Rethinking the Redistribution Effects of Trade Liberalization in Egypt: A Microsimulation Analysis*

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Abstract

This paper aims at evaluating the liberalization policies effects on inequality in Egypt with respect to gender, region and qualification level. No previous studies in Egypt, to our best knowledge, have used the Microsimulation analysis which is a good tool that allows such an evaluation and determines the redistribution aspects of macro policies. The latter consists of linking macroeconomic changes to the micro level of the economy i.e. the individual level. A Computable General Equilibrium model (CGE) is first estimated for a maximum tariff rate of 10%. And, wages and employment changes resulted from the CGE are replicated, in a second stage, into our micro data. Results show that liberalization policies have important impacts on inequalities among the Egyptian population in general. Inequality has decreased among males and females as well as among different regions of the Egyptian society but has increased among high-skilled and low-skilled workers. Results of the present research have important policy implications that have to be considered.

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1 Introduction

Macroeconomic policies, poverty and gender specific aspects must be present in the overall policy dialogue. Thus, analyzing trade liberalization impacts on the labor market and wage inequality are central for policymaking reforms in developing countries. In Egypt, the 1990's have been characterized by an accelerated structural adjustment and trade liberalization aiming at rectifying the macro imbalances in the Egyptian economy. Those economic policies are parts of the agreements that the Egyptian government has signed with the International Monetary Fund (IMF) and the World Bank aiming at rectifying the macro imbalances in the Egyptian economy. Theoretically, Becker (1957) argues that free trade implies a more competitive environment and, consequently, a less discriminating economy (against females). However, such effects have not been observed in most developing countries (see El-Hamidi, 2008). The present study aims at identify the complex inter-linkages between trade liberalization policies, inequality, wages and employment opportunities through a microsimulation methodology.

Our motivation is twofold: economic and empirical interests. On the one hand, Egypt, witnessing both macro and microeconomic changes during the last decade, has undertaken numerous policies that affected both trade and, in turn, labor market and wages inequality. Despite many efforts that have been deployed to combat it, inequality remains a serious issue in Egypt. According to the World Bank (2005), the Gini index in Egypt is 32.1. More precisely, the income share held by the lowest 10% of the population is 3.7% and the one held by the lowest 20% is 9%. Those figures are much higher for the highest 20% and 10% (44% and 30% respectively). Such inequality is observed on many levels: qualification, gender and geographic levels.

Although women's situation has highly improved, they still earn less than men. Between 1998 and 2006, the gender pay gap increased in the public enterprise sector in favor of men to reach levels comparable to the private sector. Concerning the gender level of inequality, Said (2007) has found that, after correcting productivity differences, there is a gap in favor of females is only 3% in government sectors and the gap in favor of males in the private sector is 21%. Therefore, inequality on the gender level is still a debatable issue in Egypt. In fact, such inequality becomes more important when trade policies are taken into account as females work for the government which is a non-tradable sector. El Hamidi (2008) has also found that, during trade liberalization periods, tradable sectors experienced higher levels of wage differences between men and women than non-tradable ones.

On the geographic level, such inequality is even more pronounced as urban employment represent more than 65% of the whole employment. Said (2007) has shown that living outside greater Cairo is associated with a wage disadvantage for all sector and gender groups.

Finally, inequality between skilled and unskilled is also a key aspects to understand income differences in developing countries in general and in Egypt in particular. Wage inequality and the returns to skills rose substantially as there was a sizable increase in the wage ratio between highly skilled and less skilled workers. Borjas and Ramey (1195) and Epifani and Gancia (2007) have shown that international trade can raise the relative demand for skilled labor and therefore increasing the wage skill premium.

Regarding the empirical motivation, we rely for the first time to our best knowledge, on a microsimulation approach using Egyptian data. This framework uses in the meantime a discrete choice model of labor supply and a computable general equilibrium (CGE) model by linking the Egyptian Labor Market and Panel Survey (ELMPS) of 1998 to the Social Accounting Matrix (SAM) of 2001.

To put in a nutshell, our research objectives could be summarized in the two following questions: first, how do trade liberalization measures affect the income redistribution (and hence poverty and inequality between different labor segments) and secondly, to what extent trade liberalization policies are efficient for females' wages and employment opportunities (compared to those of males). Therefore, using the microsimulation approach, we try to determine the effect of trade liberalization on the wage inequality according to the three criteria: gender, qualification level and region.

The paper is organized as follows: section 2 presents some stylized facts of the main liberalization changes that took place in the Egyptian economy between 1998 and 2004. Section 3 exhibits the methodology adopted in our study. Section 4 is devoted to the data presentation. In section 5, we present the results. And, section 6 concludes and presents the policy implications of the study.

2 Some Stylized Facts

Since the beginning of 1990's, Egypt had two remarkable waves of trade liberalization. The first one took place in the beginning of 1990s as it undertook a reform policy on many fields thanks to the Economic Reform and Structural Adjustments Program (ERSAP) dictated by the World Bank and the International Monetary Fund. Thus, it has opened its economy, increased its trade and privatized many state-owned companies. As shown in figure 1, the maximum tariff rate in Egypt decreased from 110 percent in the end of 1980's to reach 40 percent in the end of 1990's.

[Figure 1 about here]

In addition to these tariff cuts, in 2004, the government of Egypt has launched the second wave of liberalization. Its objectives were twofold: first, to reduce tariffs and rationalize the tariff structure; and second, to reduce the number of products subject to non-tariff barriers. Figure 2 presents tariffs reduction in nominal and effective terms for manufacturing sectors. It is quite obvious that both nominal and effective protection has declined for almost all manufacturing sectors after 2004 reform. Therefore, the second wave had many crucial implications as it reduced tariff dispersion, tariff lines and tariffs average. Tariff dispersion has decreased from 27 tariff brackets to 6, which in turn would simplify procedures, minimize tariff evasion, and remove possibilities of discretion and corruption. Moreover, tariff lines were reduced from 8000 to 6000 which also adds to the simplification of procedures. Finally, the tariff cuts decision stated that the average tariff rate will be reduced from 14.6 percent to 9 percent, which is less than the average of 42 percent in 1991 and 25 percent in 1995.

[Figure 2 about here]

Consequently, as Egypt had a considerable success in implementing its trade policy goals, its external trade has significantly increased. Figure 3 shows exports and imports trends for goods and services. Exports of goods have been boosted by 41.4 percent between 1990 and 1999 and then by 110.6 percent between 2004 and 2007. Obviously, thanks to the second wave, the exports growth rate is much higher than the first one. Having a quick glance on the sectoral and the gender distribution of trade between 1998 and 2005, the most important sectors witnessing a significant expansion are: transportation equipment (up by 950 percent), food products (up by 425 percent), electrical machinery (up by 268 percent) and chemicals (up by 8.11 percent). Employment opportunities for women have increased in these sectors also by 143 percent, 209 percent, 268 percent and 333 percent respectively. Obviously, such relationship between sectors expansion and females' work needs to be assessed within an empirical framework.

[Figure 3 about here]

Moreover, Figure 4 (El-Hamidi, 2008) explores the Egyptian sectors by gender in 1998 and 2006. The latter shows an important females concentration in the education and health sector, the retail and trade sector and the textile manufacturing sector. Those sectors are then more feminized than others; which could have important implications on the analysis of the liberalization impacts on females employment. Therefore, such an evaluation is crucial to determine not only the impact of trade liberalization on income redistribution and specifically on the evolution of females' poverty but also on wages and employment opportunities of both males and females in the labor market.

[Figure 4 about here]

Table 1 displays the distribution of the working population of our sample by segment [1] and economic working sector. Five economic sectors are considered here: the Government, the Agriculture sector, the Mining sector, Manufacture and the service sector. Statistics shown in this table are constructed using the Egyptian Labor Market Survey (ELMS) of 1998. Considering the government sector, we observe that 65% of the workers are males against only 25% of females. However, this proportion of females seem to be high compared to the Agriculture and the mining sectors employing very few women (only 6% and 0% respectively). In addition to this, it is quite clear that the government, contrarily to the other sectors, is characterized by a majority (80%) of a skilled working population.

[Table 1 about here]

[1]Segments are: 1. High skilled males in urban areas; 2. Low skilled males in urban areas; 3. High skilled males in rural areas; 4. Low skilled males in rural areas; 5. High skilled females in urban areas; 6. Low skilled females in urban areas; 7. High skilled females in rural areas; 8. Low skilled females in rural areas.

3 Methodology

3.1 The Microsimulation Model

The main role of the microsimulation module in the linked framework is to provide a detailed computation of net incomes at the household level, through a detailed description of the tax-benefit system of the economy, and to estimate individual behavioral responses to the policy change (see Colombo, 2007).

The literature on microsimulation models has shown that there exists three main ways to undertake a microsimulation analysis[2]. The first one is *"the integrated approach"* or the micro-accounting methodology where the representative household groups are substituted by the real number of households available in the microeconomic survey. Such a method has a clear shortcoming: it does not take into account the behavioral responses. This why, we use the second method which is the *"Top/Down approach"* where some micro-econometric work is done in order to take into account the individuals behavior (Bourguingnon et al, 2003). The third method, which is the *"Top/Down Bottom/Up approach"* was developed by Savard (2003), where there is a bi-directional link between the micro and macro levels through many iteration until they converge to the same solution. In our study, we use the **"Top/Down approach"** as it gives a relatively good compromise between simplicity, consistency while taking into account the behavior of individuals on the micro level.

In the empirical work of the present study, we opt, in a first stage, for probit model of participation. Discrete choice models have been a growth industry in econometrics and, the availability of high quality data sets on microeconomic behavior has maintained an interest in extending them. This modeling technique reveals the relationship between the probability of choosing between two or more alternatives and the attributes that characterize the choice made. Our model counts two different labor market status alternatives, and each agent is found to be in one of these conditions: being inactive or being an active

[2]For a detailed literature review on the comparison of those methodologies and their implications, see Colombo (2008)

individual. The equations of the model are the following:

Two-stage Heckman selection model:

$$log(w_{ls}) \quad = \quad \alpha_{l(ls)} + \beta_{l(ls)}.Z_{ls} + \theta_{l(ls)}.\lambda_{ls} + \nu_{ls} \qquad (1)$$

The wage equation computes the logarithm of labor income w_{ls} of individual l belonging to the subgroup s[3] as a linear function of his/her personal characteristics (vector Z_{ls}) and of λ_{ls}, which represents the inverse Mills ratio estimated for the selection model. The residual term ν_{ls} describes the effects of unobserved components on wage earnings. This equation is estimated separately for each subgroup.

The first stage of the Heckman's model consists of determining the individuals probability of participation. In our model we have arbitrarily set to zero the utility of being inactive. Vector Z of explanatory variables includes some personal characteristics of individual l of the subgroup s. The equation is defined only for individuals at working age (15-65 years old) and estimated separately for each subgroup. The explanatory variables are the age, the age squared, the marital status, the household's size and dummies for parental levels of education.

The aim of this equation in the model is to obtain efficient estimates for labor incomes only for those individuals that are observed to be inactive in the survey. These estimates are used in the case that, after a liberalization policy takes place, one or more of them will change their labor market status and become active. In this case, using these estimates, we will be able to assign a labor income to individuals that have changed their labor market status after the simulation run. For all the other individuals that are observed to receive a wage or to earn a positive income from their activity, we use instead the observed wage and income levels.

[3]Six subgroups are considered here: 1. Males; 2. Females; 3. Skilled; 4. Unskilled; 5. Urban and 6. Rural.

