food items (44 percent) than richer households (18 percent). Across households, shares devoted to food commodities decrease proportionally as income increases. The share of expenditures in manufacturing is almost constant across all deciles. Shares devoted to services increase proportionally to increases in expenditure levels.

Table 4-2 Consumption patterns household decile in Mexico (%)

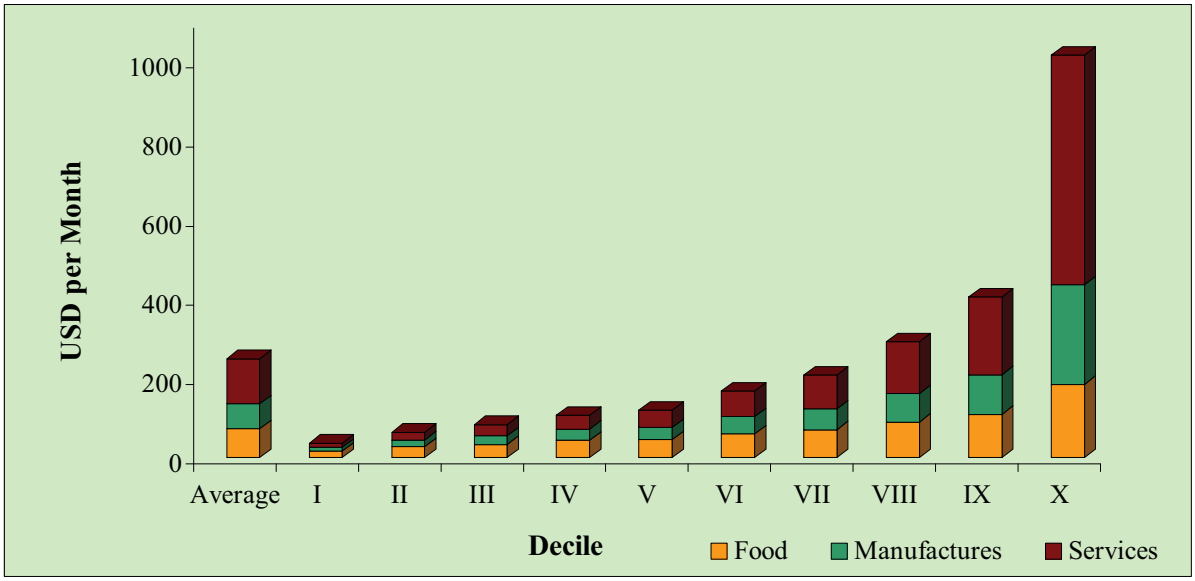
Commodity	Household deciles in Mexico										
	Total	***I***	***II***	***III***	***IV***	***V***	***VI***	***VII***	***VIII***	***IX***	***X***
Paddy rice	0.17	0.67	0.43	0.35	0.30	0.26	0.21	0.19	0.14	0.10	0.05
Wheat	0.05	0.14	0.14	0.10	0.07	0.07	0.08	0.05	0.04	0.05	0.01
Cereal grains n.e.c.	3.75	8.85	8.48	7.22	6.59	5.87	4.99	4.59	3.60	2.86	1.32
Vegetables, fruits, nuts	2.57	6.94	5.91	4.79	4.48	3.84	3.57	3.09	2.44	1.89	0.92
Oil seeds	0.55	2.25	1.83	1.22	1.09	0.85	0.71	0.69	0.46	0.29	0.12
Animal products n.e.c.	0.68	2.01	1.71	1.46	1.37	1.08	0.95	0.78	0.60	0.44	0.19
Raw Milk	1.86	2.56	2.68	2.79	2.98	2.81	2.37	2.33	2.05	1.74	0.93
Fishing	0.57	1.09	0.80	0.77	0.77	0.75	0.55	0.56	0.62	0.56	0.41
Bovine meat products	2.15	2.71	2.77	2.62	3.23	2.87	3.06	2.64	2.52	2.15	1.13
Meat products	3.36	5.58	5.32	5.37	5.53	4.70	4.54	4.31	3.62	2.95	1.56
Vegetable oils and fats	0.33	1.10	0.90	0.70	0.66	0.53	0.41	0.38	0.27	0.21	0.11
Dairy products	1.03	1.35	1.53	1.38	1.41	1.31	1.31	1.12	1.06	0.98	0.67
Sugar	0.25	1.09	0.79	0.59	0.50	0.35	0.30	0.24	0.18	0.14	0.08
Food products n.e.c.	11.64	8.02	9.85	10.47	11.79	12.22	12.50	12.66	12.89	12.56	10.74
Beverages and tobacco	0.53	0.67	0.59	0.54	0.61	0.67	0.48	0.49	0.56	0.54	0.47
Textiles	0.58	0.55	0.53	0.48	0.38	0.69	0.51	0.61	0.58	0.66	0.59
Wearing apparel	3.68	2.67	2.54	2.72	2.86	2.76	3.26	3.40	3.41	3.93	4.50
Leather products	2.10	2.05	2.18	2.34	2.52	2.34	2.37	2.41	2.24	2.15	1.71
Wood products	0.11	0.23	0.21	0.17	0.15	0.17	0.14	0.13	0.11	0.08	0.06
Paper products. publishing	0.15	0.12	0.17	0.16	0.19	0.18	0.19	0.18	0.17	0.16	0.11
Petroleum. coal products	0.21	1.27	0.70	0.51	0.39	0.36	0.26	0.17	0.16	0.09	0.04
Chem. rubber plastic prod	9.78	10.22	9.86	10.12	10.41	9.55	9.81	8.96	9.03	9.03	10.50
Ferrous metals	0.04	0.11	0.07	0.05	0.07	0.03	0.05	0.07	0.04	0.03	0.02
Electronic equipment	1.31	0.71	0.92	1.28	1.06	1.42	1.30	1.38	1.37	1.50	1.29
Machinery and equipment	0.12	0.25	0.16	0.14	0.15	0.12	0.13	0.12	0.11	0.10	0.10
Manufactures	0.62	0.45	0.50	0.51	0.52	0.59	0.61	0.65	0.65	0.62	0.68
Electricity	3.03	4.11	3.81	3.21	3.38	3.52	3.51	3.27	3.08	2.82	2.57
Gas manufacture	2.17	2.60	3.12	3.03	3.08	2.74	2.66	2.46	2.23	2.03	1.46
Water	0.81	1.08	1.06	1.10	0.96	1.00	0.96	0.85	0.92	0.86	0.55
Trade	9.44	2.97	3.58	3.76	4.57	5.03	6.23	7.18	9.71	11.27	13.64
Transport n.e.c.	5.40	6.17	7.24	8.65	7.02	7.23	7.26	7.11	6.30	5.14	2.86
Communication	4.86	2.55	3.39	3.36	3.75	4.21	4.35	5.03	5.25	5.74	5.26
Financial services n.e.c.	1.66	0.91	0.77	0.85	0.83	0.90	0.70	1.03	1.15	1.74	2.82
Insurance	3.22	1.46	2.17	1.60	1.16	1.82	2.40	2.11	3.41	3.14	4.84
Recreational & other serv.	2.75	0.52	0.87	1.23	1.13	1.27	1.71	2.01	2.06	2.98	4.54
Public admin., def. & educ.	15.40	13.10	11.00	12.00	11.10	12.60	12.20	13.90	14.20	15.90	19.20
Dwellings	3.12	0.89	1.80	2.38	2.93	3.33	3.38	2.88	2.75	2.61	3.91
Food	*28.9*	*44.4*	*43.1*	*39.8*	*40.8*	*37.5*	*35.5*	*33.6*	*30.5*	*26.9*	*18.2*
Manufactures	*25.2*	*27.1*	*26.4*	*26.4*	*26.7*	*26.1*	*26.2*	*25.2*	*24.7*	*24.6*	*24.7*
Services	*45.8*	*28.5*	*30.4*	*33.8*	*32.5*	*36.4*	*38.2*	*41.2*	*44.9*	*48.5*	*57.1*
Monthly Expenses per capita (pesos)	*2647.0*	*380.0*	*675.0*	*877.0*	*1129.0*	*1261.0*	*1777.0*	*2206.0*	*3098.0*	*4299.0*	*10771.0*
Monthly Expenses per capita (USD)	*250.9*	*35.8*	*63.7*	*82.8*	*106.5*	*119.0*	*167.6*	*208.1*	*292.2*	*405.5*	*1016.2*

Source: Author's calculations based on INEGI (2005a)

A homogeneous income distribution would be the case in which ten percent of the households in a country earn ten percent of the national income. In Mexico, households do not present a homogeneous income distribution; rather income is concentrated in the three wealthiest deciles. The national monthly income average in Mexico is USD 251 per

household, which is a value between the mean of decile VII and VIII. Consequently, more than 70 percent of Mexican households (from decile I to VII) live with less than the national expenditure mean (see Figure 4-1).

Figure 4-1 Monthly consumption per deciles in Mexico (2005)



Source: Author's calculations based on INEGI (2005a)

A detailed analysis across deciles shows how most of the wealth is concentrated in the highest deciles. Across deciles, the level of expenditure on services and manufacturing grows much faster than the one for food. In particular, the expenditure on services, which is almost non-existent in absolute values for the poorest households, grows quickly across the deciles to reach more than USD 540 per month for the wealthier deciles. Total expenditure in manufacturing products shows a similar pattern on a smaller scale. IANCHOVICHINA's et al. (2001) analysed 1996-expenditure and -income patterns for deciles in Mexico. By comparing their findings with the most recent statistics of Mexico for 2005, the analysis revealed that only the expenditure levels of richer households have increased, while poor households have experienced minor increases in their consumption expenditure. This means that in nearly 10 years, inequality in income distribution has grown slightly. These findings support the numerical figures on increasing inequality mentioned in Section 2.2.2.

4.2 Model Specification for a Complete Household Demand System in Mexico

The income distribution in Mexico represents a high disparity of income across households. This income disparity drives differences in consumption preferences across households. One way to identify consumption preferences across groups is by assessing a complete demand system for different income categories. A complete demand system is of particular importance in understanding expenditure patterns, preferences and utility for each

category. The outcomes from demand systems can be applied to forecast consumer responses to policy changes.

This section focuses on the model specification for a complete demand system. The demand system is developed for ten household categories in Mexico, its features and the collection and adjustment of data required for its calculation.

4.2.1 The Almost Ideal Demand System

For this study, the demand system proposed by DEATON and MUELLBAUER (1980) in a linear approximate version is applied. The LA/AIDS defines budget share as:

$$EXPSHR_{iht} = ALFA_{ih} + \sum_{j} GAMA_{ijh} \ln PP_{jht} + BETA_{ih} \ln\left[\frac{HHEXP_{ht}}{PPRIVHH_{ht}}\right] \qquad 4.1$$

where:

$EXPSHR_{iht}$	budget share of good i by household h in period t
PP_{jht}	price of good j for household h in period t
$HHEXP_{th}$	total expenditures by household h in period t
$PPRIVHH_{ht}$	price index in period t
$ALFA_{ih}$, $BETA_{ih}$ and $GAMA_{ijh}$	behavioural parameters

Useful indicators of expenditure behaviour are income and demand elasticities. The income and demand elasticities for the LA/AIDS are functions of $ALFA_{ih}$, $BETA_{ih}$, and $GAMA_{ijh}$. The coefficient $ALFA_{ih}$ is a representation of the minimum fixed household expenditure, which when acquired is invariable to prices and expenditure level. The expenditure coefficient $BETA_{ih}$ specific for commodity i and household h, indicates whether commodities are luxuries or necessities. Where $BETA_{ih}>0$ means that $EXPSHR_{iht}$ increases as total expenditures increases, so that commodity i is a luxury. Similarly, $BETA_{ih}<0$ means that $EXPSHR_{iht}$ decreases as the total expenditures increases, so that commodity i is a necessity (DEATON and MUELLBAUER, 1980).

The parameters $GAMA_{ijh}$ are price coefficients, $GAMA_{ijh}$ measures the change in the *i-th* budget share following a one proportional change in PP_{jht} with ($HHEXP_{ht}/PPRIVHH_{ht}$) held constant. Another attribute is the price aggregation $PPRIVHH_{ht}$, which can be replaced by any price index (DEATON and MUELLBAUER, 1980). The price index employed to linearize Equation

4.1 is the Laysperes index. This index is suggested and proved to be accurate for the LA/AIDS by MOSCHINI (1995):

$$\ln PPRIVHH_{ht} = \sum_{i=TRAD} EXPSHR_{iht} \ln \frac{P_{iht}}{P^{0}_{iht}} \qquad 4.2$$

$(\forall i \in TRAD\_COMM)$[11]

where:

$PPRIVHH_{ht}$ Laspeyres index

P_{iht} price of good i paid by household h in time t

P^{0}_{iht} price of good i paid in the period base 0

$EXPSHR_{iht}$ mean budget share of commodity i by household h in region r

The linearization of Equation 4.1 by the introduction of Equation 4.2 as the price index is considered as a first order approximation to the general relation between $EXPSHR_{iht}$, $\ln HHEXP_{ht}$ and $\ln PPRIVHH_{iht}$. Under the following parametric restrictions, the model proposed by DEATON and MUELLBAUER (1980), satisfies the restrictions of demand theory: additivity, homogeneity and symmetry.

The additivity requires:

$$\sum_{i \in TRAD} ALFA_{ih} = 1, \sum_{i \in TRAD} BETA_{ih} = 0, \sum_{i \in TRAD} GAMA_{ijh} = 0 \qquad 4.3$$

$(\forall i \in TRAD\_COMM)(\forall h \in HHC)$

The homogeneity is satisfied if and only if, for every j:

$$\sum_{i \in TRAD} GAMA_{jih} = 0 \qquad 4.4$$

symmetry is satisfied if: $GAMA_{ijh} = GAMA_{jih}$ $(\forall j \in TRAD\_COMM)$

Following these definitions, consumer behaviour is ruled by a first satisfaction of needs or by subsistence coverage ($ALFA_{ih}$). Following this, the remaining income is distributed in constant proportions of $BETA_{ih}$ at given prices of all commodities and total income for household h.

[11] See Appendix A for a complete description of sets and variables used in this study.

The income/expenditure- ($EPLS_{ih}$), uncompensated (Marshallian) own and cross-price- ($ECRSL_{iih}$ and $ECRSL_{ijh}$) elasticities, and the compensated (Hicksian) own and cross-price ($HICELS_{iih}$ and $HICELS_{ijh}$) elasticities are estimated by using the equations derived in Appendix B. In the coming equations the subscript of the region in Appendix B has been suppressed:

$$ECRLS_{iih} = \frac{GAMA_{iih}}{EXPSHR_{ih}} - BETA_{ih} - 1 \qquad \text{uncompensated own-price elasticities} \qquad 4.5$$

$$HICELS_{iih} = \frac{GAMA_{iih}}{EXPSHR_{ih}} + EXPSHR_{ih} - 1 \qquad \text{compensated own-price elasticities} \qquad 4.6$$

$$ECRSL_{ijh} = \frac{GAMA_{ijh}}{EXPSHR_{ih}} - BETA_{ih}\frac{EXPSHR_{jh}}{EXPSHR_{ih}} \qquad \text{uncompensated cross-price elasticities} \qquad 4.7$$

$$HICELS_{ijh} = \frac{GAMA_{ijh}}{EXPSHR_{ih}} + EXPSHR_{jh} \qquad \text{compensated cross-price elasticities} \qquad 4.8$$

$$EPLS_{ih} = 1 + \frac{BETA_{ih}}{EXPSHR_{ih}} \qquad \text{expenditure elasticities} \qquad 4.9$$

where:

$ALFA_{ijh}$ $BETA_{ih,}$ and $GAMA_{ijh}$	parameters of the LA/AIDS model
$EXPSHR_{ih}$ and $EXPSHR_{jh}$	means of expenditure share of commodities i and j respectively over the period of time t

The sign of cross-price elasticities (Hicksian and Marshallian) indicates the substitutability or complementarily between the commodity groups considered. Cross-price elasticities with a positive sign indicate a substitution relationship between the commodities (e.g., butter and margarine). Cross-price elasticities with a negative sign indicate complementarity between commodities. Complementary commodities are used jointly (e.g., a lamp and electricity).

4.2.2 Differences between AIDS and LA/AIDS

Since the development of the AIDS by DEATON and MUELLBAUER (1980), the demand system has become a widely used method for estimating consumer demand parameters. However, the original non-linear price index suggested by DEATON and MUELLBAUER (1980) can be substituted by any other linear price index. BUSE (1994) found that from 1980 to 1991, 68 out of 89 studies performed have adapted the AIDS in the linearized form taking the Stone price index. Since prices will never be totally collinear, it is broadly cited that applying the Stone index might not give accurate results (GREEN and ALSTON, 1990; ALSTON, et al., 1994; MOSCHINI, 1995; ASCHE and WESSELLS, 1997). The relationship between the parameters of the LA/AIDS, and the corresponding parameters of the AIDS is not known. In addition, it is not known whether the LA/AIDS with a Stone price index has satisfactory theoretical properties (GREEN and ALSTON, 1990, MOSCHINI, 1995). A main drawback of the Stone index is that it does not satisfy the fundamental property of index numbers because it varies with changes in the units of measurement for prices (MOSCHINI, 1995). However, the use of an appropriate price index avoids this problem, and the values obtained are close approximations to the non-linear AIDS (ALSTON, et al., 1994; MOSCHINI, 1995). One of the solutions to assure accurate results is that prices are scaled by their sample mean. MOSCHINI's suggestion is the use of another price index, which can be normalised. From the proposed indices, the Laspeyres price index is suggested to overcome the problem. This study uses the Laspeyres price index, which is directly reported by the Mexican government.

Another difference between the original demand system and many linearized demand systems is the substitution of logarithm base ten (log) with logarithm base e (ln). The effect of this substitution transforms the variable budget share $EXPSHR_{iht}$ in a dependent variable of changes in ln p_{jht} and ln ($HHEXP_{ht}/PPRIVHH_{ht}$). So that the values of $ALFA_{ih}$, and $GAMA_{ijh}$ behavioural parameters will be different to those obtained with the non-linear version, but not biased from continuous calculations with ln instead of log.

4.2.3 Data Sources for the LA/AIDS

The data set required for the estimation of the LA/AIDS model has been collected from different sources. The data consists of commodities prices, commodities price indices, expenditure per capita per commodity and total expenditure per capita. This section describes the sources of this information and when needed the procedures performed for their calculation. Data required and collected for the LA/AIDS is presented in Table 4-3, and is further displayed one by one.

Table 4-3 Data sources for a complete household demand system in Mexico

Data	Representation in Equation 4-1	Source	Period collected
Price of commodity j	PP_{jht}	National Bank of Mexico (Banco Nacional de Mexico) Published in the Official Federation Journal (Diario Oficial de la Federación)	every six months from 2000 to 2005
Consumer price index of household h	$PPRIVHH_{ht}$	National Bank of Mexico (Banco Nacional de Mexico) Published in the Official Federation Journal (Diario Oficial de la Federación)	every six months from 2000 to 2005
Per capita expenditures on commodity i	$EXPSHR_{iht}$*$HHEXP_{ht}$	Encuesta Nacional de Ingresos y Egresos de los Hogares (ENIGH), published by INEGI	2000, 2002, 2004, 2005
Total expenditure	$HHEXP_{ht}$	Encuesta Nacional de Ingresos y Egresos de los Hogares, (ENIGH), published by INEGI	2000, 2002, 2004, 2005

Source: Own design

Commodity Prices

Commodity prices are published in Mexico in the Official Federation Journal[12] (OFJ). The prices are collected and provided for their publication by the Mexican Bank. Prices paid by consumers in Mexico are monitored every six months. The publication contains prices for approximately 2000 products collected in 46 representative national localities, including small municipalities as well as industrialised cities.

For the LA/AIDS estimation, prices here are required to be linked to household deciles. However, the ENIGH classifies households by their income and expenditure levels; and no information is included with respect to the geographical localization of households. The only geographical distinction applied in the ENIGH is based on the rural/urban classification. The ENIGH defines those households located in counties with less than 2,500 inhabitants as rural households. The limitation here is that prices paid by a given household decile are an explicit requirement for the LA/AIDS estimation.

[12] The OFJ is daily published and contains modifications in the Mexican legislation including: regulations, decisions, new laws, and reports. There is an online edition: www.dof.gob.mx.

Prices across Mexican localities differ significantly across the country, as a diversity of authors have already reported (CLINE, 2004; CONFORTI, 2004; MUNDLAK and LARSON, 1992 and NICITA, 2004 and BATRES-MARQUEZ, et al., 2006). The price transmission from trade liberalisation at the local level in Mexico has been assessed by NICITA in 2005. Price transmission in Mexico is heterogeneous. The effects of trade liberalisation are likely to be concentrated in the Northern states, which are geographically close to the main trading partner of Mexico: the USA. Thus, households in the Southern states are barely influenced by these effects, mainly due to the limited effect of trade reforms on prices in those zones, where the incidence rate of subsistence agriculture is large (NICITA, 2005).

These differences in prices are caused by differences in transport infrastructure, market power along the production chain and transaction costs for different localities. These effects are referred to as price transmission. Price transmission can be analysed from the spatial view, which has as its main objective the investigation of the differences between world price and location prices in one country (NICITA, 2005). As prices across regions in Mexico differ considerably, there is differentiated price transmission within localities in Mexico. Research focused on the patterns by which regional price transmission occurs has been developed (MUNDLAK and LARSON, 1992; SHARMA, 2002; BALCOMBE and MORRISON, 2002).

The assumption of the same price for households across different states in Mexico would yield biased results when performing the LA/AIDS estimation. Differences in prices are demonstrated to exist, and therefore must be taken into account in this estimation, as an empirical test proved in this study[13]. In this study, differences in prices are assessed as the differences in local markets published by the OFJ for different cities in Mexico. The determination of price transmission across localities in Mexico is out of the scope of this study. However, some remarks about the importance of inclusion of price transmission in CGE models are provided in Section 4.4.

Nonetheless, there is no official publication or linkage with prices paid and household deciles and localities or household deciles. Thus, a linkage relating deciles and prices must be built. To bridge prices paid by consumers and household deciles, a link between prices by localities reported in the OFJ with deciles expenditures reported in the ENIGH has been created. This link has been constructed with the help of a previous study on geospatial

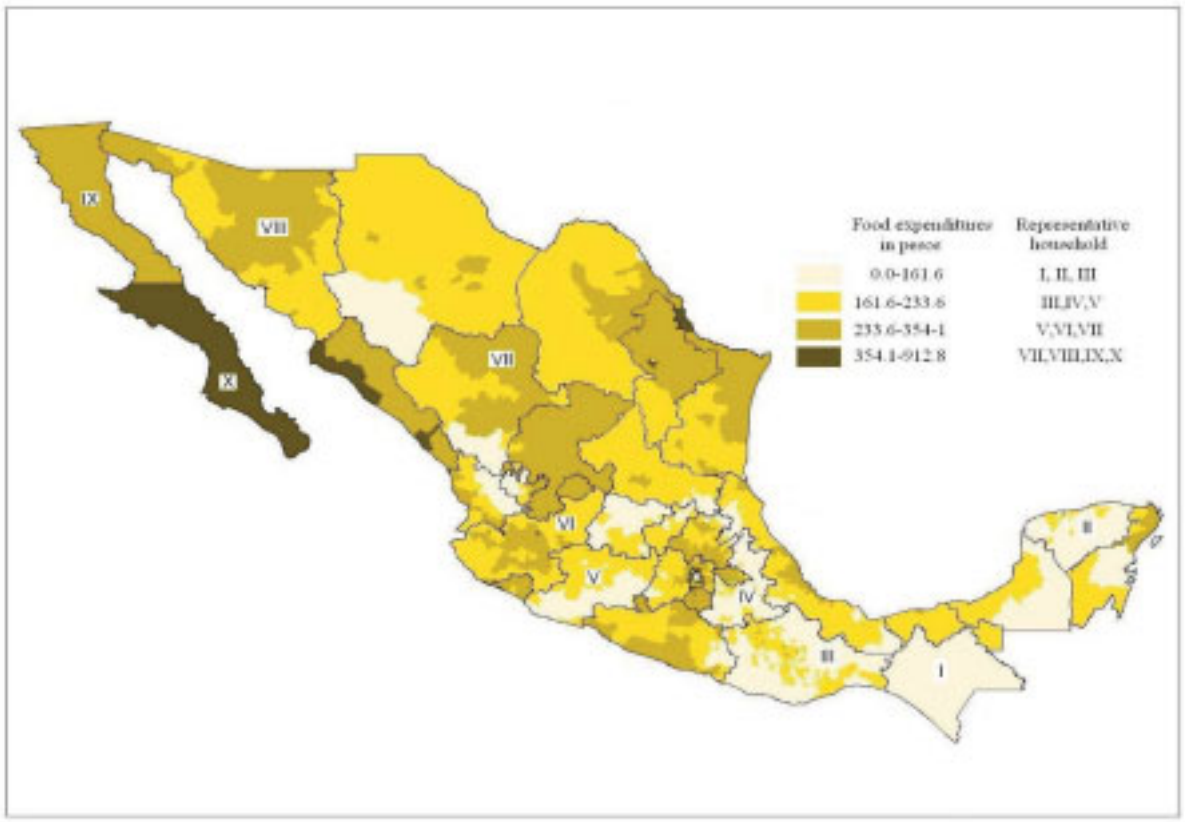
[13] Prior to the inclusion of different prices for different deciles, homogeneous household prices were tested for the estimation of the LA/AIDS. However, the results were always biased.

distribution of food expenditures in Mexico (BELLON et al., 2004). BELLON et al. mapped and predicted future food expenditure per capita for municipalities based on historical values. First, the 46 localities reported in the OFJ are selected from the municipalities cited by BELLON et al. (2004) to obtain food expenditures in these localities. At this stage, local prices have been linked to total food expenditures. The next step comprises the comparison of food expenditures from deciles reported in the ENIGH to food expenditures for localities for 2002. Resuming, the bridge to connect locality prices from the OFJ with total decile expenditures is built using the values of food expenditures from different municipalities reported by BELLON et al. (2004). This connection implied the assumption of a geographical distribution of household deciles across the country[14]. Figure 4-2 shows the average food expenditure paid in Mexican pesos in different localities in Mexico and the matching food expenditures by deciles.

Other authors facing the same constraints as in this study have estimated real prices from price indices reported in the household surveys, to obtain real expenditures (MOSCHINI, 2001; CARPENTIER and GUYMARD, 2001; MDAFRI and BRORSEN, 1993). This approach is convenient if price indices are reported together with household expenditures, which is not the case for the information published in the ENIGH.

[14] Given that BELLON et al (2004) publishes average food expenditures in relatively small regions, the probability of having a high density of a given household decile in one region is relatively high.

Figure 4-2 Matching food expenditures and geographical position of household deciles



Source: Modified from BELLON et al., (2004)

Of course, in a given locality there are households from other deciles than solely from the matching food expenditure decile. However, the average of the population paying those prices and with given food expenditures are representative for the municipalities and thus for the decile. This assumption facilitates the linkage of prices reported by the OFJ for municipalities with the expenditures paid by deciles reported in the household survey. The representative household decile is the one with most households in a given locality. Thus, prices reported for selected municipalities are taken as prices paid by the predominant decile in that region. Each of the products included in the OFJ is weighted according to the frequency of acquisition by the household decile.

HICKS (1946) assumed that if prices of several commodities, which can be taken as a group, move in proportion to each other; they can be studied as a single commodity. In taking into account this assumption, in this study it is possible to group all commodities published in the OFJ into ten composite commodities. The prices published in the OFJ record information for approximately 2000 products from which 205 types are food commodities. This procedure then assumes implicitly what in similar approaches has been called weak separability. The weak separability exists when preferences over commodities in the same group are independent of the quantities of goods consumed in other groups (KEBEDE, 2008). In this

study, the price of 2000 products has to be aggregated into composite commodities. This aggregation reduces noticeably the number of equations in the demand system, by reducing products from 2000 into 10 composite commodities. Prices of composite commodities are estimated in this study aggregating single commodities from the OFJ:

$$PP_I = \sum_{i \in TRAD} \left(p_i * \frac{q_i p_i}{X_I} \right) \qquad 4.10$$

where:

PP_I price of composite commodity I

p_i price of commodity i in composite commodity I

q_i quantity consumed of commodity i in composite commodity I

X_I total expenditure of composite commodity I

Equation 4.10 is derived from the composite commodity theorem of HICKS (1946), and it assumes perfect aggregation of commodities i´s in composite I in a given period of time. This aggregations reduces the number of price parameters to be integrated in the LA/AIDS from 2000 to 10 commodity prices.

Consumer Price Index

The Mexican Bank publishes every six months the Laspeyres price indices for approximately 2000 products in 46 representative national localities, including small municipalities as well as industrialised cities, in the OFJ. Prices indices for each decile have been obtained taking the same localities as those chosen for the linkages of prices and deciles every 6 months (April and October) from 2000 to 2005 (Table 4-4). Each of the products included in the OFJ is weighted according to the frequency of acquisition by household decile. Finally, an average price index is calculated for each category of aggregated commodities, following a similar strategy as the one for prices in Equation 4.10.

Household Expenditures

Expenditures (total and by commodity) are taken from the latter three documented ENIGHs. These surveys were assembled between 2000 and 2005 and contain information on expenditure values, household expenditure by commodity, and total household expenditure.

The ENIGH survey is conducted every two years[15] and compiles information for all Mexican households, on their structure and distribution of income and expenditure of rural and urban households. The ENIGH measures consumption at the household level of fifteen categories of consumable goods (food, beverages and tobacco) and twenty-three categories of durable goods (manufactures and services). The household survey also collects data on monetary and non-monetary sources of income and expenditure reported in Table 4-1 and 4-2 respectively. The total number of households in the ENIGH survey was 24 50 169 in 2002, 25 845 081 households in 2004 and 25,710,321 by 2005. All households from the ENIGH are embedded in this estimation. The calculation of the LA/AIDS requires expenditure per capita, as the ENIGH report expenditures per household decile and not per capita, a required adjustment has been necessary to transform per household data into per capita data. In order to obtain total per capita expenditure, the number of members per decile has been calculated from the ENIGH for 2004 and is presented in Table 4-4. The household expenditures (total and by commodity) have been divided by the average number of household members.

Table 4-4 Geographical and demographic household linkages (2004)

Representative decile prices	Locality	Household members		
		Total Average	Children	Adults
I	Tehuantepec	2.4	0.6	2.0
II	Puebla	3.1	1.0	2.5
III	Veracruz	3.5	1.2	2.8
IV	Acapulco	3.6	1.3	2.9
V	Leon	3.7	1.3	3.0
VI	Tampico	3.9	1.2	3.2
VII	Hermosillo	3.9	1.1	3.3
VIII	Fresnillo	4.0	1.1	3.4
IX	Culiacan	4.1	1.0	3.5
X	La Paz	3.8	0.9	3.3

Source: Author's calculations with data from INEGI (2004) and own concordance with data from the OFJ.

4.2.4 Commodity Aggregation

The aggregation of commodities is a reflection of major commodities consumed by household deciles in Mexico. Commodities aggregated in the same category are considered substitutes of each other (e.g., cereals considers e.g. rice substitute of wheat), with weak separability across household deciles. In this sense, this is the first approach devoted to the assessment of a complete demand system for Mexico considering food and non-food

[15] The ENIGH is collected since 1976 every two years. As an exceptional case, in 2005 an ENIGH survey was conducted.

commodities, and the first approach assessing different household categories[16]. The aggregation contemplates six food commodities (cereals, vegetables and fruits, dairy products, meat, processed food and tobacco and beverages), and four non-food commodities (housing services, energy, manufactures and services). The corresponding matching categories reported in the ENIGH survey are aggregated and presented in Table 4-5.

Table 4-5 Sector aggregation and its concordance with the Mexican ENIGH survey

Model Aggregation	ENIGH category
Cereals	cereals
Vegetables and fruits	tubers, vegetables, legumes, fruits
Dairy and animal products	milk, dairy products, animal products, oils and fats
Meat	meat, fish and seafood
Housing services	real state taxes, imputed rent and other housing services (e.g. private security)
Processed Food	sugar and honey, coffee, tea and chocolate, spices, other processed food, non-alcohol drinks, food consumed and prepared outside home
Tobacco and beverages	tobacco, alcohol, and other beverages
Energy	water and water distribution, electricity and electricity distribution, gas and gas distribution
Manufactures	wearing apparel, chemical products, furniture, electronic products, transport vehicles, articles for personal care and other manufactures
Services	health services, transport services, education services, recreation services and communications

Source: Own concordance based on the sector aggregation from INEGI (2004).

4.3 A Complete Household Demand System in Mexico

This section describes the results and interpretation of the complete household demand system for Mexico based on Equation 4.1. A household demand system for each decile has been estimated. Each household demand system consists of a set of expenditure share equations, one equation for each commodity. Every expenditure share equation defines the expenditure share devoted to a given commodity as a function of the prices of other commodities, total expenditure and a price index. Therefore, there is one set of expenditure share equations for each household decile.

[16] NICITA (2005) has calculated elasticities only for food commodities for all households in Mexico and for quintiles.

The demand systems integrate expenditure structures and household preferences. The household demand systems have been estimated as a simultaneous system for ten composite commodities for each household category. For the estimation of the parameters $ALFA_{ih}$, $BETA_{ih}$ and $GAMA_{ijh}$, the Iterated Seemingly Unrelated Regressions (ITSUR) method is applied. The ITSUR developed by ZELLNER (1962) estimates approximations which are asymptotically equivalent to Ordinary Least Squares (OLS) and maximum likelihood estimates (ZELLNER, 1962). The SUR is classified as a multivariate linear regression. A characteristic aspect of SUR regressions is the fact that they are formed by a set of equations that are apparently unrelated. If this set of equations is solved using for example the OLS method for each equation separately, the results obtained are biased (RAMANATHAN, 2002). In SUR models the error terms or residuals from different equations in a set of equations are correlated.

In the case of the LA/AIDS, the application of the SUR assumes that a household decile (here represented as a set of equations or a LA/AIDS) will allocate expenditure first in specific $ALFA_{ih}$ proportions for each commodity (or individual equations from the set of equations). Subsequently, after the allocation of all $ALFA_{ih}$s there is an *expenditure surplus* in which all commodities are seemingly unrelated. This *expenditure surplus* or residual will be allocated according to $BETA_{ih}$s and $GAMA_{ijh}$s among commodities. Thus, the SUR assumes that the covariances of the single commodity equations in a LA/AIDS for a given household decile are correlated through the $BETA_{ih}$ and the $GAMA_{ijh}$ values.

Due to the additivity restriction (Equation 4.3), the covariance matrix is singular. To avoid singularity problems when computing the parameters, one equation must be omitted from the computation. The estimated parameters are the same, independent from which equation is eliminated.

The estimated parameters satisfy the adding-up, homogeneity and symmetry restrictions (Equations 4.3, 4.4 and 4.5). Values of the structural parameters for the LA/AIDS model are shown in Appendix C. In a conventional OLS model, the value of R^2 provides information on the goodness of fit from the estimations. In the case of the SUR method, this goodness of fit might be fixed in advance through the fixation of the convergence criteria. The convergence criteria fixed for the ITSUR process in this study is 0.0001 to ensure fewer deviations from original values. The computer software used to calculate parameters is the Statistical Analysis Software (SAS) Version 9.1.

4.3.1 Coefficients

This section presents and describes the estimated LA/AIDS parameters. Appendix C reports the $ALFA_{ih}$s, $BETA_{ih}$s, and $GAMA_{ijh}$s estimates for each commodity by household decile and the corresponding probability value[17]. Percentage errors are obtained from the t-test. From the 750 estimated parameters, 62 percent are statistically different from zero at the 0.05 level based on an asymptotic t-test. At the 0.1 level of an asymptotic t-test 75 percent of the estimated parameters are statistically different from zero.

At the 0.05 level of the t-test, from all deciles, decile III presents the highest percent (76 percent) of estimated parameters that are statistically different from zero, while decile IX has the lowest with 44 percent of estimated parameters statistically different from zero. Taking a 0.1 level for the asymptotic t-test, again decile III presents the highest percent (89 percent) of estimated parameters statistically different from zero, while decile IX has the lowest with 61 percent of estimated parameters statistically different from zero (Appendix C).

The $ALFA_{ih}$ values might be seen as the logarithm of the fixed minimum share of expenditure reserved for consumption of commodity i by household h and normalised prices. Following, the interpretation of $BETA_{ih}$, values given in Section 4.2.1. From the values, if $BETA_{ih}$ is negative then, commodity i is a necessity for the household h. On the contrary, if $BETA_{ih}$ is positive then the commodity is considered a luxury for household h. Luxury commodities are bought at a lower level when income decreases.

According to the classification of commodities given their $BETA_{ih}$ values, commodities consumed by deciles are classified in Table 4-6. As a general trend, poor households consider both processed food and services to be luxury commodities. Processed foods and services are more widespread in urban areas, and are quite rare in rural areas. Incidentally, in rural areas 61.8 percent of the population live in poverty and do not cover their basic asset needs, including mostly educational and health services (Table 2-6). These households are mostly classified in one of the first deciles (I-V), so that with the exception of deciles VI and VII the rest of the households considering services as luxury are poor. In addition, it is worth remembering that a considerable number of these households are located in rural areas. In these areas, services such as health services, educational services, transportation, trade, public administration and insurance are not easily accessible, and where the distance required to

[17] The p-value is the two-tailed probability computed using the t distribution. It is the probability of observing a greater absolute value of t under the null hypothesis. If the p-value is less than the pre-specified alpha level (for this study 0.05 and 0.1) we conclude that estimated parameters are statistically representative and significantly different from zero.

reach the services might be an additional obstacle for the households to cover their needs of these commodities.

Table 4-6 Preference of commodities by deciles in Mexico according to $BETA_{ih}$ estimates

Household decile	Luxury commodities
I	processed food, manufactures, services, housing services
II	energy
III	processed food, tobacco and beverages
IV	tobacco and beverages, services, housing services
V	energy, manufactures, tobacco and beverages, housing services
VI	cereals, vegetables, tobacco and beverages, services
VII	tobacco and beverages, manufactures, housing services
VIII	tobacco and beverages, manufactures
IX	dairy products, energy, tobacco and beverages
X	cereals, vegetables, dairy products, meat, tobacco and beverages, services

Source: Author's calculations

On the other hand, rich households consider as luxuries: vegetables, meat and dairy products. These kind of products are normally considered a necessity of all households. However, when income rises, the variety of cereals, vegetables and dairy products can increase as prices increase. Wealthier households try to obtain the best quality in the market regardless of the price. Thus, consumption of exotic edible and organic products increases with the well-being of households converting basic food into luxuries. It is reasonable then, to observe these trends only in the two richest deciles and mainly in decile X.

Overall, all households in Mexico classify as luxury the consumption of tobacco and beverages, regardless of the expenditure level. The classification of commodities according to their $BETA_{ih}$ value is an indicator of reactions to share expenditures when prices increase and other variables are constant (ceteres paribus). A more comprehensive interpretation of consuming behaviour of households is described in coming sections, where the elasticities of prices and expenditures are considered.

Although all parameters for the ten deciles and ten commodities are estimable, some values are biased and not significantly different from zero at the 5 percent significance level (see Appendix C). To bypass this problem it is recommended in future studies to disaggregate manufactures and services into a higher number of commodities composites. A feasible

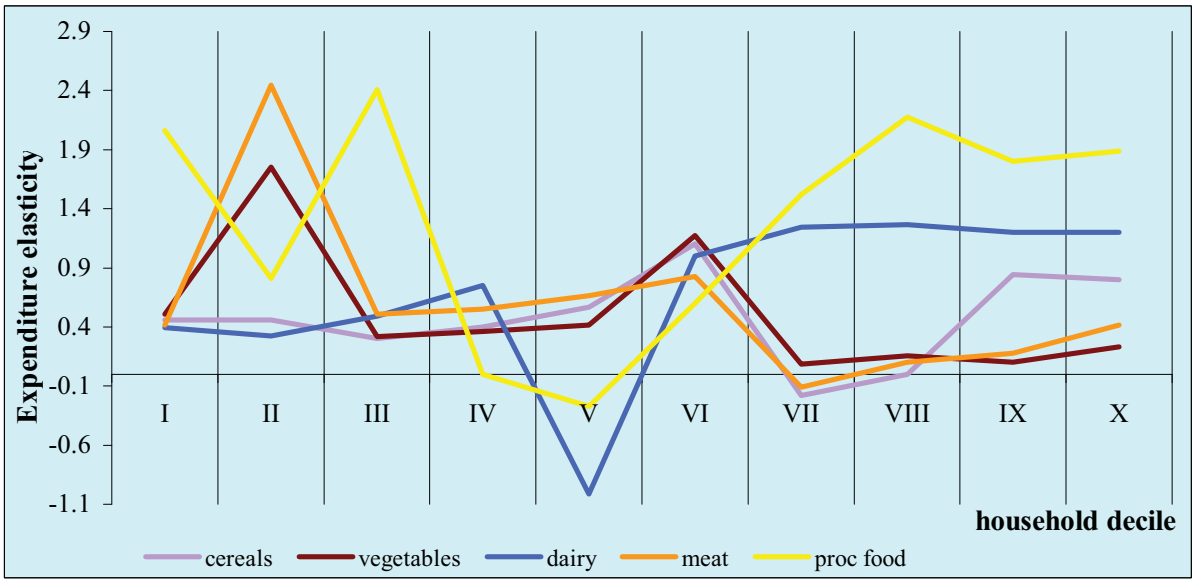
approach to group commodities consumed by households is classifying consumed products in durable and non-durable manufactures (LEWBEL, 1996).

4.3.2 Expenditure Elasticities

The expenditure elasticity reflects the changes in demand with respect to increases of the real expenditure by one percent. Expenditure elasticities are the ratio of the proportional change of quantity purchased to the proportional change in expenditure. Appendix D contains my own estimations of expenditure elasticities for deciles in Mexico as well as previous values found in Mexico for overall households (SEALE et al., 2003). As it can be seen in Appendix D, all expenditure elasticities were estimable; however, 28 elasticities up to the 100 estimated were biased. Those biased elasticities are neglected in the coming discussion, as these values are not significantly different from zero under the statistical restrictions imposed. However, detailed information of all estimations is presented in Appendix D.

With the priority of this study on agricultural trade liberalisation, the focus is given on agricultural trade liberalisation. Thus, the following analysis of expenditure elasticities considers only food commodities. In Figure 4-3, expenditure values for food groups calculated for the deciles in Mexico are depicted.

Figure 4-3 Expenditure elasticities for food groups in Mexico and for Mexican households



Source: Author's calculations

Starting with the first decile, the highest expenditure elasticity estimated corresponds to processed food (2.06), while dairy products are the most inelastic (0.39). The relatively low expenditure elasticities for basic food items such as cereals, vegetables and dairy products reveals slower expenditure responses to changes of expenditure levels. Retaking expenditure characteristics of these households in Section 4.1, this decile compared to other deciles

allocates an important proportion of their expenditures to the consumption of cereals, vegetables, raw milk, animal and dairy products. Thus, these households will cover their food consumption even at higher prices. The results are low expenditure elasticities for staple foods and high elasticities for processed food and non-food products.

Values calculated of expenditure elasticities for decile II suggest a higher response of these households to meat (2.44), vegetables (1.75) and processed food (0.81), while inelastic behaviour is found for cereals (0.46) and dairy products (0.32). The comparatively higher response of these households to changes in income gives reasons to believe that most of these households are more reliant on monetary income sources than households in decile I. This assumption comes from the higher changes in consumption of meat and vegetables for decile II than for decile I. Albeit, both deciles have similar consumption preferences as reviewed in Section 2.2. It is noteworthy to compare the income structure of these deciles in Table 4-1, monetary income (wages, profits and rental income) for decile II is higher (58.00 percent) than non-monetary income. On the contrary, decile I relies mostly on non-monetary sources (53.07 percent).

As in the previous case, decile III shows similar responses to expenditure changes for food products. The most elastic expenditure commodity is processed food (2.40), while response to other products is lower: cereals (0.30), vegetables (0.31). In addition, changes in consumption of dairy products (0.49) and meat (0.51) indicate particular preferences of these households e.g., by a increase in total expenditure these households will concentrate more consumption on processed food than on consumption of meat or dairy products. Similarly, the consumption of cereals and vegetables will not change as much as in comparison with the consumption of meat of dairy products when expenditure changes. These preferences might be related to households' composition. For example, the low response of cereals and vegetables indicates a high dependency on these products for their basic diets.

The expenditure elasticities of decile IV for food commodities were not significant at a 0.05 percent significance level. However, four out of five expenditure elasticities for non-food commodities were significant at a 0.05 percent significance level. This might be an indicator that, either substitution and complementary effects play a higher role on consumption or that these households do not have clear trends relating food consumption with increases in their income level.

Expenditure elasticities for decile V were all significant. The highest elasticity estimated corresponds to dairy products (-1.01), the most inelastic commodity is processed food (-0.27). In this decile the opposite trends are observed from those previously described

for lower expenditure deciles. Households in decile V, contrary to decile I, are more elastic to changes in prices of cereals, vegetables and meat. Thus, as expenditure levels increase across deciles, it is expected to observe also changes in household preferences. Households in this decile prefer the consumption of cereals, vegetables and processed food over meat and dairy products. The expenditure elasticities for non-food commodities are overall higher than those observed for food products.

Wealthier households (from decile VI to X) have a higher number of expenditure elasticities non significantly different from zero for food commodities (50 percent). Thus, these households do not modify sharply their food expenditure patterns in response to changes in income. Because they are able to afford and cover their nutritional needs. From decile VII to X preferences are similar and point at a higher inelasticity for cereals, vegetables and meat, while a higher elasticity is expected for processed food and dairy products.

A cross-country study performed by SEALE et al. (2003) reports expenditure and cross-price elasticities for products consumed by households in Mexico (average). The estimates reported by SEALE et al. (2003) are also provided in Appendix D. The expenditure values reported by SEALE et al. (2003) for overall households in Mexico follow the trend of low-income households. The more elastic food commodities reported by are processed food (1.18) followed by dairy products (0.68) and meat (0.62). The more inelastic food products are vegetables (0.50) and cereals (0.36). Expenditure elasticities calculated by SEALE et al. seem to be more related to the values found in this study for poorer households (deciles I to III).

The classification of commodities by values of $BETA_{ih}$ depends solely on changes of income ($HHEXP_{ht}$) (Table 4-6), while the classification of products by expenditure elasticities in the LA/AIDS takes account of changes in real income ($HHEXP_{ht}/PPRIVHH_{ht}$). Therefore, these two classifications provide different trends. According to their expenditure elasticities, commodities can be classified into normal and inferior commodities (VARIAN, 2002). Normal commodities have a positive expenditure elasticity of demand and might be classified as luxury or necessity commodities. Necessities are normal commodities which have an expenditure elasticity in the range $0 < i_i < 1$, meaning that the demand increases, but less than proportionately to expenditure increases. Luxury commodities are normal commodities presenting expenditure elasticities greater than 1, so that the demand increases more than proportionately to an increase in expenditure. Inferior commodities present negative expenditure elasticity of demand, so that demand decreases when expenditure increases, suggesting substitution of goods (e.g., public transport by own car) or the purchase of the

same items but with a higher quality (e.g., standard agricultural commodities by organic agricultural commodities).

Classification of commodities according to their expenditure elasticities is presented in Table 4-7. An analysis across household categories shows that commodities considered as normal and necessities for most of the low expenditure households (deciles I to V) are cereals and dairy products. Luxuries for deciles I to V are in general manufactures and housing services. Inferior goods are only detected for decile II (housing services), decile V (dairy products, processed food and services) and for decile VII (meat).

Table 4-7 Classification of commodities by household decile in Mexico according to their expenditure elasticities

Household decile	Necessities	Luxuries	Inferiors
I	cereals, vegetables dairy products, energy, meat, manufactures	services, processed food, housing services, tobacco and beverages	--
II	dairy products, processed food, energy	vegetables, meat, manufactures	housing services
III	cereals, dairy products, meat, tobacco and beverages	processed food, manufactures, housing services	---
IV	tobacco and beverages	manufactures, housing services, services	---
V	cereals, vegetables, meat	energy, tobacco and beverages, housing services, manufactures	dairy products, processed food, services
VI	meat, tobacco and beverages	cereals, vegetables, manufactures, services, housing services	---
VII	---	dairy products, processed food, tobacco and beverages, energy, manufactures, services	meat
VIII	vegetables	dairy products, processed food, tobacco and beverages, energy, manufactures, housing services	---
IX	cereals, meat, tobacco and beverages	energy, services, housing services	---
X	vegetables and meat	processed food, tobacco and beverages, services	manufactures, housing services

Source: Author's calculations

The three last deciles containing the wealthiest households in Mexico have the following luxury commodities profile: decile VIII dairy products, processed food, tobacco and beverages, energy, manufactures and services, for decile IX energy, for decile X processed food, tobacco and beverages and services (see Appendix D and Table 4-7).

Results of elasticities show that households in five different deciles classify processed food as a luxury. Three household categories classify also dairy products as luxury commodities. Vegetables are seen as luxury commodities for household deciles II and VI. Finally, meat and cereals are also sorted as luxury by deciles II and VI respectively. This point has fundamental implications by comparison to poverty figures, in which nearly 30 percent of the population live under food poverty. Households under some kind of assets poverty are grouped in deciles I to V. These households present as similarity the classification of basic food items as necessity (cereals, vegetables and dairy products), as income increases through deciles other commodities such as tobacco and beverages become necessities as well. Non-poor households classify as necessities vegetables and meat. These commodities are comparatively more expensive than cereals and dairy products, which are their regular substitutes.

Regarding inferior goods, households tend to buy less and substitute them for other commodities as income increases e.g., cereals are replaced by processed food or meat. Commodities signalised as inferior products are: dairy products, processed food and services for decile V, housing services for households II and X; meat for decile VII, and manufactures and housing services for decile X (see Appendix D).

Commodities that in some deciles are necessities, such as meat for poor households become inferior commodities for wealthier households. An opposite situation is observed for processed food, which is a necessity for wealthier households and an inferior good for poor households (Table 4-7). These results can be tracked as a substitution of items for others similar but entailing a better quality e.g., in the case of manufactures: poor households buy cheap manufactures with narrow controls of quality, while richer households might buy only good quality manufactures when their income rises. Other examples are given in the case of food items. For poor households some food items (here meat) are necessities, while for richer households might be inferior goods, because richer households may start purchasing organic food products which are comparatively more expensive than conventional food items.

A general overview of expenditure elasticities across household categories indicates that poor households in Mexico react in a differentiated manner when income increases, giving priority to consumption of food items such as cereals, vegetables and dairy products. Consumption of non-food products is achieved only after the coverage of food needs. On the other side are the richer households, whose responses are either not significantly different to zero or they distribute income across non-food and food items.

4.3.3 Uncompensated Own-price Elasticities

Own-price elasticities explain how household demand for commodity i changes due to a one percent rise in price of commodity i. Increases in the price of commodities normally cause a decrease in demand for commodities. If the expenditure share of a commodity rises with price $\eta_i > -1$, then the commodity is price inelastic. If expenditure share falls $\eta_i < -1$, then the commodity is price elastic. If the uncompensated demand for a commodity rises with own-price, $\eta_i > 0$, commodity i is a Giffen good (VARIAN, 2002).

Estimated decile values of uncompensated own-price elasticities as well as average own-price elasticities estimated previously for overall households in Mexico (SEALE et al., 2003) are reported in Appendix E. The own-price elasticities for all commodities across household categories were all estimable and negative. From the 100 elasticities estimated, 15 own-price elasticities are not significantly different from zero with a 95 percent probability. All estimated parameters and their corresponding probabilities of significance are presented in Appendix E. The following discussion addresses only those values found to be significantly different from zero at a 0.05 significance level.

The comparison of values between uncompensated own-price elasticities and expenditure elasticities reveals that the absolute values of own-price elasticities are higher than the expenditure elasticities, which indicates that households effects of own-prices play a higher role on demand than changes in household income. In general, energy sectors, manufactures, services and housing services tend to be more elastic than food commodities. Poorest deciles (I and II) are elastic to own-prices, while deciles IX and X are elastic to prices of cereals and dairy products (see Appendix E).

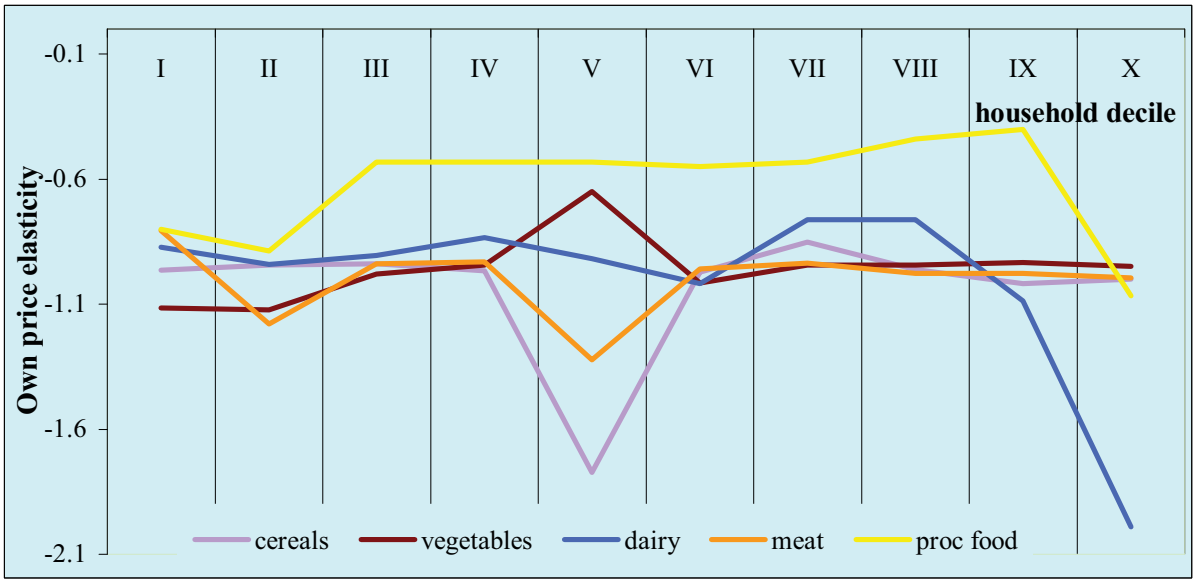
The evaluation of values estimated in this study and those calculated by SEALE et al., (2003) reveals important differences (Appendix E). Elasticities calculated by SEALE et al., are in general lower than those calculated in this study. SEALE et al., found higher responsiveness to changes in prices of housing services, processed food, and tobacco and beverages. In this study, higher responsiveness was found in changes of prices for energy commodities, services and, in some deciles for manufactures.

