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Agricultural Trade Liberalization and Poverty in Tunisia: Micro-simulation in a General Equilibrium Framework

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Abstract

The paper quantitatively assesses different options of unilateral and multilateral liberalization of trade in agricultural products. While acknowledging that non-tariff barriers and other measures, such as trade facilitation, have reduce the scope of the openness of the Tunisian economy, the analysis suggests that the current FTA signed with the European Union has been costly for the agriculture sector and the rural populations. Moving toward more multilateral trade liberalization may generate advantages and gains for rural populations. The analysis is based on simulations of a Computable General Equilibrium model of the Tunisia economy using a Social Accounting Matrix for 1996 as base, which integrates a full micro-module database. The overall impact of the fourth scenarios tested are quite limited on macroeconomic activity and poverty given the nature itself of the model used, which incorporates many rigidities for production factors and ignores dynamic effects associated with trade liberalization.

I. Introduction

The pattern and trends in poverty are central in policymaking and policy reform in developing countries. Several policies that have undergone reforms, such as food price subsidies, general cash transfers, and expansion in public sector employment, have traditionally been justified on the basis of supporting the needy. After the conclusion of the Uruguay Round in 1994, most of developing countries moved towards liberalizing their economies either under the WTO or regional trade agreements or both of them. This new openness has been accompanied by concern that the poor will be adversely affected, and that the distribution of income in developing countries will deteriorate. Accordingly, the issue of trade and poverty in developing-country has become the focus of much research in the last several years (Reimer, J.J., 2002). Accordingly, regionalism and globalization presents both challenges and opportunities for developing countries in general and household, mostly the poor of them, in particular. Likewise, accompanying domestic reforms may have a strong impact on income distribution. Accounting for the effects of economic policy on the distribution of welfare among individuals and households has long been on the agenda of economists. Doing it satisfactorily has proved difficult, however. Progress in economic analysis and the increasing availability of micro-economic household data eased things a little. At the same time, the growing intensity of the debate on distribution, poverty, and the social effects of globalization have made the issue a practical operational objective for national governments, multilateral agencies and other aid agencies (Bourguignon, et al., 2002b).

This study aims at clarifying and estimating the effects on households of the reduction of barriers to trade on agricultural products through bilateral and multilateral trade liberalization. The approach adopted in this study is based on numerical general equilibrium and micro-simulation technique for Tunisia where the effects of each reform and external shock on household income, welfare, and level of poverty will be accounted.

The focus on trade policies is justified by the relatively high level of degree of openness of the Tunisian economy compared to other countries in the region. In fact, and in addition to its involvement in many regional trade agreements (with the European Union, with the Arab countries under the GAFTA and Agadir agreements…), Tunisia is a member of WTO and is actively participating in the current multilateral trade negotiations under the "Doha Round". The current multilateral trade negotiations are expected to more liberalize international trade, and mostly for agricultural products market beyond the Uruguay Round current targets, and that should induce significant price and income effects for countries in the MENA region where the agriculture sector continue to play a crucial role both in terms of employment and economic activity. At the same time, further liberalization will expose the country to international price shocks in a more direct way.

In this study, the following questions will be addressed: How Tunisian economy will be affected by bilateral (mainly the Euro-Med partnership agreement) and multilateral (modalities of implementation of the Honk Kong ministerial declaration on agricultural trade) agricultural trade liberalization scenarios? How these changes affect the poor and the non-poor households? And at the micro level, how will rural households react to these macro changes given that poverty in Tunisia is more a rural issue on which the ongoing liberalization program is likely to have significant bearing.

The report is organized as follows. Section 2 overviews the macroeconomic achievements and poverty patterns in Tunisia. Section 3 describes trade protection and trade structure in the Tunisian agri-food sectors as well as the main features of agricultural policy in

Tunisia. Section 4 analyzes the relationship between trade openness and poverty and discusses methodological issues. Section 5 presents the database and the model used in the present study. Section 6 presents simulations results and last section concludes.

2. Macroeconomic achievements and poverty overview in Tunisia

2.1. Macroeconomic achievements. It is well admitted that the incidence of poverty (H, i.e. the proportion of people who are poor) is fully determined by the poverty line (z), the mean of the income distribution (μ) and the associated Lorenz curve (L). Accordingly, the level of poverty can decrease due to an increase of the mean income (μ) with respect to a constant poverty line (z), or due to a reduction in relative inequality (L). Thus, poverty reduction can be achieved through income growth or income redistribution, or a combination of the two. This explains how growth is important for poverty reduction. The decreasing trend in poverty incidence observed in Tunisia during the last three decades is a result of combined relatively sustained high economic growth and a coherent social policy implemented in the country. In this respect, social achievements and equity are considered among Tunisia's greatest assets, which have distinguished it from other countries in the region and ensured internal cohesion. The level of government's budgetary expenditures for social policies has remained consistently high even during the years of stabilization and adjustment, accounting to 5-6% of GDP for education and 2.2% of GDP for health (World Bank, 1995). With increasing international competition and closer integration with Europe, the enhancement of those achievements are more important now with the presence of an important middle class (nearly 80% of the country's population) and growing of the working population (62.8% of the population are between 15 and 59 years of age in 2002 compared to only 53% in 1984).

As far as economic growth is concerned, figures that GDP growth was high in the 1990s and the 200s, especially between 1995 and 2000, when GDP grew, on average, by 5.6 percent per year. The services sector, together with construction and manufacturing, were the main contributors. Agricultural output, an important determinant for rural poverty, grew at an average rate of 7.8 percent between 1995 and 2000. Moderate population growth meant that GDP per capita increased by one third over the 1990s real terms. As a result, Tunisia grew faster than other countries in the MENA region and advanced into to the group of top ten richest middle income countries.

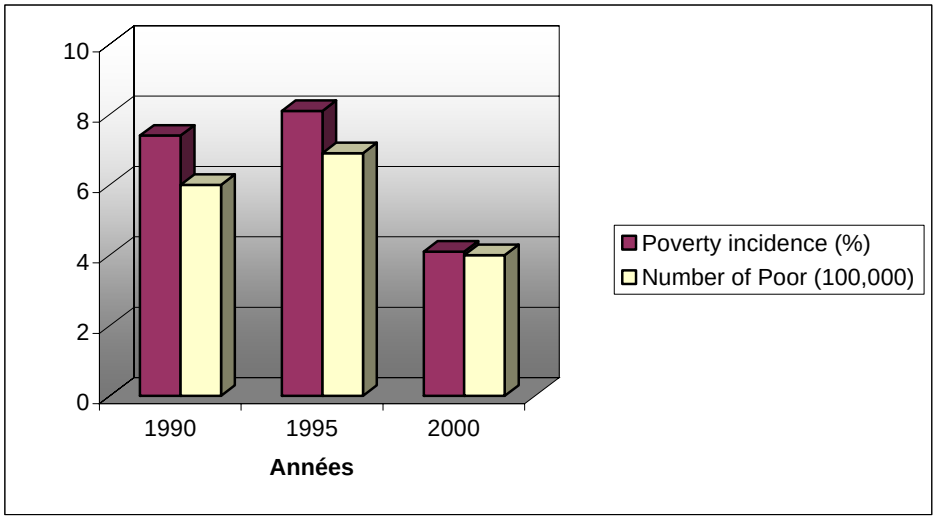
While economic growth in Tunisia is one of highest in the MENA region, unemployment rate still exceptionally high. Recent official estimations establish a rate of 15% (INS, 2000). Unemployment has become the lowest in the services sector and the highest in manufacturing; 54 percent of the unemployed are connected to manufacturing, which is going through hard adjustments. In 2001, the service sector accounted for the largest share of the labor force (40 percent), and the lowest unemployment rate (2 percent). Indeed, the share of investments in services is increasing. This low rate of unemployment reflects the large number of civil servants (who belong to this sector) whose jobs are the most stable. The public sector has also been recruiting faster than expected, hence compensating for the private sector, which has been globally creating fewer jobs than expected. Public enterprises and public administration, which account for around 20 percent of total employment, employ as already indicated the majority of the educated labor force. Overall, the increase in unemployment among the educated labor force reflects both the weakness of the demand by the private sector for educated workers and also the weakness of the links between the education system and the market**.** Nevertheless, this does not mean that the return to education has been altogether so low. This issue requires more precise

calculations and appraisal of the investment in human capital. Agricultural sector still dominated by unskilled wage-workers and family farmers. The issue of unemployment in rural area in general, and particularly for workers occupied in agricultural activities is quite different than what is prevailing in urban areas.

2.2. Poverty Profile. According official estimations, Tunisia has an impressive record of poverty reduction over the years, cutting the incidence of poverty (using the national line poverty) from 40% in 1960 to 11% by 1985 and further to 7.4% by 1990. Then poverty stagnated between 1990 and 1995 (8.1%[1]) but resumed its decline between 1995 and 2000 where its incidence attained its lowest level (4.1%). At the same time, the growth rate of population declined and life expectancy increased markedly, regional disparities were reduced, and improvements achieved in education, access to health care and basic infrastructure. The distribution of income improved until 1990 as the Gini coefficient fell from 0.434 in 1985 to 0.401 in 1990, but increased to 0.417 in 1995 and fell again to 0.409 in 2000. Average per capita expenditures for the lowest deciles of the population moved closer to mean expenditures for the country as a whole. In absolute term the number of poor increased from 600,000 in 1990 to 690,000 in 1995 and fell to 400,000 in 2000 (World Bank, 2003). Given that, the distribution of consumption is quite steep near the poverty line, many households can be vulnerable to sliding back into low incomes.

The last decade has been characterized by two very distinct patterns: an increase in poverty during its first half, due mainly to a prolonged drought leading to a severe drop in agricultural production over 1993-95, which was most likely accompanied by a deterioration in income inequality. The second half of the decade was characterized by an improvement in the poverty situation due to an increase in consumption expenditures (GDP grew on average by 5.6% and agricultural output by 7.8% according to World Bank (2003).

Figure 1: Evolution of poverty in Tunisia (1990-2000)



Source: World Bank (2003)

[1] Using the World bank's poverty line, the results are different from those estimated b y INS. More information can be found in World Bank (2003).

Given poverty changes depend upon growth records and income distribution evolution. The elasticity of poverty to growth was found to be negative in Tunisia as in most countries. Therefore positive growth of per capita income over 1990-95 should have resulted in declining poverty, all else being equal (Van Eeghen, 1995). However, due to the increase of inequality in income distribution, income equality may have deteriorated between 1990 and 1995. This deterioration is mainly due to the drop in agricultural incomes, which has reduced the incomes of poor households more significantly than those of other households, who rely more on non-agricultural income. During the period 1995-2000, the acceleration of growth and the decrease in income inequality can explain why the poverty incidence fell so significantly.

Regarding the characteristics of the poor in Tunisia, poverty remains primarily a rural phenomenon: in 2000, the incidence of rural poverty was 8.3% compared to 0.8% in metropolitan areas and 2.3% in other urban areas (table 1). With less than 40% of the total population, rural areas accounted for 74% of the poor in 2000 compared to 76% in 1990 (World Bank, 2003).

Table 1: Poverty lines and Poverty Incidence, 1990, 1995 and 2000

	Year	Lower Poverty Lines (core poverty) in TD	Poverty incidence
Metropolitan	1990	236	2.8
	1995	306	1.8
	2000	357	0.8
Other Urban	1990	210	3.5
	1995	272	4.2
	2000	318	2.3
Rural	1990	194	14.8
	1995	252	15.8
	2000	294	8.3

Source: World Bank, 2003

Generally, and both in urban and rural areas, poor households have more members than the non poor households. The average size of poor households is about seven persons in rural areas and six in urban areas compared to the national averages of six and five respectively. There is also a strong association between low human capital and poverty in both rural and urban areas, where over 60% of poor household heads have no formal education compared to about 40% for non-poor households. Poor rural households engaged in production activities typically have access to land, but their land holdings are small (averaging 2 hectares), rarely irrigated, and often exhibit low productivity, especially in rain-fed areas. The urban poor are mostly wage earners in low-skill occupations. According the INS (2003), poverty incidence increased in agriculture, fishing, and in the construction sectors and fell in tourism and commercial activities between 1990 and 1995. In 2000, the poorest households are still concentrated in the construction and agricultural sectors.

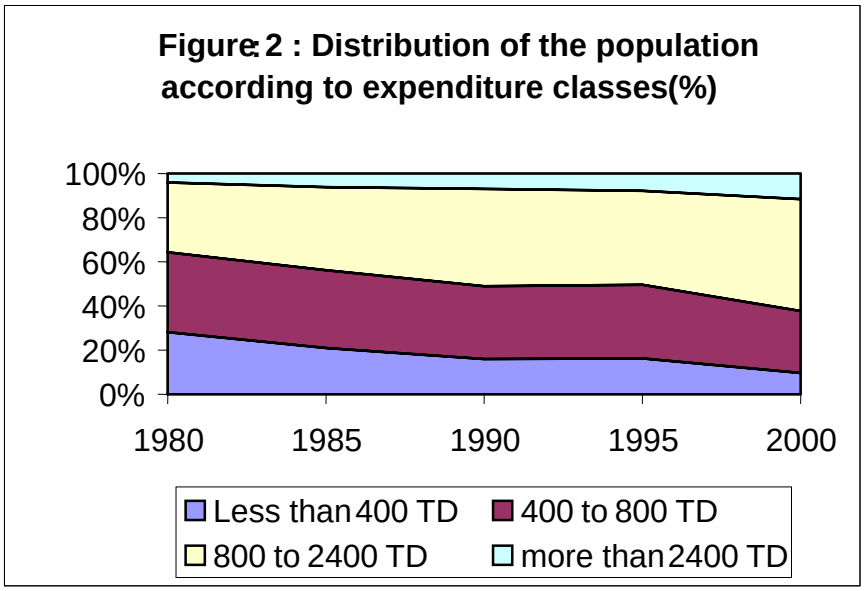
Regarding income and expenditure of Tunisian households, the results of the five years census on household budgets and consumption conducted by INS (2000) show that the average annual expenditures per capita amounts to 1329 Tunisian Dinars (TD), recording an improvement of 6.5% at current prices and 3.6% at constant prices compared to the same census results conducted in 1995. The results show also that the increasing in the level of expenditures per capita have been more important in the rural area (10%) than in the urban counterpart (5.9%), which means a reduction of the gap of expenditure levels between the two areas. In this context, it is important to point out that the annual expenditures per capita in rural area, represents 58% of the annual expenditures of an urban area citizen in 2000. This share was estimated at 48% in 1995. Furthermore, table 2 shows that between 1980 and 2000, the annual current expenditures per capita have grown rapidly from 248 TD to 1329 TD implying more than a fivefold increasing in 20 years and corresponding to an annual average growth rate of 8.8%. The annual average growth rate of rural households' expenditures has risen more than the urban households, respectively 9.3% against 8.3%.