3.2 The Macroeconomic Model

3.2.1 The Model Assumptions

CGE models are powerful tools to capture, in a general equilibrium framework, all direct and indirect effects of macroeconomic shocks (wherever the shock occurs in the economy) on sectoral production and factor demands. This is why we use a CGE model that was constructed by Decaluwé et al. (2001) to assess the impact of different economic policies on developing countries. The central assumption is that the economy is a small open one which has no influence on world prices (price taker). Such assumption is consistent with the Egyptian economy. Moreover, it is a perfect competition model, therefore the profit maximization condition implies that the price of production factor is equal to its marginal productivity. The model belongs to real models where the currency is an instrument of exchange and a unit of account only. Therefore, the currency remains neutral, meaning that price changes affect only the decisions of production and consumption. All Prices are normalized in the benchmark scenario. Regarding the factors of production, the labor is perfectly mobile between production sectors, while capital is specific to each one of them. They are internationally immobile. Hence, factor endowments are not affected by resources transfers with the Rest of the World. Regarding labor mobility, the number of Egyptian international migrants is estimated at 4% of the Egyptian population and 1.5% of world migrants (Nassar, 2005). Such proportions show to what extent the labor immobility assumption holds in our case. By contrast, international capital mobility as well as internal labor migration (from rural to urban areas) are one of the most important issues for the Egyptian economy. As we are trying to capture the effect of trade liberalization, such aspects are not in the center of the present paper. However, future research should extend this model in order to take these issues into full consideration.

The existence of foreign savings has no impact on the volume of productive capital. Industries use not only production factors but also intermediate products from other activities. Households allocate their revenues between consumption and savings and and firms allocate them between investment and savings. Exported goods and those sold on the domestic market are not identical, which leads to an elasticity of transformation among the two commercial products. Reflecting the nature of the classical framework, competition and resource allocation are adjusted through the flexible movement of prices.

3.2.2 The Model Structure

This CGE model has common features with other CGE models as follows. Production factors (labor and capital) are complementary in the value added following a Constant Elasticity Substitution (CES) function (with constant returns to scale). A perfect complementarity (à la Leontief, i.e. technical substitution elasticity is zero) exists between, on the one hand, intermediate inputs and, on the other between intermediate inputs and production factors or value added. Each market satisfies the neoclassical hypothesis of perfect competition: perfect homogeneity of labor force, perfect sectoral and geographical mobility.

Modeling the labor market is an essential aspect of our model. As we are interested in determining the impact of trade policy on the inequality based on three criteria: gender, region and qualification level, we have developed a nested CES function between different segments as shown in Figure 6. The unique labor factor is disaggregated into rural and urban labor in the first level of the nested CES. These two types of labor are imperfect substitutes in sectoral production, with identical elasticities of substitution in each sector [4]. Afterwards, in each group (rural and urban), there is a CES between males and females. Finally, the third level is the one between skilled and unskilled workers. Such a modeling allows us to take into account the imperfect substitutability between different segments. Each level of the CES yields different wages between different segments.

[Figure 6 about here]

Households maximize their utility function represented by a Linear Expenditure System (LES) subject to their income constraint. Consequently, expenditure on the $i^t h$ commodity consists of expenditure on the minimum required quantity for that commodity plus the proportion of the budget which is left over after paying for all minimum requirements. This proportion is the marginal budget share that determines the allocation of supernumerary income. Domestic production is distributed between domestic consumption and

[4] We use the same elasticity of substitution for all sectors. However, substitution between male and female work may be greater in some sectors than others. Unfortunately, the lack of available data on these parameters justifies the use of uniform elasticities in different sectors.

foreign exports through a Constant Elasticity of Transformation (CET) function. Imports are differentiated by origin following an Armington-function. The latter is combined with domestic production through a CES function to satisfy domestic demand. Firms have revenues coming from capital remuneration and transfers. Their expenditures are divided between investment cost and transfers to households. Households and firms pay taxes to government. Moreover, many transfers are made among economic agents, i.e. households, firms, government and the rest of the world.

The main closure rules are introduced in order to fit the Egyptian economy. Government expenditures in goods and services are assumed constant in real terms. Capital is specific to each sector. All transfers, public wages and public employment are constant. On the external level, the current account balance as well as international prices are assumed fixed (Egypt is modeled as a small open economy). Therefore, exchange rate adjusts in order to satisfy this constraint. The producer price index is the numéraire. Welfare is measured through the equivalent variation that is based on household consumption. Appendices 2 and 3 present respectively the model structure, its notation and its equation.

3.3 Linking the Two Models

The basic difficulty of the microsimulation approach is to ensure consistency between the micro and macro levels of the analysis. A growing literature highlights the linking macro- micro models (see Ahmed and Donoghue 2004). And the main reason for such a linking is the need to conduct the micro analysis of changes in macroeconomic policies. In this conventional macro- micro literature, integration of CGE and microsimulation models has received the largest share of exposure and discussions. However, it is still a relatively new field in both developed and developing countries. We integrate a CGE and a microsimulation model so that a shock to the CGE model (such as changes in tariffs) transmits the changes in wages, prices and employment levels to the microsimulation model. In order to link the macroeconomic CGE model and the microeconometric model, some accounting equations have to be computed.

First, the total household h's net income YH_h is defined by the sum of the labor income of its members YL_{hl} (with $Wdum_{hl}$ a dummy variable equals 1 if individual l

is a wage-worker and 0 otherwise), any exogenous income YX_h, i.e. transfers from the government or the rest of the world to the households net of direct taxes TDH_h as follows:

$$YDH_h = \sum_{l=1}^{8} YL_{hl}.Wdum_{hl} + YX_h - TDH_h \tag{2}$$

In order to compute the real income, a household specific consumer price index has to be calculated by adding the composite price PC_i of commodity i weighted by the budgetary share allocated to this commodity over the 16 sectors of the economy:

$$PCI_h = \sum_{i=1}^{16} \gamma_{hi}.PC_i \tag{3}$$

Dividing the nominal income by the PCI_h yields the household's real income YHR_h:

$$YDHR_h = \frac{YDH_h}{PCI_h} \tag{4}$$

Once those variables are computed, the microsimulation can be run and two main changes are taken into account.

First, the change in average earnings in the microsimulation must be equal to the changes in the wage rate generated by the CGE model. In other terms, the household income is shocked by the change in the wage obtained from the CGE $\triangle w$ yielding the logarithm of wage earnings:

$$\log(YL_{ls}) = \log[\widehat{YL}_{ls}(1 + \triangle w)] \tag{5}$$

Secondly, the changes in the number of wage workers in the microsimulation LD_L^{MS} must be equal to those observed in the CGE model LD_L^{CGE}:

$$\triangle LD_L^{MS} = \triangle LD_L^{CGE} \tag{6}$$

This equation is crucial to our analysis as the $\triangle LD_L^{CGE}$ determines the level of employment after the liberalization shock for the whole economy but $\triangle LD_L^{MS}$ determines who, the inactive population, has the highest probability of becoming active if the shock induces an increase in labor demand.

To put in a nutshell, we impose the macroeconomic results obtained from the CGE model onto the microeconomic level in order to determine the impact of trade liberalization on the different segments of the Egyptian society.

4 Data

4.1 Micro Data: ELMS 1998

Data used in this study are obtained from the Egyptian Labor Market Survey of 1998 (ELMS). The ELMS is a national-representative household survey covering 5,000 households. These households were selected from a CAPMAS (Central Agency for Public Mobilizations and Statistics) master sample prepared in 1995. The questionnaire is composed of three major sections: (1) a household questionnaire administered to the head of household or the head's spouse that contains information on basic demographic characteristics of household members, movement of household members in and out of the household since 1998, ownership of durable goods and assets, and housing conditions, (2) an individual questionnaire administered to the individual him or herself containing information on parental background, detailed education histories, activity status, job search and unemployment, detailed employment characteristics, a module on women's work, migration histories, job histories, time use, earnings and fertility. (3) a household enterprise and income module that elicits information on all agricultural and non-agricultural enterprises operated by the household as well as all income sources, including remittances and transfers.

In the present research, we consider all individuals aged between 15 and 65 years old. Those can be either active (41 %) or inactive (59%). The inactive population is composed of individuals out of the labor force, unemployed, self employed or unpaid family workers. Our working sample consists on 14 796 individuals equally divided between males and females. And, following an eight-segments division with respect to gender, region and qualification level, we observe, as shown in table 2, that 34.46%, 34.5% and 31.03% of the masculine rural population are respectively illiterate, low skilled and highly skilled. However, females in rural areas seem to be more concentrated in the illiterate situation with 57.43% against only 24.70% and 17.88% as low skilled and high skilled respectively. In contrast, urban areas are characterized by more equality in education between males and females. For instance, 29,32% of urban males against 28,30% of females have a low level of education.

[Table 2 about here]

Table 3 represents the mean wages of the working population by segment. Generally, males, in mean, have higher wages than females regardless the level of education and the region of residence. Not surprisingly, the segment benefiting from the highest mean wage is the one of highly skilled males living in urban areas. The latter has a mean wage of 262.7396 against 218.2871 for its female's counterpart. However, the lowest mean wage goes for low skilled females living in rural areas.

[Table 3 about here]

4.2 Macro Data: The Social Accounting Matrix 2000-2001

The Social Accounting Matrix (SAM) of Egypt 2000/2001 was constructed by the National Institute of Planning, an institute attached to the Ministry of Planning. The structure of the matrix is as follows: it consists of six major accounts: the production factors, the economic agents, the industries, the composite products, the capital and finally the taxes which is an independent account of the government one. The SAM incorporates two production factors: labor and capital, six economic agents: households (rural and urban), companies (private and public), government and the Rest of the World (RoW). Regarding the industries, the SAM takes into account 17 branches structured as follows: two branches for agriculture (crop production and animal production), eleven branches for industry (oil and mining, tobacco, food industries, spinning and weaving, clothing (including leather), chemical industries, non-metal industries, industries of basic metals, metal industries, machinery and equipment and other industries) and finally four branches for the services sector (construction and electricity, communication and transport, other productive services and social services). The composite products account includes the same sectors mentioned above. Finally, the taxes account includes: direct taxes, indirect taxes, subsidies and tariffs on imports.

As we need to take into account the heterogeneity of economic agents on the labor market, and specifically the gender aspects, we have disaggregated the labor in the Egyptian SAM into eight different segments according to region, qualification and gender yielding eight different segments. Such a disaggregation allows us to determine the impact of trade liberalization on the inequality between males and females, rural and urban areas and skilled and unskilled workers. This was done using the micro data.

We follow Rutherford et al. (1993) in selecting the benchmark elasticities. Labor-capital substitution varies across sectors, ranging from 0.43 to 1.99. Trade elasticities are taken from Konan and Maskus (1997). The substitution elasticity between domestic and imported goods (both intermediates and consumption) is set at 2.0. The transformation elasticity between domestic and exported output also is set to 5.0. As to the labor market, substitution elasticity between rural and urban workers is set to a low value of 0.5. Substitution between between males and females is slightly higher and fixed to 0.7. Finally, according to Decaluwé et al. (2001), skilled and unskilled workers are less substitutable with an elasticity equal to 0.5.

5 Results

5.1 Microeconomic Results

Table 4 displays the results of the probit model of participation. The dependent variable equals to one if the individual l is active i.e a wage worker and equals to zero otherwise. The model is run separately for each subgroup s. All the results conform to the literature. The probability of being active increases with age and decreases with the age squared. And, this is verified for all subgroups. Marriage differently affects males and females. Married males, contrarily to their females counterparts, have a higher probability to be a active relative to single ones. Such results can be explained by the additional responsibilities that married males should bear and the family burden that their wives have to encounter. This domestic burden (child care and household chores) increases her probability of being a housewife (inactive) rather than being active. In addition, the probability of being active decreases with the household size for all subgroups. This is due to the transferability of revenues and tasks among the members of the same household. And, as expected, the parental education and specifically the father's education has important effects on the individual professional carrier and status in the labor market.