In Figure 4-4 own-price elasticities for food items are portrayed. In general, own-price elasticities for low expenditure deciles are more inelastic than those found for higher expenditure deciles. In the Figure 4-4, it can be seen that the more elastic values of elasticities across the low expenditure deciles (I to IV) are. The higher elasticities are detected for demand of vegetables (green line) and of meat (blue line), while the most inelastic is processed food (red line). For the middle decile V the more own-price elastic products are

cereals (-1.7) and meat (-1.3). According to the definition of poverty in Mexico (Section 2.2) households in decile V are in the borderline between poverty and non poverty. Any change in income and expenditure levels experienced by these households can represent the difference between the poor/non poor status. Therefore, the high responsiveness observed in expenditure and own-price elasticities in this decile.

High expenditure deciles (VI-IX) do respond less to changes in processed food (red line) and dairy products (dark purple), while reactions to changes in own-prices of vegetables, meat and cereals are quite similar. Thereby, sharp responses by decile IX and X are estimated for processed food (-1.0) and for dairy products (-2.0).

Figure 4-4 Uncompensated own-price elasticities for food groups in Mexico and for Mexican households



Source: Author's calculations

The elasticities estimated in this study follow the same trends as SEALE et al.'s own-price elasticities only for deciles I to III. Overall, elasticities reported by SEALE et al., for México tend to be lower than the elasticities calculated in this study. The main reasons for these differences might be found in the procedures applied, as SEALE et al. (2003) take a cross-country comparison to prices of international markets. In contrast, the present study takes as reference domestic prices to do the calculations at the household level. Additionally, the effect of a different distribution of income is shadowed in SEALE et al.,'s study, while this study takes into account these income distribution differences. As a result, the food price elasticities of richer households are higher, while poor households react more inelastically to food prices.

4.3.4 Uncompensated Cross-Price Elasticities

Appendix F reports the complete matrices of uncompensated and compensated cross-price elasticities estimated for Mexican household deciles. Cross-price elasticities being significantly different from zero vary between 54 (decile V and X) and 83 (decile VII) percent of total estimates. Since the inclusion of either the standard error or the probabilities of significance would make the matrices difficult to interpret, the values in italics are those for which the probability of being significantly different from zero is higher than 95 percent. Values in bold are not significantly different from zero at the 0.05 significance level. This section will focus exclusively on the discussion of significant values.

Results for decile I show that these households have few significant elasticity values, since 46 out of 100 of the elasticities are biased. Trends show substitution effects taking place either amongst food items (cereals, vegetables, meat and dairy products) or amongst non-food items (energy, manufactures, and services). Additionally, cross-price elasticities for non-food items are higher than elasticities for food items. This implies that households are more responsive to substitute commodities due to a rise in prices of non-food items than due to a rise in the prices of food items. In this sense, it must be borne in mind that a considerable number of these households rely upon a substantial share of staple consumption on barter and subsistence farming, on which change of market prices do not play an important role.

The higher number of elasticities significantly different from zero in decile II indicates a higher level of responsiveness to prices than in decile I. Similarly, to decile I, household relationships present clear patterns indicating separability for food or for non-food items. The cross-price elasticities of food and non-food items are not significantly different from zero at a the 0.05 significance level. However, in this decile households do react homogeneously to changes in prices of non-food and food items.

In deciles III and IV, the number of estimated elasticities significantly different from zero are higher. Services and manufacturing sectors do not appear to have any trend relating substitution or complementary effects with other commodities. Also in these cases, households are more responsive to changes in prices of non-food commodities than to changes of food items. For decile V it is difficult to observe a trend because only 54 percent of its cross-price elasticities are significantly different from zero. However, from the few significant different from zero elasticities, it might be inferred that substitution and complementation relationships occur within food items or within non-food items.

The demand behaviour of deciles VI to VIII is much more dynamic. In these households, interactions across non-food and food items are detected. Food commodities and

non-food commodities tend to be complementary commodities in these households. Responses to prices appear to have the same intensity for food and non-food items, as no specific trend in the magnitude of the cross-price elasticities is observed. Decile IX also shares these characteristics, with the important exception that responses to changes in prices of non-food items are higher than to changes in prices of food items.

Decile X, containing the richest households in Mexico, has only 54 percent of its cross-price elasticities being significantly different from zero. Substitutability and complementary seldom appears for food items. Households in this decile, however, tend to complement non-food products with food commodities.

As an example, tables containing substitutability and complementarity relationships for the lowest and highest income deciles are now displayed.

In Table 4-8 substitutability and complementarity relationships for decile I are presented. In Table 4-8 it becomes evident that most of the substitution effects are observed within food commodities e.g., cereals by vegetables, vegetables by dairy products, dairy products by vegetables, dairy products by meat, meat by vegetables, processed food by meat etc. Complementary relationships are more frequently observed within food and non-food commodities e.g., cereals and manufactures, cereals and services, vegetables and tobacco and beverages, dairy products and tobacco and beverages, dairy products and energy, meat and manufactures, meat and other services, tobacco and beverages and dairy products, energy and manufactures, energy and services, manufactures and processed food, services and meat, services and tobacco and beverages, and services and energy, etc.

Table 4-8 Complementarity and substitutability relationships in decile I according to uncompensated cross-price elasticities

	Cereals	*Vegetables*	*Dairy products*	*Meat*	*Proc Food*	*Tob and bev*	*Energy*	*Manuf*	*Serv*	*Hous services*
Cereals		S						C	C	S
Vegetables	S		S	C		C				S
Dairy products		S		S		C	C	S		S
Meat		S						C	C	S
Proc Food				S		S	S	C		
Tob and bev									S	
Energy										S
Manuf									S	
Serv				C		C	C	S		

C: Complementarity, S: Substitutability

Source: Own design

The frequent substitution relationships observed amongst food issues in this decile suggest that these households consume the cheapest food products regardless of special preferences. Moreover, when prices of vegetables are affordable, they consume vegetables, if prices increase they substitute vegetables by cereals, dairy products or meat, being this decision a dependent factor on the cheapest commodity price. In all cases non-food products will only be consumed in the case where food needs have been satisfied.

Similarly, in Table 4-9 substitutability and complementarity relationships for decile X are displayed. As can be seen in Table 4-9, substitution effects are rare e.g., vegetables by tobacco and beverages, dairy products by cereals, dairy products by meat, dairy products by services, processed food by services, services by dairy products, services by housing services etc. Households in decile X cover their food and their non-food needs. Substitution relationships are therefore rare, as these households do not have to substitute products when prices of the given commodities soar. Complementary relationships are more common in decile X. However, these relationships do not have a specific substitution pattern food-food or food-non-food. Additionally, the complementary relationships indicate a high degree of affordability of consumption.

Table 4-9 Complementarity and substitutability relationships in decile X according to uncompensated cross-price elasticities

	Cereals	*Vegetables*	*Dairy products*	*Meat*	*Proc Food*	*Tob and bev*	*Energy*	*Manuf*	*Serv*	*Hous services*
Cereals			S		C			C		C
Vegetables				C	C	S		C		C
Dairy products				S	S				S	
Meat		C	C		C			C	C	C
Proc Food									S	C
Tob and bev			C						C	C
Energy			C						C	
Manuf										
Serv	C	C	C	C	C		C	S		S

C: Complementarity, S: Substitutability

Source: Own design

4.3.5 Compensated Cross-Price Elasticities

In decile I the values of compensated elasticities for: cereals, vegetables, dairy products, and meat are considerably lower than for the uncompensated elasticities for decile I, suggesting a higher sensitivity of households to income changes than to changes in own-prices for food commodities. This is of special importance when considering that the

expenditure share of poor households devoted to food items varies between 60 and 45 percent (Table 4-2).

Deciles II to X overall have higher compensated cross-price elasticities than uncompensated cross-price elasticities, which indicates a higher response to changes of own-prices than to changes in total household income (see Appendix F). In general, the trends of compensated cross-price elasticities are similar to uncompensated cross-price elasticities.

In order to keep results in a tractable dimension, preferences of two deciles are comprehensively presented. Preferences for the poorest and the richest decile are presented in Table 4-10 and 4-11 respectively. The preferences for the remaining household deciles can be derived from Appendix F.

In Table 4-10 substitutability and complementarity relationships for decile I are presented. The observed trends for uncompensated cross-price elasticities are similar to those displayed in Table 4-8. For decile I most of the substitution effects are observed within food commodities e.g., cereals by vegetables, cereals vegetables by dairy products, dairy products by vegetables, dairy products by meat, meat by vegetables, etc. Complementary relationships are more frequent within food and non-food commodities e.g., vegetables and tobacco and beverages, dairy products and tobacco and beverages, dairy products and energy, meat and manufactures, meat and other services, processed food and manufactures, processed food and housing services, tobacco and beverages and vegetables, etc.

Table 4-10 Complementarity and substitutability relationships in decile I according to compensated cross-price elasticities

	Cereals	*Vegetables*	*Dairy products*	*Meat*	*Proc Food*	*Tob and bev*	*Energy*	*Manuf*	*Serv*	*Hous services*
Cereals		S						C	C	S
Vegetables			S	C		C				S
Dairy products		S		S		C	C	S		S
Meat		S						C	C	S
Proc Food				C		S	S	C		C
Tob and bev									S	
Energy								C	C	
Manuf					C					
Serv				C		C	S			

C: Complementarity, S: Substitutability

Source: Own design

The likely substitutability and complementarity relationships for commodities in decile X are presented in Table 4-11. Substitution effects in this decile are rare, some patterns are found e.g., vegetables by tobacco and beverages, dairy products by meat, dairy products by

processed food, dairy products by services, processed food by services, services by dairy products, services by processed food, etc. Complementary relationships are more common in decile X. These relationships have a specific complementarity pattern for food to non-food.

Table 4-11 Complementarity and substitutability relationships in decile X according to compensated cross-price elasticities

	Cereals	*Vegetables*	*Dairy products*	*Meat*	*Proc Food*	*Tob and bev*	*Energy*	*Manuf*	*Serv*	*Hous services*
Cereals					C			C		C
Vegetables				C	C	S		C		S
Dairy products	C			S	S					S
Meat		C	C		C			C	C	C
Proc Food										S
Tob and bev			C							C
Energy			C							C
Manuf										S
Serv	C		C	C	C					

C: Complementarity, S: Substitutability

Source: Own design

4.3.6 The LA/AIDS for Mexican Households

This section has presented the estimation of a complete consumer demand system for households in Mexico taking the ENIGHs conducted in 2000, 2002, 2004 and 2005. Households in Mexico are stratified following the structure of the ENIGH into ten categories. To the best of our knowledge, this is the first study of this length or scope, based on total population in Mexico and covering all sold commodities, with data obtained from the ENIGH and the National Bank of Mexico. However, a similar study for Brazil was found (ASANO and FIUZA,2001). The results show a striking conformity to microeconomic theory. The estimated price and income (expenditure) elasticities are close to that predicted by economic theory. In addition, this study shows that Mexican household deciles have remarkable differences in preferences and structures of consumption. These results give quantitative explanations to some facts that have already been inferred qualitatively by other authors (HERNÁNDEZ-LAOS, 2000; HANDA et al., 2001 and SZÉKELY, 2005).

Values of elasticities and parameters estimated in this study might be applied in other research projects, e.g., integration of parameters in CGE models, as guidance for evaluating various policy related issues that might cause changes in expenditure patterns on Mexican household categories to changes in expenditure patterns.

This demand system shows that households in different deciles present different preferences and thus different expenditure behaviour. In rich households the decisions of

purchase between food products and other products and services are independently made. Meanwhile, poor households try to first cover their food needs, and as a result of this, are delaying the acquisition of other goods and services. Nevertheless, to define more specifically the consumption of manufactures by different households in Mexico, the importance of a more comprehensive strategy to aggregate these commodities is underlined; in such a strategy higher numbers of manufacturing sectors must be included.

4.4 Development of the Household Module

The literature review in Section 3.4 shows studies focused on the analysis of trade liberalisation and their impacts on households. From Section 3.4 is inferred the limited number of cases where the differential structure of household expenditures has been addressed. As it has been stated in previous sections of this chapter, household deciles in Mexico do have different preferences determining their expenditure patterns. This section describes the methodology developed in this study. This new methodology assesses differences in preferences of households in a global context developing a household module linked to the GTAP model.

The household module takes the changes in prices from the standard version of the GTAP model and evaluates the impact of those changes in decile expenditures. In this sense, this model might be categorised according to Section 3.4 as a micro macro approach. Likewise as in the macro micro simulation, this study takes the price changes from the GTAP standard version and in concordance with the LA/AIDS demand function expenditure changes for deciles are adjusted. This approach provides straightforward expenditure changes in percentage levels and in values. An additional feature of this approach is the *top-down* structure, meaning that the results obtained from the micro simulations are not transmitted to the GTAP model to generate a solution taking into account household behaviour.

The methodology here proposed encloses two main steps. The first step is constituted by the current platform of the GTAP model. Expenditures at the national level in GTAP are allocated into three final consumers: government, private consumption and savings (see Section 3.3.2.3). Regional per capita utility is defined as a Cobb Douglas function composed of government and private utility as well as savings (which are savings for government and households for future periods) (see Figure 3-5) (HERTEL, 1997). Per capita utility is seen as a variable depending on per capita demand. Hence, private utility is defined on the basis of a given level of commodity consumption (qp_{ir}). Further, this research will exclusively focus on the private consumption that represents households in one region of the GTAP model.

The second step is the methodological contribution of this research. In this research emphasis is given to differentiated expenditures made by household categories. The approach proposed here adopts changes in the prices paid by the private household agent from the GTAP model and integrates them into a household module. The description of the standard version of the GTAP model has been reviewed in Section 3.3. This section continues with the presentation of the economic background supporting the household module developed in this study.

The household module adopts elasticities from the LA/AIDS presented in Section 4.3 and uses them to model expenditure behaviour. As an additional feature to previous CGE studies assessing household income distribution, this expenditure system might be evaluated simultaneously for different countries, as the extension contains a new set to include household categories in regions, and new parameters to consider elasticities for different regions. This approach can be used to evaluate changes in expenditure patterns for different regions simultaneously. The household module comprises three main elements:

- Changes in commodities household shares with respect to total expenditure of household h
- Changes in the value of consumption of commodity i by household h in region r
- Changes in total expenditure of household h in region r

These three components perform under the assumptions of a LA/AIDS, and link household decile' expenditure with total national expenditure of commodity i through VPA_{ir}.

Recalling Section 3.3.2.3, the changes in prices paid by private households depend on the prices of domestic and import commodities consumed by private households. After the update of the prices paid by private households for composite commodities, these changes in prices will drive changes in expenditure patterns of household categories. In this case, ten household categories for Mexico have been taken as an example. The assumptions on weak separability over composite commodities in the household module are the same as from the LA/AIDS described in Section 4.1 and 4.3.

Under the assumption of direct weak separability, diverse authors have isolated complete demand systems for groups of items (e.g., food consumption). Some studies based on these assumptions were performed by FULPONI (1989), FAN, et al. (1995); GAO, et al. (1997) and SELLEN and GODDARD (1997). However, in this study weak separability is assumed in order to simultaneously determine changes in expenditures for several composite commodities.

In the GTAP model changes in quantities consumed by private households are estimated through a CDE function. In absolute terms, the allocation of private commodities at the regional level is defined in GTAP as (HERTEL, 1997):

$$VPA_{ir}=PP_{ir}*QP_{ir} \qquad 4.11$$

where:

VPA_{ir} total value of private household consumption of commodity i in region r

PP_{ir} private consumption price for composite commodities i in region r

QP_{ir} total quantity of commodity consumed i in region r

Differentiating both sides of Equation 4.11, and dividing by VPA_{ir} it is obtained:

$$\frac{dVPA_{ir}}{VPA_{ir}} = \frac{d(PP_{ir} * QP_{ir})}{QP_{ir} * PP_{ir}} \qquad 4.12$$

Percent changes in the value of total regional private consumption of commodity i are calculated as (HERTEL, 1997):

$$vpa_{ir} = pp_{ir} + qp_{ir} \qquad 4.13$$

Equation 4.13 denotes the percentage changes of total regional private consumption of commodity i in region r in GTAP are derived from the income of private households in region r:

$$QP_{ir} = f(PP_{ir}, YP_r) \qquad 4.14$$

where: QP_{ir} represent the *n x 1* vector of commodity quantities i consumed by all household categories in a region r, PP_{ir} the price paid by private household agent in each region, and YP_r is total expenditure of private households in region r.

In the household module, changes in expenditure patterns are calculated by adopting changes in prices paid by private households. Consequently, the changes in consumption quantities of *h-th* of commodity i are: qph_{ihr}. Here, it is worth emphasizing that as qp_{ir} come

from CDE functions and qph_{ihr} comes from a LA/AIDS function, perfect aggregation is not assumed nor expected[18].

The demand function for each household category is given as a function of private consumption price for composite commodities and total income, assuming weak separability of demand:

$$QPH_{ihr}=f\,(PP_{ir}, HHEXP_{hr}) \qquad 4.15$$

where: QPH_{ihr} is the *m x 1* vector of quantities corresponding to the commodity *i-th* consumed by the *h-th* household, at private consumption price for composite commodities PP_{ir}, and $HHEXP_{hr}$ is the total expenditure of the *h-th* household. The following step is the definition of total household expenditure for the *h-th* household in a region r:

$$HHEXP_{hr}=\sum_{i\in TRAD} QPH_{ihr} * PP_{ir} = \sum_{i\in TRAD} VDHH_{ihr} \qquad 4.16$$

where:

$HHEXP_{hr}$ total expenditure of the *h-th* household in region r

$VDHH_{ihr}$ value of good i consumed by the *h-th* household in region r

In general, changes in prices across localities and household deciles in Mexico will not be uniform due to differences in spatial price relationships. As mentioned in Section 2.3.5, price transmission in Mexico is found to be affected by trade liberalisation. According to NICITA (2005) the Northern states in Mexico are more likely to be affected with the effects of trade between Mexico and the USA. The low changes in prices as result of trade liberalisation observed in the Southern states contrasts with the price transmission of the Northern states in Mexico. The inclusion of the price transmission patterns in this approach would require the household module to include (a) transport structures within Mexico, (b) local differences in the production chain within the country and (c) the investigation of possible geographical differences in returns to scale in the production structures. As has been previously discussed (MCNEW (1996); BALCOMBE and MORRISON (2002) and BARRET and LI, (2003)), the price transmission is the result of different factors driving spatial differences in prices such as local

[18] qp_{ir} is the average of changes in household categories, to obtained perfect aggregation, it will be required to calculate qph_{ihr}'s whose average across households would yield qp_{ir}, which is nearly technical impossible (SAVARD, 2005).

economic policies and different geographic production structures (GOODWIN and HARPER, 2000). I would recommend modelling the differences in price transmission through the inclusion of all these driving factors in the CGE model. The inclusion of "price transmission elasticities" within a CGE model is seen as a flawed approach because these elasticities do not give information on the separate effects of the policy changes driving the price differences. The inclusion of a structure driving differences in prices along states in Mexico is out of the scope of this study. However, it is important to bear in mind these existing factors.

Thus, the study of price transmission in the literature points against the model of perfect competition because it takes into account distortions in the market such as imperfections along the production chain, distortions in markets, monopolistic behaviour, etc (RAPSOMANIKIS et al., 2003). As the GTAP model assumes perfect competition, the Law of One Price (LOP) is also assumed to regulate spatial price relationships across localities in Mexico. Additionally, it is assumed that differences in prices along the production chain will be transmitted uniformly across the country.

The possible consequences of this assumption according to the results exposed by NICITA (2005) are (a) an under (in the Northern states) and (b) over (in the Southern states) estimation of price effects on the expenditures of households in Mexico.

Therefore, it is assumed in this approach that the price paid by different deciles is constant across one region. Commodities are assumed to aggregate perfectly across households. Thus, in the baseline, regional values of commodity i consumed (VPA_{ir}) equalise total values across household categories of commodity i consumed ($VDHH_{ihr}$) as:

$$VPA_{ir} = \sum_{h \in HHC} QPH_{ihr} * PP_{ir} = \sum_{h \in HHC} VDHH_{ihr} \qquad 4.17$$

Additionally, the budget share by the *h-th* household in region r ($SHRHH_{ihr}$) of total private consumption of commodity i in region r (VPA_{ir}) is defined as:

$$SHRHH_{ihr} = \frac{QPH_{ihr} * PP_{ir}}{VPA_{ir}} = \frac{VDHH_{ihr}}{VPA_{ir}} \qquad 4.18$$

where:

$SHRHH_{ihr}$ share of VPA_{ir} consumed by the *h-th* household

4.4.1 Changes in Household's Expenditure Shares

Household expenditure share of commodity i is defined as the value of commodity i consumed by the *h-th* household in region r divided by total expenditure of the *h-th* household:

$$EXPSHR_{ihr} = \frac{VDHH_{ihr}}{HHEXP_{hr}} \qquad 4.19$$

where:

$EXPSHR_{ihr}$ household expenditure share devoted to commodity i by the *h-th* household in region r

The relationship between regional level and household level is achieved by solving 4.18 for $VDHH_{ihr}$ with further substitution into 4.19:

$$EXPSHR_{ihr} = \frac{SHRHH_{ihr} * VPA_{ir}}{HHEXP_{hr}} \qquad 4.20$$

At the household level, budget shares $EXPSHR_{ihr}$ are calculated through an LA/AIDS (DEATON and MUELLBAUER, 1980) following equation 4.1:

$$EXPSHR_{ihr} = ALFA_{ih} + \sum_{j} GAMA_{ijhr} \ln PP_{jr} + BETA_{ihr} \ln\left[\frac{HHEXP_{hr}}{PPRIVHH_{hr}}\right]$$

Further details of the LA/AIDS have been mentioned in Section 4.2, elasticity interpretation and the underlying theory are also provided in Section 4.3 taking as an example the case of Mexico.

The percentage change in households expenditure share (wph_{ihr}) is obtained by the differentiation of Equation 4.19 with respect to prices of cross commodities and to total expenditures (DEATON and MUELLBAUER, 1980):

$$dEXPSHR_{ihr} = \frac{\partial EXPSHR_{ihr}}{\partial PP_{jr}} dPP_{jr} + \frac{\partial EXPSHR_{ihr}}{\partial HHEXP_{hr}} dHHEXP_{hr} \qquad 4.21$$

In Equation 4.21, each term on the right side indicates the percent change in $EXPSHR_{ihr}$ resulting from a small change in: (a) cross-prices (PP_{jr}), and (b) total household expenditure ($HHEXP_{hr}$). The economical interpretation of the first term of Equation 4.21, represents the marginal share of commodity i as a function of price changes of other consumed commodities,

and similarly the second term represents the marginal share of commodity i as a function of the changes in total household expenditures. The total differentiation of 4.21 yields after simplification (detailed differentiation is included in Appendix G):

$$wph_{ihr} = \frac{\left(\sum_{j \in TRAD} GAMA_{ijhr} - BETA_{ihr} * EXPSHR_{jhr} \right) * pp_{jr} + BETA_{ihr} * hh\exp_{hr}}{EXPSHR_{ihr}} \qquad 4.22$$

Substituting in 4.22 Marshallian cross-prices elasticities and expenditure elasticities represented in Equations 4.7 and 4.9:

$$wph_{ihr} = \sum_{j \in TRAD} \left(ECRSL_{ijhr} * pp_{jr} \right) + (EPLS_{ihr} - 1) * hhexp_{hr} \qquad 4.23$$

which represents the changes in consumption share of commodity i of total household expenditure as function of changes in the price of commodity j and total expenditure.

4.4.2 Changes in Values of Consumption

The calculation of changes in values of consumption of commodity i by household h in region r is achieved by solving Equation 4.19 for $VDHH_{ihr}$:

$$VDHH_{ihr} = EXPSHR_{ihr} * HHEXP_{hr} \qquad 4.24$$

Obtaining the differential of Equation 4.24:

$$dVDHH_{ihr} = HHEXP_{hr} * dEXPSHR_{ihr} + EXPSHR_{ihr} * dHHEXP_{ir} \qquad 4.25$$

Dividing both sides of Equation 4.25 by $VDHH_{ihr}$, and expressing terms as percent changes, we obtain:

$$xphh_{ihr} = wph_{ihr} + hh\exp_{hr} \qquad 4.26$$

where:

$xphh_{ihr}$ changes of value for good i consumed by household h in region r

4.4.3 Changes in Total Household Expenditure

The calculation of changes in expenditures derives from the differential of equation 4.16:

$$dHHEXP_{hr} = \sum_{i \in TRAD} dVDHH_{ihr} \qquad 4.27$$

Dividing Equation 4.27 through $HHEXP_{hr}$, changes in expenditures are obtained:

$$hh\,exp_{hr} = \sum_{i \in TRAD} \left(\frac{VDHH_{ihr} * xphh_{ihr}}{HHEXP_{hr}} \right) \qquad 4.28$$

Substituting the value of $EXPSHR_{ihr}$ (Equation 4.19) into 4.28

$$hh\,exp_{hr} = \sum_{i \in TRAD} EXPSHR_{ihr} * xphh_{ihr} \qquad 4.29$$

Calculation of changes in expenditures is performed through the composite changes in prices and quantities at the regional level from Equation 4.13 (qp_{ir} and pp_{ir}):

$$hh\,exp_{hr} = \sum_{i \in TRAD} EXPSHR_{ihr} * (qp_{ir} + pp_{ir}) \qquad 4.30$$

The choice of average regional changes (pp_{ir} and qp_{ir}) instead of household changes ($xphh_{ihr}$) is instrumented in order to avoid singular matrices in the computational solving process of the model. Recalling Equation 4.26, $xphh_{ihr} = wph_{ihr} + hh\,exp_{hr}$, this might imply that Equation 4.30 should be defined as: $hh\,exp_{hr} = \sum_{i \in TRAD} EXPSHR_{ihr} * xphh_{ihr}$ which would cause a singularity problem in the computation of the model.

5 Empirical Analysis

The aim of this chapter is to present the empirical application of the household module developed to work with the GTAP model, as well as the analysis of the results obtained from three different simulations. Since some components of the GTAP data base are extended to feed the household module, the first section describes the GTAP data base, its structure and main components. The second section is the introduction of the experimental work for this research, and presents the implementation of an updated IOT for Mexico. The updating of the IOT for Mexico is seen as a necessary requirement in obtaining reliable results in this study. The reasons for this view are also explained. The third section describes comprehensively the construction of the household module and the procedure to make it compatible with the GTAP framework. The household module consists of modifications of some of the components of the GTAP data base addressed in Section 4.4. The fourth section presents the chosen sector and country aggregation for the empirical analysis. In the fifth section, three different scenarios to be implemented on the GTAP model with the household module are highlighted. The sixth section presents the results of the scenario simulations, with special focus on the effects obtained for household expenditures in Mexico. The seventh section analyses the sensitivity of these results, whilst the eighth Section recommends possible improvements on this work.

5.1 GTAP Data Base

The veracity of results from CGE models depends strongly on the accuracy of their data bases (HERTEL et al., 2004; HESS and VON CRAMON-TAUBADEL, 2008). The data base of a CGE model must have as much reliable information as possible in order to be as close as possible to the real world situation. The data base of the GTAP model is continuously updated by their users, who have built a network of economists pursuing the same goal: to contribute to the construction and development of an actualised, accurate and global CGE model. The project is supported by several prestigious international institutions such as the World Bank (WB), the WTO, the OECD, as well as national institutions such as the Johann Heinrich von Thünen Institute (vTI) in Germany; the Agricultural Economics Research Institute in the Netherlands; the US- International Trade Commission (US-ITC) in the USA, etc.

As mentioned in Section 3.3, every version of the model is fully documented, making the information and procedures available for everyone. This information consists of the compilation and harmonisation procedures performed to obtain a consistent data base. Given that the sources of these data usually have different origins; this documentation is of special

importance, because it permits users to access procedures used to harmonise information from different sources. Thus, the data base can also be converted to be used in other models (e.g., the CRUSOE model, the MIRAGE model, etc.).

The data set used for this study is the GTAP data base version 6.2 (released in 2005). The data base was developed from the economy as of 2001. It consists of data on bilateral trade, transport, and protection matrices linking 87 country and regional economic data bases, where 14 out of the 87 countries are composite regions, e.g., Rest of Southeast Asia (XSA) or Sub-Saharan Africa (XSS). Moreover, 57 sectors are covered including a very detailed agricultural sector with 12 agricultural primary sectors and 8 food processing sectors. The remaining sectors comprise services, manufacturers and other primaries. Finally, in addition to those country- and sector matrices, the data base also contains five production factors: natural resources, land, capital, unskilled labour, and skilled labour (DIMARANAN and MCDOUGALL, 2005).

Input Output Tables

The data base includes IOTs that have been compiled by researchers linked to the GTAP project. As the closure of the results is highly dependent on the actualization of the data base, one of the main goals is to have a suitable actualised data base. For this reason, it is desirable to integrate new regions, as well as the regular updating of IOT for the existing regions in the model. This work is done by researchers with particular interest in the study of a country or region, who also have access to statistical information for the country or region. In some cases, contributors are also researchers linked to statistical institutes in countries. The IOT required for the GTAP model has a given format. In countries where IOT are published regularly by the state, contributors must -in most of the cases- only rearrange the structure and harmonise data required from the IOT to obtain the desired structure. Then, the updated IOT can be further incorporated into the GTAP data base. The procedures to contribute with an IOT are detailed documented in the GTAP homepage. Additionally, for the recompilation of an IOT it is possible to consult the GTAP team when particular questions emerge.

Trade Data

The trade data in the GTAP data base is composed of six elements. There are four bilateral matrices; these matrices contain the value of bilateral trade at different prices. The remaining two elements from the trade data gather information on other costs incurred when trading. The first two arrangements from the bilateral data contain the value of bilateral trade at the price free on board (*fob)* and the cost, insurance and freight price *(cif).* The other two

out of four bilateral matrices represent the value of trade at market prices in exporting and importing countries. The two elements regarding trading information comprise the costs of services of transportation from transporting goods from the export to the import region (MC DOUGALL, 2006).

The backbone of the trade data is contained in the four matrices describing bilateral trade. The information contained in these four matrices has been collected from different sources such as the COMTRADE data from the United Nations, which includes information on commodity classification (HS; Rev2, ISIC etc), export region, and import region. As COMTRADE contains information only on merchandise commodities (goods but not services), the information on services has been collected from the International Monetary Found (IMF). Other sources of information applied for data conciliation are the FAO Statistical Data Base (FAOSTAT), and the data base of the United Nations Conference on Trade and Development (UNCTAD) (MC DOUGALL, 2006).

Energy Data

The data source for energy data base comes from the International Energy Agency's "Extended Energy Balances" (EEB) published in 2003, with data from 2001. The energy balances constitute arrays of quantity of energy usage (in kilo tones of equivalent oil) by commodity. Other information concerns energy flows, prices and taxes. The data base also contains the money value of energy usage by energy commodity and energy use class. Different values of trade in energy commodities for products expressed at *cif* and *fob* prices by GTAP commodity and specific to source and destination region are included. The energy data also provides information on energy output subsidy by industry and power of taxes levied on intermediate usage and private consumption of energy commodities by GTAP commodity and industry (MC DOUGALL and LEE, 2006).

Protection Data

This data set contains protection measures for domestic market, imports and exports. The domestic support data includes output subsidies, intermediate input subsidies, land-based payments and capital-based payments. The protection data covering import measures includes agricultural and merchandise tariffs obtained from the Market Maps (MAcMap) data base compiled by the Centre D'Etudes Prospectives et D'Informations Internationales (CEPII). The MAcMap has been compiled with information from the Trade Analysis and Information System (TRAINS) provided by the UNCTAD, and the equivalent base tariff provided by the WTO. The export protection instruments cover agricultural export subsidies, estimates of the

export tax equivalent (ETE) of the quotas under the Agreement on Textiles and Clothing (ATC), voluntary price undertakings, and voluntary export restraints (VERs) (DIMARANAN, 2006).

Behavioural Parameters

Behavioural parameters are required for the computation of the model, such as elasticities of substitution between commodities (Armington elasticities), elasticities of substitution between production factors, elasticities of transformation between factors in commodities, price elasticities, and income elasticities of private households. Armington elasticities and substitution elasticities were taken from HERTEL et al. (2004), who estimated elasticities of substitution among imports from different sources using the approach proposed by HUMMELS (1999). HUMMELS identified substitution elasticities by exploiting cross-sectional variation in delivered prices, all this compilation was subjected to cross-country conciliation. Elasticities and parameters for the CDE function in the GTAP data base version 6.2 have been calibrated from the work done by HERTEL and REIMER (2004). In their study HERTEL and REIMER estimated an implicit, directly additive demand system (AIDADS) first using cross-country data on consumer expenditures from the International Comparison Project (ICP) and then using the GTAP data. The authors found that the two data sets produce results that are quite consistent despite their differing origins, and the fact that the ICP data are based on consumer goods that embody wholesale/retail margins, while margins demand is treated separately in the GTAP model. Given the similarity of the results, the estimation based on the GTAP data was found to be favourable since it readily matched the input-output-based production and trade data (HERTEL, 1997; DIMANARANAN; et al., 2006).

A complete description of the data base and the conciliation methods of information sources are to be found in HERTEL (1997); DIMARANAN and MCDOUGALL (2005), and in the GTAP homepage for old versions and for the latest updates.

5.2 Construction of an Input Output Table for Mexico

This section presents the construction of an IOT for Mexico to update the data base of the Mexican economy in the GTAP model. The IOT is a 57-commodity aggregation of the economic transactions for Mexico in 2002. LEONTIEF (1953) developed the Input Output analysis as a theoretical framework and as an applied economic tool to analyse a market economy. This methodology presented the construction of the first IOT for the United States for the years 1919 and 1929. Since then, tables describing interrelations among producers and consumers of an economy have been constructed for over 90 countries (UN, 1999). The integration of an input output framework into applied general equilibrium models, started

with the economic analysis of SHOVEN and WHALLEY (1992). The framework developed by SHOVEN and WHALLEY turned out to be relatively flexible and suitable for application in many disciplines of economic and policy issues, including agricultural economics, structural economics, national accounts, and economics of growth. The Shoven-Whalley approach is normally based on a multi-sector data set, such as the one provided by an IOT (RUTHERFORD and PALTSEV, 1999; ARROW and HAHN, 1971; LEONTIEF, 1953).

The general format for an IOT is presented in Figure 5-1. An IOT registers the economic transactions between sectors in a closed economy during a determined period of time, e.g., within a year. The transactions are classified according to their purpose, namely either as intermediate or as final consumption. Intermediates might be of domestic or import origin. Furthermore, an IOT includes the value added consisting of labour, capital, direct and indirect taxation.

Figure 5-1 General Format of an IOT

		INTERMEDIATE USE (n)	FINAL USE(m)	OUTPUT(n)
		1 2 3 …n	Private Governmt Invest Export	
DOMESTIC PRODUCTION (n)	1 2 : n	A_{nn}	B_{nm}	C_n
IMPORTS(n)	1 2 : n	D_{nn}	E_{nm}	F_n
VALUE ADDED (v) Labour Capital Taxes	L C T	G_{vn}		H_v
Total INPUT (n)		I_n		

Source: Own design

In a traditional IOT, arrangement A_{nn} is a matrix representing intermediate industrial demand of domestic production with dimensions (n x n). The columns contain the sector use of outputs of production or intermediate inputs. The rows represent sector output A_{nn}, for example A_{ij} is a value in matrix A_{nn} and represents the amount of sector i´s output used in the production of sector j. Matrix B_{nm} represent final consumption (m) namely private, government, investments, change in stocks, exports of domestic production (n). Matrix C_{nn} is the total sector domestic production. Matrices D_{nn}, E_{nm}, F_n, contain similar information respectively but for the import commodities. Matrix G_v represents factors needed for the production of these commodities such as labour, capital, as well as other costs like taxes and

depreciation. Matrix H_v contains the total value added per sector. If an IOT is balanced, the column I_n should be the same as row C_n because total outputs must be equal to total inputs. Hence, the term "input-output table".

5.2.1 Construction of an Input Output Table for Mexico

The last IOT for Mexico incorporated into the GTAP data base dated back to 1985. However, in the period accounting for the last 20 years important changes in the Mexican economy have occurred including two economic crises and important agreements towards trade liberalisation. In addition, significant changes in population dynamics have modified the structure of Mexican households (see Section 2.3). All these changes have affected and modified the structure of national and international economic transactions in Mexico. In the light of these changes in the Mexican economy, the need for an updated IOT into the GTAP framework is seen as a priority (GONZÁLEZ-MELLADO, 2006).

One of the main purposes of the GTAP project is to have the model data base as updated as possible in order to obtain results close to the current worldwide economic conditions. The updated IOT for Mexico in the GTAP framework increases the reliability of results, not only for this study, but also for future research, in which Mexico is closely regarded as member of multilateral and bilateral economic agreements such as the NAFTA, an OECD country member or on the ongoing WTO negotiations.

The structure of the IOT for Mexico is presented in Table 5-1. The table here described for the GTAP data base records transactions between 57 sectors contained in the GTAP framework, and the five final-demand consumers regarded in GTAP. The table is divided downwards in three main sections: domestic, import and value added. The first part represents domestic commodities including commodities for intermediate and final use (for industries and final consumers, respectively). The section below the domestic section corresponds to import commodities, similarly to domestic; these are allocated into intermediate and final use (for industries and final consumers respectively). The bottom part of Table 5-1 contains other costs such as value added by sector and indirect taxes.

Each row in Table 5-1 accounts for the sales or outputs by the industry named on the left (paddy rice, wheat, cereals, etc.) to the industries identified across the top of the table (paddy rice, wheat, cereals, etc.), these sales represent the intermediate consumption. Sales also go to the final consumers who are listed in the right-hand section of the table (investment, private consumption, government consumption, change in stocks, exports). Export goods from Mexico to other nations are listed under exports in the final-demand

section, regardless of their stage of production. The sum of a row is the total output or total sales of an industry.

Each column in Table 5-1 records the purchases, or inputs, by the sector identified at the top of the column (paddy rice, wheat, cereals etc) from the sectors (domestic and import) named at the left (domestic and import: paddy rice, wheat, cereals etc). Purchases from industries made outside Mexico are identified in the second part of the matrix and are called import intermediate demand. These imports may be either of goods not produced at all in Mexico or of goods produced in Mexico but in quantities insufficient to meet local needs. Purchases of each industry also include payments by the sector to employees, holders of capital, and land. These costs are contained in the row and separated in the part of the table labelled as value added. The sum of the entries in each column represents the total purchases by sector. The total purchases and payments must equal total sales. Total sales are the sum over each row. Inputs (purchases) equal outputs (sales).

Table 5-1 Input Output Matrix pre-commodity-tax usage values according to GTAP criteria

		Domestic intermediate demand													Domestic Final demand					Output e.g. Sales
		pdr	wht	gro	v_f	.	.	.	.	.	.	ros	osg	dwe	Sub-Total	a	b	c	d	e	
Intermediate Inputs	1 pdr Paddy rice	13325	0	627	1699	1165	0	0	103	1283	0	0	0	0	3707	0	16126	13270	0	1824	79404
	2 wht Wheat	0	42616	0	0	0	0	41523	5783	9215	0	0	0	2692	28061	0	14690	25686	0	1469	1627746
	3 gro Cereal grains nec	0	0	95304	8025	0	0	12605	118790	0	0	284870	0	0	343094	0	891463	7306	0	2569	2964735
	4 v_f Vegetables, fruit, nuts	0	0	198531	348765		45	212950	34355	0	365	10987	5	2877	12432	0	14305	11772	0	4736	1157968
	.	0	0	0	7	3430	0	12	0	98	543	0	0		13406	0	25397	2090	0	633	1913893
	.	0	0	0	835468	104	460092	0	0	0	0	818	0	52819	680	93396	7287	5996	0	64	319390
	.	0	0	794	0	0	0	4592	0	0	0	0	0	0	212	0	8643	71	0	510	828179
	.	0	0	0	50433	5072	1623	2974	4754	5775	56156	72554	4956	6754	29798	0	38814	3194	0	3395	59714
	.	0	0	0	0	0	0	0	338437	2901215	0	99424	0	0	57316	11752	34002	2798	4278	5567	726433
	.	0	39	0	47285	674	67996	110432	0	0	0	80715	176	0	93550	0	139	44	0	610	914437
	.	0	0	0	0	0	0	7881	1237847	15152	0	446627	0	0	50617	5620	1798	0	13	0	6315
	.	0	0	0	0	0	0	7376			1433	0	1263	0	703	0	327	105	0	16607	1386835
	.	0	45	214	0	0	1901	3360	16781	15583	0	0	0	8359	7941	0	706	226	0	539144	17039
	.	29	0	2007	0	0	0	4795		8308	0	0	0	0	13571	0	736713	6062	0	22418	1071697
	.	0	0	0	0	1318	0	0	0	0	0	0	0	2432	885	28871	21662	1780	0	23329	765193
	.	843	13886	2656	216478	2243	6518	77578	15408	19748	1785	11426	6786	348	5612	0	3059	3837	25356	61213	270343
	.	0	0	0	2513	7826	6382	655	2722	5426	4662	10852	0	5330	75328	13296	42482	56052	26093	1222	395534
	.	0	0	0	0	0	0	0	0	0	0	0	0	0	663	37	0	0	0	0	4582447
	.	630	0	0	5459	0	0	0	0	963	2861	544113	1740	0	1217	0	887645	11162	0	289620	37
	.	0	0	0	0	0	0	0	30402	31211	14232	5357	3292	8208	171	0	710159	70110	114479	88818	1188427
	.	0	0	0	2076	67021	0	2056	0	974	2322	0	0	0	606	0	1361	656001	10589	35790	10944921
	55 ros Recreational and other services	705	0	0	9872	0	0	1668718	0	969	313	2764	867	0	19563	12997	21306	857	67	687	5546001
	.	0	0	0	0	0	0	0	0	0	0	0	0	0	22361	0	3542	546	54	54687	10035685
	56 osg Public administration	0	0	0	58427	0	0	0	0	57522	0	9840	0	0	245	0	0	0	0	0	45336477
	57 dwe Dwellings	253	21	84	535	256	865	25	45	8425	656	54	54	57	3549	0	354	35496	238900	6498	654376568
		Import intermediate demand														Imported Final demand					
	1 pdr Paddy rice	2007	0	0	0	4795		8308	0	0	0	0	63811	0	537	710159	86700	114479	656001		
	2 wht Wheat	0	0	1318	0	0	0	0	0	0	0	2432	0	0	4545	27105	35790	136143	775191		
	3 gro Cereal grains nec	2656	216478	2243	6518	77578	15408	19748	1785	11426	6786	348	21896	0	342	293	557319	7186472	37182		
	.	0	2513	7826	6382	655	2722	5426	4662	10852	0	5330	3884	9106	543	13089	293368	16264	75892		
	.	0	0	0	0	0	0	0	0	0	0	0	0	0	76	2459701	31510	507831	316201		
	.	0	5459	0	0	0	0	963	2861	544113	1740	0	0	0	87	50828	42799	557793	51318		
	.	0	0	0	0	0	30402	31211	14232	5357	3292	8208	554	0	3342	305122	1112173	216409	357009		
	55 ros Recreational and other services	0	2076	67021	0	2056	0	974	2322	0	0	0	497	0	4473	82389	35927	445028	171587		
	56 osg Public administration	0	9872	0	0	1668718	0	969	313	2764	867	0	0	0	231	143344	76645	35 17607	648880		
	57 dwe Dwellings	0	0	0	0	0	0	0	0	0	0	0	0	0	3985	29142	1424720	171679	114494		
															321	491	63191	149401	56687		
	Added value	671525	36826	22254	22155	835354	586816	195445	149885	39743	43260	35436	5634	1623	346						
	Indirect taxes	0	0	0	3393873	8836124	0	2307085	0	860505	0	0	436	2443	324						
	Input per sector	34243	324454	534265	8867878	1639255	1325392	35868	2865482	5470905	6455477	54247843	5433460	63456	6560						

Column codes are:
a: Investment
b: Private consumption
c: Governmental consumption
d: Change in stocks
e: Exports

Source: Own design

5.2.2 Source Data

The data collected to fulfil the criteria of the IOT was obtained from the homepage of the INEGI and from the Homepage of the Mexican Ministry of Finance and Public Credit (SHCP). The IOT has been compiled to be included in the GTAP data base version 6.2. The INEGI publishes regularly National Accounts for each main Division of the North American Industry Classification System –NAICS- (INEGI[19]). Table 5-2 lists the divisions and thus publications consulted from the INEGI and the data collected from each publication. The first row corresponds to the main sources published and used for the construction of the IOT. The second row of Table 5-2 contains the information obtained from each publication. Information was collected for each main Division (Table 5-2). The NAICS divisions and published as single documents by the INEGI are: Agriculture and Livestock, Mining, Manufacturing, Construction, Energy (electricity, gas and water), Trade, Transports (including storage and communications), Financial Services and Communal Services.

Table 5-2 Data sources from the INEGI for the construction of an IOT for Mexico

Data sources[1]	Agriculture, Livestock, Forestry and Fishery Mining Manufacturing Industry Construction Electricity, Gas and Water Trade, Hotels and Restaurants Transports, Storage and Communications Financial Services, Insurances, and State Agencies Communal Services, Recreational and Cultural Activities
Data collected:[2] *value of*	Production Labour Capital Difference in Stocks National Investments Imports Exports Domestic Consumption by Households Import Consumption by Households Domestic Consumption by Government Import Consumption by Government Intermediate Purchases by Classification (sector)

[1] from the official series of publications of National Accounts

[2] at constant prices in pesos of 1993; In the case of imports the given prices are CIF prices at purchaser price, in the case of exports the given prices are FOB prices at purchaser price

Source: Own design

[19] Sistema de Cuentas Nacionales: For an online version of the Mexican National Accounts consult: http://www2.inegi.gob.mx/estestint/SCN.asp

The information selected was collected from the economy as of 2002 and published in different documents in 2003. The economic activities classified by the INEGI in main divisions are found disaggregated in up to 1778 different activities in total, which were aggregated according to the criteria required for the GTAP data base. The conciliation of some data was particularly difficult due to discordances in units or base year or period of the values (yearly or quarterly). Finally after compiling the IOT, all the values in the Mexican IOT were converted into thousands USD.

Information on taxes was collected from the SHCP. This information was composed by different types of taxes paid by different players in the Mexican economy. The taxes collected in Mexico and collected for the IOT table are: production taxes, private taxes, import duties (SHCP, 1984).

5.2.3 Empirical Application

The IOT developed in this research follows the format established for the integration of IOTs into the GTAP data base. In the unified GTAP format, an IOT is a compound of four arrays: UF, UP, OP and MF.

Matrix UP

The first array in Table 5-3 is the array covering the Usage Free of taxes (UF) or as it is called in the GTAP documentation pre-commodity-tax usage values (HUFF et al., 1999). The array UF compiles the intermediate usage of domestic and import products by commodity and industry as well as final consumption excluding taxes. The array UF is a matrix 117 (57 domestic commodities + 57 import commodities + 3 categories of value added) x 63 (57 domestic commodities + five final consumers).

By taking as an example the nomenclature presented in Figure 5-1, the UF matrix would be built as presented in the Table 5-3. The values of matrices $(A_{nn} + B_{nm})$ x $(D_{nn} + E_{nm} + G_{vn})$, where A_{nn} is the intermediate usage of domestic products by commodity and industry (57x57); B_{nm} is the matrix containing final consumption by commodity by consumer (57x5), where final consumers are private and governmental consumption, investments, and change in stocks and exports. Array D_{nn}, is the intermediate usage of imports by commodity by industry (57x57). Array G_{vn} is the value added (labour (skilled and unskilled), capital and land) (57x4).

Table 5-3 Matrix of pre-commodity-tax usage values (UF)

	Industry	Investment	Private	Government	Change in stocks	Exports
Domestic commodities	A_{nn}	$B_{n,invest}$	$B_{n,private}$	$B_{n,governm}$	$B_{n,stock}$	$B_{n,exports}$
Imported commodities	D_{nn}	$E_{n,invest}$	$E_{n,private}$	$E_{n,governm}$	$E_{n,stock}$	$E_{n,exports}$
Labour	G_{vn}	0	0	0	0	0
Capital	G_{vn}	0	0	0	0	0
Land	G_{vn}	0	0	0	0	0

Source: adapted from HUFF et al. (1999)

Matrix UF

The second array in the IOT is UP, the matrix of commodity Usage values Post- taxes (UP). This array has the same structure as UF, however in this case, the values taken for this matrix include intermediate and final consumer taxes (T_{xx}) (see Table 5-4).

Table 5-4 Matrix of post-commodity-tax usage values (UP)

	Industry	Investment	private	Government	Change in stocks	Exports
Domestic commodities	$A_{nn}+T_{nn}$	$B_{n,invest}$ $+T_{n,invest}$	$B_{n,private}$ $+T_{n,private}$	$B_{n,governm}$ $+T_{n,governm}$	$B_{n,stock}$ $+TB_{n,stock}$	$B_{n,exports}$ $+T_{n,exports}$
Imported commodities	$D_{nn}+T_{nn}$	$E_{n,invest}$ $+T_{n,invest}$	$E_{n,\ private}$ $+T_{n,\ private}$	$E_{n,governm}$ $+T_{n,governm}$	$E_{n,stock}$ $+TB_{n,stock}$	$E_{n,exports}$ $+T_{n,exports}$
Labour	$G_{vn}+T_{vn}$	0	0	0	0	0
Capital	$G_{vn}+T_{vn}$	0	0	0	0	0
Land	$G_{vn}+T_{vn}$	0	0	0	0	0

Source: adapted from HUFF et al. (1999)

The array for the Mexican IOT contains, however, only information of post commodity tax values for final consumers, due to the lack of sufficient information; post commodity tax values for intermediates are not included.

Matrix OP

OP contains the total output by industry including indirect taxes. The dimension of the matrix OP is 57, which is equivalent to the 57 domestic commodity sectors. Each row in the vector refers to a domestic sector. For each domestic sector OP is equal to the sum across inputs of the post-commodity-tax usage values (UP) plus non-commodity indirect taxes (non-commodity indirect taxes, net, by industry) (HUFF et al., 1999).

Matrix MF

MF refers to a vector of imports, import duties excluded, with dimension 57. In this case, each row refers to an imported commodity. For each imported commodity, MF is equal to the sum across uses of the pre-commodity-tax usage values (UF) less import duties (HUFF et al., 1999).

5.2.4 Mapping between the Mexican Classification and the GTAP Concordance

Appendix H shows the concordance of the GTAP commodity classification to the NAICS, which is considerably more disaggregated than the GTAP classification. The concordance of sectors was based on the aggregation of Mexican sectors to fulfil the sector definitions of the GTAP commodity classification.

Harmonisation problems arose within different sources of information of Mexican publications. Occasionally, the values reported in two different sources for one parameter were not the same. In such cases, the value considered taken for the IOT was the one fitting better for the structure of the IOT. In other cases, the value taken for the IOT was the average of values found in diverse sources.

Another deviation was faced in some main divisions when the reported values were not totally disaggregated, e.g., in the Mexican classification Electricity, Gas and Water are all in the same division and category. In the GTAP classification, they are in three different sectors. In this case a R and S (RAS) approach was applied in order to split this single sector from the primary data into three sectors for the IOT. The RAS method takes as given the representative IOT of the world and splits proportionally the single sector into three separate sectors by weighting the share of each sector compared to the representative IOT of the world. The world representative IOT is an average of all IOT contributed to the GTAP data base.

5.2.5 Final Remarks on the IOT for Mexico

This Section has described the creation of an IOT for its further integration in the GTAP model. The inclusion of an updated IOT for Mexico reflecting the 2002 economic situation into the GTAP model increases the reliability of results of future steps of this study such as the assessment of changes in household expenditure patterns. The updated IOT for Mexico will allow GTAP users to perform future studies on economic trade and political analysis with the recent changes in Mexico in structures, production functions and intersectional relationships.

The information contained in an IOT gives an overview of the economic structure of a closed economy. Furthermore, it provides information on economic production costs per sector and per consumption recipient. For the purposes of this study, the updated IOT also presents considerable advantages, given that the sources of the IOT and the AIDS system developed in the preceding Chapter are the same. The construction of the IOT at this stage evades future inconsistencies created by different sources of information between the GTAP framework and the extension derived in this study.

The use of this IOT it is not limited to the integration in the GTAP model. The further applications of this IOT depend on the economist's purposes of use. The IOT might also be used to up date or complement data bases for other economic models.

5.3 Data of Household Deciles in the Extended GTAP Framework

The main purpose of this study is the assessment of changes in expenditure patterns of Mexican households caused by trade reforms. This assessment demands the inclusion of new information in the GTAP framework to be used in the household module. As the expenditure behaviour of households has already been assessed (see Chapter 4), the next step for the development of the household module is the inclusion of this information in the GTAP data base. The required modifications in different components of the GTAP framework to construct the household module are explained in this section.

The theoretical basis of these modifications has been described in Section 4.4. This section comprises the changes that have been implemented in the data base (coefficients, parameters, etc), and the addition of new behavioural equations in the main model. All these elements are presented in Table 5-5 and described one by one in this section.

