

# Impact statement of the Euro-Mediterranean partnership agreement

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## Impact of the association agreement between Lebanon and the European Union : methodological description of a CGE Model

Preliminary report

الجمهورية اللبنانية  
مكتب وزير الدولة لشؤون التنمية الإدارية  
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## **1 INTRODUCTION**

As are a large number of countries, Lebanon is currently considering participation in the Association Agreement with the European Union.

However, Lebanon is a country that is distinct from other Arab countries.

It has an economic structure (and policy structure, but that is out of the field of our analysis) very different from its Mediterranean neighbours. In particular, it is marked by a long experience of liberalism and open markets. The state has never played a major role in the operation of the economy.

Nevertheless, this agreement association raises several questions

- What will be the effect of the Association Agreement on the principal macroeconomic aggregates?
- What will be the impacts on Lebanese producers (reduction of the costs, of intermediary production, amount of investments and loans to increase productivity, etc.)?
- Can they absorb the shock to competitiveness?
- Will competition also reduce the production cost of domestically produced goods?
- Will Lebanese producers become competitive in relation to imported products?
- Etc.

This report presents the CGE (Computeable General Equilibrium) model that was built during the present mission, set up by the European Union and the Ministry of Finance to evaluate the costs and benefits of the suppression of tariffs on European imports.

Nevertheless, the construction of an economic model cannot be done without a preliminary and detailed analysis of the economic environment of the country. We stress that at least one man-year would be necessary to work out a genuine CGE model making it possible to analyze in detail the socio-economic impacts of the Association Agreement with the European Union.

In the first section we describe the background to our elaboration of a CGE model, and we will present the statistical situation in Lebanon. Then, we will sketch a short outline of the Lebanese economy and current issues as regards commercial policy.

We present, in the second section, the modeling approach and the theoretical choices that led us to define the CGE model used to analyze the impacts of the Association Agreement.

The third sub-section has been reserved for the technical description of the model and the presentation of the main equations.

The fourth sector has been devoted to present results of simulations and in particular for the comparison of the results obtained using the model. Due to the fact that the CGE model built within the framework of this study is only a methodological model, the corresponding conclusions are necessarily very brief.

We will present in the last section the general recommendations for the elaboration of a more sophisticated model to analyze more deeply the impact of the Association Agreement on the Lebanese economy. In addition, the needs in terms of statistical data, which will result from the construction of the updated model, will make it possible to identify the needs of Lebanon for the improvement of their management of the statistical and economic data.

## **2 BACKGROUND TO THE BUILDING OF A CGE MODEL**

We will briefly mention some specific issues, which had to focus on carefully for this analysis.

## **2.1 The statistical data**

### ***2.1.1 The present situation***

The analysis of the impact of the Association Agreement is not a simple matter, since the usual difficulties are amplified in Lebanon by the general deficiencies of the statistical system. Since the paralysis, which affected the Lebanese administration at the beginning of 1973, the national accounts have been almost non-existent over the period 1973-1994. The new Central Administration of the Statistics, created in 1979 to replace the old central Directorate of Statistics started to function in an effective way only from October 1994, once endowed with the essential working tools.

While waiting the rebuilding of the statistical apparatus of the country, the ACS (Administration Centrale de la Statistique) undertook to draw up a first estimate of the level of economic activity of the country from the available statistics. This involves mainly the elements of the goods and services account for the years 1994 and 1995 which are published in the review "The State of the economic accounts 1994-1995" of October 1997. The provisional accounts for 1996 and 1997 are available, but not published yet.

The result is that currently, one of the only working tools, which the modeller could have, is the Input-Output table of the goods and services grouped in 14 production branches for the years 1994 and 1995. This table is however very incomplete and still inaccurate in particulars:

- services are badly measured; for example, the input-output table shows a service sector, but imports and exports represent a zero value, which would suggest that Lebanon doesn't have any international service trade.
- Deflators are also very poorly measured. The supply-demand resource balance is available for certain years (1972,1973,1977,1994,1995), but only in current Lebanese pounds.
- In the balance of payments statistics, the data related to services and the transfer of capital is also very insufficient. Transport is treated as a percentage of imports while the other services concern only the movements carried out by the state and its administration.
- Concerning the state of the agents' accounts (households, firms, importers, Administration and rest of the world) it cannot be established, in view of the lack of statistics. In particular, incomes, transfers, as well as the assets and the liabilities of the households are poorly measured.

A financial estimate of the state of the accounts of the administrations and of the institutions has been carried out by using the sources of the Ministry of Finance and the assessments of the bank of Lebanon, but the figures are very approximate, as the important amount of the "errors and omissions" in the tables concerning the monetary situation of Lebanon testifies. In a general way, all the data which concern the financial transactions with the outside (transfers, deposits of non-resident, etc.) is very badly known, not to say ignored.

In summary, the missing or not yet collected data are the following:

- wages/profit distribution of value-added by sectors
- imported distribution/domestic products
- product of the intermediate consumption of the branches
- transfers between agents (in particular between the rest of the world and households, companies and the government; government transfers to households and companies)
- service exports,
- capital stocks in agriculture, distribution and services
- savings of agents and in particular households.

### **2.1.2 Improvement to statistic database**

Concerning the strengthening of national accounting statistics, the ACS carried out during the period of 1997 to 1999 broad surveys designed to collect information on the national accounts on coherent bases:

- *In 1997-98:*
  - a survey of households to consider consumption and income
  - surveys within the services sector to determine production
- *In 1998-99:*
  - a survey of households to study employment and unemployment.
  - a new census of industry.

In addition, an agricultural statistics programme was set up in the Ministry of Agriculture in collaboration with the ACS.

Previously, the Ministry of Industry had carried out a census of industry in 1994 with the aid of the GTZ in Germany.

## **2.2 Data related to an impact analysis**

In contrast to the other countries involved in Euro-Med agreements, the economy of Lebanon rests mainly on financial flows, which do not rest on a real activity internal to the country (the money supply M3 nearly twice the size of GDP). Financial flows are extremely difficult to break up, but one can say that half of the economy depends only on factors which are monetary like the real interest rate or the exchange rate and that the other half is also strongly tributary to monetary factors.

### **2.2.1 The service sector**

Lebanon is mainly a service country, especially banking. This sector employs three quarters of the working population while less than 10% work in the agricultural sector and 15% in industry. Within the services sector, 22% works in wholesale and retail distribution and 11% work in the construction industry, whereas the administration and teaching occupy most workers, respectively 8.5 and 8.6% of the jobs.

The place of services in the economy is therefore much more important than any other sector in the constitution of GDP. Therefore, it would be very important, in terms of modelling, to know how well the service sector will be incorporated into the field of the impact analysis.

But, generally the service sector is the most difficult to measure, which means that the results concerning the impact of the Association Agreement on GDP are likely to under-estimated

For instance:

- how the knowledge transfer will be measured ?
- will it be feasible to measure quantitatively the value-added of technological information or of a patent contained in an electronic mail ?
- how will one measure for example the advice that foreign banks will have within the local banks ?
- etc.

These are only some examples of numerous problems associated with the accurate measurement of economic and financial flows that should be taken into account in order to calculate all of the economic effects of the Association Agreement. These important impacts will not be measured quantitatively by means of an economic model.

Besides, in the Lebanese case, these difficulties will be enhanced by the predominance of the banking sector and the rules of confidentiality, which concern all financial transactions in Lebanon.

Considering these elements and the predominance of the service sector in the Lebanese economy, this means that the impact of the Association Agreement will be certainly underestimated by the model.

### **2.2.2 Other sectors**

The analysis of the impact of the Association Agreement will be easier to analyse on the agricultural and industrial sectors, on the one hand because the data are more available and on the other hand because this involves the production of agricultural products and industrial goods.

Unlike the service sector, competition of local people receiving benefits with foreign companies will naturally cause to affect the internal activity, in particular in the non-competitive sectors. In fact in Lebanon in numerous cases, this competition will not take place, because the products offered by foreign companies are not covered (or in a marginal way) by the local companies.

Nevertheless, it will be more difficult to measure the sectoral divergences between, on the one hand earnings currently obtained by certain companies thanks to the protection or monopoly position they enjoy (or the cost which results from it in terms of loss of competitiveness on a competitive market), and on the other hand the gain obtained by other companies which will increase their competitiveness by negotiating agreements with foreign companies (new technologies, transfer of technical performance, opening of markets, etc.).

### **2.2.3 Foreign investment**

The category of services, which will accompany direct foreign investments, will be also an important variable to analyse for the evaluation of the impact of the Association Agreement. But direct foreign investments are by themselves difficult to measure and in addition, they are only a relative indicator of the activity of the services, which will be carried out abroad.

What is clear is that a major effect of the association agreement, if it is well executed, will be a greater co-operation with European companies and an increase in investments coming from the European Union. But, as was mentioned previously, capital flows and transfers of services are very poorly measured and will remain so, whatever efforts are made to get reliable statistics.

In the case of Lebanon, service liberalisation will have especially an effect on the installation of foreign people receiving benefits. Initially, Lebanon should therefore benefit from direct foreign investments that will improve its capital balance, but this impact will not be very easy to measure.

In addition, as regards technology transfers, the transfer of skills and know-how, to give to the Lebanese products a satisfactory level to the standards, will be at the same time more important than the trade of goods and more difficult to measure. It will also be the case of banks and insurance companies, when the liberalisation of the economy following the signature of the Association Agreement leads to partnerships making it possible to improve the provision of services and to diversify the products.

Within the framework of the analysis carried out for the setting up of the model for Lebanon, it will be therefore both important and difficult to measure very accurately the exchanges of services with foreign countries, as well as all external investments and technology transfers.

### **2.2.4 International trade**

For international trade, the statistical obstacle is even more important. In fact, cross-border trade is often difficult to measure at the level of the goods, but almost impossible at the level of the national accounts when software, engineering or services for insurance are involved.

Here again, it will be difficult to measure the impact the Association Agreement will have on these variables.

Without going more into details, we can already point out that it is almost impossible, if we take only official data into consideration, to have an idea of the importance of the international trade of services in Lebanon, since it means to analyse quantitatively what will be the impact of the Association Agreement on these variables.

### **3 THE MODELING APPROACH**

#### **3.1 The choice of the model**

Many kinds of models could have been developed for analysing the impact of the Association Agreement, but their entire structure should have been clearly defined before their elaboration. Models are seldom multi-purpose and they are generally built for an individual application (in this precise case, to evaluate the impact of the Association Agreement on the Lebanese economy). Thus, the choices concerning the behavioural functions (in particular the investment function of each agent, the decomposition of the economy into sectors and sub sectors, the level of desegregation of the economy, the method of closure, etc.) are closely connected with the type of question that is studied.

Generally the choice is made between two types of models: econometric models and CGE models. We will briefly present the advantages and the limitations of the CGE models in comparison with econometric models and explain why they are more appropriate for analysing the impact of the Association Agreement on the Lebanese economy, especially from a sectoral viewpoint.

#### **3.2 Theoretical description of a CGE model**

Mainly research workers at the World Bank initiated the first CGE model applications in the developing economies. The use of the CGE models was at the beginning directed towards the examination of commercial policy, then extended to numerous other fields: taxation, energy and industrial policy, price regulation, etc. At the beginning of the 1980s the World Bank used to develop CGE models as a basis for the evaluation of structural adjustment policies.

As their title indicates, CGE models involve a general equilibrium which, in accordance with the neoclassic theory, describes the operation of a market economy in which a certain number of individual agents seek to maximize their objective function, taking into account constraints on resources and technology. The term "computeable" designates the fact that those are numerical applications of a competitive general WALRAS'S equilibrium model, the modern version of which was formulated for the first time by ARROW and DEBREU (1954).

Only the relative prices (or real prices), i.e. expressed in terms of the price of a good chosen as "cash" are important. If all the prices vary in the same proportions, then the general equilibrium is not modified. In other words, the demand and supply relations are zero degree homogeneous in relation to the monetary prices, while those of expenditure and of incomes are one degree homogeneous in relation to these same prices. The variations of the "cash" price are exogenous to the model, this price only being used to convert the relative prices into monetary prices, without any relation with the sector of the economy. This hypothesis amounts to stating the neutrality of the currency.

In relation to the reference plan that the competitive WALRAS equilibrium model constitutes, CGE models evolved deeply, thanks to the introduction of behavioral rigidities or of the mechanisms of imperfect competition, which will be described in point 6.5.

### **3.3 Comparison with econometric models**

CGE models are not genuine forecast instruments, but rather simulation models, which make it possible to answer in a coherent and detailed way, the questions raised by the application of economic policy measures. They cannot therefore consequently describe reality with precision, but can emphasize the medium-term tendencies around which the economy tends.

This manner of proceeding is very different from that which motivates the construction of econometric models, the aim of which is to explain and account for the development of the past that they project then on the future.

#### ***3.3.1 The advantages of CGE models***

The scope of the CGE models is today very broad. Thanks in particular to the conciliation of the micro-economic and macro approaches, these models are more common instruments of evaluation of economic policies in the developing countries.

The general structure of these models permits a detailed decomposition of the production sectors, of the categories of consumers, of the types of assets, etc. who allows not only to analyse the overall effect on saving of an economic policy decision (or of an exogenous shock), but also to take the measure of the induced modifications on the allocation of the resources, the distribution of the incomes and thus to evaluate the gain or the loss in welfare associated with the measure considered.

The advantage of the CGE model lies less in the economic forecast than in the alternative analysis or the comprehension of the economic mechanisms. In view of their development methodology, these models are above all medium-term alternative policy simulation models, more than short-term forecasting models, except when one carries out a dynamic calibration since it is then possible to compare the results provided by the model over several years.

The simulation models constitute essential tools to better understand the economic mechanisms and to demonstrate the issues of the economic policy decisions, as the analysis of the impact of the Association Agreement. Besides, the elaboration of CGE models was largely encouraged by the development of computer software facilitating their resolution. It also results from the principle of their development that requires a numerical base limited to one year, thus allowing to deal with insufficiency data over long periods.

However, in view of the absence of time series in Lebanon, the CGE model may be the best-adapted tool to carry out the impact of the Association Agreement on the Lebanese Economy.

#### ***3.3.2 The limitations of CGE models***

CGE models have their weaknesses. Among most generally recognised, one can underline:

- their major sensitivity to the values of the parameters that they incorporate. These parameters are not calculated using econometric estimation techniques, but to enable to give the result of the basic SAM (Social Accounting Matrix). Sometimes they are based on theoretical work or on the hypotheses of their authors. It proves therefore essential, in support of the results, to present a sensitivity analysis making it possible to check robustness of the parameters of the model. For this reason, an additional work should be carried out within the framework of this impact study, to analyse the results provided by the CGE model according to the sensitivity of the parameters that were introduced.
- In comparison with econometric models, another limitation of the CGE model comes from their lack of empirical validation, as they do not make it possible to account for the development of the past. CGE models are calculated on the data of a certain year, the economy being supposed to be in equilibrium this year. This manner of proceeding is very different from that which generally prevails for the construction of

the econometric models, which aim to explain and account for the development of the past that they project on the future.

- Unlike econometric models which analyse the economy only from a partial viewpoint, the elaboration of a sectoral CGE model needs all the data which are required by the Social Accounting Matrix on all the aspects of economic activity: production by sectors, intermediary consumption, investment, consumption, distribution of the incomes, taxation, public expenditure, etc. However in the case of Lebanon, apart from the service sector (in particular banking) this disadvantage is only partially true, as numerous studies made it possible to obtain consistent information. These were ultimately Input-Output tables and especially the incomplete level of its data that placed most problems regarding the development of the CGE model.

Thus, after having exposed the principles which form the basis for the construction of the Lebanon CGE model, we will briefly present, rather on an illustrative basis than in terms of economic analysis, the CGE model built up during this mission, which is a relatively simplified model but nevertheless broken up in 7 branches to enable sectoral analysis.

## **4 THE CGE MODEL FOR LEBANON**

### **4.1 The description of the CGE model**

The model developed for Lebanon is a conventional CGE model with constant returns to scale and perfect competition output.

The model that we built for Lebanon is based, in its broad outline, on the Dervis, Melo and Robinson model (1982), which has been the inspiration for numerous models built for the developing countries. More precisely, we used the various works realized by COLLANGE<sup>1</sup> who designed numerous CGE models for the developing countries. This involves a dynamic model (capital and supply of work) in an open economy with a fixed exchange rate.

Its data are based on a Social Accounting Matrix with 7 sectors and 6 agents. The model is still incomplete and imperfect (see point 6.5 for the future improvements of the model), but nevertheless able to analyze the impacts of the abolition of some trade tariffs as a stepping-stone for further liberalization.

### **4.2 The limitations of the results**

1. Given the simple structure of the model, the results should be considered as initial indicators.
2. Since the model is not sufficiently disaggregated it does not take all the necessary elements into account, it does not totally reflect the effects of tariff dispersion across sectors and trading partners.
3. The nature of the model is dynamic (slightly), but these variables are restricted to the supply of labour (which is related to the population growth rate) and the capital stock. Thus, the positive effects of trade liberalization will only be related to the level of investment made in the different sectors.

### **4.3 The Social Accounting Matrix (SAM)**

The construction of a CGE model rests, in general, on a Social Accounting Matrix (SAM). The SAM synthesizes, in a single table, all the transactions carried out between various economic agents and constitute, in fact a synthesis of the Input-Output table and the macro economic aggregates. The SAM characterizes the key values in the economy in a consistent manner.

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<sup>1</sup> Gerald COLLANGE is a French senior economist of the "Agence Française de Développement", specialized in economic modelling.