Table 2: Trend in the average annual expenditures per capita

	Current prices in TD/capita/year					Average annual rate of growth (in %)			
	1980	1985	1990	1995	2000	80-85	85-90	90-95	95-2000
Urban	332	619	890	1209	1604	13,3	7,2	6,7	5,8
Rural	157	294	460	581	864	13,4	8,9	5	8,3
Total	248	471	716	966	1329	13,7	8,3	6,5	6,6

Source: INS, 2000

The breakdown of the population according to expenditure classes shows a net improvement of the standard of living accompanied by a decrease of the poorest population proportion and an increase of the middle and well-heeled proportion as illustrated by figure 2.



Source: INS, 2000

The socio-professional category of the household's head constitutes an additional indication of the level of the household standard of living. Table 3 gives the annual expenditures per household and per capita according to the socio-professional category of the head of the household in 2000. This table shows that the lowest level of expenditures concerns households where the heads are unemployed followed by those whose working in agricultural sector as wage-workers. According the World Bank (2003), poverty is closely linked to unemployment in Tunisia: households with an unemployed head have a very high probability of being poor (19%).

Table 3: Household annual expenditures according to the professional category of the head of household

Socio-professional category of the household head	Annual expenditures per household (TD)	Annual expenditures per capita (TD)
Senior managers and liberal professions	13227	2846
Middle managers and liberal professions	10151	2110
Other employers	8182	1597
Small businessman	8064	1537
Artisan's and independents	6175	1176
Non agricultural workers	5365	1036
Farmers	5732	1024
Agricultural workers	3986	731
Actives without jobs	3329	656
Retired people	7590	1744
Other inactive	3992	1387
Income coming from outside the household residence	4320	1064
Aggregate	6450	1329

Source: INS, 2000.

3. Trade Structure and Trade Protection in the Tunisian Agri-food Sector

3.1. Overview of agriculture and food processing sectors in Tunisia. Despite the permanent changes observed in the Tunisian economy (industrialization, growth of service sector and the development of tourism), the agricultural sector remains economically and socially important for its contribution to the achievement of national objectives as regards to food security, employment, regional equilibrium and social cohesion. The relative contribution of agriculture and fisheries sector and the associated food processing industries in the economy remains relatively high attaining 15% of the national GDP (Table 4).

Table 4: Contribution of agriculture sector and the food processing industries to GDP (TD Millions)

		1995	1996	1997	1998	1999	2000	2001
Tunisian GDP	Nominal prices	17051,8	19066,2	20898,2	22560,8	24671,6	26685,3	28757,2
	1990 prices	13074,3	14008,6	14770,7	15477,4	16414,5	17181,3	18027,5
Value Added of Agriculture Sector	Nominal prices	1938,2	2614,6	2759,7	2865,6	3210,9	3297,5	3347,0
	1990 prices	1572,8	2037,5	2098,0	2077,0	2306,0	2283,0	2248,8
Contribution to GDP		11,4%	13,7%	13,2%	12,7%	13,0%	12,4%	11,6%
Value Added of Food Processing Industries	Nominal prices	555,7	586,2	700,5	708,3	816,5	862,7	903,2
	1990 prices	426,1	434,4	517,0	501,3	565,5	608,4	593,2
Contribution to GDP		3,3%	3,1%	3,4%	3,1%	3,3%	3,2%	3,1%

Source: Tunisian Ministry of Agriculture and Central Bank of Tunisia, Tunisia.

In Tunisia, agricultural sector is characterized by a certain specialization in fruit, horticultural and livestock production (Table 5), but still vulnerable to limitations in natural resources and recurrent droughts.

Table 5: Production Structure of Tunisian Agriculture Sector (TD Millions at current prices)

	1995	1996	1997	1998	1999	2000	2001
Total value of Agricultural Production	2291,3	2985,7	3167,3	3284,5	3683,6	3760,5	3861,5
• Cereals	161,5	650,3	275,3	429,4	459,8	285,1	363,5
• Fruit production	592,6	647,3	1116,4	809,6	950,7	1118,6	803,8
• Horticultural production	388,5	444,4	442,3	515,0	598,7	600,1	462,1
• Livestock production	898,3	963,8	1091,0	1181,6	1316,5	1379,2	1390,3
• Fisheries production	183,5	202,4	241,0	247,5	249,2	273,4	277,5

Source: Tunisian Ministry of Agriculture and Central Bank of Tunisia, Tunisia.

Currently, food processing exports represent close to 10% of Tunisia total exports. The structure of the Tunisian food processing exports remained the same during the last few years. Olive oil is by far the main agricultural product exported and represents 30% of the food processing exports. Roughly, 60% of the Tunisian olive oil production is exported and Tunisia assures close to 20% of world-wide sales. Fish and sea food products represent the second group by order of importance representing 20% of total food processing exports. Fruit exports, essentially dates and citrus fruits, come in the third place. Dates exports recorded a sustained growth during the last decade.

Table 6: Structure of Tunisian food processing trade (TD Millions at nominal prices)

	1995	1996	1997	1998	1999	2000	2001
Food Processing Imports							
Meat	11,7	8,2	15,7	10,2	6,3	10,7	0,2
Milk, cheese, butte, etc…	50,6	27,9	43,0	24,8	21,2	28,1	29,1
Cereals	403,1	241,9	348,8	326,9	268,1	382,9	513,4
Vegetable oils	111,0	112,5	99,6	140,2	126,7	103,9	69,2
Tea and coffee	35,0	32,5	46,0	45,1	40,4	43,7	49,5
Sugar	68,6	87,4	92,2	108,2	79,1	74,5	79,9
Food Processing Exports							
Olive oil	216,6	117,1	288,4	212,6	382,7	263,9	200,3
Fish and sea food	74,1	90,8	107,3	125,7	102,1	119,9	126,5
Dates	58,3	46,7	52,1	70,1	56,3	52,8	105,6
Citrus fruit	10,6	9,1	6,4	9,5	8,5	9,9	12,8
Wine and alcoholic beverages	14,8	6,4	6,4	6,0	6,9	6,8	8,4
Meal preparations	39,8	26,3	65,3	63,9	60,6	35,9	26,0

Source: Tunisian Ministry of Agriculture and Central Bank of Tunisia, Tunisia.

Food processing imports, on the other hand, represent more than 10% of the value of total imports in Tunisia. The structure of food processing imports reveals the chronic dependence on cereal imports. Indeed, in 2001, cereals represented more than 60% of Tunisia food processing imports). The food processing balance presents a continual deficit. Even if the recovery of the commercial balance was one of the principal objectives of the structural adjustment program in Tunisia, the value of exports is far from allowing payment of food imports. A closer look at the Tunisian food processing flows by destination reveals a dependence of the Tunisian food

processing exports on the EU market which stand a strong intra Mediterranean competition. This situation is the result of the historical preferences and the relatively good prices received that did not encourage the Tunisian exporters to develop new strategies and diversify markets.

3.2. Agriculture Policy in Tunisia. The evolution of Tunisian agriculture reflects a sustained commitment by the government, in the course of the last three decades, involving public investment in the infrastructure, subsidies for private investment, price stabilization, training and extension, and import protection in the interests of rural development, food security and self-sufficiency, and social stability. The implementation of the structural adjustment program for the agricultural sector, between 1986 and 1996, began the liberalization of Tunisian agriculture, the improvement in the competitiveness of the agri-food industries and their adaptation to the qualitative and sanitary requirements of the international markets. With the exception of wheat, agricultural production activities have been substantially liberalized, input and interest rates subsidies have been practically eliminated; the price of water continues to be adjusted; and the marketing boards have partially lost their monopolies.

3.2.1. Tax benefits, investment subsidies, and domestic support. The tax benefits conferred by the Investment Incentives Code to encourage agricultural development include the deduction of the amounts invested from taxable profits; exemption from customs duties and the suspension of VAT and consumption tax due on imports of capital goods for which there are no locally manufactured equivalents; the suspension of VAT on locally manufactured capital goods; and the exemption of the investment from income tax for ten years. The financial benefits include an (investment) subsidy of 7% of the cost of the investment (maximum 300,000 TD); another subsidy of 1% of the total cost of investment with a ceiling of 5000 TD as the State's contribution to project design costs. In 2002, under its development programs, Tunisia spent 91 millions TD on encouraging investment in agriculture by subsidizing the cost of private investments in selected activities (WTO, 2005).

Concerning domestic support, Tunisia declared to WTO a zero current total aggregate measurement of support (AMS) for the year 2002, as compared with a maximum commitment of 61.12 million TD on the following products: durum and soft wheat, barley, milk, olive oil, and sugar beet. The support declared for 2002 was "de minimis"; it consisted of fixed producer buying prices for wheat and intervention prices for other products. The 61 millions TD reported by Tunisia as measures exempt from the reduction commitment ("green box"), are mostly spent on water and soil conservation and forestation programs. In addition, Tunisia declares an additional 8.3 million TD as an irrigation subsidy. In fact, farmers in public irrigated area still paying water at below its real cost. Additionally, farmers and agri-food enterprises are entitled to special electricity and diesel tariffs. Tunisia also subsidizes exports of agricultural products. These subsidies consist of payments intended to reduce processing and air freight costs (WTO, 2005).

3.2.2. Agricultural Pricing Policy and Food Subsidies. The agricultural and fisheries sector was subject to two forms of price control: control of production prices and control of prices for agricultural input. Since 1986, Tunisia has been conducting a program of structural adjustment aimed at reforming the agricultural sector by shifting its prices closer to those in world markets and reducing production subsidies. While subsidies on inputs were removed totally (except for

water), support for agricultural production through investment subsidies remained at a very high level for some activities (see section on agricultural policy at activity level).

Concerning the control of production prices, excepting certain products that continue to benefit from guaranteed public prices (milk and cereals), market prices for all the other products are freely determined. Furthermore, and since the beginning of the 1990s, the Tunisian economic policy has radically changed to the detriment of the agricultural sector. For pricing policy, the situation had radically changed. In fact, when domestic production is limited for a given product, mainly for vegetables and meats, prices tend to rise. Public authorities implement a set of maximum prices at the level of wholesale or retail markets, without any compensation for the farmers. However, when prices are at very low levels, due to the abundance of local production, no instrument of support for the farmers is applied. This policy, which is inscribed within an objective of controlling inflation at the expense of the agricultural sector, has heavily affected farmers' incomes during the last few years. Small farmers, producing vegetables, are the most affected by this policy.

3.2.3. External Protection. Two instruments still used by the Tunisian authorities to protect the domestic production from outside competition: tariff and non-tariff policies. The content of both began to be modified in 1995 with the implementation of GATT, but the two instruments still largely used in Tunisia.

a. Tariff Barriers. Tunisian customs duties are still among the highest in the world. In fact, the non-discriminatory duties rose to 34.5% on average in 2002, against an average rate of 12.8% in the same year for countries with intermediate incomes levels. Moreover, these duties have scarcely evolved since the beginning of the 1990s, whereas they have been reduced to more than 40% on average in the latter countries.

Concerning agriculture and the food processing sectors, they continue to be highly protected. Since the partnership agreement with the EU has bearing only non-agricultural and manufactured food products, agricultural trade continues to be governed by the commitments that Tunisia has taken within the multilateral framework of the WTO. In principle, quantitative restrictions have been converted to customs duties, but, as many member-states, consolidated duties have been fixed at very high levels. While nominal protection had risen on the eve of the GATT agreement signed in Marrakech in 1994 at an average rate of 39% and 46% respectively for agriculture and the food processing sectors, the respective rates rose to 136% and 88% in 1997. They have been reduced, through the years, in conformity with the agreement on agriculture, but still remain at very high levels, 89% on average for agricultural products and 72% for agro-industry products (Table 7).

Table 7: Nominal Protection by Major Economic Activity (1995-2003)

	1995	**2000**	**2001**	**2002**		**2003**	
		UE	**UE**	**UE**	**RM**	**UE**	**RM**
Agriculture & Fishing	39	126	100	98	98	89	89
Manufacturing	43	39	36	33	45	29	42
Non-Manufactured Industries	11	11	3	3	9	1	3
Total of the economy	34	42	36	35	43	31	39
Total, except agriculture and food processing	30	21	16	15	24	12	22

Source: Chemingui and Lahouel (2004)

For agricultural and food processing products, tariffs varied greatly between products. Customs duty and other import taxes were generally high for fruit, forest cultivation products, tobacco, meat, dairy products, products derived from the processing of cereals, canned foods, and beverages. They were less high for cereals, livestock, oils and sugar, four categories which together account for 60% of agricultural imports. Nevertheless, Tunisia has preserved preferential customs duties, as part of its offer to the GATT agreements of 1994, which are applied for certain products, within the limits of the quotas, set by public authorities. Preferential rates are much lower than the maximum consolidated tariffs. (cf. table 8). In general, preferential quotas are set at levels that cover the deficit of the food balance in certain agricultural products. The importation operations at preferential tariffs are on the whole officiously granted to public operators. Accordingly, cereals, under tariff quota, are imported exclusively by the Tunisian Grain Board and sugar by the Tunisian Trade Board. Special TQ authorization to import products subject to TQ is required. This license is issued by the Ministry of Trade. Private operators do not practically benefit from imports within the framework of preferential quotas (TQ). The objective of this policy is to guarantee the continuity of the necessary importation operations in order to satisfy domestic demands at relatively low costs, while protecting local production through the exclusion of private operators from these imports.

Table 8: Imports under tariff quotas, 2001-04, and customs duty rates, 2005

Description of product	2005		Tariff quota commitments (tons)	Utilization rate (2001)	Utilization rate (2002)	Utilization rate (2003)	Utilization rate (2004)
	Average quota rate	Average out-of-quota rate					
Calves and bullocks	27	82	3000	0	0	0	97
Bovine meat	27	88	8000	0	0	0	100
Sheep and goat meat	27	125	380	0	0	0	100
Milk powder	17	76	20000	10	19	35	43
Butter	35	100	4000	60	88	48	49
Cheese	27	139	1500	100	100	100	100
Beans	25	60	1300	0	0	0	0
Durum wheat	17	73	300000	100	100	0	0
Soft wheat	17	73	600000	100	100	85	100
Barley	17	73	200000	100	100	100	100
Sugars	15	42	100000	100	100	100	228
Shelled almonds	43	60	1335	70	100	0	0
Tomato concentrate	43	100	155	0	0	0	100

Source: WTO (2005)

Effective protection has decreased, yet it is still high. It increased during the first years of the dismantling of tariffs on European manufactured products because of the retained dismantling sequence, which begins with input and finished products that do not compete with local production. This situation has been redressed with the entry of the fourth list of competing products in the dismantling phase of customs duties (table 9). Concerning agricultural and agro-industrial products, effective protection has followed a declining tendency, albeit very limited. In fact, the effective protection of this sector decreased from 162% in 2000 to 108% in 2003. This is the direct result of the cost reduction of imported intermediate materials and equipment.