[Table 4 about here]

Similarly, in table 5, the results of the Heckman selection model are shown. The dependent variable here is the logarithm of the individual's hourly wage estimated by dividing the weekly wage by the number of working days during the reference week. The Heckman wage equation is also run separately for each subgroup. It is quite clear that, contrarily to males, the females's wages significantly decrease with age. And, when looking to the results obtained for the skilled population, we observe that the household size negatively affects the individual's wage. Moreover, living in rural areas in Egypt seems to have negative impacts on wages. But, this results can be explained by the higher costs of living in urban areas as Cairo for instance. An important result of those regressions is the positive relation between the level of education and wages for all subgroups. For males, being a skilled worker relative to a non skilled one increases the logarithm of wage by 74% against an increase of 57.3% for females. A similar result is observed for both urban and rural subgroups.

[Table 5 about here]

Note that the constants obtained in the wage regressions are then shocked by the changes in wages that result from the CGE model in order to determine the liberalization effects on wages of the active population. Results of the CGE are analyzed in the next section.

5.2 Macroeconomic Results

In order to assess the effects of trade liberalization, we use a Swiss formula[5]. The tariff reduction is computed as follows:

$$T^{*} = \frac{T^{ini}.Coefficient}{T^{ini} + Coefficient} \tag{7}$$

where T^{*} is the new tariff rate, T^{ini} is the initial tariff rate and $Coefficient$ is the used coefficient which is equal to the maximum tariff rate. In our case we use an ambitious coefficient equal to 10%. Three simulations are implemented:

The first simulation and the most ambitious sets the maximum tariff of all the sectors to 10% through an unconditional trade liberalization. Clearly, it is unrealistic but for the sake of comparison it is simulated to see to what extent Egypt may benefit and/or lose from such a liberalization. The second simulation sets the maximum tariff of agriculture to 10% through an unconditional trade liberalization. As agriculture is one of the most protected sectors in Egypt, we try to determine the effect of its liberalization especially that Egypt is a net importer of agriculture products. Finally, the third simulation assesses another partial liberalization using the Girard formula or the Swiss formula by setting the maximum tariff of textiles and garments to 10%. The rationale behind such a simulation is explained by the fact that Egypt has a comparative advantage in this sector. Therefore, once it is liberalized, it should have a positive impact on employment, exports, and therefore wages.

Table 6 displays the macroeconomic effects of the 3 simulations. It is worth mentioning that trade liberalization has a positive effect on the Egyptian economy as total import, total export and consumption are boosted. Clearly, the more Egypt liberalizes its external trade, the higher are the gains that are generated in the short run. For instance, when Egypt liberalizes the textile and garment sectors, total exports are boosted by 0.36% and total imports by 0.15%. Those modest figures are explained by the fact that Egypt has

[5]This formula is designed to cut and harmonize tariff rates. It was first introduced by the Swiss Delegation to the WTO during the Doha Development Round. The aim was to provide a mechanism where maximum tariffs could be agreed, and where existing low tariff countries would make a commitment to some reduction

already liberalized those sectors, this is why more liberalization does not generate high gains. By contrast, when agriculture is liberalized, those figures increase to reach 1.5% for total exports and 0.6% for total imports. Finally, when trade is fully liberalized, the highest gains are generated as total exports are boosted by 5.6% (thanks to a significant depreciation) and total imports by 2.2% (thanks to lower tariffs).

[Tables 6 about here]

Removing tariffs reduces consumption prices by 0.94% when trade is fully liberalized raising real revenues of different households. Therefore, total consumption increases by 1% and in turn, urban and rural welfare witness the highest improvement by 0.65% and 1% respectively. Agriculture liberalization yields lower welfare gains (0.1% and 0.3% respectively) but they are still more important than those coming from textile and garments liberalization (0.02% and 0.05% respectively).

[Tables 7, 8 and 9 about here]

Turning to the labor market, it is quite clear that trade is skill biased. Table 7 shows that when trade is fully liberalized, skilled workers in urban and rural areas are positively affected. In urban areas, skilled females witness a higher wage variation (0.9%) than skilled males (0.27%) thanks to higher labor demand especially in chemicals, clothes and social services. This last sector is one of the most intensive in skilled females after the manufacturing one. Clearly, females are concentrated in the textile sector since it is intensive in unskilled labor which is more frequent among females as they are less educated than males. On the hand, services is an important employer of females as it allows for a better reconciliation between work and family lives (maternity leaves, flexible working hours and stability).

As Egypt does not have a comparative advantage in agriculture, when the latter is liberalized, production shrinks along with the labor demand that reduces more for unskilled males and females pushing their wages down by 0.72% and 0.52% respectively in urban areas. Such a result may be surprising as one can perceive agriculture as an unskilled-females-intensive sector. In reality, unskilled females working in agriculture, and particulary in rural areas, usually belong to the informal sector or the subsistence work. Such a sector is not taken into account in our analysis as we are focusing only on the formal one. However, studying the impact of liberalization on informal sector is on our research agenda as it represents a significant part of the females employment in general, and the agriculture sector in particular.

Finally, when garments and textiles are liberalized, their imports raise. Although Egypt has a comparative advantage in garments and textiles, it faces a fierce competition coming from the Asian countries which are much more competitive. Therefore, domestic production declines, labor demand decreases by 0.27% for textiles and 1.55% for garments. This in turn reduces the wage for all segments, especially skilled males and females by 0.04%.

5.3 Microsimulation Results

After replicating the CGE results on the microeconomic level using the Top Down approach, we can simply determine the effect of trade liberalization on individuals income. Such an analysis is allowed by the microsimulation as we can undertake a poverty and inequality analysis using the Lorenz curve, the Gini coefficient and the Theil index.

Table 10 displays the Gini coefficient and the Theil index for according to gender, qualification and region for our three simulations.

First, it is quite clear that in all the simulations, inequality between skilled and unskilled is the most important issue in Egypt as the Gini index goes up from 42.5% to 78% in the case of the agriculture liberalization, 52% when textile and garments are liberalized and 78.3% when all sectors are liberalized simultaneously. The same patterns can be observed for the Theil index. This shows to what extent trade liberalization increases the skill premia as mentioned above.

As to gender inequality, agriculture and total liberalization increase inequality between males and females (from 42% to 51.5% and 56.5% respectively). Interestingly, textile liberalization reduces such an inequality as males wages decrease more than females ones.

Finally, regional inequality is negatively affected by agriculture and total liberalization while it is positively affected by the textiles and garments one. This is due to the fact that when the latter sector is liberalized, wages decrease for all segments, especially among urban ones which, in turn reduces the gap between urban and rural areas. By contrast, in the other two simulations, this gap increases.

[Table 10]

Those results are represented in Figures 7, 8 and 9 that display the Lorenz curve for the different labor segments. First, Figure7 shows the same pattern for skilled vs. unskilled wage workers. Among the latter, inequality is more pronounced. This result is confirm to the literature on trade effect on the skill premium between skilled and unskilled. Similarly, having a quick glance on Figure 8, we observe a more egalitarian income distribution among females relative to their counterparts. Finally, the inequality scheme for rural vs. urban regions is rather similar as shown in Figure 9.

In conclusion, the most important aspect of inequality is the one between skilled and unskilled workers. From a policy implication standpoint, the government of Egypt can reduce such an inequality through an improvement of the education system that increases the workers qualifications.

[Figures 7, 8 and 9 about here]

6 Conclusion

The present research develops a microsimulation analysis in order to evaluate the impact of trade liberalization policies on the Egyptian labor market taking into consideration the gender issues. Our analysis aims at identifying the effects of those measures on redistribution aspects. For this, we rely on a macro - micro approach integrating results obtained from a discrete choice model of labor supply in a Computable General Equilibrium model (CGE).

The results of the discrete choice model of labor supply show important effects of marriage on the females labor market choices. Moreover, a higher level of education significantly affect the individual's choice. The latter increases the probability of being a wage worker rather than being inactive.

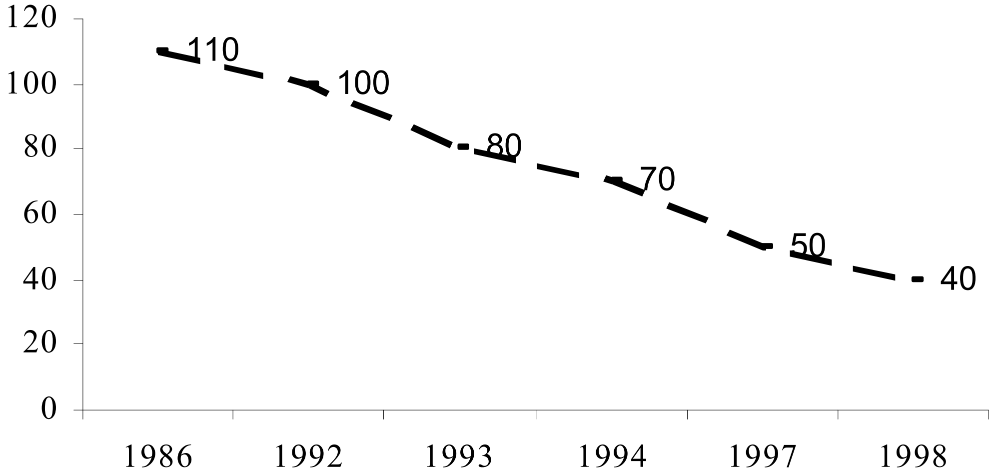
Our main findings from the CGE model show that welfare increase is triggered by the price effect of trade liberalization. It is worth mentioning also that trade liberalization has different effects on each sector. The most important sectors witnessing an increase in their exports are: transport services, chemicals and animal products. Imports of garments, processed food and vegetables raise as Egypt is a net importer of such products. Clearly, Asian countries have a comparative advantage in those products, that is why Egypt increases its imports of such products, which in turn, boosts the households welfare. Finally, in the short term, real wages increase but decrease on the long run, which reduces the households welfare. Such observations highlight the importance of a multilateral trade liberalization not a unilateral one as mentioned below.

Our research agenda includes some methodological and technical aspects in order to better assess the effects of trade liberalization. On the one hand, it would be more interesting to take into account not only the tariff imposed by Egypt but also the one imposed by its trade partners. Such a point should allow us to assess the effect of multilateral trade liberalization which is more beneficial than unilateral one. This conclusion is in line with the literature on trade liberalization: a country gains more when its main partners liberalize their trade simultaneously. Furthermore, we have also to disaggregate the Rest of the World into many agents, namely by introducing Egypt's main trade partners: U.S.A., E.U and Arab countries. In addition, and the most important, we have to introduce imperfect competition in the model. This assumption is more realistic assumption and crucial for trade liberalization issues. Finally, our simulations have been run in a static framework without taking into account long run benefits. Our analysis should be extended to assess the effect of liberalization through a dynamic approach.