Through the calibration process, which will be described on point 4.4.8, these values can be used to generate many of the key parameter values.

The major interest of the SAM is to represent in a synthetic way all the relations between employment, income distribution and the structure of production. Indeed, the SAM rests on detailed descriptions:

- of the production accounts by branches,
- of an account of the production factors
- of the accounts of the institutional sectors.

The data required for the SAM are:

- the value added and the intermediary consumption by sectors (Input-Output Matrix for 1997 elaborated by the ACS),
- the imports and exports by each source and destination countries,
- the Lebanon 's trade tax by trading partners (Import tax and Export tax),
- the commercial margins by products,
- the final consumption by agents
- the private and public investments.

These data have been gathered into an Excel workbook (CGE model78.xls). The basic 'SAM' for 1997 (SAM sheet) is designed to adjust and organize the basic macro data.

The model coefficients result from the values of the SAM variables in 1997 and the "calibration" calculations.

#### **4.3.1 Description of the SAM for Lebanon**

The SAM supporting our CGE model has been mainly built up from the Input-Output table provided (unofficially) by the ACS for 1997.

- The Social Accounting Matrix comprises six accounts:
  - account of the production factors (capital and work),
  - agents' current account (households, enterprises, Importers/wholesalers, State, European Union, Rest of the World),
  - production account,
  - goods and services account (internal goods and export goods),
  - capital (or accumulation) account.
- The economy has been disaggregated in 7 producing sectors:
  - Agriculture,
  - Agro-food Industries,
  - Textile and leather industries,
  - Mineral, metal, machines,
  - Wood, chemicals, furniture,
  - Other industries and Real Estate,
  - Trade & Services.

and 14 goods (each good can be produced locally or imported).

- Six categories of agents have been taken into account:
  - Households
  - Firms
  - Importers & resellers
  - Government
  - European Union
  - Rest of the World
- The Input-Output table enables in particular to obtain:
  - the intermediate consumption of the branches between imported products and local products,
  - production by branches

- the commercial margins,
- the taxation of the products (taxes on imports and local taxes),
- the final jobs by branches (consumption, GFCF, exports).

A key feature of the SAM is that income always equals expenditure for the economy as a whole. Thus the budget constraints require that the row sum (expenditure) must equal the column sum (income).

**Table 1. Social Accounting Matrix (SAM) for Lebanon: 1997 figures (current values)**

SAM	1997														
	FACTORS					AGENTS					BRANCHES				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Billions of Lebanese pounds															
1 Labour	0.0	0.0	0.0	0.0		0.0		0.0	2960.8	453.2	287.7	949.7	874.2	2465.7	10194.3
2 Capital	0.0	0.0	0.0	0.0		0.0		0.0	155.8	23.9	15.1	50.0	46.0	129.8	536.5
3 Households	18185.6	813.6	0.0	0.0		250.0	4881.4	4492.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4 Firms	0.0	143.6	0.0	0.0		611.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 Importers and wholesalers															
6 State	0.0	0.0	1147.2	506.6		0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7 European union	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8 Rest of the World	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9 Agriculture	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 Agro Food Ind.	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11 Text. Ind. Leather	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12 Mineral, Metal, machines	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13 Wood, chemistry, furniture	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14 Other Ind. and BTP															
15 Trade & Services	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16 Agriculture	0.0	0.0	5770.8	0.0		303.7		0.0	526.7	635.4	4.8	0.0	2.9	10.3	7.9
17 Agro Food Ind.	0.0	0.0	3229.1	0.0		170.0		0.0	65.9	232.5	0.0	0.0	1.7	0.0	0.0
18 Text. Ind. Leather	0.0	0.0	1500.1	0.0		79.0		0.0	3.6	0.0	330.4	0.0	18.4	5.9	3.4
19 Mineral, Metal, machines	0.0	0.0	2488.2	0.0		439.1		0.0	3.8	66.7	1.6	916.2	116.1	2191.2	420.5
20 Wood, chemistry, furniture	0.0	0.0	1914.8	0.0		212.8		0.0	196.3	12.4	11.9	19.3	766.2	552.9	362.4
21 Other Ind. and BTP			2898.8			680.0		0.0	17.8	47.6	16.7	79.0	56.1	1263.6	339.7
22 Trade & Services	0.0	0.0	4231.7	0.0		746.8		0.0	19.7	16.2	8.7	34.8	31.7	177.7	713.5
23 Agriculture	0.0	0.0	0.0	0.0		0.0	74.5	173.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24 Agro Food Ind.	0.0	0.0	0.0	0.0		0.0	25.1	58.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25 Text. Ind. Leather	0.0	0.0	0.0	0.0		0.0	48.0	111.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26 Mineral, Metal, machines	0.0	0.0	0.0	0.0		0.0	92.9	216.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27 Wood, chemistry, furniture	0.0	0.0	0.0	0.0		0.0	57.8	134.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28 Other Ind. and BTP							76.9	179.5							
29 Trade & Services	0.0	0.0	0.0	0.0		0.0	69.0	161.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30 Accumulation	0.0	0.0	5442.5	248.0		-19.4	192.4	448.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<b>Total resources</b>	<b>18186</b>	<b>957</b>	<b>28623</b>	<b>755</b>	<b>0</b>	<b>3473</b>	<b>5518</b>	<b>5978</b>	<b>3950</b>	<b>1488</b>	<b>677</b>	<b>2049</b>	<b>1913</b>	<b>6797</b>	<b>12578</b>

**SAM**

Billions of Lebanese pounds		PRODUCTS										EXPORTS										ACCUM.	Total
		16	17	18	19	20	21	22	23	24	25	26	27	28	29	30							
1	Labor	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18186						
2	Capital	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	957						
3	Households	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	28623						
4	Firms	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	755						
5	Importers and wholesalers	2411.8	926.2	381.1	1158.9	568.6	921.2	-6367.8									0						
6	State	78.3	213.9	166.1	630.2	177.7	552.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3473						
7	European union	514.4	554.3	425.9	2428.3	854.0	741.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5518						
8	Rest of the World	557.3	600.4	461.3	2630.7	925.1	802.7	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5978						
9	Agriculture	3950.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3950						
10	Ind Agro Alim	0.0	1487.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1488						
11	Ind text. Leather	0.0		676.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	677						
12	Mineral, Metals, machines	0.0		0.0	2049.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2049						
13	Wood, chemistry, furniture	0.0	0.0	0.0	0.0	1913.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1913						
14	Aut Ind and BTP					6797.1											6797						
15	Trade & Services							12578.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12578						
16	Agriculture	0.0	0.0	0.0	0.0	0.0	0.0	0.0	248.2	0.0	0.0	0.0	0.0	0.0	0.0	1.4	7512						
17	Ind Agro Alim	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	83.6	0.0	0.0	0.0	0.0	0.0	0.1	3783						
18	Ind text. Leather	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	159.9	0.0	0.0	0.0	0.0	10.7	2111						
19	Mineral, Metals, machines	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	309.5	0.0	0.0	0.0	1944.2	8897						
20	Wood, chemistry, furniture	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	192.7	0.0	0.0	197.1	4439						
21	Oth. Ind and BTP													256.4		4158.7	9814						
22	Trade & services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	230.0	0.2	6211						
23	Agriculture	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	248						
24	Ind Agro Alim	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	84						
25	Ind text. Leather	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	160						
26	Mineral, Metals, Machines	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	310						
27	Wood, chemistry, furniture	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	193						
28	Aut Ind and BTP																256						
29	Trade & services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	230						
30	Accumulation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6312						
Total resources		7512	3783	2111	8897	4439	9815	6211	248	84	160	310	193	256	230	6312	143502						

**Table 2. Social Accounting Matrix (SAM) for Lebanon: variables names**

SAM	Billions of Lebanese pounds														
	FACTORS					AGENTS					BRANCHES				
	1997	£ inst.	2	3	4	5	6	7	8	9	10	11	12	13	14
1 Labor										sal1	sal2	sal3	sal4	sal5	sal6
2 Capital										rk1	rk2	rk3	rk4	rk5	rk6
3 Households	sal	rk1	rk2	rk3	rk4	rk5	rk6	rk7	rk8	rk9	rk10	rk11	rk12	rk13	rk14
4 Firms															
5 Importers and wholesalers															
6 State															
7 European union															
8 Rest of the World															
9 Agriculture															
10 Ind Agro Alim															
11 Ind text. Leather															
12 Mineral, Metals, machines															
13 Wood, chemistry, furniture															
14 Other Ind and BTP															
15 Trade & Services															
16 Agriculture															
17 Ind Agro Alim															
18 Ind text. Leather															
19 Mineral, Metals, machines															
20 Wood, chemistry, furniture															
21 Oth. Ind and BTP															
22 Trade & services															
23 Agriculture															
24 Ind Agro Alim															
25 Ind text. Leather															
26 Mineral, Metals, Machin															
27 Wood, chemistry, furniture															
28 Aut Ind and BTP															
29 Trade & services															
30 Accumulation															

Expenditures appear along the rows, and incomes down the columns.

SAM	Billion of Lebanese pounds	PRODUCTS										EXPORTS							ACCUM
		16	17	18	19	20	21	22	23	24	25	26	27	28	29	30			
1	Labor																		
2	Capital																		
3	Households																		
4	Firms																		
5	Importers and wholesalers	mcu1	mcu2	mcu3	mcu4	mcu5	mcu6	mcu7											
6	State	taxm1	taxm2	taxm3	taxm4	taxm5	taxm6	taxm7											
7	European union	meu1	meu2	meu3	meu4	meu5	meu6	meu7											
8	Rest of the World	mru1	mru2	mru3	mru4	mru5	mru6	mru7											
9	Agriculture	xsu1																	
10	Ind Agro Alim		xsu2																
11	Ind text. Leather			xsu3															
12	Mineral, Metals, machines				xsu4														
13	Wood, chemistry, furniture					xsu5													
14	Oth. Ind and BTP						xsu6												
15	Trade & Services							xsu7											
16	Agriculture								xu1									iu1	
17	Ind Agro Alim									xu2								iu2	
18	Ind text. Leather										xu3							iu3	
19	Mineral, Metals, machines											xu4						iu4	
20	Wood, chemistry, furniture												xu5					iu5	
21	Oth Ind and BTP													xu6				iu6	
22	Trade & services														xu7			iu7	
23	Agriculture																		
24	Ind Agro Alim																		
25	Ind text. Leather																		
26	Mineral, Metals, Machin																		
27	Wood, chemistry, furniture																		
28	Oth. Ind and BTP																		
29	Trade & services																		
30	Accumulation																		

### 4.3.2 Analysis of the Social Accounting Matrix

We observe from tables 1 and 2 that:

- Households, enterprises and government receive all income.
- Firms' revenue comes from capital revenue and transfers from the government,
- Government income comes from direct taxes on households and enterprises and from indirect taxes on imports and production.
- Households income derives from wages and capital revenue plus transfers from abroad,
- Two different trading partners are distinguished: the European Union and Rest of the World both on the import and export sides.
- The role of government is reduced to being only responsible for collecting the revenues associated with protection, and redistributing them to the firms.
- The financial inflows considered are very broad, including foreign direct investment, portfolio investment, loans, net factor service income, and grants.

Firms produce goods a part of which is intended for the domestic market and the other part is exported. It is considered that a "composite good" (basket of domestic goods and imported goods) is sold on the internal market. (Another hypothesis would have been to consider that firms produce separate assets for the domestic market and for the export market).

#### • Income accounts

The earnings ( $wi.Ldi$ ) are distributed to households and incomes from capital are distributed to the households ( $Rkm$ ) and the firms ( $Rke$ ).

The households' income corresponds to the sum of the paid wages ( $w.L$ ) on which they pay taxes ( $TYM$ ), buy consumer goods ( $\sum Pci.Cmi$ ) and save ( $SMU$ ).

The income of the firms corresponds to the sum of the profits ( $\sum Rkei$ ) less the salaries given to households ( $w.L$ ). The difference between this and the tax paid to the government ( $TaxRK$ ) constitutes their saving ( $SEU$ ).

The incomes of the government are made up of the taxes on the households' income ( $TYM$ ), the taxes of the companies ( $TaxRK$ ), the taxes on production ( $\sum Taxxi$ ), the duties on imports ( $\sum Tmi$ ) and the external capital contributions from the European Union ( $TEG$ ) and from the Rest of the World ( $TRG$ ). The difference between the incomes of the government and its expenditure in consumer goods constitutes the public saving. ( $SGU$ ).

The account of the Rest Of the World (broken up for our study in accounts of the European Union and of the Rest of the World) represent the income of the Rest Of the World, made up by the exports and its expenditure, corresponding to imports. The difference between the two corresponds to the foreign saving in currencies, or to the loans/external transfers of the country.

#### • Production account

The production account breaks down (in column) the production between the value added and the intermediate consumption. It is checked (on-line) that the value of production is equal to the production cost.

#### • Goods and services account

The market of the domestic goods shows, on-line, the intermediate and final uses (consumption and investment) of the goods and services. The total of the column corresponds to the overall resources of the economy expressed at the market price; (i.e. including the indirect taxes).

The market of the export of goods enables us to check that the value of exports paid by the rest of the world is equal to the value of exports paid on the internal market, plus the taxation of exports. The country is small in world markets, facing fixed world prices for exports and imports.

#### • Capital account

The accumulation account makes it possible to calculate total investment (IU) from equality:  $IU = (SEU+SMU+SGU+E).BC$ ; BC representing the Trade balance of Lebanon and E the exchange rate in real terms.

#### **4.4 The basic structure of the model**

##### **4.4.1 Goods and services supply and factor demand**

The majority of CGE models define production functions of the neoclassical type which admit substitution between work and the capital, while intermediate consumption is complementary with them. The production function is written in the following general form:

$$(1) \quad X_i = f(A_i, K_i, LD_i)$$

in which, for each sector  $i$ ,  $X$  represents the volume of production,  $A$  is a constant reflecting the level of technical progress,  $K$  is the capital stock which is fixed in the short run and  $LD_i$  the demand for labour.

The hypothesis of a perfectly competitive labour market means that the wage rate  $w$  is equal to the marginal productivity of work (in value)

$$(2) \quad w = PVA_i - \delta X_i / \delta LD_i$$

where  $PVA_i$  is the value added price:

$$(3) \quad PVA_i = PX_i (1 - tx_i) - \sum a_{ij} . P_j$$

$PX_i$  is the production price (local) and  $tx_i$  the tax rate on production.  $a_{ij}$  are the elements of the matrix of the technical coefficients.

In the model that we worked out, the offer of work (LS) is exogenous and dynamic. It evolves with the demographic growth rate.

The supply of labour (LS) is exogenous and the balance of the labour market is obtained when the latter equalises demand (hypothesis of full employment):

$$(4) \quad \sum LD_i = LS$$

The market of the export of goods makes it possible to check that the value of exports paid by the rest of the world is equal to that of exports paid on the internal market, plus the taxation of exports. The difference between the two corresponds to the foreign saving in currencies (F\$), or to the external loans of the country:

$$(5) \quad F\$ = \sum P_{wmi} . M_i - \sum P_{wei} . EX_i$$

The computation scheme of the model being defined, we will now describe successively the determination of the supply of goods and services and the corresponding demand of factors, then the formation of the incomes and the demand of goods and services. Finally, we will present the solution of general equilibrium.

Thus, from a series of prices determined at the beginning in an exogenous way, ( $P_1, \dots, P_n$ ), each sector will seek to maximise its profit under the constraint of its capital assets ( $K_i$ ) and of the wage rate ( $w$ ). Neoclassic production functions are strictly concave and the solution is consequently unique. Thus, for a given price vector, corresponds a single vector of the outputs ( $X_1, \dots, X_n$ ), and its aggregation constitutes the level  $X$  of the overall supply:

$$(6) \quad X = X(P_1, \dots, P_n)$$



#### 4.4.2 The constitution of income

The income of each agent (denoted  $Y$ ) is determined from their budgetary constraints:

$$(7) \quad \text{the Households' income: } YM = \sum (w - LD_i)$$

$$(8) \quad \text{income of the firms: } YE = \sum (PVA_i.X_i - w.LD_i)$$

$$(9) \quad \text{income of the state: } YG = \sum Ty.w.LD_i + \sum ts. (PVA_i.X_i - w.LD_i) + tx_i. \sum P_xi.X_i + \sum tmi.E. PWM_i.M_i + \sum tei.E. PWE_i.EX_i + E.F\$$$

It is supposed that agents save a fraction of their income, from which we can calculate the total saving:

$$(10) \quad S = sm. (1 - ty). YM + (1 - ts). YE + YG - \sum Pi.CG_i$$

#### 4.4.3 The demand for goods and services

It is supposed that there is only one category of households which buys consumer goods according to an exogenous scale in volume:

$$(11) \quad C_i = \beta_i. CM/P_i$$

where  $C_i$  represents the consumption in volume of the good  $i$ ,  $CM$  the households' total consumption in value and  $\beta_i$ , the exogenous share of the households' consumption in good  $i$ . Total consumption in value depends on the disposable income of the households, i.e.

$$(12) \quad CM = (1 - sm). (1 - ty). YM$$

The total consumption of the state ( $CG$ ) is exogenous in volume and is distributed by products according to a fixed proportion. It is an economic policy variable:

$$(13) \quad G_i = \phi_i. CG$$

Investment is determined by the overall amount of the saving  $S$ . This representation corresponds to the closure of the neoclassic type. It is supposed that the value of the investment of the sector  $j$  is a fixed proportion  $H_j$  of saving. Finally, the investment by sector of origin is given from the following relation:

$$(14) \quad I_i = H_{ij}. S/PK_j$$

Where  $P_{ki}$  represents the unit price of the capital.