Table 5-5 New variables and parameters in the GTAP extension

Coefficients	Description
$VDHH_{ihr}$	Value of expenditure on commodity i by household h in region r
$HHEXP_{hr}$	Total expenditure of household h in region r
$EXPSHR_{ihr}$	Household expenditure share devoted to commodity i by household h in region r
Variables	
wph_{ihr}	Change in expenditure share devoted to commodity i by household h in region r
$vdhh_{ihr}$	Change in value of expenditure on commodity i by household h in region r
$hhexp_{hr}$	Change in total expenditure of household h in region r
$pprivhh_{hr}$	Change in price index of household h in region r
Parameters	
$ECRSL_{ijhr}$	Uncompensated cross-price elasticities of commodity i by increases in commodity j household h in region r (from LA/AIDS)
$EPSL_{ihr}$	Expenditure elasticities of commodity i by household h in region r (from LA/AIDS)
Sets	
HHC	Household deciles
Equations	

4.23 Change in expenditure share

$$wph_{ihr} = \sum_{j \in TRAD} \left(ECRLS_{ijhr} * pp_{jr} \right) + (EPLS_{ihr} - 1) * hhexp_{hr}$$

4.26 Change in value of expenditure

$$vdhh_{ihr} = wph_{ihr} + hh\,exp_{ir}$$

4.30 Change in total household's expenditure

$$hh\,exp_{hr} = \sum_{i \in TRAD} EXPSHR_{ihr} * (qp_{ir} + pp_{ir})$$

Source: Own design

Additions in the GTAP Data Base

The development of the household module comprises the addition of three new coefficients containing values observed in the base year (2002) for ten household categories. The first coefficient is $VDHH_{ihr}$ which represents the value of consumption of commodity i by household h in region r. $VDHH_{ihr}$ is updated based on changes of total households' expenditures ($hhexp_{hr}$) and on changes of households expenditure shares on commodities

(wph_{ihr}) (see Section 4.4). The second coefficient to be integrated is $HHEXP_{hr}$, which computes the total value of expenditures made by household h in region r. $HHEXP_{hr}$ is updated through the variable $hhexp_{hr}$. The third coefficient is $EXPSHR_{ihr}$ which calculates the household expenditure share as the ratio of $VDHH_{ihr}$ and the $HHEXP_{hr}$ (see Section 4.4). These coefficients have to be updated as a result of changes in international trade and national economic conditions.

Additions in the GTAP Table Main Model File

The variables integrated for the household module represent changes in values, expenditure levels, and expenditure patterns for household categories, The first variable is wph_{ihr} which is a percentage change variable and is directly related to the LA/AIDS. The variable wph_{ihr} is modelled as a LA/AIDS function (see Equation 4-1). The second variable $hhexp_{hr}$ calculates the percentage changes in total expenditure levels as function of changes in prices and quantities of commodities of household h in region r. The third variable is $vphh_{ihr}$ and represents the changes in value of expenses on commodity i of household h in region r as a function of $exphh_{hr}$ and wph_{ihr}. A complete description of these equations and their derivation is provided in Section 4.4. The full programming code in GEMPACK of the household module is provided in Appendix I.

Additions of Sets

The standard GTAP version does not contain a set for representing household categories in the model. For present purposes, a new set HHC corresponding to household categories is introduced. This set adds the possibility of introducing household categories. In this study ten different household categories have been set up, however the number of household categories can be modified for the convenience of each study.

Additional Elasticities for the Household Module

The two new parameters integrated into the parameter file of the main model are the uncompensated cross-price elasticities [$ECRLS_{ijhr}$] and the expenditure elasticities [$EPSL_{ihr}$] obtained from the LA/AIDS and described in Section 4.3. Following the criteria described in Section 4.3, the insertion of cross-price elasticities has only taken into account those elasticities whose percent level of confidence is more than 95 percent. For expenditure elasticities the same criterion was applied, except that in this case, elasticities not significantly different from zero have been fixed to one (see Section 4.3 and Appendix D and F). The inclusion of unitary expenditure elasticities is justified as all commodities do have an expenditure elasticity.

The integration of these elements in the different components of the GTAP framework constitutes the development of the household module proposed in this study for assessing changes in expenditure of household categories.

5.4 Sectoral and Regional Aggregation of the GTAP Data Base

Version 6.2 of the GTAP data base contains information on 87 countries/regions, 57 commodities and 5 primary activities. This data base corresponds to the global economy as of 2001. Due to the large interconnections within the 87 regions, to make the simulations computationally feasible, it is necessary to aggregate the data base. Having Mexico as the central region of this study, the aggregation of sectors and regions must be done in a suitable manner, considering the most important commodities for Mexican households and main trading partners respectively. Thus, the main Mexican trading partners as well as the most consumed commodities by households in Mexico are considered. In this sense, the commodity aggregation has been designed based on expenditure patterns of households in Mexico, while the sector aggregation has been designed based on the bilateral structure of Mexico.

Countries having a ratified FTA with Mexico have been selected as single regions (see Section 2.4). The most important Mexican trading partners are located in the Americas, but also other blocs and countries like the EU-27, and Japan are important. These countries and regions absorbed 95 percent of total bilateral trade. Therefore, these countries and regions must be studied with more detail, whereas the remaining countries are aggregated according to geographic localization. Table 5-6 shows the regional aggregation considered in this study, conformed by 15 regions.

The country aggregation covers 15 regions; six are aggregate regions and nine are single countries. As single regions, the USA and Canada are considered to evaluate the bilateral flows within NAFTA, and the possible variations of trade that might be experienced as result of increasing trade with other trading partner countries. NAFTA embeds 90 percent of Mexican total bilateral trade, which is clear evidence for the importance of the inclusion of Canada and the USA as single regions in the analysis. At the same time, NAFTA is based on six bilateral trade agreements. Thus the structure and products of the tariff cuts program for Mexico-USA is different from the tariff cuts program for Mexico-Canada (see Appendix J). Japan is also a single region separated from Asia as a result of the EPA initiated in 2005 between Mexico and Japan. This study considers the EU-27 as an economic union with 27 member countries (2004 status), through the performance

of a pre-simulation to eliminate tariffs within Central and Eastern European Countries (CEEC) countries and the EU-15 (See Figure 5-2).

Mexico has signed FTA's with Costa Rica, Guatemala, Honduras and el Salvador (see Section 2.4). These countries are aggregated in one single region CAM in the GTAP data base. In the case of version 6.2 of the GTAP data base, the inclusion of Ecuador, Paraguay and Bolivia as single regions is an important factor contributing to the reliability of this study. In parallel with other important improvement in this version is the update for Chile (SCHUSCHNY and LUDENA, 2006) and Mexico (GONZÁLEZ-MELLADO, 2006). With the same purpose, other trading partners are represented as single regions in the scenario simulations.

Table 5-6 Country aggregation used by the simulation of scenarios

No.	Code	Country	Economic Agreement
Free Trade Agreements			
1	MEX	Mexico	
2	USA	USA	NAFTA
3	CAN	Canada	
4	EU-15	Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, United Kingdom	EU-15-CEEC form the EU-27 (Customs union)
5	CEEC	Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovak Republic, Slovenia	FTA Mexico-EU-27
6	JAP	Japan	Economic Partnership with Japan
7	VEN	Venezuela	FTA Mexico-Bolivia
8	CHL	Chile	FTA Mexico-Chile
9	CAM	Central America	FTA Mexico-Costa Rica FTA Mexico-Guatemala, Honduras and El Salvador
10	CHE	Switzerland	FTA Mexico-EFTA
Partial Preferential Agreements			
11	ARG	Argentina	MERCOSUR
12	BRA	Brazil	
Other Trading partners			
13	REUR	Rest of Europe	n.a.
14	RASIA	Rest of Asia	n.a.
15	ROW	Rest of the World	n.a.

Source: Own design

The criteria to group commodities was set up according to (a) Mexican trade characteristics (considering significant bilateral trade commodity flows) and (b) preferences

of household deciles in Mexico (as will be presented in the description of scenarios, an important trade share corresponds to food and food commodities). An overview of the sector aggregation is presented in Table 5-7. Commodity aggregation is compacted into ten main products. On the side of international trade, manufactures are, together with food commodities, the most traded commodities. Imports of manufactures come mostly from the USA, Canada, and Japan and exports are sent primarily to Colombia, EU-27, EFTA, Bolivia, Chile and Uruguay. Other services such as technical cooperation are part of agreements with Colombia, El Salvador, Guatemala, and Honduras, Nicaragua. The most important investments in Mexican sectors come mainly from the USA, Canada, EU-27, and Japan. Traded flows of food commodities are a noticeable part of the FTA signed with Costa Rica and Colombia, El Salvador, Guatemala, and Honduras, Nicaragua, EU-27, EFTA, Bolivia, Chile, Brazil, and Japan (See Section 2.4).

Table 5-7 Commodity aggregation of the GTAP data base

No	Code	Description	Commodity Sector in GTAP version 6
1	cer	cereals and gains	paddy rice wheat cereal grains n.e.c. processed rice
2	veg	vegetables, fruits, and horticultural products	vegetables, fruit, nuts oil seeds sugar cane, sugar beet crops n.e.c.
3	dairy products	dairy products and animal products	raw milk dairy products animal products n.e.c.
4	meat	meat and meat products	meat of: cattle, sheep, goats, horse meat products n.e.c.
5	proc food	processed food	vegetable oils and fats sugar food products n.e.c.
6	tob and bev	tobacco, alcohol and non alcohol beverages	tobacco and beverages and related products
7	enrg	energetic sectors	gas manufacture, distribution electricity water coal, oil, gas
8	manufs	manufactures and machinery	textiles, wearing apparel; leather products; wood products, paper products, publishing; petroleum, coal products; mineral products n.e.c., ferrous metals, metals n.e.c., metal products, motor vehicles and parts, transport equipment n.e.c., electronic equipment, machinery and equipment n.e.c., manufactures n.e.c.
9	serv	services	transport, public administration, education, defence, recreation and other services; insurance; construction; business services n.e.c.; communication; financial services n.e.c.; air transport; trade; transport n.e.c.
10	hous serv	housing services and primary activities	dwellings

Source: Own design

As households in Mexico allocate on average nearly half of their expenditures to food commodities, the sector aggregation has six food commodities and four non-food

commodities. The consideration of six food commodities tries to cover the importance of these products for Mexican households as approximately 70 percent of households in Mexico designate more than one third of total expenditures to food items. This high share of food consumption has to be investigated with detail to follow reactions of households to changes in prices. The changes in consumption follow the preferences found in Chapter 4. This study assesses how household expenditures will be re-allocated after trade liberalisation reforms. The other four sectors are non-food sectors; one of them is housing services, which includes primary activities, dwellings and imputed rent. This sector can be a suitable indicator of household welfare for deciles in Mexico as it includes the costs covered by households either as rents paid or as imputed rent. Expenditures on housing services have been found to be an appropriate indicator of welfare in Mexico (FONTENLA et al., 2008). Moreover, FONTENLA et al. (2008) show a strong positive influence of increasing income on higher demand of housing services in Mexico. The energy sector includes electricity, gas, and water distribution. Poor households have a low share in this sector, as some of those services might not been consumed by the household or provided in the zones where the households are headed (rural areas). Whereas wealthier households tend to spend more on these services, as they can afford to acquire larger housing tenures that require the consumption of proportionally higher amounts of electricity and gas than a small.

5.5 Scenarios of the Empirical Analysis

This section defines the scenarios simulated with the standard version of the GTAP model and the household module. In this research, the simulation of three different scenarios has been specified. The first scenario is focused on the cuts in food commodities as scheduled in three FTAs signed by Mexico. The second scenario pictures a possible outcome for the agricultural sector as part of the ongoing WTO negotiations. The third scenario simulates full trade liberalisation. The ultimate feature of this study is the incorporation of household categories in this international framework. At the centre of this study are the effects of multilateral trade liberalisation on households in Mexico, these scenarios address different conditions of possible future global liberalisation stages that Mexico will experience (see Appendix J for a complete description of the documentations and policies underlying these scenarios).

The baseline for this study implements the EU enlargement as of 2007 with 27 member countries. The first scenario called “FTAs” (from Free Trade Agreements) describes the tariff elimination in food commodities as scheduled under different FTAs ratified by Mexico. In this case, the three largest trade agreements namely the NAFTA (to be

completed by January 1, 2008). These FTAs are: the FTA EU-27-Mexico (to be completed by January 1, 2010), and the EPA Japan-Mexico (to be completed by January 1, 2015). FTAs scenario simulates the liberalisation stages that Mexico will face with their most important trading partners the USA, Canada, EU-27 and Japan (WTO, 2008a). A detailed description of the FTAs documentation is provided in Appendix J. The bilateral structure of tariffs levied on food commodities after the full implementation of scenario FTAs is presented in Table 5-8.

Table 5-8 Overview of scenario FTAs final Ad Valorem tariffs on agricultural imports (%)

from Mexico into	***Canada***	***United States***	***Japan***	***EU-27***
Cer	0	0	0.0	3.68
Veg	0	0	1.02	2.22
Dairy products	0	0	2.00	46.48
Meat	0	0	25.16	3.99
Proc Food	5.40	0	5.28	3.75
Tob and bev	0	0	2.70	n.a.
into Mexico from	***Canada***	***United States***	***Japan***	***EU-27***
Cer	0	0	0.0	3.21
Veg	0	0	2.14	0.60
Dairy products	60.80	1.06	19.22	8.91
Meat	0	0	11.44	2.52
Proc Food	1.02	0.02	10.05	7.90
Tob and bev	22.80	3.19	2.15	0.79

Source: Author's calculations based on the GTAP data base and bilateral trade documentation

The second scenario addressed here as DDA (Doha Development Agenda) evaluates possible outcomes from cuts according to the negotiations in the framework of the WTO agreements. The potential impacts of the WTO agreement are controversial and are a complex task to assess. The different perceptions of the member countries have slowed down the negotiations, which until 2008 have not been conclusive. A concrete scenario simulating the outcomes of the WTO negotiations is not possible to include, given that the WTO member countries have not reached any concrete commitment on cuts in tariff and export subsidies. The limitations in reaching a common agreement are caused by the lack of consensus within member countries as not even a general consensus has been reached[20]. The final results obtained here are trends that national economies might follow specifically under these conditions. The scenario DDA is merely a speculation and should not be taken as projection. At this chronological stage it just possible to show the implications that specific cuts might cause. This scenario is a stylised representation meant to illustrate the

[20] The WTO negotiations have not agreed yet (as of June 2008) which cuts are to be applied in what imports. Although different proposal drafts for WTO negotiations have been published (WTO, 2008b, WTO, 2008c).

implications of an alternative DDA outcome negotiation for multilateral market access (Table 5-9).

Table 5-9 Overview of scenarios

Instrument on agriculture and food markets	Scenarios		
	FTAs	**Doha Round**	**Full Trade Liberalisation**
Import tariff cuts	Products from the USA, Canada and Mexico scheduled as part of the NAFTA negotiations by 2008 Products from the EU-27 and Mexico scheduled as part of the in the FTA Mexico EU negotiations by 2010 Products from Japan and Mexico scheduled as part of the EPA Mexico Japan negotiations by 2015	Agricultural and food processed products from developed countries: -60 percent Agricultural and food processed products from developing countries: -40 percent	Total elimination in all regions
Export subsidies cuts	n.a.	Total elimination in all regions	Total elimination in all regions

Source: own design (see Appendix J)

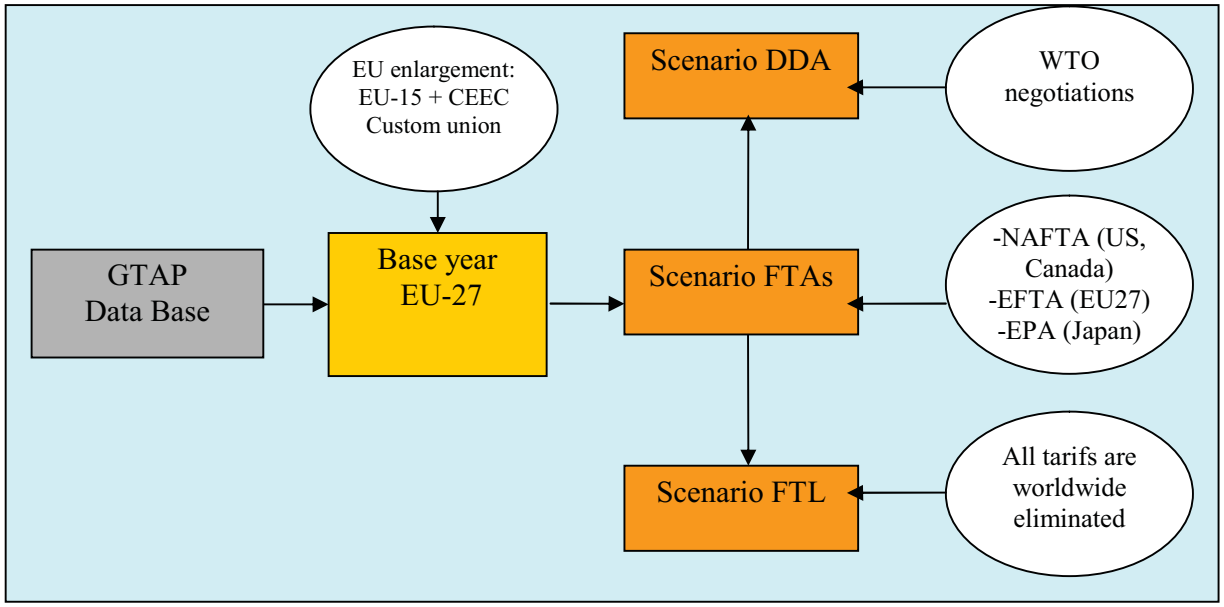
Other important points to bear in mind are the complexity of the structure of tariff reductions and export subsidy programs in each country. In the standard version of the GTAP model, commodities can not be distinguished at the 6-digit HS level as exposed in the WTO negotiation proposals. Thus, this study conducts simulations on cuts for import tariffs and for export subsidies without calculating tiered and linear formulas. Moreover, tariff cuts are simulated as an average of tariff elimination rather than the application of tiered and linear formulas. Scenario DDA applies average tariff cuts of 60 percent in high-income countries and 40 percent in low-income countries for food commodities. Countries considered as having a high-income are: the USA, Canada, EU-27, Switzerland and Japan. Countries considered to have a low-income are: Bolivia, Colombia, Chile, Nicaragua, CAM, Argentina, Brazil, Uruguay, Ecuador, Peru, Paraguay, the REUR and RASIA (see Appendix J for a complete description of the DDA negotiation on agriculture).

In a realistic perspective, a common agreement among WTO member countries is expected to be reached by 2015 (WTO, 2008c), after the completion of cut schedules of the trade agreements regarded in scenario FTAs. Hence, this scenario takes as baseline the updated data base after the simulation of tariff cuts contemplated in scenario FTAs (see Figure 5-2).

Finally, the third scenario simulates multilateral full trade liberalisation. This scenario shows the potential effects that total elimination of subsidies and import tariff worldwide would have on the global markets and specifically on Mexico. This scenario, together with

scenario DDA might serve as a reference to observed trends for Mexico in terms of what stage of global liberalisation would be more convenient for Mexico and for Mexican households. This study would give quantitative bases towards its posture for future DDA negotiations, taking into account bilateral commitments signed by 2008. A general overview of this scenario is presented in Table 5-9. Finally, the sequential implementation of the three scenarios simulated in this study is depicted in Figure 5-2. These scenarios are simulated with the software GEMPACK Version 7.0, which is the platform of the GTAP model, further software utilised, is RunGTAP and Analyse GE.

Figure 5-2 Sequential implementation of scenarios



Source: Own design

5.6 Results

This section describes the results obtained from the simulations of the three scenarios described in the latter Section. These results are focused on trade flows and changes in welfare at international level; whereas in Mexico changes in quantities, prices and expenditures of private households are also analysed.

Although the results generated reap global changes, for the analytical interest of this study mostly the Mexican economy and households in Mexico are analysed in depth. Previously other projects have focused on trade liberalisation and its effects for a cross-country scope (IVANIC, 2004; HERTEL et al., 2007; BROCKMEIER et al., 2008; etc).

Hence, in this study the main focus is given to the economic impact of agricultural trade liberalisation on Mexico, particularly on Mexican household expenditures. It is important to keep in mind that reforms in the agricultural sector constitute solely a part of

international trade, e.g., bilateral trade and, moreover, many other reforms in other sectors are adopted in parallel. Accordingly, results presented here are the effects of the specific cuts in tariffs and export subsidies described in Section 5.5. The effects of other important factors such as trade reforms in non-agricultural sectors as well as unforeseen factors such as unexpectedly high soaring prices of food commodities are not taken into account.

The sequence of analysis is performed as follows: (a) changes in international trade for the involved regions; (b) changes in price and quantities consumed by private households in Mexico; (c) effects on household expenditures in Mexico, and d) the effects on international welfare and its decomposition.

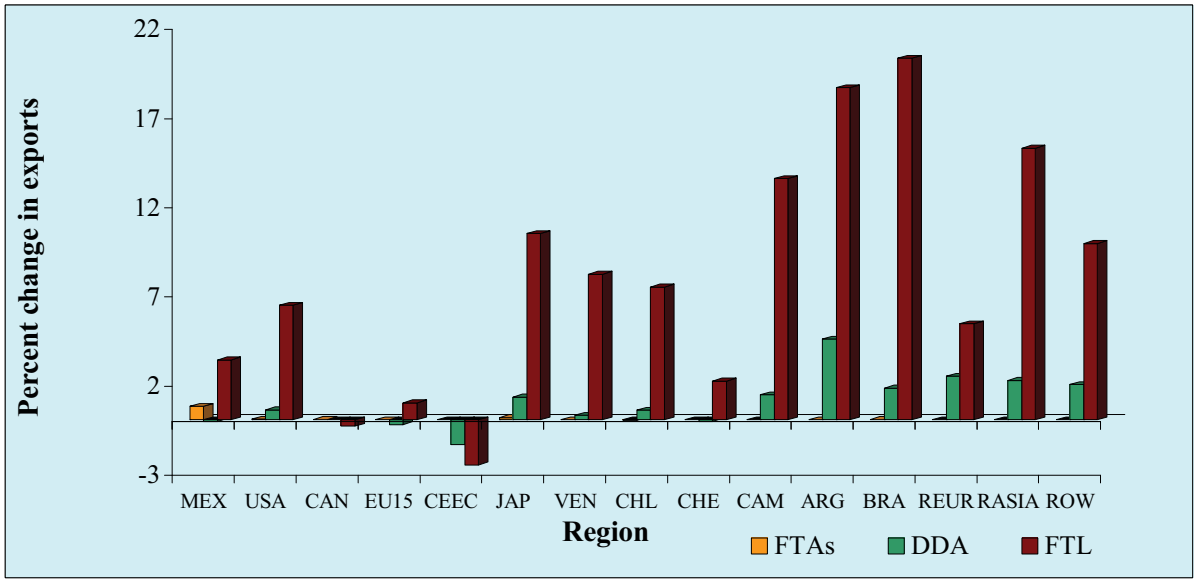
5.6.1 Trade Effects

As the main point of this section, the results presented here are focused on Mexico and on its main trading partners. Figure 5-3 shows the percentage changes in total exports for the regions studied, considering the scenarios FTAs, DDA and FTL.

FTAs

The scenario FTAs assumes a complete elimination of tariffs on food commodities according to the FTAs signed with the USA, Canada, the EU-27 as well as the EPA Mexico-Japan. As observed in Figure 5-3, the main increasing exports observed in this scenario concern Mexico (0.7 percent). With the implementation of FTAs, import tariffs for Mexican products entering into the USA, Canada, the EU-27 and Japan will be eliminated. Thus, prices of imports from Mexico with trading partners are comparatively cheaper than other imports on which tariffs are still levied. These preferential treatments to imports from Mexico increase their demand in the USA, Canada, the EU-27 and Japan. The expanding demand of Mexican products promotes the increase in production output to supply the export demands. Exports coming from the USA (0.03 percent) and Japan (0.13 percent) will also increase to a lesser extent in comparison to Mexico. Due to the low economic weight of Mexico at global level, other zones not involved in the FTAs considered in this scenario do not present notable differences in export patterns. However, due to the high importance of this scenario for the Mexican economy, these exports are decomposed in terms of effects caused by single FTAs (Figure 5-4).

Figure 5-3 Percent changes of exports by regions under three different simulations



Source: Author's calculations

DDA

This scenario considers the tariff cuts of a possible outcome for the negotiations in the framework of the Doha Round concerning the agricultural sector. In this scenario, policy reforms have been conducted for all regions. Therefore, changes in exports are observed in all regions. Countries with competitive agricultural markets increase their exports i.e., Argentina, Brazil, Japan and the USA. The results in Figure 5-3 show that the largest positive export changes take place in medium-income countries[21] i.e., Argentina (4.5 percent), Brazil (1.8 percent), CAM (1.3 percent), Chile (0.2 percent) and Venezuela (0.2 percent). These developments reveal the positive effects brought about by agricultural trade liberalisation in Latin America. Thus, trade liberalisation fosters the expansion of exports from Latin American countries. In a similar study (GIORDANO et al., 2007); comparable trends for the region have been found. In particular, for Brazil with the second largest export growth in Latin America after Uruguay. Likewise, the results obtained for Argentina, Chile, and Venezuela follow the same trend in this study as in GIORDANO et al.'s results. The magnitude of the changes are different because in the study performed by GIORDANO et al., the actual proposals for the WTO have been modelled i.e., the USA, the G20, and the EU proposals as well as the Swiss formula. In all the scenarios simulated by GIORDANO et al., the results follow the same trends found in this study. Thus, these countries can expand export shares in liberalised economies.

[21] The terms low- medium- and high-income countries refers to the World Bank classification (WORLD BANK, 2007).

In the EU-27, exports decline for both blocs: EU-15 former (-0.28 percent) and CEEC recent accession countries (-1.41 percent). In the case of the EU-27, the negative development is due to high protection of agricultural markets. With the tariff reduction implemented, other price-convenient products coming from outside the customs union can enter into the EU market. The increase in imports from external trading patterns causes a decrease in intra-trade in the EU-27. Additionally, the elimination of export subsidies will reduce the export competitiveness of the region. Other studies (BROCKMEIER et al., 2008; BROCKMEIER and PELIKAN, 2008) have assessed the effects of the WTO negotiations on the exports from the EU-27 with negative results for food commodities (see Section 5.6.1.2).

Other countries observing negative development for exports are Switzerland (-0.1 percent), Canada (-0.02 percent) and Mexico (-0.1 percent). It is important to bear in mind that Mexico and Canada, under the baseline scenario, have been granted preferential trade rules (FTAs) in the US market. This special treatment in the US market was gained by NAFTA. After the partial multilateral liberalisation, the prices of formerly competitive import products from Canada and Mexico will have to compete with other cheaper imports from other regions. With the multilateral erosion of tariffs, US imports from other regions increase, while imports from Mexico and Canada decline.

FTL

The scenario FTL involves elimination of all import tariffs and all export subsidies at the global level. Subsequently, the results obtained for the simulation of this scenario show export growth for all regions, because removing trade distortions leads to increasing trade, improved exploitation of comparative advantages and maximization of production efficiency. The elimination of all import tariffs and export subsidies also causes the suppression of trade agreements and customs unions. As all products compete, free of trade barriers, countries such as Brazil (20.3 percent), Argentina (18.6 percent) and regions such as the Rest of Asia[22] (15.2 percent) experience the highest increases in exports. The complete abolishment of tariffs and export subsidies increase global exports by 6 percent (average). The erosion of external tariff barriers by the EU-27 could cause decreases in preferences of products within the EU-27 represented in Figure 5-3 as EU-15 and CEEC. This holds true for exports from countries with lower production costs, which after the tariff elimination have more possibilities to access to the European market. In this sense, the twelve EU recent accession countries will observe the highest losses. As the EU-15 has

[22] India and China are included in the bloc Rest of Asia.

already abolished tariff barriers with CEEC, no exports growth is expected in intra- trade in the EU-27. Thus, European exports expand only from old EU members to other regions outside the customs union. A similar effect is observed on the decreasing trends of Canadian exports towards the US market. An important factor to remember in the case of Canada is that a high share of exports is acquired by the USA. After the multilateral liberalisation, US imports are supplied by other regions with lower production costs than Canada.

The main difference between effects in the medium-income countries and high-income countries lies in the changes in prices of production. In general, the agricultural sector is characterised by a high demand for unskilled labour for production (BUFFIE, 2001). The prices of production factors in low and medium-income countries are normally cheaper than in developed countries[23]. In particular, the changes in production output are due to trade liberalisation.

5.6.1.1 Decomposition of FTAs

This section presents the changes in exports caused by the single implementation of the trade agreements contemplated in scenario FTAs, namely NAFTA (Mexico-Canada-USA), the FTA Mexico EU-27 and the EPA Mexico-Japan. These results are presented in Figure 5-4. A general inspection of Figure 5-4 shows rising trends for Mexican exports as a result of each of the three trade agreements considered.

NAFTA

As shown in Figure 5-4, the full completion of tariff cuts in accordance with the agricultural chapter of NAFTA will bring the highest increases in Mexican exports. It is noteworthy to mention that even before NAFTA, Mexican trade with the USA and Canada reached 95 percent. The ratification of NAFTA, however, will permit Mexican agricultural exports to enter in the USA and Canada under preferential circumstances over other agricultural exports from regions outside the FTA e.g., Chile and CAM that have negative developments (-0.03 and -0.02 percent respectively). The second country with higher growth in exports is the USA. This is evidence for a potential complementarity of the USA and Mexican economies. Additionally, the tariffs levied on imports in Mexico are the highest from the three NAFTA members (FRANCOIS and SHIELLS, 1994). Within the NAFTA members, Canada appears to experience a decline in exports. Given that NAFTA was in the first period a bilateral trade agreement between the USA and Canada, the later inclusion of

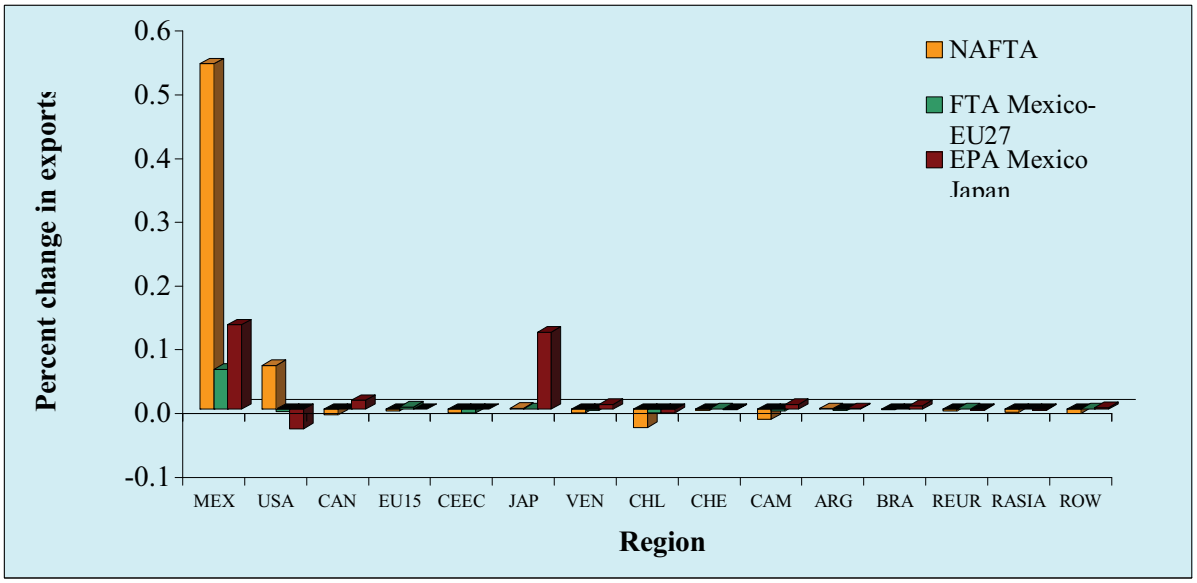
[23] The results generated in this study include changes of import and export prices. However, they are not included in this analysis to keep the analysis of results in a convenient span.

Mexico in 1994 leads to direct competition between Mexican and Canadian imports in the US market, which, as suggested by these results, would have a negative effect for Canada. These findings also show the potential export growth in Mexico fostered by access to the US market will not outweigh the increasing imports from USA and Canada into Mexico.

FTA Mexico- EU-27

By simulating the FTA between Mexico and the EU-27, small increases of exports are observed mainly for Mexico (0.06 percent) and also for the EU-15 (0.02 percent), while the CEECs would have a slight decline in exports (-0.003 percent). Thus, it might be that a share of imports in EU-15 countries from CEECs will be displaced by Mexican imports. Other regions do not have significant changes.

Figure 5-4 Disaggregation of effects in scenario FTAs regarding changes in global exports



Source: Author's calculations

EPA

The third trade agreement considered in Figure 5-4 is the EPA between Japan and Mexico. The EPA would cause not only increases in exports from Mexico and from Japan, but also modest export growth for other regions in America such as CAM, Canada, and Venezuela, while losses in exports are expected mainly in the USA and Chile. These results indicate that trade diversion towards imports from regions and countries such as CAM, Canada, and Venezuela into the USA and Chile may take place under the sole implementation of the EPA for Mexico-Japan. The implementation of this EPA without NAFTA would cause noticeable trade diversion between Mexico and Japan, affecting Mexican trade with other trading partners, particularly with the USA.

5.6.1.2 Changes in Export Destinations

After analyzing the export changes in country exports, it is useful to determine the bilateral differences of these observed changes. Insofar as the destinations of exports are concerned, adjustments in bilateral trade flows under the three scenarios are highlighted in Table 5-10.

FTAs

The simulation of scenario FTAs reveals significant movements for Mexican and Japanese exports. Mexican exports lose diversity and are more oriented to Japan (49 percent), EU-15 (0.4 percent) and Switzerland (1.2 percent). In parallel, Mexican imports from the USA (1.6 percent), the EU-15 (1.3 percent) and Japan (0.3 percent) increase. These results suggest a reinforcement of trade caused by the implementation of tariff cuts within the FTAs signatory countries.

On the other hand, Mexican imports coming from Latin America (mainly Argentina, Chile and CAM) decline as a result of the FTAs, while Japanese imports from other regions than Mexico drop. Another negatively affected share are the exports from CEECs to EU-15. Trade between CEECs and the EU-15 declines driven by the increasing entry of products from Mexico into the EU-15. Other bilateral flows appear not to be severely affected under this scenario.

DDA

As highlighted in Table 5-10, under scenario, DDA changes in bilateral trade in all regions and countries are observed. The partial elimination of tariffs levied on agricultural commodities reduces the effects of FTAs and customs unions. The effects of this partial liberalisation are seen in Table 5-10 particularly for the case of Mexico. Flows of Mexican exports, especially to Latin America and Switzerland increase. In addition, losses in export values from Mexican trading partners are to be expected. These trends are rooted in the trade diversion caused by bilateral agreements considered under the baseline of this scenario, which is the outcome of the simulation of scenario FTAs. After the partial removal of trade barriers, imports from Mexican FTAs partners compete with other imports. From the results it is to be expected that other more competitive suppliers are able to cover demands in international markets at lower prices than the Mexican exports. The highest export increases are observed for Chile. Increases in Chilean exports are observed into CAM (38.3 percent), Argentina (12.4 percent), Brazil (8.3 percent) and also into the REUR (46.3 percent to REUR). Most of the countries in this study will expand exports to world regions, except

CEECs (losing the preferential entrance into EU-15). Other regions e.g., in Latin America: CAM, Argentina and Brazil increase global and regional trade.

Table 5-10 Percent changes in bilateral trade

		Import														
Export	**Scenario**	**MEX**	**USA**	**CAN**	**EU-15**	**CEEC**	**JAP**	**VEN**	**CHL**	**CHE**	**CAM**	**ARG**	**BRA**	**REUR**	**RASIA**	**ROW**
MEX	*FTAs*	0.0	-0.5	-0.5	0.4	-5.4	49.0	-0.3	-0.7	1.2	-0.3	-0.7	-0.7	-0.5	-0.5	-0.4
	DDA	0.0	-0.3	-0.2	-1.2	-1.5	-1.6	3.1	1.9	12.3	3.4	7.9	6.9	0.9	-0.2	0.7
	FTL	0.0	-0.8	2.3	1.9	-6.4	-34.1	36.6	-17.9	13.2	25.6	40.3	53.3	10.6	37.2	16.2
USA	*FTAs*	1.6	0.0	0.0	-0.1	-0.1	-0.8	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
	DDA	-1.3	0.0	0.2	-1.0	-1.5	1.3	1.4	2.1	-0.9	2.6	6.8	6.0	6.0	1.3	1.3
	FTL	-29.9	0.0	-6.3	5.6	-0.9	12.0	10.3	15.6	63.9	13.6	27.8	27.4	7.0	13.4	5.2
CAN	*FTAs*	-5.3	0.1	0.0	0.0	0.1	-0.9	0.3	0.1	0.0	0.2	0.0	0.0	0.0	0.1	0.2
	DDA	5.8	0.2	0.0	-0.9	-6.6	5.6	2.1	4.5	0.0	4.4	6.5	6.6	0.6	-2.1	4.5
	FTL	-0.6	-6.1	0.0	5.7	-10.2	41.8	19.6	19.9	10.0	15.3	24.0	23.7	0.8	9.2	7.4
EU-15	*FTAs*	1.3	0.1	0.0	0.0	0.0	-0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	DDA	1.1	1.0	1.1	-0.6	-0.5	0.4	0.8	2.9	0.1	1.2	7.5	7.4	0.0	0.6	0.2
	FTL	35.9	0.7	4.3	-6.7	0.1	8.0	5.5	10.1	-28.0	12.9	28.9	31.0	6.6	22.8	8.2
CEEC	*FTAs*	-2.0	0.1	0.0	-0.3	0.0	-0.7	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
	DDA	-22.9	-1.6	-2.2	2.2	2.0	-5.7	-8.1	2.3	-0.6	-3.9	6.3	7.3	-29.3	-2.0	-9.8
	FTL	8.3	-5.5	-0.8	-5.1	1.1	2.4	7.5	10.0	13.9	4.1	23.6	25.5	-10.9	14.3	0.3
JAP	*FTAs*	0.3	0.2	0.2	0.1	0.1	0.0	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	DDA	1.8	1.6	1.6	0.4	0.2	0.0	2.5	3.3	0.5	2.4	8.3	7.6	0.5	1.3	1.1
	FTL	32.6	-6.4	3.1	8.4	-2.0	0.0	46.9	9.4	-21.1	18.6	29.8	36.9	0.2	17.0	7.6
VEN	*FTAs*	-0.3	0.0	0.0	0.0	0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	DDA	1.2	0.2	0.4	0.7	-10.6	-0.2	0.0	1.0	-1.2	0.4	7.9	4.1	-0.1	-0.2	0.2
	FTL	-0.1	-24.4	-12.5	-4.8	1.1	12.4	0.0	17.1	-9.3	-24.7	40.9	4.5	9.9	54.7	0.0
CHL	*FTAs*	-2.3	0.1	0.2	0.1	0.2	-0.3	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	DDA	3.8	-2.0	-3.5	-1.4	-6.7	-4.6	9.5	0.0	3.3	8.2	12.4	8.3	46.3	-3.0	3.1
	FTL	-28.4	-11.7	-16.5	-10.8	-17.1	-20.6	11.0	0.0	-16.4	9.1	32.1	11.3	93.3	-23.8	5.3
CHE	*FTAs*	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	DDA	1.2	0.8	0.9	-0.5	-2.6	0.3	1.5	2.6	0.0	1.7	7.3	7.0	0.2	0.7	2.6
	FTL	29.4	1.1	7.1	-1.0	-18.1	5.5	4.4	15.1	0.0	3.0	26.5	25.4	11.5	13.5	-0.9
CAM	*FTAs*	-1.0	0.0	0.1	0.0	0.1	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	DDA	-0.1	-1.7	-2.9	9.7	-1.3	-5.3	-3.4	1.9	-2.3	-1.8	12.2	1.3	14.6	-1.9	0.8
	FTL	25.3	20.4	2.8	19.1	-18.9	-6.1	-49.7	11.3	-13.4	-25.1	29.9	14.7	22.4	3.9	7.9
ARG	*FTAs*	-1.4	0.0	0.1	0.0	0.0	-0.1	0.1	0.0	-0.1	0.1	0.0	0.0	0.0	0.1	0.1
	DDA	11.6	-9.2	-7.7	-6.6	-23.3	-23.6	-8.8	-4.4	7.8	-5.4	0.0	-5.1	-3.7	40.8	-9.4
	FTL	47.9	-9.0	-18.5	-15.1	-41.6	-40.8	19.7	-5.6	-9.3	-2.3	0.0	9.2	-24.8	64.4	-44.6
BRA	*FTAs*	-0.2	0.1	0.1	0.0	0.1	-1.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1
	DDA	-14.7	-15.8	-16.0	11.4	-23.0	-21.7	-14.9	-11.3	8.6	-12.2	-9.1	0.0	30.1	27.3	-9.5
	FTL	28.0	-40.3	-40.3	34.6	-55.9	-61.9	6.3	-13.8	11.7	-25.9	-71.5	0.0	14.8	64.9	-42.1
REUR	*FTAs*	-0.1	0.0	0.0	0.0	0.0	-0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	DDA	1.3	0.2	-0.6	-0.7	0.2	-6.4	1.4	1.9	-0.7	0.1	6.7	7.5	5.0	0.3	0.2
	FTL	16.9	-4.9	-28.4	1.6	-2.1	-6.2	-1.0	8.0	-13.3	21.4	18.4	15.5	35.0	21.3	9.7
RASIA	*FTAs*	-0.2	0.1	0.1	0.0	0.0	-0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	DDA	3.4	0.0	1.1	0.0	-1.7	2.9	4.6	1.7	1.6	2.6	7.4	6.6	1.6	2.1	3.6
	FTL	37.3	9.3	15.4	14.7	-7.8	8.5	26.2	8.6	8.5	19.1	34.8	30.6	19.8	11.1	31.8
ROW	*FTAs*	-0.3	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	DDA	4.7	0.3	1.0	1.2	-4.0	0.4	5.1	5.3	3.9	2.5	7.0	3.0	2.4	-0.1	2.0
	FTL	26.2	10.2	8.7	7.3	-26.5	1.4	-6.3	25.6	15.9	17.6	5.1	8.4	-6.5	19.6	7.6

Source: Author's calculations

FTL

The full trade liberalisation eliminates all import tariffs and export subsidies across regions. In general, the simulation of scenario FTL causes the highest changes amongst the three scenarios simulated. The full elimination of tariffs enhances trade because the demand of imports from competitive producers increases. As result countries with competitive production chains increase their exports to supply international demands. Moreover, the elimination of export subsidies enhances trade among countries because international prices will increase, benefiting producers in regions who used to receive low (or no) export subsidies. Under this scenario, global trade allows consumers and firms to buy products from the cheapest source of supply worldwide. Hence, this ensures that production takes place according to comparative advantages.

In North America declining exports within the region are observed, exports from the USA into Mexico fall (-29.9 percent), also exports from Mexico and Canada into the USA are slightly reduced (-0.8 and -6.1 percent respectively). The entrance of other imports drives these results, which might be better substitutes of domestic products in the respective importing country. In contrast, exports from NAFTA countries to Latin America increase dramatically, mainly to Argentina, Brazil and CAM. Other countries in Latin America also increase the percent of exports absorbed by NAFTA countries. Exports from NAFTA countries to other geographical zones also enlarge, with major affluence to the EU-15 and observing a declining trend to the CEECs. Growing exports within Latin American countries and to other regions are also observed. Latin American exports to CEECs countries and to Japan reduce due to the raise in regional trade. In the case of Mexico, the percentage of exports to Japan is negatively affected (-34 percent) due to the removal of preferences granted by the ratification of the EPA Mexico-Japan. The EU-27 increases export flow to Mexico and Latin America, especially to Argentina, Chile, Venezuela, CAM, while intra-trade in the EU-15 drops (-6.7 percent). In addition, exports from the CEECs to the USA, Canada, and to REUR fall.

In general, the results show that a higher regional integration will take place in the Americas as the result of the elimination of trade distortions. However, also inter regional trade would increase, mainly to Europe.

5.6.1.3 Changes in Exported Commodities

The effect on the sectoral distribution of trade liberalisation for the three simulations is presented in Table 5-11. The implementation of scenario FTAs increases the global percentage of agricultural exports, particularly of cereals and meat (USD 570 Mio and USD

1218 Mio respectively). Sectors showing declining export trends are: tobacco and beverages (USD -9.9 Mio), manufactures (USD -129.0 Mio) and services (USD -35.0 Mio). This scenario considers tariff cuts only in food sectors; thus, the difference in relative prices of food and non-food prices will shift productive factors to food sectors. With the increase in demand of productive factors in agricultural sectors, also the return to productive factors in agricultural sectors will increase. The mobile productive factors involved in other production chains will move to agricultural sectors, which are more profitable. Recalling Section 3.3.3., the closure in the standard version of GTAP model ensures total employment. The model closure assures that sluggish production factors (labour and capital) shift to the most competitive production sectors within a country or region. A spill over effect occurs in the returns to factors of production. As a result, the output in those less competitive sectors will drop and therefore the export-oriented production of tobacco and beverages, manufactures and services shrink.

Table 5-11 Changes in international export values of commodities

	FTAs		DDA		FTL	
Commodity	**Percent**	**USD Mio**	**percent**	**USD Mio**	**percent**	**USD Mio**
Cer	1.7	570.2	1.7	8569.9	105.9	34767.4
Veg	0.1	135.1	0.1	7769.8	19.9	22843.4
Dairy products	0.1	36.5	0.1	453.8	9.7	4544.3
Meat	1.9	1218.1	1.9	5104.2	38.2	24308.2
Proc Food	0.0	135.1	0.1	13081.1	16.5	27321.0
Tob and bev	0.0	-9.9	0.0	1910.9	8.9	4690.9
Enrg	0.0	45.4	0.0	1491.4	1.7	5339.7
Manufs	0.0	-129.0	0.0	11271.5	6.6	321662.5
Serv	0.0	-35.3	0.0	236.8	-0.2	-1988.3
Hous serv	0.1	1.3	0.0	-14.2	0.1	65.8

Source: Author's calculations

In scenario DDA tariff cuts in food commodities and export subsidies for all products are considered. These eliminations promote the competitiveness in production, mainly of food commodities. The partial elimination of tariffs in food commodities will support global trade facilitation. Logically, those sectors currently highly protected show a remarkable increase in exports e.g., cereals (USD 8.57 Bil) and manufactures (USD 11.27 Bil). The increases in value of exports are highly concentrated in cereals, vegetables (USD 7.7 Bil), processed food (USD 13.1 Bil) and manufactures. The results indicate not only gains for agricultural sectors, but also for other non-agricultural sectors such as manufactures.

The conditions simulated in FTL highly boosts export values for all sectors. Under this scenario the most likely sector to expand by far is manufacturing (USD 321.6 Bil), followed by cereals (USD 34.7 Bil), processed food (USD 27.3 Bil) and meats (USD 24.3 Bil). Not

surprisingly, all these products are protected sectors for many regions whose high tariffs and/or export subsidies had been eliminated in this scenario. These findings are also consistent with the fact that the highest import tariffs world wide are levied on agricultural crops and processed food (17 percent global average) followed by manufactures (10 percent global average).

However, to identify the regions profiting from these changes, it is necessary to evaluate the disaggregated effects of trade gains for the different countries and regions. Table 5-12 contains the disaggregated results of changes in trade balance by regions. Trade balance is estimated as the difference in change of the export at FOB prices and changes in import at CIF prices by commodities in one region.

FTAs

The first part of Table 5-12 presents the changes in the trade balance caused by the simulation of scenario FTAs. In the case of Mexico, rises in trade balance of meat (USD 1.4 Bil), vegetables (USD 175 Mio) and processed food (USD 69 Mio) are expected. Simultaneously, trade balance in non-agricultural sectors deteriorates. This scenario shows the highest rises in agricultural trade balance for Mexico (USD 1.03 Bil) and the USA (USD 396 Mio). In parallel, Mexico and the USA show a decrease in trade of non-agricultural sectors. The reason for these decreases is directly related to the sole implementation of tariff cuts for the agricultural chapters of the contemplated FTAs in this scenario. The non-agricultural sectors continue to be subject to tariffs: The tariffs reduce their competitiveness in comparison to agricultural sectors. Thus, prices of productive factors in non-agricultural sectors fall, while the demand and remuneration of productive factors in agricultural sectors increases. This situation generates a shift in factors of production towards higher production in agricultural sectors. Given that, other industries are still subject to tariffs, the comparative advantage points at greater gains in the agricultural sectors. Thus, production in non agricultural sectors decreases. The value of imported manufactures increases as a result of the specialization of Mexican productive factors in agricultural sectors. The overall result would be a total negative trade balance for all sectors in Mexico (USD -296 Mio).

In the USA and Canada the results obtained have different patterns. In the USA, the increases in exports are expected for cereals (USD 555 Mio), dairy products (USD 42 Mio), meat (USD 125 Mio) and tobacco and beverages (USD 1 Mio). Simultaneously, in these sectors Mexican imports increase. Canada experiences falls in exports relative to imports in all agricultural sectors, excepting dairy products. Regarding total trade, Canada (USD 29 Mio) and the USA (USD 72 Mio) improve total trade balance.

Changes in the trade balance of the EU-27 have important differences between old and new members. The CEEC bloc has focused trade mainly within the EU-27. With the tariff reduction for imports from Mexico, the number of import substitutes in the EU market increases. Subsequently, imports from Mexican products gain a share in the EU market. Mexican products thus compete with CEEC imports in the EU-15.

The major changes observed for CEEC exports are negative values for meat (USD -30 Mio) and dairy products (USD -10 Mio); the change in total agricultural trade is USD -20 Mio. The picture in former member of the EU-15 suggests other production structures. The highest gains are observed in processed foods (USD 136 Mio). The highest declining trend is exposed for meats, a sector in which Mexico registers important export expansion. The effects in the EU-15 are drops in total agricultural trade balance (USD -30 Mio). Although the positive total trade balance (USD 69 Mio) driven mainly by increase in exports of processed food, manufactures and services.

The trade balance changes in Japan are dominated by the important losses in the meat sector (USD -682 Mio) which at the same time is one of the highest protected sectors in Japan. The agricultural production in other sectors does not outweigh losses in meat production. Therefore, the total agricultural trade balance persists in being negative (USD -642 Mio). However, a significant expansion in manufactures turns the total trade balance positive in Japan (USD 67 Mio).

Table 5-12 Changes in agricultural trade balance of commodities (USD Mio)

	Scenario FTAs													
Sector	**MEX**	**USA**	**CAN**	**EU-15**	**CEEC**	**JAP**	**VEN**	**CHL**	**CHE**	**CAM**	**ARG**	**BRA**	**REUR**	**ROW**
Cer	-612	555	-46	5	1	18	0	2	-1	1	4	3	1	60
Veg	175	-192	-4	3	6	-2	-1	-4	0	-7	0	-2	1	3
Dairy products	-36	42	1	3	-10	5	0	0	1	0	-2	0	0	-3
Meat	1449	125	-109	-172	-30	-682	0	-16	-1	-10	-2	-29	-16	-496
Proc Food	69	-135	-11	136	-3	18	-1	-4	2	-19	-5	-3	-4	-50
Tob and bev	-13	1	0	-5	16	1	0	0	1	0	0	0	1	0
Total Agricultural	*1032*	*396*	*-169*	*-30*	*-20*	*-642*	*-2*	*-22*	*2*	*-35*	*-5*	*-31*	*-17*	*-486*
Enrg	15	5	-6	-2	-1	-16	1	-2	0	-2	1	-2	7	2
Manufs	-1201	-239	176	59	24	647	3	19	-1	37	6	45	12	402
Serv	-122	-80	23	34	6	72	0	4	1	9	2	7	8	81
Hous serv	-20	-10	5	8	1	6	0	0	0	2	0	0	1	7
Total	-296	72	29	69	10	67	2	-1	2	11	4	19	11	6
	Scenario DDA													
Sector	**MEX**	**USA**	**CAN**	**EU-15**	**CEEC**	**JAP**	**VEN**	**CHL**	**CHE**	**CAM**	**ARG**	**BRA**	**REUR**	**ROW**
Cer	73	761	234	-1026	-377	-2049	-15	-13	119	-223	847	1464	113	-341
Veg	19	1077	-86	-530	845	165	6	162	-102	1335	1428	687	-323	-5273
Dairy products	-111	162	142	-2695	-1600	-263	-26	50	-149	-61	162	-68	42	4503
Meat	73	3608	272	-6601	-3465	-2219	-7	316	-130	-75	160	4854	361	2514
Proc Food	11	189	-212	-5988	-72	-3192	-33	-122	-235	880	193	606	-1298	7859
Tob and bev	38	261	-14	237	109	-178	-13	57	0	-111	-8	-27	-89	-375
Total Agricultural	*103*	*6058*	*336*	*-16603*	*-4560*	*-7736*	*-88*	*450*	*-497*	*1745*	*2782*	*7516*	*-1194*	*8887*
Enrg	-96	499	-111	376	178	124	-132	53	27	115	-26	446	1003	-2793
Manufs	160	-4214	-442	7085	3397	8164	232	-402	130	-1530	-1995	-9282	753	-3623
Serv	207	1467	351	11202	1078	1728	23	-16	450	-213	-607	-1836	-1070	-8029
Hous serv	16	-88	11	735	143	67	1	-4	8	-54	-125	-79	-91	-544
Total	*390*	*3722*	*145*	*2795*	*236*	*2347*	*36*	*81*	*118*	*63*	*29*	*-3235*	*-599*	*-6102*
	Scenario FTL													
Sector	**MEX**	**USA**	**CAN**	**EU-15**	**CEEC**	**JAP**	**VEN**	**CHL**	**CHE**	**CAM**	**ARG**	**BRA**	**REUR**	**ROW**
Cer	154	2343	2562	-1037	-230	-6879	-26	-29	835	-438	2938	10410	61	-11104
Veg	451	7860	-296	-806	848	293	54	163	-312	2893	3272	104	-443	-14722
Dairy products	-551	-130	-249	-2411	-1098	-697	-32	47	-64	-352	200	-383	-34	5493
Meat	-997	11349	1635	-15877	-3695	-7616	-12	3162	-630	-422	204	14816	-1537	-2549
Proc Food	41	3033	-229	-9882	-254	-6682	43	-544	-221	1121	-320	-772	-1581	12847
Tob and bev	67	1410	40	1121	215	-448	-22	58	25	-347	-29	-73	-169	-170
Total Agricultural	*-835*	*25865*	*3463*	*-28892*	*-4214*	*-22029*	*5*	*2857*	*-367*	*2455*	*6265*	*24102*	*-3703*	*-10205*
Enrg	294	1723	3	1134	368	439	1027	249	52	51	-28	1369	-284	-3531
Manufs	-1188	-7679	-5096	24619	3863	31760	-1693	-2938	-2087	-4683	-5799	-33099	-1679	800
Serv	1407	13484	2835	25661	2567	2554	292	-53	589	-701	-847	-4819	2109	-21013
Hous serv	118	563	196	1045	235	-62	24	-24	2	-226	-211	-228	8	-1421
Total	-204	33956	1401	23567	2819	12662	-345	91	-1811	-3104	-620	-12675	-3549	-35370

Source: Author's calculations

DDA

The second part of Table 5-12 exposes the effects of simulating the implementation of DDA scenario. In contrast to scenario FTAs, the relative changes in the trade balance here are more distributed across regions. In this scenario exports from Mexico, the USA, Canada,

Chile, CAM, Argentina, Brazil and ROW increase more than imports for agricultural and food commodities.