Tables and Figures

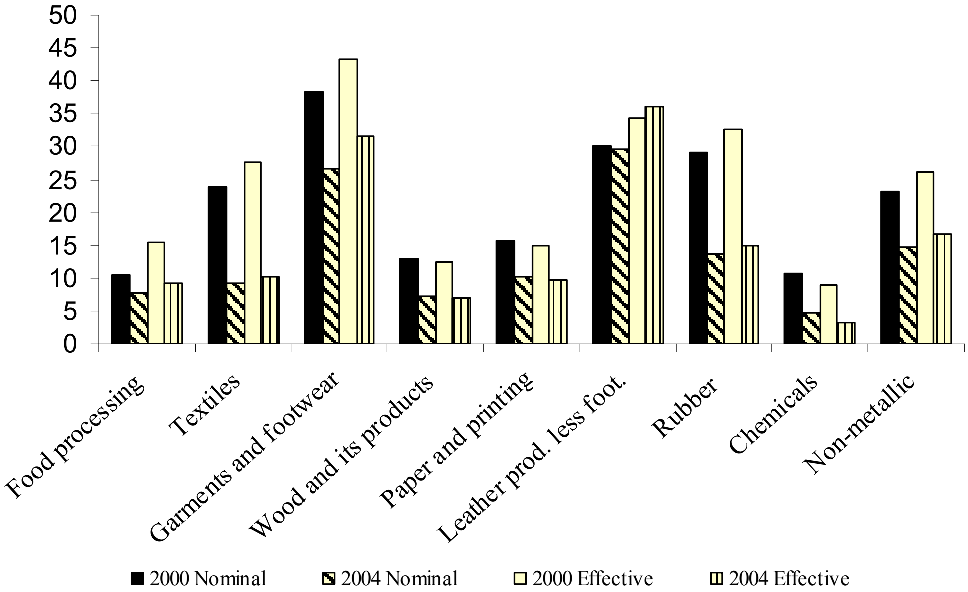
1. Descriptive Statistics

Figure 1:
Maxim Tariff Rate



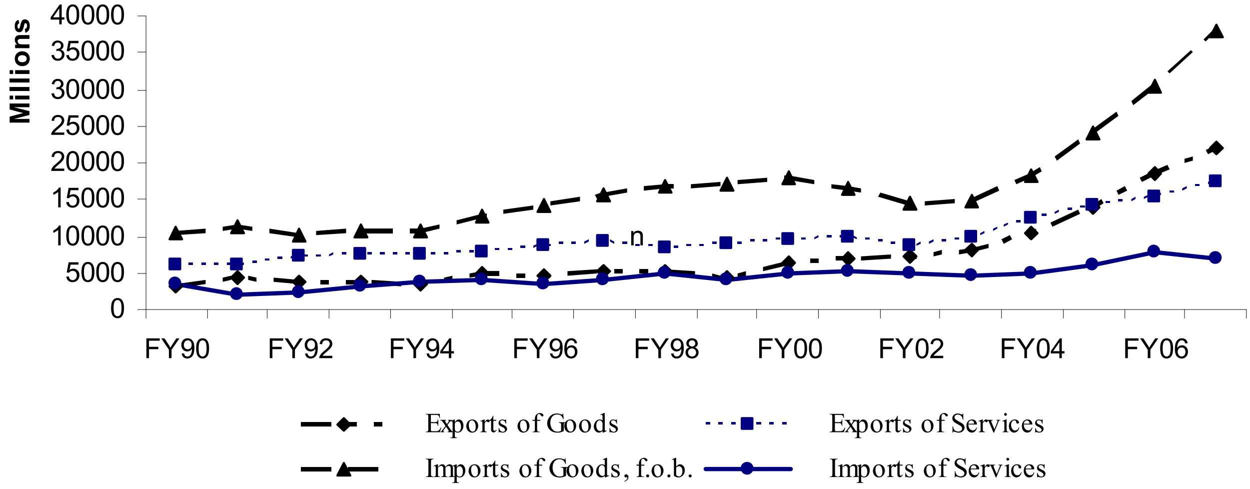
Source: CAPMAS, 2008.

Figure 2:
Nominal and Effective Rates of Protection in the Egyptian Manufacturing Activities



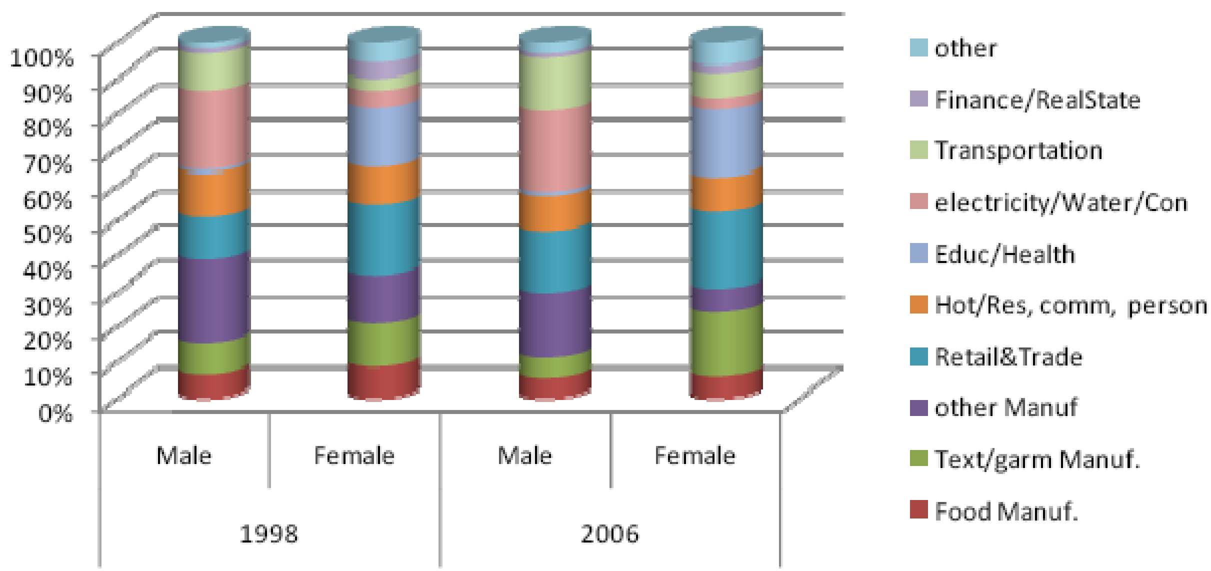
Source: CAPMAS, 2008.

Figure 3:
Egypt's Trade: Exports and Imports



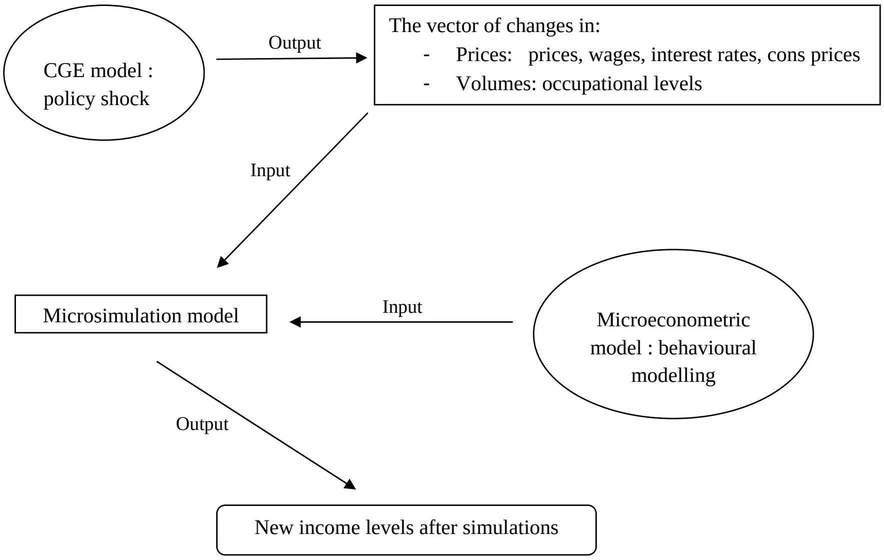
Source: CAPMAS, 2008.

Figure 4:
Sectors and Gender



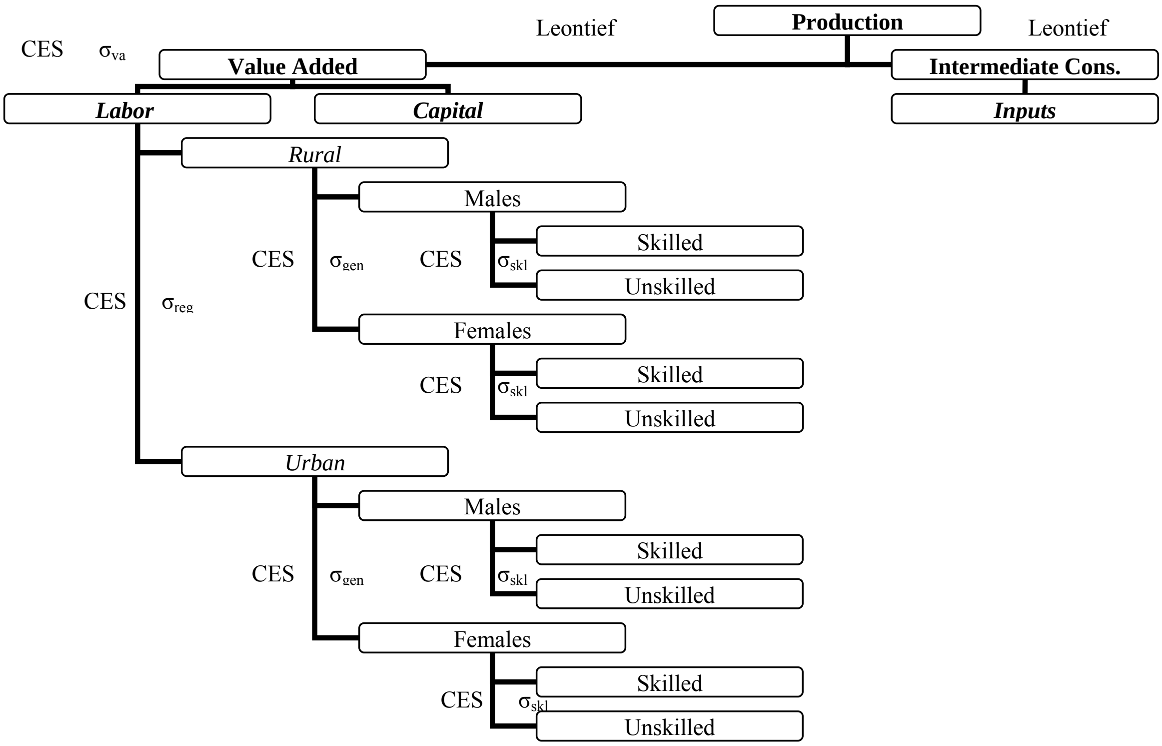
Source: F. El-Hamidi, 2008.

Figure 5:
Micro-simulation Mechanisms: Top Down Approach



Source: Adapted from Colombo (2008).

Figure 6:
Production Structure



Source: Constructed by the authors.

Table 1: Labor by Working Sector and Segment

	Males				Females				Total
	Rural		Urban		Rural		Urban		
	Skill	**Unskill**	**Skill**	**Unskill**	**Skill**	**Unskill**	**Skill**	**Unskill**	
Government	276	183	754	218	112	7	607	35	**2192.00**
	13%	8%	34%	10%	5%	0%	28%	2%	**100%**
Agriculture	61.00	383.00	37.00	116.00	1.00	23.00	1.00	10.00	**632.00**
	10%	61%	6%	18%	0%	4%	0%	2%	**100%**
Mining	2.00	4.00	7.00	8.00	0.00	0.00	0.00	0.00	**21.00**
	10%	19%	33%	38%	0%	0%	0%	0%	**100%**
Manufacture	70.00	167.00	292.00	325.00	4.00	20.00	43.00	40.00	**961.00**
	7%	17%	30%	34%	0%	2%	4%	4%	**100%**
Services	130.00	330.00	579.00	752.00	15.00	52.00	114.00	79.00	**2051.00**
	6%	16%	28%	37%	1%	3%	6%	4%	**100%**
TOTAL	**539.39**	**1068.05**	**1670.04**	**1420.00**	**132.06**	**102.06**	**765.32**	**164.07**	**5862.00**
	9%	**18%**	**28%**	**24%**	**2%**	**2%**	**13%**	**3%**	**100%**

Notes: Constructed using the ELMS 1998.