Overall investment is thus expressed as a function of the initial vector of prices since it depends only of saving, which are connected with incomes which, in turn, depend on prices:

$$(15) \quad I = I(P_1, \dots, P_N)$$

The request for intermediate goods is written simply:

$$(16) \quad C_{li} = \sum a_{ij}. X_j$$

where  $a_{ij}$  represent the technical elements of the matrix of (input/output) coefficients which are fixed.

#### 4.4.4 The foreign trade

To be in conformity with reality, it is necessary to give up certain extreme hypotheses of the neo-classic theory of international trade which have received no empirical validation, for example, the following:

- the hypothesis of the marginal nation which, coupled with the existence of functions as a constant scale of output production led, contrary to empirical observation, to the extreme specialisation of production;
- the hypothesis of perfect substitutability between the internal goods and the imported goods, which even excludes the possibility from trade with double direction and leads to the "law of one price" which is not observed in reality.

Retaining the opposite hypothesis of perfect complementarity between imported and domestic goods, which underlies input-output models, would introduce a too strong rigidity into behaviour: a rise in import prices would lead to an increased trade deficit, without giving any possibility to act by means of the exchange policy or commercial policy.

Thus, as the majority of CGE models analysing commercial trade, we will retain a median hypothesis. For the same category of products, domestic production and imports are supposed to have different characteristics and prices. The neoclassical hypothesis of homogeneity of the products is thus abandoned to the benefit of imperfect substitutability between the products of different origins. This hypothesis, which was postulated by ARMINGTON (1969), comes to introducing the concept of differentiation of the goods by country of origin in the structure of the demand.

#### • Imports

According to the proposition of Armington, for each category of products  $i$ , the demand for the composite good  $Q_i$ , is defined as a constant elasticity of substitution (CES) function of the imported goods ( $M_i$ ) and of the goods produced locally ( $DD_i$ ).

$$(17) \quad Q_i = B_i \cdot [\delta_i \cdot M_i^{-\rho_i} + (1 - \delta_i) DD_i^{-\rho_i}]^{-1/\rho_i}$$

where are  $B_i$ ,  $\delta_i$  and  $\rho_i$  are parameters.  $M_i$  and  $DD_i$  play the role of 'inputs' entering the composition of the good  $Q_i$ , in a similar way as capital and labour inputs in a traditional production function.

The goal consists in finding the ratio ( $M_i/DD_i$ ) which equalizes the marginal rate of substitution (represented by the slope of the iso-cost curve of the composite product) and the price ratio of the internal goods to imported goods price. If  $PD_i$  is the internal goods price and  $PM_i$  the price of the goods imported in local currency, the first order condition which minimizes the cost is written:

$$(18) \quad \frac{M_i}{DD_i} = \left[ \frac{\delta_i}{1-\delta_i} \right]^{\sigma_{mi}} \left[ \frac{PD_i}{PM_i} \right]^{\sigma_{mi}}$$

This formulation shows that the consumer can choose a certain combination of the goods between  $M_i$  and  $DD_i$  according to the relative prices of these products. This relation has the advantage of being very flexible, because it is possible to select the value of the parameters or of the elasticities:

- for the perfectly non exchangeable goods, one will have  $\delta_i = 0$ ,
- for the exchangeable goods, we can make the distinction according to their more or less high degree of marketing by adjusting the value of  $\sigma_{mi}$ :
- if  $\sigma_{mi} = 0$ , the share of imports in the total demand will remain constant and independent of the relative prices of the internal and external goods,
- if  $\sigma_{mi}$  takes high values, the possibility of substitution between the internal goods and the price variations then leads to a major variation of the quantities. At the limit, if  $\sigma_{mi}$  is infinite, we have  $PD_i = PM_i$ .

The following function means that  $PD_i$  is no longer equal to  $PM_i$ .  $PD_i$  is fixed in an exogenous way in the model, while the price of imports on the internal market is determined by the following relation:

$$(19) \quad PM_i = PWM.E. (1 + tmi)$$

$E$  represents the exchange rate and  $tmi$  the rate of the customs duties applied to the corresponding sector. This hypothesis is in conformity with the traditional theory, according to which the country can exert no influence on the world markets prices.

Fixing the  $PM_i$  price by means of the exchange rate and by means of the customs duties, we can influence the relative pricing system and also the composition of the demand between the external and internal goods, and therefore on the price of the internal goods. The composition (in terms local/imported) of the composite good  $Q_i$  does not depend on the relative price ( $PD_i/PM_i$ ).

#### • Exports

At the level of exports, Lebanon is considered as a small country, which leads to an exogenous fixing of the prices of exports by the world market.

Then, two types of prices are distinguished:

- the world price  $PWE_i$  expressed in dollars and which is exogenous,
- the domestic  $PE_i$  export price, expressed in national currency, which depends on the world price in dollars, on the exchange rate and on the taxation rate ( $te_i$ ):

$$(20) \quad PE_i = \frac{PWE_i}{1+te_i}$$

$PE_i$  is thus determined in a local way in the model according to the exchange rate and to the taxation rate. The division of the offer of the goods produced locally between the domestic and external markets is established via a constant transformation elasticity function:

$$(21) \quad X = B_i^e \left[ \gamma_i EX_i^{\sigma_i} + (1-\gamma_i) DS_i^{\sigma_i} \right]^{1/\rho_i}$$

The first order condition makes it possible to deduce the relative share of exports from the relation of the domestic demand:

$$(22) \quad \frac{EX_i}{DS_i} = \left[ \frac{1-\gamma_i}{\gamma_i} \right]^{\sigma_i} \left[ \frac{PE_i}{PD_i} \right]^{\rho_i}$$

We can see that it depends on the relationship between the domestic price of the exported goods and the price of the consumed goods on the internal market. An increase in the domestic prices of exports will involve an increase in the supply of exports. The modification of the level of exports can come from a change in the exchange rate, in the taxation rates or in the world price. A fall in the export tax or a devaluation of the exchange rate will contribute to increasing the relative price exported in relation to the goods sold on the domestic market.

#### 4.4.5 The general equilibrium solution

We saw that it is the relative prices and income which determine the total demand for each category of composite goods. A part of this demand is satisfied by imports, the other part by the production of domestic goods. The equilibrium conditions on the goods and services market are written (in volume terms):

$$(23) \quad QO_i = CMO_i + CGO_i + CIO_i + IO_i$$

$$(24) \quad DD_i = DS_i$$

where  $CMO_i$  and  $CGO_i$  represent respectively the demand for final consumer goods by households and the state,  $CIO_i$  the request for intermediate goods and  $IO_i$  the demand for capital goods.

Under the hypothesis that consumers of the imported and local goods minimize their costs, the prices of composite goods ( $P_i$ ) are deduced as a performance index of the CES (Constant Elasticity of Substitution) aggregated function:

$$(25) \quad P_i = \frac{1}{B_i^m} \left[ \delta_i^{\sigma_i} P M_i^{1-\sigma_i} + (1-\delta_i)^{\sigma_i} \cdot P D_i^{1-\sigma_i} \right]^{1/\sigma_i}$$

In a similar way the production price is derived from the CET (Constant Elasticity of Transformation) function:

$$(26) \quad P X_i = \frac{1}{B_i^e} \left[ \gamma_i^{\sigma_i} P E_i^{1+\sigma_i} + (1-\gamma_i)^{\sigma_i} \cdot P D_i^{1+\sigma_i} \right]^{1/(1+\sigma_i)}$$

Lastly, the condition of balance of the current balance is written (in currencies):

$$(27) \quad \sum P W M_i . M_i = \sum P W E_i . X_i - F\$ = 0$$

where F\$ does represent the endogenous value of the net external transfers.

On the whole, we come to a system of  $18.n+7$  equations and  $18.n+7$  variables. However, under the terms of the law of Walras, the described system is not independent. One of the equations is redundant and it is necessary to constrain a variable to a fixed value. To preserve the homogeneity of the model in relation to the prices, the price of PINDEX in the following form is generally fixed:

$$(28) \quad \sum - \Omega_i P_i = \text{PINDEX}$$

$P_i$  denotes the prices of the composite goods which depend at the same time on  $P D_i$  and on  $E$  (real exchange rate). PINDEX is an exogenous index of the level of the prices. Then, the model can be solved. It includes  $18.n + 8$  equations but only  $18.n + 7$  endogenous variables. According to the Walras law, it is enough then to suppress one equation, for example the balance of the current balance, to lead to a perfectly given system. The model comprises then  $18.n + 7$  independent equations and  $18.n + 7$  endogenous variables.

The rule of price standardization needs to have one price for the «numéraire», which is in this case, is equal to general consumer prices. In this case, only the relative prices, i.e. expressed in relation to the «numéraire» are important. The produced or consumed quantities do not change, if they vary in the same proportion.

The operational limits of this model are obvious: it cannot be used to analyze the causes of inflation, since the latter is exogenous and has no real effect as the currency is neutral.

Fixing in an exogenous way the domestic prices and the wage rate starts the solution algorithm of the model. The primary initial data of primary factors are given. The calculation of the marginal productivity of labour, the derivative of the behavior of maximization of the producers' profit, makes it possible to determine the demand for labour which is then compared to the labour supply. The wage rate adjusts itself until balance is achieved on the labour market. Balance wages and the volume of employment make it possible to evaluate the demand for goods and services, which shares itself between internal goods and imported goods (composite goods) according to their relative prices. Service supply is determined from the demand for labour and from the market prices. It is distributed on the internal market and foreign countries (exports) according to the relative price. The respective levels of supply and of demand are then compared and the model proceeds then by iteration, revising the initial prices until general equilibrium is reached.

#### 4.4.6 Calibration of the CGE model

The matrix reproduces the construction of the CGE model is based on the principle of calibration, which consists in solving the model by reverse calculation, i.e. to determine the numerical values of the parameters, which are perfectly compatible with the initial structure of the economy, such as it. If the calibration procedure is correct, it has to make it possible to find the initial data when the model "runs" of itself.

Let us consider for example a production function of Cobb-Douglas type, with constant returns to scale:

$$X = A K^\alpha . L^{1-\alpha}$$

Knowing the values of  $X$ ,  $K$ ,  $L$ , of the production price  $P$  and of the factor price ( $r$  and  $w$ ) it then possible to determine  $\alpha$  then  $A$ : the first order conditions of the maximization of the profit make it possible to determine  $\alpha$  and  $A$  by the following equations:

$$\alpha = \frac{r \cdot K}{P \cdot X} \text{ and } A = \frac{X}{K^{\alpha} L^{1-\alpha}}$$

This method, allows us to find a value for  $\alpha$  and  $A$  from a numerical basis limited only to one year, but it does not make it possible to validate the model on past data, in contrast to econometric models. However, using econometric methods to calculate the coefficients of a CGE model for the developing countries presents numerous difficulties: on the one hand owing to the lack of statistical series over long period ; also because the application of this method to models based on a large number of sectors and of households would require to consider a too large number of parameters. Thus, in spite of its limitation, calibration method remains, to our knowledge, the only used for the estimate of the CGE models in the developing countries.

#### **4.4.7 Instruments and methods of resolution of the CGE models**

The development of the CGE model was facilitated by the availability of several software packages having their own solution algorithm and making it possible to solve the CGE models in the form of problems of maximization under constraints, without it being necessary to write the first order conditions. Software most often used is G.A.M.S (General Algebraic Modeling System), which was developed in the 1980s by the World Bank. This software makes it possible to solve easily the non-linear models thanks to a relatively simple programming language, the writing of the equations remaining close to their original mathematical expression.

Other software than G.A.M.S. is of course available on the market. In particular SIMPC software makes it possible to solve a large number of simultaneous equations (up to 380,000), and also CGE models, thanks to its method of resolution of the implicit equations, if they are not written in a too complex manner. It is the SIMPC software, which has been used to work out the model designed for Lebanon, with Excel as a user interface. This model runs in DOS and can be launched directly from Excel through a macro command.

We should notice that it is also possible to work out CGE models, obviously very simplified, on EXCEL. This can be a good approach at the start, but becomes quickly unusable as soon as the model becomes more complex or disaggregated.

Once the basic macro data, trade share, and tax rates are assigned, the values on the Social Accounting Matrix (SAM) are automatically computed.

After solving the model with the SIMPC software, the results are send to different lotus files which can be read by Excel. The sheets of the workbook CGE model78.xls related to this simulation are the following ones:

- Synt \_ Ref \_ const: gathers the synthetically results of the "reference simulation" in constant prices (without shock)
- Synt \_ Ref \_ cour: gathers the synthetically results of the "reference simulation" in constant prices (without shock)
- Synt \_ Var \_ const: gathers the synthetically results of the "varying simulation" in constant prices (with shock)
- Synt \_ Var \_ cour: gathers the synthetically results of the "varying simulation" in constant prices (with shock)
- Synt \_ Ref \_ const: gathers the synthetically results of the reference simulation in constant prices (with shock)
- Synt \_ Pdif \_ const: gathers the synthetically results of the difference in percentage between the "varying simulation" and the "reference simulation" in constant prices.

## **5 THE IMPACTS ON THE ASSOCIATION AGREEMENT**

### **5.1 The suppression of all tariffs on imports in 2001**

As the effects of the Association Agreement in the presence of competition are numerous, we will be limited to the reduction of the customs tariffs or of the quantitative barriers on imports.

Lebanon's import protection represents about 16% of imports. Under the European Union Association Agreement, the tariff rates of Lebanon are assumed to be reduced to 0% before the end of 2010. To simulate the suppression of import duties, we changed in the first year, in the 7 different branches, Lebanon's import tax rates against European from their current values to zero.

#### ***5.1.1 The impact description***

Before the shock:

Lebanon import duties in 2001	
TmE1	0.07
TmE2	0.19
TmE3	0.19
TmE4	0.12
TmE5	0.10
TmE6	0.36
TmE7	0.0

After the shock:

Lebanon import duties in 2001	
TmE1	0.0
TmE2	0.0
TmE3	0.0
TmE4	0.0
TmE5	0.0
TmE6	0.0
TmE7	0.0

#### ***5.1.2 The results of the simulation***

The impacts of regional trade liberalization can be divided into four categories:

- trade creation from earnings,
- losses/gains from trade diversion,
- welfare impact,
- terms of trade effects.

The main results of the simulation have been gathered on the following table:

**Table 1: Complete import liberalization in 2001****Import Liberalization**Lebanon suppress all Tariff against EU on  
2001

Description	Base Values	Sim Results	% Change
Revenue	24482.1	23883.0	-2.45
Value added in constant prices	3370.2	3381.9	0.10
Quantity of domestic goods	34313.4	34346.1	0.35
Quantity of imported goods	13784.1	15248.3	10.62
Consumer price index	1.0	1.0	-0.05
Import expenditure	13784.1	15248.3	10.62
Domestic price of imports	1.0	1.0	0.42
Quantity of imports from EU	6616.4	8004.6	20.98
Quantity of imports from ROW	7167.8	7243.8	1.06
Revenue from production	34400.2	34420.9	0.06
Producer price	1.01	1.02	1.36
Quantity of exports	1726.5	1558.8	-9.72
Trade tax revenue (Import plus export tax)	2207.2	1217.8	-44.83
Revenue from exports	1726.5	1558.8	-9.72
Price of the composite export goods	1.0	1.0	0.00
Quantity of exports to EU	518.0	467.6	-9.72
Quantities of exports to ROW	1208.6	1091.1	-9.72

- **Impact on foreign trade**

With the import liberalization resulting from Lebanon' s tariff reduction against European partners, the fall in the price of imports from European countries increases the imports from these countries (trade creation effect) whereas this also causes consumers to substitute away from the goods supplied by the rest of the world (trade diversion effect).

- ***Imports***

Imports from European countries increase by 21 percent while imports from other trading partners increase by only 1 percent. Total imports increase by 10.6 percent.

- ***VAT compensation***

Without a parallel introduction of VAT, the removal of the taxation of imports would have as a major risk of not affecting the prices, because this country already is in a context of deflation. In fact, importers would probably take the opportunity to increase or reconstitute their margins.

On the other hand, if VAT is introduced into compensation of the loss of tax revenues on the import products, the prices and the margins should remain unchanged.

- ***Intermediary consumption***

Intermediary consumption is lowering about 3.4%. This is due to the decreasing of the production in all sectors except trade & services. But intermediary consumption is also lowering because of the diminution of the prices of imported products.

It must be stressed that the introduction of VAT for compensation of the loss in trade tariff revenues will not affect intermediary consumption. VAT is a tax, which affects only final consumption, which means that at the level of the intermediary consumption, only the profit resulting from the decreasing of import prices will be felt.

Unfortunately detailed data are missing to analyze the distribution of intermediate consumption between domestic products and imported products, but elasticity in relation to the demand of imports being very strong, the result on the demand will be very visible.

Thus we can assume that in the current Lebanon context of unemployment and overcapacity of production, the most logical decision to make the earnings resulting from the fall of the imported products profitable, will be to invest to improve the productivity of the company.

In these conditions, the impact of the Association Agreement would be all the more positive.

#### **- Exports**

The exports of Lebanon represent in 1999 10.9% of imports, i.e. 4% of GDP. In addition, exports to the European Union account for only 17.5% of the total. It is seen therefore that from the macroeconomic point of view the impact of the association agreement, even if it will also be positive, will remain very marginal.

In fact the results show a significant decrease in exports to the European Union of 9.7%, which is the same as the decrease of exports in general. This is due to the price-effect resulting from the increase in domestic prices (themselves resulting from the increase in demand).