In Table 5-12 export expansions for Brazil are estimated in agricultural sectors. Brazil as a single region depicts the highest gain in agricultural trade balance. Large export expansions from Brazil are seen for meat (USD 4.8 Bil) and cereals (USD 1.4 Bil). Recalling bilateral flows in Table 5-10, Brazil increases exports to the EU-15 (11 percent), and REUR (30.1 percent). Thus, it is reasonable to think that these flows to EU-15 and REUR correspond to a higher extent to agricultural commodities (mainly meat and cereals). A similar trend is followed by Argentina. In Table 5-12 all agricultural exports from Argentina increase, especially dairy products (USD 162 Bil), while in Table 5-10 exports from Argentina to Mexico increase by 11.6 percent, it can be inferred that these exports might go to Mexico.

A notable point to highlight in these results is that Brazil and Argentina expand their export opportunities in countries that in the baseline belonged to trade blocs such as the EU-15 for Brazilian exports and Mexico for Argentinean exports. In this sense the NAFTA and the EU-27 implemented external tariffs to external countries, and eliminated the import tariffs within the EU-27 and partially as agreed in the FTA with Mexico. In the midst of the DDA implementation, imports from third parties face lower tariffs within NAFTA and EU-27. In contrast to NAFTA members, the exports of food commodities from the EU-27 shrink. Similar sector trends have been obtained and analysed in other studies (BROCKMEIER et al., 2008; BROCKMEIER and PELIKAN, 2008). BROCKMEIER et al., (2008) analyse single elements of the trade reforms proposed as part of the WTO negotiations for the agricultural products. Their results explain the causes behind the shrinking trends in agricultural trade balances in the EU-27. They found that cereals and meats (mostly bovine meat) are more affected by the entrance of imports. However, the retractile trends of milk (which in this study is included in the commodity dairy products) and cereals are tracked back to the erosion of export subsidies for producers in the EU-27 (BROCKMEIER et al., 2008). Thus, a share of intra-trade in the EU-27 is based on trade diversion. The implementation of tariff cuts for third countries decreases intra-trade diversion in the EU-27 and preferences of selected products shift to cheaper suppliers from other countries such as Brazil.

Thereby, Brazil is the major exporter (USD 7.5 Bil). Losses in trade balance are observed in high-income countries and regions e.g., EU-15, CEEC, Japan, Switzerland and REUR. The only middle-income country with deterioration in agricultural trade balance is Venezuela.

FTL

The third section of Table 5-12 presents the effects of a full abolition of tariffs and export subsidies across regions. In this scenario, all preferences formed by trade agreements or customs unions are removed. Under these conditions, traded commodities from all countries have full market access at the global level. Then changes in the trade balance under these conditions, are significantly higher than those observed in the previous two scenarios. The highest gains in total agricultural trade balance are observed in the USA (USD 25.9 Bil), Brazil (USD 24.1 Bil) and other countries in Latin America. The results for total trade balance look different across regions. The non-agricultural trade balance in high-income countries will profit by much more than low-income countries. The USA (USD 33.9 Bil), the EU-15 (USD 23.5 Bil), Japan (USD 12.6 Bil), CEEC (USD 2.8 Bil) and Canada (USD 1.4 Bil) observe the highest increases in exports, mainly as a result of non-agricultural trade liberalisation.

A notable fact in this scenario is the high increase in agricultural profits registered for Latin American countries. Agricultural trade balances for Brazil (USD 24.1 Bil), Argentina (USD 6.2 Bil), CAM (USD 2.4 Bil), Chile (USD 2.8 Bil), and Venezuela (USD 5 Mio) increase. Recalling Table 5-10, an important share of trade creation is granted to intra - Latin American trade. However, also global trade creation is accounted for mainly in food commodities from Latin American exports to the REUR and ROW. Under the depicted conditions in this scenario, these countries might shift stronger production factors to agricultural sectors, while imports of non-agricultural sectors would increase, causing a conversion of sign for the total trade balance. Only in the case of Chile a positive total trade balance is obtained (USD 91 Mio).

In Mexico the simulated conditions brought more quantities imported than exported (USD -835 Mio) and in magnitude similar to the gains achieved by the free trade agreements considered in the benchmark of this scenario (USD 1.03 Bil). Regarding non-agricultural trade balance in Mexico, it expands exports, which implies comparative advantages for non-agricultural sectors over agricultural sectors.

The results for USA and Canada signalise growth in trade balance of both agricultural and non-agricultural sectors, which place these two countries as important competitive countries.

For the EU-27 and Japan the results display similar trends. These two regions will have negative developments from the agricultural trade liberalisation. The loses are to be

expected as the agricultural sectors in these countries account for the highest trade distortions worldwide. Especially affected sectors are the meat and processed foods for the EU-15, CEEC and Japan. These flows are the result of two main factors. First, agricultural commodities in other regions are produced cheaper, and after the elimination of tariffs consumers are able to purchase cheaper import substitutes. Second, the producers in these regions do not receive export subsidies anymore. The cut in subsidies increases the prices of domestic agricultural production. However, the shift of productive factors to non-agricultural production causes an overall positive development of total trade balance albeit the decreases in the agricultural sectors.

Full trade liberalisation denotes a particular influence of initial protection over the final outcomes. The liberalisation of sectors that in the base year are highly protected (either through tariffs or export subsidies) improve the allocation of production factors to the most competitive sectors. These reallocations would lead to higher gains for producers and consumers. As the results show, in the case of Mexico, NAFTA has led to reductions in trade balance of cereals, and gains of meat exports. Moreover, under a liberalised market it would acquire an inverse trend. Under the particular conditions simulated in this study, the results suggest a higher potential of Mexican resources for non-agricultural sectors. It is worth remembering that other non-agricultural sectors have been considered in the FTAs and WTO negotiations and not only the agricultural chapter as tailored in the simulations of this study.

5.6.2 Changes of Prices and Quantities of the Representative Private Household in Mexico

The implementation of international trade policies reorganises not only trade patterns as seen in Section 5.6.1 but also domestic output. In sectors with expanding imports, domestic production slows down and output decreases. These changes cause spill over effects on demand for factors of production. Production factors are also reallocated to those sectors with increasing demand. Accordingly, domestic output increases significantly in those sectors where the production demand increases.

Turning to consumption of private households, the quantities consumed by households are a composite of import and domestic products. The ratio of import/domestic composite commodities consumed by private household varies as a function of domestic production and imports. Additionally, prices paid by private households will change if prices of domestic and import commodities change (see Section 3.3.2.3).

The methodology in this study takes changes in prices paid by private households to analyse modifications in household expenditures. Therefore, changes in prices and quantities for private households are first analysed. As mentioned in the preceding Chapters, households have different preferences and thus, react differently to even the same change in price. These reactions are mainly based on different household behaviour driven by modifications in prices. The results discussed here are focused on Mexico. Changes in quantities consumed and prices paid by private households in Mexico for different commodities under the three scenarios simulated are presented in Table 5-13. Furthermore, the prices paid by private households will be linked to changes in household expenditures.

FTAs

This scenario presents the largest changes for quantities and prices paid by private households in Mexico. In this scenario as seen in Table 5-13, changes in prices are higher than quantities consumed, with the large trend of increasing consumed quantities at lower prices. In the case of cereals and dairy products, we have seen in Table 5-12 that increasing imports are expected. A reason for these increasing imports would be lower import prices than domestic prices, which would justify the lower prices paid by consumers and the increasing quantities demanded. Generally, demand for all other consumed products increases, while prices fall. Thus, implementation of this scenario represents gains in consumer surplus in Mexico.

Other important fact to be noticed are the highest falls in prices and increase in quantities purchased of cereals, vegetables and processed food, which are in most of the cases components of the basic food basket of low expenditure households in Mexico.

Table 5-13 Changes in private consumption price for composite commodities in Mexico (%)

	FTAs		**DDA**		**FTL**	
	qp	pp	qp	pp	qp	pp
Cer	1.35	-5.73	-0.24	0.54	-0.82	0.23
Veg	0.36	-1.28	-0.15	0.08	-0.71	-0.45
Dairy products	0.36	-0.94	-0.02	-0.51	0.29	-4.45
Meat	0.16	-0.26	-0.06	-0.35	-0.27	-2.65
Proc Food	0.45	-1.28	-0.08	-0.29	-0.39	-2.20
Tob and bev	0.19	-0.39	-0.05	-0.40	-0.29	-2.56
Enrg	0.11	-0.01	0.03	-0.63	-1.66	0.17
Manufs	0.05	0.11	-0.10	-0.28	0.17	-3.98
Serv	0.01	0.21	-0.09	-0.36	-0.49	-2.47
Hous serv	0.04	0.16	-0.11	-0.36	-0.62	-2.37

Source: Author's calculations

DDA

The changes in prices and quantities acquired by households reveal inverse trends to those observed for scenario FTA. Prices for cereals and vegetables increase in comparison to FTAs scenario. In contrast to scenario FTAs, under DDA scenario conditions, Mexico turns out to be a net exporter (see Table 5-12). In scenario FTAs the involved partner countries cut tariff imports on products, but producers still obtain export subsidies. The subsidy of exports reduces world prices and raises domestic prices in subsidizing countries. The export subsidies allow producers in the USA, Canada and the EU-27 to export at lower prices than the actual world market price. Then products are imported into Mexico at lower prices than domestic produced products in Mexico (due to zero tariffs levied and the effect of export subsidies). Thus, consumers also face benefits and demand for import products increases. When export subsidies are eliminated, world prices will increase and domestic prices in the countries that used to grant the subsidies increase. With increasing import prices, the demand for those former subsidised products will fall. At hand of these results, it is likely that prices of imports from former suppliers are higher under these conditions than domestic production in Mexico. Thus, consumers' demand for domestic products in Mexico increases. At the same time as this scenario contemplates multilateral tariff elimination, other commodities from different destinations enter into domestic markets at lower prices. This might be the case of dairy products, meat, processed food, manufactures and services in Mexico.

FTL

Large changes are observed in food commodities, which happen to be the most distorted products by market protection across world regions (ANDERSON et al., 2006). The results of FTL scenario are driven by the same mechanisms described in scenario DDA. However, in this case, the elimination of import tariffs also involves non-agricultural sectors. In this scenario, the demand for domestic non-agricultural commodities increases as seen in Table 5-12. This leads to an increase in production of non-agricultural commodities in Mexico. The reallocation of production factors in this scenario is more drastic to the one observed in scenario DDA, because the cuts in import tariffs and export subsidies are fully eliminated in all countries and sectors. These changes require the reallocation of factors of production to the most competitive sectors, while consumers redirect their demand to cheaper products. Therefore, trends in this scenario are different to those observed in the two previous scenarios. Increases in prices are only documented for cereals and energetic products, while decline of demand is a general trend across sectors. In the case of

manufactures, prices fall by -3.98 percent, while private households' demand increases only slightly (0.17 percent). As also highlighted in Table 5-12, under this scenario an important flow of import products supply domestic markets. Thus, if countries eliminate trade distortions world wide, prices paid by households are the result of consumption from the cheapest source worldwide, either domestic or imported.

5.6.3 Changes in Household Expenditures Shares

This section evaluates the changes in household expenditure led by price changes. As in Chapter 4, households are classified in ten categories. The ten percent of households in Mexico with the lowest expenditure level are enclosed in decile I, while the ten percent of richest households are in decile X. The results are analysed from different perspectives. First, the results are evaluated across scenarios and basic explanations based upon the theory of consumer behaviour are elucidated. Later, changes in expenditure shares of selected food commodities are analysed to differentiate reactions caused by specific scenarios for the same sector across deciles. Finally, changes of household expenditure shares are analysed for selected deciles and associated to consumption preferences detected in Chapter 4.

5.6.3.1 Changes in Expenditure Shares

In Table 5-14, changes in expenditure shares caused by the three simulations are presented. To keep analyses within a manageable span, the assessment examine only food commodities. The analyses are based on the effects of prices and changes in expenditure described by the theory of consumer behaviour. The effects of prices are unidirectional, if the price for a good increases then demand for this product decreases[24] and substitution effects take place. In contrast, the effects of changes in the income/expenditure level over the demand might be a positive or a negative effect. For a normal good, the demand increases when income increases. For an inferior good, the demand drops when income increases (VARIAN, 2002). The following analysis interprets the structure of the changes in expenditure shares observed in Table 5-14. Hence, the values of income elasticities (see Appendix D) are analysed to identify normal goods. Then, the mechanisms driving the directions of commodity expenditures according to changes in prices and in total expenditures are predicted (last row by each scenario in Table 5-14).

[24] Ordinary goods react to increases in prices by decreasing demand. Most of the goods in this study are classified as ordinary goods. Some exceptions are Giffen goods, these will be identified for the FTAs scenario.

As a basic mechanism, and considering rises in prices, it is expected for normal goods with increasing expenditure levels, and for inferior goods with decreasing expenditure levels:

a) Demand increases when income effects are higher than substitution effects, and

b) Demand decreases when income effects are lower than substitution effects.

For normal goods with decreasing expenditure levels and for inferior goods with increasing expenditure levels:

a) Demand decreases when income effects are higher than substitution effects, and

b) Demand increases when income effects are lower than substitution effects.

In Appendix D we observe that across deciles all food commodities are regarded as normal for all deciles with the following exceptions (which are inferior goods): dairy products and processed food for decile V as well as meat for decile VII. The inferior goods might be classified as Giffen goods[25] only if their expenditure shares increases when their prices increase. Therefore, looking at the own-price elasticities reported in Appendix E, for meat consumption of decile VII (-0.93), expenditure share of dairy products (-0.76) and of processed food (not significantly different from zero) of decile V it can be concluded that none of these commodities are Giffen goods. Whenever the price of these inferior commodities has the same sign as changes in own-prices, this is due to substitution effects rather than to own-price effects.

The distinction of inferior goods that are not Giffen goods is important to show reasons for the preference of these commodities. A Giffen commodity is observed by households with few substitution possibilities mostly caused by a restricted low-income. It is also related to high expenditure shares devoted to the consumption of that specific commodity (staple cereals for poor households). When the price of a Giffen commodity increases households, still continue consuming the same commodity at the same level, because this commodity is the cheapest one they can afford to satisfy a minimum level of utility.

In contrast, inferior goods that are not Giffen are more related to quality improvement and more often documented for wealthier households. The expenditure share of these commodities decreases as income increases led by an increase in the quality of the commodity purchased. However, when the price of this commodity increases, households tend to substitute

[25] A Giffen good is an inferior good that by decreasing prices consumption increases. This effect only can be observed in inferior goods. If the income effect outweighs the substitution effect, then the inferior good can be classified as Giffen good. For inferior goods, the income effect in opposite direction might be reinforced or abated by the effect of prices, while for normal goods the income effect reinforces the effect of prices.

it for other commodities that are capable of reaching the same utility level as the inferior good at a lower price. The inferior goods documented in this study are observed in households that are indeed in the border between poor/non poor (decile V). In the case of decile VII, this is the first decile income upwards, in which meat is not classified as a necessity but as an inferior good. In other words, this is the first decile able to afford the required share of meat to fulfil needs. Thus, as income increases quality will also be improved, while in deciles VI and downwards meat is not upgraded with increasing incomes but quantities to fulfil basic needs. Deciles VIII and upwards do not classified meat as inferior because they can afford to improve quality without having to reduce the quantity consumed.

FTAs

Increasing income is observed according to Table 5-14 under this scenario for deciles I, IV, and VII. Thus, one would expect for deciles I, IV and VII, and for dairy products and processed food in decile V (inferior goods with drop in expenditure level) that:

a) Expenditure shares increase when income effects are higher than substitution effects.

b) Expenditure shares decline when income effects are lower than substitution effects.

Deciles with declining expenditure levels in scenario FTAs are decile II, III, V, VI, VIII, IX and X. It is expected for these deciles, including also the consumption of meat (inferior good with increasing expenditure level in decile VII), that:

c) Expenditure shares decrease when income effects are higher than substitution effects.

d) Expenditure shares increase when income effects are lower than substitution effects.

DDA

Looking at price changes in Table 5-13, cereals and vegetables have increases in prices under scenario DDA while the remaining commodities have declining prices.

In Table 5-14, changes in percent expenditures are positive for deciles II, III, V, VI, VIII, IX and X. Thus, it is expected (also for consumption of meat by decile VII), that:

a) Expenditure shares increase because the income increases, and the commodity is preferred over others (especially for prices for dairy products, meat, processed food and tobacco and beverages that in this scenario have diminishing price changes).

b) Expenditure shares increase when income effects are higher than substitution effects.

c) Expenditure shares decline when income effects are lower than substitution effects (more likely to be observed by cereals and vegetables, because their price increases according to Table 5-13).

Table 5-14 Percent changes in expenditure shares of Mexican households under scenarios

	Free Trade Agreements (FTAs)									
	I	II	III	IV	V	VI	VII	VIII	IX	X
Cereals	6.06	-0.21	-0.07	-0.10	-3.36	0.21	0.37	-0.04	0.03	0.08
Vegetables	1.90	0.02	-0.62	-0.53	0.77	0.21	-0.48	-0.19	-0.46	0.34
Dairy products	0.87	-0.41	-0.30	-0.52	-0.87	0.16	0.14	-1.14	-1.89	-0.25
Meat	-0.04	0.09	-0.38	-0.62	2.87	-0.08	-0.60	-0.40	0.04	0.01
Proc Food	0.51	-0.10	0.42	1.93	-12.49	0.12	1.01	-0.20	-0.96	0.18
Tob and bev	0.65	-0.51	2.54	-0.19	0.21	1.69	1.42	1.39	1.64	0.15
Energy	0.13	-0.75	-0.48	0.40	0.85	-1.32	0.38	0.09	0.44	0.02
Manufactures	-2.51	1.56	-0.48	-0.13	1.10	-0.33	0.43	-0.27	-0.49	0.08
Services	-0.66	-4.87	-0.08	3.84	0.11	-0.13	-0.55	-0.41	0.30	-1.05
Hous serv	0.63	-0.16	-2.16	-0.71	2.28	-1.58	2.86	-0.72	0.45	-0.17
Total Expenditure	*7.55*	*-5.34*	*-1.62*	*3.37*	*-8.53*	*-1.05*	*4.99*	*-1.90*	*-0.90*	*-0.60*
	Doha Development Agenda (DDA)									
	I	II	III	IV	V	VI	VII	VIII	IX	X
Cereals	-0.86	-0.89	-0.41	-0.44	-0.72	-0.46	-0.66	-0.81	-0.40	-0.72
Vegetables	-0.38	-0.27	-0.71	-0.46	-0.79	-0.50	-0.52	-0.52	-0.85	-0.47
Dairy products	0.15	-0.43	-0.42	-0.58	-0.38	-0.84	0.00	0.61	0.47	1.25
Meat	-0.32	-0.17	-0.39	-0.48	-0.63	-0.43	-0.02	-0.75	-0.39	-0.44
Proc Food	-0.34	-0.80	-0.38	0.61	-0.41	-0.69	-0.11	-0.03	-0.37	-1.58
Tob and bev	-0.44	-0.82	0.52	0.05	-0.07	0.46	-0.09	-0.23	0.24	-1.01
Energy	0.70	-0.18	-0.66	-1.37	-0.16	-0.92	-0.69	-0.48	-0.80	-0.34
Manufactures	-0.23	0.32	-0.02	-1.91	-0.45	-0.20	-0.93	-0.79	-0.33	0.70
Services	-0.39	-0.60	-0.50	-1.63	-0.34	-0.73	-0.36	-0.45	-0.32	-1.18
Hous serv	-0.48	0.04	0.00	-1.20	-1.06	-1.13	-1.86	-1.57	0.08	1.41
Total Expenditure	*-4.77*	*4.77*	*2.50*	*-1.70*	*9.54*	*2.31*	*-2.09*	*3.09*	*1.99*	*1.16*
	Full Trade Liberalisation (FTL)									
	I	II	III	IV	V	VI	VII	VIII	IX	X
Cereals	-3.00	-6.82	-3.16	-2.82	-5.36	-2.56	-4.00	-6.04	-2.89	-3.16
Vegetables	-1.34	-1.44	-5.37	-3.02	-4.76	-3.45	-4.16	-3.89	-6.95	-0.71
Dairy products	3.84	-3.96	-2.97	-3.22	-2.02	-4.16	-2.60	0.66	-2.94	21.19
Meat	-2.81	-2.06	-3.12	-3.62	-1.66	-2.80	-0.53	-5.60	-2.61	-2.59
Proc Food	-9.29	-2.96	-1.46	5.71	-10.47	-3.09	-3.80	-3.26	-6.95	-14.57
Tob and bev	-3.83	-6.55	4.92	0.17	-1.04	2.43	1.90	0.80	5.04	-9.17
Energy	-4.60	0.27	-4.81	-9.36	-1.70	-7.17	-4.86	-3.41	-5.46	-2.47
Manufactures	6.38	1.16	-0.58	-14.22	-3.34	-1.64	-6.21	-5.95	-2.82	4.91
Services	1.56	-2.65	-3.70	8.93	0.31	-4.89	-2.25	-3.07	-1.09	-11.83
Hous serv	-4.43	2.24	2.44	-4.85	-15.05	-6.78	-16.61	-10.69	1.49	13.30
Total Expenditure	*-17.52*	*-22.76*	*-17.81*	*-26.31*	*-45.08*	*-34.12*	*-43.11*	*-40.45*	*-25.18*	*-5.12*

Source: Author's calculations

Deciles with declining expenditure levels in scenario DDA are decile I, IV and VII. Thus, it is expected for all commodities across these deciles as well as for dairy products and processed food consumed by decile V that:

d) Expenditure shares increase when income effects are lower than substitution effects (more likely to be observed by dairy products, meat, processed food and tobacco and beverages, because their price falls according to Table 5-13).

e) Expenditure shares decrease when income effects are higher than substitution effects (more likely to be observed by cereals and vegetables, because their price increases according to Table 5-13).

FTL

Looking at Table 5-13 for scenario FTL, only the price of cereals has increased, whereas the prices of remaining commodities fall.

In Table 5-14, all households have negative changes in expenditures. Thus, it is expected, that:

a) Expenditure shares decrease invariably, as price increases and other products will be preferred (likely to be observed in cereals).

b) Expenditure shares decrease when income effects are higher than substitution effects.

c) Expenditure shares increase when income effects are lower than substitution effects.

For consumption of dairy products and processed food by decile V and for meat consumption by decile VII:

d) Expenditure shares increase when income effects are higher than substitution effects.

e) Expenditure shares decline when income effects are lower than substitution effects.

When all prices fall, it is also possible to think of increases in household purchasing power at the same or lower expenditure levels. As a result, the expenditure shares would denote adjustment of the same quantities demanded at lower prices.

5.6.3.2 Changes in Expenditure Shares by Deciles

In this section, the single changes in expenditure shares for food and non-food commodities of selected deciles are analysed. In order to draw a sizeable body of interpretation, the revision covers four out of the ten deciles. Two deciles are classified under the poverty line of assets according to Section 2.2.1 (deciles II and IV), and the other two deciles over the poverty line of assets (deciles VI and IX).

Decile II

Changes in expenditure shares in decile II are presented in the Figure 5-5. In general for this decile, the highest changes in food commodities are to be expected under scenario FTL and for non-food commodities under scenario FTAs and FTL.

As observed in Figure 5-5, under scenario FTAs, changes in expenditure shares for food items are all negative, excepting meat. For non-food commodities changes are higher than those observed for food commodities, with the single increasing trends for manufactures. As it might be recalled from Section 4.4, that these households react quite inelastically to changes in prices of food commodities, whereas reactions to price changes of non-food items are stronger. Main reasons for this relative inelasticity to food commodities lies in the high share that these households allocate in food products. In this decile, particularly it is expected that households do not cover their food requirements (Section 2.2.1). The increase therefore in prices of non-food items together with the fall in prices of food items causes a shift in preferences towards food consumption. These patterns are supported by the cross-price elasticities estimated in Chapter 4 and presented in Appendix F. Substitution relationships between meat-vegetables and meat-dairy products as well as meat-services are evident. In the case of meat it can be inferred that substitution effects together with the decrease in prices of meats promotes a higher consumption of meat for these households. The higher changes are observed for non-food commodities. The decline in prices of other non-food commodities will promote substitution effects and a higher consumption of those products preferred. It is important to keep in mind that the preferences found for this decile suggest only food-food and non-food-non-food substitution relationships. These effects lead to increases in expenditure shares for the commodities manufactures and housing services and important drops in expenditure shares of services and energy.

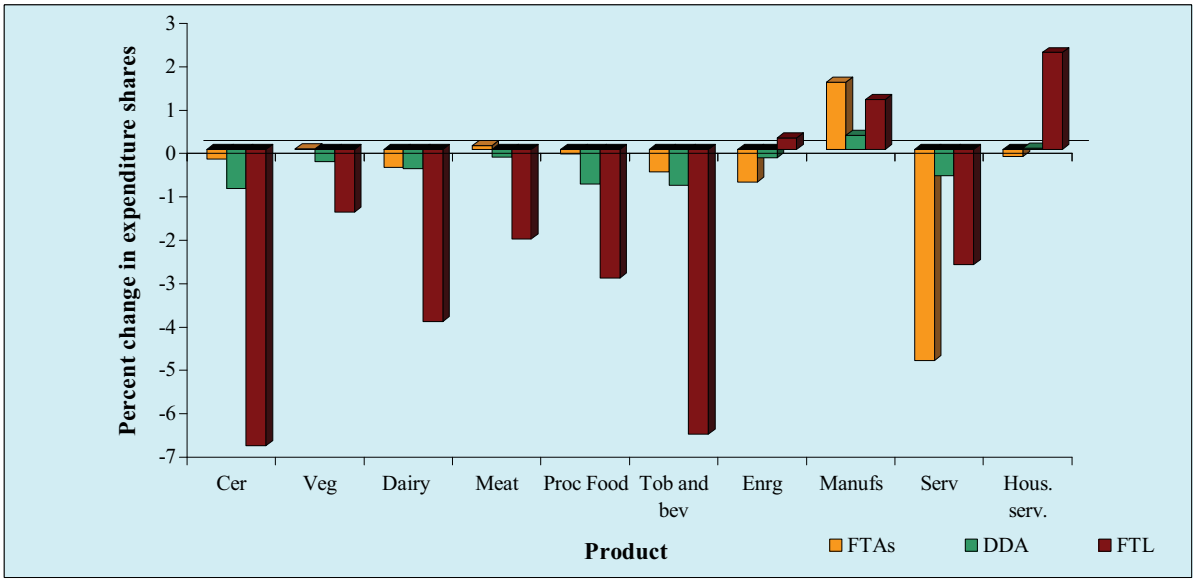
Under scenarios DDA and FTL, the changes in expenditure shares of food commodities are higher in absolute values than the changes observed for non-food commodities. Changes under scenario DDA are a bit higher than in scenario FTAs. In scenario DDA, the drop in expenditure share of some food commodities is principally attributed to higher prices of cereals and vegetables as the change in total expenditure is negative in both cases (Table 5-14). Under these conditions households still attempt to cover their food needs. In the case of vegetables and cereals the increasing prices lead households to restrict consumption of other commodities to purchase cereals and vegetables. Even with the reallocation of expenditures, the expenditure share for food as well as for non-food commodities are both negative. The only two exceptions in both scenarios are housing

services and manufactures. The increase in expenditure share of manufactures and housing services might signalise substitution effects within non-food commodities, especially because the changes observed for non-food commodities are higher than those obtained for food commodities.

The scenario yielding the highest changes in expenditure shares is FTL. All the expenditure shares under this scenario fall drastically. An important collapse in expenditure share is registered for cereals, as remark, the price of cereals under this scenario increases. The probable substitution effects of cereals for other food-commodities still would not outweigh the decreasing trends of other expenditure shares for food items. On the other hand, the expenditure shares of non-food commodities might increase as result of the decreasing prices.

Under these conditions can be said that households in decile II might improve their consumer surplus towards better living qualities under scenario FTAs as in general the food commodities will have decreasing expenditure shares and non-food items would have increasing expenditure shares. These trends are regularly observed in wealthier households.

Figure 5-5 Changes in expenditure shares of decile II in Mexico under three scenarios



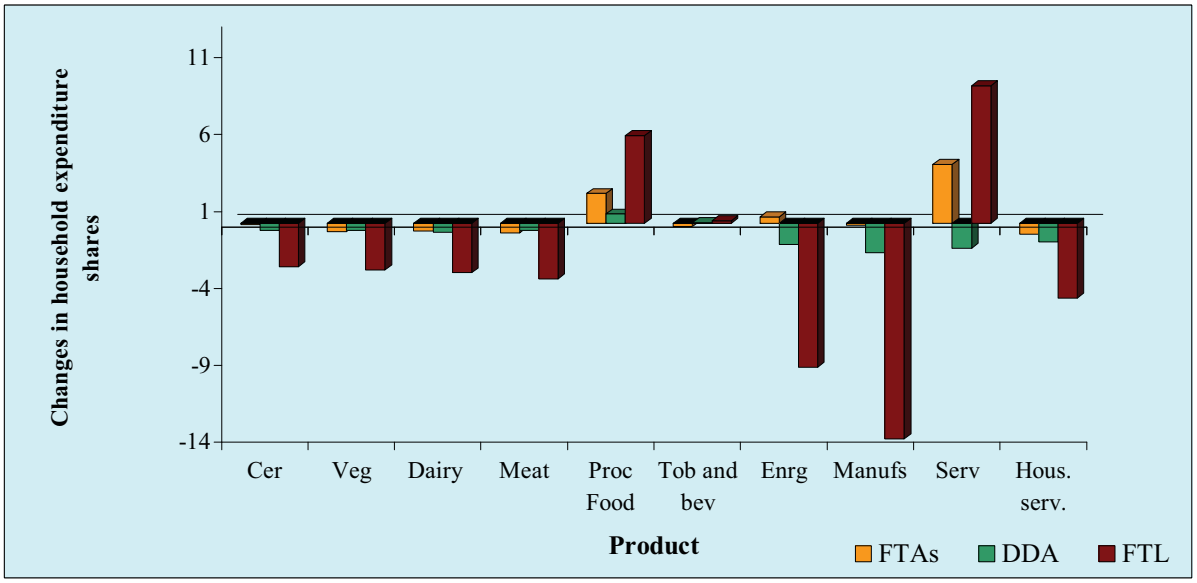
Source: Author's calculations

Decile IV

Changes in expenditure shares calculated for decile IV are shown in Figure 5-6. This decile contains the households in the poverty boundary between poverty of capacities and poverty of assets according to official figures presented in Section 2.2.1.

The changes in expenditure shares observed by simulation of the FTA scenario denote falls for cereals, vegetables, dairy products and meat sectors, which have decreasing prices in this scenario. Albeit the increase in total expenditure obtained for this decile, these sectors have declining expenditure shares. Thus, given that the expenditure level is above the capacities poverty line, it can be inferred that these households consume the same food quantities at lower prices. Instead, the increase of total expenditure is allocated for the consumption of services. Health and schooling services are embedded in the category of services, but we know from Chapter 2 that these households do not cover their basic needs here. In addition, the increase in the expenditure share of processed food observed in this simulation implies an improvement in the utility of these households.

Figure 5-6 Changes in expenditure share of decile IV in Mexico under three scenarios



Source: Author's calculations

The decreasing food expenditure shares in scenarios DDA and FTL are associated to the fall in prices of these commodities, because as mentioned above, these households cover already their food needs. Only in the case of cereals and vegetables (with rise in prices), it is likely that substitution effects take place towards an increase in consumption of processed food. Regarding the consumption of non-food commodities, variable trends are observed. The decrease in consumption of non-food commodities might be associated with the fall in prices. As also the total expenditures decrease in these households, it can be possible that households experience an improvement in the purchasing power and thus to consume the same quantities of non-food commodities at lower prices (see Figure 5-6).

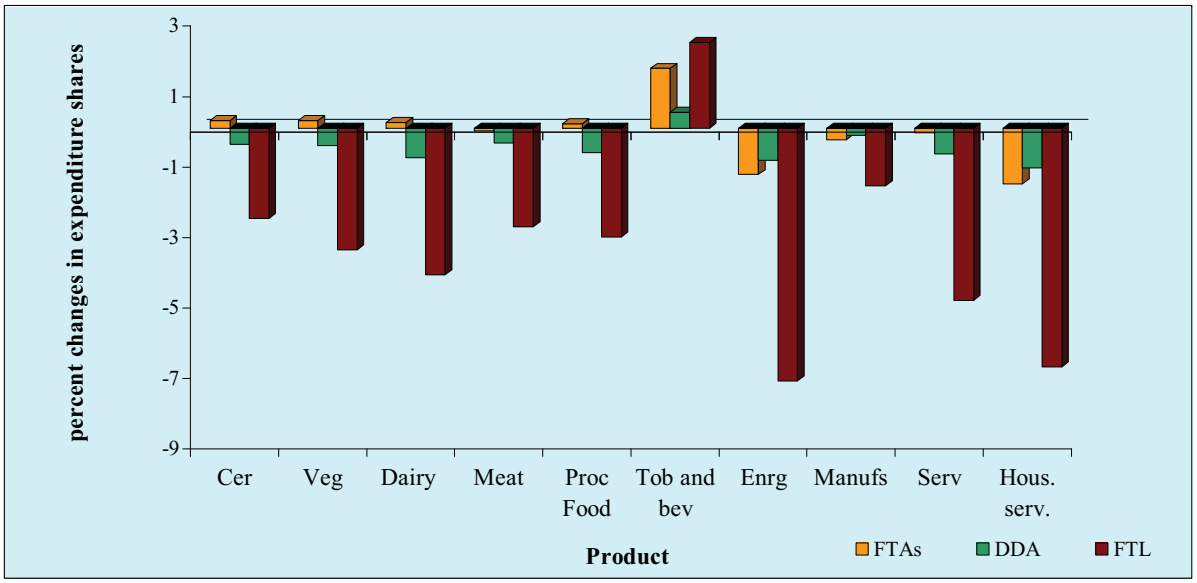
Decile VI

The changes in expenditure shares for decile VI are presented in Figure 5-7. Given the relative high welfare accomplished by these households, this group is the first decile classifying staple food as luxuries (cereals and vegetables in Table 4-7). Thus, the expenditure shares of cereals and vegetables increase as the result of the purchase of same quantities and better quality of these staple foods. At the same time, this is the fist decile above the poverty line of assets according to Section 2.2.1. In scenario FTAs, the results for decile VI indicate a slight increase in expenditure shares of all food commodities except for meat. At the same time, the expenditure shares for all non-food commodities reduces, which under this scenario has increasing prices. The results also show an increase in the expenditure share of tobacco and beverages, which is also classified as a necessity. Among other items, soft drinks are embedded in this classification, the increasing consumption of which would explain the expansion in the expenditure share of these products. The negative changes in expenditure share for meat, which in spite of the drop in prices decreases, might give evidence of substitution of meat consumption for food substitutes such as cereals (see Appendix F). With the increase of prices in non-food commodities, households slightly reduce consumption of these products. In the conditions depicted in Chapter 2, these households exactly, cover their basic needs of food and non-food commodities without income surpluses. When food prices decrease, these households tend to have an income surplus. Then, surplus income is allocated to other commodities such as tobacco and beverages. Although the households in this decile might also allocate income to other sectors, the relative prices of tobacco and beverages are still lower than prices of other non-food commodities such as manufactures and services. This creates a preference for tobacco and beverages over manufactures and services under the given conditions.

Trends observed for scenarios DDA and FTL are pretty much similar, the expenditure shares of all commodities (excepting tobacco and beverages) decrease. The changes in prices in this scenario fall for all commodities, with the exception of cereals and vegetables as observed in Table 5-13. Thus, households might curtail consumption of cereals and vegetables. The generalised fall in prices of remaining food and non-food commodities, and the negative changes in expenditure shares might signalised the effect of improvement in the purchasing power of these households. The almost unchanged relative prices improve purchasing power and allow households to purchase same or even more quantities with a lower total expenditure. Finally, those commodities with increasing prices (cereals and

vegetables) might be partially substituted by other commodities with lower prices such as meat or processed food (see Appendix F).

Figure 5-7 Changes expenditure shares of decile VI in Mexico under three scenarios



Source: Author's calculations

The results presented here show the preferences of the households just above the poverty line. These households increase consumption of staple foods at decreasing prices more driven more by quality improvement than by nourishment improvement as occurs in poor households. For food policies in Mexico, these results imply that these households might change the quality and/or quantity of food consumed according to the level of changes in prices of food and non-food commodities. However, to obtain more conclusive arguments it is necessary to estimate quality elasticities across household deciles.

Decile VIII

The results obtained for decile VIII are presented in Figure 5-8. The expenditures allocated to services (44 percent), which is considerably higher than the expenditure share for food (30 percent) can be seen as an example of the wealth status of the households in this decile. The economic situation of these households described in Section 4.2 shows their wealth. This decile is the first decile with expenditure levels over the national average, thus all needs are assured. In theory, changes in prices might not drastically change their preferences. However, the results show changes in expenditure shares.

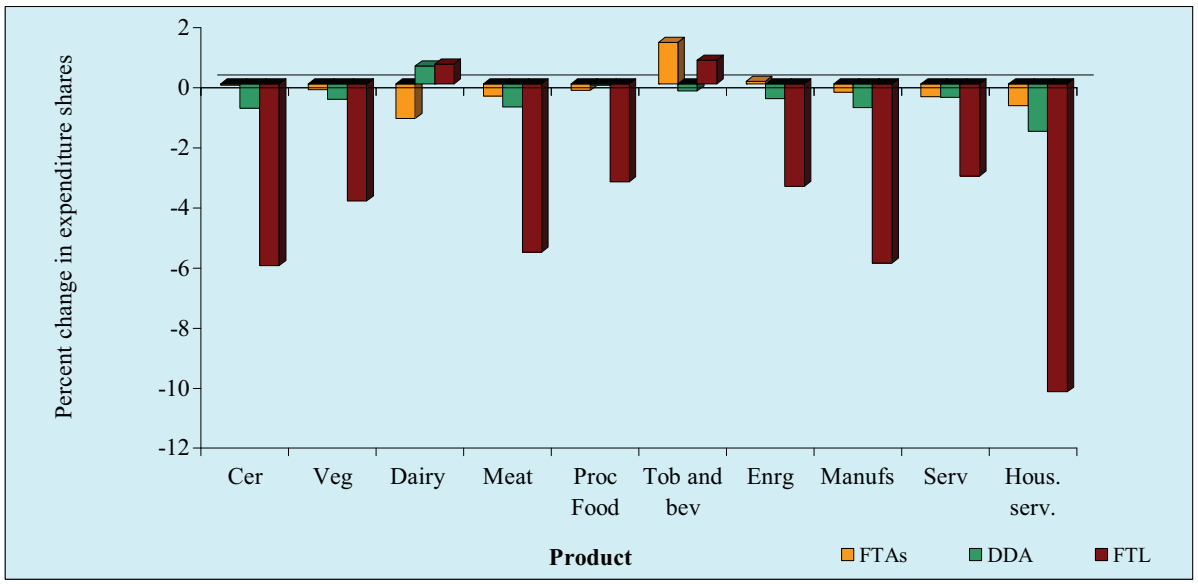
Over the three scenarios, all food and non-food commodities will have decreases in expenditure shares, the exceptions are dairy products and tobacco and beverages. Under scenario FTAs, the expenditure shares decrease for all commodities except for tobacco and beverages. With the fall in prices of other food commodities, households might have a

residual income of other commodities with lower prices. This residual income is high enough to increase consumption of tobacco and beverages, which according to Table 5-13, is a necessity for decile VIII.

In scenario DDA, the trends are fairly different. The expenditure share of dairy products increases while other food commodities observe decreasing expenditure shares. However, in this case the increase in prices in cereals and vegetables might be seen as a trigger to increase the expenditure share of dairy products. In the case of non-food commodities, decreases of expenditure shares are comparable to those observed for food commodities. The fall in prices of non-food sectors abets the improvement of household utility. According to Table 5-13, these households have an increase in total expenditure under scenario DDA. Thus, consumption of luxury commodities such as dairy products is enhanced.

In scenario FTL, where the prices for all products are lower than prices in scenarios FTAs and DDA, households can afford to gather enough income surplus to reallocate expenditures to both luxuries: dairy products and tobacco and beverages. The case of increase in consumption of these two items it is not necessarily bound to increasing quantities, but probably to increasing quality of purchased products.

Figure 5-8 Changes in expenditure shares of in decile VIII in Mexico under three scenarios



Source: Author's calculations

5.6.3.3 Changes in Expenditure Shares by Commodities

This section provides insight into the forces that lead to changes in the expenditure shares of selected food commodities. Additionally, the likely impact of the prices changes on the expenditure shares across deciles for selected food commodities (i.e., cereals,

vegetables and fruits, dairy and animal products, and meat) is assessed. The changes in expenditure shares are presented in this manner to evaluate possible trends that might exist across deciles under the same scenario for a single commodity.

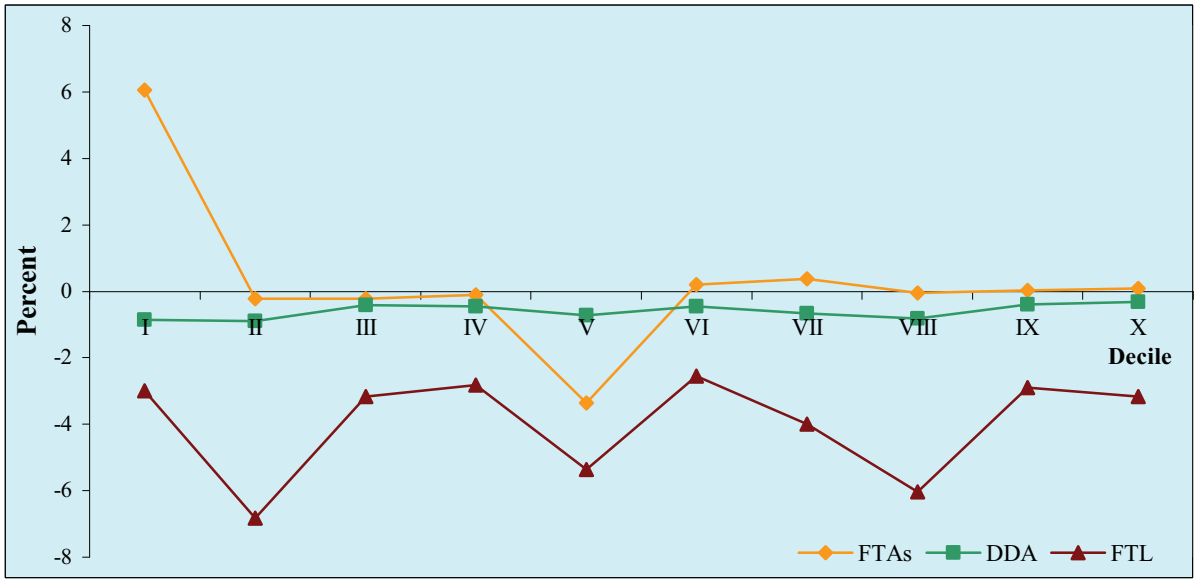
Cereals

Cereals expenditure share declines consistently across household categories. Decile I allocates nearly 10 percent of their total expenditures for cereals, while decile X allots only 1.3 percent (Table 4-2). Additionally, the analysis of preferences presented in Section 4.3 shows a fairly homogenous response to own-price changes of cereals (Figure 4-4). In Section 4.3, a stronger key factor found for consumption of cereals is the total expenditure. Cereals expenditure elasticities are higher for households with higher expenditure levels (Figure 4-3). The cross-price elasticities presented in Appendix D show low values for preferences of poor deciles to substitute cereals with other items (food or non-food commodities). In contrast, households in richer deciles tend to substitute more cereals for other items when prices of other products change. Thus, intuitively a stronger reaction to cereal consumption by poor deciles can only be driven by own-price. In the case of wealthier households, the response is only dependent on the price changes of other commodities consumed and of the expenditure levels. Then, the observed increases of consumption by decile I are first motivated to cover basic food needs, while other poor deciles (II to V) consume cereals more in line with the changes in own-prices observed under each scenario.

The changes in expenditures shares assigned to cereals across deciles are illustrated in Figure 5-9 for three different scenarios. At first glance, changes across deciles under scenario DDA have similar values. Under scenario FTAs, low expenditure deciles (except decile I) have negative changes in expenditure patterns, while medium and high expenditure deciles slightly increase their expenditure shares for cereals. In the case of scenario FTL, all changes are negative; however, there is no clear trend to identify across deciles.

The reason for the different trends across deciles under different scenarios is based on the different changes in prices of other consumed products. For example, in the case of scenario FTAs with decreasing prices in cereals. Households from decile I increase their consumption, probably determined by the low prices and the need to cover basic cereal needs (See Section 2.2.1). The preferences towards cereal consumption changes under scenarios DDA and FTL, where prices of cereals increase and parallel other price commodities decrease. The particular set of relative prices in the new conditions determines the expenditure share devoted to cereals according to the preferences presented in Chapter 4.

Figure 5-9 Change in expenditure share of cereals across deciles under three scenarios



Source: Author's calculations

For domestic policies, these results have important implications, since they highlight the importance of responses of households to cereal preferences. The results in scenario FTAs show drastic reactions of poor households to price changes of cereals. The estimates of Chapter 4 and the households responses here presented suggest that a general increase in total household expenditure is likely to be followed by an increase of cereal consumption by poor households. Under the same conditions wealthier households will keep consuming the same cereals expenditure shares.

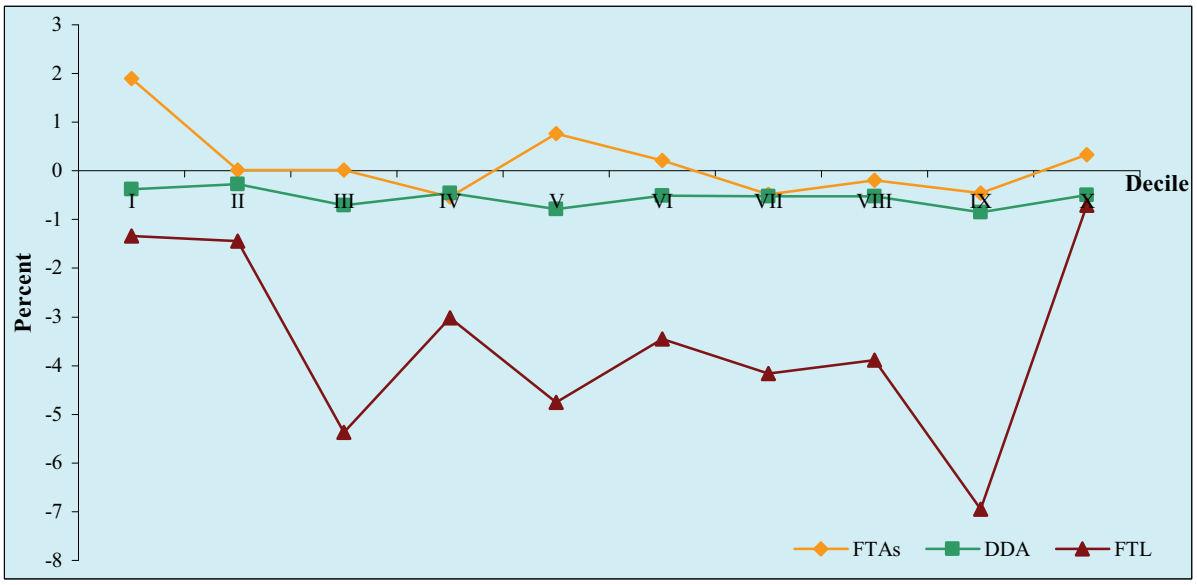
Thus, falls in cereals prices promote increasing consumption of cereals by poor households, whereas in wealthier households they promote substitution with other food and non-food items.

Vegetables

The differences in expenditure share devoted to vegetables for the different simulations are presented in Figure 5-10. Similar trends to changes in expenditures shares for cereals are here observed for vegetables. Under scenario DDA changes in expenditure share across households are quite similar. Changes under scenario FTAs do not have a clear trend across deciles. To cover basic vegetable consumption needs, the poorest households consume more when prices diminish. Decreasing trends in the consumption of vegetables are observed by rising income in scenario FTL. According to Figure 4-3, the lower responses to changes in total expenditures are observed in households with high expenditure levels. Regarding responses to own-prices, poorer households are more responsive than

wealthier households and react accordingly to the direction of the price change (see Figure 4-4). Therefore, when prices of vegetables fall the poorest households in decile I increase the expenditure share for vegetables. For deciles II to VI, changes are more likely to reflect household preferences towards specific relative prices. For deciles VII to X differences in expenditure shares for vegetables are explained as the overwhelming effect of price changes over substitution effects (see Figure 4-4 and 5-6).

Figure 5-10 Change in expenditure share of vegetables across deciles under three scenarios



Source: Author's calculations

From these results, it is worth taking a closer look at scenario FTL. As the changes in prices of food and non-food commodities occur simultaneously, poor households slightly decrease the expenditure share of vegetables mainly driven by total expenditure, own-price effects and the high preference towards cereals (Figure 5-5). However, the decrease in expenditure shares of richer households are more conditioned by substitution effects (deciles VI-IX) or to improve consumption quality (decile X).

The declining trend in the vegetable consumption as expenditure level increases and the need of poor households to cover basic consumption needs have important implications for food policy, research and investments in agriculture. The results show that policies decreasing prices of vegetables improve the welfare of poor households as their basic consumption needs might be covered. With a general decrease of relative prices, the poor households have a decreasing vegetable expenditure share, which is rooted in improvements of consumer surplus, while richer households decrease considerable expenditure shares for

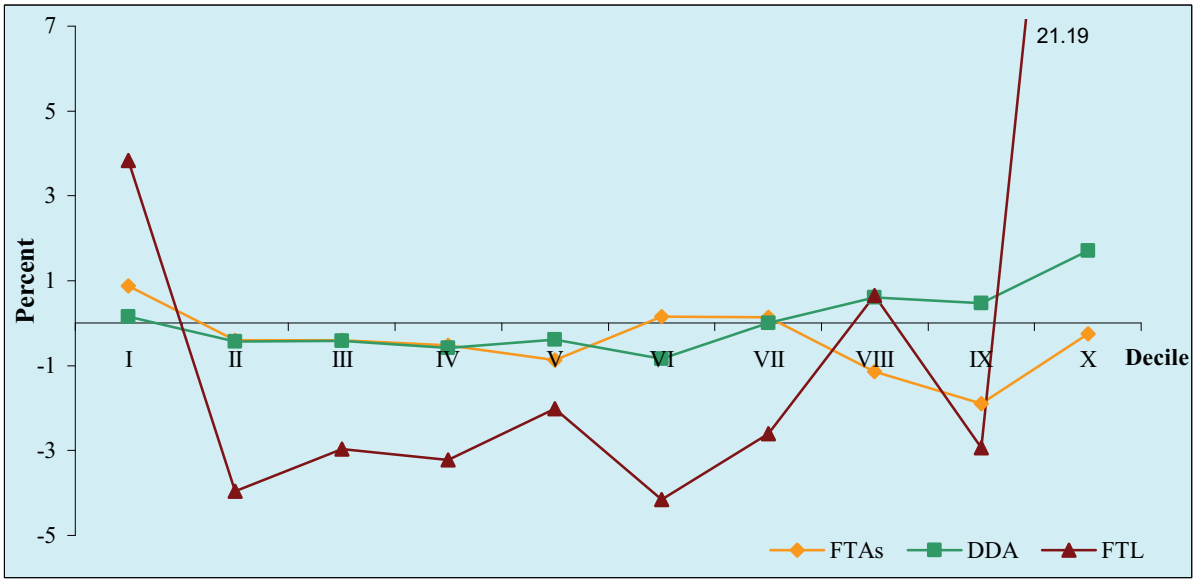
vegetables to consume other commodities (food and non-food) or to improve quality of purchased vegetables.

Dairy products

Households' preferences towards consumption of dairy products found in this study indicate that poor deciles are less responsive than wealthier households to changes in total expenditure. Additionally, poor households tend to have low cross-price relationships related to expenditure shares of dairy products (decile I to VI), while wealthier deciles (VII to X) complement consumption of dairy products with non-food items.

As result, households in Mexico modify expenditure shares of dairy products as illustrated in Figure 5-11. A quick scan of Figure 5-11 reveals that trends between scenario FTAs and DDA in deciles II to V are similar. Also, by comparing deciles VIII to X, similar patterns are found across scenarios DDA and FTAs with higher values in simulation DDA. The expenditure shares of dairy products under simulation DDA fall for low expenditure deciles (II to V), and gradually for decile VI increases. The changes in expenditure shares under scenario FTL do not have a clear trend. A remarkable characteristic of this scenario is the drastic increase in expenditure share by decile X under scenario FTL (21.19 percent). A reason for this high increase can be related to a comparatively high decrease in the value of dairy products under this scenario (-4.45 percent). The decile X appears to have an eminent preference for dairy products, recalling the Appendix E the own-price elasticity of decile X for dairy products is -1.99. The explanation for these results is tracked back to the consumption preferences of households in decile X under the particular economic conditions simulated under scenario FTL. In this scenario, other food items have decreasing prices, though not as low as dairy products. In general, dairy products are more expensive than staple foods such as cereals and vegetables. Thus, even with the decreasing prices in scenario FTL, poor households cannot substitute cereals or vegetables to consume more dairy products. However, richer households can afford this substitution and they prefer to consume dairy products over other products with higher relative prices (cereals, vegetables, meat, processed food and tobacco and beverages).