Table 2: Labor by Gender, Region and Qualification Level

		Males		**Females**		**Total**	
Rural Areas	**Illiterate**	864	34.46%	1,465	57.43%	2,329	46,05%
	Low Skilled	865	34.50%	630	24.70%	1,495	29,56%
	High Skilled	778	31.03%	456	17.88%	1,234	24,40%
	Total	2,507	100%	2,551	100%	5,058	100%
Urban Areas	**Illiterate**	1,223	25,69%	1,810	36,88%	3,043	31,35%
	Low Skilled	1,407	29,32%	1,389	28,30%	2,796	28,80%
	High Skilled	2,159	44,99%	1,709	34,82%	3,868	39,85%
	Total	4,799	100%	4,908	100%	9,707	100%

Notes: Constructed using the ELMS 1998.

Table 3: Mean Wages of the Working Population

		Mean Wages
Males	**Skilled in Rural**	173.2372
	Unskilled in Rural	129.8379
	Skilled in Urban	262.7396
	Unskilled in Urban	146.7782
Females	**Skilled in Rural**	132.9048
	Unskilled in Rural	89.55001
	Skilled in Urban	218.2871
	Unskilled in Urban	139.3214

Notes: Constructed using the ELMS 1998.

2. Results

Microeconomic Results

Table 4: Results of the Selection Model of Participation by Gender, Qualification Level and Region

	Gender		Qualification		Region	
	Males	**Females**	**Unskilled**	**Skilled**	**Urban**	**Rural**
age	0.225***	0.229***	0.114***	0.307***	0.216***	0.163***
	(0.0085)	(0.0119)	(0.0081)	(0.0119)	(0.0076)	(0.0115)
age square	-0.00278***	-0.00300***	-0.00142***	-0.00349***	-0.00266***	-0.00208***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(9.39e-05)	(0.0001)
Married/	0.136**	-0.377***	0.0181	-0.325***	-0.126***	0.0148
	(0.0530)	(0.0497)	(0.0455)	(0.0511)	(0.0382)	(0.0579)
hh size	-0.0360***	-0.0990***	-0.00790	-0.0171**	-0.0310***	-0.0279***
	(0.0058)	(0.0095)	(0.0056)	(0.0079)	(0.0059)	(0.0068)
Father educ.2/	0.195**	0.465***	-0.146	-0.0109	0.146**	0.380**
	(0.0871)	(0.0826)	(0.107)	(0.0777)	(0.0620)	(0.151)
Father educ.3/	0.341***	0.751***	0.115	-0.0218	0.434***	0.102
	(0.0963)	(0.0864)	(0.137)	(0.0768)	(0.0673)	(0.178)
Father educ.4/	0.176*	0.644***	-0.635***	-0.0758	0.289***	0.236
	(0.0972)	(0.0930)	(0.217)	(0.0802)	(0.0686)	(0.246)
Mother educ.2/	-0.204	0.312**	-0.0564	-0.338***	-0.0278	0.417
	(0.183)	(0.147)	(0.347)	(0.125)	(0.116)	(0.539)
Mother educ.3/	-0.192	0.0899	0.0166	-0.325**	-0.102	0.362
	(0.183)	(0.168)	(0.407)	(0.133)	(0.125)	(0.537)
Mother educ.4/	0.429	-0.0457	-0.179	-0.0678	-0.00701	0.468
	(0.293)	(0.199)	(0.547)	(0.178)	(0.158)	(0.838)
lambda	-0.933***	-0.188**	0.723	0.00528	-0.866***	-1.256*
	(0.343)	(0.0749)	(0.846)	(0.163)	(0.215)	(0.690)
Constant	-4.007***	-4.313***	-2.986***	-5.558***	-4.139***	-3.435***
	(0.149)	(0.201)	(0.136)	(0.213)	(0.134)	(0.191)
Obs.	7306	7459	9663	5102	9707	5058

Notes: (i.) Standard errors in parentheses. (ii.) ***, ** and * represent respectively statistical significance at the 1%, 5% and 10% levels. (iii.)/ refers to dummy variables. (iv.) Inactivity is the base outcome

Table 5: Results of the Heckman Wage Equations by Gender, Qualification Level and Region

	Gender		Qualification		Region	
	Males	**Females**	**Unskilled**	**Skilled**	**Urban**	**Rural**
age	-0.0667	-0.0415***	0.154*	0.0464*	-0.0826**	-0.0509
	(0.0563)	(0.0161)	(0.0803)	(0.0281)	(0.0338)	(0.0919)
age square	0.00124*	0.000955***	-0.00150	-0.000112	0.00147***	0.00105
	(0.000686)	(0.000213)	(0.000996)	(0.000328)	(0.000420)	(0.00117)
hh size	0.00884	0.0153	-0.00758	-0.0201***	0.00801	0.0211
	(0.0116)	(0.0115)	(0.0126)	(0.00656)	(0.00997)	(0.0200)
Rural/	-0.180***	-0.201***	-0.144**	-0.201***		
	(0.0402)	(0.0491)	(0.0661)	(0.0355)		
Skill/	0.740***	0.573***			0.736***	0.611***
	(0.0375)	(0.0559)			(0.0368)	(0.0665)
Female/			0.225*	-0.0580*	-0.0428	0.0145
			(0.118)	(0.0297)	(0.0367)	(0.0914)
Constant	5.723***	4.898***	-0.0365	3.753***	6.150***	6.068**
	(1.275)	(0.347)	(2.685)	(0.651)	(0.812)	(2.420)
Observations	7306	7459	9663	5102	9707	5058

Notes: (i.) Standard errors in parentheses. (ii.) ***, ** and * represent respectively statistical significance at the 1%, 5% and 10% levels. (iii.)/ refers to dummy variables.(iv.) Inactivity is the base outcome

Macroeconomic Results

Table 6: Key Macroeconomic Variables

Variables	Textile	Agriculture	Total
GDP	0.00	0.02	-0.02
Investment	-0.08	-0.39	-1.52
Total Exports	0.36	1.53	5.57
Total Imports	0.15	0.58	2.21
Total Cons.	0.04	0.24	0.99
CPI	-0.04	-0.25	-0.94
Welfare Rural	0.05	0.30	1.03
Welfare Urban	0.02	0.11	0.65
Exchange Rate	0.19	1.00	3.21
Gov. Revenues	-0.32	-1.46	-6.30

Notes: (i.) Source: Authors calculations.
(ii.) Those figures are calculated with respect to the Base Year scenario.

Table 7: Macroeconomic Results: Real Wage Variations

Variables	Textile	Agriculture	Total
Urban Male Skilled	-0.04	0.33	0.27
Rural Male Skilled	-0.05	0.49	0.40
Urban Female Skilled	-0.04	0.91	0.91
Rural Female Skilled	-0.01	0.85	1.16
Urban Male Unskilled	0.01	-0.72	-0.43
Rural Male Unskilled	-0.01	-0.42	-0.25
Urban Female Unskilled	-0.01	-0.52	-0.39
Rural Female Unskilled	-0.02	0.19	0.33

Notes: (i.) Source: Authors calculations.
(ii.) Those figures are calculated with respect to the Base Year scenario.

Table 8: Labor Demand Variations for Males

	Males											
	Urban Skilled			**Rural Skilled**			**Urban Unskilled**			**Rural Unskilled**		
	Textile	**Agr**	**Total**	**Textile**	**Agr**	**Total**	**Textile**	**Agr**	**Total**	**Textile**	**Agr**	**Total**
AGRVEG	0.09	-2.35	-1.78	0.09	-2.42	-1.84	0.07	-1.83	-1.44	0.07	-1.98	-1.52
AGRANM	0.09	-2.29	-1.62	0.09	-2.36	-1.67	0.06	-1.77	-1.27	0.07	-1.91	-1.36
INDOIL	0.09	0.24	0.80	0.10	0.16	0.74	0.07	0.77	1.15	0.08	0.62	1.06
INDFOOD	0.11	2.00	-1.49	0.11	1.92	-1.55	0.08	2.54	-1.14	0.09	2.38	-1.23
INDTOB	0.13	0.38	-14.94	0.13	0.29	-15.00	0.10	0.91	-14.64	0.11	0.75	-14.72
INDSPIN	-1.55	0.84	0.75	-1.54	0.76	0.69	-1.57	1.37	1.10	-1.56	1.22	1.01
INDCLO	-0.27	0.36	1.43	-0.27	0.28	1.36	-0.30	0.89	1.78	-0.29	0.74	1.69
INDCHM	0.14	0.57	1.68	0.15	0.49	1.61	0.12	1.10	2.03	0.13	0.95	1.94
INDNMET	0.10	0.31	-0.99	0.11	0.22	-1.06	0.08	0.84	-0.65	0.09	0.68	-0.74
INDBAS	0.16	0.59	0.15	0.16	0.50	0.08	0.13	1.12	0.50	0.14	0.96	0.41
INDMET	0.08	0.32	-2.67	0.08	0.24	-2.74	0.05	0.85	-2.33	0.06	0.70	-2.42
INDENG	0.07	0.13	-1.63	0.07	0.04	-1.69	0.05	0.66	-1.28	0.05	0.50	-1.37
INDOTH	0.16	0.60	-2.10	0.16	0.52	-2.16	0.13	1.14	-1.75	0.14	0.98	-1.84
SERTRA	0.20	0.80	2.91	0.20	0.71	2.84	0.17	1.33	3.27	0.18	1.17	3.18
SEROTH	0.03	0.29	0.47	0.03	0.21	0.41	0.00	0.82	0.82	0.01	0.67	0.73
SOCSER	0.09	0.14	0.94	0.09	0.06	0.88	0.06	0.67	1.30	0.07	0.52	1.20

Notes: (i.) Source: Authors calculations.
(ii.) Those figures are calculated with respect to the Base Year scenario.

Table 9: Labor Demand Variations for Females

	Females											
	Urban Skilled			**Rural Skilled**			**Urban Unskilled**			**Rural Unskilled**		
	Textile	**Agr**	**Total**	**Textile**	**Agr**	**Total**	**Textile**	**Agr**	**Total**	**Textile**	**Agr**	**Total**
AGRVEG	0.09	-2.63	-2.09	0.07	-2.69	-2.31	0.08	-1.94	-1.45	0.08	-2.37	-1.91
AGRANM	0.09	-2.57	-1.92	0.07	-2.63	-2.14	0.07	-1.87	-1.28	0.08	-2.31	-1.74
INDOIL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INDFOOD	0.11	1.62	-1.89	0.09	1.65	-2.03	0.09	2.35	-1.24	0.09	1.99	-1.63
INDTOB	0.13	0.00	-15.28	0.11	0.03	-15.41	0.12	0.72	-14.73	0.12	0.36	-15.06
INDSPIN	-1.54	0.46	0.35	-1.56	0.49	0.20	-1.56	1.18	1.00	-1.56	0.82	0.61
INDCLO	-0.27	-0.01	1.02	-0.29	0.02	0.87	-0.28	0.70	1.68	-0.28	0.35	1.28
INDCHM	0.15	0.19	1.27	0.13	0.22	1.12	0.13	0.91	1.93	0.13	0.55	1.54
INDNMET	0.10	-0.07	-1.39	0.08	-0.04	-1.54	0.09	0.64	-0.75	0.09	0.29	-1.13
INDBAS	0.16	0.21	-0.25	0.14	0.24	-0.40	0.15	0.93	0.40	0.15	0.57	0.01
INDMET	0.08	-0.05	-3.07	0.06	-0.02	-3.21	0.06	0.66	-2.43	0.06	0.31	-2.81
INDENG	0.07	-0.25	-2.02	0.05	-0.22	-2.17	0.06	0.46	-1.38	0.06	0.11	-1.76
INDOTH	0.16	0.23	-2.49	0.14	0.26	-2.63	0.14	0.94	-1.85	0.14	0.59	-2.23
SERTRA	0.20	0.39	2.47	0.18	0.44	2.33	0.18	1.11	3.14	0.18	0.77	2.75
SEROTH	0.03	-0.11	0.05	0.01	-0.07	-0.09	0.02	0.60	0.70	0.02	0.26	0.32
SOCSER	0.09	-0.26	0.52	0.07	-0.22	0.38	0.08	0.45	1.17	0.08	0.11	0.79

Notes: (i.) Source: Authors calculations.
(ii.) Those figures are calculated with respect to the Base Year scenario.