This effect didn't take into account the introduction of VAT, which will compensate for the increase of domestic prices and the investments that will improve productivity.

Besides:

- the fall on the taxation of products imported from Europe will make Lebanese exports more competitive towards its principal Arab partners (Saudi Arabia, United Arab Emirates, Syria), which will raise the Lebanese exports to these countries.
- If, as was supposed, contractors use space for manoeuvre given by the decrease of imports to invest, the quality of their products should improve and their exports even more benefit from it.

#### **5.1.3 Impact on tax revenues of the government.**

Tax income coming from the customs revenues was considered in 1999 at approximately 2 000 billion Lebanese pounds, i.e. approximately 8% of GDP. Insofar as:

- half of imports come from the European Union,
- the average nominal tariff is identical for products coming from the European Union or from other countries,

The results of the model show that tariff dismantling resulting from the signing of the agreement will cause for the state a loss of customs revenues of 23.11% in 2001, which means approximately 3.7% of GDP.

This loss will easily be compensated by the introduction of VAT in 2001, which should bring back tax income estimated at approximately 3% of GDP as from the first year. This measure falls under modernizations of the tax policy of the state, which, by other actions intends to increase its tax income of almost 4.5% of the GDP in 5 years. These earnings will therefore distinctly compensate the loss due to the removal of the customs tariffs on the European products.

#### **5.1.4 Impact on the different sectors.**

The detailed results of the impacts on the different sectors on supply and demand are gathered in the four tables below (constant and current prices).



**Table 2a: Complete import liberalization in 2001 (detailed results in current prices): supply**

Diff. Variant/Baseline	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
<b>Current prices</b>										
<b>SUPPLY</b>										
<b>Production</b>	<b>0.06%</b>	<b>0.09%</b>	<b>0.12%</b>	<b>0.13%</b>	<b>0.15%</b>	<b>0.16%</b>	<b>0.18%</b>	<b>0.19%</b>	<b>0.20%</b>	<b>0.21%</b>
Agriculture	-0.02%	0.04%	0.10%	0.15%	0.20%	0.24%	0.28%	0.32%	0.36%	0.39%
Agro Food Ind.	-5.20%	-5.15%	-5.11%	-5.08%	-5.05%	-5.02%	-5.00%	-4.98%	-4.95%	-4.94%
Text. Ind. Leather	-14.02%	-13.99%	-13.96%	-13.93%	-13.90%	-13.87%	13.85%	-13.82%	-13.80%	-13.77%
Mineral, Metal, machines	-13.43%	-13.41%	-13.39%	-13.38%	-13.37%	-13.37%	13.36%	-13.36%	-13.35%	-13.34%
Wood, chemistry, furniture	-5.00%	-4.97%	-4.94%	-4.92%	-4.90%	-4.88%	-4.87%	-4.85%	-4.84%	-4.82%
Other Ind. and BTP	-1.19%	-1.18%	-1.18%	-1.19%	-1.19%	-1.19%	-1.19%	-1.19%	-1.19%	-1.18%
Trade & Services	5.41%	5.51%	5.59%	5.67%	5.73%	5.78%	5.83%	5.88%	5.91%	5.95%
<b>Imports</b>	<b>10.62%</b>	<b>10.68%</b>	<b>10.73%</b>	<b>10.77%</b>	<b>10.81%</b>	<b>10.84%</b>	<b>10.87%</b>	<b>10.89%</b>	<b>10.92%</b>	<b>10.94%</b>
<b>European Union</b>	<b>20.98%</b>	<b>21.07%</b>	<b>21.14%</b>	<b>21.20%</b>	<b>21.26%</b>	<b>21.30%</b>	<b>21.35%</b>	<b>21.39%</b>	<b>21.42%</b>	<b>21.46%</b>
Agriculture	10.50%	10.59%	10.67%	10.74%	10.80%	10.86%	10.91%	10.96%	11.00%	11.04%
Agro Food Ind.	23.99%	24.07%	24.14%	24.19%	24.25%	24.29%	24.34%	24.37%	24.41%	24.44%
Text. Ind. Leather	21.42%	21.49%	21.56%	21.61%	21.66%	21.70%	21.74%	21.78%	21.81%	21.85%
Mineral, Metal, machines	15.78%	15.79%	15.80%	15.80%	15.81%	15.81%	15.81%	15.81%	15.82%	15.82%
Wood, chemistry, furniture	12.39%	12.43%	12.46%	12.48%	12.50%	12.52%	12.54%	12.55%	12.57%	12.59%
Other Ind. and BTP	50.52%	50.51%	50.50%	50.49%	50.48%	50.48%	50.47%	50.47%	50.47%	50.47%
Trade & Services	3.90%	4.00%	4.09%	4.16%	4.22%	4.28%	4.33%	4.37%	4.41%	4.45%
<b>Rest of the World</b>	<b>1.06%</b>	<b>1.10%</b>	<b>1.12%</b>	<b>1.14%</b>	<b>1.16%</b>	<b>1.18%</b>	<b>1.19%</b>	<b>1.21%</b>	<b>1.22%</b>	<b>1.23%</b>
Agriculture	1.53%	1.62%	1.69%	1.75%	1.81%	1.86%	1.91%	1.95%	2.00%	2.03%
Agro Food Ind.	1.12%	1.18%	1.23%	1.28%	1.32%	1.36%	1.40%	1.43%	1.46%	1.49%
Text. Ind. Leather	-1.17%	-1.12%	-1.07%	-1.02%	-0.99%	-0.95%	-0.92%	-0.89%	-0.86%	-0.83%
Mineral, Metal, machines	0.56%	0.58%	0.58%	0.59%	0.59%	0.59%	0.59%	0.60%	0.60%	0.60%
Wood, chemistry, furniture	0.25%	0.29%	0.31%	0.34%	0.36%	0.37%	0.39%	0.40%	0.42%	0.43%
Other Ind. and BTP	4.25%	4.25%	4.24%	4.23%	4.22%	4.22%	4.22%	4.21%	4.21%	4.22%
Trade & Services	3.90%	4.00%	4.09%	4.16%	4.22%	4.28%	4.33%	4.37%	4.41%	4.45%
<b>Commercial Margin</b>										
Agriculture	0.53%	0.55%	0.57%	0.58%	0.59%	0.59%	0.60%	0.61%	0.61%	0.61%
Agro Food Ind.	6.69%	6.76%	6.82%	6.88%	6.93%	6.98%	7.03%	7.07%	7.11%	7.15%
Text. Ind. Leather	7.44%	7.53%	7.61%	7.68%	7.75%	7.80%	7.85%	7.89%	7.93%	7.96%
Mineral, Metal, machines	11.81%	11.75%	11.69%	11.63%	11.57%	11.52%	11.46%	11.41%	11.37%	11.32%
Wood, chemistry, furniture	8.70%	8.68%	8.65%	8.62%	8.59%	8.55%	8.51%	8.47%	8.43%	8.39%
Other Ind. and BTP	25.73%	25.41%	25.13%	24.88%	24.64%	24.43%	24.24%	24.05%	23.88%	23.72%
Trade & Services	9.26%	9.36%	9.45%	9.52%	9.58%	9.63%	9.67%	9.71%	9.74%	9.76%
<b>Custom duties</b>	<b>-47.13%</b>	<b>-47.11%</b>	<b>-47.10%</b>	<b>-47.08%</b>	<b>-47.07%</b>	<b>-47.07%</b>	<b>47.06%</b>	<b>-47.05%</b>	<b>-47.04%</b>	<b>-47.04%</b>

**Table 2b: Complete import liberalization in 2001 (detailed results in current prices) ; demand**

Diff. Variant/Baseline	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
<b>Current prices</b>										
<b>DEMAND</b>										
Intermediary consumption	-3.39%	-3.38%	-3.38%	-3.38%	-3.38%	-3.39%	-3.39%	-3.40%	-3.40%	-3.40%
Agriculture	-3.46%	-3.43%	-3.40%	-3.38%	-3.36%	-3.34%	-3.32%	-3.30%	-3.29%	-3.27%
Agro Food Ind.	-4.71%	-4.69%	-4.66%	-4.64%	-4.62%	-4.61%	-4.59%	-4.58%	-4.56%	-4.55%
Text. Ind. Leather	-13.37%	-13.33%	-13.30%	-13.27%	-13.24%	-13.21%	-13.18%	-13.15%	-13.13%	-13.11%
Mineral, Metal, machines	-4.44%	-4.44%	-4.45%	-4.46%	-4.48%	-4.49%	-4.50%	-4.51%	-4.52%	-4.53%
Wood, chemistry, furniture	-2.51%	-2.49%	-2.48%	-2.48%	-2.48%	-2.47%	-2.47%	-2.47%	-2.47%	-2.47%
Other Ind. and BTP	-1.77%	-1.78%	-1.79%	-1.80%	-1.82%	-1.83%	-1.84%	-1.85%	-1.86%	-1.87%
Trade & Services	-0.17%	-0.17%	-0.18%	-0.19%	-0.19%	-0.20%	-0.21%	-0.22%	-0.22%	-0.23%
<b>Final consumption</b>	<b>1.27%</b>	<b>1.32%</b>	<b>1.37%</b>	<b>1.41%</b>	<b>1.45%</b>	<b>1.48%</b>	<b>1.51%</b>	<b>1.54%</b>	<b>1.57%</b>	<b>1.59%</b>
Public	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Private	1.42%	1.48%	1.54%	1.58%	1.63%	1.66%	1.70%	1.73%	1.76%	1.79%
<b>Investment</b>	<b>7.23%</b>	<b>7.05%</b>	<b>6.89%</b>	<b>6.76%</b>	<b>6.64%</b>	<b>6.54%</b>	<b>6.46%</b>	<b>6.39%</b>	<b>6.33%</b>	<b>6.28%</b>
Agriculture	7.23%	7.05%	6.89%	6.76%	6.64%	6.54%	6.46%	6.39%	6.33%	6.28%
Agro Food Ind.	7.23%	7.05%	6.89%	6.76%	6.64%	6.54%	6.46%	6.39%	6.33%	6.28%
Text. Ind. Leather	7.23%	7.05%	6.89%	6.76%	6.64%	6.54%	6.46%	6.39%	6.33%	6.28%
Mineral, Metal, machines	7.23%	7.05%	6.89%	6.76%	6.64%	6.54%	6.46%	6.39%	6.33%	6.28%
Wood, chemistry, furniture	7.23%	7.05%	6.89%	6.76%	6.64%	6.54%	6.46%	6.39%	6.33%	6.28%
Other Ind. and BTP	7.23%	7.05%	6.89%	6.76%	6.64%	6.54%	6.46%	6.39%	6.33%	6.28%
Trade & Services	7.23%	7.05%	6.89%	6.76%	6.64%	6.54%	6.46%	6.39%	6.33%	6.28%
<b>Export</b>	<b>-9.72%</b>	<b>-9.74%</b>	<b>-9.76%</b>	<b>-9.78%</b>	<b>-9.80%</b>	<b>-9.82%</b>	<b>-9.83%</b>	<b>-9.85%</b>	<b>-9.86%</b>	<b>-9.88%</b>
<b>European Union</b>	<b>-9.72%</b>	<b>-9.74%</b>	<b>-9.76%</b>	<b>-9.78%</b>	<b>-9.80%</b>	<b>-9.82%</b>	<b>-9.83%</b>	<b>-9.85%</b>	<b>-9.86%</b>	<b>-9.88%</b>
Agriculture	-1.50%	-1.46%	-1.43%	-1.39%	-1.36%	-1.33%	-1.30%	-1.28%	-1.25%	-1.23%
Agro Food Ind.	-11.17%	-11.16%	-11.15%	-11.14%	-11.13%	-11.12%	-11.11%	-11.10%	-11.10%	-11.09%
Text. Ind. Leather	-22.73%	-22.72%	-22.71%	-22.70%	-22.68%	-22.67%	-22.66%	-22.64%	-22.63%	-22.61%
Mineral, Metal, machines	-23.65%	-23.61%	-23.59%	-23.58%	-23.57%	-23.56%	-23.55%	-23.54%	-23.53%	-23.52%
Wood, chemistry, furniture	-9.32%	-9.29%	-9.27%	-9.25%	-9.24%	-9.23%	-9.21%	-9.20%	-9.19%	-9.18%
Other Ind. and BTP	-5.99%	-5.99%	-5.98%	-5.98%	-5.99%	-5.99%	-5.99%	-5.99%	-5.99%	-5.98%
Trade & Services	7.05%	7.14%	7.21%	7.28%	7.33%	7.38%	7.42%	7.46%	7.49%	7.51%
<b>Rest of the World</b>	<b>-9.72%</b>	<b>-9.74%</b>	<b>-9.76%</b>	<b>-9.78%</b>	<b>-9.80%</b>	<b>-9.82%</b>	<b>-9.83%</b>	<b>-9.85%</b>	<b>-9.86%</b>	<b>-9.88%</b>
Agriculture	-1.50%	-1.46%	-1.43%	-1.39%	-1.36%	-1.33%	-1.30%	-1.28%	-1.25%	-1.23%
Agro Food Ind.	-11.17%	-11.16%	-11.15%	-11.14%	-11.13%	-11.12%	-11.11%	-11.10%	-11.10%	-11.09%
Text. Ind. Leather	-22.73%	-22.72%	-22.71%	-22.70%	-22.68%	-22.67%	-22.66%	-22.64%	-22.63%	-22.61%
Mineral, Metal, machines	-23.65%	-23.61%	-23.59%	-23.58%	-23.57%	-23.56%	-23.55%	-23.54%	-23.53%	-23.52%
Wood, chemistry, furniture	-9.32%	-9.29%	-9.27%	-9.25%	-9.24%	-9.23%	-9.21%	-9.20%	-9.19%	-9.18%
Other Ind. and BTP	-5.99%	-5.99%	-5.98%	-5.98%	-5.99%	-5.99%	-5.99%	-5.99%	-5.99%	-5.98%
Trade & Services	7.05%	7.14%	7.21%	7.28%	7.33%	7.38%	7.42%	7.46%	7.49%	7.51%
<b>GDP in current prices</b>	<b>-2.48%</b>	<b>-2.46%</b>	<b>-2.45%</b>	<b>-2.44%</b>	<b>-2.43%</b>	<b>-2.43%</b>	<b>-2.42%</b>	<b>-2.42%</b>	<b>-2.41%</b>	<b>-2.41%</b>

**Table 3a: Complete import liberalization in 2001 (detailed results in constant prices) ; supply**

Diff. Variant/ Baseline	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
(Constants prices)										
<b>SUPPLY</b>										
<b>Production</b>	<b>0.10%</b>	<b>0.12%</b>	<b>0.14%</b>	<b>0.16%</b>	<b>0.17%</b>	<b>0.18%</b>	<b>0.19%</b>	<b>0.20%</b>	<b>0.21%</b>	<b>0.21%</b>
Agriculture	-0.05%	0.01%	0.06%	0.11%	0.15%	0.19%	0.23%	0.27%	0.30%	0.33%
Agro Food Ind.	-5.42%	-5.39%	-5.36%	-5.33%	-5.30%	-5.28%	-5.26%	-5.24%	-5.22%	-5.20%
Text. Ind. Leather	-14.05%	-14.02%	-13.99%	-13.97%	-13.94%	-13.92%	-13.89%	-13.87%	-13.85%	-13.83%
Mineral, Metal, machines	-13.42%	-13.39%	-13.38%	-13.37%	-13.36%	-13.36%	-13.35%	-13.35%	-13.34%	-13.33%
Wood, chemistry, furniture	-5.00%	-4.98%	-4.95%	-4.93%	-4.92%	-4.90%	-4.89%	-4.87%	-4.86%	-4.85%
Other Ind. and BTP	-1.17%	-1.17%	-1.17%	-1.17%	-1.17%	-1.18%	-1.18%	-1.18%	-1.18%	-1.18%
Trade & Services	5.52%	5.62%	5.70%	5.77%	5.82%	5.88%	5.92%	5.96%	5.99%	6.02%
<b>Imports</b>	<b>10.62%</b>	<b>10.68%</b>	<b>10.73%</b>	<b>10.77%</b>	<b>10.81%</b>	<b>10.84%</b>	<b>10.87%</b>	<b>10.89%</b>	<b>10.92%</b>	<b>10.94%</b>
<b>European Union</b>	<b>20.98%</b>	<b>21.07%</b>	<b>21.14%</b>	<b>21.20%</b>	<b>21.26%</b>	<b>21.30%</b>	<b>21.35%</b>	<b>21.39%</b>	<b>21.42%</b>	<b>21.46%</b>
Agriculture	10.50%	10.59%	10.67%	10.74%	10.80%	10.86%	10.91%	10.96%	11.00%	11.04%
Agro Food Ind.	23.99%	24.07%	24.14%	24.19%	24.25%	24.29%	24.34%	24.37%	24.41%	24.44%
Text. Ind. Leather	21.42%	21.49%	21.56%	21.61%	21.66%	21.70%	21.74%	21.78%	21.81%	21.85%
Mineral, Metal, machines	15.78%	15.79%	15.80%	15.80%	15.81%	15.81%	15.81%	15.81%	15.82%	15.82%
Wood, chemistry, furniture	12.39%	12.43%	12.46%	12.48%	12.50%	12.52%	12.54%	12.55%	12.57%	12.59%
Other Ind. and BTP	50.52%	50.51%	50.50%	50.49%	50.48%	50.48%	50.47%	50.47%	50.47%	50.47%
Trade & Services	3.90%	4.00%	4.09%	4.16%	4.22%	4.28%	4.33%	4.37%	4.41%	4.45%
<b>Rest of the World</b>	<b>1.06%</b>	<b>1.10%</b>	<b>1.12%</b>	<b>1.14%</b>	<b>1.16%</b>	<b>1.18%</b>	<b>1.19%</b>	<b>1.21%</b>	<b>1.22%</b>	<b>1.23%</b>
Agriculture	1.53%	1.62%	1.69%	1.75%	1.81%	1.86%	1.91%	1.95%	2.00%	2.03%
Agro Food Ind.	1.12%	1.18%	1.23%	1.28%	1.32%	1.36%	1.40%	1.43%	1.46%	1.49%
Text. Ind. Leather	-1.17%	-1.12%	-1.07%	-1.02%	-0.99%	-0.95%	-0.92%	-0.89%	-0.86%	-0.83%
Mineral, Metal, machines	0.56%	0.58%	0.58%	0.59%	0.59%	0.59%	0.59%	0.60%	0.60%	0.60%
Wood, chemistry, furniture	0.25%	0.29%	0.31%	0.34%	0.36%	0.37%	0.39%	0.40%	0.42%	0.43%
Other Ind. and BTP	4.25%	4.25%	4.24%	4.23%	4.22%	4.22%	4.22%	4.21%	4.21%	4.22%
Trade & Services	3.90%	4.00%	4.09%	4.16%	4.22%	4.28%	4.33%	4.37%	4.41%	4.45%
<b>Commercial Margins</b>										
Agriculture	-1.04%	-1.08%	-1.11%	-1.13%	-1.16%	-1.18%	-1.20%	-1.21%	-1.23%	-1.25%
Agro Food Ind.	5.84%	5.88%	5.91%	5.95%	5.98%	6.01%	6.04%	6.07%	6.10%	6.12%
Text. Ind. Leather	6.82%	6.88%	6.94%	7.00%	7.05%	7.09%	7.13%	7.16%	7.19%	7.21%
Mineral, Metal, machines	11.20%	11.15%	11.08%	11.02%	10.95%	10.89%	10.83%	10.77%	10.72%	10.66%
Wood, chemistry, furniture	7.82%	7.79%	7.76%	7.72%	7.68%	7.63%	7.59%	7.54%	7.49%	7.44%
Other Ind. and BTP	24.90%	24.58%	24.30%	24.04%	23.81%	23.59%	23.39%	23.20%	23.03%	22.86%
Trade & Services	8.38%	8.50%	8.59%	8.67%	8.73%	8.79%	8.83%	8.87%	8.91%	8.94%
Custom duties	-47.29%	-47.31%	-47.34%	-47.37%	-47.40%	-47.42%	-47.45%	-47.48%	-47.51%	-47.53%