Figure 5-11 Change in expenditure share of dairy products across deciles under three scenarios



Source: Author's calculations

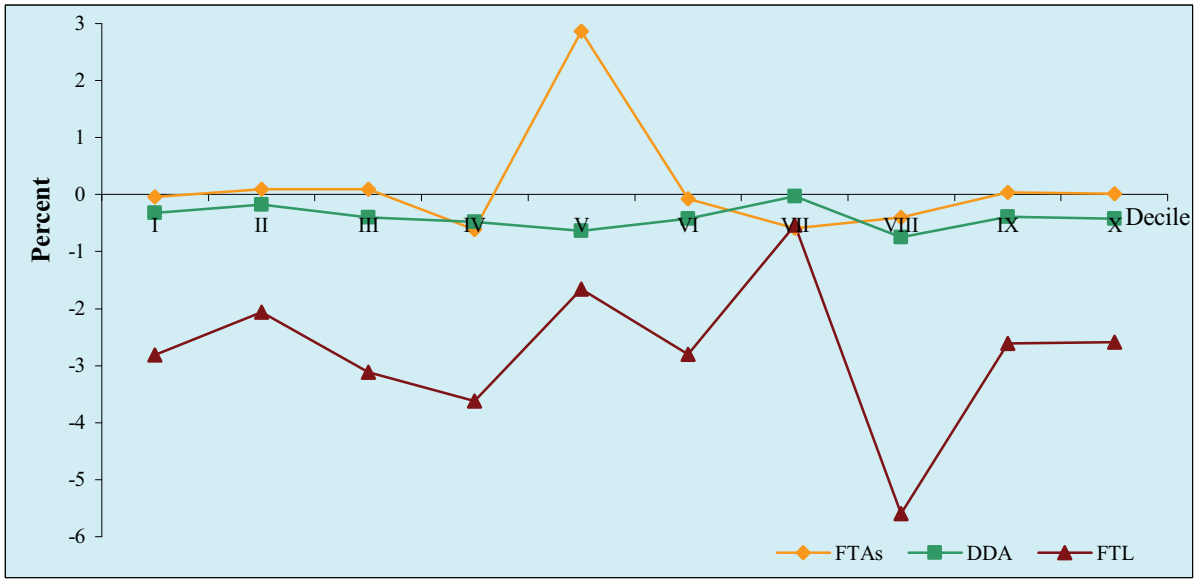
Meat

The changes in expenditure shares of meat are presented in Figure 5-12. Meat is one of the most important products of the food basket for poor households since 9.3 percent of total expenditures are allocated to the purchase of meat (Table 4-2). Additionally, poor households have higher own-price elasticities than richer households. Richer households however, allocate only 3.1 percent of total expenditure to the consumption of meats and their meat consumption is less responsive to changes in total expenditure (Appendix D).

With a slight increase in prices (scenario FTAs: 0.16 percent), the expenditure share for meat is positive for deciles I, II, III and V, whereas for decile VI to VIII it turns negative. These differences are due to the particular household preferences mentioned previously. Poor households react more inelastically and exhibit low cross-price elasticities. Non-poor households do not reveal any significant substitution or complementary relationship of meat with other items; rather changes are based more on own-price elasticities (Appendix F).

By the declining meat prices obtained under scenario DDA and FTL (-0.35 and -2.65, respectively), poor households proportionally decrease meat expenditure shares. Meat is one of the most expensive food items. It is therefore possible that households either prefer to substitute meat by other lower priced food commodities or that they keep the same level of consumption but at a lower price. Sharp responses to prices changes observed by decile V are closely related to the expenditure elasticity exhibit in Appendix D as well as to the substitution effects that prices of other commodities might have on meat consumption (Appendix F).

Figure 5-12 Change in expenditure share of meat across deciles under three scenarios



Source: Author's calculations

Across commodities, it is observed that under scenario FTAs households tend to have a differentiated trend between households from deciles II and V. Households from deciles VI to IX have another trend. The changes under scenario DDA across households shows similar trends for several commodities. In contrast, under scenario FTAs expenditure share changes have different trends across deciles. The most variable changes are obtained under scenario FTL. The presentation of different trends under different trade liberalisation conditions also gives evidence about the complexity of the process under which expenditure shares are allocated, i.e., according to preferences and substitution possibilities.

Another important remark from this analysis is the importance of cereals and meat for poor household deciles. Poor deciles allocate nearly 20 percent of total expenditures in these items, whereas wealthier deciles allocate only 5 percent of total income for the same items (Table 4-2). Accordingly, in these simulations poor households have stronger responses to own-price changes than richer households. Therefore, food policies with high effects on prices of meat and cereals will affect more poor households than wealthier households. Additionally, changes in household expenditure shares are either driven mostly by substitution effects, by own-price effects or by total expenditure effects. These household preferences have been estimated and described in Chapter 4.

5.6.4 Welfare

Trade reforms are not only accompanied by changes in exports, imports, outputs produced and levels consumed, but the dismantling of market distortions will also change welfare in the countries and regions involved. The changes in welfare in the GTAP are

measured by the equivalent variation (EV). The EV is an indicator that compares the level of the total income in the baseline taking the pre-existing taxes and export subsidies into consideration with the new levels of taxes and export subsidies after the simulation in one region or country. It represents the money required to reach the total utility in the baseline after the simulation. The EV is the sum of allocative effects (AE), the terms of trade (TOT) and the investment saving (I-S) effects (HUFF and HERTEL, 2000). The I-S effects originate from the changes in the relative prices of savings and investments, which in the standard version is nearly zero. The AE come from changes in one region or country between imports and domestic production. Finally, the TOT represents the money value of the changes in relative prices of imports and exports in one region or country. In Table 5-15, changes in welfare from the three different simulations are presented for Mexico and other trading partners. The changes in welfare presented are EV, AE and TOT. The following results describe each scenario simulated.

Table 5-15 Changes in welfare under different liberalisation conditions (USD Mio)

	FTAs					
	Mex	*USA*	*Can*	*EU-15*	*CEEC*	*Japan*
Allocative efficiency	222.01	-95.13	1.86	8.18	21.83	68.04
Terms of Trade	117.69	147.88	-50.87	0.66	-5.46	-114.82
Equivalent Variation	313.86	75.31	-47.63	0.20	15.16	-37.33
	DDA					
	Mex	*USA*	*Can*	*EU-15*	*CEEC*	*Japan*
Allocative efficiency	-5.32	-261.69	245.17	6070.97	3655.44	4328.18
Terms of Trade	-515.88	1889.41	-262.25	1553.72	1538.41	-1873.50
Equivalent Variation	-478.70	2314.83	27.27	8097.26	5066.12	2848.26
	FTL					
	Mex	*USA*	*Can*	*EU-15*	*CEEC*	*Japan*
Allocative efficiency	1931.88	-521.88	263.31	7254.93	3295.65	9574.48
Terms of Trade	-3679.78	17.43	-1914.47	1717.37	2408.64	3174.73
Equivalent Variation	-1237.31	-2551.91	-1202.66	10104.23	5640.76	12932.55

Source: Author's calculations

The first scenario simulated is FTAs. In this scenario the major changes are positive gains observed for Mexico (USD 313.86 Mio), the USA (USD 75.31 Mio), and slightly for the EU-27[26] (USD 15.36 Mio); while Canada (USD -47.63 Mio) and Japan (USD -37.33 Mio) experience losses. Gains for Mexico suggest that the FTAs effects on the producers and consumers improve through the access of imports from the USA (mainly) and Canada more than the offset shortage from the import tariffs that have been eliminated. In this scenario, the basic conclusion is that these FTAs will benefit Mexico to a higher extent while other trading partners do not have such noteworthy gains.

[26] EU-27 represents the sum of effects depicted for EU-15 and CEEC.

The changes in welfare observed in scenario DDA have greater changes than those observed in scenario FTAs. Also changes in welfare are distributed more globally and have different trends. The USA (USD 2.31 Bil), the EU-27 (USD 13.16 Bil), Japan (USD 2.8 Bil), and Canada (USD 27.27 Mio) clearly benefit in welfare terms. Incidentally, the EU-27 is the region with the highest benefits and simultaneously the one with the highest export subsidies worldwide. Thus, it is expected that a significant share of the positive gains in the EU-27 come from the effective reallocation of export subsidies. The only country with negative EV is Mexico (USD -478.7 Mio). These losses track to those gains observed in scenario FTAs (USD 313.8 Mio). These corresponding numbers suggest a trade diversion under scenario FTAs favouring the Mexican economy, which is dismantled under scenario DDA.

The FTL scenario also efficiently reallocates resources by abolishing preferences created through scenario FTAs and facilitates trade by the eliminating of all import tariffs and export subsidies. In this scenario, important losses in NAFTA members are observed. With these results, it becomes evident that under full trade liberalisation the preferential agreements will withdraw welfare effects diverted by NAFTA. The main winner is Japan with an increase of USD 12.9 Bil (see Table 5-15).

From a general analysis of Table 5-15, gains in TOT over the three scenarios are observed for the USA (from USD 17.43 to USD 1889.41 Mio) and the EU-15 (from USD 0.66 to USD 1717.37 Mio). The counterfactual results are observed for Canada with losses over the three scenarios (from USD -50 Mio to USD -1914.47 Mio). By a comparison of results obtained for Mexico, it becomes evident that the gain in welfare obtained from the preferential agreements in scenario FTAs will be revoked as further multilateral trade liberalisation takes place. However, these results also sustain the same trends of similar results on multilateral trade liberalisation for low-income countries in which the results of possible outcomes of the Doha Round are rather small (OLARREAGA and HOEKMAN, 2007). In the case of Mexico and NAFTA partners, as well as in the case of the EU-27, the DDA and FTL represent an abolishment of the trade preferences, and especially in the case of Mexico with slightly negative effects. The opposing situation is experienced by other countries with high potential to expand exports and imply therefore enhancement in welfare for them.

5.7 Sensitivity Analysis

A sensitivity analysis is applied to measure how robustly a model reacts to changes in the value of exogenous variables such as elasticities, policy distortions (shocks), etc. The

purpose of the sensitivity analysis is to identify the dependence of results on a given set of exogenous variables, which often are not calculated in the same study (as for example in the case of elasticities). The different sources of some exogenous variables, such as parameters, create the need for a statistical evaluation to consider the performance of all elements together in the model. The sensitivity of results to exogenous variables is performed by setting different exogenous variable values to see how a change in exogenous variables influences the values of interest in the research.

Most methods applied to implement a sensitivity analysis are based on a Monte Carlo Analysis and a Systematic Sensitivity Analysis (SSA) (ARNDT, 1996; BROCKMEIER, 2003). Both methods are based on the probability that results are correct at a given variation interval of exogenous variables. The Monte Carlo Analysis (MCA) is a sampling method, which does not require analysing the equation set of the model. This method involves the running of specific components of the model at a given set of sample points, and establishing a relationship between parameters tested and results obtained using the model results at the sample points.

Since the MCA requires a large number of model runs, its applicability is often limited to models smaller than the GTAP model. In contrast to computational models which normally take five minutes to solve, 1000 Monte Carlo repetitions would take nearly 3.5 days (ARNDT, 1996). Thus, this study follows the approach presented by ARNDT (1996) for conducting SSA in global models, the Gaussian Quadrature (GQ). The GQ, as in the case of the MCA, views exogenous variables as random variables with associated distributions. However, in this case, results of means and standard deviations are obtained through the construction of a distribution based on the variation in exogenous variables. This procedure requires a lower number of model runs suitable to be used in global models.

The selection of exogenous variables for the SSA is based on the focus pursued in each particular study. In this study the two sets of GTAP parameters that govern household consumption are: the Armington elasticities (responsible for substitution between domestic and imported commodities) and the LA/AIDS elasticities (responsible for substitution at the household level between commodities). Elasticities within each set have been set to vary uniformly (all increased or decreased by the same factor), but the two sets of parameters are varied independently. The variations have triangular probability distributions. The mean and standard deviation of the change in household consumption are calculated from the set of simulations generated by varying the elasticities by 50 percent. The triangular probability

performed is based on the method suggested by LIU and PRECKEL (1995)[27] and described by ARNDT (1996). A confidence interval using the mean and standard deviation is calculated.

The triangular probability distributions range between:

Armington elasticities — centred on value used as the standard in the GTAP model: lower bound is halving of the standard value, upper bound is doubling of the standard value; and

Expenditure elasticities — obtained from the LA/AIDS model described in Chapter 4. Both types of elasticities varied symmetrically around value by 50 percent. The macroeconomic results present changes in the Armington elasticities, while the changes in households' expenditures were obtained from the changes in the expenditure elasticities.

Table 5-16 contains the results of the sensitivity analysis for welfare changes for Mexico. The results include the values obtained in the corresponding scenario simulated, the mean value and the confidence interval. The confidence interval has been calculated from the mean and the standard deviation. From these results, the importance of the Armington elasticity in determining the size of the allocative efficiency gains can be seen. The size of the allocative efficiency gains are variable depending on the Armington elasticity used. A high Armington elasticity implies that imports are highly substitutable for local production, which depending on the domestic and international conditions might increase, create or divert trade. A higher Armington elasticity than the one used in the GTAP data base will intensify trade creation, resulting in higher allocative efficiency for Mexico. Under scenario FTAs, for example, gains will range between 482.29 USD Mio and 144.07 USD Mio per year, given the probability distributions obtained from the sensitivity analysis. Hence, varying Armington elasticities by ±50 percent still sees the three scenarios delivering results with a 95 percent of confidence.

The sensitivity analysis has provided further valuable insights into the relationships between the modelling parameters and the observed results. For example, the gains in TOT under scenario FTAs appear to be relatively invariant to scaling of the Armington elasticities (indicated by the narrow confidence interval). At a 95 percent confidence, changes in TOT for Mexico obtained in the simulations will be between the intervals of confidence for the three scenarios. The EV would be the welfare value with the highest changes at a 95 percent of

[27] This document was not officially published.

confidence. Scenario DDA is the one with the highest fluctuation from USD -363.3 to USD -600.37 Mio.

Table 5-16 Sensitivity analysis of welfare changes in Mexico for three simulations (USD Mio)

Scenario	Allocative Efficiency	Terms of Trade	Equivalent Variation
FTAs	222.01	117.69	313.86
Mean	215.12	117.51	313.18
upper limit	246.85	131.87	482.29
lower limit	183.65	124.25	144.07
DDA	-5.32	-515.88	-478.70
Mean	-5.31	-523.16	-481.85
upper limit	-4.41	-462.67	-363.33
lower limit	-6.21	-583.65	-600.37
FTL	1931.88	-3679.78	-1237.31
Mean	1946.06	-3697.64	-1242.81
upper limit	2752.48	-3500.42	-443.66
lower limit	1139.64	-3894.86	-2041.96

Source: Author's own calculations

For the calculation of changes at the household level, key parameters are the price and expenditure elasticities that govern the willingness of the consumer in each decile to purchase a commodity when total expenditure change. Due to the lack of information regarding income structures, changes in income and therefore in total expenditures are not modelled in this study. Hence, the sensitivity analysis considering the household expenditure elasticities confers information about the influence of total expenditure levels on the results. At the household level, results of the sensitivity analysis by variation of ±50 percent in expenditure elasticities from the LA/AIDS are presented in Tables 5-17, 5-18 and 5-19 for scenarios FTAs, DDA and FTL, respectively. In these tables, values obtained from the simulations are compared with means and confidence intervals from the SSA.

FTAs

In Table 5-17, the sensitivity analysis conducted shows that the simulated effects of scenario FTAs on household expenditures range in all cases within the 95 percent confidence interval. As in the case above, lower and upper bounds have been specified and (triangular) probability distributions are assigned to the simulated effects of household expenditures.

As observed in Table 5-17, with 95 percent certainty it can be said that, under the conditions simulated in scenario FTAs and supposing normal distribution, consumption of all commodities across deciles will be within the confidence interval. All values obtained

from the simulation lie within the interval of confidence. In some cases, the confidence interval is very narrow, but still values are in line with the statistics.

Table 5-17 Sensitivity analysis of changes in household expenditures in Mexico (FTAs) (%)

		I	II	III	IV	V	VI	VII	VIII	IX	X
Cereals	FTA	6.06	-0.21	-0.07	-0.10	-3.36	0.21	0.37	-0.04	0.03	0.08
	Mean	6.06	-0.21	-0.07	-0.10	-3.36	0.21	0.37	-0.04	0.03	0.08
	upper limit	6.06	-0.19	-0.07	-0.08	-3.36	0.22	0.37	-0.03	0.05	0.11
	lower limit	6.05	-0.23	-0.08	-0.11	-3.36	0.20	0.37	-0.05	0.02	0.05
Vegetables	FTA	1.90	0.02	-0.62	-0.53	0.77	0.21	-0.48	-0.19	-0.46	0.34
	Mean	1.90	0.02	-0.62	-0.53	0.77	0.21	-0.48	-0.19	-0.46	0.34
	upper limit	1.90	0.06	-0.61	-0.52	0.77	0.22	-0.48	-0.19	-0.44	0.34
	lower limit	1.89	-0.01	-0.63	-0.55	0.77	0.20	-0.48	-0.20	-0.48	0.33
Dairy prod.	FTA	0.87	-0.41	-0.30	-0.52	-0.87	0.16	0.14	-1.14	-1.89	-0.25
	Mean	0.87	-0.41	-0.30	-0.52	-0.87	0.16	0.14	-1.14	-1.89	-0.25
	upper limit	0.88	-0.40	-0.30	-0.50	-0.86	0.16	0.14	-1.14	-1.87	-0.22
	lower limit	0.87	-0.41	-0.31	-0.53	-0.87	0.15	0.14	-1.15	-1.90	-0.28
Meat	FTA	-0.04	0.09	-0.38	-0.62	2.87	-0.08	-0.60	-0.40	0.04	0.01
	Mean	-0.04	0.09	-0.38	-0.62	2.87	-0.08	-0.60	-0.40	0.04	0.01
	upper limit	-0.03	0.14	-0.37	-0.60	2.87	-0.07	-0.60	-0.39	0.04	0.03
	lower limit	-0.04	0.04	-0.39	-0.63	2.87	-0.08	-0.60	-0.41	0.03	0.00
Proc Food	FTA	0.51	-0.10	0.42	1.93	-12.49	0.12	1.01	-0.20	-0.96	0.18
	Mean	0.51	-0.10	0.42	1.93	-12.49	0.12	1.01	-0.20	-0.96	0.18
	upper limit	0.53	-0.09	0.45	1.95	-12.49	0.12	1.01	-0.19	-0.94	0.23
	lower limit	0.49	-0.12	0.39	1.91	-12.49	0.12	1.01	-0.22	-0.98	0.12
Tob and Bev	FTA	0.65	-0.51	2.54	-0.19	0.21	1.69	1.42	1.39	1.64	0.15
	Mean	0.65	-0.51	2.54	-0.19	0.21	1.69	1.42	1.39	1.64	0.15
	upper limit	0.66	-0.49	2.55	-0.18	0.22	1.69	1.42	1.40	1.65	0.18
	lower limit	0.64	-0.53	2.53	-0.20	0.21	1.69	1.42	1.39	1.62	0.12
Energy	FTA	0.13	-0.75	-0.48	0.40	0.85	-1.32	0.38	0.09	0.44	0.02
	Mean	0.13	-0.75	-0.48	0.40	0.85	-1.32	0.38	0.09	0.44	0.02
	upper limit	0.13	-0.75	-0.46	0.42	0.85	-1.31	0.38	0.09	0.47	0.05
	lower limit	0.12	-0.75	-0.49	0.38	0.84	-1.33	0.38	0.08	0.41	-0.01
Manufactures	FTA	-2.51	1.56	-0.48	-0.13	1.10	-0.33	0.43	-0.27	-0.49	0.08
	Mean	-2.51	1.56	-0.48	-0.13	1.10	-0.33	0.43	-0.27	-0.49	0.08
	upper limit	-2.50	1.56	-0.47	-0.06	1.10	-0.33	0.43	-0.26	-0.48	0.13
	lower limit	-2.52	1.56	-0.49	-0.21	1.09	-0.34	0.43	-0.29	-0.51	0.04
Services	FTA	-0.66	-4.87	-0.08	3.84	0.11	-0.13	-0.55	-0.41	0.30	-1.05
	Mean	-0.66	-4.87	-0.08	3.84	0.11	-0.13	-0.55	-0.41	0.30	-1.05
	upper limit	-0.64	-4.84	-0.07	3.86	0.11	-0.12	-0.55	-0.41	0.32	-0.99
	lower limit	-0.67	-4.89	-0.10	3.82	0.10	-0.15	-0.55	-0.42	0.28	-1.10
Housing serv	FTA	0.63	-0.16	-2.16	-0.71	2.28	-1.58	2.86	-0.72	0.45	-0.17
	Mean	0.63	-0.16	-2.16	-0.71	2.28	-1.58	2.86	-0.72	0.45	-0.17
	upper limit	0.64	-0.15	-2.16	-0.68	2.29	-1.57	2.87	-0.70	0.47	-0.10
	lower limit	0.61	-0.17	-2.17	-0.75	2.27	-1.60	2.86	-0.73	0.44	-0.25

Source: Author's own calculations

DDA

Results of the SSA for scenario DDA depicted in Table 5-18 present a broader confidence interval than the SSA of scenario FTAs. With few exceptions, all upper and lower limits have the same algebraic sign. A noteworthy case is decile II in which three commodities have a change of algebraic sign: processed food, manufactures and housing

services, but even these values range within the confidence interval. With all the calculations ranging within the confidence interval at 95 percent probability, the robustness of the calculations is proven. In all cases percent changes from the simulation of scenario DDA are valid with a 95 percent confidence.

Table 5-18 Sensitivity analysis of changes in household expenditures in Mexico (DDA) (%)

		I	II	III	IV	V	VI	VII	VIII	IX	X
Cereals	DDA	-0.86	-0.89	-0.41	-0.44	-0.72	-0.46	-0.66	-0.81	-0.40	-0.72
	Mean	-0.86	-0.89	-0.41	-0.44	-0.72	-0.46	-0.66	-0.81	-0.40	-0.72
	upper limit	-0.78	-0.73	-0.37	-0.28	-0.62	-0.27	-0.49	-0.65	-0.25	-0.55
	lower limit	-0.93	-1.06	-0.46	-0.61	-0.81	-0.64	-0.82	-0.98	-0.54	-0.89
Vegetables	DDA	-0.38	-0.27	-0.71	-0.46	-0.79	-0.50	-0.52	-0.52	-0.85	-0.47
	Mean	-0.38	-0.27	-0.71	-0.46	-0.79	-0.50	-0.52	-0.52	-0.85	-0.47
	upper limit	-0.30	0.01	-0.55	-0.29	-0.72	-0.31	-0.35	-0.49	-0.68	-0.43
	lower limit	-0.46	-0.56	-0.87	-0.62	-0.86	-0.70	-0.68	-0.54	-1.02	-0.51
Dairy prod	DDA	0.15	-0.43	-0.42	-0.58	-0.38	-0.84	0.00	0.61	0.47	1.25
	Mean	0.15	-0.43	-0.42	-0.58	-0.38	-0.84	0.00	0.61	0.47	1.25
	upper limit	0.21	-0.38	-0.34	-0.42	-0.21	-0.67	0.21	0.82	0.64	1.42
	lower limit	0.09	-0.49	-0.50	-0.74	-0.55	-1.00	-0.21	0.39	0.30	1.07
Meat	DDA	-0.32	-0.17	-0.39	-0.48	-0.63	-0.42	-0.02	-0.75	-0.39	-0.44
	Mean	-0.32	-0.17	-0.39	-0.48	-0.63	-0.43	-0.02	-0.75	-0.39	-0.44
	upper limit	-0.26	0.23	-0.31	-0.31	-0.52	-0.29	-0.01	-0.59	-0.36	-0.37
	lower limit	-0.39	-0.57	-0.48	-0.64	-0.74	-0.56	-0.04	-0.92	-0.42	-0.51
Proc Food	DDA	-0.34	-0.80	-0.38	0.61	-0.41	-0.69	-0.10	-0.03	-0.37	-1.58
	Mean	-0.34	-0.80	-0.38	0.61	-0.41	-0.69	-0.11	-0.03	-0.37	-1.58
	upper limit	-0.01	-0.66	0.01	0.77	-0.37	-0.69	0.13	0.34	-0.20	-1.26
	lower limit	-0.67	-0.93	-0.77	0.44	-0.46	-0.69	-0.34	-0.40	-0.54	-1.90
Tob and Bev	DDA	-0.44	-0.82	0.52	0.05	-0.07	0.46	-0.09	-0.23	0.23	-1.01
	Mean	-0.44	-0.82	0.52	0.05	-0.07	0.46	-0.09	-0.23	0.24	-1.01
	upper limit	-0.24	-0.66	0.65	0.15	0.10	0.54	0.12	-0.06	0.36	-0.82
	lower limit	-0.64	-0.98	0.38	-0.05	-0.25	0.37	-0.29	-0.40	0.10	-1.20
Energy	DDA	0.70	-0.18	-0.66	-1.37	-0.16	-0.92	-0.69	-0.48	-0.80	-0.34
	Mean	0.70	-0.18	-0.66	-1.37	-0.16	-0.92	-0.69	-0.48	-0.80	-0.34
	upper limit	0.79	-0.16	-0.50	-1.20	0.03	-0.75	-0.37	-0.31	-0.52	-0.17
	lower limit	0.61	-0.20	-0.82	-1.53	-0.36	-1.08	-1.01	-0.66	-1.07	-0.51
Manufactures	DDA	-0.23	0.32	-0.02	-1.91	-0.45	-0.20	-0.93	-0.79	-0.33	0.70
	Mean	-0.23	0.32	-0.02	-1.91	-0.45	-0.20	-0.93	-0.79	-0.33	0.70
	upper limit	-0.02	0.32	0.12	-1.15	-0.28	-0.11	-0.73	-0.40	-0.18	0.95
	lower limit	-0.44	0.32	-0.16	-2.67	-0.63	-0.29	-1.13	-1.19	-0.48	0.45
Services	DDA	-0.39	-0.60	-0.50	-1.63	-0.34	-0.73	-0.36	-0.45	-0.32	-1.18
	Mean	-0.39	-0.60	-0.50	-1.63	-0.34	-0.73	-0.36	-0.45	-0.32	-1.18
	upper limit	-0.13	-0.39	-0.33	-1.45	-0.12	-0.40	-0.19	-0.28	-0.16	-0.85
	lower limit	-0.65	-0.82	-0.66	-1.81	-0.57	-1.07	-0.53	-0.62	-0.48	-1.50
Housing serv	DDA	-0.48	0.04	0.00	-1.20	-1.06	-1.13	-1.86	-1.57	0.08	1.41
	Mean	-0.48	0.04	0.00	-1.20	-1.06	-1.13	-1.86	-1.57	0.08	1.41
	upper limit	-0.20	0.12	0.04	-0.87	-0.73	-0.84	-1.40	-1.10	0.18	1.85
	lower limit	-0.76	-0.04	-0.04	-1.54	-1.39	-1.42	-2.32	-2.03	-0.02	0.96

Source: Author's own calculations

FTL

The results of the sensitivity analysis of changes in expenditure shares under scenario FTL is presented in Table 5-19. The SSA of results obtained for scenario FTL presents the broadest confidence interval. Even though the variations are higher than in the two previous simulations, all the results still range within the confidence interval built at a 95 probability, when varying household expenditure elasticities are ±50 percent.

Table 5-19 Sensitivity analysis of changes in household expenditures in Mexico (FTL) (%)

		I	II	III	IV	V	VI	VII	VIII	IX	X
Cereals	FTL	-3.00	-6.82	-3.16	-2.82	-5.36	-2.56	-4.00	-6.04	-2.89	-3.16
	Mean	-2.99	-6.82	-3.16	-2.82	-5.36	-2.56	-4.00	-6.04	-2.89	-3.16
	upper limit	-2.49	-5.78	-2.84	-1.75	-4.77	-1.39	-2.95	-5.01	-1.99	-2.11
	lower limit	-3.50	-7.86	-3.49	-3.88	-5.95	-3.73	-5.04	-7.07	-3.78	-4.21
Vegetables	FTL	-1.34	-1.44	-5.37	-3.02	-4.76	-3.45	-4.16	-3.89	-6.95	-0.71
	Mean	-1.34	-1.43	-5.37	-3.01	-4.76	-3.45	-4.16	-3.89	-6.95	-0.71
	upper limit	-0.77	0.48	-4.32	-1.96	-4.33	-2.22	-3.11	-3.72	-5.93	-0.46
	lower limit	-1.91	-3.35	-6.42	-4.07	-5.20	-4.68	-5.20	-4.05	-7.97	-0.96
Dairy products Prod.	FTL	3.84	-3.96	-2.97	-3.22	-2.02	-4.16	-2.60	0.66	-2.94	21.19
	Mean	3.84	-3.96	-2.97	-3.22	-2.01	-4.16	-2.59	0.66	-2.94	21.19
	upper limit	4.30	-3.62	-2.44	-2.16	-0.93	-3.12	-1.28	2.04	-1.89	22.48
	lower limit	3.38	-4.30	-3.50	-4.28	-3.10	-5.21	-3.91	-0.71	-3.99	19.90
Meat	FTL	-2.81	-2.06	-3.12	-3.62	-1.66	-2.80	-0.53	-5.60	-2.61	-2.60
	Mean	-2.81	-2.05	-3.12	-3.62	-1.66	-2.79	-0.53	-5.60	-2.61	-2.59
	upper limit	-2.35	0.60	-2.58	-2.57	-0.93	-1.92	-0.42	-4.57	-2.42	-2.16
	lower limit	-3.26	-4.70	-3.66	-4.67	-2.38	-3.66	-0.65	-6.63	-2.79	-3.03
Proc Food	FTL	-9.29	-2.96	-1.46	5.71	-10.47	-3.09	-3.80	-3.26	-6.95	-14.57
	Mean	-9.28	-2.96	-1.45	5.71	-10.47	-3.09	-3.79	-3.25	-6.95	-14.56
	upper limit	-7.16	-2.08	1.17	6.85	-10.20	-3.09	-2.20	-0.97	-5.94	-12.79
	lower limit	-11.40	-3.83	-4.06	4.57	-10.74	-3.09	-5.38	-5.53	-7.96	-16.33
Tob & Bev	FTL	-3.83	-6.55	4.92	0.17	-1.04	2.43	1.90	0.80	5.04	-9.17
	Mean	-3.83	-6.55	4.93	0.17	-1.04	2.43	1.90	0.80	5.04	-9.17
	upper limit	-2.45	-5.50	5.86	0.83	0.10	2.98	3.25	1.91	6.05	-8.07
	lower limit	-5.20	-7.59	3.99	-0.49	-2.18	1.88	0.55	-0.31	4.03	-10.27
Energy	FTL	-4.60	0.27	-4.81	-9.36	-1.70	-7.17	-4.86	-3.41	-5.46	-2.47
	Mean	-4.60	0.27	-4.81	-9.36	-1.70	-7.17	-4.85	-3.41	-5.45	-2.47
	upper limit	-4.00	0.41	-3.75	-8.36	-0.43	-6.16	-2.84	-2.31	-3.79	-1.42
	lower limit	-5.19	0.14	-5.86	-10.36	-2.96	-8.18	-6.87	-4.51	-7.12	-3.53
Manufactures	FTL	6.38	1.16	-0.58	-14.22	-3.34	-1.64	-6.21	-5.95	-2.82	4.91
	Mean	6.38	1.16	-0.58	-14.18	-3.33	-1.64	-6.21	-5.94	-2.82	4.91
	upper limit	7.97	1.16	0.34	-9.70	-2.21	-1.05	-4.96	-3.52	-1.87	6.54
	lower limit	4.79	1.16	-1.50	-18.67	-4.45	-2.22	-7.45	-8.36	-3.76	3.28
Services	FTL	1.56	-2.65	-3.70	8.93	0.31	-4.89	-2.25	-3.07	-1.09	-11.83
	Mean	1.57	-2.64	-3.70	8.94	0.32	-4.88	-2.25	-3.07	-1.09	-11.82
	upper limit	3.44	-1.22	-2.64	10.25	1.81	-2.79	-1.18	-2.01	-0.05	-9.99
	lower limit	-0.31	-4.06	-4.77	7.62	-1.18	-6.98	-3.31	-4.12	-2.12	-13.65
Housing serv	FTL	-4.43	2.24	2.44	-4.85	-15.05	-6.78	-16.61	-10.69	1.49	13.30
	Mean	-4.42	2.25	2.44	-4.84	-15.05	-6.77	-16.59	-10.68	1.49	13.32
	upper limit	-2.51	2.79	2.70	-2.69	-13.16	-5.00	-14.03	-7.95	2.15	16.39
	lower limit	-6.32	1.70	2.18	-7.00	-16.93	-8.55	-19.15	-13.41	0.83	10.25

Source: Author's own calculations

The overall comparison of the SSA for the three scenarios evaluating percent changes in household expenditures in function of the expenditure elasticities obtained from the LA/AIDS shows quite narrow confidence intervals. Furthermore, with some few exceptions, the algebraic sign of the simulation values correspond to both signs from the bound of the confidence interval. The results obtained for the three simulations fall within the confidence interval constructed, based on means and standard deviations obtained from the SSA.

5.8 Qualifications

This study presents an approach to analyse household expenditures in a CGE framework. However, the wide possibilities to integrate household analysis in a CGE context are not restricted only to the methodology presented here. In this section some of the methodological limitations as well as possible future extensions of this approach are exposed.

The procedure used to measure price and expenditure elasticities did not include some basic information typically considered in the determination of elasticities such as demographic characteristics (DEATON and LAROQUE, 1992). The demographic characteristics of households introduce differences in the composition of households associated with differences in consumption preferences for adults and children. Demographic characteristics have not been included in this study due to a lack of demographic characteristics per decile in the ENIGH. Another useful experiment still to be performed in a future extension of this research will be a test of the sensitivity of the LA/AIDS elasticities to different price indices than those performed by MOSCHINI, (1995) and ASCHE and WESSELLS (1997). This test would shed light on the robustness of the price and expenditure elasticities when the price index varies.

Regarding the market structure in the CGE model, a variety of assumptions has been made in this study. Constant returns to scale and perfect competition are the major assumptions underlying the GTAP model. These assumptions neglect potential important gains from international trade liberalisation. Undoubtedly, the results would improve with an appraisal of imperfect competitions such as monopolistic behaviour, response of output firms to other firms' prices, maximization of profits shifting quantities produced.

Moving to the household module based on the LA/AIDS parameters, important restrictions have been set. As the main objective of this research is to capture changes in households' expenditures, it would be important as well to include the links between households and their respective income sources. The trade reforms alter commodity prices including non-tradable commodities and services, wages and returns to land and capital that

are closely related to households' income sources. In this study, the income sources of households have not been included. The patterns of income sources for households could also permit a more precise empirical framework to evaluate households' welfare according to expenditure and income patterns. The household module presented in this study includes only the structure of tradable commodities, however and especially for households in developing countries, the inclusion of saving mechanisms (positive and negative savings) is important to determine household welfare.

Another likely extension of this methodology would be the modelling of transportation and communications infrastructure affecting price transmission mechanisms. As noted by NICITA (2005), in Mexico, the effect of changes in international prices on domestic prices have geographical differences (e.g., south-north, urban-rural). NICITA's estimates show differences even between price transmission of food commodities and manufactures. Therefore, it is expected that the distributional effects of trade liberalisation will not be uniform across all regions in Mexico, and thus across deciles.

Another possibility to develop a sensitivity analysis would be the inclusion of another set of expenditure and cross-price elasticities into the GTAP model to compare variations caused by elasticities from different sources in the changes of household expenditure shares.

In order to obtain comprehensive information on the welfare changes experienced by each household decile, it is necessary to perform a study on consumption equivalence scales and quality preferences. The assessment of consumption equivalence scales would give insight into the possibilities to compare welfare and utility between different household categories. Meanwhile the study of quality preferences would provide information on the quality improvements when changing prices and income. As observed in Section 5.6.3, changes in expenditure shares of wealthier households might be related to quality improvements rather than quantity changes. Additionally, poorer households can also react to increase of prices reducing quality of items purchased before they reduce quantity consumed.

Finally, regarding the design of scenarios, this study has been limited to a possible agricultural negotiation outcome of the Doha Round according to an adoption of the Falconer proposal in the agricultural sector as of 2008. Nonetheless, the Doha Round will also include cuts in other non-agricultural sectors which will have important repercussions in the results obtained. Further studies should also include tariff cuts in other non-agricultural sectors.

6 Summary and Conclusions

6.1 Summary

Any global reform has important repercussions for households in one country. First, the reforms will change prices of the consumption bundle. Second, trade reforms modify the demand for labour and other household income sources. In Mexico, the possible implications of trade liberalisation for households are of special interest for Latin America due to the high extent of liberalisation measurements implemented, and to the country role model played by Mexico in Central America.

In order to evaluate these repercussions on expenditure patterns, the main objectives of this study are to document the differences in consumption preferences of households in Mexico and to evaluate the effects of agricultural trade liberalisation on households' expenditures in Mexico. As described in Chapter 2, geographical, political and historical differences in Mexico seem to contribute to the need for a disaggregation of households effects into different categories when evaluating trade reforms. Chapter 2 also describes the prevailing income inequality amongst households in Mexico, which opens the question of possible differences in expenditure preferences across household categories. Considering all these factors at the same time is a quite complex task, therefore the application of an instrument involving a global framework is required.

After exploring the economic conditions governing in Mexico, this study chooses the multi regional and multi sectoral CGE model developed by the GTAP as assessment methodology. The GTAP model is chosen amongst other CGE models due to the complete integration of global agricultural structures linked to other national and international economies through trade flows. The complete structure of the GTAP model is therefore reviewed in detail in Chapter 3 to further explain what parameters can be integrated to calculate changes in expenditure patterns for different household categories.

The parameters to be integrated into a household module developed to work with price changes from the GTAP model have been obtained. These parameters come from a complete demand system for each household decile as described in Chapter 4. The demand systems for Mexican households have been developed following the LA/AIDS empirical framework (DEATON and MUELLBAUER, 1980). According to the assessment of the households' demand systems presented in Chapter 4, households with the lowest expenditure level (decile I) react rapidly to increases in income by increasing consumption of non-food commodities. Even though these households do not cover basic food needs; and should logically increase their

food purchases with increases in income, this latter statement only holds true for cereals by a considerably high change in prices. Presumably, and according to income formation in Chapter 4.1.1, poor households depend stronger on non-market channels such as barter, self-consumption, or transfer to acquire food than on local trade. Substitution effects observed for poor households indicate a distinction between food and non-food commodities, because substitution takes place in a food - food or non-food - non-food basis. Households in deciles II to V respond to price changes more rapidly modifying expenditure shares for food commodities than for non-food commodities. Households in deciles I to V are under the assets poverty line and thus considered as poor in Mexico. For food commodities, the most observed effects in poor households are substitution effects. For non-food commodities, the most commonly observed effects are complementary relationships with food commodities and substitution effects with non-food commodities. Substitution between food and non-food commodities is rather seldom. The interpretation of these results then signalises the primary need of households to consume food commodities when relative prices of both food and non-food commodities change. In contrast, wealthier households (from decile VI to X) respond equally to changes in relative prices presenting complementary patterns within food and non-food commodities. Nonetheless, richer households are more responsive to price changes of non-food than to price changes of food commodities.

After calculating the expenditure and cross-price elasticities, the assessment of household categories into the GTAP model is achieved through the development of a household module. The household module is based on expenditure and cross-price elasticities obtained in Section 4.3, which are specific for each household decile in Mexico. The household module is described in Section 4.4, as this module gives straightforward updated values of expenses per commodity per household in a region, the variety of applications in poverty measurement and income distribution in an international framework is large. Although in this study only households' expenditures in Mexico are analysed, the approach supports the simultaneous household analyses for cross-country studies.

Furthermore, the household module is used to evaluate the differentiated effects of international agricultural trade reforms on Mexican households by simulating three different scenarios. For the simulation of these scenarios, the GTAP data base is aggregated into 14 regions (Mexico, USA, Canada, EU-15, CEEC, Japan, Chile, Venezuela, Central America, Switzerland, Argentina, Brazil, Rest of Europe, Rest of Asia, and the ROW). The sectoral aggregation contains 10 commodities (cereals, vegetables and fruits, dairy and animal products, meat, processed food, tobacco and beverages, energy, manufactures, housing services and other

services). The scenarios are designed accordingly to analyse the impacts of bilateral agreements (scenario FTAs) and different stages of multilateral trade liberalisation (scenarios DDA and FTL) on household expenditures in Mexico. The first scenario, labelled as Free Trade Agreements (FTAs), addresses the staged tariff elimination levied on agricultural products according to the full implementation of three FTAs. These FTAs represent bilateral agreements that Mexico has undersigned with its most important trading partners (the USA, Canada, Japan and the EU-27). The second scenario simulates a possible outcome of the Doha Development Agreement named DDA. This scenario contemplates the elimination of all export subsidies for all countries. Tariffs are reduced by 60 percent in food commodities entering in the USA, Canada, Japan, the EU-27, Switzerland, and Rest of Europe. Tariffs in food commodities entering into Mexico, Chile, Venezuela, Central America, Argentina, Brazil, Rest of Asia, and the ROW are cut by 40 percent. The third scenario called FTL simulates the case of a complete abolition of all import tariffs and export subsidies in all countries and regions in the world. Scenarios DDA and FTL are implemented taking as a baseline the updated values of scenario FTAs as these tariff cuts will actually take place.

Most of the changes for the Mexican economy are observed in the results of the simulation of scenario FTAs. In the first simulation is observed that total Mexican exports increase to a noteworthy extent. These exports increase relative to imports to destinations such as Japan, the EU-15 and Switzerland. Main products exported by Mexico under scenario FTAs are vegetables and meat, while imports of cereals and dairy products increase. In the overall results of scenario FTAs Mexico is a net importer. The single simulation of FTAs shows that even with the implementation of the NAFTA, Mexico is a net importer under this FTA. However, the sole implementation of the FTA Mexico-EU-27 or the EPA Mexico-Japan would convert Mexico in a net exporter. Because of these modifications in the trade flows, prices of all food products fall. The lowest change in prices is observed for cereal (-5.73). At the household level, the results show decreasing trends of household expenditures for cereals (decile II to V), vegetables (decile III, IV, VII, VIII and IX), dairy products (decile II to V and VIII and IX), meat (decile I, III to VIII and X) and processed food (decile II, V, VIII).

In scenario DDA, an increase is anticipated in the prices of cereals and vegetables. Other food and non-food commodities show downward trends. After the implementation of the DDA, exports from regions like Japan, Venezuela, the USA, Argentina, Brazil and Chile increase. On the other hand, exports from Mexico, Canada and CEEC decrease. After the implementation of the FTAs and with the erosion of trade preferences assumed by the DDA simulation, Mexican exports will compete with other products. As a result, exports to main trading partners decrease,

while increases in Mexican exports to Latin America and Switzerland are observed. In scenario DDA, the most exported Mexican products will be cereals and meat, but also vegetables, processed food and tobacco and beverages. The results suggest that in the process of WTO negotiations, and before a multilateral agreement towards liberalisation, Mexico should take advantage of the special entrance of Mexican products in markets of trading partners. At the household level, negative changes in expenditure shares of Mexican households are expected for all food commodities except for dairy products in wealthier households. In addition, expenditure shares for tobacco and beverage increase for deciles III, VI and IX.

The results obtained for the simulation of scenario FTL augment the trends observed in scenario DDA. Under a fully liberalised environment, the FTAs considered in the baseline are dissolved through the equal competition of imports in the global markets. As a result of this equal competition, most of the regions increase exports. The highest increases in exports expected are for Brazil, Argentina and Japan, as single regions. As a result of the erosion of preferences for Mexican exports by trading partners supposed in the baseline, decreasing Mexican exports to most trading partners and increasing exports to Latin America are feasible. Also Mexican imports increase considerably in this scenario. At the household level, declining prices for all products in Mexico are likely. Cereals as single sector have rising trends. In response to these price changes, most of the deciles shrink expenditure shares devoted to all commodities, especially in the case of cereals with increasing prices.

The results for welfare of the three scenarios across regions illustrate improvements in the terms of trade and the equivalent variation for Mexico under scenario FTAs, while these improvements obtained from the preferential agreements will be revoked in scenario DDA. The simulation of scenario DDA encloses partial global cuts in tariffs, and total elimination of export subsidies. For the USA, benefits are observed for scenarios FTAs and DDA, where only cuts in agricultural commodities are contemplated. In scenario FTL, with full elimination of tariff imports, the results have adverse impacts on the USA welfare. The EU-27 improves welfare under the three scenarios, while Japan would slightly have negative development under scenario FTAs and improved welfare under scenarios DDA and FTL.

Additionally, a sensitivity analysis of the results has been performed. The sensitivity analysis provides further valuable insights into the relationships between the modelling parameters and the observed results. The sensitivity analysis regards a 50-percent-variation of Armington elasticities. Household expenditure elasticities also have been included in the sensitivity analysis. The terms of trade effect on Mexico appears to be relatively invariant to

scaling of the Armington elasticities (indicated a small standard deviation) at a 95 percent confidence. These sensitivity analyses validate the results obtained in this study for Mexico and Mexican households under the three scenarios simulated. The total equivalent variation in Mexico is expected to vary between USD 144.1 and 482.3 Mio under scenario FTAs, with the highest losses under scenario FTL ranging between USD -443.6 and -2041 Mio under scenario FTL.

At the household level, results of the sensitivity analysis are obtained by variation of ±50 percent in expenditure elasticities from the LA/AIDS for scenarios FTAs, DDA and FTL. The sensitivity analysis conducted shows that the simulated effects of the three scenarios on household expenditures range in all cases within the 95 percent confidence interval. As in the case above, lower and upper bounds have been specified and (triangular) probability distributions are assigned to the simulated effects of household expenditures. The overall comparison of SSA shows that with some few exceptions, the algebraic sign of the simulation values correspond to both signs from the bound of the confidence interval. All results for the three scenarios fall within the confidence interval constructed, based on means and standard deviations obtained from the SSA.

The comparison of results obtained from the three simulations for the changes in household expenditure share shows that households react either positively or negatively according to the magnitude of changes in own-price of commodities. This effect is even more notorious for food commodities consumed by poor households. In the second place, households are more responsive to changes in relative prices; this is observed particularly for preferences of non-food commodities by wealthier households.

Overall, deciles in Mexico present different patterns of expenditure shares, most of them related to their condition in the initial period. As result of different schemes of global liberalisation, commodity prices, and thus household expenditure allocations, change. Primarily, poor households tend to cover their needs on food items. Households might achieve the coverage of basic food needs by the reduction of expenditure shares devoted to non-food commodities. Non-poor households might present a decrease in expenditure shares for all commodities, which does not necessarily mean that these households consume less, but it might mean that the purchasing power gained benefits from the drop in prices.

6.2 Conclusions

The household demand systems

Demand systems are well-suited instruments to measure consumer's responses to changes in relative prices and income level. A demand system describes how households given an expenditure level allocate total expenditures in dependence on a range of commodity prices. In the particular case of this study, demand systems for household deciles in Mexico have been estimated. The household preferences are represented by the income and price elasticities estimated from the demand system. Thereby, these elasticities might be further used as parameters in partial and general equilibrium models.

The price elasticities estimated show that poor household deciles behave less elastically to changes in food prices than non-poor households. Regarding only food commodities, poor households are more responsive to change prices of staple foods than to other food items. Non-poor households react more to price changes of non-food commodities than to price changes of food commodities.

The income elasticities show a first trend of poor households to cover food needs when increasing income and in second term an increase in the consumption of non-food commodities. Non-poor households increase consumption of non-food commodities faster than consumption of food commodities. Thereby, the responses of poor households are higher for food items, while response of non-poor households is higher for non-food items.

These assessments give empirical evidence of household preferences that might serve as guidelines to design target specific policies. The estimation of income and price elasticities performed as part of this study permits policy modellers to identify household consumption preferences and reactions to changes in prices and real income.

The household module

Based on the estimated elasticities from the demand system, the integration of household preferences into a household module has been achieved. The household module has additionally been connected to a CGE model, the GTAP model. The designed household module is characterised by the linkage of changes in macro economic factors with their respective impacts on household expenditures. This household module can be applied for the study of one country or on a cross – country basis when income and price elasticities for each country are available and the countries are regarded as single regions in the GTAP model. The results obtained with the household module deliver information on changes of household preferences as result of

modifications in international and national trade policies. In this particular case, the elasticities for ten household categories in Mexico are adopted. The sensitivity analysis performed demonstrates the robustness of the changes in expenditure levels to the values of income elasticities included in this study.

Driving forces of expenditure changes

Cereals are considered a basic staple food for all households. Therefore, households cover basic cereal needs regardless of price. These preferences are especially emphasized in poor households, because they have a narrower expenditure bundle. Only in cases where the relative prices place in disadvantage the cereal consumption, then households will substitute cereals and shift consumption to other food products (e.g., rise in price of cereals and decrease in price of vegetables in scenario FTL).

The results from the simulations offer clear differences in reactions regarding the changes in relative prices of food and non-food commodities. In scenario FTAs, the higher responses are observed for poor households. In this scenario relative prices of commodities favoured food commodities, thus poor households tend to cover food needs promoted by the lower prices. Richer households however reduce expenditure shares of food commodities and reallocate expenditures to non-food commodities.

In scenario DDA, responses across deciles have a similar magnitude across deciles, and with similar decreasing trends for all food commodities. Under scenario DDA, the prices of cereals and vegetables increase, while prices of remaining commodities decrease. Poor households decrease expenditure shares of non-food commodities to be able to attain food needs. Richer households show a uniform decrease in expenditure shares of all commodities, which was driven by the generalised lower prices. Overall, the changes observed in scenario DDA are smaller than those observed for scenario FTAs and scenario FTL.

In scenario FTL, prices of non-food commodities fall more than prices of food commodities. Subsequently, expenditure share changes have different trends than those observed in previous scenarios. In scenario FTL greater changes are observed for non-poor households than for poor households. In this scenario prices of all commodities apart from cereals decrease. Under these conditions, cereal consumption of poor households decreases considerably and is substituted by other food commodities with decreasing prices. Changes in expenditure shares of non-food commodities by poor households are in function of the relative prices of food commodities. Poor households experience a decrease in food expenditure shares mainly driven by the fall in food prices, while increase in non-food

commodities may occur (mainly manufactures and services). Richer households in scenario FTL tend to decrease uniformly expenditure share of all commodities.

The results suggest that food policies also have effects on consumption of non-food items. Thus, it is required to consider household adjustments to policy changes in all sectors rather than sectoral studies. The cross-price elasticity estimates and the reactions highlighted here suggest that policy targeted to food items, such as cereals and meat, will have the highest effects on poor households because these households allocate a major share to these products. Additionally, simultaneous effects on the consumption of other commodities for all household deciles are identified.

Based on the estimated elasticities and the response of households to changes in prices presented in this research, the implementation of the agricultural chapter of FTAs and a possible outcome of the DDA will have little effect on household total expenditures in Mexico. This statement holds also for all household deciles in Mexico. Nonetheless, future research might also include the impacts of trade reforms in non-food sectors over household expenditure level and expenditure shares.

Policy implications for household's expenditure allocation

Mexico has to negotiate trade agreements (bilateral and multilateral) with caution and based on negotiation strategies that provide protection to certain commodities while strengthening competitive export sectors. The main conclusion of this study related to policy recommendations is that Mexico's efforts to reach a bilateral trade agreement with main trading partners pay off as prices of consumed commodities decrease due to lower values of import commodities.

The FTAs scenario was identified as the most profitable trade setting for the poorest Mexican households, as the price of staple foods decreases considerably. A restricted multilateral agreement considering a partial liberalisation (scenario DDA), was found to be the most prudent and advantageous trade setting for the Mexican households as benefits will be distributed equally across more household deciles.

The full trade liberalisation was found to improve the performance of export sectors worldwide. The high prices brought about in Mexico might been compensated with gains for farm households, while urban households might lose. However, the inclusion of the income side is required to make conclusive statements on the real effects of a fully liberalised economy in Mexico.

Outlook

This investigation on the modifications of expenditure patterns of Mexican households certainly does not cover all the aspects that have to be considered to comprehensively analyse the effects of trade liberalisation on Mexican households. However, it provides a guidance on the possible directions that Mexican households might take under the specific conditions and restrictions assumed.

Additional implementations in the household module are required to complete the empirical framework proposed in this study. Particularly, a complete simulation of other bilateral or multilateral trade agreements is seen as a necessary further implementation to be undertaken in future studies on Mexican expenditures, i.e., Mercosur in Latin America. For a better understanding of the behaviour of household deciles, the consideration of income patterns as well as demographic characteristics of households needs to be explicitly considered. Future model applications should reflect the increasing importance of global trade changes on household welfare. Primarily, further modelling of policy impacts on household welfare requires further research on household savings and time preferences due to the acquisition of durable goods and non tradable goods, equivalence scales and assessment of quality preferences.

7 References

ADELMAN I. AND S. ROBINSON (1978): *Income distribution policy in developing countries: A case study of Korea,* Oxford University press.

AGUILAR M. (2001):"La educación en México (1970-2000): De una estrategia Nacional a una estrategia regional" *Revista La Tarea* 16, SNTE Mexico.

ALADI (2005): Evolución del Comercio recíproco entre los países suscriptores del Acuerdo de Complementación Económica No. 33 (Colombia-México-Venezuela).

ALSTON J. M., K. FOSTER and R.D. GREEN (1994): "Estimating Elasticities with the Linear Approximate Almost Ideal Demand System: Some Monte Carlo Results", *The Review of Economics and Statistics.* MIT Press. 76(2):351-56.

ANDERSON K., MARTIN W. and D. VAN DER MENSBRUGGHE (2006): "Market and Welfare Implication of the Doha Reform Scenarios", In Anderson K., and Martin W., eds., *Agricultural Trade Reform and the Doha Development Agenda,* New York: Palgrave Macmillan and the World Bank.

ARMINGTON P. S. (1969): "A Theory of Demand for Products Distinguished by Place of Production", IMF Staff Paper No 16.