Microsimulation Results

Table 10: Inequality Indices by Gender, Qualification Level and Region

		Baseline	Agriculture	Textile	All sectors
Gender	**Gini coefficient**	42.53%	51.5%	33.5%	56.5%
	Theil Index	0.36	0.52	0.20	0.64
Skill	**Gini coefficient**	42.53%	77.9%	52.1%	78.3%
	Theil Index	0.36	1.26	0.47	1.28
Region	**Gini coefficient**	42.53%	55.4%	31.8%	59.3%
	Theil Index	0.36	0.55	0.19	0.64

Notes: (i.) Source: Authors calculations.
(ii.)

Figure 7:
Lorenz Curve: By Qualification

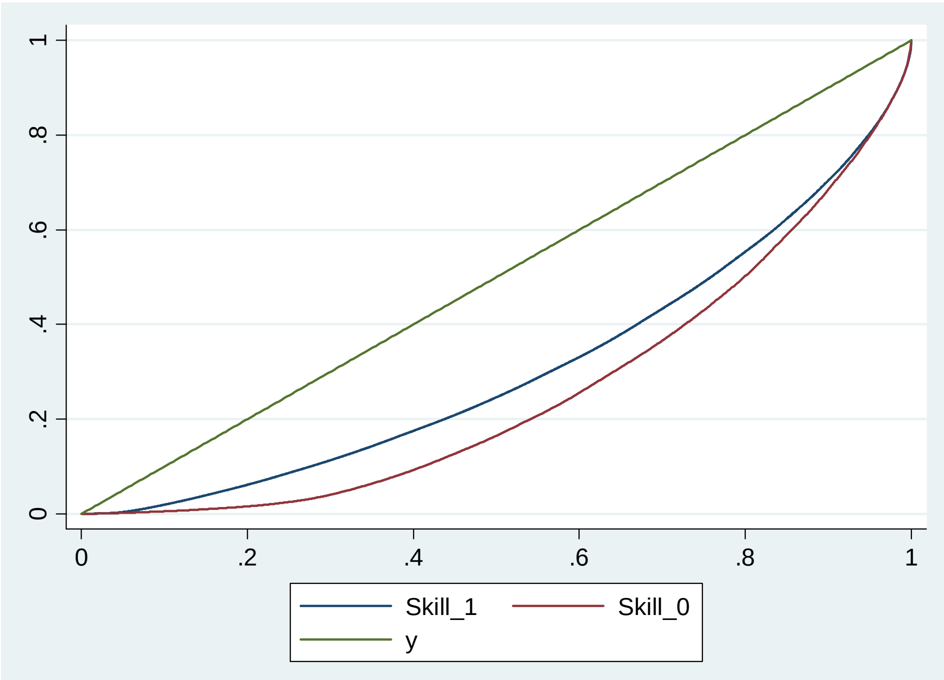


Figure 8:
Lorenz Curve: By Gender

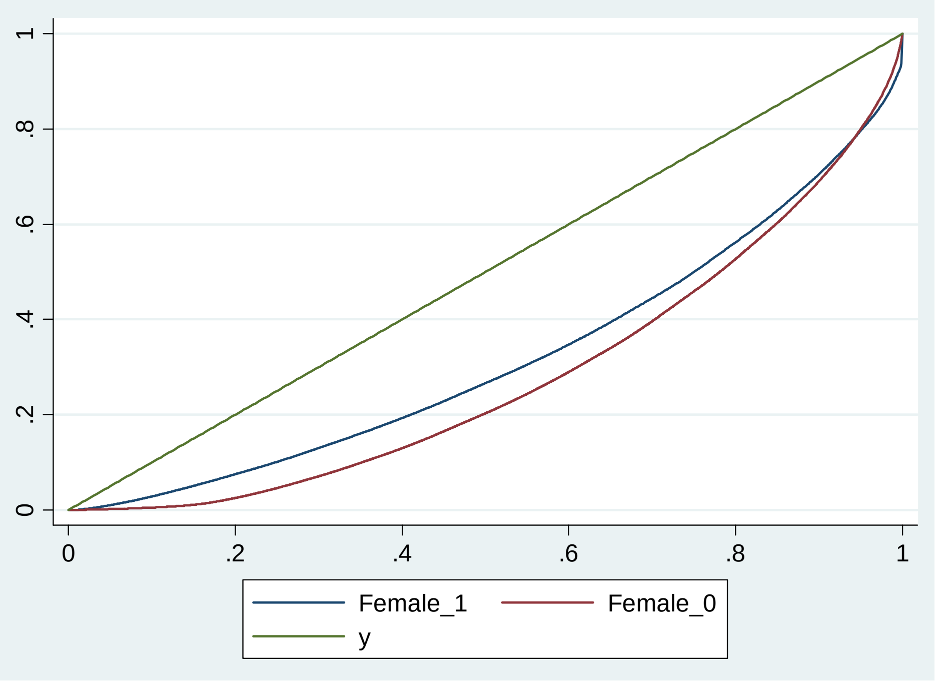
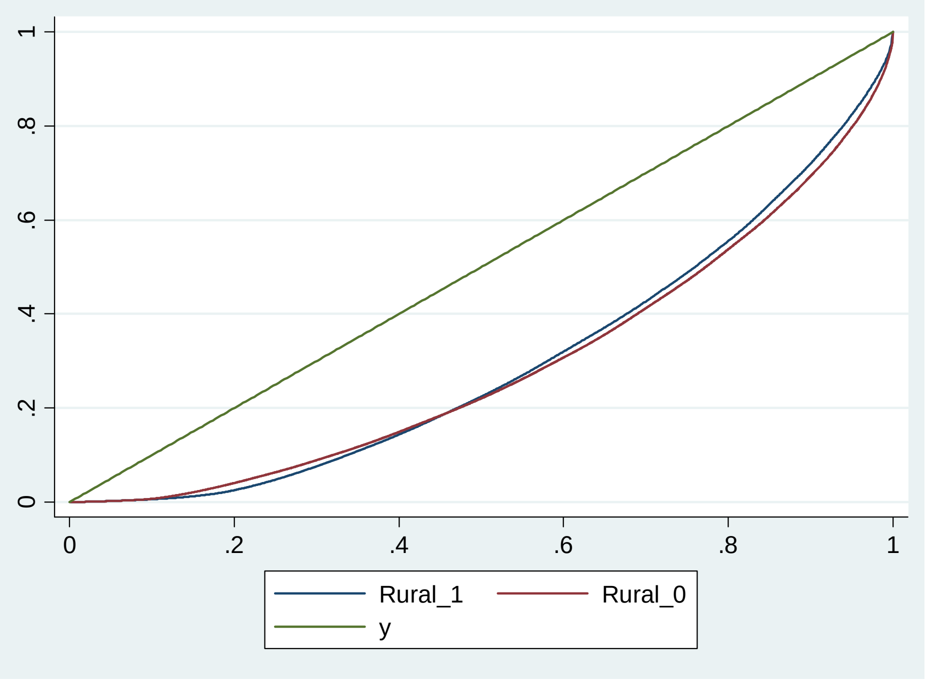


Figure 9:
Lorenz Curve: By Region



References

[1] Ahmed, V. and O'Donoghue, C., (2004) "Using CGE and Microsimulation Models for Income Distribution Analyses: A Survey", March.

[2] Annabi, N., Cockburn, J. and Decaluwé, B., (2004) "A Sequential Dynamic CGE Model For Poverty Analysis", May.

[3] Assaad, R., (2007), "Labour supply, employment and unemployment in the Egyptian economy: 1988-2006". Population Council Working Paper 0701.

[4] Barssoum, G., (2007), "Egypt labour market panel survey 2006: Report on methodology and data collection". Economic research forum (ERF) working paper 0704.

[5] Beneria, L. and Bisnath, S., (1996), "Gender and poverty: An analysis for action", UNDP Gender in Development Monography series 2.

[6] Bourguignon, F., Robilliard, A. S. and Robinson, S., (2006) "Examining the Social Impact of the Indonesian Financial Crisis using a Micro Macro Model", March.

[7] Bourguignon, F., Robilliard, A. S. and Robinson, S., (2003) "Representative versus real households in the macro-economic modeling of inequality", DELTA Working Papers 2003-05, DELTA (Ecole normale supérieure).

[8] Borjas, G. and Ramey, V., (1995) "Foreign Competition, Market Power and Wage Inequality" *The Quarterly Journal of Economics*, Vol. 110, No. 4 (Nov., 1995), pp. 1075-1110

[9] Chemingui, M.A. and Thabet, C., (2008), "Agriculture trade liberalization and poverty in Tunisia: Micro- simulation in a General equilibrium framework", Economic research forum (ERF) working paper 402.

[10] Colombo, G. (2008), "Linking CGE and Microsimulation Models: A Comparison of Different Approaches", ZEW Discussion Paper No. 08-054, Mannheim.

[11] Colombo, G. (2008), "The Effects of DR-CAFTA in Nicaragua: A CGE-Microsimulation Model for Poverty and Inequality Analysis", mimeo.

[12] Decaluwé, B., Martens A. and Savard L., (2001) "La Politique Economique du Développement et les Modèles d'Equilibre Général Calculable", Les Presses de l'Université de Montréal, Montréal, Canada, septembre.

[13] Decaluwé, B., Dumont J. C. and Savard L., (1999) "Measuring Poverty and Inequality in a Computable General Equilibrium Framework", Université Laval, Cahier de Recherche du C'ERFA 99-20.

[14] Eby Konan, D. and Maskus K., (1996) "A Computable General Equilibrium Analysis of Egyptian Trade Liberalization Scenarios", World Bank Working Paper No. 97-1, August.

[15] Edward, S., (1987), "Sequencing economic liberalization in developing countries", Finance and Development, March.

[16] El-Hamidi, F., (2008), "Trade liberalization, gender segmentation, and wage Discrimination: Evidence from Egypt", Economic Research Forum Working Paper 414.

[17] Elson, D., (1992), "Labor markets as gendered institutions: Efficiency and empowerment issues", in World development, vol.27, No. 3.

[18] Epifani, P. and Gancia G., (2007) "TThe Skill Bias of World Trade", *mimeo* March.

[19] Fofana, I., Cockburn J., Decaluwé B. and Robichaud V., (2006) "Un Modèle Standard d'Equilibre Général Calculable pour l'Analyse des Politiques Economiques", Centre Universitaire sur le Risque , les Politiques Economiques et l'Emploi (CIRPEE) et le Réseau de Recherche sur les Politques Economiques et la Pauvreté (PEP), Université de Laval, Québec, Canada, July.

[20] Fontana, M. et al., (1998), "Global trade expansion and liberalization: Gender issues and impacts", Bridge Briefings on Development and Gender, Report No. 42, Brighton, IDS/ University of Sussex.