**Table 3b: Complete import liberalization in 2001 (detailed results in constant prices) ; demand**

Diff. Variant/ Baseline (Constants prices)	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
<b>DEMAND</b>										
<b>Intermediary</b>										
<b>consumption</b>	<b>-3.38%</b>	<b>-3.37%</b>	<b>-3.37%</b>	<b>-3.37%</b>	<b>-3.38%</b>	<b>-3.38%</b>	<b>-3.39%</b>	<b>-3.39%</b>	<b>-3.39%</b>	<b>-3.40%</b>
Agriculture	-3.96%	-3.94%	-3.93%	-3.92%	-3.90%	-3.89%	-3.88%	-3.87%	-3.86%	-3.85%
Agro Food Ind.	-5.00%	-4.99%	-4.97%	-4.96%	-4.95%	-4.94%	-4.93%	-4.92%	-4.91%	-4.90%
Text. Ind. Leather	-13.49%	-13.46%	-13.43%	-13.40%	-13.37%	-13.35%	-13.32%	-13.30%	-13.27%	-13.25%
Mineral, Metal, machines	-4.50%	-4.49%	-4.50%	-4.51%	-4.52%	-4.53%	-4.54%	-4.55%	-4.56%	-4.57%
Wood, chemistry, ffurniture	-2.62%	-2.61%	-2.60%	-2.60%	-2.59%	-2.59%	-2.59%	-2.59%	-2.59%	-2.59%
Other Ind. and BTP	-1.80%	-1.80%	-1.81%	-1.82%	-1.83%	-1.85%	-1.86%	-1.87%	-1.87%	-1.88%
Trade & Services	1.07%	1.07%	1.06%	1.05%	1.04%	1.03%	1.01%	1.00%	0.99%	0.98%
<b>Final</b>										
<b>consumption</b>	<b>1.32%</b>	<b>1.37%</b>	<b>1.41%</b>	<b>1.45%</b>	<b>1.48%</b>	<b>1.51%</b>	<b>1.54%</b>	<b>1.57%</b>	<b>1.59%</b>	<b>1.61%</b>
Public	-0.20%	-0.24%	-0.28%	-0.32%	-0.35%	-0.39%	-0.41%	-0.44%	-0.46%	-0.49%
Private	1.51%	1.57%	1.62%	1.67%	1.71%	1.75%	1.79%	1.82%	1.85%	1.88%
<b>Investment</b>	<b>7.18%</b>	<b>7.01%</b>	<b>6.86%</b>	<b>6.72%</b>	<b>6.61%</b>	<b>6.51%</b>	<b>6.43%</b>	<b>6.36%</b>	<b>6.30%</b>	<b>6.25%</b>
Agriculture	6.67%	6.47%	6.31%	6.16%	6.04%	5.93%	5.84%	5.77%	5.70%	5.65%
Agro Food Ind.	6.90%	6.71%	6.54%	6.40%	6.28%	6.17%	6.08%	6.01%	5.94%	5.89%
Text. Ind. Leather	7.08%	6.89%	6.73%	6.59%	6.47%	6.37%	6.29%	6.21%	6.15%	6.10%
Mineral, Metal, machines	7.17%	6.99%	6.84%	6.71%	6.59%	6.50%	6.41%	6.34%	6.28%	6.24%
Wood, chemistry, furniture	7.10%	6.92%	6.76%	6.63%	6.51%	6.41%	6.33%	6.26%	6.20%	6.15%
Other Ind. and BTP	7.20%	7.02%	6.87%	6.74%	6.62%	6.53%	6.44%	6.37%	6.31%	6.26%
Trade & Services	8.57%	8.38%	8.22%	8.08%	7.96%	7.86%	7.77%	7.69%	7.62%	7.57%
<b>Export</b>	<b>-9.72%</b>	<b>-9.74%</b>	<b>-9.76%</b>	<b>-9.78%</b>	<b>-9.80%</b>	<b>-9.82%</b>	<b>-9.83%</b>	<b>-9.85%</b>	<b>-9.86%</b>	<b>-9.88%</b>
<b>European Union</b>	<b>-9.72%</b>	<b>-9.74%</b>	<b>-9.76%</b>	<b>-9.78%</b>	<b>-9.80%</b>	<b>-9.82%</b>	<b>-9.83%</b>	<b>-9.85%</b>	<b>-9.86%</b>	<b>-9.88%</b>
Agriculture	-1.50%	-1.46%	-1.43%	-1.39%	-1.36%	-1.33%	-1.30%	-1.28%	-1.25%	-1.23%
Agro Food Ind.	-11.17%	-11.16%	-11.15%	-11.14%	-11.13%	-11.12%	-11.11%	-11.10%	-11.10%	-11.09%
Text. Ind. Leather	-22.73%	-22.72%	-22.71%	-22.70%	-22.68%	-22.67%	-22.66%	-22.64%	-22.63%	-22.61%
Mineral, Metal, machines	-23.65%	-23.61%	-23.59%	-23.58%	-23.57%	-23.56%	-23.55%	-23.54%	-23.53%	-23.52%
Wood, chemistry, ffurniture	-9.32%	-9.29%	-9.27%	-9.25%	-9.24%	-9.23%	-9.21%	-9.20%	-9.19%	-9.18%
Other Ind. and BTP	-5.99%	-5.99%	-5.98%	-5.98%	-5.99%	-5.99%	-5.99%	-5.99%	-5.99%	-5.98%
Trade & Services	7.05%	7.14%	7.21%	7.28%	7.33%	7.38%	7.42%	7.46%	7.49%	7.51%
<b>Rest of the World</b>	<b>-9.72%</b>	<b>-9.74%</b>	<b>-9.76%</b>	<b>-9.78%</b>	<b>-9.80%</b>	<b>-9.82%</b>	<b>-9.83%</b>	<b>-9.85%</b>	<b>-9.86%</b>	<b>-9.88%</b>
Agriculture	-1.50%	-1.46%	-1.43%	-1.39%	-1.36%	-1.33%	-1.30%	-1.28%	-1.25%	-1.23%
Agro Food Ind.	-11.17%	-11.16%	-11.15%	-11.14%	-11.13%	-11.12%	-11.11%	-11.10%	-11.10%	-11.09%
Text. Ind. Leather	-22.73%	-22.72%	-22.71%	-22.70%	-22.68%	-22.67%	-22.66%	-22.64%	-22.63%	-22.61%
Mineral, Metal, machines	-23.65%	-23.61%	-23.59%	-23.58%	-23.57%	-23.56%	-23.55%	-23.54%	-23.53%	-23.52%
Wood, chemistry, ffurniture	-9.32%	-9.29%	-9.27%	-9.25%	-9.24%	-9.23%	-9.21%	-9.20%	-9.19%	-9.18%
Other Ind. and BTP	-5.99%	-5.99%	-5.98%	-5.98%	-5.99%	-5.99%	-5.99%	-5.99%	-5.99%	-5.98%
Trade & Services	7.05%	7.14%	7.21%	7.28%	7.33%	7.38%	7.42%	7.46%	7.49%	7.51%

- Impact on production and value added

**Table 4: Complete import liberalization in 2001 (detailed results in constant prices) ; demand**

Diff. Variant/Baseline	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
(Constants prices)										
Values added	2.06%	2.12%	2.16%	2.20%	2.24%	2.27%	2.29%	2.32%	2.34%	2.36%
Agriculture	0.35%	0.42%	0.48%	0.53%	0.58%	0.63%	0.67%	0.71%	0.75%	0.78%
Agro Food Ind.	-4.32%	-4.26%	-4.20%	-4.15%	-4.10%	-4.06%	-4.02%	-3.99%	-3.96%	-3.93%
Text. Ind. Leather	13.49%	13.44%	13.40%	13.36%	13.32%	13.29%	13.26%	13.23%	13.21%	13.18%
Mineral, Metal, machines	12.89%	12.87%	12.85%	12.83%	12.82%	12.81%	12.79%	12.78%	12.77%	12.75%
Wood, chemistry, furniture	-4.18%	-4.15%	-4.12%	-4.09%	-4.07%	-4.04%	-4.02%	-4.00%	-3.98%	-3.96%
Other Ind. and BTP	-0.01%	-0.01%	-0.01%	0.00%	0.00%	0.01%	0.02%	0.03%	0.04%	0.06%
Trade & Services	5.86%	5.96%	6.04%	6.11%	6.18%	6.23%	6.28%	6.32%	6.36%	6.39%

Diff. Variant/Baseline	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
(Currents Prices)										
Values added	2.01%	2.07%	2.12%	2.16%	2.20%	2.23%	2.26%	2.29%	2.32%	2.34%
Agriculture	0.29%	0.37%	0.43%	0.49%	0.55%	0.59%	0.64%	0.68%	0.72%	0.76%
Agro Food Ind.	-4.38%	-4.30%	-4.24%	-4.19%	-4.14%	-4.09%	-4.05%	-4.02%	-3.98%	-3.95%
Text. Ind. Leather	13.54%	13.48%	13.44%	13.39%	13.36%	13.32%	13.29%	13.26%	13.23%	13.20%
Mineral, Metal, machines	12.94%	12.91%	12.89%	12.87%	12.85%	12.84%	12.82%	12.81%	12.79%	12.77%
Wood, chemistry, furniture	-4.23%	-4.19%	-4.16%	-4.13%	-4.10%	-4.08%	-4.05%	-4.03%	-4.01%	-3.99%
Other Ind. and BTP	-0.07%	-0.06%	-0.05%	-0.04%	-0.03%	-0.02%	-0.01%	0.00%	0.02%	0.03%
Trade & Services	5.80%	5.90%	5.99%	6.07%	6.14%	6.20%	6.25%	6.29%	6.33%	6.37%

This impact on value added measured at the sectoral level points out that although overall the result is generally positive there is a significant differentiation between sectors:

- Industrial sectors suffer from trade liberalization (mainly textile & leather industries and mineral metal machines)
- The impact on the agriculture sector is not significant (this is mainly due to the relatively low substitutions between domestic and imported goods and the weak increase of prices)
- commerce and services largely benefit from trade liberalization.

## **5.2 Main comments upon the results of the simulation**

In our CGE model, which assumes perfect competition, products are homogeneous but differentiated according to their origin (local or imported product) and according to their destination (local or exported product) with CES and CET aggregation functions, respectively.

### **5.2.1 The results from the demand side**

On the demand side, we have the traditional analysis. The elimination of the import duties generates a fall in import prices and a consequent reorientation of internal demand towards imported products. The extent of the impact depends on the initial level of the tariff barriers, on the importance of imports in domestic consumption and on the elasticity of substitution between local and imported products, in addition to various effects of general balance. It follows a fall in the price and in the local production level on the internal market and a reallocation of the resources towards the production of exports and of non-traded goods of which the relative prices increase. The breadth of this effect depends on the slope of the supply curve which is determined in particular by the elasticity of substitution between, on the one hand, the production for the internal market, and on the other hand, exports and non-traded goods production.

### **5.2.2 The results on the production side**

The suppression of the duties on imports can have more important effects for the local producers on the side of the production costs. Indeed, by reducing the cost of the imported and local inputs, the producers will increase their supply. On the internal market, this second effect tends to make the local product prices reduce even more, while increasing the levels of their sales. For sectors intensive in imported inputs, this supply effect can be sufficiently strong to reverse the depressive effect of the demand leading to a significant increase in local production intended for the internal market. Given the importance of imported intermediate consumption in Lebanon, this effect of expansion of commercial liberalization deserves close attention.

### **5.2.3 The allocation of the resources**

In the traditional CGE model, a lowering of the trade barriers usually leads to a reduction in prices in the protected sectors relative to prices in the less protected sectors. These changes in relative prices cause reallocation of the resources of the sectors before relatively protected towards the less protected sectors.

### **5.2.4 The commercial trade**

In the same way, the liberalization of trade encourages the opening of the economy by increasing the relative prices of the exportable goods in comparison with those of the substitutes for the imported goods.

Finally, certain results are explained by strong dependence of a sector in relation to another either as a principal input supplier or as a principal consumer. For instance, the farm inputs represent the most important share of the production costs of the agro-food industries and, consequently, the farm price trend will largely determine the price of the agro-food industries.

## **5.3 The results of the Agreement not analyzed by the model**

### **5.3.1 The monopoly situation**

The model assumes perfect competition between the different producers, but imperfect competition is also present in Lebanon. The barriers at the entry of new competitors, foreigners and locals, on the local market prevent real competition inside the country<sup>2</sup>. Besides, the instruments of commercial policy, are particularly marked: high customs duties, quantitative restrictions, absence of regulation mechanisms, heavy administration procedures, difficulties of granting user licences, underdeveloped capital market, etc. etc.

One can therefore expect that signature of the Association Agreement will reduce the power of the local producers' market, which could modify considerably the predictions regarding the consequences of this agreement. Moreover, in Lebanon, small importance of the local market encourages the concentration of the important companies in the hands of a minority, which is likely to encourage collusion.

At the theoretical level, the introduction of imperfect competition can modify in a radical way and even reverse the forecasts of the traditional analysis of commercial policy. However, if the firms of the protected sectors work under conditions of imperfect competition, that could modify these conclusions. This is particularly the case in Lebanon where the trade barriers are an important source of the power of the local producers' market.

Thus, the suppression of tariffs on European imports could lead to an expansion of protected sectors, a contraction of the non-protected sectors and of the losses of well being, contrary to traditional analysis.

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<sup>2</sup> Martin estimated that the hidden cost upon imports were more important than the duties themselves (draft: 1996)

Since these two effects come into play in opposite directions, it is impossible to say a priori if the "monopolist" will increase or decrease his production. Another question, which must be raised in the present "zero inflation" situation in Lebanon, is whether this effect can meet an increase in demand.

Let us note that it is still true that the sectors before relatively protected will have to bear increased competition on the part of imports. However, since imperfect competition is generally associated with the highly protected sectors, the manufacturing sector in particular, the pro-competitive effect will be also felt more strongly. In theory, this second effect can be rather powerful so that the strongly protected sectors experience an expansion following commercial liberalization while the less protected sectors contract.

With regard to the sectors with perfect competition, the fall in the domestic prices in the branches with imperfect competition reduce the demand for the products of the other sectors. However, for this demand must be added, on the one hand, the effect of the reduction of the costs of the inputs coming from the sectors with imperfect competition, and on the other hand, the increased demand coming from these sectors for the products on the other branches.

Thus, for instance, the agro-food product prices could therefore increase (making then internal demand decrease) in view of the increase in the agricultural product prices: the expansion of the latter results in an increase in demand, and therefore the price and finally the level of production of the mining industries.

On the assumption that the local products would be imperfectly substitutable to the imported products (hypothesis of Armington), the lowering of the trade barriers has then two principal effects, a demand-effect and a supply-effect. First of all, there is the traditional effect of reduction in the demand of the local product given the reduction of the imported substitute product price. This effect will make local production decrease. However in imperfect competition, a second effect will be added to it. Facing increased foreign competition, the monopolist undergoes a fall of his market power, which leads to a fall in the margin rate and in his monopoly price and a rise in his sales on the internal market (pro-competitive effect).