Table 9: Effective Protection by Major Economic Activity (1995-2002)

	1995	2000	2001	2002		2003	
		UE	*UE*	UE	RM	UE	RM
Agriculture & fishing	45	162	123	120	118	110	108
Manufacturing	85	68	60	57	92	49	87
Non-manufacturing industries	12	15	3	4	11	1	1
Total of the economy	41	63	50	49	60	44	54
Total, except agriculture and food processing	34	30	20	19	34	16	29

Source : Institute of Quantitatives Studies, « Protection effective des activités économiques, Evolution et perspectives (2003-2008), 2003

b. Non-Tariff Barriers. The monopolization of the import of certain food and agricultural products by public monopolies (Tunisian Office of Commerce, Oil Office,) continues to represent the main tool of protection of the agricultural and food sector in Tunisia. This monopolization represents quite an important part of Tunisian imports. The Office of Commerce still keeps the monopoly of importing products considered as basic: sugar, coffee, tea, black pepper, cocoa beans, rice, kidney beans, dry yeast as well as some fresh and dry fruit and vegetables and tinned food. In principle, the importation of most of these products is subject to regulation by "Bid Specifications", which take long to be elaborated and published by the administration. As long as these "Bid Specifications" are not ready and made public, the Office of Commerce keeps the monopoly of importing the food products mentioned above. For the other agro-alimentary products, which should be freely imported, getting an import authorization, instead of a license, makes such operations almost impossible. Tunisian administration often refuses importation requests, without any justification.

Technical control also represents an indirect tool for the protection of domestic production. In general, technical control aims at checking up the conformity of imported products with the sanitary and security norms. Technical control has been consolidated since the adhesion of Tunisia to the WTO in 1995. Although it is only applied to around the quarter of the customs positions, or to worth 37% of imports in 1994, the portions of customs positions and of the value of imports, subject to this control, rose respectively to more than 30% and 43% in 2001. The quasi-totality of this increase concerns the control of consumption goods through certification, but systematic control remains very important, bearing on almost 14% of the imports in terms of customs positions. It is this kind of control that mostly causes deadline and efficiency problems.

The control of conformity with the sanitary, phyto-sanitary or technical norms is legitimate, being, by the way, practiced in all the countries of the world. However, it has to be effected in an efficacious and less costly manner for the importer, so as not to become a non-customs restriction on imports. Very often, technical control is used in Tunisia for protectionist ends.

It follows that the custom clearance of imports, destined for the local market, are still very heavy, contrary to those that are applied to imports by off-shore enterprises, which are quite light. For the imports of agro-alimentary products, which are exclusively destined for the domestic market, they still suffer from very long clearance deadlines, estimated at three weeks on average, against some days in more performing countries. The reasons are the slowness of

customs procedures and the delays, taken by the technical control. These excessive delays are translated into supplementary costs, added to customs duties.

The tariff equivalent of the non-tariff barriers provides an indicator for the scale of this type of protection. In order to assess this for the main agricultural products imported into Tunisia in 1992, Chemingui and Dessus (2001) have used the approach developed by Baldwin (1989). Out of 19 agricultural and food products studied, six showed significant levels of tariff equivalent. Sugar had the highest non-tariff protection, with a tariff equivalent of 28%, followed by hard wheat (20%). The other protected products were barley, soft wheat, vegetable produce and canned goods.

3.2.4. Consumption Subsidies. The consumer price for each product whose producer price is subject to administrative control is also itself controlled. This is particularly true of staple commodities like cereals and milk. By means of the General Fund of Compensation (CGC), the Tunisian government has subsidized the consumption of basic foodstuffs since 1970. The subsidies have been applied uniformly to whoever chooses to buy subsidized products at whatever quantity. The subsidies of the CGC have been introduced to satisfy a somewhat contradictory host of objectives. These objectives comprise: (1) the stabilization of the fluctuating prices of basic products; (2) the preservation of the purchasing power of the underprivileged households; (3) and the redistribution of incomes in favor of low-income groups.

Since 2000, the products, covered by the subsidies of the CGC, are cereals and their derived products, vegetal oil and milk. In spite of the successive reductions of food subsidies, since the adoption of the program of structural adjustment in 1996, these subsidies still represent a relatively important share of the government expenditure. (cf. table 10).

Table 10: Structure and Importance of Consumption Subsidies for food products

	1999	**2000**	**2001**	**2002**	**2003**	**2004**
Share in Total Food Subsidies (in %)	64.2	73.9				
• Cereals	29.3	20.4	80.5	72.5	64.4	70.7
• Oil	5.5	5.7	15.1	23.7	32.6	26.7
• Milk	1.0	0.0	4.4	3.8	3.0	2.5
• Sugar			0.0	0.0	0.0	0.0
Food Subsidies/Gov. Exp. (in %)	2.1	2.0	2.1	1.8	1.7	1.9
Food Subsidies/GDP (in %)	0.8	0.8	0.8	0.7	0.6	0.7
Subsidies/Capita (TND)	21.1	19.5	21.0	18.1	17.3	19.4

Source: Our calculations using data from the Central Bank of Tunisia (2005) and the National Institute of Statistics (2005)
Note: Gov.Exp.: Total Government Expenditures

The cereal sub-sector represents the most politically sensitive, complex and costly part of the system of subsidies. Subsidies are injected at three levels of the commercialization channel: collection of local production, importation, and, flour milling. The Cereal Office (CO) runs the payment of subsidies in the cereal sub-sector in the name of the CGC, in that it benefits from the position of a monopoly over the cereal imports as much as over the collection of the locally produced cereals by the farmers. With the OC, two technically private and well-regulated co-operatives work in the name of the OC according to the same mechanism. As for the subsidies deposited to the sub-sector of vegetal oil, the National Office of Oil (ONH) controls the importation and the refining of vegetal oil. The consumption price of vegetal oil is set below the

cost, and the ONH is refunded the difference by the CGC. Presently, the milk sub-sector represents only a limited part of the expenses of consumption subsidies. This has been the fruit of developing local production and improving the productivity of private industries.

3.2.5. Trade Reform and Current External Protection for Agri-Food Products.

During the 1980s, Tunisia was a highly-regulated economy with considerable state participation. Overtime, however, numerous measures have been taken into account to enhance the role of the international market. In this regard, and in addition to it's commitments into the GATT agreement, Tunisia has undertaken additional liberalization commitments regionally.

Tunisia's trade reform was announced as a gradual and selective process that should have liberalized imports during a fifteen-year period starting from 1995. It is important to notice that Tunisian strategy for smoothing the adjustments imposed by the liberalization of imports was to accompany this liberalization with an important upgrading program ("mise a niveau") of its economy and a coherent macroeconomic policy aiming to keep the macroeconomic equilibrium of the country.

The most important liberalization commitment undertaken by Tunisia is related to the association agreement signed with the European Union that will lead to free trade in industrial products with the EU by 2010. The European Union is Tunisia's leading trade partner, accounting for 76 per cent of Tunisia's two-way trade. This dependence is primarily due to industry – 80% of imported industrial products come from Europe and 78% of Tunisia's industrial exports are for the European market – but much the same holds for agricultural products and their derivatives, since 70% of Tunisia's exports of such products go to the EU. European imports constitute somewhat less than half of total import of agricultural and agri-food products (approximately 40%). The association agreement with the European Union is thus of vital importance, as it is likely to modify appreciably the structure and intensity of Tunisia's trade with its primary partner. As was already mentioned, the trade provisions of Euro-Mediterranean agreements are characterized by tariff dismantling at differing rates from one product to another. Tunisia began its tariff dismantling with respect to the European Union in 1996, not waiting for ratification by the European countries where the agreement's official coming into force in March 1998. Dismantling of List 4 (goods computing with domestic production) have began in 2001. Talks with the EU on liberalization of services started in 2003, while agricultural trade is amended by an additional protocol, which entered into force in the First January 2001. This additional protocol increased the duties-free quotas for the main Tunisian agricultural export products, such as olive oil and citrus. Eight years later, tariffs on industrial products imported from the European Union saw their protection level highly reduced. Thus, for products in list I and II (composed by raw materials and equipment goods for production activities), their imports is exempted from any duty taxes. Products in list III, registered a 72% reduction of their initial duty taxes, passing from 43% in 1996 to 12.04% in 2003 in average. Products in list IV, which concerns directly consumers (textiles, apparel, leather products…), shown their protection rate decreased from 43% to 18.9%, which corresponds to 56% reduction in the initial tariff rate.

In order to limit trade diversion and benefit from the buoyancy of other markets, Tunisia unilaterally dismantled the tariffs for all its partners in 1996 on some capital goods having no domestic equivalent, which correspond to the products on List 1 in the association agreement signed with the European Union. Capital goods with domestic equivalents will be liberalized over 5 or 12 years. The authorities also dismantled in a non-discriminatory manner the tariffs on

foreign inputs, by decreasing gradually the rate on inputs having domestic competitors, from 43% in 1996 to 25% in 2001, and it's planned to keep it at 10%. Moreover, Tunisia has signed a regional trade agreement with Jordan, Egypt and Morocco (Agadir Agreement) in order to establish a free trade area among them allowing an eventual cumulation of rules of origin with the EU. Tunisia is also a member of the GAFTA, which came into force in January 1998. The latter provides for gradual tariff dismantling over 10 years, except for services and a fairly long negative list of agricultural products. Tunisia has also signed in agreement with Turkey to establish a free trade area.

Regarding protection applied for agricultural products, Table 11 presents the effective tariff rates applied on main agricultural and food products imported by Tunisia. Overall, and regarding the Tunisian current tariff policy, a minimum rate is applied to all imports with the exception of those covered by tariff rate quotas (TRQs). For those imports, preferential tariffs are applied if the imported volume level is below the imposed quota, while discouraging tariffs are applied for exceeding quantities. All duties are expressed ad-valorem and based on the cost insurance freight (CIF) value. There are no special or combined duties.

Table 11: Structure of production, trade, consumption, and protection for agriculture and food processing products in the year 2001 (in %)

Commodity	Effective tariff rates
Cereal crops	10.40
Leguminous crops	64.90
Fodder crops	0.50
Sugar-beet and other industrial crops	56.20
Olives	0.00
Fruits products	61.80
Vegetables crops	2.10
Other Horticultural products	13.80
Livestock Products	11.50
Other livestock	32.30
Forestry products	29.40
Fishing products	7.10
Meat	10.30
Dairy products	63.00
Milling products	57.70
Olive oil	19.10
Canned products	70.20
Sugar	24.00
Other agri-food Ind.	46.00
Beverage	53.20
Tobacco industries	58.00

Source: INS, 2002

Figures show that nominal effective protection still very high for agricultural and food processing products imported in Tunisia. The most protected products are leguminous crops, sugar beet and other industrial crops, fruits, dairy products, milling products, canned products, beverages and tobacco. For all these products, protection exceeds 50%. In opposite, cereal crops, fodder crops, vegetables, fishing, and meat are among the less protected products.

4. Trade and Poverty: Literature Review and Analytical Tool

4.1. The relationship between Trade and Poverty. Trade liberalization is expected to have an impact on various stakeholders through various transmission channels: employment, prices (production, consumption, and wages), assets and transfers. Indeed, trade liberalization affects sectoral demand for labor, particularly those that employ the poor and are producing tradable commodities. Contractions and layoffs in the non-tradable sectors may occur. Consequently, the welfare of households in general and of low income-households in particular can be affected.

Prices determine real household income directly as they have an important bearing on income and indirectly on non income measures of welfare. For the poor agricultural farmers, the cuts in input subsidies (fertilizers, pesticides, animal feed and irrigation water) in the frame of the internal reforms had little impacts on their incomes because of their low use of these inputs. This implies that the impacts of trade liberalization on their incomes will be canalized mainly by the relative change of their output prices. Trade liberalization is also expected to affect the value of households' assets (houses, land, water etc...) through changes in their levels or returns. Cuts in transfers in the form of producer and consumer subsidies is always associated with internal reforms associated with trade reforms, which will have direct effects on poor households' income. The net results of trade liberalization will depend on the adjustment capacity of poor rural households, which is likely to be weak, and the efficiency of the government accompanying programs.

Economic growth generally helps to reduce poverty. International experience strongly indicates that rapid and sustained economic growth remains the primary vehicle for reducing poverty. For example, in an analysis of twenty developing countries, Bruno et al. (1998) found that a 10 percent increase in mean survey income led to a 20 percent drop in the proportion of people living on less than one dollar a day. On a different data set of 26 developing countries, Roemer and Gugerty (1997) found that a GDP growth rate of 10 percent a year is associated with a 9.2 percent increase in mean income for the poorest 20 percent of the population provided that there are non major changes in income distribution. Furthermore, faster rates of per capita GDP growth should lead to higher rates of poverty reduction. According to the World Bank (2003), the observed poverty decline in Tunisia is the result of a sustained per capita GDP growth. Given that economic growth in Tunisia was generated from activities, which are labor intensive, the growth benefiting more the poor[2]. The elasticity of poverty is roughly negative 4-5, when estimated at a poverty line of 1 US dollar per day. This means that for every 1 percent increase in real GDP growth the number of poor people declines by 4 to 5 percent. The relatively high growth elasticity could be explained by the small poverty gap index (see table 12) which indicates how close poor people are on average to the chosen poverty line. Recent data from Tunisia suggests the elasticity of poverty reduction to growth may be declining, meaning that faster growth will be needed to achieve similar reduction in poverty as in the past. However, the

[2] Richard (2002) argues that the link between growth and poverty reduction is clearer when economic growth is measured by survey mean income (consumption).

speed with which an economic growth can reduces income poverty is largely a function of the distribution of income (Cling and al., 2003). For example, based on a large sample of developing countries, the poverty headcount index for an economy with a Gini coefficient of 0.1 falls by almost 3.0 percent for each percentage point of economic growth, while the fall is only by 1.5 percent for an economy where Gini coefficient equal 0.6.

Table 12: Head count index and poverty gap, 1990-2000:

	Year	Head count index (%)	Poverty Gap (%)
National	1990	7.4	1.7
	1995	7.6	1.6
	2000	4.1	0.82
Urban	1990	3.5	0.7
	1995	3.6	0.7
	2000	1.6	0.29
Rural	1990	13.1	3.2
	1995	13.9	3.1
	2000	8.3	1.72

Source: World Bank, 2003

The strong redistribution effects of trade liberalization have been also firmly established by economists. The work carried out by Bussolo and Solignac Lecomte (1999) has shown for example, that in Sub-Saharan Africa, a reduction of average tariffs from 40% to 10% entails real income losses of 35% for urban employers and 41% for recipients of trade rents, compared with a gain of 20% for farmers. The overall net gain to the economy is estimated at 2.5%. The relatively small size of this efficiency gain compared to the redistribution effects makes trade liberalization a hard task for policy makers to carry out.