[21] Haan, P., (2004), "Discrete choice labor supply: Conditional logit vs. random coefficient models". DIW discussion paper 394.

[22] Korayem, K., (1997), “Egypt’s economic reform and structural adjustment (ER-SAP)”, ECES Working Paper 19, october.

[23] Nassar, H. 2005, “Migration, Transfer and Development in Egypt” CARIM Research Report 2005/01.

[24] Rutherford, T., Rutstrom, E. and Tarr, D. (1993) “Morocco’s Free Trade Agreement with the European Community : a Quantitative Assessment”, *Policy Research Working Paper Series* No. 1173, The World Bank.

[25] Said, M., (2007) “The Fall and Rise of Earnings and Inequality in Egypt: New Evidence From the ELMPS, 2006”, *ERF Working Paper* 0708.

[26] Savard L. (2003) “Poverty and Income Distribution in A CGE-Household Micro-simulation Model: Top-Down/Bottom-Up Approach”, CIRPÉE, Working Papers 03-43, Université Laval.

[27] World Bank, (1991b), “Egypt’s economy in the 1990’s: challenges and opportunities”, Washington, DC, June.

[28] World Bank, (1991c), “Egypt, alleviating poverty during structural adjustment”, Washington, DC.

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Appendix 1: List of sectors

The Egyptian SAM includes 17 sectors. For the sake of modeling, two service sectors have been merged in order to avoid zero values present in the SAM. Those sectors are distributed as follows: 2 agricultural sectors, 11 industrial ones and 3 services sectors as follows:

Table 11: List of sectors included in the SAM

Abbreviation	Sector
AGRVEG	Agriculture vegetal production
AGRANM	Agriculture animal production
INDOIL	Oil and extraction industry
INDFOOD	Food industry
INDTOB	Tobacco industry
INDSPIN	Spinning and weaving industry
INDCLO	Clothes(includes leather)
INDCHM	Chemical industries
INDNMET	Non-metal industries
INDBAS	Basic metal industries
INDMET	Metal industries
INDENG	Enginery and machinery industries
INDOTH	Other industries
SERTRA	Transport and communication services
SEROTH	Other services
SOCSER	Social services

Appendix 2: The Model Notation

Indices definition

h	Household of type h
i and j	Sectors of the economy (16 sectors)
l	Individuals and type of labor
t	Time index

Parameters definition

1- Production functions

ν_j	Share of the value added in the production (Leontief) of sector j
io_j	Share of intermediary consumption in the production (Leontief) of sector j
aij_{ij}	Intermediary consumption of good i by unity of production of sector j
δ_j	Share of sector j value added of in GDP at factor cost

2- CES function between capital and labor

A_j^{va}	Scale parameter of the value added CES function of sector j
α_j^{va}	Share parameter of the value added CES function of sector j
ρ_j^{va}	Substitution parameter between labor and capital
σ_j^{va}	Substitution elasticity (value added function)

3- CES function between types of labor

First level

A_j^{reg}	Scale parameter of the labor CES function in urban/rural
ρ_j^{reg}	Substitution parameter between labor in urban/rural
σ_i^{reg}	Substitution elasticity parameter among labor in urban/rural
α_j^{reg}	Share parameter of the labor CES function in urban/rural

Second level

$A_j^{UR,gen}$	Scale parameter of the labor CES function among males/females in urban
$\rho_j^{UR,gen}$	Substitution parameter between labor among males/females in urban
$\sigma_i^{UR,gen}$	Substitution elasticity parameter among males/females in urban
$\alpha_j^{UR,gen}$	Share parameter of the labor CES function among males/females in urban
$A_j^{RU,gen}$	Scale parameter of the labor CES function among males/females in rural
$\rho_j^{RU,gen}$	Substitution parameter between labor among males/females in rural
$\sigma_i^{RU,gen}$	Substitution elasticity parameter among males/females in rural
$\alpha_j^{RU,gen}$	Share parameter of the labor CES function among males/females in rural

Third level

$A_j^{URMA,skl}$	Scale parameter of the labor CES function skilled/unskilled males in urban
$\rho_j^{URMA,skl}$	Substitution parameter between labor among skilled/unskilled males in urban
$\sigma_i^{URMA,skl}$	Substitution elasticity parameter among skilled/unskilled males in urban
$\alpha_j^{URMA,skl}$	Share parameter of the labor CES function among skilled/unskilled males in urban
$A_j^{URFE,skl}$	Scale parameter of the labor CES function skilled/unskilled females in urban
$\rho_j^{URFE,skl}$	Substitution parameter between labor among skilled/unskilled females in urban
$\sigma_i^{URFE,skl}$	Substitution elasticity parameter among skilled/unskilled females in urban
$\alpha_j^{URFE,skl}$	Share parameter of the labor CES function among skilled/unskilled females in urban
$A_j^{RUMA,skl}$	Scale parameter of the labor CES function skilled/unskilled males in rural
$\rho_j^{RUMA,skl}$	Substitution parameter between labor among skilled/unskilled males in rural
$\sigma_i^{RUMA,skl}$	Substitution elasticity parameter among skilled/unskilled males in rural
$\alpha_j^{RUMA,skl}$	Share parameter of the labor CES function among skilled/unskilled males in rural
$A_j^{RUFE,skl}$	Scale parameter of the labor CES function skilled/unskilled females in rural
$\rho_j^{RUFE,skl}$	Substitution parameter between labor among skilled/unskilled females in urban
$\sigma_i^{RUFE,skl}$	Substitution elasticity parameter among skilled/unskilled females in rural
$\alpha_j^{RUFE,skl}$	Share parameter of the labor CES function among skilled/unskilled females in rural

4- Demand functions

φ_h	Household h propensity to save
γ_{ih}	Budgetary share of good i in the income of household h
μ_i	Share of investment demand of sector i in total investment
λ_w^H	Share of Household h in the wages bill
$C_{i,h}^{min}$	Minimal consumption of good i by household h

5- Tax rates

tx_j	Indirect taxes rate applied on sector j products
tm_j	Import tariff rate applied on sector j products
te_j	Export tariff rate applied on sector j products
tp_j	Production tax rate applied on sector j
tyh_h	Direct tax rate applied on household h income
tyf	Direct tax rate applied on firms income

6- CES function between imports and domestic production

A_j^m	Scale parameter of the Armington CES function
α_j^m	Share parameter of the Armington CES function
ρ_j^m	Substitution parameter
σ_j^m	Substitution elasticity (Armington function)

7- CET function between exports and domestic production

B_j^e	Scale parameter of the CET production function
β_j^e	Share parameter of the CET production function
τ_j^e	Transformation elasticity (CET production function)
ε_j^e	Price elasticity
κ_j^e	Transformation parameter
EXD_j^o	Scale parameter of exports

Variables definition

A- Endogenous variables

1- Production

VA_j	Value added of sector j
XS_j	Production of sector j
XXS_j	Production of sector j at basic prices
CI_j	Total intermediary consumption of sector j
$DI_{i,j}$	Intermediary demand of product i by sector j

2- Production factors

KD_j	Capital demand by sector j
LS	Labor supply
LD_j	Labor demand by sector j
W_j	Wage rate in sector I

First level

$LFD_{UR,j}$	Labor demand of sector j in urban areas
$LFD_{RU,j}$	Labor demand of sector j in rural areas
$W_{UR,j}$	Wage rate of sector j in urban areas
$W_{RU,j}$	Wage rate of sector j in rural areas

Second level

$LFD_{URMA,j}$	Labor demand of males working sector j in urban areas
$LFD_{RUMA,j}$	Labor demand of males working sector j in rural areas
$W_{URMA,j}$	Wage rate of males working sector j in urban areas
$W_{RUMA,j}$	Wage rate of males working sector j in rural areas
$LFD_{URFE,j}$	Labor demand of females working sector j in urban areas
$LFD_{RUFE,j}$	Labor demand of females working sector j in rural areas
$W_{URFE,j}$	Wage rate of females working sector j in urban areas
$W_{RUFE,j}$	Wage rate of females working sector j in rural areas

Third level

$LFD_{URMASK,j}$	Labor demand of skilled males working sector j in urban areas
$LFD_{RUMASK,j}$	Labor demand of skilled males working sector j in rural areas
$W_{URMASK,j}$	Wage rate of skilled males working sector j in urban areas
$W_{RUMASK,j}$	Wage rate of skilled males working sector j in rural areas
$LFD_{URFESK,j}$	Labor demand of skilled females working sector j in urban areas
$LFD_{RUFESK,j}$	Labor demand of skilled females working sector j in rural areas
$W_{URFESK,j}$	Wage rate of skilled females working sector j in urban areas
$W_{RUFESK,j}$	Wage rate of skilled females working sector j in rural areas
$LFD_{URMAUK,j}$	Labor demand of unskilled males working sector j in urban areas
$LFD_{RUMAUK,j}$	Labor demand of unskilled males working sector j in rural areas
$W_{URMAUK,j}$	Wage rate of unskilled males working sector j in urban areas
$W_{RUMAUK,j}$	Wage rate of unskilled males working sector j in rural areas
$LFD_{URFEUK,j}$	Labor demand of unskilled females working sector j in urban areas
$LFD_{RUFEUK,j}$	Labor demand of unskilled females working sector j in rural areas
$W_{URFEUK,j}$	Wage rate of unskilled females working sector j in urban areas
$W_{RUFEUK,j}$	Wage rate of unskilled females working sector j in rural areas

3- Prices

r_j	Capital return in sector j
Pv_j	Value added price of sector j
Pc_j	Market price of the composite good belonging to sector j
P_j	Production price on factor cost of sector j
Pl_j	Producer price of sector j product sold on the domestic market
$Pfob_j$	Fob price of the exported good j
Pm_j	Domestic price of the imported good j
Pe_j	Producer price of the exported good j
$Pinv_j$	Investment price index
PCI_h	Consumer price index for household h
e	Nominal exchange rate

4- Revenues and Savings

YH_h	Household h income
YDH_h	Disposable income of household h
YF	Firms income
YG	Government income
SH_h	Household h savings
SF	Firms savings
SG	Government savings

5- Tax revenues

TDH_h	Receipts from direct taxes of household h
TDF	Receipts from direct taxes of firms
TI_j	Receipts from indirect of sector j
TIM_j	Receipts from import tariffs of goods j
TIE_j	Receipts from export tariffs of goods j
TIP_j	Receipts from production taxes

6- External Trade

EX_j	Export supply of product j
EXD_j	Export demand of product j
M_j	Import demand of product j
D_j	Domestic production of sector j sold on the domestic market
Q_j	Supply of composite product belonging to sector j

7- Final Demand

$C_{i,h}$	Consumption of good i by household h
INV_i	Investment demand of product i
DIT_i	Total intermediary demand of input i
IT	Gross fixed capital formation
$ITVOL$	Volume of total investment
EV_h	Equivalent variation of household h

8- Other variables

$savadj$	Adjustment variable for investment and savings
$Leon$	Walras law verification variable

B- Exogenous variables

w^g	Worker L wage rate in government
G_i	Public consumption of product i
LD_G	Labor demand by public sector
TG_h	Transfers made by the government to household h
DIV_h	Dividends distributed by firms to household h
Pwm_j	International import price of product j (foreign currency)
Pwe_j	International export price of product j (foreign currency)
$Pindex$	GDP deflator, numéraire
CAB	Current account balance (external savings)
$TR_{ROW,h}$	Transfers from the Rest of the World to household h
$TR_{h,f}$	Transfers from household h to the firms
$TR_{ROW,f}$	Transfers from the Rest of the World to the firms
$TR_{G,f}$	Transfers from the government to the firms
$TR_{ROW,G}$	Transfers from the Rest of the World to the government
$TR_{G,ROW}$	Transfers from the government to the Rest of the World