Imperfect competition can modify the impact of the association agreement. For the majority of the sectors with imperfect competition, the impact is such as envisaged by the theory. They react to the reduction of their power on local market by adopting low prices and higher production levels on the internal market in relation to simulation in perfect competition. On the other hand the pro-competitive effect can appear particularly strong in the various industries such as the textile branch. In addition, the reduction of the prices on the internal market in these sectors make the relative export prices increase, which encourages them to increase also the level of their export. Thus, at constant trade balance, the increase in exports will also be used to finance an import rise.

Regarding the effects on welfare, the introduction of imperfect competition has much more important effects, leading to a tripling of the earnings in the case of a high hypothesis on the extent of imperfect competition. This result shows that imperfect competition generates significant losses of effectiveness, which reabsorb partially when the local producers are exposed to competing imports. At these earnings those more modest are added, coming from the use of economies of scale. Thus, the argument for the liberalization of trade in Lebanon is strengthened.

### **5.3.2 The scale of level of production**

It would be necessary to wonder whether the scale of levels of production is really constant in Lebanon, as it was the hypothesis of the model. In fact, several characteristics of Lebanon indicate that there are unexploited economies of scale. First of all, the imperfect competition itself encourages the local producers to restrict their production to sub-optimal levels. Moreover, in a considerable number of activities, which are protected of foreign competition, in particular the manufacturing activities, the size of the internal market is too small to make it possible for the local producers to reach an efficient production scale. Nevertheless, it would be the case, given the consequent under-utilisation of local production capacity, the efficiency gains which would result from an increase in the local production scale would be all the more important.

### **5.3.3 The foreign trade**

At the level of foreign trade, the adjustment of the balance of payments can occur through a mechanism of rationing imports, which can cover directly the permitted quantities or be exerted through the prices. In the latter case, it is advisable to identify well those which perceive the revenue generated by the situation of rationing, or virtual monopoly, as it is the case in Lebanon. One of the principal concerns of an E.G.C model built for Lebanon would be to seek to represent the behaviour of "search for revenue"

("rent seeking") of the importers, and to measure the waste of the resources which results from it, as well as the loss of efficiency for the economy.

The distortions created by the presence of a highly overvalued official exchange rate, that is essentially irrelevant for trade transactions, have not been calculated (the data would have been modified to take into account that specific feature). What is clear is that, the positive results given by the model will be underestimated in comparison with an exchange rate reflecting more the real situation of the Lebanese economy.

## **6 THE IMPROVEMENTS OF THE CGE MODEL**

In order to better describe the reality of the Lebanese economy, the CGE model that we built and just described will have to be improved both at the level of the SAM and at the level of the model itself.

After having described the extensions which can be brought to the social accounting matrix, we will briefly mention the improvements which can be brought to the model, of which we will mention only the most interesting ones which can improve the analysis of the impact of the association agreement: imperfect competition, inter-temporal dynamics and the introduction of the monetary and financial assets.

### **6.1 Development of a SAM at the previous year prices**

Presently, the ACS in current prices provides the data appearing in the Input-Output table. To be able to put inflation in obviousness, it is necessary also to produce an Input-Output table at the previous year prices, as the data have to be calculated also in constant prices.

### **6.2 Construction of a more elaborated SAM**

The Input-Output tables provided by the Central Administration of Statistics are at the same time incomplete and not very reliable, so that the first task which will be necessary to focus on for the development of the SAM (Social Accounting Matrix) will be to reinforce the reliability of the Input-Output Table.

It will be necessary, before any construction of a CGE model that the Social Accounting Matrix and the Input-Output table, built up by the ACS for the years 1994 to 1998, were completed.

The first task will be to consider the missing data of the table on employment-resource provided by the ACS, in particular at the level of trade and services (the exports of which should not be pointless).

The second task to be carried out will consist in including the additional variables that could be introduced to allow refinement of the impact analysis. Once the SAM would have been extended, the model could be more disaggregated and be improved in order to reproduce the values of the SAM of the basic year (1998).

This representation could be extended to detailed classifications of the production factors and of the accounts of the institutional sectors. For example, it would be possible to divide the households according to their income level as well as to demonstrate homogeneous target groups (rich or poor, urban or rural) or to distinguish the firms according to their dimension (public-sector or private, financial or not financial companies, etc.).

This fine decomposition has been started in our example, but that would be obviously necessary go further in that direction, to make a detailed socio-economic study of the impact of the Association Agreement with the European Union.

The proposed recommendations for the future decomposition of the SAM are the following:

- **Sectors**

It would be advised to use decomposition in 15 branches according to the following classification:

- Food agriculture
- Export agriculture
- Livestock-farming
- Agro-food industry
- Textile industry



- Non-metallic Mineral.
- Metals, machines
- Chemistry, wood
- Furniture
- Other industries
- Construction
- Transport and communication.
- Trade
- Other commercial services
- Non-commercial services.

- **Agents**

In the event of introduction of the financial assets, (which is strongly recommended for the analysis of the Lebanese economy in which the financial sector is leading) banks should be introduced as a new agent.

It would also be desirable, in order to allow the introduction of imperfect competition, to differentiate the companies between competitive and non-competitive ones (or between protected sector and non protected sector).

We would have therefore the following decomposition:

- Households,
- Competitive firms,
- Non competitive firms,
- Importers & wholesalers,
- State,
- Banks,
- European Union,
- Rest of the World.

### **6.3 Variables of the model:**

#### **6.3.1 The Input-Output table**

In the model that was worked out, for each one of these sectors, imported intermediate consumption was not differentiated according to its origin. To allow for an analysis of substitution between the local products and the imported products, it would be necessary to distinguish between intermediate consumption in local products and intermediate consumption in imported products.

It will be advisable therefore to calculate for each sector:

- intermediate consumption technical coefficients in local products
- intermediate consumption technical coefficients in imported products;

#### **6.3.2 Taxes and margins:**

The taxes on production have already been included into the Social Accounting Matrix and the equations of the model. Thus more detailed simulations with VAT (Value Added Tax) can be realised with the model without any major modification.

On the other hand, the margins should be decomposed on local products and imported products, between transport margins and commercial margins.

#### **6.3.3 The final and intermediary consumption**

Presently, the model only considers of the consumption of products through the different sectors of the economy. It would be necessary to go further in the desegregation by:

- differentiating the final and intermediary consumption between local and imported products:
- differentiating the consumption between commercial consumption and non-commercial consumption (self-consumption or informal consumption).

### **6.3.4 The stocks**

Stocks are not considered in the matrix produced by the ACS. They should be outlined into the new SAM.

## **6.4 The complementary block of the current year;**

- Employees' remuneration;
- Social security contributions;
- Taxes and duties;
- Wages;
- Transfers;
- Subsidies;
- Production rate;
- Production coefficient at factor costs for the services.

All these variables are already available.

## **6.5 Improvements of the model**

### ***6.5.1 Imperfect competition***

For the modelling of imperfect competition, it will be advised to refer to the work carried out by COCKBURN, DECALUWE, and DOSTIE for their studies on Tunisia making it possible to analyse the impact of commercial liberalisation supplements in Tunisia by using three alternatives of the model: perfect competition and constant output; imperfect competition and constant output; imperfect competition and increasing output<sup>3</sup>. Thus, while models with perfect competition show a contraction of the protected sector (generally manufacturer) and an expansion of the less protected sector (generally agricultural sector) connected with the modification of the relative prices, the models with imperfect competition conclude, on the other hand, to an expansion of the manufacturing sector. This result derives from the behaviour of the firms of the manufacturing sector. In consequence of the erosion of their monopoly power, that the rise in the price-elasticity of their demand reflects, they reduce their margins and increase the volume of their production.

Thus, it would be particularly interesting to carry out a more thorough analysis to know if the manufacturing sector of Lebanon would behave in the same way. However, one can already point out that in view of the weakness of the domestic demand in Lebanon, the additional outlets can be only on export.

Moreover, the ambiguous effects of commercial liberalization measures at the level of the allocation of the resources were illustrated in several CGE model. Devarajan and Rodrik (1991) carried out comparisons regarding the reallocation of the resources resulting from commercial liberalisation in the Cameroon under three different scenarios: perfect competition, Cournot oligopoly with and without economies of scale. The results of simulations showed an expansion of the manufacturing sector to the detriment of the agricultural sector while the opposite occurred in simulations in perfect competition.

The introduction of the economies of scale in the sectors with imperfect competition comes for its part only to strengthen this new reallocation of the resources.

### ***6.5.2 Behavioral rigidities***

In order to transcribe better the economic reality of the developing countries, a number of models introduce the possibility of adjustment of the markets by the quantities: for example, on the market of the goods, prices can be fixed by a mark-up rule and the adjustment can occur by the variation of the utilization rate of production capacities; on the labor market, the nominal wages can be fixed, or even partially indexed on the price growth rate and (or) on the unemployment rate (Phillips effect). In this case, the effective demand for work can differ from the notional demand (neoclassic) and cause unemployment. These approaches, are closer to economic reality observed in these countries, and could be introduced into the model which has been built for Lebanon.

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<sup>3</sup> " COCKBURN, DECALUWE, and DOSTIE : the lessons of the marriage between the calculable general balance models and the new theory of international trade: application to Tunisia "

The introduction of rigidities into behaviour (partial adjustment of the nominal wage on the price index, fixing of the exchange rate etc) makes it possible to play on the intensity of the links between the general level of the prices and the real sector of the economy. For example, if the nominal wage is rigid, any increase in the general level of the prices will have a strong effect on the level of employment. At the opposite, if the exchange rate and the wages became flexible, the real sector of the economy will be little affected by the variations of the general level of the prices (this is the case in the model that we built, where the general index of the prices was made endogenous, but where the level of wage adjusting oneself by the equilibrium between supply and work demand, which is exogenous).

### **6.5.3 *Inter temporal dynamics***

The CGE models, which are worked out in the developing countries, are generally static models. Simulations are made in comparative static, i.e. the results are compared in relation to a situation of reference, supposed to represent the behaviour of the economy in the absence of shock. The analysis does not allow obviously to treat the process of adjustment and cost which results from this shock, since it supposes implicitly that, on the studied period, all the modifications generated by the initial shock take effect immediately.

The dynamic models can mitigate these disadvantages while making it possible to take into account the periods of adjustment of the economy. However, the dynamics of the CGE models remains rather worn. It corresponds in fact to a juxtaposition of temporary balances, where the behaviour of the current period depends only on last periods. In this case, agents have a "myopic" behaviour; in other words, they use no information on the future of the economy to take their present decisions. In the models of this type, the link between the periods is established through the stock variations (financial capital and assets), population or exogenous change flows (technical progress, population etc).

The most recent work endeavours to improve the dynamic aspect of the CGE models, while bringing real inter temporal behaviour. Contrary to the simple dynamic models, these models try to incorporate behaviour "on the future", i.e. agents maximise objective functions on an inter temporal horizon.

The intra-temporal behaviour of the firms and the households then corresponds to those generally retained in the static models. At the level of the firms, the production of the composite good is shared between the internal market and exports according to a function of C.E.T type. The distribution of the total expenditure of the households' consumption between the various goods sold on the market occurs in two steps: on the one hand, they decide on the allocation of total consumption between the categories of goods produced by the various branches of the economy; on the other hand, they "decide" for each category of goods, the relative share of the goods produced locally and imported.

The resolution of the models with inter temporal behaviour is naturally more difficult than the one of the static models with simple dynamics. Their solution requires to define a stationary or a balanced growth state, from which one defines the pathway of the economy. Nevertheless, within the framework of the analysis of the impact of the association agreement, it will be a real improvement to introduce dynamic behaviour into the model. The investment, a key variable, is moreover itself an inter-temporal variable (difference between capital stocks in  $t$  and  $t+1$ ). Expectation behaviour (of the profits or of the costs), of the producers should therefore be introduced into the model by modelling the fact that agents maximise their objective function.

### **6.5.4 *The financial assets***

The CGE traditional models remain above all instruments of multi sectoral analysis centred on the analysis of the industrial strategies, protection and commercial policy.

Within the framework of our analysis, to enable at the same time both sectoral and macroeconomic approaches, it will be necessary to introduce financial assets for a better comprehension of the macroeconomic and financial consequences of the Association Agreement.

Thus, it would be recommended to associate, with the real part of the CGE models, an accounting block for monetary and financial flows enabling to determine the general level of the prices and the interest rate.

The integration of the financial assets will make it possible to formalise jointly a saving (or consumption) function and an investment function. In this case, for a given general level of prices, the ex post adjustment between the level of the saving and the level of investment occurs through the variations of the interest rate (IS-LM structure).

In the second place, the introduction of the monetary block makes it possible to make endogenous the general level of the prices, which serves as a "numéraire" to the model. It can be determined simply by the adjustment between supply and demand of currency, the latter being represented by a function as a neoclassic type. According to this specification, any variation of the offer of currency affects the general level of the prices appreciably but the effect on the real sector of the economy depends, in last resort, on the degree of homogeneity of the economy.

Therefore, the introduction of the currency and of the non monetary financial assets will make it possible to widen the scope of the CGE model to the field of the macroeconomic analysis. It will enable to give recommendations for a stabilisation policy which will use the instruments of the monetary policy (interest rates, rediscount ceilings, control of the advances of the central Bank to the state, auditing of the arrears of the state, etc.), which certain variables as the interest rates or the bank loans to the private sector are determining in the specific context of the Lebanese economy.

The introduction of financial assets will also modify the process of allocation of the households' portfolio. One of the most current modelling is to consider that, initially, households decide on the amount of their saving which depends at the same time on their nominal income (Y) and on their wealth, then secondly, they decide on the allocation of their wealth between the various assets according to a desegregation function.

This enlargement of the model to financial assets poses nevertheless consistency problems between flows and stocks insofar as the evaluation prices are different and where it is necessary to take into account the re-evaluations of the value of stocks. The construction of such Social Accounting Matrices is rather difficult and poses serious consistency problems between data extracted from real national accounts and the financial data that comes from other sources, in particular from the Bank of Lebanon.

In view of the very individual economic situation that prevails in Lebanon (overvaluation of the Lebanese pound in relation to the dollar, important debt rate, deflation), this analysis should be led very thoroughly in order to model correctly the equations of the agents' behaviour.

#### **6.5.5 Private investment function**

The construction of our CGE model was based on the traditional CGE models, which focus on the sectoral allocation of investment, and use the neoclassic closure to determine overall investment (investment = saving).

At the request of investment corresponds a need for financing of the firms which is, in general, ensured by self-financing and (or) by a call to the internal and external loans. The arbitration of the firms between these two types of loans is specified according to their respective costs.

To enhance the capacities of analysing the behaviour of the producers, it would be proposed to define an explicit function for private investment, since it will be a key variable in a context of introducing more competition of the economy. Therefore, it will be necessary to carry out more investigations on the identified sectors.

Besides, it will be advisable to well identify if, after the signature of the agreement association, there is a source of external financing to which the companies will be able to have recourse. It was already identified that companies can have access to the internal market, but that involved segmented credit, leading to a rationing credit situation for the companies.

With the extended model, arbitration between internal loans and external loans would be calculated by derivation of maximisation behaviour of the firms, as it was the case for the households.

As we know that the interest rates are quite different in relation with the type of expense, it would be necessary to introduce into the model a distinction between the demand for short-term credit of the companies and the demand for long-term credit for financing purposes.

## **7 RECOMMENDATIONS**

The impact on the Lebanese economy of an Association Agreement will be consequently particularly limited compared to the other Mediterranean countries.

When the key figures of the Lebanese economy are analysed over the last three years (1997, 1998, 1999) one notices that the cover rate of exports in relation to imports, even if it remains weak, is in regular progression (8.6% in 1997, 10.1% in 1998, 10.9% in 1999).

A better cover rate of exports in relation to imports will enable Lebanon to reduce the capital flows, which reduce the deficit of its balance of payments mainly owing to the overvaluation of the Lebanese pound and owing to the very high real interest rates, which increases the debt of the state.

It is also important to note that even independently of the Association Agreement signature, the government policy is in fact more or less obliged to follow the same direction, i.e. to reduce barriers on imports for many reasons:

- in a context of economic stagnation it will be extremely difficult for the government to introduce VAT without compensation at the level of the customs tariffs.
- besides it is well known that the taxation of the imported products, from where they come, generally cause a counterpart of the countries concerned, who limits the trade flows and generally slows down economic development.
- the world liberalization environment which increases competition, the association agreements that Lebanon has with the other Mediterranean countries, or the WTO push for the same logic of reducing tariffs on imports.

Therefore, the fall in the taxation of the imported products is part of a dynamic logic from which Lebanon will be hardly able to escape.

On the other hand, it will be quite important for the government, at least in the beginning, to keep revenues from a certain number of highly taxed commodities, by moving them to an excise tax regime when they are not, rather than excluding them from the tariff liberalization exercise (petrol, alcohol, tobacco, perfumes, jewelry, luxury cars, etc.).

## **8 CONCLUSION**

This study has examined the implications of the Association Agreement with the European Union. Lebanon sources about 48 percent of its imports from European Union, and 30% of its exports are directed to European markets. These figures imply that Lebanon could find interest in participating in European Association Agreement, since Lebanon can expect a relatively substantial gain from an improved access to European markets.

We developed a simple quantitative model of the Lebanon economy to help assess the implications of the participation in the European Agreement Association for Lebanon. The model had relatively limited data requirements, but was nevertheless sufficient to analyze at a sectoral level the implications of trade creation, trade diversion, and market access that this agreement would involve. Quantitatively, two simulations were made:

- the first one made the hypothesis of a suppression of all the trade barriers against European Union in year 2001,
- the second one simulated a progressive tariff dismantling from 2001 until 2010.