Theoretical analysis also shows the positive correlation between trade and poverty. The standard Stopler-Samuelson result of trade liberalization in economies that are labor-abundant and capital-scarce is that labor gains at the expense of capital owners (see Winter, 1999 for an analysis of the mechanism). Since poor people are more likely to be found in the wage earners' group than among capital owners, trade liberalization should redistribute income towards some poorer groups of the population. Where trade restrictions are protecting skilled labor-intensive sectors, their removal will shift income towards unskilled laborers who are, obviously, more likely to be among the poor and the poorest. But when natural resources are important as an additional factor of production, the picture becomes more complicated. For instance, in Latin America and Africa, trade liberalization may have actually resulted in a shift in the distribution of earnings away from unskilled workers by expanding exports of certain sectors that are intensive in the combined use of natural resources and skilled labor (see for example, Bussolo and Lay, 2003). Moreover, the standard result is valid provided perfect functioning of all markets. However, if there is labor market segmentation, it can be easily shown that the protected workers or the insiders could gain at the expense of informal workers and the jobless. Overall, the re-distributional impact of trade reforms plays an important role in the assessment of who is in the end paying the adjustment costs and in the search for instruments that could be used to eventually alleviate these burdens. The analysis of this impact is highly complex because trade reforms have macroeconomic linkages while the effects on income and poverty are inherently microeconomic issues. In fact, in an area of globalization, domestic prices are no longer

determined exclusively by participants in local or even regional markets. An increase in international prices would be transmitted directly to domestic prices. This would change terms of trade which are the primary determinants of real output and incomes in both urban and rural areas. The relative prices of goods also exert powerful influence on wages, migration, and thus on poverty levels.

Important second-order demand effects also play a role. The final outcome for the poor depends on how households spend additional income, whether the items desired can be imported to the local areas in response to increased demand, and, if not, whether increased demand will lead to new local production or simply to price rises. A recent study done by Delgato et al. (1999) discerns three sets of conditions for positive demand effects. First, increments to household incomes should be spent in large part on goods and services locally produced. Second, the local goods in question often should not have good substitutes that can be imported cheaply. Third, underused productive resources are available in local areas, which can be drawn into production by increased local demand for the things that they can produce.

Positive price shocks are not the only type of shocks that globalization may bring. Actually negative external shocks are also likely to occur. It is worthwhile to notice that in this case different transmission mechanisms may operate. A clear recent example is given by the financial crisis in East Asia. According to Delgato et al. (1999) “almost overnight the crisis has rolled back many of the gains that were made in reducing absolute poverty”. Among the highlighted linkages are those of labor migration and interactions between the urban and labor markets. Initially the most visible effects of the economic crisis were massive job layoffs and reduced wages in urban areas. Then large numbers of urban workers returned to their villages and this has pushed down agricultural wages. Combined with more expensive agricultural credit and the high farm-household debt incurred during the boom years, the consequences for the poor may be clearly be disastrous, especially in the rural areas where few government safety nets exist. With financial sectors on shaky ground, high unemployment rates, rising food prices and food shortages, and competitive advantages in agriculture in some countries, agriculture will play an important role as the region resumes growth. Agriculture may partly compensate for the other sectors and may play a major part during the recovery because of its low import content. Its reactivation may also help alleviate the worst consequences for the poor. In Indonesia, for example, coffee, fruits, palm oil, and rubber exports has moderated the negative effects of the crisis and made a significant dent in the import cost of rice. In Vietnam the crisis has set in motion more rice production, which will also help to alleviate trade imbalances.

Thus, it is obvious that trade policy reforms will result in some households winning and some others are losing. Given the diversity of households in an actual economy, even the most attractive reforms will typically result in some households losing, at least in the short run. One stand is just to accept these losses if they were necessary costs to move the economy to a higher level of efficiency and competitiveness. An alternative stand is to argue against any reform that hurts any group, especially if it is poor. These stylized positions sound extreme, but as Harrison and al. (2000) have argued, they have prevailed on many occasions. For Richardson (1995), the real question, which brings us back to the old compensation issue, is whether reforms should be implemented just if total benefits exceed total costs, or only if those who lose are fully compensated.

Given the high correlation between trade and poverty on one side and the labor segmentation in developing countries on the other, it is important to take into account

heterogeneity and labor market segmentation when analyzing the effects of trade liberalization on poverty. The next section presents the methodology used in the present study.

4.2. Modeling Trade Liberalization and Poverty. Accounting for the effects of trade policy on the distribution of welfare among individuals and households has long been on the agenda of economists. Some economists have used aggregate indicators such as the levels of wages and employment, or the value added in different sectors, in order to assess the effects of different trade regimes on the distribution of income (Beyer et al, 1999; Harrison and Hansen, 1999). As this approach fails to capture the mix of effects on specific households and their responses to prices, other economists have used more developed models to account for the interrelationship between labor markets and prices of staple agricultural goods. For instance, Ravallion (1989) used a partial equilibrium model to examine the rural welfare distributional effects of changes in food prices under induced wage responses for rural Bangladesh. Levy and van Wijnbergen (1992) also followed this partial equilibrium approach when analyzing the effects of changing production and consumption subsidies on agricultural goods on income of different household categories. Other economists have used econometric models to analyze the impact of trade on income distribution and poverty, where a huge body of literature exists (Dollar, 1992; Edwards, 1992; Ben-David, 1993; Sachs and Warner, 1995, etc.).

A more comprehensive way of modeling the overall impact of policy changes on the economy is CGE modeling[3], which incorporates many important general equilibrium interactions that are present in the economic system. These models are well suited to explain medium- to long-term trends and structural responses to changes in development policy. An effort to adapt CGE models to the analysis of different adjustment programs and to estimate the costs of other strategies was made in the late 1980's by the OECD, through the work of Bourguignon et al. (1991). Their "macro-micro" model links the short-run impacts of macroeconomic policies that affect the distribution of income through inflation, interest rates and other asset price changes with the medium-run impacts of structural adjustment policies that affect the distribution of income through relative commodity and factor price changes. To measure distributive impacts, these extended CGE models map factor income to different types of households. The models were applied to analyze different policy changes in several developing countries. Comprehensive as they are, these modified CGE models require extensive work and resources. Research carried out at the World Bank for Panama and Iran are examples of such an approach. The procedure used in these cases is a straightforward combination of household surveys, which provide the structure of households' consumption at the moment of simulation, and of simulated or actual price changes. The change in the cost of living by segment of the population is then used to assess the impact on income distribution. These studies provide an upper bound measurement of the required increase in income for each group to purchase the same quantities of goods as in the base situation.

[3] Numerical general equilibrium models are the most widely used tools for simulating the impact of public policies or external shocks on various economic variables. The extensive use of these kinds of models in developing countries is mainly due to the fact that they can be run on the basis of a one-year database. This is an important argument in developing countries where long-time series are often not available, incomplete, or of bad quality. The other argument in favor of their use is that they include the most important economic variables in an integrated framework.

Decaluwé and *al.* (1999[a]) have evaluated the relevance of different types of general equilibrium modeling for measuring the impact of economic policy shocks on poverty and income distribution. Three approaches were identified from the literature and implemented using an archetypal economy: i) the first is based on a traditional form of the CGE model, which specifies a large number of households in order to integrate inter group income inequalities, ii) the second uses survey data to estimate the distribution function and average variations by group, which allows for the estimation of poverty evolution, iii) the third approach includes individual data directly integrated in the general equilibrium model framework according to the principles of micro-simulations. The results show the importance of intra-group information and therefore the relevance of micro-simulation exercises. In another study, Decaluwé and al. (1999[b]) have highlighted the usefulness of Social Accounting Matrices (SAM) and CGE models to address issues related to income distribution and poverty. Their CGE model was calibrated again on an archetypal African SAM and an interesting innovation of its specification has been made (endogenizing the poverty line). However, Rutherford and Tarr (2004) on the basis of their study on Russia conclude that using 150000 households or only a few household categories does not change results as much as expected. Their explanation is that from a micro-simulation CGE model we are simply moving from a sample of few households (CGE-RH) to a much more important sample (CGE-MS). The issue of the relevance of micro-simulation still not yet established and the cost related to developing a micro-simulated CGE model is not yet justified.

Understanding the current consumption patterns in a given country and the anticipated behavioral responses of households to price and income changes following trade liberalization (Anne Case, 2000) is a primer condition to develop a suitable tool for impact analysis. This means that a framework allowing simultaneously the analysis of the behavior of households in the past through survey analysis, and to simulate what will be this behavior in the future depending on the evolution of the economic environment have to be developed. In this regard, Anne Case (2000) estimates income and price elasticities for thirteen commodity groups in South Africa, and proposes to use them as intermediate inputs in the CGE model developed by Devarajan and van der Mensbrugghe (2000) to assess the impact of trade liberalization on income distribution in South Africa. More recently, Cockburn (2001) has attempted to bridge the gap between CGE models and poverty/distribution analysis by constructing a CGE model that explicitly models all households from a nationally representative household survey in Nepal. Households are characterized by their sources of income and their consumption patterns, which in turn determine how they are individually affected by macroeconomic shocks. The author underlined the suitability of this type of fully disaggregated model for analyzing distributional impacts of trade liberalization.

Accordingly, the most promising direction for estimating the impact of trade reform on poverty consists in seeking a true integration between CGE model and the observed heterogeneity of households as observed in a household survey. There are two main ways to achieve the consistency between the macro framework and the micro-economic surveys. The first one, proposed by Cogneau and Robilliard (2000)[4] has been labeled the "fully integrated micro-macro framework". It is based on a standard CGE model where representative households and workers are replaced by a full sample of households and workers whose behaviors are observed from household and labor force surveys. The advantage of this method is its ability to capture the impact of macroeconomic changes on workers and households, and also the feed-

[4] Cogneau D. and A.S. Robilliard (2000), "Income distribution, Poverty and Growth in Madagascar: Microsimulations in a general equilibrium framework", IFPRI Working Paper 61/2000.

back effects of micro-simulation on the macro part of the model. The second approach that can be implemented is the "sequential micro-macro framework". The macro part of the model is an extended CGE model which is supposed to describe the functioning of the economy under analysis. The link with the micro-simulation model is through a vector of prices, wages, and aggregate employment. Knowing the change in the link variables resulting from a shock in the macro-part of the model, the micro household database is modified in a way that is consistent with the link variables. Their approach combines a standard multi-sector CGE model with a micro-simulation model that describes real income generation behavior among a representative sample of households. This micro-simulation model will be based on econometric reduced form equations for individual earnings, household incomes, and the occupational choice of all household members at working age. The micro-simulation model will be used to generate changes in individual wages and employment status in a way that is consistent with the set of macro variables fed by the macro or CGE model. When this is done, the full distribution of real household income corresponding to the shock or policy change initially stimulated in the macro model may be evaluated (Bourguignon et al., 2002a).

For this study, we have preferred the first approach following the work of Cogneau and Robillard (2000) and Cockburn (2001). This approach consists in moving from representative to real households within the CGE model. It works to replace a small number of RHs by the full sample in the household survey. This approach, however, requires at one's disposal the same models at the individual or household level as in CGE/RH models at the representative group level. It is important to note that there may be intermediate solutions between working with a few representatives household groups and with several thousands of real households. According to Bourguignon et al. (2002b), one may be satisfied by expanding the original RH approach to several hundreds of households defined on the basis of clusters typically found in household survey samples. This approach is named "full integration". Currently, general equilibrium analysis with full-integrated microsimulation analysis is still very rare and most of models are in the category of partial equilibrium. In developed countries, general equilibrium effects have been incorporated by combining an aggregate CGE model and a partial-equilibrium micro-simulation model sequentially (Meager -1993, Dixon, Malakellis and Meagher -1996). In developing countries, there are only three CGE microsimulation models: Cogneau (1997) and Cogneau and Robilliard (2000) for Madagasacar and Cockburn (2001) for Nepal. The results obtained clearly show the importance of intra-group information and therefore the relevance of micro-simulation exercises. This exercise will allows us to break down the contribution of average income variations, of the poverty line, and of income distribution in the determination of the poverty head count.

5. The micro-simulation CGE model for Tunisia

The micro-simulation approach, as it might be, (full-integrated or top-down approaches) necessitates the availability of data, relative as much to the different expenditure posts as to the different income sources of all households. In the case of Tunisia, like many other developing countries, the available quantitative data from the different surveys on household's budgets and expenditures, is only limited to expenditure side. Quantitative information on income sources as well as on the level of saving (or debt) per household are not yet taken into account in the conduction of Tunisian household surveys. An initial important task in this study consists of preparing the micro-module to be integrated in the Social Accounting Matrix for Tunisia. The next sections describe the different steps behind the building of a full integrated micro-

simulation CGE model for Tunisia. These steps include: building a SAM with one household category, preparation of the micro-module, and calibration of the static CGE model.

5.1. The Social Accounting Matrix for Tunisia. At the beginning of this study, we planned to use the 2000 household expenditures survey. Accordingly, we started by building a detailed SAM for the year 2001 but given the impossibility to access to the raw data related to the 2000 Household expenditures surveys, we turned to the 1995 household expenditures survey. The representative sample provided by the INS covers only 400 households. In order to reduce the sources of inconsistencies between macro-data and micro-data when balancing the original SAM with the micro-module, we choose to build another SAM for the year 1996[5]. The data used for building the detailed 1996 SAM for Tunisia has been drawn from various sources including input-output table, national accounts, government budget, and trade statistics. Two main steps were followed to build the detailed 1996 SAM for Tunisia: building a Macro SAM and a Micro SAM.

The Macro SAM is highly aggregated and tends to be based on data that are available on an annual basis with a relatively short time lag (as opposed to micro data which typically is available with longer delays and not for all years). It provides a consistent view of payments at the macro level that can serve as a framework. The accounts in the Tunisian Macro SAM for Tunisia are presented in Table 13. It explains the acronyms used for the accounts of the Macro SAM and summarizes the kinds of payments made and received by each account. Table 14 displays the Macro SAM for the year 1996.

Table 13. Accounts in Macro SAM

Account acronym	Description
ACT	Production activities.
COM	Commodities.
LAB	Labor.
CAP	Capital (physical capital, land, and natural resources capital).
PRV	Domestic non-government institutions (including households and enterprises).
GOV	Government.
D-TAX	Direct taxes.
TNSP	Indirect taxes net of subsidies.
TARR	Tariffs on imports
SUBM	Subsidies on imports
ROW	Rest of the world.
S-I	Savings-investment account.

[5] The year 1996 is the most close to the 1995 household expenditures survey for which a SAM is already available for the Tunisian economy.