ARNDT C. (1996) "An Introduction to Systematic Sensitivity Analysis Via Gaussian Quadrature", GTAP Technical Papers 305, Centre for Global Trade Analysis, Department of Agricultural Economics, Purdue University.

ARROW K. J. and F. H. HAHN (1971): *General Competitive Analysis*, Edinburgh, Oliver and Boyd.

ASCHE F. and C. WESSELLS (1997): "On Price Indices in the Almost Ideal Demand System", *American Journal of Agricultural Economics*, 79 (4):1182-1185.

ASANO S. and E. P. S. FIUZA (2001): "Estimation of the Brazilian Consumer Demand System", Working Paper No. 793, Rio de Janeiro, IPEA.

BALCOMBE K.G. and J. MORRISON (2002): "Commodity Price Transmission: a Critical Review of Techniques and an Application to Selected Export Commodities", *Report to the Food and Agriculture Organization,* United Nations.

BATRES-MARQUEZ S.P., R. CLEMENS and H.H. JENSEN (2006): "The Changing Structure of Pork Trade, Production, and Processing in Mexico", MATRIC Briefing Paper 06-

MBP 10, Midwest Agribusiness Trade Research and Information Centre, Iowa State University, Available online: http://www.card.iastate.edu/publications/DBS/PDFFiles/06mbp10.pdf (Accessed 11/29/2006).

BARRETT C. and J. LI (2003): "Distinguishing between Equilibrium and Integration in Spatial Price Analysis", *American Journal of Agricultural Economic,* 84(2):292-307.

BELLON M. D. P. HODSON, E. MARTÍNEZ-ROMERO, Y. MONTOYA, J. BECERRIL and J. W. WHITE (2004): "Geospatial Dimensions of Poverty and Food Security – A Case Study of Mexico", CIMMYT, http://www.cimmyt.cgiar.org/gis/povertymexico/ (Accessed 05/03/2006).

BENTO DE SOUZA FERREIRA J. and M. HORRIDGE (2005): "The Doha Round, Poverty, and Regional Inequality in Brazil*"*, *World Bank Policy Research Working Paper* 3701.

BIBI S. and R. CHATTI (2006): "Trade Liberalisation and the Dynamics of Poverty in Tunisia: A Layered CGE Micro Simulation Analysis, MPIA Working Paper.

BOCCANFUSO D., CABRAL F., CISSE A. and L. SAVARD (2003): "Pauvreté et Distribution De Revenus Au Sénégal: Une Approche par la Modélisation en Équilibre Général Calculable Micro-Simulé", Cahiers de recherche 0333, CIRPEE University of Laval, Canada.

BOURGUIGNON F., DE MELO J. and A. SUWA (1991): "Distributional Effects of Adjustment Policies: Simulations for Two Archetypes Economies", Policy Research Working Paper Series 674, The World Bank.

BOURGUIGNON F., A.S. ROBILLIARD and S. ROBINSON (2003): "Representative Versus Real Households in the Macro-Economic Modeling of Inequality", DELTA working paper 2003-05.

BROCKMEIER M. (2003): *Ökonomische Auswirkungen der EU-Osterweiterung auf den Agrar- und Ernährungssektor. Simulationen auf der Basis eines Allgemeinen Gleichgewichtsmodells, Habilitationsschrift*, Kiel: Wissenschaftsverlag Vauk, Germany.

BROCKMEIER M., KLEPPER R and J. PELIKAN (2008): "Die WTO Verhandlungen und die CAP", *Agrarwirtschaft,* 57 (Heft 3/4):165-177.

BROCKMEIER M. and J. PELIKAN. (2008);. "WTO Agricultural Market Access: A Moving Target in The WTO-Negotiation?", *Food Policy,* 33(3):250–59.

BRÚ E. and M.H. ROSAL (2001): "Economía Informal y Trabajo Decente en Centroamérica y República Dominicana", San José, Costa Rica, ILO.

BUFFIE E. (2001): *Trade Policy in Developing Countries*, Cambridge University Press, United Kingdom.

BUSE A. (1994): "Evaluating the Linearized Almost Ideal Demand System", *American Journal of Agricultural Economic,* 76(4): 781-793.

CABRERA G. (1990): "Politicas de Población y Cambio Demográfico en el Siglo XX", In: *México en el umbral del milenio,* Centro de Estudios Sociologicos, El Colegio de México. Mexico.

CARPENTIER A. and H. GUYOMARD (2001): "Unconditional Elasticities in Two Stage Demand Systems: an Approximate Solution", *American Journal of Agricultural Economics,* 83(1): 222-229.

CHEMINGNI M. and C. THABET (2005): "Agricultural Trade Liberation and Poverty in Rural Areas in Tunisia: Micro simulations in a General Equilibrium Framework", A Research Paper Presented to the Poverty and Economic Policy (PEP) Research Network, General Meeting June 13-17, 2005, Colombo, Sri Lanka.

CHRISTENSEN L. R., D. W. JORGENSON and L. J. LAU (1975): "Transcendental Logarithmic Utility Functions", *American Economic Review,* 65(3): 367-83.

CLINE W. (2004): *Trade Policy and Global Poverty, Center for Global Development,* Institute for International Relations, Washington DC, USA.

CFFA COALITION FOR FAIR FISHERIES ARRANGEMENTS (2006): "Comparing EU Free Trade Agreements", agritrade.cta.int/en/content/download/4408/110569/file/InBrief+FTA+6J_e_CFFA.pdf (Accessed 12/12/2007).

COCKBURN J. (2001): "Trade Liberalisation and Poverty in Nepal A Computable General Equilibrium Micro simulation Analysis", Working paper 2002-11, Centre for the Study of African Economies, Oxford University.

COCKBURN J. and M.-H. CLOUTIER (2002): "How to Build an Integrated CGE Micro Simulation Model: Step-by Step Instructions with an Illustrative Exercise", PEP

MPIA Documentation, www.pep-net.org/new-pep/Group/MPIA/mpia-train/Microsimulation_fichiers/microsim.pdf (Accessed 11/10/2007).

COCKBURN J. and B. DECALUWÉ (2006): "Replacing Representative with Real Households in Dynamic CGE Analysis of Poverty: Challenges and Opportunities", PEP MPIA Documentation.

COCKBURN J., DECALUWÉ B. and S. ROBICHAUD (2006): "Trade Liberalisation and Poverty: Lessons from Asia and Africa", PEP MPIA Documentation.

COGNEAU D. and S. ROBILLIARD (2000): "Growth, Distribution and Poverty in Madagascar: Learning from a Micro simulation Model in a General Equilibrium Framework", Working Paper International Food Policy Research Institute, Washington DC, USA.

COLL-HURTADO A. and M.L. GODINEZ- CALDERON (2003): "La Agrícultura en Mexico: Un Atlas en Blanco y Negro", *Textos Monográficos: 5. Economia*, Instituto de Geografía, UNAM, Mexico.

COMITE TÉCNICO PARA LA MEDICION DE LA POBREZA (2005): "Medicion de la Pobreza 2002-2004 Mexico", www.sedesol.gob.mx/prensa/comunicados/presentaciones/MediciondelaPobreza2002-2004.ppt, (Accessed 08/02/2006).

CONDON B. J. (2007): "The EU - Mexico FTA" Working Paper, Instituto Tecnológico Autónomo de. México, Department of Business Administration, ITAM, http://ssrn.com/abstract=958715 (Accessed 09/12/2007).

CONFORTI P. (2004): "Price Transmission in Selected Agricultural Markets", Foodstuffs service (ESCB) Commodities and Trade Division, Commodity and Trade research Policy Research, FAO, Working Paper 7, Rom, Italy.

CORBACHO A. AND G. SCHWARTZ (2002): "Income Distribution and Social Expenditure Policies in Mexico: What Can we Learn from the Data?" *Lateinamerika Analysen 1*, University of Hamburg, Germany (1):5-64.

CORTÉS F. (2003): "El Ingreso y la Desigualdad en su Distribucion en México", *Paneles de Población,* Universidad Autónoma de México, Mexico, 5(3):137-153.

CORONG E. (2005): "Growth, Trade Liberalisation and Poverty in the Philippines: An Integrated Sequential Dynamic CGE Micro simulation Analysis," A Research Paper

Presented to the Poverty and Economic Policy (PEP) Research Network, General Meeting June 13-17, 2005, Colombo, Sri Lanka.

CORORATON C. and J. COCKBURN (2007): "Trade reform and poverty—Lessons from the Philippines: A CGE Micro simulation Analysis" *Journal of Policy Modeling*, 29(1): 141-163.

CRANFIELD J., P. PRECKEL, J. EALES and T. HERTEL (2002): "Estimating Consumer Demands across the Development Spectrum: Maximum Likelihood Estimates of an Implicit Direct Additivity Model", *Journal of Development Economics*, 68(2): 289-307.

CROUCH R. (1972): *Macroeconomics*, Harcourt Brace Jovanovitch, New York, USA.

DAVIES J. (2004): "Microsimulation, CGE models and Macro Modeling for transition and Developing Countries", Working Papers WIDER, Helsinki, Finland.

DEATON A. (1997): *The Analysis of Household Surveys. A Microeconometric Approach to Development Polic,.* The World Bank and the Johns Hopkins University Press, USA.

DEATON A. and J. MUELLBAUER (1980): "An Almost Ideal Demand System", *American Economic Review,* 70(3): 312-26.

DEATON A. and G. LAROQUE (1992): "On the Behaviour of Commodity Prices," *Review of Economic Studies*, Blackwell Publishing, 59(1):1-23.

DECALUWÉ B., A. PATRY, L. SAVARD and E. THORBECKE (1999): "Poverty Analysis Within a General Equilibrium Framework", Working Paper 99-09, African Economic Research Consortium, Nairobi, Kenia.

DEJAVARAN S. and S. ROBINSON (2002): "The influence of Computable General Equilibrium Models on Policy", International Food Policy Research Institute, TMD Discussion Paper No 98.

DERVIS K., J. DE MELO and S. ROBINSON (1982): *General Equilibrium Models for Development Policy,* Cambridge University Press, Cambridge, U.K.

DIMARANAN B. (2006): "Construction of the Protection Data base"; Chapter 16A, GTAP 6 Data Base documentation"; Last update: January 18, 2007, GTAP Project.

DIMARANAN B., R., MCDOUGALL and T., HERTEL (2006): "Behavioral Parameters" Chapter 20, GTAP 6 Data Base documentation", GTAP Project.

DIMARANAN B. and R., MCDOUGALL (2005): "GTAP 6 Data Package Documentation" Last update: January 18, 2007, GTAP Project.

EDGERTON D.L. (1997): "Weak separability and estimation of elasticities in multistage demand systems", *American Journal of Agricultural Economics,* 79(1): 62-79.

FAN S., WAILES E. J. and G. L. CRAMER (1995): "Household Demand in Rural China: A Two-Stage LES-AIDS Model", *American Journal of Agricultural Economics*, 77(1): 54-62.

FERRAIRA F. and HORRIDGE M. (2004): "Economic Integration, Poverty and Regional Inequality in Brazil", 7th Annual Conference on Global Economic Analysis, USA.

FRANCOIS J. and SHIELLS C. (1994): "AGE Models of North American Free Trade", in *Modeling Trade Policy, Applied General equilibrium Assessment of North American Free Trade,* Cambridge University Press.

FREE TRADE AGREEMENT MEXICO- EU-27 DOCUMENTATION (2004): http://trade.ec.europa.eu/doclib/docs/2004/october/tradoc_111724.pdf (Accessed 22/10/2007).

FOREIGN TRADE INFORMATION SYSTEM (2007): http://www.sice.oas.org/ctyindex/MEX/MEXagreements_e.asp (Accessed 10/19/2007).

FONTENLA M., GONZÁLEZ F. and J.C. NAVARRO (2008): "Determinants of Housing Expenditure in Mexico", *Applied Economics Letters*, http://www.informaworld.com/10.1080/13504850701675466 (Accessed 07/12/2008).

FULPONI L. (1989): "The Almost Ideal Demand System: An Application to Food and Meat Groups for France", *Journal of Agricultural Economics*, 40(1): 82 - 92.

GARICA-SALAZAR J.A. (2001): "Efecto de PROCAMPO Sobre la Producción y Saldo de Comercio Exterior de Maiz" *Agrociencia*, Mexico, 35(6): 671-683.

GALINDO-GONZÁLEZ, G. (1996): "Las Innovaciones Agrícolas y el Desarrollo Rural en México. Problemas del Desarrollo"; *Comunicación Rural México,* Mexico, 27(105): 69-80.

GAO X. WAILES E. J. and G. L. CRAMER (1997): "A Microeconometric Analysis of Consumer Taste Determination and Taste Change for Beef", *American Journal of Agricultural Economics,* 79(2):73-582.

GIORDANO P., MENDEZ-PARRA M., and WATANUKI M., (2007): "Agriculture in the Doha Development Agenda: An Opportunity for Latin America" Paper presented at the X GTAP Conference, Purdue University, 2007, https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=2368, (Accessed 07/02/2008).

GREEN R. and J. ALSTON (1990): "Elasticities in AIDS Models", *American Agricultural Economics Association*, 72(2): 442-445.

GOODWIN B.K. and D.C. HARPER (2000) "Price Transmission, Threshold Behaviour, and Asymmetric Adjustment in the US Pork Sector"; *Journal of Agricultural and Applied Economics*, 32(2):545-553:

GONZÁLEZ-MELLADO A. (2006): "Version 6.2 Documentation IO Tables: Mexico" GTAP Data Base Documentation, Center for Global Trade Analysis, Department of Agricultural Economics, Purdue University.

HANDA S., M.C. HUERTA, R. PEREZ and B. STRAFFON (2001): "Poverty, Inequality and Spillover in Mexico's Education, Health and Nutrition Program", Discussion Paper No 101, International Food Policy Research Institute.

HANOCH G. (1975): "Production and demand models with direct or indirect implicit additivity" *Econometrica,* 43(3):395-419.

HANSON G. (2005): *Emigration, Labour Supply, and Earnings in Mexico,* University of California, San Diego and National Bureau of Economic Research, USA.

HARRISON W. and K. PEARSON (2002): "GEMPACK User Documentation Realease 8.0" Center of Policy Studies and IMPACT Project, Melbourne, Australia, http://www.monash.edu.au/policy/gempack.htm (Accessed 10/16/2005).

HENRIQUES G. and R. PATEL (2003): "Agricultural trade liberalisation and Mexico", Police Brief No 7, Institute for Food and Development Policy.

HENRIQUES G. and R. PATEL (2004): "NAFTA, Maize, and Mexico's Agricultural Trade Liberalisation", Americas Program Special Report February, USA.

HERNÁNDEZ-LAOS E. (2000): "Crecimiento económico, distribución del ingreso y pobreza en México"*, Revista de Comercio Exterior,* 50 (10): 863–873, Mexico.

HERRERA RAMOS J.M. (2002): "La nueva política social en Mexico y su diseño institucional: El caso de PROCAMPO", Congreso Internacional del CLAD Sobre la Reforma de Estado y de la Administración Pública, Portugal.

HERTEL, T.W., ED. (1997): *Global Trade Analysis: Modeling and Applications,* New York: Cambridge University Press, USA.

HERTEL T., D. HUMMELS, M. IVANIC, and R. KEENEY (2004): "How Confident can be in CGE-Based Assessments of Free Trade Agreements?", GTAP Working Papers 26, Center for Global Trade Analysis, Department of Agricultural Economics, Purdue University, USA.

HERTEL T., M. IVANIC, P. PRECKEL and J. CRANFIELD (2003): "Trade Liberalisation and the Structure of Poverty in Developing Countries", GTAP Working Papers 1207, Center for Global Trade Analysis, Department of Agricultural Economics, Purdue University, USA.

HERTEL T. and J.J. REIMER (2004): "Predicting the Poverty Impacts of Trade Liberalisation: A Survey", Policy Research Working Paper 3444,World Bank.

HERTEL T. and M. IVANIC (2005): "Assessing the World Market Impacts of Multilateral Trade Reforms" in *Poverty Impacts of a WTO Impacts of the Doha Development Agenda* Hertel, T., and Winters, L., World Bank.

HERTEL T., IVANIC M., PRECKEL P. V. and J. A.L. CRANFIELD (2005): "The Earnings Effects of Multilateral Trade Liberalisation: Implications for Poverty Reduction," in T.W. Hertel and L.A. Winters (eds.), *Poverty and the WTO: Impacts of the Doha Development Agenda*, Palgrave Macmillan and World Bank.

HERTEL T. and A. WINTERS (2005): *Poverty and the WTO: Impacts of the Doha Development Agenda.* World Bank.

HERTEL T., KEENEY R., IVANIC M. and A. WINTERS (2007): "Distributional effects of WTO Agricultural Reforms in Rich and Poor Countries", *Economic Policy,* www.economic-policy.org (Accessed 03/20/2008).

HESS S. and S. VON CRAMON-TAUBADEL (2008): "Meta response surface design for General and Partial Equilibrium Models", Paper Presented at the Eleventh Annual Conference on Global Economic Analysis, Helsinki, Finland.

HICKS J. (1946): *Value and Capital*, Claredon Press, Oxford UK.

HUFF K., R. MCDOUGALL and T. WALMSLEY (1999): "Contributing Input-Output Tables to the GTAP Data Base", GTAP Technical Papers 304, Center for Global Trade Analysis, Department of Agricultural Economics, Purdue University, USA.

HUFF K. and T. HERTEL (2000): "Decomposition Welfare Changes in the GTAP Model", GTAP Technical Papers 5, Center for Global Trade Analysis, Department of Agricultural Economics, Purdue University, USA.

HUMMELS D. (1999): "Toward Geography Of Trade Cost", GTAP Working Papers 12, Center for Global Trade Analysis, Department of Agricultural Economics, Purdue University, USA.

IANCHOVICHINA E., A.NICITA and I.SOLOAGA (2001): "Trade Reforms and Households Welfare: the Case of Mexico", *The World Economy,* 25(7):945-72.

INEGI (2003): *Desarrollo Económico y Contrastes de México,* www.inegi.gob.mx/inegi/contenidos/espanol/prensa/contenidos/articulos/economicas/desarrollo03.pdf, (Accessed 11/01/2005).

INEGI (2004): *Encuesta Nacional de Ingresos y Gastos de los Hogares*, INEGI, Mexico City, http://www.inegi.gob.mx/prod_serv/contenidos/espanol/biblioteca/default.asp?accion=andupc=702825451288andseccionB=bd, (Accessed 01/07/2006).

INEGI (2005a): *Encuesta Nacional de Ingresos y Gastos de los Hogares,* INEGI, Mexico City, http://www.inegi.gob.mx/est/contenidos/espanol/sistemas/enigh/enigh_2005/default.asp#, (Accessed 01/07/2006).

INEGI (2005b): *Encuesta Nacional de Empleo*, INEGI, Mexico City, http://www.inegi.gob.mx/prod_serv/contenidos/espanol/biblioteca/default.asp?accion=andupc=702825000797andseccionB=bd, (Accessed 01/07/2006).

INEGI (2007): *Estadísticas Económicas, Producto Interno Bruto Trimestral en México*, http://www.inegi.gob.mx/prod_serv/contenidos/espanol/bvinegi/productos/derivada/coyuntura/pib/pib.pdf, (Accessed 09/03/2007).

INEGI (2008a): *Estadísticas del comercio exterior de México*, http://www.inegi.gob.mx/prod_serv/contenidos/espanol/bvinegi/productos/continuas/economicas/exterior/mensual/ece/ece.pdf, (Accessed 02/04/2007).

INEGI (2008b): *Producto Interno Bruto Trimestral*, http://www.inegi.gob.mx/prod_serv/contenidos/espanol/bvinegi/productos/derivada/coyuntura/pib/pib.pdf, (Accessed 04/22/2007).

IVANIC M. (2004): "Reconciliation of the GTAP and Household Survey Data", GTAP Research Memoranda 1408, Center for Global Trade Analysis, Department of Agricultural Economics, Purdue University, USA.

DE JANVRY A., E. SADOULET and A FARGEIX (1991): "Politically Feasible and Equitable Adjustment: Some Alternatives for Ecuador*", World Development,* 19(11):1577-1594.

JARQUE C.M. (1987): "An Application of LDV Models to Household Expenditure Analysis in Mexico", *Journal of Econometrics*, 36(1): 31-54.

JEJEEBHOY S. (1996): *Women´s Education, Autonomy and Reproductive Behaviour: Experience from Developing Countries,* Oxford University Press, UK.

JAPAN EXTERNAL TRADE ORGANIZATION, PRESS RELEASE (2006): "JETRO Report Examines Effects of Japan Mexico EPA One Year after its Entry in Force", http://www.jetro.go.jp/en/news/releases/20060407850-news, (Accessed 11/14/2007).

JOHANSEN L. (1960): *A Multisector Study of Economic Growth*, North-Holland, Amsterdam.

KEBEDE B. (2008): "Intra-Household Allocations in Rural Ethiopia: A Demand Systems Approach", *Review of Income and Wealth*, 54(1):1-26.

KILLINGSWORTH M. and J. HECKMAN (1986): "Female Labour Supply. A Survey" in O. Ashenfelter and R. Layards (editors) *Handbook of Labour Economics* (1):1059-1085 New York Elvesier Science Publishers.

KYEREME S.S. and E. THORBECKE (1991): "Factors Affecting Poverty in Ghana", *Journal of Development Studies*, 28, 1: 39-52.

LEE HARRIS R. (2001): "A Computable General Equilibrium Analysis of Mexico's Agricultural Policy Reforms", IFPRI Discussion Paper No 65.

LEONTIEF W. W. (1953): *Studies in the Structure of the American Economy,* Oxford University Press.

LEWBEL A. (1996): "Aggregation without Separability: A Generalized Composite Commodity Theorem", *American Economic Review*, 86(3): 524–543.

LIU S. and P PRECKEL (1995): "Momentum corrected Monte Carlo", Unpublished manuscript.

LOFGREN H., S. ROBINSON and M. EL-SAID (2004): "Poverty and Inequality Analysis in a General Equilibrium Framework: The Representative Household Approach" Chap 15 *in* Bourguignon *"Techniques and Tools for Evaluating the Poverty Impact of Economic Policies"* The World Bank.

LÓPEZ-ACEVEDO G. (2005): "Income Generation and Social Protection for the Poor", The World Bank, http://siteresources.worldbank.org/INTMEXICO/Resources/A_Study_of_Rural_Poverty_in_Mexico.pdf, (Accessed 03/01/2007).

LÓPEZ CALVA L. (2002): "The Many Mexicos: Income Inequality and Polarization in Urban Mexico during the 90s", Colegio de Mexico, www.wider.unu.edu/conference/conference-2002-2/papers/luis-f-lopes-calva.pdf, (Accessed 29/08/2007).

LÓPEZ RAMIREZ A. (2005): *El Perfil Sociodemográfico de los Hogares en México 1976-1997*, CONAPO, www.conapo.gob.mx/publicaciones/CuaTec/pdf/hogares.pdf, (Accessed 06/29/2006), Mexico.

LUSTIG N. and M. SZÉKELY (1997): "Mexico: Evolución Económica, Pobreza y Desigualdad en México," paper prepared for the UNDP-IADB-ECLAC project on "The Determinants of Poverty in Latin America," IADB.

MC DOUGALL R. (2006): "Construction of the Trade Data, Chapter 17, GTAP 6 Data Base documentation", Last update: January 18, 2007, GTAP Project.

MC DOUGALL R. and H. LEE (2006): "An Energy Data Base for GTAP" Chapter 15A, GTAP 6 Data Base documentation". Last update: January 18, 2007, GTAP Project.

MC NEW K. (1996) "Spatial Market Integration: definition, Theory and evidence", *Agricultural and Resource Economics Review*, 25(1):1-11.

MDAFRI A. and B.W. BRORSEN (1993): "Demand for Red Meat, Poultry and Fish in Morocco. An Almost Ideal Demand System", *American Journal of Agricultural Economics,* 9(2):155-163.

MELLA J. and A. MERCADO (2006): "La Economía Agropecuaria Mexicana y el TLCAN", *Comercio Exterior,* 56(3):181-193.

DE MELO J. (1988): "Computable General Equilibrium Models for Trade Policy Analysis in Developing Countries: A Survey", *Journal of Policy Modeling*, 10(4): 469-503.

MINISTRY OF ECONOMY (2006): *Programa de Expansión economica Internacional*, http://www.se.gob.mx, (Accessed 10/25/2007).

MINISTRY OF FOREIGN AFFAIRS OF JAPAN (2007): Agreement between Japan and the United Mexican States for the Strengthening of the Economic Partnership, http://www.mofa.go.jp/region/latin/mexico/agreement/overview.html,(Accessed 10/30/2007).

MINISTRY OF SOCIAL DEVELOPMENT (2007): *Program OPORTUNIDADES* homepage: www.oportunidades.gob.mx, (Accessed 05/28/2007).

MOSCHINI G. (1995): "Units of Measurement and the Stone Index in Demand System Estimation", *American Journal of Agricultural Economics,* 77(1):63-68.

MOSCHINI G. (2001): "Flexible Multistage Demand System Based on Indirect Separability" Iowa State University, Department of Economics, Staff General Research Papers.

MUNDLAK Y. and D.F. LARSON (1992): "On the Transmission of World Agricultural Prices", *World Bank Economic Review*, 6(3): 399-422.

NICITA A. (2004): "Efficiency and Equity of a Marginal Tax Reform - Income, Quality, and Price Elasticities for Mexico", World Bank Policy Research Working Paper 3266.

NICITA A. (2005): "Multilateral Trade Liberalisation and Mexican Households: the Effect of the Doha Development Agenda", World Bank Policy Research Working Paper 3707.

OFFICIAL JOURNAL OF THE FEDERATION (2004): *Decree to Approve the Program of International Trade and Investment Promotion*, 14 April 2004, www.dof.gob.mx, (Accessed 23/02/2006).

OECD (2006): "Poverty Alleviation, Directorate for Employment", Labour and Social Affairs, www.oecd.org/dataoecd/51/59/38120467.pdf, (Accessed 08/29/2007).

OECD(2007): "An Analysis of the Mexican School System in Light of PISA 2006", Directorate for Education, www.sep.gob.mx/work/resources/LocalContent/92146/1/Mex_PISA-OCDE2006.pdf , (Accessed 03/25/2008).

OLARREAGA M. and B. HOEKMAN (2007): "Global Trade Liberalisation and Poor Countries: Poverty Impacts and Policy Implications", in *Global Trade and Poor Nations: The Poverty Impacts and Policy Implications of Liberalisation*, by Olarreaga M. and B. Hoekman Brookings Institution Press, Yale Centre for the Study of Globalization, USA.

PÁNUCO-LAGUETTE H. and M. SZÉKELY (1996): "Income Distribution and Poverty in Mexico" in Bulmer-Thomas V. (editor):The *New Economic Model in Latin America and its Impact on Income Distribution and Poverty*, (London: Mcmillan press).

RAVALLION M. and M. LOKSHIN (2004): "Gainers and Losers from Trade Reform in Morocco", Mimeo, paper presented at the Seventh Annual Conference on Global Economic Analysis, Washington, DC, USA.

RAMALES-OSORIO, M.C. and M. DÍAZ OLEDO (2005): "La economía informal en México, Insuficiencias del modelo de desarrollo y exceso de trámites", *Observatorio de la Economía Latinoamericana*, (48):34-38.

RAMANATHAN R., (2002): *Introductory Econometrics with Applications*, Fifth edition, Harcourt College Publishers.

RAPSOMANIKIS G., HALLAM D. and P. Conforti (2003): "Market Integration and Price Transmission in Selected Food and Cash Crops Markets of Developing Countries: Review and Applications", *Commodity Market Review 2003-2004*, FAO Rome, Italy, http://www.fao.org/DOCREP/006/Y5117E/y5117e00.htm#Contents, (Accessed 10/22/2008).

REYES TÉPACH M. (2005): "El gasto público y privado en educación: su distribución entre los hogares del país, 1998-2005", www.diputados.gob.mx/cedia/sia/se/SIA-DEC-ISS-05-05.pdf, (Accessed 05/29/2006).

ROBILLARD A.-S., F. BOURGUIGNON, and S. Robinson (2001): "Crisis and Income Distribution: A Micro-Macro Model for Indonesia." *International Food Policy Research Institute, Washington, D.C.*

ROBILLIARD A.-S. and S. ROBINSON (2005): "The social impact of a WTO agreement in Indonesia", Policy Research Working Paper Series 3747.

ROS J. and C. BOUILLON (2002): "Mexico: Trade liberalisation, growth, inequality and poverty". In Roberto Vos, Lance Taylor and Ricardo Pães de Barros, eds., *Economic*

Liberalisation, Distribution and Poverty: Latin America in the 1990s, Cheltenham, UK and Northampton, MA: Edward Elgar, Chapter 9.

RUTHERFORD T. and S. PALTSEV (1999): "From an Input-Output Table to a General Equilibrium Model: Assessing the Excess Burden of Indirect Taxes in Russia" University of Colorado.

RUTHERFORD T., D. TARR and O. SHEPOTYLO (2005): "Poverty effects of Russia's WTO accession: Modelling "Real" Households and Endogenous Productivity Effects", Policy Research Working Paper Series 3473, The World Bank.

RUBIO G. and I. SOLOAGA (2004): "Assessing the vulnerability of Agricultural households to macroeconomic shocks: Evidence from Mexico", *Journal of Agricultural and Development Economics,* 1(1):45-65.

SAUDOLET E., JANVRY A. and B. DAVIS (2001): "Cash transfer Programs With Income Multipliers: Procampo in Mexico", IFPRI, Discussion Paper.

SAVARD L. (2005): "Poverty and Inequality Analysis within a CGE Framework: A comparative Analysis of the Representative Agent and Micro simulation Approaches", *Development Policy Review*, 23(3): 313-331.

SAGARPA (2001): *Programa Sectorial de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación 2001-2006*, www.sagarpa.gob.mx/Dgg/FTP/Sectorial1.pdf, (Accessed 09/15/2006).

SAGARPA (2005): *Anuario Estadistico 2004*, http://www.siea.sagarpa.gob.mx/AAgricola.html, (Accessed 08/23/2006).

SHCP (1984): *Reglamento de la Ley Del Impuesto Sobre La Renta*, http://info4.juridicas.unam.mx/ijure/nrm/1/375/default.htm?s=iste, (Accessed 01/21/2006).

SECOFI (1996): Programa de Política Industrial, Comercio Exterior y Desrregulación Económica, http://zedillo.presidencia.gob.mx/pages/prog-sec.html, (Accessed 08/28/2007).

SEALE J. JR., A. REGMI and J. BERNSTEIN (2003): "International Evidence on Food Consumption Patterns", in Regmi ed., *Electronic Report from the Economic Research Service,* Technical Bulletin Number 1904, Department of Agriculture, Economic Research Service, USA.

SELLEN D. and E. GODDARD (1997): "Weak Separability in Coffee Demand Systems", *European Review of Agricultural Economics,* 24(1):133-144.

SHARMA R. (2002): "The Transmission of World Price Signals: Concepts, Issues and Some Evidence from Asian Cereal Markets", Paper submitted to the OECD Global Forum on Agriculture, OECD CCNM/GF/AGR(2002)10.

SHOVEN J. and J. WHALLEY (1972): "A general equilibrium calculation of the effects of differential taxation of income from capital in the U.S", *Journal of Public Economics*, 1(3-4):281-321.

SHOVEN J. and J. WHALLEY (1984): "Applied General Equilibrium Models of Taxation and International Trade: An Introduction and Survey", *Journal of Economic Literature*, 22(3):1007-1051.

SHOVEN J. and J. WHALLEY (1992): *Applying General Equilibrium,* Cambridge University Press.

SILLER-CEPEDA J. (2003): *Situación Actual de la Industria Hortofrutícola en México, Producción, Comercialización y Exportación de Cultivo Hortícolas*, Centro de Investigación en Alimentación y Desarrollo, A.C., www.uaaan.mx/academic/Horticultura/Memhort03/Ponencia_04.pdf, (Accessed 23/07/2006).

STONE, J. R. N. (1954): "Linear Expenditure Systems and Demand Analysis: an Application to the Pattern of British Demand", *Economic Journal*, 64(255): 511-527.

SURRY Y., HERRARD N. and Y. ROUX (2002): "Modeling Trade in Processed Food Products: an Econometric Investigation for France", *European Review of Agricultural Economics,* 29(1):1-27.

SZÉKELY M. (2005): "Es Posible un México con Menor Pobreza y Desigualdad", Chapter in J. A. Aguilar, *México, Cronicas de un País Posible*, Conaculta-Fondo de Cultura Económica.

SCHUSCHNY A., J. DURAN and C. DE MIGUEL (2007): "El Modelo GTAP y las Preferencias Arancelarias en América Latina y el Caribe: Reconciliando su Año Base con la Evolución Reciente de la Agenda de Liberalización Regional", Serie Manuales, ECLAC, http://www.eclac.org/cgibin/getProd.asp?xml=/publicaciones/xml/7/27947/P27947.xmlandxsl=/dmaah/tpl/p9f.xslandbase=/tpl/top-bottom.xslt, (Accessed 12/02/2007).

SCHUSCHNY A. and C. LUDENA (2006): "Version 6.2 Documentation IO Tables: Chile", GTAP Data Base Documentation, Center for Global Trade Analysis, Department of Agricultural Economics, Purdue University.

TAYLOR E. and A. YÚNEZ NAUDE (2001): "The Determinants of Nonfarm Activities and Incomes of Rural Households in Mexico, with Emphasis on Education", *World Development,* 29(3):561-572.

TAYLOR R.L., W.P. FALCON and A. PUENTE-GONZÁLEZ (2001): "Policy Reforms and Mexican Agriculture", CIMMYT Economics Program Paper No. 01-01, Mexico.

TOCKMAN V. (1995): "The Informal Sector in Latin America: 15 Years Later" in D. Turmann et al. *The Informal Sector Revisited* OECD Paris.

THEIL H. (1975): *Theory and Measurement of Consumer Demand,* Volume 2, Amsterdam: North-Holland.

THURLOW J. and D. VAN SEVENTER (2002): "A Standard Computable General Equilibrium Model for South Africa", TMD Discussion Papers 100, IFPRI.

USDA (2006): *Mexico Livestock Annual,* Washington, DC: Foreign Agricultural Service, http://www.fas.usda.gov/gainfiles/200608/146208819.pdf, (Accessed 03/12/2007).

UNITED NATIONS DEVELOPMENT PROGRAMME (2004): *National Human Development Report 2004. Mexico,* United Nations.

UN (1999): *Handbook of Input-Output Tables: Compilation and Analysis,* New York, United Nations.

USDOJ (2006): "Marijuana- National Drug Threat Assessment 2006", http://www.usdoj.gov/ndic/pubs11/18862/marijuan.htm, (Accessed 01/09/2008).

VEGA-MARTÍNEZ L. (2005): "La Pobreza en México", *Observatorio de la Economía Latinoamericana*, Issue 44, http://www.eumed.net/cursecon/ecolat/mx/2005/lvm-pobreza.htm, (Accessed 04/12/2007).

VARIAN H. (2002): *Intermediate Microeconomics,* Ed Norton College Books, USA.

WAEHLER G. and K. RICKERTSEN (2003): "Forecasting Ability of Theory-Constrained Two Stage Demand Systems", *European Review of Agricultural Economics,* 30(4):539-558.

WINTERS A., N. MCCULLOCH and A. MCKAY (2004): "Trade Liberalisation and Poverty: The Evidence So Far"*, Journal of Economic Literature*, 42(1):72-115.

WORLD BANK (2004): *Mexico - Basic Education Development Program (Phase Three)*, Project Research Report, http://go.worldbank.org/RX4J2YOK50, (Accessed 03/25/2008).

WORLD BANK (2005): *Poverty in Mexico. An Assessment of Conditions, Trends and Government Strategy,* Project Research Report, http://go.worldbank.org/XZGOGUSXZ0, (Accessed 28/06/2006).

WORLD BANK (2007): *World Development Indicators 2007,* Compact Disc.

WORLD TRADE ORGANIZATION (2008a): *Trade Policy Review: Mexico,* http://www.wto.org/english/tratop_e/tpr_e/tp295_e.htm, (Accessed 05/05/2008).

WORLD TRADE ORGANIZATION (2008b): *Revised Draft Modalities for Agriculture*, http://www.wto.org/english/tratop_e/agric_e/chair_texts08_e.htm, (Accessed 05/19/2008).

WORLD TRADE ORGANIZATION (2008c): *Draft Modalities for Non-Agricultural Market Access,* www.wto.int/english/tratop_e/markacc_e/namachairtxt_feb08_e.doc, (Accessed 05/19/2008).

WORLD TRADE ORGANIZATION (2008d): *Report to the Trade Negotiations Committee*, Committee on Agriculture Special Session Geneva 11 August 2008, http://www.wto.org/english/tratop_e/agric_e/chair_texts08_e.htm, (Accessed 20/09/2008).

YUNEZ-NAUNDE A. (2003): "The Dismantling of CONASUPO, a Mexican State Trader in Agriculture", *The World Economy*, 26(1):97-122.

ZELLNER A. (1962): "An efficient Method of Estimating Seemingly Unrelated Regression Equations and Tests for Aggregation Bias", *Journal of the American Statistical Association,* 57(298): 348–368.

8 Appendices

Appendix A. Abbreviations, and Elements of the GTAP model

Abbreviations

AIDADS	An Implicit Directly Additive Demand System
AIDS	Almost Ideal Demand System
ALADI	Latin American Integration Association
AMS	Aggregate Measurement of Support
APEC	Asia Pacific Economic Cooperation
ATC	Agreement on Textiles and Clothing
CDE	Constant Difference of Elasticities
CES	Constant Elasticity of Substitution
CEEC	Central and Eastern European Countries
CET	Constant Elasticity of Transformation
CEPII	Centre D'Etudes Prospectives et D'Informations Internationales
CGE	Computable General Equilibrium
CONASUPO	National Company of Popular Subsistence (Compañía Nacional de Abasto y Subsistencia Popular)
DDA	Doha Development Agenda
ECLAC	Economic Commission for Latin America and the Caribbean
ELES	Extended Linear Expenditure System
ENIGH	National Household Income and Expenditures Survey (Encuesta Nacional de Ingresos y Gastos de los Hogares)
EPA	Economic Partnership Agreement
EOI	Export Oriented Industrialization
EU-27	European Union (27 member countries)
FTA EU-27-Mexico	Free Trade Agreement EU-27 - Mexico
FAO	Food and Agriculture Organization of the United Nations
FAOSTAT	FAO Statistical Data Base

FTIS	Foreign Trade Information System
FTAs	Free Trade Agreements
GDP	Gross Domestic Product
GAMS	Generalized Algebraic Modelling System
GATT	General Agreement on Tariffs and Trade
GEMPACK	General Equilibrium Modelling Package
GTAP	Global Trade Analysis Project
ICP	International Comparison Project
INEGI	National Institute of Statistical Geography and Informatics (Instituto Nacional de Estadística Geografía e Informática)
IOT	Input Output Table
IMF	International Monetary Found
ITSUR	Iterative Seemingly Unrelated Regression Estimation
ISI	Import Substitution Industrialization
LA/AIDS	Linear Almost Ideal Demand System
LES	Linear Expenditure System
LOP	Law of One Price
MCA	Monte Carlo Analysis
NAFTA	North American Free Trade Agreement (TLCAN- Tratado de Libre Comercio de America del Norte)
NAICS	North American Industry Classification System
OECD	Organization for Economic Co-operation and Development
OFJ	Official Federation Journal
PEP	Poverty and Economic Policy Network
PROCAMPO	Program of Direct Payments to the Countryside (Programa de Apoyos Directos al Campo)
QAIDS	Quadratic Almost Ideal demand System
SAM	Social Account Matrix

SAGARPA	Mexican Ministry of Agriculture, Livestock, Rural Development, Fishing and Food (Secretaría de Agrícultura, Ganadería, Desarrollo Rural, Pesca y Alimentación)
SAS	Statistical Analysis Software
SSA	Systematic Sensitivity Analysis
SE	Mexican Ministry of Energy (Secretaría de Energía)
SECOFI	Mexican Ministry of Trade and Industrial Development (Secretaría de Comercio y Fomento Industrial)
SHCP	Mexican Ministry of Finance and Public Credit (Secretaría de Hacienda y Crédito Público)
TA	Trade Agreement
TRAINS	Trade Analysis and Information System
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development
USA	United States of America
USDOJ	United States Department of Justice
VER	Voluntary Export Restrains
WTO	World Trade Organization

Elements of the GTAP model

Sets

REG	regions in the model
TRAD_COMM	traded commodities
MARG_COMM	margin commodities subset of TRAD_COMM
NMRG_COMM	non-margin commodities (TRAD_COMM - MARG_COMM)
CGDS_COMM	capital goods commodities
ENDW_COMM	endowment commodities
ENDWS_COMM	sluggish endowment commodities: skilled and unskilled labour (subset of ENDW_COMM)
ENDWM_COMM	mobile endowment commodities: capital, labour, and land (subset of ENDW_COMM)
PROD_COMM	produced commodities (= TRAD_COMM and CGDS_COMM) and subset of NSAV_COMM

DEMD_COMM	demanded commodities (= ENDW_COMM and TRAD_COMM)
NSAV_COMM	non-savings commodities (= DEMD_COMM and CGDS_COMM)
HHC	household categories

Coefficients and Parameters

EVOA(i,r)	value of commodity i output in region r.
EVFA(i,j,r)	producer expenditure on i by industry j, in region r, valued at agents' prices
SAVE(r)	expenditure on net savings in region r valued at agents' prices
VDFA(i,j,r)	purchases of domestic commodity i for use in industry j in region r
VDEP(r)	value of capital depreciation, in r
VDFM(i,j,r)	purchases of domestic commodity i for use in industry j in region r
VDPA(i,r)	private household expenditure on domestic commodity i in region r
VDGA(i,r)	government household expenditure on domestic commodity i in region r
VDGM(i,r)	government household expenditure on domestic commodity i in region r
VFM(i,j,r)	producer expenditure on i by industry j, in region r, valued at market prices
VIFA(i,j,r)	purchases of imported i for use in industry j in region r
VIFM(i,j,r)	purchases of imports i for use in industry j in region r
VIMS(i,r,s)	imports of commodity i from region r to region s, valued at domestic market prices
VIPA(i,r)	private household expenditure on imported i in region r
VDPM(i,r)	private household expenditure on domestic i in region r
VIGA(i,r)	government household expenditure on imported i region r
VIGM(i,r)	government household expenditure on i in region r
VIPM(i,r)	private household expenditure on i in region r

VIWS(i,r,s)	imports of commodity i from region r to region s, valued cif (tradables only)
VKB(r)	value of beginning-of-period capital stock, in region r
VST(i,r)	exports of commodity i from region r for international transportation valued at market prices (tradables only)
VXMD(i,r,s)	exports of commodity i from region r to region s valued at market prices (tradables only)
VXWD(i,r,s)	exports of commodity i from region r to region s valued fob (tradables only)

Technology and Preference Parameters

ESUBD(i)	elasticity of substitution between domestic and imported goods in the Armington aggregation structure for all agents in all regions
ESUBM(i)	elasticity of substitution among imports from different destinations in the Armington aggregation structure of all agents in all regions.
ESUBVA(j)	elasticity of substitution between capital, labour, and possibly land, in the production of value-added in j
INCPAR(i,r)	expansion parameter in the CDE minimum expenditure function
SUBPAR(i,r)	substitution parameter in the CDE minimum expenditure function

Quantities

qo(i,r)	industry output of commodity i in region r
qoes(i,j,r)	supply of sluggish endowment i used in industry j in region r
qxs(i,r,s)	export sales of commodity i from r to region s
qst(i,r)	sales of commodity i from region r to international transport
qds(i,r)	domestic sales of commodity i in region r
qfe(i,j,r)	demand for endowment i for use in industry j in region r
qva(j,r)	value-added in industry j of region r
qf(i,j,r)	demand for commodity i for use in industry j in region r
qfm(i,j,s)	intermediate demands for aggregate imports of i by industry j in region s

qfd(i,j,s)	industry demands for domestic commodity i by industry j in region r
qp(i,r)	private household demand for commodity i in region r
qg(i,r)	government household demand for commodity i in region r
qpm(i,s)	private household demand for imports of i in region s
qpd(i,s)	private household demand for domestic i in region s
qgm(i,s)	government household demand for imports of i in region s
qgd(i,s)	government household demand for domestic i in region s
ksvces(r)	capital services = qo("capital",r)
qcgds(r)	output of capital goods sector = qo("cgds", r)
qsave(r)	regional demand for NET savings
qim(i,s)	aggregate imports of i in region s
qiw(i,s)	aggregate imports of commodity i in region s, cif weights
qxw(i,r)	aggregate exports of commodity i from region r, fob weights
qxwreg(r)	volume of merchandise exports, by region r
qiwreg(r)	volume of merchandise imports, by region r
qxwcom(i)	volume of global merchandise exports by commodity i
qiwcom(i)	volume of global merchandise imports by commodity i
qxwwld	volume of world trade
qow(i)	quantity index for world supply of good i
kb(r)	beginning-of-period capital stock, in region r
ke(r)	end-of-period capital stock, in region r
globalcgds	global supply of capital goods for NET investment
qt	quantity of global shipping services provided
pop(r)	population in region r
walras_dem	demand in the omitted market--global demand for savings
walras_sup	supply in omitted market--global supply of cgds composite
qgdp(r)	GDP quantity index

Prices

ps(i,r)	supply price of commodity i in region r
pf(i,j,r)	firms' price for commodity i for use in industry j in region r
pfe(i,j,r)	firms' price for endowment commodity i in industry j of region r
pva(j,r)	firms' price of value-added in industry j of region r

pfm(i,j,s)	price of intermediate imports of industry i by industry j in region s
pfd(i,j,s)	price of intermediate domestic purchases of i by industry j in region s
pp(i,r)	private household price for commodity i in region r
ppm(i,s)	price of imports of i by private households in region s
ppd(i,s)	price of domestic commodity i to private households in region s
pgov(r)	price for government household expenditures in region r
ppriv(r)	price for private household expenditures in region r
pg(i,r)	government household price for commodity i in region r
pgm(i,s)	price of imports of commodity i by government households in region s
pgd(i,s)	price of domestic commodity i to government households in region s
pm(i,r)	market price of commodity i in region r
pim(i,r)	market price of composite import i in region r
piw(i,r)	world price of composite import i in region r
pxw(i,r)	aggregate exports price of commodity i from region r
pxwreg(r)	price of merchandise exports, by region r
piwreg(r)	price of merchandise imports, by region r
pxwcom(i)	price of global merchandise exports by commodity i
piwcom(i)	price of global merchandise imports by commodity i
pxwwld	price of world trade
pw(i)	world price for total commodity i supplies
pmes(i,j,r)	market price of sluggish endowment used by industry j in region r
pms(i,r,s)	domestic price for good i supplied from region r to region s
pfob(i,r,s)	FOB world price of commodity i supplied from region r to region s
pcif(i,r,s)	CIF world price of commodity i supplied from region r to region s
pt	price of global shipping services provided
rental(r)	rental rate on capital = ps("capital",r)
rorc(r)	current net rate of return on capital stock, in region r

rore(r)	expected net rate of return on capital stock, in region r
rorg	global net rate of return on capital stock
psave	price of capital goods supplied to savers
pcgds(r)	price of investment goods = ps("cgds",r)
psw(r)	price received for tradables produced in region r
pdw(r)	price paid for tradables used in region r
tot(r)	terms of trade for region r: tot(r) = psw(r) - pdw(r)
pr(i,r)	ratio of domestic to imported prices of commodity i in region r
pgdp(r)	GDP price index

Technical Changes

ao(j,r)	output augmenting technical change in sector j of region r
afe(i,j,r)	primary factor i augmenting tech change in industry j of region r
af(i,j,r)	composite intermediate input i augmenting tech change in industry j of region r
ava(i,r)	value added augmenting tech change in sector i of region r
atr(i,r,s)	tech change parameter in shipping of commodity from region r to region s

Taxes

to(i,r)	output (or income) tax on commodity i in region r
tf(i,j,r)	tax on primary factor i used by industry j in region r
tpm(i,r)	tax on imported i purchased by private households in region r
tpd(i,r)	tax on domestic i purchased by private household in region r
tgm(i,r)	tax on imported i purchased by government household in region r
tgd(i,r)	tax on domestic i purchased by government household in region r
tfm(i,j,r)	tax on imported i purchased by industry j in region r
tfd(i,j,r)	tax on domestic i purchased by industry j in region r
txs(i,r,s)	combined tax in r on good i bound for region s
tms(i,r,s)	import tax in s on good i imported from region r
tm(i,s)	import levy (source generic)
tx(i,r)	export tax (subsidy) (destination generic)

Appendix B. Derivation of the LA/AIDS Elasticities

Uncompensated Price elasticities

Uncompensated price elasticities in any demand system are defined by:

$$ECRLS_{ijhr} = -\delta_{ij} + \frac{\partial EXPSHR_{ihr}}{\partial PP_{jr}} * \frac{PP_{jr}}{EXPSHR_{ihr}} \qquad B1$$

where δ_{ij} is the Kronecker delta (δ_{ij}= 1 for i=j; own-price elasticity; δ_{ij}=0 for i≠j; cross-price elasticities). The derivation of the expenditure share ($EXPSHR_{ihr}$) with respect to price of j (PP_{jr}) is performed taking the value of $EXPSHR_{ihr}$ from Equation 4.1:

$$\frac{\partial EXPSHR_{ihr}}{\partial PP_{jr}} = \frac{\partial\left\{ALFA_{ih} + \sum_{j \in TRAD} GAMA_{ijhr} * \ln PP_{jr} + BETA_{ihr} \ln\left[\frac{HHEXP_{hr}}{PPRIV_{hr}}\right]\right\}}{\partial PP_{jr}} \qquad B2$$

Simplifying B2 yields:

$$\frac{\partial EXPSHR_{ihr}}{\partial PP_{jr}} = \frac{\partial\left\{\sum_{j \in TRAD} GAMA_{ijhr} \ln PP_{jr} - BETA_{ihr} \ln PPRIV_{hr}\right\}}{\partial PP_{jr}} \qquad B3$$

Substituting the Laspeyres index price (Equation 4.2) into B3:

$$\frac{\partial(EXPSHR_{ihr})}{\partial PP_{jr}} = \frac{\partial\left\{\sum_{j \in TRAD} GAMA_{ijhr} \ln PP_{jr} - BETA_{ihr} \sum_{i \in TRAD} EXPSHR_{ihr} \ln \frac{PP_{ir}}{PP_{ir}^{0}}\right\}}{\partial PP_{jr}} \qquad B4$$

After deriving and simplifying:

$$\frac{\partial EXPSHR_{ihr}}{\partial PP_{jr}} = \frac{GAMA_{ijhr}}{PP_{jr}} - BETA_{ihr} * \frac{EXPSHR_{jhr}}{PP_{jr}} \qquad B5$$

Substituting Equation B5 in B1:

$$ECRLS_{ijhr} = \delta_{ijhr} + \left(\frac{GAMA_{ijhr}}{PP_{jr}} - BETA_{ihr} * \frac{EXPSHR_{jhr}}{PP_{jr}} \right) * \frac{PP_{jr}}{EXPSHR_{ihr}}$$

B6

Simplifying:

$$ECRLS_{ijhr} = \delta_{ijhr} + \frac{\left(GAMA_{ijhr} - BETA_{ihr} * EXPSHR_{jhr}\right)}{EXPSHR_{ihr}}$$

B7

Equation B7 represents the uncompensated price elasticities or Marshallian price elasticities. Thus, uncompensated own-price elasticities are:

$$ECRLS_{iihr} = \frac{GAMA_{iihr}}{EXPSHR_{ihr}} - BETA_{ihr} - 1 \qquad B8$$

and uncompensated cross-price elasticities are:

$$ECRLS_{ijhr} = \frac{\left(GAMA_{ijhr} - BETA_{ihr} * EXPSHR_{jhr}\right)}{EXPSHR_{ihr}} \qquad B9$$

Expenditure Price Elasticities

Expenditure elasticities are defined as the percentage change in quantity demanded of commodity i with respect to a one percent change in total income:

$$EPLS_{ihr} = \frac{\partial Q_{ihr}}{\partial HHEXP_{hr}} \qquad B10$$

Considering that:

$$EXPSHR_{ihr} = \frac{PP_{ir} * Q_{ihr}}{HHEXP_{hr}} \qquad B11$$

and solving Equation B11 for Q_{ihr} :

$$Q_{ihr} = \frac{EXPSHR_{ihr} * HHEXP_{hr}}{PP_{ir}} \qquad B12$$

Following the rule chain from Equations B10 and B12, it yields:

$$EPLS_{ihr} = \frac{\partial\left(\frac{EXPSHR_{ihr} * HHEXP_{hr}}{PP_{ir}}\right)}{\partial HHEXP_{hr}} * \frac{HHEXP_{hr} * PP_{ir}}{EXPSHR_{ihr} * HHEXP_{hr}} + \frac{\partial EXPSHR_{ihr}}{\partial HHEXP_{hr}} * \frac{HHEXP_{hr}}{EXPSHR_{ihr}}$$

B13

Deriving the first term of Equation B13:

$$\frac{\partial\left(\frac{EXPSHR_{ihr} * HHEXP_{hr}}{PP_{ir}}\right)}{\partial HHEXP_{hr}} = \frac{EXPSHR_{ihr}}{PP_{ir}}$$

B14

Deriving the second term of Equation B13:

$$\frac{\partial EXPSHR_{ihr}}{\partial HHEXP_{hr}} = \frac{\partial\left\{ALFA_{ih} + \sum_{j \in TRAD} GAMA_{ijhr} \ln PP_{jr} + BETA_{ihr} \ln\left[\frac{HHEXP_{hr}}{PPRIV_{hr}}\right]\right\}}{\partial HHEXP_{hr}}$$

B15

Solving B15:

$$\frac{\partial EXPSHR_{ihr}}{\partial HHEXP_{hr}} = \frac{\partial\left\{BETA_{ihr} \ln\left[\frac{HHEXP_{hr}}{PPRIV_{hr}}\right]\right\}}{\partial HHEXP_{hr}} = \frac{\partial\{BETA_{ihr} \ln(HHEXP_{hr} - \ln PPRIV_{hr})\}}{\partial HHEXP_{hr}} = \frac{\partial\{BETA_{ihr} \ln HHEXP_{hr}\}}{\partial HHEXP_{hr}}$$