On the import side, the quantitative results of the model showed that this liberalization policy generated relatively significant gains in revenues for the households (4%) and the enterprises (1%) from trade creation, as lower prices of imports means less expensive intermediary consumption goods for the enterprises and final goods for the households. This trade diversion also results in a significant net loss of tariff revenues (-23%). There are both gains and losses on the export side from sectoral viewpoints, but as a whole there is a slight decrease of exports to the European markets.

A result to which has not been sufficiently taken into account by the model and deserve close attention are two sides of commercial liberalization on the production costs and the structure of demand for intermediate consumption.

- As regards the production costs, even the sectors protected by a strong taxation of competing imports can appear themselves as the large winners of liberalization owing to the even more important impact on the cost of their inputs. Whereas the reduction of the import charges affects partially the prices of the products of the sector (being given their imperfect substitutability), it affects entirely the prices of its imported inputs (and partially on the prices of its local inputs), inputs that come often for the most part from the sector itself. This mechanism is nothing else than the old concept of effective protection in a context of imperfect substitutability between imported and local products and of strong intra-sector intermediate consumption.
- Moreover, we noted that commercial liberalization has a strong impact on the sectors of which the domestic demand is composed mainly by intermediate consumption. The impacts of the

Association Agreement on the sector depends then on the development, favourable or not, of the downstream sectors.

Concerning static welfare gains, they are relatively high for the households (about 1100 Billions of L£), per year, small in overall for the enterprises (9.1 billions of L£) and the losses are about 1000 Billions of L£ for the government. But as it was previously said the greatest benefit will certainly arise from an increase in exports of services and other non quantitatively measurable facts, which will help Lebanon increase its integration with the world economy, and by the same token to achieve sustained higher growth rates. Besides, due to the fact that tariff barriers are not the only obstacles to the trade liberalization in Lebanon the decrease of intermediary consumption goods will be probably much higher than measured by the model.

A second interesting fact given by our dynamic CGE model is that the gains also tend to increase every year. Clearly, these results suggest that there is a strong case for using the European Association Agreement as an initial step on the road to a broader liberalization package.

Both types of simulations cause reductions in tariff revenues, with the first simulation reducing overall revenues from retained imports by more than 45 percent in 2001, and the second one showing a progressive reduction of revenues from imports from 3.5% in 2001 to 45% in 2010. Clearly, replacing these revenues by the introduction of Value Added Tax will be an important issue.

The complementary analysis should be carried out to supplement the results of our model. They act in no point as real predictions regarding amplitude of the effects of the association agreement. The object of this analysis was initially to assess within an applied framework the discussed ambiguous impact.

Indeed, the major positive effects of the Association Agreement will focus on the service sector, but this will not be sufficiently taken into account by the model that has been developed during this mission.

In view of this complementary analysis, one can conclude that the welfare effects are likely to be much higher than anticipated in the CGE model, as the main positive impacts of the Association Agreement have not been quantified.

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## ANNEX: Equations of the CGE model in TSP syntax

### Equations

The model equations are written in TSP syntax, which can be understood by TSP, SIMPC and Eviews econometrics software.

EGC REAL MODEL OF LEBANON TO SEVEN SECTORS AND SIX AGENTS IN OPEN ECONOMY

[ i=1,2,3,4,5,6,7\j=1,2,3,4,5,6,]

#### • BRANCHES\PRODUCTS

- 1 AGRICULTURE
- 2 AGRI FOOD INDUSTRIES
- 3 INDUSTRIES TEXTILE, LEATHER
- 4 ORES, METALS, MACHINES
- 5 WOOD, CHEMISTRY, FURNITURE
- 6 OTHER INDUSTRY AND BTP
- 7 TRADE & SERVICES

#### • LABEL OF THE PARAMETERS

A(i)	SCALE COEFFICIENT
AL(i)	SHARE OF WAGES IN THE VALUE ADDED
BEC(i)	HOUSEHOLD CONSUMPTION DISTRIBUTION
BEG(i)	PUBLIC CONSUMPTION DISTRIBUTION
BEI(i)	REPARTITION TOTAL INVESTMENT
LEMPDAK	SHARES OF THE INCOME OF THE CAPITAL PAID TO THE HOUSEHOLDS
A(I,j)	TECHNICAL COEFFICIENTS FOR INTERMEDIATE CONSUMPTION
TYM	TAX RATE OF THE HOUSEHOLDS INCOME
TX(i)	INDIRECT TAX RATE
TRK	TAX RATE OF THE COMPANIES INCOME FROM CAPITAL
PMS	MARGINAL PROPENSITY OF SAVING
sY(i)	SUBST ELASTICITY. EXPORT PRODUCTS/ DOMEST. PRODUCTS
sIM(i)	SUBST ELASTICITY IMPORT PRODUCTS/ DOMEST. PRODUCTS
sIES(i)	SUBST ELASTICITY BETWEEN EXPORTED PRODUCTS
sIMS(i)	SUBST ELASTICITY BETWEEN IMPORTED PRODUCTS
TX(i)	TAXATION RATES ON THE VALUE ADDED
ALME(i)	SHARE OF THE PRODUCTS OF THE EUROPEAN UNION IN THE IMPORTS
ALMR(i)	SHARE THE PRODUCTS OF THE REST OF THE WORLD IN THE IMPORTS
ALXE(i)	SHARE THE PRODUCTS OF THE EUROPEAN UNION IN THE EXPORTS
ALXR(i)	SHARE FROM THE PRODUCTS OF THE REST OF THE WORLD IN THE EXPORTS
TMED(i)	VAR. IN % OF THE TAXATION RATE OF THE IMPORTS OF THE EUROPEAN UNION
TMR(i)	TAXATION RATES ON EXPORTS OF THE EUROPEAN UNION
TEE(i)	TAXATION RATES ON EXPORTS OF THE EUROPEAN UNIO7N
TER(i)	TAXATION RATES ON EXPORTS OF THE REST OF THE WORLD
Ph(i)	INTERMEDIATE COEFF.
Ga(i)	INTERMEDIATE COEFF.
BX(i)	INTERMEDIATE COEFF.
BM(i)	INTERMEDIATE COEFF.
Rh(i)	INTERMEDIATE COEFF.
Et(i)	INTERMEDIATE COEFF.
TMC(i)	COMMERCIAL MARGIN RATES

#### • LABEL OF THE VARIABLES

XSO(I)	VOLUME OF PRODUCTION BY SECTORS - CONSTANT PRICES
XSU(I)	VOLUME OF PRODUCTION BY SECTORS - CURRENT PRICES



LD(I)	DEMAND OF JOBS BY SECTORS
LG	DEMAND OF JOBS BY THE PUBLIC SECTOR
LS	TOTAL SUPPLY OF JOBS
KO(I)	STOCK OF CAPITAL IN VOLUME
PVA(I)	PRICE TO THE VALUE ADDED
PQ(I)	PRICE OF THE PRODUCTION GOODS BY SECTORS
PC(I)	PRICE OF THE CONSUMPTION GOODS
PC	AVERAGE CONSUMPTION PRICE
W	RATE OF AVERAGE SALARY
WG	RATE OF SALARY IN THE PUBLIC SECTOR
IO(I)	VOLUME OF INVESTMENT BY ORIGIN
IU(I)	INVESTMENT IN VALUE BY ORIGIN
TGE	PUBLIC TRANSFERS TO THE COMPANIES
YM	HOUSEHOLDS INCOME
YDM	DISPOSABLE INCOME OF THE HOUSEHOLDS
YG	INCOME OF THE STATE
YE	INCOME OF THE COMPANIES
SMO	HOUSEHOLDS SAVING IN VOLUME
SGO	PUBLIC SAVING IN VOLUME
SEO	FIRMS SAVING IN VOLUME
SMU	HOUSEHOLDS SAVING IN VALUE
SGU	PUBLIC SAVING IN VALUE
SEU	FIRMS SAVING IN VALUE
RK(I)	INCOME OF THE CAPITAL BY SECTORS
RKM	INCOME OF THE CAPITAL FOR THE HOUSEHOLDS
TAXYM	INCOME TAX OF THE HOUSEHOLDS
TAXRK	TAX ON THE COMPANIES
TAXX(I)	INDIRECT TAX
CMU	TOTAL CONSUMPTION OF HOUSEHOLDS IN VALUE
CGU	PUBLIC CONSUMPTION IN VALUE
CMO	TOTAL CONSUMPTION DES HOUSEHOLDS IN VOLUME
CGO	PUBLIC CONSUMPTION IN VOLUME
CO(I)	TOTAL CONSUMPTION OF GOODS (I) IN VOLUME
CU(I)	TOTAL CONSUMPTION OF GOODS (I) IN VALUE
DIO(I)	INTERMEDIATE REQUESTS FOR GOODS (I) IN VOLUME
CIO(I)	INTERMEDIARIES CONSUMPTION OF GOODS (I) IN VOLUME
DIU(I)	INTERMEDIATE REQUESTS FOR GOODS (I) IN VALUE
CIU(I)	CONSUMPTION INTERMEDIATE OF GOODS (I) IN VALUE

#### REAL CGE MODEL FOR LEBANON OF SEPT SECTEURS IN OPEN ECONOMY

##### PARAM

[i=1,2,3,4,5,6,7\[j=1,2,3,4,5,6,7]  
A[i,j]!

[i=1,2,3,4,5,6,7]  
SIE[i] SiM[i] SiEs[i] SiMs[i] TX[i] Al[i] A[i]  
BeC[i] BeG[i] BeI[i] TMR[i] TEE[i] TER[i] Ph[i] Ga[i]  
BX[i] BM[i] Rh[i] Et[i] tmc[i] Alme[i] Almr[i] Alxe[i] Alxr[i] !

LeK PMS TYM TRK !

##### PRODUCTION-EMPLOYMENT-SALARY

[i=1,2,3,4,5,6,7]  
Supply of products - constant prices  
FRML XSO[i] XSO[i] = A[i]\*LD[i]\*\*Al[i]\*KO[i]\*\*(1-Al[i]);

Demand of labor  
FRML LD[i] LD[i] = (PVA[i]/W)\*Al[i]\*XSO[i];

Rates of salary

IDENT W W = W + LS - ( $\sum_{j=1,2,3,4,5,6,7} LD_{<j>} + LG$ );

#### REVENUE-SAVING

[i=1,2,3,4,5,6,7]

Wages paid by the companies

IDENT SAL[i] SAL[i] = W\*LD[i];

Total of wages

IDENT SAL SAL =  $\sum_{j=1,2,3,4,5,6,7} SAL_{<j>}$ ;

Income of the capital for the households

FRML RKM RKM = LeK\*( $\sum_{j=1,2,3,4,5,6,7} RK_{<j>}$ );

Households' income

FRML YM YM = SAL+RKM+SALG+(TEM+TRM);

Disposable income of the households

FRML YDM YDM = YM\*(1-TYM);

[i=1,2,3,4,5,6,7]

Income of the capital for each company

FRML RK[i] RK[i] = PVA[i]\*XSO[i]-W\*LD[i];

Total income of the capital for the enterprises

FRML RKE RKE = (1-LeK)\*( $\sum_{j=1,2,3,4,5,6,7} RK_{<j>}$ );

Total income of the companies

FRML YE YE = RKE+TGE;!

Income of the government - current prices

FRML YGU YGU = TaxYM+TaxRK+( $\sum_{j=1,2,3,4,5,6,7} TaxX_{<j>} + TAXMU_{<j>}$ )+TEG+TRG;!

Income of the government - current prices

FRML YGO YGO = TaxYM/PC+TaxRK/PC+( $\sum_{j=1,2,3,4,5,6,7} TaxX_{<j>}/PC + TAXMO_{<j>}$ )  
+TEG/PC+TRG/PC;

[i=1,2,3,4,5,6,7]

Taxation of the production of the companies

FRML TaxX[i] TaxX[i] = TX[i]\*XXSU[i];

Taxes on households' incomes

FRML TaxYM TaxYM = TYM\*YM;

Taxation of the income of the capital

FRML TaxRK TaxRK = TRK\*( $\sum_{j=1,2,3,4,5,6,7} RK_{<j>}$ );

[i=1,2,3,4,5,6,7]

Taxation of the imports of the European Union - current prices

FRML TaxMEU[i] TaxMEU[i] = TME[i]\*MEU[i];

Taxation of the imports of the Rest of the World - current prices

FRML TaxMRU[i] TaxMRU[i] = TMR[i]\*MRU[i];

Taxation of imports (total) - current prices

FRML TaxMU[i] TaxMU[i] = TaxMEU[i]+TaxMRU[i];

Taxation of the imports of the European Union - constant prices

FRML TaxMEO[i] TaxMEO[i] = TaxMEU[i]/PWM[i];

Taxation of the imports of the Rest of the World - constant prices

FRML TaxMRO[i] TaxMRO[i] = TaxMRU[i]/PWM[i];

Taxation of imports (total) - constant prices

FRML TaxMO[i] TaxMO[i] = TaxMEO[i]+TaxMRO[i];

Households' saving

FRML SMU SMU = PMS\*YDM;

Saving of the companies

FRML SEU SEU = YE-TaxRK;

Government's saving

FRML SGU SGU = YGU-SALG-TGE-CGU;

Total investment

FRML IU IU = SEU+SMU+SGU+FFU;

#### DEMAND

Consumption of the households (total)

FRML CMU CMU = YDM-SMU;

[i=1,2,3,4,5,6,7]

Households' consumption (by products) - current prices

FRML CMU[i] CMU[i] = BeC[i]\*CMU;

Households' consumption (by products) - constant prices

FRML CMO[i] CMO[i] = CMU[i]/PC[i];

[i=1,2,3,4,5,6,7]

Government's consumption (by products) - current prices

FRML CGU[i] CGU[i] = BeG[i]\*CGU;

Government's consumption (by products) - constant prices

FRML CGO[i] CGO[i] = CGU[i]/PC[i];

[i=1,2,3,4,5,6,7]

Total consumption (by products) - current prices

FRML CU[i] CU[i] = CMU[i]+CGU[i] ;

Total consumption (by products) - constant prices

FRML CO[i] CO[i] = CU[i]/PC[i] ;

[i=1,2,3,4,5,6,7]

Intermediate consumption by products - current prices

FRML CIU[i] CIU[i] = { $\sum_{j=1,2,3,4,5,6,7} A_{<j>[i]} * XSO[i] * PC_{<j>}$ };

Intermediate consumption by products - constant prices

FRML CIO[i] CIO[i] = { $\sum_{j=1,2,3,4,5,6,7} A_{<j>[i]} * XSO[i]$ };

Intermediate demand by products - current prices

FRML DIU[i] DIU[i] = { $\sum_{j=1,2,3,4,5,6,7} A_{[i]<j>} * XSO_{<j>} * PC[i]$ };

Intermediate demand by products - constant prices

FRML DIO[i] DIO[i] = { $\sum_{j=1,2,3,4,5,6,7} A_{[i]<j>} * XSO_{<j>}$ };

[i=1,2,3,4,5,6,7]

Domestic prices by products

FRML PD[i] PD[i] = PD[i]+XXSO[i]+MEO[i]+MRO[i]+MCO[i]+TAXMO[i]  
-DIO[i]-CO[i]-IO[i]-XO[i] ;!

[i=1,2,3,4,5,6,7]

Intermediate consumption by products - current prices

FRML IU[i] IU[i] = BeI[i]\*IU ;

Intermediate consumption by products - constant prices

FRML IO[i] IO[i] = IU[i]/PC[i] ;

Total demand for products

[i=1,2,3,4,5,6,7]

FRML DXO[i] DXO[i] = (DLO[i]\*PD[i]+XO[i]\*PX[i])/PQ[i];!

Demand for domestic goods - constant prices

[i=1,2,3,4,5,6,7]

FRML DLO[i] DLO[i] = ((1/BX[i]\*\*Ph[i]))\*(1/(1-Ga[i]))  
\*(XXSO[i]\*\*Ph[i]-BX[i]\*\*Ph[i]\*Ga[i]\*XO[i]\*\*Ph[i]))\*(1/Ph[i]);

Demand for domestic goods - current prices

FRML DLU[i] DLU[i] = DLO[i]\*PD[i] ;

Local demand of composite assets - constant prices

[i=1,2,3,4,5,6,7]

FRML QO[i] QO[i] = BM[i]\*(Et[i]\*MO[i]\*\*(-Rh[i]))+(1-Et[i])  
\*DLO[i]\*\*(-Rh[i]))\*\*(-1/Rh[i]);

Local demand of composite assets - current prices

FRML QU[i] QU[i] = DIU[i]+CU[i]+IU[i] ; !

#### FOREIGN TRADE

[i=1,2,3,4,5,6,7]

Exports to the European Union by products - constant prices

FRML XEO[i] XEO[i] = AlxE[i]\*XO[i] ;

Exports to the European Union by products - constant prices

FRML XEU[i] XEU[i] = XEO[i]\*PWX[i] ;

[i=1,2,3,4,5,6,7]

Exports to the Rest of the World by products - constant prices

FRML XRO[i] XRO[i] = AlxR[i]\*XO[i] ;

Exports to the Rest of the World by products - current prices

FRML XRU[i] XRU[i] = XRO[i]\*PWX[i] ;!

[i=1,2,3,4,5,6,7]

Total exports by products - constant prices

FRML XO[i] XO[i] = ((PX[i]/PD[i])\*\*SiE[i]\*((1-Ga[i])  
/Ga[i])\*\*SiE[i])\*DLO[i];

Total exports by products - current prices

FRML XU[i] XU[i] = XO[i]\*PWX[i] ;!