Table 14: Macro SAM for Tunisia for the year 2001 (in millions TD)

	1	2	3	4	5	6	7	8	9	10	11	12	TOT
ACT		39910.565											39910.565
COM	22027.805					11610.217	2975.873	8029.903				4760.025	49403.823
TNSP	1072.465												1072.465
LAB	8381.613												8381.613
CAP	8428.682												8428.682
PRIV				8381.613	8428.682	1379.281	1522.188	809.932					20521.696
GOV			1072.465			2528.419		1194.062	868.46	1327.660	-160.235		6830.831
ROW		8325.833				749.43	1446.392						10521.655
D-TAX						868.46							868.460
TARR		1327.66											1327.660
SUBM		-160.235											-160.235
Sa-In						3395.889	886.378	487.758					4760.025
TOT	39910.565	49403.823	1072.465	8381.613	8428.682	20521.696	6830.831	10521.655	868.460	1327.660	-160.235	4760.025	

Concerning the micro SAM, it was constructed in several steps. In the first step, we constructed a Micro SAM that had more activities and commodities than the original input-output table established by the National Institute of Statistics (19 activities and their corresponding commodities). The disaggregation of activities and commodities was carried out in order to match with the commodity structure of the household expenditures data provided by the INS. Thus, this disaggregation concerns mainly agriculture and agri-food processing commodities given the importance of these commodities in the Tunisian households expenditures. Given that the Macro SAM and the IO table were fully consistent and balanced. Additional data on the different components of supply and demand are provided by the INS. This covers sectoral imports and exports, final consumption, duties on imports, investment, stock variation, and other indirect taxes. Transfers among institutions and direct taxes payments are also provided by the INS. In the second step of building the Micro SAM, the labor and capital accounts were disaggregated, the labor account into 5 categories and the capital account into land remuneration, other natural resources, and physical capital. The values affected to these new factors are deduced from the total remuneration of capital as appears in the original IO table. Table 15 lists the different account forming the last version of the Social Accounting Matrix for Tunisia for the year 1996.

Table 15: Dimensions of the Tunisian SAM for the year 1996

Activities	Commodities	Production Factors and other accounts
Cereal crops	Cereal crops	*** Production factors**
Leguminous crops	Leguminous crops	Physical Capital
Fruits products	Fruits products	Natural Resources
Vegetables crops	Vegetables crops	Land
Meat	Meat	Non-wages agricultural workers
Fishing products	Fishing products	Skilled wage-workers in agricultural sector
Dairy products	Dairy products	Unskilled wage-workers in agricultural sector
Sugar	Sugar	Skilled non-agricultural workers
Olive oil	Olive oil	Unskilled non-agricultural workers
Beverages	Beverages	
Tobacco industries	Tobacco industries	*** Institutions**
Other agri-food Ind.	Other agri-food Ind.	Households
Other-Manufactured Products	Other-Manufactured Products	Government
Non-Manufacturing	Non-Manufacturing	European Union
Services	Services	Rest of the word
		*** Fiscal Instruments**
		Indirect taxes nets of subsidies on production
		Subsidies on imports
		Tariffs
		Direct taxes
		*** Other accounts**
		Saving-investment

5.2. Preparation of the Micro-Module. While quantitative data on income sources for households are not included in the household expenditures survey conducted every five year in Tunisia, important qualitative data allow an estimation of the different income sources. It goes without saying that the estimations of the income sources of each household by no means substitute the real data that the surveys can yield, but to proceed to estimations allows the undertaking of prospective studies on the evolution of poverty in Tunisia under different policy scenarios. In fact, the static analyses on the state of poverty in Tunisia can be carried out, using detailed data about consumption, yet proceeding to prospective or simulation analyses cannot be fulfilled in the absence of data about income sources. It is well established that the variation of the level of poverty in a country is the twin result of the modification of prices, relative to consumer goods, and the variations of incomes, following changes to wage levels and rents. Very often, the reform of economic policies, such as the trade liberalization, entails changing effects as much for consumption as for incomes. To confine oneself to the consumption side in the analysis of the evolution of poverty omits an important and main component, which is the changing of income levels. We believe that the mistakes, linked to problems of estimation of the different income posts of households, are much less important than the mistakes, relative to the ignorance of the income-effect in the analysis of the evolution of poverty.

Since we have chosen the fully integrated micro-simulation approach for analyzing the effect of agricultural trade liberalization on poverty, the estimation of income sources of the different households, included in the sample, seems to be indispensable. In what follows, we describe the different steps followed in the manipulation and preparation of micro-data on household income and expenditures for a full-integration in the social accounting matrix for Tunisia. As we explained above, the National Institute of Statistics in Tunisia carries out a survey on the budget and consumption of Tunisian households every five years. The most recent survey was conducted in 2000 and covers a sample of 12018 Households. We tried all official and semi-official ways to obtain the raw data of this survey or at least a representative sample within the surveyed sample. However, due to the confidential character of this data, we couldn't succeed in obtaining any sample related to this survey. Nevertheless, we obtained raw data relative to approximately 400 households from the 1995 household expenditures survey. The exploration and manipulation of these data revealed many inconsistencies, which pushed us to express some reserves as for the quality of the data mainly regarding it's consistency with macro-data as reported in the national accounts for the year 1995. The sample of 400 households is expected to be representative of the whole sample of 10415 Households surveyed in 1995.

*** Representativeness of the Sample.** The first step before building the micro-module is to check the level of representativeness of the available sample of households, which accounted 400. To do that, we classified the 12 categories of professional status of the household's head as defined by the INS under only 5 categories according the need of this study. We estimate the share of each of the five classes in the number of households in the whole sample and we selected the same share in the small sample to be used in this study. To be consistent with the whole sample, 3 households are dropped from the small sample. Table 1 below provides details on the repartition of the whole sample and the available sample according the adopted classification of households.

Table 16: Representativeness of the sample by socio-professional category of the household's head in 1995

Socio-Professional Category of the Household's Head	Number of households in the whole sample	Number of households in the small sample	Number of households at national level	Total population
* Managers and Liberal Professions	2853 (27.4%)	108 (27.2%)	490100 (28.8%)	2570500 (28.5%)
* Other employers, Artisans and independents and workers in non-agricultural activities	2955 (28.4%)	111 (28.0%)	490300 (28.9%)	2725500 (30.3%)
* Farmers	1349 (13.0%)	52 (13.1%)	200700 (11.8%)	1218100 (13.5%)
* Agricultural Wage-paid	882 (8.4%)	33 (8.3%)	130800 (7.7%)	752100 (8.4%)
* Retired and unemployed	2376 (22.8%)	93 (23.4)	387500 (22.8%)	1735300 (19.3%)
Total	10415	397	1699400	9001500

Source: Author's calculations based on INS data
Note: In parentheses, the percentage from the total of every column

*** Estimation of sources of income by household and integration of the Micro-Module in the SAM.** Given the lack of data on income distribution, we considered the distribution of the total expenditure among the different categories of households included in the sample a proxy for income distribution in the country. Thus, after calculating the total of expenditures for every household, we assumed that the total revenue for every household is equal to the total of its expenses. Although this working hypothesis omits the fact that many households have a saving level and others are rather indebted, the use of a real model without financial assets will not influence the results of our study. Indeed, a homogeneous saving level for all the households of the used sample will be determined afterwards, during the balancing of the SAM.

Once the total income of every household is measured, we moved on to the estimation of the different sources of income. The qualitative information collected through the Tunisian household survey related to the professional status of the householder as well as on the other household members allows us to sketch out a table about the income sources of each member as well as of the whole household. After constituting this table, which includes the different working members of the household of the sample that we have in hand, we moved then to the estimation of the income of every household member. Certainly, the income that we are going to estimate for all the members of a household must equal the total income, or the total value of the expenses of each household. For this purpose, we have established three main income sources: wages, rents, and transfers. The main source of income for the majority of Tunisian households is the salary. Thus based on the results of the employment survey conducted annually by the INS, we have estimated the income derived from the salaries received by all the members of a household, with reference to the grid of salaries relative to the year 1996 and 1997 (INS, 1998), which is established for each professional category and for the main economic activities. For independent workers, who do not get a salary, we have estimated an equivalent-salary, equal to the salary level given by the same activity to a salaried worker, with the same level of qualification as the independent worker subject of the estimation.

For a more simplification of the estimation process of income's sources of each household, we have admitted that only poor households receive transfers, mostly in the shape of governmental aids, or transfers by other household members, who work abroad and represent an important support for this category of households in Tunisia. Moreover, we suppose that poor households do not receive rents. These rents represent the income of invested capital and for capital owners (such as land). For independent workers in a given economic activity, two household categories can be distinguished. Poor households, in the case when the total activity income only covers a part of the salary-equivalent, which is inferior to the poverty line considered in Tunisia, and the non-poor households. For the non-poor households exercising an independent work, the activity income must exceed the level of the poverty line considered in Tunisia. Both wages and rents received by every household are differentiated according to the economic activities, wherein the members of each household work as a wage-earner or as an independent worker. The amount that is in between salaries (and or equivalent-salaries) and the total income of each household represents the transfers for poor households, and the rents for the non-poor among them.

Finally, we proceeded to the integration of the micro-module in the detailed SAM for Tunisia. Prior to the full integration, we estimate a new micro-module based on the share of every household category in the total population of Tunisia. This was carried out by multiplying revenues and expenditures for every household in the small sample used by their respective shares in the total of Tunisian. Accordingly, a new micro-module containing the structure of

income and expenditures of the total population of Tunisia is obtained. The last step of data preparation consists to integrate the new micro-module in the SAM. In this context, and when the micro-module is imposed on the 1996 SAM table, assuming otherwise unchanged column coefficients, most of the accounts are, as expected, out of balance. An estimation approach is needed to generate a balanced SAM table. We applied the cross-entropy approach given its practical advantages and its theoretical basis in information theory (see for example Golan et al. 1996). Cross entropy is a technique for solving underdetermined estimation problems that has been applied to the estimation of IO tables (Golan et al. 1994) and social accounting matrices (Robinson et al. 2001; and Robinson and El-Said 2000) as well as a wide range of other problems inside and outside economics.

In our case, the problem is to estimate a new Micro-Module with minimum entropy distance relative to the prior Micro-Module drawing on the information presented in the 1996 SAM, subject to the constraints that row and column totals of the new SAM be equal for all accounts and that control values be satisfied (exactly or with error). The entropy distance depends on differences between the two tables in terms of column coefficients and control values[6].

5.3. The model. The following paragraphs are not intended to describe precisely the characteristics of the model employed here, but rather to describe in non-mathematical terms its main hypotheses, mechanisms, and the statistical information used for the Tunisian economy. The reader may refer for this purpose to Beghin et al. (1996) for a formal presentation of this class of models, and to the Annex 2 attached to this paper.

In this model, prices are endogenous on each market (goods, factors) and equalize supplies and demands, so as to obtain the equilibrium. The equilibrium is general in the sense that it concerns all the markets simultaneously. For instance, a decrease in tariffs on imports will affect the demand of imports of both final and intermediate goods. This will in turn affect the supply of domestic goods and the demand of factors in each activity. This will equally affect the price of goods and the income of households, and the budget of the government, who will need to find another source of financing. The model uses the information contained in the SAM for 1998. The basic features of the model are summarized below.

Supply is modeled using nested constant elasticity of substitution (CES) functions, which describe the substitution and complement relations among the various inputs. Producers are cost-minimizers and constant return to scale is assumed. Output results from two composite goods: intermediate consumption and value added, combined in fixed proportions. The intermediate aggregate is obtained by combining all products in fixed proportions (Leontief structure). The value-added is then decomposed in two substitutable parts: labor and capital. Labor is disaggregated in a first step between three components, family workers, skilled and unskilled. Unskilled workers are further disaggregated between unskilled working in agricultural and skilled in non-agricultural activities. Capital is disaggregated between the different categories. A more detailed presentation of labor market modeling is provided in this section.

Even if static, this model is therefore intended to capture long term re-allocation effects of different trade policies, since adjustment costs of reallocating productive factors are ignored. However, it does not incorporate the dynamic effects of trade policies, and notably their impact

[6] For detailed presentation of cross entropy model applied for SAM balancing, see Robinson and El-Said (2000); and Robinson et al. (2001) and more recently Lofgren et al. (2004).

on GDP growth, since resources (labor, capital, and productivity) are fixed in this model. Interpretations of results are therefore to be taken with caution, since they only indicate what would be the impact of a given policy on the allocation of resources, and not on their level.

Income from labor and capital is allocated to the different households according a fixed coefficients derived from the SAM. Household demand is derived from maximizing the utility function, subject to the constraints of available income and consumer price vector. Household utility is a positive function of consumption of the various products and savings. Income elasticities are differentiated by product and by category of households. The calibration of the model determines a per capita subsistence minimum for each product and each household, which will be consumed whatever the price and the income of the households, while the remaining demand is derived through an optimization process. The subsistence share in the consumption of basic goods is higher than in the consumption of luxury goods. Government and investment demands are disaggregated in sectoral demands once their total value is determined according to fixed coefficient functions.

The model assumes imperfect substitution among goods originating from different geographical areas (the so-called Armington assumption). Import demand results from a CES aggregation function of domestic and imported goods. Export supply is symmetrically modeled as a constant elasticity of transformation function. Producers decide to allocate their output to domestic or foreign markets responding to relative prices. At the second stage, importers (exporters) choose the optimal choice of demand (supply) across regions, again as a function of the relative imports (exports) prices and the degree of substitution across regions. Substitution elasticity between domestic and imported products is set at 2.2, and at 5.0 between imported products according to origin (EU or ROW). The elasticity of transformation between products intended for the domestic market and products for export is 5.0, and 8.0 between the different destinations for export products.[7]

Finally, several macro-economic constraints are introduced in this model. First, the small country assumption holds, the Tunisian economy being unable to change world prices; thus, its imports and exports prices are exogenous. Capital transfers are exogenous as well, and therefore the trade balance is fixed, so as to achieve the balance of payments equilibrium. Second, the model imposes a fixed real government deficit, and fixed real public expenditures. Public receipts thus adjust endogenously in order to achieve the predetermined net government position, by shifting uniformly the income taxes on households. Third, investment is determined by the availability of savings, the latter originating from households, government and abroad. Since government and foreign savings are exogenous in this model, changes in investment volumes reflect changes in household savings and changes in the price of investment.

Policy impacts are compared to the situation observed in 1996, in terms of real consumption and investment, exports and imports volumes, real wages, real rate of return of capital, and poverty indicators and households' welfare. The chosen yardstick for welfare is the assessment of equivalent variation, which is the sum of two terms. The first one measures the

[7] Production function and trade elasticities come from the empirical literature devoted to CGE models. They are not specific to Tunisia. See for instance Burniaux, Nicoletti and Oliveira-Martins (1992), Konan and Maskus (1997) or more recently Gallaway, McDaniel and Rivera (2000).

gain (or the loss) of disposable income caused by the reform, and the second one measures the income needed after the reform to obtain the same level of utility as before the reform.

Since the main focus of this study is to evaluate the impact of trade policy reform on poverty, the labor markets in Tunisia is disaggregated into five categories. Consequently, the Tunisian labor category is disaggregated according to sector of employment (i.e. agricultural activities *versus* non-agricultural activities) and skill level (i.e. skilled *versus* un-skilled). A fifth category specific to the agricultural sector was added to the four categories listed above, familial work related to the unpaid work performed by the farmers and their family members. We use the relative wages across the sectors for the respective labor categories to distinguish between skilled and unskilled labor for those working in agricultural and non-agricultural activities.