B16

Resulting finally in:

$$\frac{\partial EXPSHR_{ihr}}{\partial HHEXP_{hr}} = \frac{BETA_{ihr}}{HHEXP_{hr}}$$

B17

Substituting in Equation B13 the values of Equation B14 and B17 and

$$EPLS_{ihr} = \frac{EXPSHR_{ihr}}{PP_{ir}} * \frac{HHEXP_{hr} * PP_{ir}}{EXPSHR_{ihr} * HHEXP_{hr}} + \frac{BETA_{ihr}}{HHEXP_{hr}} * \frac{HHEXP_{hr}}{EXPSHR_{ihr}}$$

B18

Simplifying:

$$EPLS_{ihr} = 1 + \frac{BETA_{ihr}}{EXPSHR_{ihr}}$$

B19

Compensated Price Elasticities

Uncompensated elasticities might be easily transformed into Hicksian (compensated) elasticities through the Slutsky equations:

$$HICELS_{ijhr} = ECRLS_{ijhr} + EXPSHR_{jhr} * EPLS_{ihr} \qquad B20$$

Substituting in Equation B20 the values of Equations B7 and B19:

$$HICELS_{ijhr} = \delta_{ijhr} + \frac{\left(GAMA_{ijhr} - BETA_{ihr} * EXPSHR_{jhr}\right)}{EXPSHR_{ihr}} + EXPSHR_{jhr} * \left(1 + \frac{BETA_{ihr}}{EXPSHR_{ihr}}\right) \qquad B21$$

Simplifying Equation B21:

$$HICELS_{ijhr} = \delta_{ijhr} + \frac{GAMA_{ijhr}}{EXPSHR_{ihr}} + EXPSHR_{jhr} \qquad B22$$

The compensated own-price elasticity is represented as:

$$HICELS_{iihr} = \frac{GAMA_{ijhr}}{EXPSHR_{ihr}} + EXPSHR_{ihr} - 1 \qquad B23$$

Subsequently the compensated cross-price elasticities are:

$$HICELS_{ijhr} = \frac{GAMA_{ijhr}}{EXPSHR_{ihr}} + EXPSHR_{jhr} \qquad B24$$

Appendix C. Parameters of the LA/AIDS for Household Deciles in Mexico

Decile I	GAMA cereals	GAMA vegetables	GAMA dairy products	GAMA meat	GAMA food	GAMA tobbev	GAMA energy	GAMA manufc	GAMA services	GAMA housing	ALFA	BETA
cereals	**-0.003**	*0.012*	*-0.026*	*0.020*	*-0.030*	*-0.013*	*-0.013*	*0.012*	*0.039*	0.003	*0.302*	*-0.033*
	(0.3)	*(0.003)*	*(<.0001)*	*(<.0001)*	*(0.02)*	*(0.04)*	*(<.0001)*	*(0.03)*	*(0.02)*		*(<.0001)*	*(<.0001)*
vegetables		*-0.017*	*0.013*	*-0.039*	**-0.004**	*0.016*	**-0.016**	*0.018*	**0.016**		*0.301*	*-0.032*
		(0.001)	*(0.002)*	*(<.0001)*	**(0.8)**	*(<.0001)*	**(0.06)**	*(0.02)*	**(0.4)**	0.002	*(<.0001)*	*(<.0001)*
dairy			*-0.021*	*0.043*	**-0.017**	**-0.004**	*0.023*	*-0.038*	**0.022**		*0.423*	*-0.047*
products			*(0.0009)*	*(<.0001)*	**(0.2)**	**(0.1)**	*(0.05)*	*(0.004)*	**(0.2)**	0.007	*(<.0001)*	*(<.0001)*
meat				*-0.067*	**0.014**	*0.016*	*-0.020*	*0.019*	**0.015**		*0.415*	*-0.046*
				(<.0001)	**(0.2)**	*(<.0001)*	*(0.03)*	*(0.01)*	**(0.3)**	-0.001	*(<.0001)*	*(<.0001)*
processed					**0.038**	*-0.045*	**0.000**	*0.091*	**-0.061**		*-0.473*	*0.080*
food					**(0.6)**	*(<.0001)*	**(0.9)**	*(0.005)*	**(0.5)**	0.014	*(<.0001)*	*(<.0001)*
tobbev						*-0.016*	**-0.013**	**-0.005**	*0.061*		*0.744*	*-0.087*
						(<.0001)	**(0.1)**	**(0.5)**	*(<.0001)*	0.002	*(<.0001)*	*(<.0001)*
energy							-0.171	*0.103*	*0.143*		**0.181**	**-0.018**
							(0.006)	*(0.02)*	*(0.01)*	-0.035	**(0.2)**	**(0.4)**
manufc								*-0.102*	*-0.129*		**-0.073**	**0.023**
								(0.03)	*(0.02)*	0.031	**(0.7)**	**(0.4)**
services									**-0.102**		**-0.513**	*0.109*
									(0.4)	-0.004	**(0.07)**	*(0.007)*
housing										-0.019	-0.307	0.049

The estimates in italics are significantly different from zero at the 5 percent significance level

The values in parentheses are probabilities that the estimates are significantly equal to zero

The estimates in bold are not significantly different from zero at the 5 percent significance level

Source: Author's calculations with ENIGH survey 2000-2005

Decile II	GAMA cereals	GAMA vegetables	GAMA dairy products	GAMA meat	GAMA food	GAMA tobbev	GAMA energy	GAMA manufc	GAMA services	GAMA housing	ALFA	BETA
cereals	*0.003* *(0.0001)*	*0.003* *(0.0009)*	*0.001* *(0.0002)*	*0.003* *(0.0008)*	**0.002** **(0.5)**	*-0.018* *(0.0002)*	**-0.001** **(0.6)**	*0.003* *(0.0003)*	**0.005** **(0.3)**	-0.001	*0.354* *(<.0001)*	*-0.039* *(<.0001)*
vegetables		*0.005* *(0.002)*	*0.002* *(0.0005)*	*0.004* *(0.003)*	**-0.003** **(0.6)**	*-0.023* *(0.001)*	**-0.004** **(0.2)**	*0.002* *(0.01)*	**0.016** **(0.09)**	-0.003	*0.429* *(<.0001)*	*-0.049* *(<.0001)*
dairy products			*0.001* *(0.009)*	*0.002* *(<.0001)*	**-0.002** **(0.2)**	*-0.011* *(<.0001)*	*0.003* *(0.07)*	*0.002* *(<.0001)*	**0.002** **(0.4)**	0.000	*0.239* *(<.0001)*	*-0.023* *(<.0001)*
meat				*0.003* *(0.003)*	**0.007** **(0.1)**	*-0.017* *(0.001)*	*-0.005* *(0.002)*	*0.002* *(0.002)*	**0.004** **(0.5)**	-0.002	*0.360* *(<.0001)*	*-0.038* *(<.0001)*
processed food					**0.085** **(0.1)**	**-0.044** **(0.1)**	*0.073* *(0.0003)*	*0.025* *(<.0001)*	*-0.161* *(0.02)*	0.018	**0.958** **(0.1)**	**-0.116** **(0.1)**
tobbev						*0.115* *(0.0005)*	*0.031* *(0.001)*	*-0.014* *(0.001)*	**-0.030** **(0.3)**	0.012	*-1.611* *(<.0001)*	*0.232* *(<.0001)*
energy							*-0.054* *(0.03)*	*-0.007* *(0.05)*	**-0.033** **(0.2)**	-0.003	**-0.643** **(0.16)**	**0.096** **(0.13)**
manufc								*0.003* *(0.002)*	*-0.015* *(0.01)*	0.000	*0.348* *(0.004)*	*-0.031* *(0.008)*
services									*0.236* *(0.01)*	-0.023	**0.769** **(0.3)**	**-0.069** **(0.5)**
housing										0.002	-0.203	0.037

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The estimates in bold are not significantly different from zero at the 5 percent significance level

Source: Author's calculations with ENIGH survey 2000-2005

Decile III	GAMA cereals	GAMA vegetables	GAMA dairy products	GAMA meat	GAMA food	GAMA tobbev	GAMA energy	GAMA manufc	GAMA services	GAMA housing	ALFA	BETA
cereals	*0.002* *(0.005)*	*0.002* *(0.003)*	**0.0003** **(0.5)**	**0.0004** **(0.3)**	**-0.005** **(0.1)**	**-0.004** **(0.1)**	*-0.004* *(0.06)*	*-0.002* *(0.03)*	*0.011* *(0.01)*	0.000	*0.387* *(<.0001)*	*-0.042* *(<.0001)*
vegetables		*0.003* *(0.0001)*	*0.002* *(0.0006)*	*0.002* *(0.005)*	**0.002** **(0.3)**	*-0.011* *(<.0001)*	**0.00005** **(0.9)**	*0.002* *(0.02)*	**-0.001** **(0.8)**	0.000	*0.368* *(<.0001)*	*-0.039* *(<.0001)*
dairy products			*0.005* *(<.0001)*	*0.003* *(<.0001)*	*0.009* *(0.015)*	*-0.018* *(<.0001)*	*0.006* *(0.05)*	*0.007* *(<.0001)*	*-0.013* *(0.004)*	0.000	*0.294* *(0.001)*	*-0.029* *(0.008)*
meat				*0.002* *(<.0001)*	*0.006* *(0.0016)*	*-0.010* *(<.0001)*	**-0.001** **(0.3)**	*0.003* *(<.0001)*	*-0.005* *(0.008)*	-0.001	*0.376* *(<.0001)*	*-0.038* *(<.0001)*
processed food					**0.035** **(0.1)**	*-0.037* *(0.004)*	*0.040* *(0.001)*	*0.030* *(<.0001)*	*-0.083* *(0.0016)*	0.005	*-0.665* *(0.008)*	*0.096* *(0.003)*
tobbev						*0.058* *(<.0001)*	*0.014* *(0.03)*	**-0.005** **(0.1)**	**0.001** **(0.9)**	0.012	*-1.863* *(<.0001)*	*0.251* *(<.0001)*
energy							*-0.037* *(0.02)*	**-0.007** **(0.2)**	**0.008** **(0.7)**	-0.018	**0.530** **(0.2)**	**-0.059** **(0.2)**
manufc								*0.010* *(0.002)*	*-0.032* *(0.003)*	-0.006	**0.283** **(0.1)**	**-0.019** **(0.4)**
services									*0.101* *(0.006)*	0.014	**0.799** **(0.1)**	**-0.068** **(0.3)**
housing										-0.005	0.491	-0.054

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The estimates in bold are not significantly different from zero at the 5 percent significance level

Source: Author's calculations with ENIGH survey 2000-2005

Decile IV	GAMA cereals	GAMA vegetables	GAMA dairy products	GAMA meat	GAMA food	GAMA tobbev	GAMA energy	GAMA manufc	GAMA services	GAMA housing	ALFA	BETA
cereals	**-0.0004 (0.7)**	**0.0002 (0.8)**	**-0.0002 (0.8)**	**-0.0002 (0.8)**	**0.001 (0.8)**	**-0.004 (0.5)**	**0.003 (0.4)**	**-0.002 (0.2)**	**0.003 (0.5)**	-0.001	*0.379 (0.002)*	*-0.040 (0.008)*
vegetables		**0.0002 (0.9)**	**0.005 (0.6)**	**-0.0001 (0.8)**	**0.001 (0.7)**	**-0.006 (0.3)**	**0.004 (0.4)**	**-0.002 (0.2)**	**0.004 (0.5)**	-0.002	*0.503 (0.003)*	*-0.055 (0.007)*
dairy products			**0.006 (0.6)**	*0.003 (0.02)*	*0.009 (0.02)*	**-0.009 (0.1)**	**0.002 (0.6)**	*0.008 (0.0007)*	*-0.018 (0.007)*	-0.003	*0.499 (0.0005)*	*-0.054 (0.005)*
meat				**-0.001 (0.4)**	*0.008 (0.03)*	**0.001 (0.9)**	**-0.004 (0.4)**	**-0.001 (0.5)**	**0.001 (0.9)**	-0.006	*0.783 (<.0001)*	*-0.087 (<.0001)*
processed food					*0.031 (0.01)*	**-0.026 (0.1)**	*0.011 (0.03)*	*0.024 (0.005)*	*-0.057 (0.003)*	-0.004	*0.728 (0.01)*	*-0.081 (0.02)*
tobbev						**0.016 (0.7)**	**0.015 (0.5)**	**0.012 (0.2)**	**-0.030 (0.2)**	0.031	*-2.848 (<.0001)*	*0.368 (<.0001)*
energy							**-0.041 (0.1)**	**-0.012 (0.1)**	**0.041 (0.1)**	-0.020	**0.724 (0.2)**	**-0.082 (0.2)**
manufc								*0.014 (0.0007)*	*-0.033 (0.003)*	-0.006	*0.631 (0.001)*	*-0.060 (0.01)*
services									*0.078 (0.01)*	0.011	**0.066 (0.9)**	**0.025 (0.7)**
housing										0.001	-0.464	0.066

The estimates in italics are significantly different from zero at the 5 percent significance level

The values in parentheses are probabilities that the estimates are significantly equal to zero

The estimates in bold are not significantly different from zero at the 5 percent significance level

Source: Author's calculations with ENIGH survey 2000-2005

Decile V	GAMA cereals	GAMA vegetables	GAMA dairy products	GAMA meat	GAMA food	GAMA tobbev	GAMA energy	GAMA manufc	GAMA services	GAMA housing	ALFA	BETA
cereals	**0.005**	**0.0004**	**-0.002**	**-0.002**	*-0.011*	**-0.011**	*0.007*	*0.011*	**0.001**	0.003	*0.109*	*-0.008*
	(0.1)	**(0.8)**	**(0.3)**	**(0.5)**	*(0.05)*	**(0.07)**	*(0.0006)*	*(<.0001)*	**(0.8)**		*(0.0009)*	*(0.02)*
vegetables		**0.016**	*0.015*	*0.030*	**-0.006**	*-0.036*	*-0.009*	*-0.012*	**0.005**	-0.004	*0.430*	*-0.049*
		(0.06)	*(0.01)*	*(0.005)*	**(0.5)**	*(0.002)*	*(0.003)*	*(0.006)*	**(0.5)**		*(<.0001)*	*(<.0001)*
dairy products			*0.013*	*0.020*	**-0.006**	*-0.026*	*-0.005*	*-0.008*	**-0.0003**	-0.001	*0.396*	*-0.045*
			0.007	*(0.007)*	**(0.4)**	*(0.001)*	*(0.02)*	*(0.01)*	**(0.9)**		*(<.0001)*	*(<.0001)*
meat				*0.036*	**-0.022**	*-0.045*	**-0.004**	**-0.007**	**-0.001**	-0.003	*0.496*	*-0.052*
				(0.003)	**(0.09)**	*(0.009)*	**(0.1)**	**(0.1)**	**(0.9)**		*(<.0001)*	*(<.0001)*
processed food					**0.052**	**0.026**	**-0.006**	**-0.011**	**-0.019**	0.005	*2.022*	*-0.236*
					(0.3)	**(0.4)**	**(0.6)**	**(0.4)**	**(0.4)**		*(<.0001)*	*(<.0001)*
tobbev						**-0.071**	*0.050*	*0.047*	**0.043**	0.024	*-3.583*	*0.488*
						(0.09)	*(0.0003)*	*(0.002)*	**(0.09)**		*(<.0001)*	*(<.0001)*
energy							*-0.008*	**-0.005**	**-0.007**	-0.012	**0.022**	**0.005**
							(0.05)	**(0.2)**	**(0.3)**		**(0.8)**	**(0.7)**
manufc								**0.002**	**-0.006**	-0.010	**0.076**	**0.001**
								(0.7)	**(0.5)**		**(0.4)**	**(0.9)**
services									**-0.022**	0.006	*1.230*	*-0.134*
									(0.3)		*(<.0001)*	*(<.0001)*
housing										-0.008	-0.197	0.031

The estimates in italics are significantly different from zero at the 5 percent significance level

The values in parentheses are probabilities that the estimates are significantly equal to zero

The estimates in bold are not significantly different from zero at the 5 percent significance level

Source: Author's calculations with ENIGH survey 2000-2005

Decile VI	GAMA cereals	GAMA vegetables	GAMA dairy products	GAMA meat	GAMA food	GAMA tobbev	GAMA energy	GAMA manufc	GAMA services	GAMA housing	ALFA	BETA
cereals	*0.001* *(0.02)*	*-0.001* *(0.007)*	**-0.002** **(0.1)**	*0.002* *(0.01)*	*-0.004* *(0.01)*	*-0.010* *(0.0003)*	*0.007* *(0.003)*	*-0.003* *(0.04)*	*0.004* *(0.002)*	0.005	**0.011** **(0.9)**	**0.005** **(0.7)**
vegetables		*-0.0003* *(0.002)*	*-0.001* *(0.01)*	**-0.0003** **(0.06)**	*-0.002* *(0.0003)*	**0.0002** **(0.6)**	*0.002* *(0.01)*	**0.001** **(0.2)**	**-0.001** **(0.2)**	0.002	**-0.025** **(0.5)**	**0.009** **(0.1)**
dairy products			**-0.002** **(0.4)**	**0.001** **(0.5)**	**0.003** **(0.4)**	*-0.015* *(0.001)*	*0.021* *(0.001)*	*0.007* *(0.02)*	*-0.019* *(0.01)*	0.006	**0.323** **(0.2)**	**-0.031** **(0.3)**
meat				*0.002* *(0.008)*	**-0.002** **(0.1)**	*-0.013* *(0.0005)*	*0.005* *(0.009)*	*-0.004* *(0.003)*	*0.006* *(0.02)*	0.004	*0.195* *(0.04)*	**-0.014** **(0.2)**
processed food					*0.020* *(0.003)*	*-0.012* *(0.03)*	*0.026* *(0.001)*	*0.014* *(0.001)*	*-0.042* *(0.0001)*	-0.001	*0.836* *(0.02)*	*-0.092* *(0.04)*
tobbev						*0.075* *(<.0001)*	*-0.023* *(0.006)*	*0.018* *(0.004)*	**-0.015** **(0.09)**	-0.004	*-1.193* *(0.002)*	*0.153* *(0.001)*
energy							*-0.029* *(0.002)*	*-0.017* *(0.01)*	*0.034* *(0.02)*	-0.026	*1.349* *(0.03)*	*-0.152* *(0.04)*
manufc								**0.004** **(0.3)**	**-0.003** **(0.7)**	-0.017	*0.931* *(0.01)*	*-0.090* *(0.03)*
services									**-0.006** **(0.7)**	0.041	*-1.737* *(0.03)*	*0.241* *(0.01)*
housing										-0.009	0.309	-0.029

The estimates in italics are significantly different from zero at the 5 percent significance level

The values in parentheses are probabilities that the estimates are significantly equal to zero

The estimates in bold are not significantly different from zero at the 5 percent significance level

Source: Author's calculations with ENIGH survey 2000-2005

Decile VII	GAMA cereals	GAMA vegetables	GAMA dairy products	GAMA meat	GAMA food	GAMA tobbev	GAMA energy	GAMA manufc	GAMA services	GAMA housing	ALFA	BETA
cereals	**-0.0004 (0.7)**	**-0.001 (0.4)**	**-0.0004 (0.7)**	**-0.002 (0.3)**	**-0.001 (0.7)**	*0.008 (0.03)*	**-0.005 (0.09)**	**-0.002 (0.1)**	**0.005 (0.2)**	-0.002	*0.364 (0.02)*	*-0.037 (0.03)*
vegetables		**-0.0004 (0.6)**	**0.002 (0.2)**	**-0.001 (0.4)**	**0.003 (0.1)**	**0.002 (0.5)**	**-0.004 (0.1)**	**0.0003 (0.8)**	**0.001 (0.8)**	-0.002	*0.428 (0.003)*	*-0.044 (0.007)*
dairy products			**0.005 (0.4)**	**0.006 (0.1)**	*0.012 (0.02)*	*-0.035 (<.0001)*	*0.021 (0.01)*	*0.009 (0.01)*	*-0.022 (0.007)*	0.003	**0.200 (0.5)**	**-0.017 (0.6)**
meat				*-0.005 (0.007)*	*0.007 (0.007)*	*0.010 (<.0001)*	*-0.013 (0.002)*	*0.001 (0.0009)*	*0.002 (0.002)*	-0.003	*0.771 (0.0001)*	*-0.081 (0.0003)*
processed food					*0.014 (0.007)*	*-0.038 (<.0001)*	*0.013 (0.02)*	*0.012 (0.0009)*	*-0.023 (0.001)*	0.002	**0.358 (0.09)**	**-0.035 (0.1)**
tobbev						**0.011 (0.4)**	*0.029 (0.008)*	*-0.014 (0.003)*	*0.019 (0.04)*	0.009	*-2.035 (<.0001)*	*0.248 (<.0001)*
energy							*-0.046 (0.008)*	**-0.0001 (0.9)**	**0.012 (0.5)**	-0.007	**0.336 (0.6)**	**-0.032 (0.7)**
manufc								*0.011 (0.01)*	**-0.020 (0.06)**	0.003	**-0.072 (0.8)**	**0.031 (0.5)**
services									**0.031 (0.2)**	-0.005	**1.166 (0.3)**	**-0.102 (0.4)**
housing										0.002	-0.515	0.068

The estimates in italics are significantly different from zero at the 5 percent significance level

The values in parentheses are probabilities that the estimates are significantly equal to zero

The estimates in bold are not significantly different from zero at the 5 percent significance level

Source: Author's calculations with ENIGH survey 2000-2005

Decile VIII	GAMA cereals	GAMA vegetables	GAMA dairy products	GAMA meat	GAMA food	GAMA tobbev	GAMA energy	GAMA manufc	GAMA services	GAMA housing	ALFA	BETA
cereals	**-0.00001 (0.9)**	*0.001 (0.04)*	*0.002 (0.005)*	*0.001 (0.04)*	**0.001 (0.3)**	*-0.006 (0.006)*	**0.001 (0.4)**	**0.001 (0.3)**	**-0.002 (0.6)**	0.000	**0.141 (0.3)**	**-0.012 (0.5)**
vegetables		**0.0005 (0.4)**	0.003 (0.0009)	**0.001 (0.3)**	**0.002 (0.1)**	*-0.007 (0.002)*	**0.001 (0.6)**	**0.001 (0.6)**	**-0.002 (0.7)**	0.000	**0.208 (0.3)**	**-0.018 (0.4)**
dairy products			**-0.00005 (0.8)**	*0.004 (0.003)*	*0.008 (0.005)*	*-0.026 (<.0001)*	*0.008 (0.01)*	*0.014 (<.0001*	*-0.018 (0.003)*	0.006	**0.110 (0.6)**	**-0.007 (0.8)**
meat				**0.001 (0.5)**	**0.004 (0.1)**	*-0.008 (0.01)*	*-0.003 (0.02)*	**-0.001 (0.2)**	**0.002 (0.5)**	0.000	*0.436 (0.002)*	*-0.041 (0.008)*
processed food					**0.005 (0.3)**	*-0.021 (0.0003)*	*0.006 (0.02)*	*0.008 (0.0001)*	*-0.018 (0.01)*	0.005	**0.138 (0.4)**	**-0.010 (0.6)**
tobbev						*0.057 (<.0001)*	*0.005 (0.005)*	**-0.005 (0.1)**	*0.016 (0.05)*	-0.005	*-1.284 (0.0007)*	*0.155 (0.0004)*
energy							*-0.024 (0.004)*	*-0.017 (0.01)*	**0.029 (0.08)**	-0.005	**0.966 (0.2)**	**-0.101 (0.2)**
manufc								**-0.008 (0.2)**	**0.004 (0.8)**	0.004	**1.095 (0.1)**	**-0.099 (0.2)**
services									**0.002 (0.9)**	-0.013	**-0.947 (0.6)**	**0.140 (0.5)**
housing										0.008	0.136	-0.007

The estimates in italics are significantly different from zero at the 5 percent significance level

The values in parentheses are probabilities that the estimates are significantly equal to zero

The estimates in bold are not significantly different from zero at the 5 percent significance level

Source: Author's calculations with ENIGH survey 2000-2005

Decile IX	GAMA cereals	GAMA vegetables	GAMA dairy products	GAMA meat	GAMA food	GAMA tobbev	GAMA energy	GAMA manufc	GAMA services	GAMA housing	ALFA	BETA
cereals	**-0.0003 (0.1)**	*0.0004 (0.04)*	**0.001 (0.3)**	**0.0002 (0.1)**	**-0.0003 (0.6)**	**0.0004 (0.7)**	**-0.003 (0.7)**	**-0.002 (0.3)**	**0.0023 (0.5)**	-0.003	**0.07 (0.1)**	**-0.008 (0.3)**
vegetables		*0.0009 (0.05)*	*0.004 (0.03)*	**-0.0002 (0.7)**	*0.005 (0.005)*	*-0.004 (0.04)*	*-0.004 (0.04)*	**0.003 (0.3)**	**0.001 (0.7)**	-0.006	*0.38 (<.0001)*	*-0.040 (<.0001)*
dairy products			*0.070 (0.0006)*	*-0.008 (0.006)*	*0.042 (0.0002)*	**-0.06 (0.4)**	**-0.011 (0.4)**	*0.078 (0.0001)*	*-0.092 (0.002)*	-0.032	**0.137 (0.6)**	**0.002 (0.7)**
meat				***-0.001 (0.2)***	**-0.001 (0.4)**	*0.002 (0.01)*	*-0.004 (0.02)*	*-0.012 (<.0001)*	*0.023 (<.0001)*	-0.005	*0.566 (<.0001)*	*-0.055 (<.0001)*
processed food					*0.024 (0.001)*	*-0.04 (0.0002)*	**-0.003 (0.6)**	*0.057 (<.0001)*	*-0.06 (0.0004)*	-0.014	**0.18 (0.2)**	**-0.006 (0.3)**
tobbev						*0.066 (0.003)*	**-0.004 (0.9)**	*-0.077 (0.0006)*	*0.097 (0.004)*	0.012	*-1.181 (0.0006)*	*0.115 (0.0003)*
energy							**-0.001 (0.2)**	**0.013 (0.5)**	**-0.032 (0.3)**	0.018	**-0.284 (0.6)**	**0.037 (0.5)**
manufc								*0.115 (0.0003)*	*-0.128 (0.003)*	-0.030	**0.482 (0.2)**	**-0.020 (0.5)**
services									*0.161 (0.02)*	0.043	**0.417 (0.5)**	**-0.01 (0.9)**
housing										0.017	0.277	-0.024

The estimates in italics are significantly different from zero at the 5 percent significance level

The values in parentheses are probabilities that the estimates are significantly equal to zero

The estimates in bold are not significantly different from zero at the 5 percent significance level

Source: Author's calculations with ENIGH survey 2000-2005

Decile X	GAMA cereals	GAMA vegetables	GAMA dairy products	GAMA meat	GAMA food	GAMA tobbev	GAMA energy	GAMA manufc	GAMA services	GAMA housing	ALFA	BETA
cereals	**0.00009 (0.1)**	*0.0003 (0.005)*	*0.001 (0.005)*	*0.0003 (0.001)*	*-0.0004 (0.0001)*	*0.002 (0.004)*	*-0.001 (0.05)*	*-0.002 (0.007)*	*-0.001 (0.04)*	0.001	**-0.029 (0.7)**	**0.004 (0.5)**
vegetables		**0.0002 (0.1)**	*0.002 (<.0001)*	**0.00005 (0.6)**	**0.00006 (0.7)**	**-0.001 (0.2)**	**-0.001 (0.07)**	**-0.001 (0.12)**	**-0.002 (0.1)**	0.003	**0.000 (0.9)**	**0.002 (0.8)**
dairy products			-0.022 *(<.0001)*	0.001 (0.0002)	*0.003 (0.0002)*	*-0.008 (0.02)*	**0.004 (0.07)**	*0.018 (<.0001)*	**-0.00002 (0.9)**	0.000	**-0.202 (0.4)**	**0.023 (0.4)**
meat				*0.0003 (0.02)*	*-0.0004 (0.001)*	*0.003 (0.001)*	*-0.001 (0.03)*	*-0.003 (0.001)*	*-0.002 (0.03)*	0.002	**-0.013 (0.8)**	**0.005 (0.6)**
processed food					*0.0005 (0.03)*	*-0.007 (<.0001)*	*0.002 (0.03)*	*0.003 (<.0001)*	**-0.002 (0.09)**	0.002	**0.060 (0.5)**	**-0.003 (0.7)**
tobbev						**0.066 (0.5)**	-0.014 (0.01)	-0.035 *(<.0001)*	**-0.005 (0.5)**	0.000	**-0.594 (0.4)**	**0.069 (0.3)**
energy							**0.004 (0.5)**	**0.002 (0.7)**	*0.025 (0.01)*	-0.018	**0.714 (0.4)**	**-0.066 (0.5)**
manufc								**0.009 (0.2)**	**0.019 (0.08)**	-0.011	**1.436 (0.2)**	**-0.113 (0.3)**
services									*-0.059 (0.007)*	0.027	**-0.955 (0.6)**	**0.131 (0.5)**
housing										-0.005	0.583	-0.051

The estimates in italics are significantly different from zero at the 5 percent significance level

The values in parentheses are probabilities that the estimates are significantly equal to zero

The estimates in bold are not significantly different from zero at the 5 percent significance level

Source: Author's calculations with ENIGH survey 2000-2005

Appendix D. Expenditure/Income Elasticities for Ten Households in Mexico

Commodity	*decile I*	*decile II*	*decile III*	*decile IV*	*decile V*	*decile VI*	*decile VII*	*decile VIII*	*decile IX*	*decile X*	*Average Mexico*[a]
cereals	*0.459*	**0.157**	*0.304*	**0.339**	*0.568*	*1.104*	**-0.178**	**-0.019**	*0.843*	**0.109**	0.36
	(<.0001)	**(0.13)**	*(0.006)*	**(0.30)**	*(0.001)*	*(0.001)*	**(0.2)**	**(0.39)**	*(0.0005)*	**(0.96)**	
vegetables	*0.510*	*1.752*	**0.316**	**0.128**	*0.415*	*1.175*	**0.088**	*0.156*	**-0.072**	*0.234*	0.504
	(<.0001)	*(<.0001)*	**(0.06)**	**(0.97)**	*(0.0005)*	*(<.0001)*	**(0.83)**	*(0.02)*	**(0.15)**	*(<.0001)*	
dairy products	*0.392*	*0.322*	*0.493*	**0.192**	*-1.011*	**0.325**	*1.243*	*1.265*	**0.691**	**5.171**	0.68
	(<.0001)	*(0.009)*	*(0.009)*	**(0.65)**	*(<.0001)*	**(0.66)**	*(<.0001)*	*(0.0001)*	**(0.43)**	**(0.51)**	
meat	*0.415*	*2.444*	*0.507*	**-0.029**	*0.667*	*0.825*	*-0.107*	**0.319**	*0.175*	*0.414*	0.63
	(<.0001)	*(<.0001)*	*(<.0001)*	**(0.75)**	*(0.001)*	*(<.0001)*	*(0.05)*	**(0.51)**	*(0.05)*	*(0.023)*	
processed food	*2.061*	*0.813*	*2.405*	**-0.087**	*-0.271*	**-0.606**	*1.520*	*2.172*	**0.653**	*1.886*	1.19
	(<.0001)	*(<.0001)*	*(<.0001)*	**(0.49)**	*(<.0001)*	**(0.41)**	*(<.0001)*	*(<.0001)*	**(0.09)**	*(<.0001)*	
tobbev	*1.256*	**0.074**	*0.815*	*0.605*	*1.051*	*0.501*	*1.221*	*1.012*	*0.891*	*1.111*	1.19
	(<.0001)	**(0.14)**	*(<.0001)*	*(<.0001)*	*(<.0001)*	*(<.0001)*	*(<.0001)*	*(<.0001)*	*(<.0001)*	*(0.04)*	
energy	*0.554*	*0.121*	**0.054**	**-0.128**	*1.176*	**-1.218**	*1.934*	*1.042*	*1.611*	**1.513**	0.63
	(<.0001)	*(0.01)*	**(0.27)**	**(0.53)**	*(0.0006)*	**(0.57)**	*(0.0057)*	*(0.02)*	*(0.04)*	**(0.09)**	
manufc	*1.316*	**-0.065**	*0.841*	*4.714*	*1.055*	*0.550*	*1.208*	*2.352*	*0.897*	*-1.447*	0.81
	(0.001)	**(0.83)**	*(0.0002)*	*(0.0002)*	*(0.0003)*	*(0.01)*	*(<.0001)*	*(<.0001)*	*(<.0001)*	*(0.0023)*	
services	*1.625*	*1.313*	**0.742**	*1.094*	*-1.360*	*2.024*	**0.336**	**0.335**	*0.962*	*1.902*	0.91
	(<.0001)	*(<.0001)*	**(0.08)**	*(0.0196)*	*(<.0001)*	*(<.0001)*	**(0.55)**	**(0.22)**	*(0.003)*	*(<.0001)*	
housing	1.753	-0.484	0.232	2.058	2.005	1.742	2.774	2.774	0.601	-2.546	1.31

The estimates in italics are significantly different from zero at the 5 percent significance level

The values in parentheses are probabilities that the estimates are significantly equal to zero

The estimates in bold are not significantly different from zero at the 5 percent significance level

Source: Author's calculations with ENIGH survey 2000-2005; [a]SEALE et al. (2003)

Appendix E. Uncompensated Own-price Elasticities for Household Deciles in Mexico

Commodity	*decile I*	*decile II*	*decile III*	*decile IV*	*decile V*	*decile VI*	*decile VII*	*decile VIII*	*decile IX*	*decile X*	*Average Mexico*[a]
cereals	*-0.964* *(<.0001)*	*-0.944* *(<.0001)*	*-0.939* *(<.0001)*	*-0.968* *(<.0001)*	*-1.773* *(0.0008)*	*-0.973* *(<.0001)*	*-0.851* *(<.0001)*	*-0.961* *(<.0001)*	*-1.018* *(<.0001)*	*-1.000* *(<.0001)*	-0.29
vegetables	*-1.116* *(<.0001)*	*-1.123* *(<.0001)*	*-0.979* *(<.0001)*	*-0.943* *(<.0001)*	*-0.650* *(0.02)*	*-1.015* *(<.0001)*	*-0.945* *(<.0001)*	*-0.943* *(<.0001)*	*-0.934* *(<.0001)*	*-0.948* *(<.0001)*	-0.41
dairy products	*-0.871* *(<.0001)*	*-0.941* *(<.0001)*	*-0.906* *(<.0001)*	*-0.835* *(<.0001)*	*-0.918* *(<.0001)*	*-1.019* *(<.0001)*	*-0.761* *(<.0001)*	**-0.227** **(0.15)**	*-1.120* *(0.03)*	*-1.990* *(<.0001)*	-0.55
meat	*-0.806* *(<.0001)*	*-1.178* *(<.0001)*	*-0.939* *(<.0001)*	*-0.931* *(<.0001)*	*-1.322* *(<.0001)*	*-0.959* *(<.0001)*	*-0.935* *(<.0001)*	*-0.976* *(<.0001)*	*-0.978* *(<.0001)*	*-0.994* *(<.0001)*	-0.51
processed food	**-1.056** **(0.39)**	*-0.888* *(<.0001)*	*-0.533* *(0.007)*	**-0.393** **(0.07)**	**-4.017** **(0.49)**	*-0.551* *(0.0014)*	**-0.122** **(0.13)**	*-0.439* *(0.0004)*	*-0.401* *(0.01)*	*-1.066* *(<.0001)*	-0.89
tobbev	*-0.952* *(<.0001)*	*-0.596* *(<.0001)*	*-0.743* *(<.0001)*	*-1.202* *(0.015)*	*-0.727* *(0.001)*	**-0.335** **(0.06)**	*-0.648* *(<.0001)*	*-0.741* *(<.0001)*	*-0.583* *(0.001)*	**-0.970** **(0.06)**	-0.80
energy	*-1.816* *(0.0004)*	*-0.905* *(<.0001)*	*-1.123* *(<.0001)*	*-1.235* *(<.0001)*	**-0.852** **(0.13)**	*-1.106* *(<.0001)*	*-1.024* *(<.0001)*	*-1.046* *(<.0001)*	**-0.697** **(0.06)**	*-1.277* *(0.0007)*	-0.51
manufc	*-2.083* *(0.0033)*	**-0.021** **(0.85)**	*-0.903* *(<.0001)*	*-0.857* *(<.0001)*	*-1.011* *(0.05)*	*-0.889* *(<.0001)*	*-0.881* *(<.0001)*	*-1.018* *(<.0001)*	*-0.566* *(<.0001)*	*-1.075* *(0.0003)*	-0.65
services	*-1.900* *(0.02)*	**-0.090** **(0.42)**	**-0.352** **(0.08)**	*-0.665* *(0.01)*	*-2.746* *(0.002)*	*-1.266* *(<.0001)*	**-0.254** **(0.14)**	**0.505** **(0.07)**	*-0.418* *(0.05)*	*-2.289* *(<.0001)*	-0.69
housing	-1.058	-0.863	-0.710	-0.499	-1.062	-1.008	-0.464	-0.878	-0.593	-0.621	-0.92

The estimates in italics are significantly different from zero at the 5 percent significance level

The values in parentheses are probabilities that the estimates are significantly equal to zero

The estimates in bold are not significantly different from zero at the 5 percent significance level

Source: Author's calculations with ENIGH survey 2000-2005; [a]SEALE et al. (2003)

Appendix F. Marshallian and Hicksian Demand Elasticities for Household Deciles in Mexico

DECILE I	Marshallian Elasticity Matrix									
	with respect to the price of									
Elasticity of demand for	Cereals	Vegetables	Dairy products	Meat	Proc Food	Tobbev	Energy	Manufc	Services	Housing
Cereals	*-0.964*	*-0.072*	**-0.024**	**-0.007**	**-0.086**	**-0.045**	**0.030**	*0.173*	*0.405*	-0.100
Vegetables	*-0.073*	*-1.116*	*-0.128*	*0.132*	**0.069**	*0.163*	**0.094**	**0.099**	**0.114**	-0.093
Dairy products	**-0.014**	*-0.096*	*-0.871*	*-0.059*	**0.047**	*0.131*	*0.283*	*-0.285*	**0.357**	-0.151
Meat	**-0.011**	*0.095*	*-0.063*	**-0.806**	**-0.319**	**-0.038**	**-0.126**	*0.147*	*0.553*	-0.214
Proc Food	**-0.170**	**-0.041**	**-0.085**	*-0.532*	**-1.056**	*-0.631*	*-0.740*	*1.489*	**-0.314**	0.270
Tobbev	**-0.010**	*0.118*	*0.106*	**-0.001**	*-0.283*	*-0.952*	**0.026**	**0.046**	*0.646*	0.333
Energy	**-0.015**	**0.015**	**0.093**	**-0.099**	**-0.236**	**-0.057**	*-1.816*	*0.494*	*0.890*	-0.675
Manufc	**0.079**	**0.030**	**-0.355**	**0.096**	1.449	**-0.061**	*0.969*	*-2.083*	*-1.723*	-0.307
Services	**0.132**	**-0.030**	**0.062**	*0.190*	**0.093**	*0.254*	*0.735*	*-0.817*	*-1.900*	0.096
Housing	-0.162	-0.168	-0.270	-0.341	0.530	0.481	-0.586	-0.579	0.348	
	Hicksian Elasticity Matrix									
Cereals	*-0.943*	*-0.050*	**0.000**	**0.018**	**-0.033**	**-0.018**	**0.046**	*0.214*	*0.581*	-0.075
Vegetables	*-0.044*	*-1.085*	*-0.096*	*0.165*	**0.139**	*0.198*	**0.116**	**0.151**	**0.114**	-0.061
Dairy products	**0.001**	*-0.079*	*-0.852*	*-0.039*	**0.089**	*0.153*	*0.296*	*-0.254*	**0.464**	-0.131
Meat	**0.009**	*0.118*	*-0.037*	**-0.788**	**-0.262**	**-0.009**	**-0.108**	*0.190*	*0.696*	-0.189
Proc Food	**-0.092**	**0.050**	**0.016**	*-0.428*	**-0.834**	*-0.517*	*-0.670*	*1.657*	**0.248**	0.373
Tobbev	**0.161**	*0.210*	*0.278*	**0.079**	*-0.229*	*-0.922*	**0.459**	**0.643**	*5.264*	0.413
Energy	**0.060**	**0.046**	**0.127**	**-0.075**	**-0.160**	**-0.018**	*-1.793*	*0.551*	*1.081*	-0.641
Manufc	**0.078**	**0.029**	**-0.355**	**0.096**	*1.447*	**-0.061**	*0.969*	*-2.084*	*-1.726*	-0.308
Services	**0.212**	**0.046**	**0.146**	*0.249*	**0.278**	*0.349*	*0.794*	*-0.677*	*-1.432*	0.182
Housing	-0.066	-0.060	-0.146	-0.214	0.755	0.657	-0.500	-0.426	0.657	

The estimates in bold are not significantly different from zero at the 5 percent significance level

The estimates in italics are significantly different from zero at the 5 percent significance level

Source: Author's calculations with ENIGH survey 2000-2005

DECILE II	Marshallian Elasticity Matrix									
Elasticity of demand for	with respect to the price of									
	Cereals	Vegetables	Dairy products	Meat	Proc Food	Tobbev	Energy	Manufc	Services	Housing
Cereals		*0.148*	*0.061*	*0.271*	*0.067*	**0.019**	*0.076*	**-0.007**	*0.114*	0.802
Vegetables	*-0.034*		*-0.043*	*-0.203*	*-0.039*	**-0.011**	**-0.040**	**0.072**	*-0.415*	-0.635
Dairy products	*0.052*	*0.109*		*0.249*	**0.027**	**0.014**	*0.068*	*-0.069*	*0.129*	0.640
Meat	**-0.036**	*-0.271*	**-0.035**		*-0.220*	*-0.153*	**-0.023**	*-0.256*	*-0.410*	-1.217
Proc Food	**-0.002**	*0.084*	**-0.016**	**-0.033**		*0.058*	**-0.010**	*0.282*	*-0.289*	0.146
Tobbev	**0.012**	*0.152*	**0.015**	**-0.141**	*0.177*		**-0.104**	*0.426*	*-0.485*	0.788
Energy	*0.054*	*0.140*	*0.057*	*0.295*	*0.048*	**-0.050**		**-0.041**	*0.139*	0.729
Manufc	**0.009**	*0.350*	**-0.034**	**-0.093**	*0.492*	*0.285*	**-0.019**		*-0.941*	0.474
Services	*-0.203*	*-0.172*	**-0.026**	**-0.086**	*0.057*	*-0.151*	**-0.035**	*-0.444*		-0.397
Housing	0.766	-0.991	0.626	-2.352	0.391	1.067	0.833	0.515	-0.682	
	Hicksian Elasticity Matrix									
Cereals		*0.157*	*0.065*	*0.282*	*0.075*	**0.024**	*0.081*	**-0.001**	*0.416*	0.806
Vegetables	*0.211*		*0.065*	*0.074*	*0.159*	**0.102**	**0.088**	**0.226**	*-0.415*	-0.515
Dairy products	*0.068*	*0.147*		*0.291*	**0.057**	**0.032**	*0.088*	*-0.045*	*0.175*	0.658
Meat	**0.115**	*0.071*	**0.116**		*0.056*	*0.004*	**0.157**	*-0.042*	*0.013*	-1.050
Proc Food	**0.049**	*0.199*	**0.035**	**0.097**		*0.111*	**0.050**	*0.355*	*-0.147*	0.202
Tobbev	**0.020**	*0.157*	**0.024**	**-0.130**	*0.182*		**-0.091**	*0.559*	*-0.145*	0.793
Energy	*0.067*	*0.157*	*0.064*	*0.304*	*0.061*	*-0.042*		**-0.030**	*0.159*	0.737
Manufc	**0.047**	*0.428*	**0.000**	**-0.052**	*0.554*	**0.321**	**0.022**		*-0.845*	0.512
Services	*-0.191*	*0.022*	**0.060**	**0.016**	*0.214*	*-0.062*	**0.066**	*-0.322*		-0.302
Housing	0.736	-1.058	0.596	-2.428	0.336	1.025	0.797	0.484	1.025	

The estimates in bold are not significantly different from zero at the 5 percent significance level

The estimates in italics are significantly different from zero at the 5 percent significance level

Source: Author's calculations with ENIGH survey 2000-2005

DECILE III	Marshallian Elasticity Matrix									
Elasticity of demand for	with respect to the price of									
	Cereals	Vegetables	Dairy products	Meat	Proc Food	Tobbev	Energy	Manufc	Services	Housing
Cereals		*0.082*	*0.038*	*0.058*	**0.024**	*0.054*	**0.017**	*0.067*	*0.248*	0.356
Vegetables	*0.085*		*0.073*	*0.086*	*0.106*	*-0.089*	*0.096*	*0.141*	*0.140*	0.380
Dairy products	*0.025*	*0.056*		*0.082*	*0.150*	*-0.207*	*0.144*	*0.188*	**-0.076**	0.285
Meat	*0.030*	*0.048*	*0.061*		*0.111*	*-0.045*	*0.046*	*0.119*	**0.030**	0.280
Proc Food	*-0.101*	**-0.029**	**0.024**	**-0.015**		*-0.709*	*0.451*	*0.139*	*-1.591*	-0.338
Tobbev	*-0.182*	*-0.276*	*-0.366*	*-0.330*	*-0.644*		*-0.257*	*-0.533*	*-0.595*	0.126
Energy	**-0.004**	**0.027**	**0.063**	**0.027**	*0.335*	*0.146*		**0.039**	**0.063**	0.269
Manufc	**-0.007**	**0.019**	*0.051*	*0.034*	*0.159*	**-0.013**	**-0.013**		*-0.157*	-0.982
Services	**0.086**	**0.013**	**-0.038**	**-0.007**	*0.063*	**0.030**	**0.010**	**-0.109**		0.199
Housing	0.299	0.318	0.264	0.310	-0.403	0.236	0.270	-1.359	0.236	
	Hicksian Elasticity Matrix									
Cereals		*0.102*	*0.060*	*0.085*	**0.053**	*0.089*	**0.042**	*0.113*	*0.330*	0.332
Vegetables	*0.104*		*0.094*	*0.112*	*0.133*	*-0.056*	*0.120*	*0.184*	*0.159*	0.357
Dairy products	*0.058*	*0.088*		*0.125*	*0.196*	*-0.151*	*0.184*	*0.262*	**0.065**	0.245
Meat	*0.060*	*0.078*	*0.095*		*0.155*	*0.007*	*0.083*	*0.188*	**0.162**	0.244
Proc Food	*0.024*	**0.095**	**0.161**	**0.149**		*-0.496*	*0.603*	*0.420*	*-1.056*	-0.487
Tobbev	*-0.112*	*-0.217*	*-0.296*	*-0.265*	*-0.584*		*-0.045*	**-0.533**	**-0.595**	0.067
Energy	**0.000**	**0.030**	**0.067**	**0.031**	*0.340*	*0.152*		*0.046*	*0.077*	0.265
Manufc	**0.256**	**0.236**	*0.293*	*0.301*	*0.471*	**0.361**	**0.254**		*0.785*	-1.245
Services	**0.152**	**0.061**	**0.015**	**0.053**	*0.132*	**0.113**	**0.070**	**0.000**		0.141
Housing	0.285	0.304	0.249	0.292	-0.423	0.205	0.253	-1.382	0.657	

The estimates in bold are not significantly different from zero at the 5 percent significance level

The estimates in italics are significantly different from zero at the 5 percent significance level

Source: Author's calculations with ENIGH survey 2000-2005

DECILE IV	Marshallian Elasticity Matrix									
Elasticity of demand for	with respect to the price of									
	Cereals	Vegetables	Dairy products	Meat	Proc Food	Tobbev	Energy	Manufc	Services	Housing
Cereals		**0.045**	**0.039**	*0.061*	**0.053**	**0.004**	*0.159*	*0.086*	**0.224**	-0.317
Vegetables	*0.058*		*0.074*	*0.079*	**0.080**	**-0.016**	*0.214*	*0.120*	**0.292**	-0.440
Dairy products	*0.043*	*0.061*		*0.122*	*0.208*	**-0.057**	*0.150*	*0.275*	**-0.102**	-0.416
Meat	*0.054*	*0.053*	*0.095*		*0.162*	**0.108**	*0.093*	*0.155*	*0.228*	-0.565
Proc Food	**0.083**	**0.094**	*0.241*	*0.261*		**-0.305**	*0.366*	*0.633*	*-0.662*	-0.571
Tobbev	*-0.246*	*-0.276*	*-0.324*	*-0.320*	*-0.501*		**-0.349**	*-0.505*	*-1.153*	-0.193
Energy	**0.060**	**0.069**	**0.053**	**0.026**	**0.122**	**0.173**		**0.007**	**0.453**	-0.823
Manufc	**0.008**	**0.005**	*0.070*	**0.025**	*0.171*	*0.108*	**-0.028**		**-0.127**	2.373
Services	**0.079**	**0.013**	*-0.089*	*-0.007*	*0.053*	**-0.151**	*0.178*	*-0.174*		0.154
Housing	-0.307	-0.447	-0.447	-0.772	-0.688	-0.471	-0.959	3.790	-0.471	
	Hicksian Elasticity Matrix									
Cereals		**0.066**	**0.062**	*0.090*	**0.078**	**0.038**	*0.184*	*0.137*	**0.258**	-0.338
Vegetables	*0.066*		*0.082*	*0.090*	**0.089**	**-0.003**	*0.223*	*0.139*	**0.292**	-0.448
Dairy products	*0.055*	*0.073*		*0.138*	*0.222*	**-0.038**	*0.164*	*0.304*	**-0.051**	-0.428
Meat	*0.053*	*0.051*	*0.093*		*0.160*	**0.105**	*0.091*	*0.151*	*0.220*	-0.563
Proc Food	**0.077**	**0.089**	*0.236*	*0.253*		**-0.314**	*0.360*	*0.620*	*-0.685*	-0.565
Tobbev	*-0.202*	*-0.238*	*-0.280*	*-0.269*	*-0.457*		**-0.188**	*-0.041*	*1.405*	-0.230
Energy	**0.050**	**0.061**	**0.045**	**0.017**	**0.113**	**0.160**		**-0.013**	**0.419**	-0.815
Manufc	**0.307**	**0.300**	*0.381*	**0.370**	*0.516*	*0.588*	**0.317**		**1.125**	2.081
Services	**0.130**	**0.081**	*-0.017*	*0.073*	*0.133*	**-0.040**	*0.258*	*-0.009*		0.086
Housing	-0.431	-0.577	-0.584	-0.947	-0.842	-0.782	-1.107	3.586	0.111	

The estimates in bold are not significantly different from zero at the 5 percent significance level

The estimates in italics are significantly different from zero at the 5 percent significance level

Source: Author's calculations with ENIGH survey 2000-2005

DECILE V	Marshallian Elasticity Matrix									
Elasticity of demand for	with respect to the price of									
	Cereals	Vegetables	Dairy products	Meat	Proc Food	Tobbev	Energy	Manufc	Services	Housing
Cereals		**-0.256**	**-0.255**	*-1.052*	*2.870*	**-0.583**	**-0.145**	**-0.560**	**-0.369**	0.063
Vegetables	**-0.306**		**0.206**	*0.171*	*-1.483*	*2.692*	**-0.106**	**-0.306**	**0.108**	-0.239
Dairy products	**-0.346**	**0.252**		**0.006**	**-0.370**	*2.171*	**0.148**	**-0.076**	**-0.792**	-0.175
Meat	*-0.532*	**0.047**	**-0.025**		**0.565**	*0.591*	**-0.113**	*-0.445*	**-0.327**	-0.117
Proc Food	*2.614*	*-0.778*	**-0.075**	**1.373**		**1.975**	**1.488**	**3.063**	*5.311*	-0.180
Tobbev	*-0.071*	*0.053*	**0.018**	**-0.029**	**-0.211**		*-0.231*	*-0.281*	*-0.401*	-0.081
Energy	**-0.087**	**-0.075**	**0.005**	**-0.150**	**0.554**	*-1.672*		**0.098**	*1.074*	-0.139
Manufc	**-0.220**	**-0.120**	*-0.057*	*-0.359*	**1.060**	*-1.466*	**0.083**		*0.846*	1.246
Services	**0.171**	**0.051**	**-0.191**	**-0.144**	*0.005*	**-1.076**	*1.008*	*1.066*		-0.083
Housing	0.074	-0.353	-0.253	-0.315	-1.140	-0.183	-0.218	3.850	-0.183	
	Hicksian Elasticity Matrix									
Cereals		**-0.219**	**-0.219**	*-0.982*	*3.024*	**-0.471**	**-0.102**	**-0.498**	**-0.286**	0.032
Vegetables	**-0.285**		**0.227**	*0.212*	*-1.394*	*2.757*	**-0.080**	**-0.271**	**0.108**	-0.243
Dairy products	**-0.333**	**0.268**		**0.035**	**-0.305**	*2.217*	**0.166**	**-0.051**	**-0.733**	-0.182
Meat	*-0.503*	**0.082**	**0.009**		**0.708**	*0.694*	**-0.072**	*-0.388*	**-0.195**	-0.135
Proc Food	*2.603*	*-0.792*	**-0.089**	**1.346**		**1.933**	**1.472**	**3.039**	*5.257*	-0.180
Tobbev	*0.154*	*0.097*	**0.243**	**0.073**	**-0.146**		*-0.023*	*1.542*	*6.992*	-0.119
Energy	**0.165**	**-0.014**	**0.064**	**-0.078**	**0.807**	*-1.488*		**0.200**	*1.307*	-0.179
Manufc	**0.016**	**0.176**	*0.230*	*-0.010*	**2.285**	*-0.578*	**0.431**		*1.975*	1.050
Services	**0.273**	**0.059**	**-0.183**	**-0.135**	*0.038*	**-1.052**	*1.018*	*1.079*		-0.097
Housing	-0.007	-0.454	-0.352	-0.500	-1.573	-0.338	-0.326	3.639	-0.856	

The estimates in bold are not significantly different from zero at the 5 percent significance level

The estimates in italics are significantly different from zero at the 5 percent significance level