[i=1,2,3,4,5,6,7]

Total imports by products - constant prices

FRML MO[i] MO[i] = ((Et[i]/(1-Et[i]))\*\*SiM[i]\*(PD[i]  
/PM[i])\*\*SiM[i])\*DLO[i];

Total imports by products - current prices

FRML MU[i] MU[i] = MEU[i]+MRU[i] ;!

Imports from the European Union - constant prices  
 $[i=1,2,3,4,5,6,7]$   
 $FRML\ MEO[i]\ MEO[i] = Alme[i] * (PME[i] / PM[i]) ** (-SiMs[i]) * MO[i];$

Imports from the European Union - current prices  
 $FRML\ MEU[i]\ MEU[i] = E * PWM[i] * MEO[i];$

Imports from the Rest of the World - constant prices  
 $[i=1,2,3,4,5,6,7]$   
 $FRML\ MRO[i]\ MRO[i] = Almr[i] * (PMR[i] / PM[i]) ** (-SiMs[i]) * MO[i];$

Imports from the Rest of the World - current prices  
 $FRML\ MRU[i]\ MRU[i] = E * PWM[i] * MRO[i];$

## CURRENT BALANCES

Current balance with the European Union - current prices  
 $FRML\ FFEU\ FFEU = \{\sum[j=1,2,3,4,5,6,7] PWM[j] * MEO[j]\}$   
 $- (\{\sum[j=1,2,3,4,5,6,7] PWX[j] * XEO[j]\}) - 1/E * (TEM + TEG);$

Current balance with the European Union - constant prices  
 $FRML\ FFEO\ FFEO = \{\sum[j=1,2,3,4,5,6,7] MEO[j]\}$   
 $- (\{\sum[j=1,2,3,4,5,6,7] XEO[j]\}) - 1/E * (TEM + TEG) / PC; !$

Current balance with the Rest of the World - current prices  
 $FRML\ FFRU\ FFRU = \{\sum[j=1,2,3,4,5,6,7] PWM[j] * MRO[j]\}$   
 $- (\{\sum[j=1,2,3,4,5,6,7] PWX[j] * XRO[j]\}) - 1/E * (TRM + TRG);$

Current balance with the Rest of the World - constant prices  
 $FRML\ FFRO\ FFRO = \{\sum[j=1,2,3,4,5,6,7] MRO[j]\}$   
 $- (\{\sum[j=1,2,3,4,5,6,7] XRO[j]\}) - 1/E * (TRM + TRG) / PC; !$

Overall current balance - current prices  
 $IDENT\ FFU\ FFU = FFEU + FFRU;$

Overall current balance - constant prices  
 $IDENT\ FFO\ FFO = FFEO + FFRO;$

## PRICES

$[i=1,2,3,4,5,6,7]$   
 Consumer prices per branches  
 $FRML\ PC[i]\ PC[i] = (PD[i] * DLO[i] + PM[i] * MO[i]) / QO[i];$

Deflator of the value added by products  
 $FRML\ PVA[i]\ PVA[i] = (PQ[i] * (1 + Tx[i]))$   
 $- (\{\sum[j=1,2,3,4,5,6,7] A[j][i] * PC[j]\});$

Imported products deflator of the European Union  
 $FRML\ PME[i]\ PME[i] = (1 + TME[i]) * E * PWM[i];$

Imported product deflator of the Rest of the World  
 $FRML\ PMR[i]\ PMR[i] = (1 + TMR[i]) * E * PWM[i];$

Imported product deflator  
 $FRML\ PM[i]\ PM[i] = (Alme[i] * PME[i] ** (1 - SiMs[i])$   
 $+ Almr[i] * PMR[i] ** (1 - SiMs[i])) ** (1 / (1 - SiMs[i]));$

Exported product deflator

FRML PX[i] PX[i] = E\*PWX[i];

#### MARGINS

Commercial margins out of products 1 to 6 - current prices  
[i=1,2,3,4,5,6]

FRML MCU[i] MCU[i] = QU[i]+XU[i]-XXSU[i]-MU[i]-taxMU[i] ;

Commercial margin on product 7 - current prices

FRML MCU7 MCU7 = -({ $\sum_{j=1,2,3,4,5,6}$ MCU<j>}) ;

[i=1,2,3,4,5,6]

Commercial margins products 1 to 6 - constant prices

FRML MCO[i] MCO[i] = MCU[i]/PQ[i] ;

Commercial margin on product 7 - constant prices

FRML MCO7 MCO7 = -({ $\sum_{j=1,2,3,4,5,6}$ MCO<j>}) ;!

Values added in value

[i=1,2,3,4,5,6,7]

IDENT VAU[i] VAU[i] = XXSU[i]-CIU[i] ;

Values added in volume

[i=1,2,3,4,5,6,7]

IDENT VAO[i] VAO[i] = XXSO[i]-CIO[i] ;

#### EQUILIBRIUM RELATION: DEMAND FOR PRODUCTS = SUPPLY OF PRODUCTS

Production prices index by products

[i=1,2,3,4,5,6,7]

FRML PQ[i] PQ[i] = PQ[i]+DXO[i]-(XXSO[i]+MCO[i]) ; !

#### DYNAMIC RELATIONS

[i=1,2,3,4,5,6,7]

Fixed capital stock

FRML KO[i] KO[i] = KO[i](-1)\*(1-DEPR[i])+IO[i];

Supply of work

FRML LS LS = LS(-1)\*(1+DEMO);!

#### SUMMARY VARIABLES

IDENT YU YU = SAL+RKM+WG\*LG+RKE+TVA+TAXMU ;

IDENT SALG SALG = WG\*LG;!

[i=1,2,3,4,5,6,7]

IDENT XSU[i] XSU[i] = XSO[i]\*PQ[i];

FRML XXSO[i] XXSO[i] = SAL[i]/PC+RK[i]/PC+CIO[i]+TaxX[i]/PC ;

FRML XXSU[i] XXSU[i] = XSU[i]+TaxX[i] ;

IDENT SGO SGO = YGO-CGO-SALG/PC-TGE/PC ;!

IDENT SEO SEO = RKE/PC+TGE/PC-TAXRK/PC ;!

IDENT SMO SMO = SAL/PC+RKM/PC+SALG/PC+TEM/PC+TRM/PC-TAXYM/PC-CMO ;!

IDENT TAXMU TAXMU = { $\sum_{j=1,2,3,4,5,6,7}$ TAXMU<j>} ;!

IDENT TAXMO TAXMO = { $\sum_{j=1,2,3,4,5,6,7}$ TAXMO<j>} ;!

IDENT TVA TVA = { $\sum_{j=1,2,3,4,5,6,7}$ TAXX<j>} ;!

IDENT MCU MCU = { $\sum_{j=1,2,3,4,5,6,7}$ MCU<j>} ;!

IDENT PIBU PIBU = { $\sum_{j=1,2,3,4,5,6,7}$ VAU<j>}

```

+MCU+TAXMU+{Σ[j=1,2,3,4,5,6,7]TAXX<j>} ;!
IDENT PIBO PIBO = {Σ[j=1,2,3,4,5,6,7]VAO<j>}
+{Σ[j=1,2,3,4,5,6,7]MCU<j>/PQ<j>}
+{Σ[j=1,2,3,4,5,6,7]TAXMU<j>/PC<j>}
+{Σ[j=1,2,3,4,5,6,7]TAXX<j>/PQ<j>} ; !
IDENT SVAO SVAO = {Σ[j=1,2,3,4,5,6,7]VAO<j>} ;!
IDENT SVAU SVAU = {Σ[j=1,2,3,4,5,6,7]VAU<j>} ;!

[i=1,2,3,4,5,6,7]
IDENT RESO[i] RESO[i] = XXSO[i]+MO[i]+MCO[i]+TAXMO[i] ;
IDENT EMPO[i] EMPO[i] = QO[i]+XO[i] ;
IDENT RESU[i] RESU[i] = XXSU[i]+MU[i]+MCU[i]+TAXMU[i] ;
IDENT EMPU[i] EMPU[i] = QU[i]+XU[i] ;!
IDENT CU CU = {Σ[j=1,2,3,4,5,6,7]CU<j>} ;!
IDENT CO CO = {Σ[j=1,2,3,4,5,6,7]CO<j>} ;!
IDENT PC PC = CU/CO ; !
IDENT XU XU = {Σ[j=1,2,3,4,5,6,7]XU<j>} ;!
IDENT MU MU = {Σ[j=1,2,3,4,5,6,7]MU<j>} ;!
IDENT CMO CMO = {Σ[j=1,2,3,4,5,6,7]CMO<j>} ;!
IDENT CGO CGO = {Σ[j=1,2,3,4,5,6,7]CGO<j>} ;!
IDENT CIU CIU = {Σ[j=1,2,3,4,5,6,7]CIU<j>} ;!
IDENT CIO CIO = {Σ[j=1,2,3,4,5,6,7]CIO<j>} ;!
IDENT DIU DIU = {Σ[j=1,2,3,4,5,6,7]DIU<j>} ;!
IDENT DIO DIO = {Σ[j=1,2,3,4,5,6,7]DIO<j>} ;!
IDENT QU QU = {Σ[j=1,2,3,4,5,6,7]QU<j>} ;!
IDENT QO QO = {Σ[j=1,2,3,4,5,6,7]QO<j>} ;!
IDENT IO IO = {Σ[j=1,2,3,4,5,6,7]IO<j>} ;!
IDENT XXSU XXSU = {Σ[j=1,2,3,4,5,6,7]XXSU<j>} ;!
IDENT XXSO XXSO = {Σ[j=1,2,3,4,5,6,7]XXSO<j>} ;!
IDENT RESO RESO = {Σ[j=1,2,3,4,5,6,7]RESO<j>} ;!
IDENT EMPO EMPO = {Σ[j=1,2,3,4,5,6,7]EMPO<j>} ;!
IDENT RESU RESU = {Σ[j=1,2,3,4,5,6,7]RESU<j>} ;!
IDENT EMPU EMPU = {Σ[j=1,2,3,4,5,6,7]EMPU<j>} ;!
IDENT XSU XSU = {Σ[j=1,2,3,4,5,6,7]XSU<j>} ;!
IDENT XSO XSO = {Σ[j=1,2,3,4,5,6,7]XSO<j>} ;!
IDENT MO MO = {Σ[j=1,2,3,4,5,6,7]MO<j>} ;!
IDENT PM PM = MU/MO ;!
IDENT PK PK = (XXSU-SAL-CIU)/(XXSO-SAL/PC-CIO) ;!
IDENT PQ PQ = XSU/XSO ;!

```

#### DATA PREPARATION AND CALIBRATION OF THE REAL CGE MODEL

```

[i=1,2,3,4,5,6,7]
XSO(i) = XSU(i)/PQ(i)

[i=1,2,3,4,5,6,\j=1,2,3,4,5,6,7]
CIO(i,j) = CIU(i,j)/PCs(i)
A(i,j) = CIO(i,j)/XSO [j]

[i=1,2,3,4,5,6,]
TX(i) = TaxX(i)/(XSO(i)*PQ(i))
PVA(i) = PQ(i)*(1-TX(i))-({Σ [j=1,2,3,4,5,6,]A<j>(i)*PCs <j>})
LD(i) = SAL(i)/W
Al(i) = W/PVA(i)/XSO(i)*LD(i)
IO(i) = IU(i)/PC(i)

```

```

KO(i) = KO(i) * (-1) * (1-DEPR(i)) + IO(i)
A(i) = XSO(i) / (LD(i) ** Al(i) * KO(i) ** (1-Al(i)))

[i=1,2,3,4,5,6,]
CMO(i) = CMU(i) / PC(i)
CGO(i) = CGU(i) / PC(i)
CMO = {Σ[j=1,2,3,4,5,6,] CMO<j>}
CGO = {Σ[j=1,2,3,4,5,6,] CGO<j>}
CGU = {Σ[j=1,2,3,4,5,6,] CGU<j>}

[i=1,2,3,4,5,6,]
BeC(i) = CMO(i) / CMO
BeG(i) = CGO(i) / CGO
BeI(i) = PCs(i) * IO(i) / ({Σ [j=1,2,3,4,5,6,] IO<j>})

LeK = RKM / ({Σ [j=1,2,3,4,5,6,] RK<j>})
YM = SAL + SALG + RKM + TRM + TEM

YDM = YM - TaxYM

PMS = SMU / YDM Á' 3BÁ '21

TYM = TaxYM / YM Á '3b3a '21

TRK = TaxRK / ({Σ [j=1,2,3,4,5,6,] RK <j>}) Á' 3b3a '21

[i=1,2,3,4,5,6,]
MU(i) = MEU(i) + MRU(i)
MEO(i) = MEU(i) / PWM(i)
MRO(i) = MRU(i) / PWM(i)
MO(i) = MEO(i) + MRO(i)
XU(i) = XEU(i) + XRU(i)
XO(i) = XU(i) / PWE(i)
XEO(i) = XEU(i) / PWE(i)
XRO(i) = XRU(i) / PWE(i)
TM(i) = TaxM(i) / MU(i)
TaxME(i) = 0.48 * TaxM(i)
TaxMR(i) = 0.52 * TaxM(i)
TME(i) = TaxME(i) / MEU(i)
TMR(i) = TaxMR(i) / MRU(i)
PX(i) = PWE(i) * E
Ph(i) = (1+SiE(i)) / SiE(i)
DIO(i) = {Σ[j=1,2,3,4,5,6,] CIO(i) <j>}
CO(i) = (CMU(i) + CGU(i)) / PCs(i)
QO(i) = CO(i) + DIO(i) + IO(i)
PM(i) = PWM(i) * E * (1+TM(i))
PME(i) = PWM(i) * E * (1+TME(i))
PMR(i) = PWM(i) * E * (1+TMR(i))
DLO(i) = (PCs(i) * QO(i) - PM(i) * MO(i)) / PD(i)
Ga(i) = 1 / (1+PD(i) / PX(i) * (XO(i) / DLO(i)) ** (Ph(i)-1))
BX(i) = XSO(i) / ((GA(i) * XO(i) ** PH(i) "
+ (1-GA(i)) * DLO(i) ** PH(i)) ** (1/Ph(i)))
Rh(i) = (1-SiM(i)) / SiM(i)
De(i) = (PM(i) / PD(i)) * (MO(i) / DLO(i)) ** (1/SiM(i))
Et(i) = Of(i) / (1+De(i))
BM(i) = QO(i) / (And(i) * MO(i) ** (-Rh(i))
+ (1-Et(i)) * DLO(i) ** (-Rh(i))) ** (-1/Rh(i))
MCO(i) = MCU(i) / PQ(i)
Tmc(i) = MCU(i) / XSU(i)
Almr(i) = MRO(i) / ((PMR(i) / PM(i)) ** (- SiMs(i)) * MO(i))

```



```

Alme(i) = MEO(i)/((pme(i)/PM(i))** (- SiMs(i))*MO(i))
Alxr(i) = XRO(i)/XO(i)
Alxe(i) = XEO(i)/XO(i)

```

Initialization variables

```

BC = BCe+BCr
IU = SEU+SMU+SGU+E*BC

```

Variables of the previous year

```

LS = {Σ [j=1,2,3,4,5,6,] LD <j>} +LG

```

The Stock of capital variables come from Sean Holly

```

smpl 1996 1996

```

```

KO1 = 1.5*3950
KO2 = 114.4554
KO3 = 462.64589
KO4 = 2280.15953
KO5 = 99.124616
KO6 = 488.5951
KO= 1.5*(659.6+5981)

```

```

LS = LS (+1)/(1+DEMO (+1))

```

```

[i=1,2,3,4,5,6,]
TME(i) = TME(i) (+1)

```

## Reference

- Devarajan, S., Delfin, G., Lewis, J., Robinson, S. and Sinko P., 1994, 'Policy Lessons from a Simple Open-Economy Model,' Policy Research Working paper 1375, World Bank, Washington, DC.
- COCKBURN, DECALUWE, and DOSTIE : the lessons of the marriage between the calculable general balance models and the new theory of international trade: application to Tunisia "
- (DECALUWE, B. MARTENS, A.): 1988: CGE MODELING AND DEVELOPING ECONOMIES: A CONCISE EMPIRICAL SURVEY OF 73 APPLICATIONS TO 26 COUNTRIES
- Fukase, E. and Martin, W., 1998, "Evaluating the Implications of Myanmar's Accession to the ASEAN Free Trade Area: A Simple General Equilibrium Model (CGE) Approach to Assessing the Effects of RIAs for Small Countries," World Bank, Washington, DC.
- Will Martin and Emiko Fukase - World Bank, (1999) (Draft): A Simple General Equilibrium Model for Analysis of Participation in Regional Trade Blocs4
- Martin, W. (1996), 'Measuring welfare changes with distortions,' in Francois, J. and Reinert, K. eds. *Applied Methods for Trade Policy Analysis: A Handbook*, Cambridge University Press, Cambridge, U.K.
- Martin, W. (2000), 'Assessing the Implications for Lebanon of Free Trade with the European Union' – World Bank – Preliminary draft
- Salter, W. (1959), "Internal and external balance: the role of price and expenditure effects", *Economic Record* 35:226-38.
- Varian, H. (1992), *Microeconomic Analysis*, Third Edition, W.W. Norton & Company, Inc.

الجمهورية اللبنانية  
مكتب وزير الدولة لشؤون التنمية الإدارية  
مركز مشاريع ودراسات القطاع العام