The current model version has been extended from its original structure to better account for the potential substitutability between unskilled labor engaged in agricultural and non-agricultural sectors. In particular, the model features a nested structure of the production function, which allows for a high substitutability between unskilled workers in agricultural sectors and unskilled workers in non-agricultural activities. Only at the upper nest of the production function are the respective aggregates (unskilled workers in all activities) merged with skilled labor and family workers. This more flexible functional form guarantees a more realistic substitutability between factors that are close substitutes and avoids excessive substitution of factors that are complementary to each other. Thus, family workers are considered specific for agricultural activities and are fully employed with a flexible wage, which assures the equilibrium between supply and demand for this segment. As far as skilled workers are concerned, we assume that the two categories of these workers are also specific for both activities. Then, skilled workers in agricultural activities are specific to agricultural however and skilled workers in non-agricultural activities are also specific to non-agricultural activities. We also assume that unemployment exists for unskilled and skilled workers both in agricultural and non-agricultural activities, and a real wage is assumed.

6. Simulating Trade Reforms and External Chocks

We try here to measure for Tunisia the effects in terms of macroeconomic and poverty indicators, of various scenarios of agricultural trade liberalization with only the European Union or with all trade partners. The simulations carried out in this study are based on the static model in which the time does not intervene and then the economy is not affected by structural modifications, as demography or the changes in the levels of availability of natural resources for example.

While this tool does not allow taking into account dynamical effects that will intervene during the liberalization process, it presents nevertheless the advantage to allow measuring the total gain related to the reallocation of production factors as result of tariff reduction or dismantling. Furthermore, the static analysis allows determining the mechanical loss in customs income linked to the trade liberalization as well as the loss generated by the substitution effect that represents the capacity of the economic institutions to substitute their demand on products and services according to their natures and their origins. This analysis depends equally on income which disposes the households after the reform. If one thinks that the agents have not the possibility to substitute their consumptions from a product to another, following his type or his origin, this loss should be strictly equals to the share of tariffs income coming from importing European products in the total of the tariffs income (Dessus and suwa-eisenmann, 2000).

With this model, we analyze the impact of four alternative reforms. Each scenario seeks to provide empirical estimations of the potential trade liberalization of agricultural products either with one single partner or with various partners at the same time. These scenarios are the following:

- L0: Cutting Tariffs on Imports from EU only on industrial products as specified in the partnership agreement signed between the two partners.
- L1: In addition to trade provisions specified in scenario L0, this simulation assumes a tariff dismantling on agricultural products imported from the EU.
- L2: In addition to trade provisions specified in scenario L1, tariff dismantling on agricultural imports is extended to the rest of the world.
- L3: In addition to trade provisions specified in Scenario L2, this simulation assumes a multilateral liberalization of agricultural products under the WTO Doha Round. Accordingly, we assume an average increase in international prices for all agricultural products of 15%.

For all simulations, we adopt an elasticity of substitution of capital equal to the infinite which means a perfect mobility of the physical capital among the different sectors.

Eliminating Tariffs on Industrial Imports from the European Union (L0). This measure is already implemented within the Free Trade Area agreement signed with the European Union and entered into effect in 1998. Associated costs of implementing a free trade area with the European Union limited to industrial products, such as trade diversion and tariff revenue loses are important for the case of Tunisia. But we will not focus on this issue but rather on the overall economic performance and poverty changes in the country. In this scenario, the suppression of tariffs on the industrial imports, coming from the EU, is implemented on one time according to the provisions of the free-trade agreement, signed between the two parties. The implementation of this agreement has a relatively weak macro-economic impact. The global activity has slightly improved with an increase of 0.2% of the GDP, compared with its level of the base year (1996). The total production of goods and services witnesses a more important improvement with a rate of 3.7 %, whereas the value of the final consumption knows a fall of 2%, compared with the basis year.

The increase in exports is due largely to the industrial sector, whereas agricultural exports tend to fall in volume. Gains in competitiveness allowing Tunisia to increase export market share are not due to genuine depreciation, given that the price of value added remains unchanged because the cut in revenue on capital offsets the rise in real wages. These gains are in fact due to the reduction in prices of imported input products and a lessening of the distortion of international trade other than in agriculture, a situation which benefits the industrial sector particularly.

Agricultural activity does not appear to be able to derive benefit from the increasing openness of the Tunisian economy to trade and partnership with Europe, and remains to a large extent outside the globalization process. Moreover, mobile production factors (physical capital and unskilled labor) is more captured by industry, which is translated by a drop in domestic production for most of agricultural activities as results of changes in comparative advantage to

the benefit of industrial sector. Accordingly and given such trends in sectoral productions, consumer prices for agricultural products climbs and those for industrial products falls, leading to a change in poverty patterns for all household categories. Off course the changes in poverty is also explained by the changes in wage levels and factors' incomes (physical capital and land).

Real wages for skilled workers in agricultural activities and farmers declines, and welfare of agricultural workers go down consequently. However, real wages for skilled and unskilled workers in non-agricultural sectors rises. The overall effect is an increase of poverty among farmers and workers in agricultural activities and declines of poverty for households' heads working in non-agricultural activities.

Eliminating Tariffs on all Imports from the European Union (L0) (L1). The tariff reduction withheld in the present simulation consists in to eliminate in one time all tariffs on agricultural imports from the European Union in addition to the elimination of tariffs already decided on industrial products imported also from the EU. This scenario can be seen as a reinforcement of the FTA between the two partners. As shown in table 13, this simulation has a very-weak macro-economic impact compared to the last simulation. The global activity is only improved by an additional 0.1% in GDP compared to the simulation when tariff dismantling is limited to industrial products. However, the cumulative effect of this reform is relatively modest with only 0.3% improvement in GDP compared to the base year. The loss in custom income is evaluated to around 79.7% of total government custom income in 1996. Only 8.6% of this loses could be attributed to the liberalization of trade in agricultural products.

The total level of production increased closely by 0,2% in volume compared to its level before the reform. The higher increase was realized by the same sectors of which imports widely increased, mainly the food processing industries (+1,2%). This increase in production level for these sectors shows how much lowering the tariffs could improve the efficiency of factors allocation through their affectation towards the more profitable activities and the most competitive ones. Agricultural production lowers as result of the preference granted to some imported agricultural products compared to domestic products. The sectors that have achieved more benefits from the liberalization of agricultural trade between Tunisia and the European union are those strongly dependent on imports for their intermediate consumptions. The decline in the domestic prices for these imported products increases the profitability of the installed capital in these activities and allows a reallocation of the primary production factors from the weakly integrated activities in the international trade to the more beneficial activities from trade openness.

In general, the effect of this reform on poverty is rather positive. In fact, for the two categories of agricultural households, this reform reduces the poverty levels, following the improvement of the living standards of these populations, as a direct consequence of the decrease in the prices of industrial products. This decrease has touched as much the household final consumption side as the equipment and intermediary consumption side, linked to the production operations. However, the effect of this reform on the poverty levels of the urban populations is more mitigated. In fact, the decrease of the poverty level has only touched the households of the salaried workers in the non-agricultural sectors. This decrease is the direct result of the relative development of certain urban activities, mainly, the most intensive in unskilled workforce, for which the country has a comparative advantage. This is notably the case of the textile industries and the electronic and electric industries.

Eliminating Tariffs on Industrial Imports from the European Union and on Agricultural Products only from all Origins (L2). The generalization of tariffs dismantling on imported agricultural products from the European Union to the rest of the world causes an improvement in the global activity of the country by almost 0,3% in comparison with the base year. Furthermore, the total production of goods and services increases by 4.1% compared to the base year which indicates an additional gain of 0,4% compared to the previous simulation. Total exports as well as total imports increase in comparison with the base year respectively by 26.1% and of 17.9% which means an additional increase by 2% for imports and 2.9% for exports in comparison with the previous simulation. The increase in exports is mainly explained by the increase of the demand of Tunisian products by the rest of the world in comparison with the base year. This reform induces a loss in customs income by around 79.7% in comparison with the base year.

At the sectoral level, this reform entails a fall in the domestic production of most agricultural activities. This decrease is explained by the weak capacity of resources re-allocation of the Tunisian agricultural sector. In other words, the agricultural land, suitable for cultivation in Tunisia, is characterized by an almost fixed distribution of the productive capacities. Thus, if, for example, the production price of the cereal products rises, in comparison with vegetables, the assignment of the available land from the cultivation of vegetables towards the cereal production is too limited, indeed even impossible. Accordingly, the adjustments in the Tunisian agriculture are more the result of the changes of the consumption levels than the production levels, in reaction to changes in the relative prices. The effect of this reform on poverty is rather a consolidation of the observed tendencies in the preceding scenario. Thus, the farmers' incomes are improved, especially since the improvement of the preferences given to the Tunisian agriculture by the rest of the world and the decrease in the costs of agricultural input. This mostly concerns the price of seeds and cattle food.

Unilateral Trade Reform in Tunisia and Multilateral Liberalization of Agricultural Trade (L3). Along with the three previously evoked scenarios, the last scenario (L3) simulates an increase in the prices of the main basic agricultural products, as a result of a multilateral liberalization of trade in agricultural products. The analysis of the implications of agricultural trade liberalization at the level of a country must not be limited to the mere removal of tariffs and non-tariffs barriers, imposed on the imported products. Through trade, the trade balance situation of the agricultural products, for such a small country as Tunisia, is largely determined by the world prices, mostly fixed by the bigger exporting countries. Nefarious and undesirable effects of the high agricultural protectionism in the rich exporting countries of basic agricultural products have appeared through the decades. On the one hand, protection has depressed the agricultural world prices, which, in fact, penalized all the farmers by shrinking the world market. On the other hand, protection has produced a much greater instability of the world prices, which precipitated the whole countries into the vicious circle of protection. The conclusion of the Doha round, according to the ministerial declaration of Hong Kong could appreciably affect the world market of the basic agricultural products, and considerably reduce the distortions that have affected it for so long. Thus, we simulate, here, an increase in the world prices of the basic agricultural products, resulting from thoroughly-freed world agricultural trade and the removal of all the distortions that affect them. The recorded average increase of 15 % of the world prices of the basic agricultural products, kept in this simulation at the end of the multilateral reform, is a moderate increase given the extent of current distortions affecting world trade in agricultural products.

The total production of goods and services rises by 5.2 %, compared with the basis year; say, a net reduction of 0.4 % compared with the L2 scenario. The total imports as much as the total exports rise at respective rates of 20.6 % and 30.8%, compared with the basis year. However, the net effect of this simulation is rather negative, with a respective reduction of the total imports and exports of goods and services equal to -1.4 % and -1.1 %. Compared with the basis year, this reform enhances the competitiveness of the domestic agricultural production, in relation to the imports of three categories of agricultural products: fruits, olive oil and sugar, which witness a net increase of their production level. This shock also entails a rise in the consumption prices of the main agricultural products, which consequently implies the reduction of the internal demand of these products, such as cereals. Thus, the reduction of production on the one hand, and the relatively high decrease in the consumption of the main food products on the other hand, lead to an increase of the export levels, as a net result of the rise in the export prices. This situation was actually observed during the previous agricultural year (2005) in Tunisia for olive oil, when the high level of the export prices, led to a rise in the consumption prices, which curbed the level of local demand, and consequently increased the level of exports. This scenario, thus, procures a favorable income gain for the agricultural households, which achieve more important incomes, following the rise of world prices, while the urban households witness a deterioration of their purchasing power, following the rise in the consumption prices of most agricultural products.

Thus, this scenario leads to a reduction in the poverty level with regards to the landowners (where the poverty rate goes from 9.5% to 9% between this reform and the basis year), while the reduction of the poverty level among the agricultural wage-earners is more obvious, following the generalized increase of the agricultural wages, due to an increase in the demand for agricultural work. Thus, the poverty rate for this category of households goes form 7.4% to 6.3% between this reform and the basis year. In general, the increase of poverty among the non-agricultural households only concerns the categories of the skilled workers and the inactive. The wage-earners in the agricultural sector see their situation improving, owing to the dragging effect of the increase in the agricultural wage, and on the level of non-agricultural wages for the unskilled workers.

Table 17: Macroeconomics Results (in percentage change compared to the baseyear)

Variable/Simulation	Baseyear (million TDs)	L0	L1	L2	L3
Real GDP	19210	0.2%	0.3%	0.2%	0.2%
Total Output	37416	3.7%	4.1%	5.6%	5.2%
Total Final Consumption	14586	-1.9%	-1.7%	-1.6%	-1.9%
Total Exports	8029	23.2%	26.1%	31.9%	30.8%
Total Imports	8326	15.9%	17.9%	22.0%	20.6%
Absorption	37713	0.8%	0.9%	1.5%	1.2%
pindex	1.00000	3.4%	3.1%	4.2%	5.1%
CPi	100.00000	-2.3%	-3.5%	-4.1%	-3.0%
Tariffs Income for the Government	1327	-71.0%	-79.7%	-92.9%	-92.6%

Source: Author's calculations

Table 18: Sectoral Production (in percentage change compared to the baseyear)

Variable/Simulation	Baseyear	L0	L1	L2	L3
Crops	811.3	4.6%	0.9%	-6.7%	-0.6%
Legumes	32.5	-1.8%	-0.8%	-0.1%	-1.8%
Fruits	840.2	-2.4%	-1.8%	-1.9%	3.1%
Vegetables	526.4	-0.9%	0.0%	0.0%	-1.6%
Other agricultural activities	29.1	7.5%	4.1%	6.7%	-1.4%
Fishing	276.3	-6.4%	-6.5%	-8.5%	-8.7%
Meat	633.1	-4.1%	-8.2%	-8.7%	-8.0%
Dairy products	191.3	0.1%	-14.7%	-20.4%	-13.5%
Olive oil	160.0	-0.6%	-0.7%	-0.6%	2.6%
Sugar	141.2	-1.3%	-2.9%	-6.6%	3.2%
Other food processing	2247.2	-2.3%	1.0%	2.4%	-0.8%
Beverages and tobacco	227.9	-4.0%	-7.6%	-7.7%	-6.7%

Source: Author's calculations
Note: values in the baseyear are expressed in millions TND.

Table 19: Sectoral Exports (in percentage change compared to the baseyear)

Variable/Simulation	Baseyear	L0	L1	L2	L3
Crops	2.5	23.3%	49.6%	84.3%	159.6%
Legumes	1.9	5.7%	18.6%	28.6%	95.7%
Fruits	57.1	0.1%	5.7%	6.8%	30.9%
Vegetables	5.8	11.2%	22.2%	24.9%	8.4%
Other agricultural activities	9.2	18.2%	28.0%	38.4%	5.1%
Fishing	21.3	-19.8%	-20.1%	-27.4%	-26.3%
Meat	1.6	-8.5%	-4.2%	-2.8%	74.6%
Dairy products	1.8	12.5%	17.5%	21.3%	132.5%
Olive oil	117.1	-2.9%	2.5%	4.7%	18.8%
Sugar	3.6	3.2%	14.5%	14.0%	128.5%
Other food processing	153.8	0.1%	25.0%	37.0%	12.1%
Beverages and tobacco	16.9	1.6%	3.2%	4.5%	9.5%

Source: Author's calculations
Note: values in the baseyear are expressed in millions TND.