Source: Author's calculations with ENIGH survey 2000-2005

DECILE VI	Marshallian Elasticity Matrix									
Elasticity of demand for	with respect to the price of									
	Cereals	Vegetables	Dairy products	Meat	Proc Food	Tobbev	Energy	Manufc	Services	Housing
Cereals		**-0.017**	**-0.039**	**0.029**	*-0.089*	*-0.250*	*0.143*	*-0.086*	**0.065**	0.157
Vegetables	*-0.019*		*-0.031*	*-0.020*	*-0.059*	**-0.012**	*0.030*	**-0.024**	**-0.070**	0.074
Dairy products	**-0.003**	**0.009**		**0.064**	**0.104**	*-0.253*	*0.534*	*0.289*	**-0.240**	0.297
Meat	*0.029*	**0.005**	**0.017**		**-0.019**	*-0.153*	*0.092*	**-0.016**	*0.121*	0.159
Proc Food	**0.007**	**0.036**	**0.128**	**0.083**		**-0.063**	*0.629*	*0.571*	**-0.354**	0.388
Tobbev	*-0.188*	*-0.079*	*-0.238*	*-0.267*	*-0.227*		*-0.447*	*-0.140*	*-0.556*	0.092
Energy	*0.118*	*0.087*	*0.251*	*0.149*	*0.304*	**-0.085**		**0.118**	*0.621*	0.224
Manufc	**0.005**	*0.025*	*0.057*	**0.014**	*0.098*	*0.130*	**-0.034**		**0.091**	-0.371
Services	**-0.020**	*-0.055*	*-0.126*	**-0.052**	*0.251*	*-0.156*	**0.030**	*-0.216*		0.012
Housing	0.110	0.055	0.251	0.179	0.357	0.237	0.220	-0.493	0.237	
	Hicksian Elasticity Matrix									
Cereals		**0.040**	**0.024**	**0.114**	*-0.020*	*-0.147*	*0.218*	*0.110*	**0.400**	0.080
Vegetables	*0.042*		*0.037*	*0.072*	*0.015*	**0.099**	*0.112*	**0.187**	**-0.070**	-0.009
Dairy products	**0.020**	**0.034**		**0.101**	**0.134**	*-0.209*	*0.566*	*0.374*	**-0.106**	0.264
Meat	*0.069*	**0.048**	**0.065**		**0.034**	*-0.076*	*0.149*	**0.132**	*0.357*	0.102
Proc Food	**-0.014**	**0.014**	**0.103**	**0.049**		**-0.103**	*0.600*	*0.494*	**-0.476**	0.418
Tobbev	*-0.156*	*-0.043*	*-0.206*	*-0.227*	*-0.193*		*-0.304*	*0.269*	*1.183*	0.057
Energy	*0.041*	*0.024*	*0.180*	*0.065*	*0.227*	**-0.200**		**-0.100**	*0.273*	0.309
Manufc	**0.192**	*0.162*	*0.211*	**0.197**	*0.266*	*0.379*	**0.149**		**0.846**	-0.556
Services	**0.019**	*0.041*	*-0.019*	**0.076**	*0.368*	*0.017*	**0.158**	*0.114*		-0.116
Housing	0.081	0.024	0.216	0.133	0.319	0.131	0.179	-0.548	-0.118	

The estimates in bold are not significantly different from zero at the 5 percent significance level

The estimates in italics are significantly different from zero at the 5 percent significance level

Source: Author's calculations with ENIGH survey 2000-2005

DECILE VII	Marshallian Elasticity Matrix									
Elasticity of demand for	with respect to the price of									
	Cereals	Vegetables	Dairy products	Meat	Proc Food	Tobbev	Energy	Manufc	Services	Housing
Cereals		*0.079*	*-0.153*	*0.119*	*-0.288*	*0.381*	*0.042*	*-0.180*	*1.094*	-0.444
Vegetables	*0.066*		*0.046*	*0.092*	**-0.026**	*0.122*	*0.034*	*0.129*	*0.415*	-0.501
Dairy products	*-0.200*	**-0.010**		**0.031**	*0.920*	*-1.151*	**0.005**	*1.236*	*-2.098*	-0.055
Meat	*0.067*	*0.063*	*0.082*		*0.063*	**0.079**	*0.036*	*0.054*	*0.643*	-0.618
Proc Food	*-0.295*	*-0.088*	*0.765*	**-0.034**		*-0.870*	**-0.024**	*1.368*	*-2.827*	-0.257
Tobbev	**0.050**	*-0.055*	*-0.583*	*-0.131*	*-0.523*		**-0.047**	*-0.916*	*0.712*	0.177
Energy	*-0.056*	*-0.055*	**-0.013**	*-0.098*	**-0.016**	**0.044**		**-0.107**	**-0.234**	-0.335
Manufc	*-0.093*	*-0.026*	**0.267**	*-0.078*	*0.364*	*-0.303*	**-0.014**		*-0.400*	1.586
Services	*0.092*	*0.059*	*-0.337*	*0.151*	*-0.013*	*0.492*	*0.031*	*-0.153*		-0.150
Housing	-0.291	-0.346	-0.044	-0.656	-0.210	0.504	-0.307	2.309	0.504	
	Hicksian Elasticity Matrix									
Cereals		*0.076*	*-0.157*	*0.113*	*-0.292*	*0.373*	*0.037*	*-0.194*	*1.119*	-0.457
Vegetables	*0.071*		*0.050*	*0.099*	**-0.021**	*0.131*	*0.039*	*0.146*	*0.415*	-0.506
Dairy products	*-0.145*	**0.047**		**0.119**	*0.988*	*-1.029*	**0.082**	*1.472*	*-1.750*	-0.103
Meat	*0.062*	*0.058*	*0.076*		*0.057*	**0.068**	*0.030*	*0.033*	*0.612*	-0.611
Proc Food	*-0.227*	*-0.018*	*0.847*	**0.075**		*-0.718*	**0.071**	*1.662*	*-2.395*	-0.283
Tobbev	**0.118**	*0.030*	*-0.514*	*-0.042*	*-0.445*		**0.308**	*0.100*	*4.336*	0.097
Energy	*0.053*	*0.037*	**0.093**	*0.026*	**0.092**	**0.241**		**0.274**	**0.328**	-0.370
Manufc	*0.078*	*0.091*	**0.401**	*0.079*	*0.501*	*-0.052*	**0.143**		*0.314*	1.346
Services	*0.182*	*0.080*	*-0.313*	*0.179*	*0.011*	*0.536*	*0.059*	*-0.068*		-0.195
Housing	-0.381	-0.440	-0.153	-0.802	-0.322	0.114	-0.432	2.110	-1.207	

The estimates in bold are not significantly different from zero at the 5 percent significance level

The estimates in italics are significantly different from zero at the 5 percent significance level

Source: Author's calculations with ENIGH survey 2000-2005

DECILE VIII	Marshallian Elasticity Matrix									
Elasticity of demand for	with respect to the price of									
	Cereals	Vegetables	Dairy products	Meat	Proc Food	Tobbev	Energy	Manufc	Services	Housing
Cereals		*0.044*	*0.056*	*0.081*	*-0.030*	*0.219*	*0.036*	*0.223*	*0.397*	0.089
Vegetables	*0.046*		**0.022**	*0.081*	*-0.022*	*0.263*	*0.042*	*0.197*	*0.646*	0.094
Dairy products	**-0.003**	**-0.045**		**0.075**	*0.945*	*-1.493*	**0.002**	*1.314*	*-3.464*	0.205
Meat	*0.039*	*0.035*	*0.101*		*0.106*	*0.085*	*0.022*	*0.068*	*0.471*	0.106
Proc Food	*-0.103*	*-0.121*	*0.785*	**-0.001**		*-0.908*	**-0.050**	*1.008*	*-3.674*	0.180
Tobbev	**-0.011**	*-0.005*	*-0.632*	*-0.102*	*-0.417*		**-0.019**	*-0.868*	*1.340*	0.116
Energy	**-0.037**	*-0.049*	**0.000**	*-0.077*	**0.016**	*0.078*		**-0.126**	**-0.158**	0.096
Manufc	**-0.006**	**-0.020**	**0.242**	*-0.050*	*0.260*	*-0.246*	**-0.017**		*-0.352*	-0.069
Services	*0.081*	*0.072*	*-0.481*	*0.099*	*0.000*	*0.728*	**0.049**	**-0.127**		0.000
Housing	0.048	0.058	0.146	0.101	0.127	0.352	0.083	-0.099	0.352	
	Hicksian Elasticity Matrix									
Cereals		*0.056*	*0.070*	*0.100*	*-0.016*	*0.248*	*0.054*	*0.284*	*0.445*	0.041
Vegetables	*0.053*		**0.029**	*0.092*	*-0.015*	*0.279*	*0.052*	*0.231*	*0.646*	0.054
Dairy products	**0.036**	**-0.001**		**0.144**	*0.996*	*-1.387*	**0.066**	*1.536*	*-3.143*	0.144
Meat	*0.051*	*0.049*	*0.116*		*0.122*	*0.118*	*0.042*	*0.136*	*0.569*	0.080
Proc Food	*-0.054*	*-0.066*	*0.849*	**0.085**		*-0.775*	**0.030**	*1.284*	*-3.273*	0.123
Tobbev	**0.039**	*0.066*	*-0.582*	*-0.035*	*-0.354*		**0.293**	*-0.007*	*3.872*	0.078
Energy	**0.015**	*-0.005*	**0.051**	*-0.013*	**0.067**	*0.185*		**0.096**	**0.163**	0.141
Manufc	**0.147**	**0.072**	**0.349**	*0.084*	*0.367*	*-0.025*	**0.117**		*0.317*	-0.247
Services	*0.148*	*0.097*	*-0.452*	*0.136*	*0.029*	*0.789*	**0.085**	**-0.001**		-0.102
Housing	0.014	0.019	0.101	0.041	0.083	0.160	0.028	-0.190	-0.278	

The estimates in bold are not significantly different from zero at the 5 percent significance level

The estimates in italics are significantly different from zero at the 5 percent significance level

Source: Author's calculations with ENIGH survey 2000-2005

DECILE IX	Marshallian Elasticity Matrix									
	with respect to the price of									
Elasticity of demand for	Cereals	Vegetables	Dairy products	Meat	Proc Food	Tobbev	Energy	Manufc	Services	Housing
Cereals		*0.020*	**0.055**	**0.007**	**-0.006**	**0.027**	**-0.093**	**-0.039**	**0.134**	0.116
Vegetables	*0.044*		*0.176*	*0.062*	*0.157*	**-0.001**	**-0.015**	*0.361*	*0.374*	0.150
Dairy products	*0.048*	*0.143*		*-0.223*	*1.457*	*-1.787*	**-0.277**	*2.412*	*-2.336*	-0.895
Meat	*0.023*	*0.025*	*-0.113*		**0.017**	*0.189*	**0.018**	**-0.033**	*0.606*	0.247
Proc Food	*0.001*	*0.093*	*1.149*	*-0.006*		*-0.986*	**-0.047**	*1.396*	*-1.433*	-0.293
Tobbev	*-0.036*	*-0.087*	*-0.668*	*-0.023*	*-0.503*		**-0.136**	*-1.150*	*0.538*	-0.056
Energy	*-0.043*	*-0.057*	**-0.126**	**-0.060**	**-0.053**	**-0.043**		**0.035**	**-0.501**	0.242
Manufc	**-0.006**	**0.010**	*0.309*	*-0.051*	*0.222*	*-0.289*	**0.056**		*-0.468*	0.085
Services	**0.062**	**0.006**	*-0.286*	*0.074*	*-0.126*	*0.335*	**-0.122**	*-0.441*		0.159
Housing	0.060	0.094	-0.648	0.252	-0.232	-0.231	0.236	0.152	-0.231	
	Hicksian Elasticity Matrix									
Cereals		*0.051*	**0.091**	**0.058**	**0.033**	**0.117**	**-0.044**	**0.169**	**0.110**	0.067
Vegetables	*0.042*		*0.173*	*0.058*	*0.153*	**-0.009**	**-0.019**	*0.343*	*0.374*	0.154
Dairy products	*0.071*	*0.170*		*-0.178*	*1.491*	*-1.708*	**-0.234**	*2.594*	*-2.091*	-0.939
Meat	*0.028*	*0.032*	*-0.106*		**0.025**	*0.207*	**0.028**	**0.009**	*0.662*	0.237
Proc Food	*0.022*	*0.117*	*1.177*	*0.034*		*-0.915*	**-0.008**	*1.560*	*-1.213*	-0.333
Tobbev	*0.005*	*-0.035*	*-0.627*	*0.030*	*-0.452*		**0.154**	*-0.369*	*2.295*	-0.108
Energy	*0.031*	*0.001*	**-0.059**	**0.033**	**0.020**	**0.126**		**0.423**	**0.022**	0.148
Manufc	**0.135**	**0.097**	*0.409*	*0.086*	*0.331*	*-0.040*	**0.193**		*0.306*	-0.054
Services	**0.115**	**0.041**	*-0.246*	*0.130*	*-0.082*	*0.436*	**-0.066**	*-0.208*		0.102
Housing	0.041	0.071	-0.675	0.214	-0.261	-0.383	0.200	0.086	0.677	

The estimates in bold are not significantly different from zero at the 5 percent significance level

The estimates in italics are significantly different from zero at the 5 percent significance level

Source: Author's calculations with ENIGH survey 2000-2005

DECILE X	Marshallian Elasticity Matrix									
	with respect to the price of									
Elasticity of demand for	Cereals	Vegetables	Dairy products	Meat	Proc Food	Tobbev	Energy	Manufc	Services	Housing
Cereals		**0.018**	**0.050**	**0.013**	*0.064*	**-0.057**	**0.112**	*0.425*	**0.232**	0.004
Vegetables	**0.010**		**0.060**	*0.028*	*0.073*	*-0.226*	**-0.028**	*0.559*	**0.010**	0.132
Dairy products	*-0.054*	**-0.068**		*-0.131*	*-0.271*	**0.410**	**0.154**	**-0.855**	*-5.043*	-0.357
Meat	**0.000**	*0.012*	*0.045*		*0.047*	**-0.053**	**0.048**	*0.227*	*0.232*	0.044
Proc Food	**0.006**	**0.018**	*-0.106*	**0.006**		**-0.057**	**-0.069**	**0.060**	*-1.121*	0.197
Tobbev	**0.013**	**-0.012**	*0.245*	**0.048**	**0.080**		**0.315**	**0.473**	*2.016*	0.223
Energy	**0.003**	**-0.031**	*0.146*	**-0.009**	**-0.009**	**0.132**		**-0.672**	*1.105*	0.399
Manufc	**0.003**	**0.016**	**0.055**	**0.000**	*0.028*	**-0.117**	**-0.141**		**0.183**	-0.274
Services	**0.028**	*-0.037*	*-0.207*	*-0.031*	*0.146*	**0.233**	*0.192*	*-0.117*		-0.038
Housing	0.001	0.046	-0.146	0.024	0.087	0.990	0.279	-0.435	0.990	
	Hicksian Elasticity Matrix									
Cereals		**0.021**	**0.052**	**0.017**	*0.067*	**-0.046**	**0.117**	*0.457*	**0.320**	-0.080
Vegetables	**0.015**		**0.066**	*0.036*	*0.079*	*-0.202*	**-0.018**	*0.626*	**0.010**	0.062
Dairy products	*0.022*	**0.047**		*0.049*	*-0.125*	**0.942**	**0.389**	**0.626**	*-3.106*	-0.477
Meat	**0.006**	*0.021*	*0.056*		*0.058*	**-0.011**	**0.066**	*0.346*	*0.388*	-0.030
Proc Food	**0.033**	**0.060**	*-0.056*	**0.072**		**0.137**	**0.016**	**0.600**	*-0.414*	0.140
Tobbev	**0.045**	**0.060**	*0.277*	**0.087**	**0.130**		**0.731**	**1.473**	*2.985*	0.184
Energy	**0.046**	**0.003**	*0.185*	**0.060**	**0.034**	**0.287**		**-0.239**	*1.672*	0.429
Manufc	**-0.090**	**-0.016**	**0.017**	**-0.066**	*-0.013*	**-0.266**	**-0.207**		**-0.359**	-0.381
Services	**0.067**	*0.005*	*-0.158*	*0.055*	*0.199*	**0.429**	*0.278*	*0.427*		-0.125
Housing	-0.002	0.041	-0.151	0.016	0.081	0.931	0.269	-0.456	-0.300	

The estimates in bold are not significantly different from zero at the 5 percent significance level

The estimates in italics are significantly different from zero at the 5 percent significance level

Source: Author's calculations with ENIGH survey 2000-2005

Appendix G. Changes In Budget Share of Commodity i Consumed By Household h in Region r with Respect to Prices and Total Household Expenditure.

Percent change (w_{ihr}) is obtained by the differentiation of equation 4.21 with respect to prices of third commodities and to total expenditures (DEATON and MUELLBAUER, 1980):

$$dEXPSHR_{ihr} = \frac{\partial EXPSHR_{ihr}}{\partial PP_{jr}} dPP_{jr} + \frac{\partial EXPSHR_{ihr}}{\partial HHEXP_{hr}} dHHEXP_{hr}$$

G1

Partial differentiation of Equation 4.1 with respect to price of commodity j might be taken from Equation B5 and the partial differentiation of Equation 4.1 with respect to total expenditure from Equation B17. However, in the GTAP model it not only one commodity j but several other commodities j which undergo changes in prices, so that a sum vector for changes in prices must be introduced:

$$dEXPSHR_{ihr} = \left(\sum_{j \in TRAD} \frac{GAMA_{ijhr}}{PP_{jr}} - BETA_{ihr} * \frac{EXPSHR_{jhr}}{PP_{jr}} \right) dPP_{jr} + \frac{BETA_{ihr}}{HHEXP_{hr}} dHHEXP_{hr}$$

G2

Expressing Equation G2 in percent changes of absolute values:

$$EXPSHR_{ihr} * wph_{ihr} = \left(\sum_{j \in TRAD} \frac{GAMA_{ijhr}}{PP_{jr}} - BETA_{ihr} * \frac{EXPSHR_{jhr}}{PP_{jr}} \right) *$$

$$PP_{jr} * pp_{jr} + \frac{BETA_{ihr}}{HHEXP_{hr}} * HHEXP_{hr} * hh\,exp_{hr}$$

G3

Dividing both sides of equation G3 by $EXPSHR_{ihr}$ and simplifying terms, change of expenditure share devoted to consumption of good i by household h in region r is given by:

$$wph_{ihr} = \frac{\left(\sum_{j \in TRAD} GAMA_{ijhr} - BETA_{ihr} * EXPSHR_{jhr} \right) * pp_{jr} + BETA_{ihr} * hh\,exp_{hr}}{EXPSHR_{ihr}} \qquad G4$$

Taking into account the elasticities in LA/AIDS from Equation B9 and B19, Equation G4 might be expressed as:

$$wph_{ihr} = \sum_{j \in TRAD} \left(ECRSL_{ijhr} * pp_{jr} \right) + (EPLS_{ihr} - 1) * hhexp_{hr} \qquad G5$$

which represents the changes of shares of consumed commodity i of total household expenditure as function of prices of other commodities and of total expenditure.

Appendix H. Mexican Classification and Its Matching in the GTAP Data Base (GSC 2)

GSC 2		Mexican Classification of Products and Activities	
Number	**Code**	**Code**	**Description**
1	pdr	111160	Rice
2	wht	111140	Wheat
3	gro	111131	Beans
		111132	chickpea
		111139	other leguminous
		111151	Maize grain
		111152	Sorghum grain
		111191	Oats grain
		111192	Barley grain
		111193	Sorghum feed
		111194	Oats feed
		111195	other cereals
4	v_f	111216	Potatoes
		111339	other fruits and nuts
		111410	Herbs (mainly for pharmacy)
		111910	Tobacco
		111941	Alfalfa
		111942	Grass
		111992	Peanut
		111993	Agave
		111999	Other crops(beets, maple and latex)
		0112	other legumes
5	osd	111110	Soya
		111121	Safflower
		111122	Sunflower
		111129	other oilseeds
6	c_b	111930	Sugar beet
7	pfb	111999	Other crops
8	ocr	0113	Fruits, nuts and other plants
9	ctl	0121	Cattle,
10	oap	0122	Sheep, goats, and other animals;
		0150	Hunting
11	rmk	311511	raw milk
12	wol	111920	Wool
13	for	0200	Forestry
14	fsh	0500	Fishery
15	col	1010	Coal extraction
		1030	Mining and agglomeration of peat
16	oil	11101	Crude petroleum extraction
17	gas	11102	Gas extraction
18	omn	1020	Mining of lignite
		1200	Mining of uranium and thorium
		1320	Mining of metal minerals non ferrous, except thorium and uranium
		1410	Mining of rock, sand and clay
		1421	Mining of minerals for fertilizers and other chemical products
		1422	Mining of salt
		1429	Other mining and quarrying.

GSC 2	Mexican Classification of Products and Activities		
Number	**Code**	**Number**	**Code**
19	cmt	15111	Production, processing and meat conservation of cattle meat and its products.
20	omt	15112	Production, processing and meat conservation of poultry and other livestock
21	vol	1514	Production of vegetable and animal oils
22	mil	1520	Production of dairy products
23	pcr	1534	Paddy rice processing
24	sgr	1542	Sugar
25	ofd	1512	Production, processing and conservation of fish
		1513	Production, processing and conservation of legumes
			Production of flour
		1531	Production of starch and its products
		1532	Production of animal feed crops
		1533	Production of baker's wares
		1541	Production of cocoa, chocolate and sugar confectionery
		1543	Production of macaroni, noodles, couscous and similar farinaceous products
		1544	Production de other food products
			Production non-alcoholic beverages
		1549	
		1554	
26	b_t	1551	Distillation and mix of spirits.
		1552	Production of wines
		1553	Production of drinks.
		1600	Production of cigarettes and tobacco
27	tex	1711	Production of textile fibre and staple fibre
		1712	Textile products
		1721	Manufacture of textile materials. Except wearing apparel
		1722	Manufacture carpets and carpets
		1723	Manufacture of cords, cords, twines and nets Manufacture of
		1729	other textile products. Manufacture of weaves and other textile
		1730	articles
28	wap	1810	Production of wearing apparel
29	lea	1820	Production of leather
		1911	Tannery services
		1912	Production of leather products
		1920	Production of shoes
30	lum	2010	Sawmilling and planning of wood; impregnation of wood
		2021	Manufacture of veneer sheets; manufacture of plywood, lamina board, particle board, fibre board and other panels and boards
			Manufacture of builders carpentry and joinery
		2022	Manufacture of wooden containers
		2023	Manufacture of other products of wood
		2029	Manufacture of articles of cork, straw and plaiting materials
		2101	
31	ppp	2102	Manufacture of corrugated paper and paperboard and of containers of paper and paperboard
		2109	Manufacture of other articles of paper and paperboard n.e.c.
		2211	Publishing of books
		2219	Other publishing
		2221	Printing of newspapers
		2222	Printing n.e.c.
		2230	Reproduction of recorded media
32	p_c	2310	Manufacture of coke oven products
		2320	Manufacture of refined petroleum products
		2330	Processing of nuclear fuel

GSC 2	Mexican Classification of Products and Activities		
Number	**Code**	**Number**	**Code**
33	crp	2411	Manufacture of industrial gases
		2412	Manufacture of fertilizers and nitrogen compounds
		2413	Manufacture of other inorganic basic chemicals
		2421	Manufacture of pharmaceuticals, medicinal chemicals and botanical products
		2422	Manufacture of paints, varnishes and similar coatings, printing ink and mastics
		2423	Manufacture of perfumes and toilet preparations
		2424	Manufacture of other chemical products
		2429	Manufacture of man-made fibres
		2430	Manufacture of rubber products
		2511	Manufacture of rubber tires and tubes
		2519	Manufacture of other rubber products
		2520	Manufacture of plastic products
34	nmm	2610	Manufacture of glass and glass products
		2691	Manufacture of ceramic household and ornamental articles
		2692	Manufacture of refractory ceramic products
		2693	Manufacture of ceramic tiles and flags
		2694	Manufacture of cement, lime and plaster
		2695	Manufacture of arcille and ceramic products
		2696	Manufacture of concrete products for construction purposes
		2699	Manufacture of other non-metallic mineral products
35	i_s	1310	Mining of iron ores
		2710	Manufacture of basic iron and steel and of ferro-alloys
		2731	Casting of metals
36	nfm	2720	Manufacture of basic precious and non-ferrous metals
		2732	Casting of light metals
37	fmp	2811	Manufacture of structural metal products
		2812	Manufacture of tanks, reservoirs and containers of metal
		2813	Manufacture of steam generators, except central heating hot water boilers
		2891	Forging, pressing, stamping and roll forming of metal; powder metallurgy
		2892	Treatment and coating of metals
		2893	Manufacture of cutlery
		2899	Manufacture of other fabricated metal products
38	mvh	3410	Manufacture of motor vehicles
		3420	Manufacture of bodies (coachwork) for motor vehicles; manufacture of trailers and semi-trailers
		3430	Manufacture of parts and accessories for motor vehicles and their engines
39	otn	3511	Building and repairing of ships
		3512	Building and repairing of pleasure and sporting boats
		3520	Manufacture of railway and tramway locomotives and rolling stock
		3530	Manufacture of aircraft and spacecraft
		3591	Manufacture of motorcycles
		3592	Manufacture of bicycles
		3599	Manufacture of other transport equipment n.e.c.
40	ele	3000	Manufacture of office machinery
		3210	Manufacture of electronic valves and tubes and other electronic components
		3220	Manufacture of television and radio receivers, sound or video recording or reproducing apparatus and associated goods

GSC 2	Mexican Classification of Products and Activities		
Number	**Code**	**Number**	**Code**
41	ome	2911	Manufacture of engines and turbines, except aircraft, vehicle and cycle engines
		2912	Manufacture of pumps and compressors
		2913	Manufacture of taps and valves
		2914	Manufacture of bearings, gears, gearing and driving elements
		2915	Manufacture of furnaces and furnace burners Manufacture of other general purpose machinery n.e.c.
		2919	Manufacture of agricultural and forestry machinery
		2921	Manufacture of portable hand held power tools
		2922	Manufacture of machinery for metallurgy
		2923	Manufacture of machinery for mining, quarrying and construction
		2924	Manufacture of machinery for food, beverage and tobacco processing
		2925	Manufacture of machinery for textile, apparel and leather production
		2926	Manufacture of machinery for paper and paperboard production
		2927	Manufacture of other special purpose machinery n.e.c.
		2929	Manufacture of weapons and ammunition
		2930	Manufacture of domestic appliances n.e.c.
		3110	Manufacture of electric domestic appliances
		3120	Manufacture of non-electric domestic appliances
		3130	Manufacture of medical and surgical equipment and orthopaedic appliances
		3140	Manufacture of instruments and appliances for measuring, checking, testing, navigating and other purposes, except industrial process control equipment
		3150	Manufacture of instruments and appliances for measuring, checking, testing, navigating and other purposes, except industrial process control equipment
		3190	Manufacture of industrial process control equipment
		3311	Manufacture of watches and clocks
42	omf	3610	Manufacture of furniture
		3691	Miscellaneous manufacturing n.e.c.
		3692	Manufacture of imitation jewellery
		3693	Manufacture of sports goods
		3694	Manufacture of games and toys
		3699	Other manufacturing n.e.c.
		3710	Recycling of metal waste and scrap
		3720	Recycling of non-metal waste and scrap
43	ely	4010	Production and distribution of electricity
44	gdt	4020	Manufacture of gas; distribution of gaseous fuels through mains
		4030	Steam and hot water supply
45	wtr	4100	Collection, purification and distribution of water
46	cns	4510	Site preparation
		4520	Building of complete constructions or parts thereof; civil engineering
		4530	Building installation
		4540	Building completion
		4550	Renting of construction or demolition equipment with operator

GSC 2	Mexican Classification of Products and Activities		
Number	**Code**	**Number**	**Code**
47	trd	5010	Sale of motor vehicles
		5020	Maintenance and repair of motor vehicles
		5030	Sale of motor vehicle parts and accessories
		5040	Sale, maintenance and repair of motorcycles and related parts and accessories
		5050	Retail sale of automotive fuel
		5110	Wholesale on a fee or contract basis
		5121	Wholesale of grain, seeds and animal feed crops
		5122	Wholesale of agricultural raw materials and live animals
		5131	Wholesale of household goods
		5139	Wholesale of electrical household appliances and radio and television goods
		5141	Wholesale of solid, liquid and gaseous fuels and related products
		5142	Wholesale of metals and metal ores
		5143	Wholesale of wood, construction materials and sanitary equipment
		5149	Wholesale of chemical products
		5150	Wholesale of machinery, equipment and supplies
		5190	Other wholesale
		5211	Retail sale in non-specialized stores
		5219	Other retail sale in non-specialized stores
		5220	Retail sale of food, beverages and tobacco in specialized stores
		5231	Retail sale of pharmaceutical and medical goods, cosmetic and toilet articles
		5232	Retail sale of textiles
		5233	Retail sale of furniture, lighting equipment and household articles n.e.c.
		5234	Retail sale of hardware, paints and glass
		5239	Retail sale of books, newspapers and stationery
		5240	Retail sale of second-hand goods in stores
		5251	Retail sale via mail order houses
		5252	Retail sale via stalls and markets
		5259	Other non-store retail sale
		5260	Repair of personal and household goods
		5510	Hotels, camping sites and other provision of short-stay accommodation
		5520	Bars
48	otp	6010	Transport via railways
		6021	Other scheduled passenger land transport
		6022	Other scheduled passenger land transport
		6023	Freight transport by road
		6030	Transport via pipelines
		6301	Cargo handling
		6302	Storage and warehousing
		6303	Other supporting water transport activities
		6304	Activities of travel agencies and tour operators; tourist assistance activities n.e.c.
		6309	Activities of other transport agencies
49	wtp	6110	Sea and coastal water transport
		6120	Inland water transport
50	atp	6210	Scheduled air transport
		6220	Non-scheduled air transport
51	cmn	6411	National post activities
		6412	Courier activities other than national post activities
		6420	Telecommunications
52	ofi	6511	Central banking
		6519	Other monetary intermediation
		6591	Financial leasing
		6592	Other credit granting
		6599	Other financial intermediation n.e.c.
		6711	Administration of financial markets
		6712	Security broking and fund management
		6719	Activities auxiliary to financial intermediation n.e.c.
		6720	Activities auxiliary to insurance and pension funding
		7411	Legal activities

GSC 2	Mexican Classification of Products and Activities		
Number	**Code**	**Number**	**Code**
52 (cont)	ofi (cont)	7412	Accounting, book-keeping and auditing activities; tax consultancy
			Market research and public opinion polling
		7413	Business and management consultancy activities
		7414	Architectural and engineering activities and related technical
		7421	consultancy
			Technical testing and analysis
		7422	Advertising
		7430	Labour recruitment and provision of personnel
		7491	Investigation and security activities
		7492	Industrial cleaning
		7493	Photographic activities
		7494	Packaging activities
		7495	Secretarial and translation activities
		7499	
53	isr	6601	Life insurance
		6602	Pension funding
		6603	Non-life insurance
54	obs	7111	Renting of automobiles
		7112	Renting of water transport equipment
		7113	Renting of air transport equipment
		7121	Renting of agricultural machinery and equipment
		7122	Renting of construction and civil engineering machinery and
			equipment
		7123	Renting of office machinery and equipment
55	ros	9211	Motion picture and video activities
		9212	Motion picture projection
		9213	Radio and television activities
		9214	Artistic and literary creation and interpretation
		9219	Fair and amusement park activities
		9220	News agency activities
		9231	Library and archives activities
		9232	Museums activities and preservation of historical sites and
			buildings
		9233	Botanical and zoological gardens and nature reserves activities
			Operation of sports arenas and stadiums
		9241	Gambling and betting activities
		9249	Washing and dry-cleaning of textile and fur products
		9301	Hairdressing and other beauty treatment
		9302	Funeral and related activities
		9303	Other service activities n.e.c.
		9309	
56	osg	7511	General (overall) public service activities
		7512	Regulation of the activities of agencies that provide health care,
			education, cultural services and other social services, excluding
			social security
		7513	Regulation of and contribution to more efficient operation of
			business
		7521	Foreign affairs
		7522	Defence activities
		7523	Justice and judicial activities
		7530	Compulsory social security activities
		8021	General secondary education
		8022	Technical and vocational secondary education
		8030	Higher education
		8090	Adult and other education
		8511	Hospital activities
		8512	Medical practice activities
		8519	Other human health activities
		8520	Veterinary activities
		0853	Social work activities
		9000	Sewage and refuse disposal, sanitation and similar activities
		9111	Activities of business and employers organizations
		9191	Activities of religious organizations
		9192	Activities of political organizations
		9199	Activities of other membership organizations n.e.c.
57	dwe	7010	dwellings

Appendix I. Program to Integrate the Household Module into GTAP

```
!------------------------------ ----------------------------------------------------------------------!
        !                                  Household Module                                  !
!---------------------------------------------- ----------------------------------------------------->!

!New set declaration!
Set
 HHC #household categories#
maximum size 100 read elements from file GTAPSETS header "HHC";

Variable (orig_level=EXPSHR)(all,i,TRAD_COMM)(all, h,HHC)(all,r,REG)     wph(i,h,r)
# changes in expenditure share devoted to commodity i by household h in region s #;

Variable (orig_level=VDHH)(all,i,TRAD_COMM)(all, h,HHC)(all,r,REG)     xphh(i,h,r)
#  changes of VDHH #;

Variable(all,h,HHC)(all,r,REG)     exphh(h,r)
# total expenditure changes of household h in region r #;

Variable (all,h,HHC)(all,r,REG)     pprivhh(h,r)
# private consumption price for composite commodities index for household h in region r #;

Coefficient (all, i, TRAD_COMM) (all,h,HHC) (all,r,REG)
   VDHH(i,h,r) # value of expenditure on commodity i by household h in region r #;
Read VDHH from file GTAPDATA header "VDHH";

Update(all,i,TRAD_COMM) (all,h,HHC) (all,r,REG)
   VDHH(i,h,r) = xphh(i,h,r);

Coefficient (parameter)(all,h,HHC)(all,r,REG)
   HHEXP (h,r)     # total expenditure of household h i in region r #;

Formula (initial)(all,h,HHC)(all,r,REG)
   HHEXP (h,r)=sum(i,TRAD_COMM,VDHH(i,h,r));

Coefficient (parameter)(all,i,TRAD_COMM)(all,h,HHC)(all,r,REG)
   EXPSHR(i,h,r)      #  expenditure share of household h on commodity i in region r #;

Formula(initial) (all,i,TRAD_COMM)(all,h,HHC)(all,r,REG)
   EXPSHR(i,h,r) = VDHH(i,h,r)/HHEXP(h,r);

Coefficient(parameter)(all,h,HHC)(all,r,REG)
   PPRI (h,r)      # household Laspeyres price index  #;
Read PPRI from file GTAPPARM header "PPRI";

Coefficient(parameter)(all,i,TRAD_COMM)(all,h,HHC)(all,r,REG)
   EPLS(i,h,r)      # expenditure elasticities LAIDS  #;

Read EPLS from file GTAPPARM header "XPLS";

Coefficient (parameter)(all,i,TRAD_COMM)(all,j,TRAD_COMM)(all,h,HHC)(all,r,REG)
   ECRSL (i,j,h,r) # Uncompensated cross-price elasticities from LAIDS #;

Read ECRSL from file GTAPPARM header "CPSL";
```

Equation INCDSTEQ
 # changes intotal expenditure of household h in region r#
(**all**,h,HHC)(**all**,r,REG)
exphh(h,r)= **sum**(i,TRAD_COMM,EXPSHR(i,h,r)*(qp(i,r)+pp(i,r)));

Equation WPHH
 # changes in expenditure devoted to commodity i by household h in region r #
(**all**,i,TRAD_COMM)(**all**,h,HHC)(**all**,r,REG)
xphh(i,h,r)=wph(i,h,r)+exphh(h,r);

Equation PPINXHH
#price index changes of household h in region r #
(**all**,h,HHC) (**all**,r,REG)
pprivhh(h,r)= **[sum**(i,TRAD_COMM,EXPSHR(i,h,r)*pp(i,r))**]**;

Equation SHHHDS
#changes in share expenditure share devoted to commodity i by household h in region r #
(**all**,i,TRAD_COMM)(**all**,h,HHC)(**all**,r,REG)
wph(i,h,r)= (EPLS(i,h,r)-1)*exphh(h,r)+ (**sum**(j,TRAD_COMM,ECRSL(i,j,h,r)*pp(j,r)));
!<
==========
END OF GTAP.TAB FILE
==========
>!

Appendix J. Description of the Trade Negotiations Underlying the Simulated Scenarios

Scenario Free Trade Agreements (FTAs)

This scenario contemplates the reductions in tariffs for trading partners within the three trade agreements considered in this scenario. Following each trade agreement is in detail described.

NAFTA

The NAFTA has scheduled the elimination of all trade restrictions and tariffs between the three members in a 15-years-period (from January 1, 1994 to January 1, 2008). However, the NAFTA considers also some exempted products selected by each State member (see table J-1).

Table J-1 Products set aside from the NAFTA

	Mexico	**Canada**	**USA**
Mexico		Dairy products Poultry Eggs Sugar products	NONE
Canada	Dairy products Poultry Eggs Sugar products		Dairy products Poultry Eggs Margarines
USA	NONE	Dairy products Peanut Peanut cream Sugar products Cotton	

Source: FTIS (2007)

At the beginning of the NAFTA, in January of 1994, 46 percent of the headings traded from the agricultural chapter between Mexico and the USA were freed of duties. By the fifth year of the agreement 126 headings were added to the free trade, growing to 99 percent of the total traded headings.

By January 1, 2003, after 9 years of use of the NAFTA, Mexico eliminated tariffs for the USA in wheat, barley, rice, dairy products, soy oil, soy, poultry, peaches, apples, frozen strawberries, swine, swine meat, cotton, and the seasonal tariff for oranges. The USA eliminated tariffs in wheat (durum) rice, limes, winter vegetables, dairy products and frozen strawberries. These cuts represent 99 percent of traded headings which are traded freed of tariffs. The remaining 17 headings, whose lowering of duties culminates the January 1, 2008 are vegetables, dry beans, powdered buttermilk, maize and sugar and products with sugar

from the USA into Mexico. The USA eliminates tariffs for the Mexican concentrated orange juice, winter vegetables and peanuts.

With Canada, Mexico registered 1158 headings of which 1030 were put under the general schedule of lowering of duties, 51 correspond to conditional lowering of duties and 77 were exempted of the liberation schedule. By the January 1, 2003 Mexico accumulated with Canada 1066 headings in free trade, equivalent to 92 percent of agricultural trade.

Between Mexico and Canada, the products levied with the longest liberalisation period in the schedule, and subjected to restrictions, tariffs and quotas, were those corresponding to some dairy products, meat, sugar, some early vegetables and fruits, maize, and some fats mainly.

Table J-2 Percentage of duties lowering by category in food commodities in framework of the NAFTA

Origin of imports	Immediate	1998	2003	2008
Mexico: Imports coming from the USA	36	3	43	18
USA: Imports coming from Mexico	61	6	28	6
Mexico: Imports coming from Canada	41	4	28	27
Canada: Imports coming from Mexico	88	5	7	0

Source: FTIS (2007)

FTA Mexico-EU-27

From the total of traded products between Mexico and the EU, approximately 7 percent correspond to food commodities, for which a progressive liberalisation in five phases for food commodities (2000-2010) has been scheduled. With the signature of the FTA, almost 80 percent of the total food commodities coming from Mexico into the EU and 42 percent of the EU food commodities entering into Mexico will be by 2010 free of duties. This represents 62 percent of total agricultural trade between Mexico and the EU. Some sensible products for both parties are excluded from these negotiations (sugar, meat, dairy products, cereals, bananas, and orange juice). However, special quotas must be fulfiled for some products coming from Mexico e.g., honey, avocados and orange juice. The products set aside from negotiations are presented in Table J-3. Tariffs will be eliminated or tariff-free quotas established for roughly 300 types of products, including coffee beans and wine. Some other food commodities, such as rice, wheat, apples, tangerines, dairy products, and bluefin tuna,

will not be subject to tax-free measures (Free Trade Agreement Mexico- EU-27 Documentation, 2004, CONDON,2007).

Table J-3 Products excluded from negotiations between the EU and Mexico

Main products excluded from liberalised import into the EU	**Main products excluded from liberalised import into Mexico**
bovine animals, beef, swine, poultry / dairy products / eggs / honey / cut flowers / some fruits and vegetables (e.g. olives for the production of oil, sweet maize, asparagus, peas, beans, apples, pears, strawberries, grapes, bananas) / cereals except buckwheat / sugar / some juices (tomatoes, citrus fruits, pineapple, apple, pear) / vermouth / ethyl alcohol / vinegar.	bovine animal, beef, swine poultry / dairy products / eggs / potatoes / bananas / cereals except buckwheat / roasted coffee / some oil and fats (palm oil, cobra oil, animal fats or oil) / sugar / cocoa / grape juice and grape most rum.
Main TRQs (quota/year) conceded for into the EU	**Main TRQs (quota/year) conceded for into Mexico**
eggs (1,500 t, half duty) / honey (30,000 t, half duty) / cut flowers (1,500 t, duty free) / asparagus (600 t, duty free; 1,000 t prepared, half duty) / peas (500 t, half duty) / cane molasses (275,000 t, duty free) / prepared tropical fruit (1,500 t, duty free) / juices (orange 1,000 t, half duty; 30,000 t, 25percent duty; 2,500 t pineapple juice, half duty) canned tuna (2,000 t, half duty).	No TRQ conceded

Source: Mexico EU Free Trade Agreement Documentation (2004)

The agreement classifies food commodities, including fisheries, according to a numerical system (1, 2, 3, 4, 4a, 5, 6, and 7). This numerical system of categories specifies the implementation periods of the tariff reductions for food commodities. Table J-4 defines those categories in terms of the percent of the base tariff that will be applied each year after the agreement's implementation.

Table J-4 Schedule of percent cuts in frame of the EU-Mexico FTA in food commodities

	Tariff rate applied at each year after the FTA implementation										
Category	**Entry into force**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
1	Free	-	-	-	-	-	-	-	-	-	-
2	75	50	25	Free	-	-	-	-	-	-	-
3	89	78	67	56	45	34	23	12	Free	-	-
4	100	100	100	87	75	62	50	37	25	12	Free
4a	90	80	70t	60	50	40	30	20	10	Free	-
5	Products in category 5 are in a wait list, which must be discussed by both parties to consider further steps in the process of liberalisation.										
6	Contains specifications of TRQ for both parties										
7	Contains specifications on preferential customs duties.										

Source: Mexico EU Free Trade Agreement Documentation (2004)

A classification of representative products for each classification is provided in Table J-5. Fresh fruits and vegetables and preparations thereof possessed at the beginning of the FTA base tariffs on range from 10 to 20 percent and fall into category 1. Fresh cherries are in category 3. Important exceptions include potatoes, apples, dry beans, peaches, which are in category 5. Apricots, pears and plums fall into category 4. In looking at alcoholic beverages, beer, which had a base rate of 20 percent falls into category 1. Most of the wines had a base rate of 20 percent and fall into either category 2 or 3.

Regarding preparations of fruits and vegetables, the base rate on most of these products was 20 percent. As the Table J-5 shows, 64 percent of this fall into category 1, and 18 percent fall into category 2. In category 1 is also included frozen orange juice. The remaining 18 percent are classified as category 5. Products in this latter group include canned peaches, prepared potatoes, canned tomatoes, jams and jellies, and grape juice.

Soybeans fall into category 3 for the period August 1 through January 31, which has a base rate of 15 percent. They already enter duty-free the rest of the year and therefore those falls into category 1. Regarding vegetable oils, soybean, sunflower seed, canola, sesame, and maize oil all of these products are in category 4. Wrapping tobacco, for example, had a base rate of 67 percent ad valorem, which was eliminated upon the agreement's entry into force. Cigarettes, fall into category 5 and therefore will not be subject to any reduction.

Animal feed crops, most of the oilseed meals have a base rate of 15 percent and fall into category 3. Preparations for balanced rations and milk replacers both fall into category 5. Finally, cotton and cotton wastes have a base rate of 10 percent and fall into category 3.

Table J-5 Classification of representative products to be liberalised

Category	Representative items
1	Fruits and vegetables (64 percent) / unwrapped tobacco/ soybeans (February 1-July 31)/ frozen orange juice
2	Fruits and vegetables (18 percent) /Wine
3	Soybean (August 1 – January 31)/ Fresh cherries/ Wine/ Animal feed crops / Cotton and cotton wastes
4	Vegetable oils / soybean rests / sunflower seed / canola / sesame / maize/ apricots/ pears/ plums
4a	
5	Potatoes/ apples/ dry beans/ peaches/ milk substitutes/ grains and cereals (maize, rice, sorghum, barley, rye, dry beans) / caned peaches / prepared potatoes / caned tomatoes/ jams and jellies/ grape juice/ cigarettes
6	fisheries (tuna steaks)
7	nutritional preparations

Source: Mexico EU Free Trade Agreement Documentation (2004)

Since 2003, in Mexico 37.9 percent of EU food commodities are free of tariffs, next cut stage are scheduled by 2008 and 2010, up to 42.55 percent. Analogously, 68.2 percent of European food commodities that enter since 2003 into Mexico are liberalised. Also in the same year, 71 percent of the EU fishing products entering into Mexico is liberalised. Similarly, 88 percent of total agricultural imports coming from Mexico into the EU-27. Two remaining tariff cuts schedule in 2008 and 2010 will finally liberalise 74.14 percent of total trade between Mexico and the EU. The last stage of liberalisation contemplated in the framework of this agreement corresponds to 80 percent reduction in products entering into the EU from Mexico by January 1, 2010. Also Mexico will reduce tariffs at zero on 42 percent of agricultural goods coming from the EU by January 1, 2010.

The Agreement contains tariff quotas for certain food commodities that are not subject to full liberalisation, as well as review-clauses for further liberalisation. The agreement contains provisions for co-operation in the field of customs, standards and technical regulations, Sanitary and Phytosanitary (SPS) measures, and for the opening of public procurement markets. Main TRQs are applied to a specific group of goods (Category 6) such as salmon, herring and tuna and other fish products. Mexico was given TRQs for eggs, honey, cut flowers; asparagus, avocado, strawberries, molasses, pineapple juice, frozen peas and fresh orange juice. Tuna steaks (and some other tuna products like canned tuna) are given tariff-quota concessions (Category 6) where an aggregate quantity of 2,000 tonnes is allowed with a preferential customs duty.(CFFA, 2006). Also, a preferential tariff rate quota for tuna

loins originating in Mexico is considered. Starting with a quota of 5,000 tonnes in year 1, and it will rise to 14,000 tonnes by year 2010, with a ceiling of 15,000 tonnes in subsequent years at a duty rate of 6 percent (CFFA, 2006).

The EU was granted with progressive and by 2008 total liberalisation on wines, beer, spirits and other alcoholic beverages, cut flowers, tomatoes, tobacco, olive oil and pectic substances. Mexico obtained the immediate elimination of tariffs on coffee, cacao, chickpeas, tequila, bier, mango papayas, guavas and other tropical fruit and vegetables. EU most sensitive food commodities were either excluded from the agreement or placed in a wait list to be reviewed no later than three years after the implementation of the agreement. These products (Category 5 of the tariff elimination schedule) included live bovine animals, beef and edible meat offal (either fresh or frozen) hams, certain poultry and pork products, eggs, honey, cut flowers, dairy products (such as milk, cream and yoghurt) butter, certain cheeses, some fruits and vegetables (such as bananas, apples, avocado, strawberries, grapes, peaches, pears, potatoes, peas, beans, spinach, tomatoes, mushroom) sugar and ethyl alcohol, all cereals (except buckwheat) and some fruit and vegetable juices.

EPA Mexico-Japan

From the total of traded products between Mexico and Japan, approximately 70 percent will be free of tariffs by 2015 and 30 percent will remain subject to tariffs. Excluded food commodities are fishery- and pork products mainly. With the signature of the EPA, 99.6 percent of the bilateral agricultural trade between Mexico and Japan will be by 2015 free of duties. Some sensible products for both parties are excluded from these negotiations (rice, wheat, apple, mandarin, oranges, dairy products, bluefin tuna fish, mackerel, escallop fur and fur products). However, special quotas must be fulfiled for some important products coming from Mexico e.g., honey, pork and orange juice. Products set aside from the negotiations are displayed in Table J-6 (Ministry of Foreign Affairs of Japan, 2007).

Table J-6 Exceptions from trade liberalisation between Japan and Mexico

Main products excluded from liberalised import into Japan	**Main products excluded from liberalised import into Mexico**
mandarins, pineapple, sugar and sugar products and some fresh fruits as bananas, apples, avocado	Dairy products, anchovies, potatoes, beans, manioc, coconuts, kiwis, citrus fruits, ginger, saffron, wheat, sugar (cane and dry sugar)
Main TRQs (quota/year) conceded for into Japan	**Main TRQs (quota/year) conceded for into Mexico**
Honey, tomato processed products (tomato puree, tomato paste, etc.) pork, orange juice, beef, chicken, fresh orange (initially designated tariff-free quota for market cultivation, subsequently tariff-elimination quota)	Meat of poultry (in four increasing stages) meat of swine (in eight stages) meat of rind (fours stages) honey, tomato processed products (tomato puree, tomato paste, etc.)

Source: Ministry of Foreign Affairs of Japan (2007)

The EPA Mexico Japan sets out for food commodities seven patterns (A, B4, B6, B8 Ca, X, and P) of immediate tariff elimination, staged tariff elimination/reduction, introduction of tariff quota, etc. One of the patterns is applied to each product. Classification of products according to the treatment of custom duties is presented in table J-7.

Table J-7 Classification of representative products to be liberalised (%)

	Tariff rate applied at each year after the EPA implementation										
Category	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
A	Free	-	-	-	-	-	-	-	-	-	-
B4	75.0	50.0	25.0	Free	-	-	-	-	-	-	-
B6	83.0	66.0	49.0	32.0	16.0	Free	-	-	-	-	-
B8	87.5	75.0	62.5	50.0	37.5	25.0	12.5	Free	-	-	-
Ca	91.0	82.0	73.0	64.0	55.0	46.0	37.0	28.0	19.0	9.0	Free
X	Products in category X are excluded from any reduction or elimination of customs duties										
Q	Contains specifications on preferential customs duties.										

Source: Ministry of Foreign Affairs of Japan (2007)

Japan granted immediate liberalisation for live animals. On the Mexican side progressive liberalisation for wines, beer, spirits and other alcoholic beverages, cut flowers, tomatoes, tobacco, olive oil and pectic substances was granted. Mexico obtained the immediate elimination of tariffs levied on coffee, cacao, chickpeas, tequila, mango papayas, guavas and other tropical fruit and vegetables. Japan most sensitive food commodities were

either excluded from the agreement or placed in a wait list to be reviewed (category R). These products include pineapple, sugar and sugar products and some fresh fruits as bananas, apples, avocado.

Cucumber and gherkins fall into category B8 with a base rate of 12 percent. Mushrooms containing added sugar are classified as B8 with an initial base rate of 13.4 percent. Regarding vegetable oils, soybean, sunflower seed, rapeseed, sesame seeds, and maize oil all are in category A. Since the implementation of the EPA, Japan conceded zero tariffs for non-manufactured tobacco and cigars. Smoking tobacco was set aside from the negotiations. Cigarettes, fall into category X and therefore will not be subject to any reduction.

Vegetables such as asparagus, pumpkin and cigars were liberalised since the beginning of the EPA and fall into category A. Fresh fruits such as grapefruit, frozen vegetables and mixed vegetable juices are in category B6. Other fresh fruits such as: pear, cherries, peaches, and therefrom preparations are in category B8. In looking at alcoholic beverages, tequila, wine, which have a base rate of 15 percent falls into category A.

Animal feed crops, most of the oilseed meals fall into category A. Preparations for balanced rations and milk replacers both fall into category X. Finally, cotton and cotton wastes are free from tariffs since the implementation of the EPA.

Scenario WTO

During the meeting of the WTO members in Uruguay, also known as the Uruguay Round, all food commodities were subject to trade rules by the WTO's agreement on agriculture. Upcoming WTO negotiations on trade rules took place in the Meeting in Doha at which negotiations on trade rules for food commodities were proposed. Therefore, this meeting is also called the Doha Development Agenda (DDA). The DDA hold as main objective the trade liberalisation as engine to development in poorer countries. The DDA is made up of three different support policies reforms: market access, Aggregate Measurement of Support (AMS) and export competition. However, as of July 2008 no final agreements have been reached. Also in July 2008 a falconer proposal was released. The falconer draft proposal discuses diverse measures to liberalize trade. The treatment contemplates for export competition the full abolishment of trade subsidies in all trade members. Regarding tariffs cuts, these will be subject to a tiered formula. In the top band of the tiered formula, for the output from developing countries is proposed a cut of approximately 70 percent (WTO, 2008d).

Table J-8 describes the main drafting outlined by the Falconer proposal for the multilateral liberalisation of agricultural and food commodities. The discussion has regarded tariff cuts by applying a tiered formula in four bands as progressive income tax. In this sense, for example the bands cover the intervals of current applied tariffs for developed countries as follows: 0 to ≤20 percent; >20 to ≤ 50 percent; >50 to ≤ 75 percent; and >75 percent. In developing countries, the bands are broader than for developed countries. Tariff cuts for developing countries are also more moderate than the proposed for developed countries. Proposed tariff cuts for developing countries are equivalent to ⅔ of the proposed tariff cuts for developed countries (BROCKMEIER et al., 2008). The least developed countries are exempted of tariffs cuts.

Table J-8 Elements of the Falconer proposal for the Market Access for the WTO Negotiations

Developed countries		**Developing Countries**	
Tariff level (%)	**Tariff cut (%)**	**Tariff level (%)**	**Tariff cut (%)**
>75	66-73	>130	44-49
>50 to ≤ 75	62-65	>80 to ≤ 130	41-43
>20 to ≤ 50	55-60	>30 to ≤ 80	37-40
0 to ≤20	48-52	0 to ≤30	32-35

Source: BROCKMEIER et al. (2008)