Table 20: Sectoral Imports (in percentage change compared to the baseyear)

Variable/Simulation	Baseyear	L0	L1	L2	L3
Crops	249	-6.9%	-1.3%	4.7%	-4.9%
Legumes	70.6	-4.5%	-4.5%	13.6%	-9.1%
Fruits	8	-7.0%	63.0%	203.3%	215.5%
Vegetables	13	-5.8%	14.1%	13.2%	17.9%
Other agricultural activities	20	0.8%	24.2%	37.5%	46.2%
Fishing	1.6	2.4%	1.6%	4.0%	2.4%
Meat	9.9	-2.3%	163.5%	165.2%	106.6%
Dairy products	27.9	-4.8%	59.7%	76.4%	46.8%
Olive oil	0	4.1%	21.2%	36.7%	25.0%
Sugar	87.4	-3.4%	-1.6%	11.5%	-6.1%
Other food processing	258.3	-2.0%	-9.9%	-12.3%	-7.4%
Beverages and tobacco	7.2	4.2%	103.6%	105.3%	103.8%

Source: Author's calculations
Note: values in the baseyear are expressed in millions TND.

Table 21: Effect on Poverty: (P0 Indicator)

Category of Household	Baseyear	L0	L1	L2	L3
Managers, liberal professions and independents	3.9	3.8	4.0	4.0	4.1
Wage-workers in non-agricultural sectors	9.7	9.4	9.6	9.5	9.2
Retired people, unemployed and others	3.9	4.0	4.3	4.3	4.9
Farmers	9.5	9.8	9.3	9.2	9.0
Wages-workers in Agricultural sectors	7.4	7.7	7.1	7.0	6.3
Total	6.8	6.9	6.7	6.5	6.0

Source: INS and Author's calculations

7. Conclusion

This analysis of the impact of agricultural trade liberalization on poverty in Tunisia provides evidence of the importance of decisions regarding the scope and the extent of trade liberalization that should be applied both at national as well as at global levels. While it does not intend to provide highly reliable and definitive estimates on potential poverty changes, this study showed nevertheless important trends and the magnitude of poverty changes for a multitude of scenarios of reform. The agricultural sector seems to be the unique winner from reforming trade agriculture under the condition of multilateral reform, which will be manifested by dismantling export subsidies and domestic support as well as by improving market access for Tunisian products on international markets. Those gains will very much depend also on the existing flexibility in the agricultural system in responding to pricing systems. Accordingly and when the low flexibility of resources allocation among agricultural activities is taken into account, the expected gains from the trade reforms are much lower than those predicted by the theory of international trade. However, past experiences showed that the results of trade liberalization depend on the type of formula[8] cut applied by a given country. For this purpose, the current study should be completed by a more coherent analysis, encompassing all major agricultural items affecting both the income of rural households, of the net effect on poverty of each type of formula could generate and the differential impact on consumers and producers before opting for a particular tariff reduction schema.

[8] The different formulas are defined as follow: Linear cut, linear with harmonization, deep harmonization, and Swiss formula.

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Annex 1: Main Features of the Tunisian Survey on Households Budget and Expenditures

Up to now, seven national surveys on household's budgets and expenditures were carried out consecutively in 1968, 1975, 1980, 1985, 1990, 1995 and 2000. An eighth survey relative to the year 2005 is under way. These surveys have as an objective to supply information on the acquisition of goods and services meant for consumption, on food consumption as well as on the access of households to communal health and education services. The information, gathered through direct observation of household consumption, allows the acquisition of assessing elements on the situation and evolution of the living standard and conditions of households.

The method of data collection consists of interviewing households during many visits. The period of direct observation of each sample household expenses takes four weeks. Nonetheless, for large expenses, which are made at longer frequencies such as the purchase of durable goods, the observation period takes one year, completing the month of enquiry with retrospective accounts on the 11 months, which precede the start of the survey. Part of the survey, which is devoted to food consumption, relies on the method of weighing down quantities of food intended for household consumption, ration by ration, and day by day during a week, for each sample household.

The survey's questionnaire regarding the budget and the expenses of households is made up of a main questionnaire aimed at recording collective household expenses, and of a complementary questionnaire aimed at registering the individual expenses of each household member, having an income. Students and the unemployed at the time of the survey are equally concerned by the individual questionnaire.

For the part of the main questionnaire relative to expenses, the requested information is about the expenditures that the householder makes for his needs and for those of the members in his charge, notably the expenditure categories of a collective nature (food, housing services…). The main survey questionnaire is made up of the following sections (INS, 2003):

a. Table of household composition: this table draws the list of the members, resident in the household, with their demographic characteristics, their level of education and certain information on their school attendance.
b. Information on the economic activities of the household members, aged 15 years and more: this table helps to describe the situation of the economic activity (active or inactive) for all the household members, aged 15 years and more.
c. Economic characteristics of active members: this table is meant for the collection of data about the profession, the status in the profession, the sector of activity and the kind of employment for the occupied active persons as well as the unemployment duration and information about job-seeking for the unemployed.
d. Information about the regular expenses of the household, the daily accounts, the accounts of the non-regular expenditures, retrospective accounts, and the accounts of individual expenses.

Annex 2. The General Equilibrium Model

This annex provides the technical specification of the computable general equilibrium model used to assess trade policies in the Tunisian Economy. In the equations which follow, the following indices will be used extensively:

i Production sectors. ***j*** is an alias for ***i***. *N* is the total number of sectors/products

r Represents trading partners. R is the total number of trading partners.

0 represents the initial situation.

We discuss first the following 47 generic equations which define the theoretical model and finally we list the name and dimension of each variable.

Supply

Production is based on a nested structure of *Constant Elasticity of Substitution* (CES) functions. Each sector produces a gross output, *XP*, which given the assumption of constant returns to scale is undetermined by the producer. It will be determined by equilibrium conditions. The producer therefore minimizes costs subject to a production function. Figure 1 depicts the nested decision process in the choice of production factors: at the first level, the producer chooses a mix of a value added aggregate, *KL*, and an intermediate demand aggregate, *ND*. In mathematical terms, this leads to the following formulation:

$$\min PKL_i KL_i + PN_i ND_i$$

$$\text{s.t. } XP_i = \left[a_{kl,i} KL_i^{\rho_i^p} + a_{nd,i} ND_i^{\rho_i^p} \right]^{1/\rho_i^p}$$

where *PKL* is the aggregate price of value added, *PN*, is the price of the intermediate aggregate, a_{va} and a_{nd} are the CES share parameters, and ρ is the CES exponent. The exponent is related to the substitution elasticity, via the following relationship:

$$\sigma_i^p = \frac{1}{1-\rho_i^p} \text{ and } \sigma_i^p \geq 0$$

Substitution elasticities reflect adjustment possibilities in the demand for production factors originated from variations in their relative price. Note that in the model, the share parameters incorporate the substitution elasticity using the following relationships:

$$\alpha_{kl,i} = \left(a_{kl,i}\right)^{\sigma_i^p} \text{ and } \alpha_{nd,i} = \left(a_{nd,i}\right)^{\sigma_i^p}$$

Solving the minimization problem above, yields Equations (1) and (2). Equation (1) determines the volume of aggregate intermediate demand, *ND*. Equation (2) determines the level of the value added demand *KL*. The CES dual price of *ND* and *KL*, *PX*, is defined by Equation (3) and determines the aggregate unit cost.

The next level of the CES nest concerns, on the one side, aggregate intermediate demand, *ND*, and on the other side, the *KEL* bundle. The split of *ND* into intermediate demand is assumed to follow a Leontief specification, in other words a substitution elasticity equal to zero. The demand for intermediate goods is determined by Equation (4). The price of aggregate intermediate demand is given by adding up the unit price of intermediate demand. This is specified in Equation (5). Demand for each good is specified as a demand for the Armington composite (described in more detail below), an aggregation of a domestic good and an import good which are imperfect substitutes. Therefore, while there is no substitution of one intermediate good for another, there will be substitution between domestic demand and import demand depending on the relative prices. The price of the Armington good is given by *PA*.

At the same level, the *KL* bundle is split between labor, *L*, and capital, *K*. The optimization problem is similar to above, i.e. cost minimization subject to a CES aggregation function. If *W* is the wage rate, and *R* is the price of capital, sectoral labor and capital demands are given by Equations (6) and (7). The price of *KL* bundle, *PKL*, is determined by Equation (8), which is the CES dual price. λ_j is the total factor productivity level of sector j. In the next step, capital is further disaggregated among its three categories using a CES function. Labor is split in a first step on four categories (familial workers, skilled in agricultural, skilled in non-agricultural and unskilled). Finally, unskilled labor is further disaggregated between unskilled working in agricultural and unskilled working in non-agricultural activities. Therefore factor demands are expressed in efficient units.

Factor demand equations

$$ND_j = \alpha_{nd,j}\left[\frac{PX_j}{PN_j}\right]^{\sigma_j^p} XP_j \quad (1)$$

$$KL_j = \alpha_{kl,j}\left[\frac{PX_j}{PKL_j}\right]^{\sigma_j^p} XP_j \quad (2)$$

$$PX_j = \left[\alpha_{nd,j} PN_j^{1-\sigma_j^p} + \alpha_{kl,j} PKL_j^{1-\sigma_j^p}\right]^{1/(1-\sigma_j^p)} \quad (3)$$

$$XAp_{i,j} = a_{i,j} ND_j \quad (4)$$

$$PN_j = \sum_i a_{i,j} PA_i \quad (5)$$

$$L_j = \alpha_{l,j}\left[\frac{PKL_j}{W/\lambda_j}\right]^{\sigma_j^v} KL_j \quad (6)$$

$$K_j = \alpha_{k,j}\left[\frac{PKL_j}{R/\lambda_j}\right]^{\sigma_j^v} KL_j \quad (7)$$

$$PKL_j = \left[\alpha_{l,j}\left(W/\lambda_j\right)^{1-\sigma_j^v} + \alpha_{k,j}\left(R/\lambda_j\right)^{1-\sigma_j^v}\right]^{1/(1-\sigma_j^v)} \quad (8)$$

Demand

Production generates income, both wage and non-wage, which is fully distributed to the representative Palestinian household. Additionally, it receives some net transfers from abroad. Equation (9) defines the disposable household's income, *YD*. *DT* is an adjustment parameter that may become endogenous, depending on the macro closure, as we will see below. If exogenous, it is set to zero. This income is allocated to consumption and savings using the *Extended Linear Expenditure System* (ELES) specification. The consumer problem can be set up as follows:

$$\max U = \sum_{i=1}^{n} \mu_i \ln\left(XAc_i - \theta_i\right) + \mu_s \ln\left(\frac{Hsav}{pi}\right)$$

$$\text{s.t.} \sum_{i=1}^{n} PA_i XAc_i + Hsav = YD \quad \text{and} \quad \sum_{i=1}^{n} \mu_i + \mu_s = 1$$

where U is the utility function, XAc_i is consumption by commodity, S is household saving and PA is the vector of consumer prices. $Hsav$ can be thought of as demand for a future bundle of consumer goods, and its price is the price of investment, pi. Solving the above optimization problem leads to the following demand functions:

$$XAc_i = \theta_i + \frac{\mu_i Y^*}{PA_i}$$

$$Hsav = \mu_s Y^* = YD - \sum_{i=1}^{n} PA_i XAc_i$$

$$Y^* = YD - \sum_{j=1}^{n} PA_j \theta_j$$

Consumption is the sum of two parts, θ, which is often called the *subsistence minima* or *floor consumption*, and a fraction of Y^*, which is often called the *supernumerary income*. Y^* is equal to disposable income less total expenditures on the subsistence minima.

Equation (10) defines supernumerary income, that is disposable income less total expenditures on the subsistence minima. Consumer demand for goods and services is given by Equation (11). Household savings is determined as a residual and is given in Equation (12).

Households' demand equations

$$YD = \sum_j (WL_j + RK_j) + ER \sum_r TR_r^H - DT \qquad (9)$$

$$Y^* = YD - \sum_i PA_i \theta_i \qquad (10)$$

$$XAc_i = \theta_i + \mu_i Y^* / PA_i \qquad (11)$$

$$HSav = YD - \sum_i PA_i XAc_i \qquad (12)$$

Other domestic final demands include investment and government expenditures. These final demand vectors are assumed to have fixed expenditure shares. The closure of the final demand accounts will be discussed below. Equations (13) and (14) respectively determine the government and investment demand for each type of good, and equation (15) and (16) the total values of government and investment purchases.

Other final demand equations

$$XAg_i = a_i^G TG \quad (13)$$

$$XAi_i = a_i^I \left(InvExp / \sum_i PA_i a_i^I \right) \quad (14)$$

$$GExp = \sum_i PA_i XAg_i \quad (15)$$

$$InvExp = \sum_i PA_i XAi_i \quad (16)$$

Government

Government aggregate expenditures on goods and services are fixed in real terms, and their total is *TG*. The Palestinian Government derives most of its revenues from indirect taxes. Equations (17)-(19) list the different indirect taxes paid on the consumption of domestic output and imports : value added taxes (VAT) on domestic goods, duties and purchase taxes on imports, and VAT on imports. The collection of these taxes plus some net transfers from abroad (e.g., the international aid) determine the government revenue (Equation 20). Equation (21) defines the government budget surplus/deficit in nominal terms. A^{vd}, A^{vm}, A^t are adjustment parameters that may become endogenous, depending on the macro closure, as we will see below. If exogenous, there are set to unity.

Government Equations

$$VATd = \sum_i A^{vd} \tau_i^{vd} PD_i XD_i \quad (17)$$

$$YTrade = \sum_r \sum_i A^t WPM_{ri} \tau_{ri}^m XMr_{ri} \quad (18)$$

$$VATm = \sum_i A^{vm} \tau_i^{vm} PM_i XM_i \quad (19)$$

$$GRev = VATd + YTrade + VATm + ER \sum_r TR_r^G + DT \quad (20)$$

$$S_G = GRev - GExp \quad (21)$$

Trade

The model assumes imperfect substitution among goods originating from different geographical areas (the so-called Armington assumption). Imported goods are not perfect substitutes for goods produced domestically. The demand for domestic versus imported goods will depend on their relative prices and their degree of substitution. The degree of substitution will depend on the level of disaggregation of the commodities. For example, wheat is more substitutable as a commodity than grains, which in turn are more substitutable than a commodity called primary agricultural products. Actually, the Armington assumption reflects two stylized facts: (i) Trade data shows the existence two-way trade which is consistent with the Armington assumption; (ii) As well, and related, the Armington assumption leads to a model where perfect specialization, which is rarely observed, is avoided.

Import demand results from a CES aggregation function of domestic and imported goods. To allow for the existence of multiple trading partners, the model adopts a two-level CES nesting

to represent the Armington specification. At the top level, agents (consumers, firms) choose an optimal combination of the domestic good and an import aggregate which is determined by a set of relative prices and the degree of substitutability. Let *XA* represent aggregate demand for an Armington composite, with the associated Armington price of *PA*. Each agent then minimizes the cost of obtaining the Armington composite, subject to an aggregation function. This can be formulated by:

$$\min PD\,XD + PM\,XM$$
$$\text{s.t.} XA = \left[a_d\,XD^{\rho} + a_m\,XM^{\rho}\right]^{1/\rho}$$

where *XD* is demand for the domestic good, *PD* is the price of obtaining the domestic good, *XM* is demand for the aggregate imported good, *PM* is the aggregate import price, *a* are the CES share parameters, and ρ is the CES exponent. ρ is related to the CES substitution elasticity via the following relation:

$$\rho = \frac{\sigma - 1}{\sigma} \Leftrightarrow \sigma = \frac{1}{1 - \rho}$$

At the second level of the nest, agents choose the optimal choice of imports across regions, again as a function of the relative import prices and the degree of substitution across regions. Note that the import prices are region specific, as are the tariff and purchase tax rates. The second level nest also uses a CES aggregation function. (cf. Figure 2). The CES formulation implies that the substitution of imports between any two pairs of importing partners is identical. The next table lists the solution of the optimization problem described above. Equation (22) determines domestic demand for the Armington aggregate across all agents of the economy, *XA*. Equations (23) and (24) determine respectively, the optimal demand for the domestic component of the Armington aggregate, *XD*, and aggregate import demand, *XM*. Equation (25) defines the price of the Armington bundle, *PA*, which is the CES dual price. Both the domestic price of domestic goods, and the price of the aggregate import bundle are adjusted to incorporate a value added tax, whose rate may differ between domestic and import goods.

The next equations describe the decomposition of the aggregate import bundle, *XM* into its components, i.e. imports by region of origin. Each demand component will be a function of the price of the exporting partner, as well as partner-specific import tax rates. Equation (26) determines import volume by sector and region of origin, *XMr*, where *PMr* is the partner specific import price, in domestic currency and inclusive of import taxes. Equation (27) defines the price of the aggregate import bundle, *PM*, which is the CES dual price. Equation (28) defines the domestic import price, *PMr*, which is equal to the import price of the trading partner, converted into local currency, and inclusive of the partner-specific import tax rate.

Treatment of domestic production is symmetric to the treatment of domestic demand. Export supply is modeled as a *constant elasticity of transformation* (CET) function. Producers decide to allocate their output to domestic or foreign markets responding to relative prices. Domestic producers are therefore assumed to perceive the domestic market as different from the export market. The reason is similar than for imports: a high level of aggregation. Further, export markets might be more difficult to penetrate, forcing perhaps different quality standards than those applicable for the domestic market, or more simply different tastes. This formulation assumes a production possibilities frontier where each producer maximizes sales, subject to being on the frontier, and influenced by relative prices. The optimization problem is formulated somewhat differently since the object of the local producer is to maximize sales, not to minimize costs. We therefore have:

$$\max PD\,XD + PE\,ES$$
$$s.t.\,XP = \left[\gamma_d XD^{\lambda} + \gamma_e ES^{\lambda}\right]^{1/\lambda}$$

where *XD* is aggregate domestic sales of domestic production, *ES* is foreign sales of domestic production (exports), with a producer export price of *PE*, *XP* is aggregate domestic production with a producer price of *PP*, are the CET share parameters, and λ is the CET exponent. The CET exponent is related to the CET substitution elasticity, . via the following relation:

$$\lambda = \frac{\Lambda + 1}{\Lambda} \Leftrightarrow \Lambda = \frac{1}{\lambda - 1}$$

Analogous to the Armington specification, producer supply decisions are assumed to be undertaken it two steps. First, producers choose the optimal combination of domestic supply and aggregate export supply. Then, an additional step which optimizes export supply across trading partners. The top-level producer supply decisions, in reduced form, are given by Equations (29) and (30), where the share parameters are α^t and the CET substitution elasticity is σ^t. Equation (31) is the CET dual price function, which determines sectoral domestic output.

The second-level CET nest determines the optimal supply of exports to individual trading partners, *ESr*. Equation (32) defines export supply by region of destination. Equation (33) determines the aggregate export price, *PE*.

The next equation determines export demand by the regional trading partners, and the export market equilibrium condition. Under the small-country assumption the export demand elasticity is infinity, and the exporting country faces a flat demand curve, i.e. the export price is fixed (in dollar terms), to *WPINDEX*. Equation (34) converts the domestic export producer price into the price in local currency.

Trade equations

$$XA_i = \sum_j XAp_{ij} + XAc_i + XAg_i + XAi_i \tag{22}$$

$$XD_i = \beta_i^d \left(\frac{PA_i}{PD_i\left(1 + A^{vd}\tau_i^{vd}\right)} \right)^{\sigma_i^m} XA_i \tag{23}$$

$$XM_i = \beta_i^m \left(\frac{PA_i}{PM_i\left(1 + A^{vm}\tau_i^{vm}\right)} \right)^{\sigma_i^m} XA_i \tag{24}$$

$$PA_i = \left[\beta_i^d \left(PD_i\left(1 + A^{vd}\tau_i^{vd}\right)\right)^{1-\sigma_i^m} + \beta_i^m \left(PM_i\left(1 + A^{vm}\tau_i^{vm}\right)\right)^{1-\sigma_i^m} \right]^{1/(1-\sigma_i^m)} \tag{25}$$

$$XMr_{ri} = \beta_{ri}^r \left(\frac{PM_i}{PMr_{ri}} \right)^{\sigma_i^w} XM_i \tag{26}$$

$$PM_i = \left[\sum_r \beta_{ri}^r \left(PMr_{ri}\right)^{1-\sigma_i^w} \right]^{1/\left(1-\sigma_i^w\right)} \tag{27}$$

$$PMr_{ri} = ERWPM_{ri}\left(1 + A^t \tau_{ri}^m\right) \tag{28}$$

$$XD_i = \alpha_{d,i}^t \left(\frac{PD_i}{PX_i} \right)^{\sigma_i^t} XP_i \tag{29}$$

$$ES_i = \alpha_{e,i}^t \left(\frac{PE_i}{PX_i} \right)^{\sigma_i^t} XP_i \tag{30}$$

$$PX_i = \left[\alpha_{d,i}^t PD_i^{1+\sigma_i^t} + \alpha_{e,i}^t PE_i^{1+\sigma_i^t} \right]^{/(1+\sigma_i^t)} \tag{31}$$

$$ESr_{ir} = \alpha_{ir}^r \left(\frac{PEr_{ir}}{PE_i} \right)^{\sigma_i^z} ES_i \tag{32}$$

$$PE_i = \left[\sum_r \alpha_{ir}^r \left(PEr_{ir} \right)^{1+\sigma_i^z} \right]^{1/\left(1+\sigma_i^z\right)} \tag{33}$$

$$PEr_{ir} = ERWPINDEX_{ir} \tag{34}$$

Land Market

There are two basic features of the land market. First, the aggregate supply of land is allowed to respond to changes in the real aggregate price of land. Second, the allocation of the supply of land across different economic (agricultural) activities is assumed to respond to relative land prices across these activities using a CET transformation function. Equation (35a) determines the aggregate supply of land. For finite supply elasticities, the supply curve responds positively to the real aggregate price of land. If the supply elasticity is infinite, the real price of land is fixed.[9] The aggregate supply of land is *TLnd*, with an associated price of *PTLnd*, and a supply elasticity given by $\square^T$. The aggregate (or economy-wide) price of land, *PTLnd*, is determined in equation (35b). If there is friction in the allocation of land across sectors, i.e. the CET transformation elasticity is finite, then the aggregate land price is determined by the CET dual price aggregator as a function of the sector specific land price, *PT*. If, on the other hand, land is freely mobile across sectors, i.e. the CET transformation elasticity is infinite, the law of one price holds, and the aggregate price of land is determined through the equilibrium condition equating aggregate land demand to its aggregate supply. In the polar case, with a CET elasticity of 0, land is sector specific, and the land market is fully segmented. Equation (36) determines the sectoral allocation of land across sectors, T^s, assuming the CET elasticity is finite. The equivalent statement in dual form, if the CET elasticity is infinite, is that the law of one price holds, i.e. the sector-specific land price is uniformly equal to the aggregate price. Finally, equation (37) represent sectoral land market equilibrium in the case of a finite CET elasticity. In the case of an infinite elasticity, equation (38) trivially sets supply equal to demand.

[9] In most cases, one would assume that the supply elasticity of land is low.

$$(35)\quad \begin{cases} TLnd = \chi^T \left(\dfrac{PTLnd}{PGDP} \right)^{\eta^T} & \text{if} \quad 0 \le \eta^T < \infty \\ PTLnd = PGDP\ PTLnd_0 & \text{if} \quad \eta^T = \infty \end{cases}$$

$$(36)\quad \begin{cases} PTLnd = \left[\sum_{ag} \gamma_{ag}^T PT_{ag}^{\ 1+\omega^t} \right]^{1/\left(1+\omega^T\right)} & \text{if} \quad 0 \le \omega^T < \infty \\ TLnd = \sum_{ag} T_{ag}^d & \text{if} \quad \omega^T = \infty \end{cases}$$

$$(37)\quad \begin{cases} T_{ag}^s = \gamma_{ag}^T \left(\dfrac{PT_{ag}}{PTLnd} \right)^{\omega^T} TLnd & \text{if} \quad 0 \le \omega^T < \infty \\ PT_{ag} = PTLnd & \text{if} \quad \omega^T = \infty \end{cases}$$

$$(38)\quad T_{ag}^d = T_{ag}^s$$

Sector-specific Factors

The modelling of sector specific factors is straightforward. A constant elasticity supply function is assumed (eventually with a value of infinity). Equilibrium of supply and demand determines the factor price. Equation (39) specifies the supply function for the sector specific factor, F^s, with the supply elasticity given by η^F. Equation (40) is the equilibrium condition. In the case of a finite supply elasticity, it determines the sector-specific factor price, *PF*. In the case of an infinite supply elasticity, it trivially equates supply with demand.

$$(39)\quad \begin{cases} F_i^s = \chi_i^F \left(\dfrac{PF_i}{PGDP} \right)^{\eta^F} & \text{if} \quad 0 \le \eta^F < \infty \\ PF_i = PGDP\ PF_{i,0} & \text{if} \quad \eta^F = \infty \end{cases}$$

$$(40)\quad F_i^s = F_i^d$$

Labor and Capital Market Equilibrium

Family labor and capital are fully employed, perfectly mobile, and their amount is fixed. There is therefore a uniform wage rate across sectors, *W*, as well as a uniform rental rate, *R*. Equations (41) and (42) define the market equilibrium on each market.

For the other categories of labor, unemployment is taken into account for all the segments. The equilibrium on the labor market for these categories is given by other equations.

Labor and capital market equilibrium

$$\sum_i K_i = K^s \qquad (41)$$

$$\sum_i L_i = L^s \qquad (42)$$

Three macro closures are considered. Government real savings, *RSG*, are fixed (Equation 43), as well as are government real expenditures, *TG*. Public receipts thus adjust endogenously to achieve the predetermined government net position. The compensation schema considered in this version considers an endogenous shift in household taxes on income. Equation (44) is the ubiquitous savings equals investment equation. *InvExp* is the value of private investment expenditures, whose value must equal total resources allocated to the private investment sector: total household savings, government savings, and the sum across regions of foreign capital flows. The last closure rule concerns the balance of payments. First, we make the small country assumption for imports, i.e. local consumption of imports will not affect the border price of imports, *WPM*. Equation (45) is the overall balance of payments equation. The value of imports, at world (border) prices, must equal the value of exports, at border prices plus net transfers and factor payments, and plus net capital inflows.

Macro closures

$$RSg = S_G / P \tag{43}$$

$$InvExp = Hsav + ER\sum_r S_{fr} + S_G \tag{44}$$

$$ER\sum_r\sum_i WPM_{ri} XMr_{ri} = \sum_r\sum_i PEr_{ir} ESr_{ir} + ER\sum_r \left(S_{fr} + TR_r^G + TR_r^H\right) \tag{45}$$

The following equations are used to calculate the investment price and domestic price indexes which are respectively used to inflate real savings and real government savings. The numéraire of the model is the exchange rate, *ER*.

Price indexes

$$pi = \frac{\sum_i PA_i XAi_i}{\sum_i PA_{i,0} XAi_i} \tag{46}$$

$$P = \frac{\sum_i WL_i^d + \sum_i RK_i^d}{\sum_i W_0 L_i^d + \sum_i R_0 K_i^d} \tag{47}$$

Finally, we describe below the measure of households' welfare used in this model to assess the impact of simulated reforms. The first formula is derived from the household utility function, and represents the expenditure function at the current level of consumption (i.e. current utility), but at base year prices. Typically, this is written as $E(p_0, u)$. A measure of welfare, *EV*, is to calculate the difference between the expenditure function at current prices and utility, i.e. $E(p_,, u)$ and $E(p_0, u)$, once accounted for the change in disposable income.

Welfare measures

$$E(p_0,u) = \sum_i PA_{i,0}\theta_i + \exp\left(\sum_i \mu_i \ln\left(\frac{PA_{i,0}}{\mu_i}\left(XAc_i - \theta_i\right)\right) + \mu_s \ln\left(\frac{pi_0}{\mu_s}\frac{HSav}{pi}\right)\right)$$

$$EV = YD - YD_0 + E(p_0,u) - E(p,u)$$

The last table lists the name, definition and dimension of each endogenous variable. *N* is the number of products and *R* the number of trading partners.

Variable Name	Description	Dimension
PX_i	Unit production cost	*N*
PD_i	Domestic producer price	*N*
PE_i	Export price	*N*
PN_i	Aggregate price of intermediate demand	*N*
PKL_i	Price of value added	*N*
W	Wage	*1*
R	Rental rate of capital	*1*
PA_i	Armington price	*N*
PM_i	Import price	*N*
PEr_{ir}	Export price by region	*N R*
PMr_{ir}	Import price by region	*R N*
cpi	Consumer price index	*1*
P	Domestic price level	*1*
XP_i	Sectoral output	*N*
ND_i	Sectoral aggregate intermediate demand	*N*
KL_i	Sectoral aggregate value added	*N*
L_i	Sectoral labor demand	*N*
K_i	Sectoral capital demand	*N*
XAp_{ij}	Intermediate demand by product and sector	*N N*
XAc_i	Household consumption by product	*N*
XAi_i	Investment expenditure by product	*N*
XAg_i	Government expenditure by product	*N*
XA_i	Armington	*N*
XM_i	Imports	*N*
XMr_{ri}	Imports by region	*R N*
ES_i	Exports	*N*

ESr_{ir}	Exports by region	$N\,R$
YD	Household income	1
Y^{*}	Household supernumerary income	1
$HSav$	Household saving	1
$GExp$	Government nominal expenditures	1
$GExp$	Investment nominal expenditures	1
$VATd$	VAT revenues on domestic goods	1
$VATm$	VAT revenues on imported goods	1
$Ytrade$	Import tax revenues	1
$GRev$	Government revenues	1
S_G	Government saving	1
K^s	Capital supply	1
L^s	Labor supply	1
λ_i	Sectoral productivity level	N

In this static model, capital supply, labor supply and sectoral productivity levels are considered exogenous as well.