The Model Equations

1- Production Bloc

$$XS_j = min[(\frac{CI_j}{io_j})(\frac{VA_j}{\nu_j})] \tag{A1}$$

$$XXS_j = XS_j.tp_j \tag{A2}$$

$$VA_j = A_j^{va}[\alpha_j^{va} LD_j^{-\rho_j^{va}} + (1-\alpha_j^{va}) KD_j^{-\rho_j^{va}}]^{\frac{-1}{\rho_j^{va}}} \tag{A3}$$

$$CI_j = io_j XS_j \tag{A4}$$

$$DI_{ij} = aij_{ij} CI_j \tag{A5}$$

$$LD_j = (\frac{\alpha_j^{va}}{1-\alpha_j^{va}})^{\sigma_j^{va}} (\frac{r_j}{W_j})^{\sigma_j^{va}} KD_j \tag{A6}$$

First level

$$LD_j = A_j^{reg}[\alpha_j^{reg} LFD_{UR,j}^{-\rho_j^{reg}} + (1-\alpha_j^{reg}) LFD_{RU,j}^{-\rho_j^{reg}}]^{\frac{-1}{\rho_j^{reg}}} \tag{A7}$$

$$LFD_{UR,j} = (\frac{\alpha_j^{reg}}{1-\alpha_j^{reg}})^{\sigma_j^{reg}} (\frac{W_{RU,j}}{W_{UR,j}})^{\sigma_j^{reg}} LFD_{RU,j} \tag{A8}$$

$$W_j = (W_{UR,j} LFD_{UR,j} + W_{RU,j} LFD_{RU,j})/LD_j \tag{A9}$$

Second level

$$LFD_{UR,j} = A_j^{UR,gen}[\alpha_j^{UR,gen} LFD_{URFE,j}^{-\rho_j^{UR,gen}} + (1-\alpha_j^{UR,gen}) LFD_{URMA,j}^{-\rho_j^{UR,gen}}]^{\frac{-1}{\rho_j^{UR,gen}}} \tag{A10}$$

$$LFD_{URMA,j} = (\frac{\alpha_j^{UR,gen}}{1-\alpha_j^{UR,gen}})^{\sigma_j^{UR,gen}} (\frac{W_{URFE,j}}{W_{URMA,j}})^{\sigma_j^{UR,gen}} LFD_{URFE,j} \tag{A11}$$

$$W_{UR,j} = (W_{URMA,j} LFD_{URMA,j} + W_{URFE,j} LFD_{URFE,j})/LFD_{UR,j} \tag{A12}$$

$$LFD_{RU,j} = A_j^{RU,gen}[\alpha_j^{RU,gen} LFD_{RUFE,j}^{-\rho_j^{RU,gen}} + (1-\alpha_j^{RU,gen}) LFD_{RUMA,j}^{-\rho_j^{RU,gen}}]^{\frac{-1}{\rho_j^{RU,gen}}} \tag{A13}$$

$$LFD_{RUMA,j} = (\frac{\alpha_j^{RU,gen}}{1-\alpha_j^{RU,gen}})^{\sigma_j^{RU,gen}} (\frac{W_{RUFE,j}}{W_{RUMA,j}})^{\sigma_j^{RU,gen}} LFD_{RUFE,j} \quad (A14)$$

$$W_{RU,j} = (W_{RUMA,j}LFD_{RUMA,j} + W_{RUFE,j}LFD_{RUFE,j})/LFD_{RU,j} \quad (A15)$$

Third level

$$\begin{aligned} LFD_{URMA,j} &= A_j^{URMA,skl}[\alpha_j^{URMA,skl} LFD_{URMASK,j}^{-\rho_j^{URMA,skl}} \\ &+(1-\alpha_j^{URMA,skl}) LFD_{URMAUK,j}^{-\rho_j^{URMA,skl}}]^{\frac{-1}{\rho_j^{URMA,skl}}} \end{aligned} \quad (A16)$$

$$\begin{aligned} LFD_{URMASK,j} &= (\frac{\alpha_j^{URMA,skl}}{1-\alpha_j^{URMA,skl}})^{\sigma_j^{URMA,skl}} \times \\ &(\frac{W_{URMAUK,j}}{W_{URMASK,j}})^{\sigma_j^{URMA,skl}} LFD_{URMAUK,j} \end{aligned} \quad (A17)$$

$$\begin{aligned} W_{URMA,j} &= (W_{URMASK,j}LFD_{URMASK,j} \\ &+W_{URMAUK,j}LFD_{URMAUK,j})/LFD_{URMA,j} \end{aligned} \quad (A18)$$

$$\begin{aligned} LFD_{RUMA,j} &= A_j^{RUMA,skl}[\alpha_j^{RUMA,skl} LFD_{RUMASK,j}^{-\rho_j^{RUMA,skl}} \\ &+(1-\alpha_j^{RUMA,skl}) LFD_{RUMAUK,j}^{-\rho_j^{RUMA,skl}}]^{\frac{-1}{\rho_j^{RUMA,skl}}} \end{aligned} \quad (A19)$$

$$\begin{aligned} LFD_{RUMASK,j} &= (\frac{\alpha_j^{RUMA,skl}}{1-\alpha_j^{RUMA,skl}})^{\sigma_j^{RUMA,skl}} \times \\ &(\frac{W_{RUMAUK,j}}{W_{RUMASK,j}})^{\sigma_j^{RUMA,skl}} LFD_{RUMAUK,j} \end{aligned} \quad (A20)$$

$$\begin{aligned} W_{RUMA,j} &= (W_{RUMASK,j}LFD_{RUMASK,j} \\ &+W_{RUMAUK,j}LFD_{RUMAUK,j})/LFD_{RUMA,j} \end{aligned} \quad (A21)$$

$$\begin{aligned} LFD_{URFE,j} &= A_j^{URFE,skl}[\alpha_j^{URFE,skl} LFD_{URFESK,j}^{-\rho_j^{URFE,skl}} \\ &+(1-\alpha_j^{URFE,skl}) LFD_{URFEUK,j}^{-\rho_j^{URFE,skl}}]^{\frac{-1}{\rho_j^{URFE,skl}}} \end{aligned} \quad (A22)$$

$$LFD_{URFESK,j} = (\frac{\alpha_j^{URFE,skl}}{1-\alpha_j^{URFE,skl}})^{\sigma_j^{URFE,skl}} \times (\frac{W_{URFEUK,j}}{W_{URFESK,j}})^{\sigma_j^{URFE,skl}} LFD_{URFEUK,j} \tag{A23}$$

$$W_{URFE,j} = (W_{URFESK,j} LFD_{URFESK,j} + W_{URFEUK,j} LFD_{URFEUK,j})/LFD_{URFE,j} \tag{A24}$$

$$LFD_{RUFE,j} = A_j^{RU,skl}[\alpha_j^{RUFE,skl} LFD_{RUFESK,j}^{-\rho_j^{RUFE,skl}} + (1-\alpha_j^{RUFE,skl}) LFD_{RUFEUK,j}^{-\rho_j^{RUFE,skl}}]^{\frac{-1}{\rho_j^{RUFE,skl}}} \tag{A25}$$

$$LFD_{RUFESK,j} = (\frac{\alpha_j^{RUFE,skl}}{1-\alpha_j^{RUFE,skl}})^{\sigma_j^{RUFE,skl}} \times (\frac{W_{RUFEUK,j}}{W_{RUFESK,j}})^{\sigma_j^{RUFE,skl}} LFD_{RUFEUK,j} \tag{A26}$$

$$W_{RUFE,j} = (W_{RUFESK,j} LFD_{RUFESK,j} + W_{RUFEUK,j} LFD_{RUFEUK,j})/LFD_{RUFE,j} \tag{A27}$$

2- Revenues and Savings Bloc

$$YH_h = \lambda_w^h \sum_{j=1}^{16} LD_j.w + TR_{G,h} + DIV_h + TR_{ROW,h} + \lambda_w^h.LG_G \tag{A28}$$

$$YDH_h = YH_h - TD_h - TR_{h,e} \tag{A29}$$

$$YF = \sum_{j=1}^{16} r_j KD_j + TR_{ROW,f} + \sum_{h=hu}^{hr} TR_{h,f} + TR_{G,f} \tag{A30}$$

$$SH_h = \varphi_h YDH_h \tag{A31}$$

$$SF = YF - \sum_{h=hu}^{hr} DIV_h - TDF \tag{A32}$$

3- Government Revenues and Savings

$$TIP_j = tp_j P_j XS_j \tag{A33}$$

$$TI_j = tx_j(Pl_j D_j) + tx_j(1 + tm_j + tt_j)e_t Pwm_j M_j \tag{A34}$$

$$TIM_j = tm_j Pwm_j e M_j \tag{A35}$$

$$TIE_j = te_j Pe_j EX_j \tag{A36}$$

$$TDH_h = tyh_h YH_h \tag{A37}$$

$$TDF = tyf YF \tag{A38}$$

$$\begin{aligned} YG &= \sum_{j=1}^{16} TIM_j + \sum_{j=1}^{16} TIE_j + \sum_{j=1}^{16} TI_j \\ &+ \sum_{h=hu}^{hr} TDH_h + TDF + TR_{ROW,G} \end{aligned} \tag{A39}$$

$$SG = YG - \sum_{j=1}^{16} G_i - \sum_{h=hu}^{hr} TR_h - TR_{G,f} - wLD_G - TR_{G,ROW} \tag{A40}$$

4- Final Demand Bloc

$$PC_i C_{i,h} = PC_i C_{i,h}^{min} + \gamma_{ih}(YDH_h - \sum_i PC_i C_{ih}^{min}) \tag{A41}$$

(A42)

$$INV_i = \frac{\mu_i IT}{Pc_i} \tag{A43}$$

$$DIT_i = \sum_{j=1}^{16} DI_{ij} \tag{A44}$$

5- Prices Bloc

$$Pv_j = \frac{P_j XS_j - \sum_{i=1}^{16} Pc_i DI_{i,j}}{VA_j} \tag{A45}$$

$$r_j = \frac{Pv_j VA_j - w_j LD_j}{KD_j} \tag{A46}$$

$$Pm_j = ePwm_j(1+tm_j)(1+tx_j) \tag{A47}$$

$$Pe_j = \frac{ePfob_j}{(1+te_j)} \tag{A48}$$

$$Pc_j = (1+tx_j)\frac{Pl_j D_j + Pm_j M_j}{Q_j} \tag{A49}$$

$$P_j = \frac{Pl_j D_j + Pe_j EX_j}{XS_j} \tag{A50}$$

$$Pinv_j = \prod(\frac{Pc_j}{\mu_j})^{\mu_j} \tag{A51}$$

$$Pindex = \sum_{j=1}^{16} Pv_j \delta_j \tag{A52}$$

$$PCI_h = \sum_{i=1}^{16} \gamma_{hi}.PC_i \tag{A53}$$

6- International Trade Bloc

$$XS_j = B_j^e[\beta_j^e EX_j^{-\kappa_j^e} + (1-\beta_j^e)D_j^{-\kappa_j^e}]^{-\frac{1}{\kappa_j^e}} \tag{A54}$$

$$EX_j = [(\frac{1-\beta_j^e}{\beta_j^e})(\frac{Pe_j}{Pl_j})]^{\tau_j^e} D_j \tag{A55}$$

$$EXD_j = EXD_j^o(\frac{Pwe_j}{Pfob_j})^{\varepsilon_j^e} \tag{A56}$$

$$Q_j = A_j^m[\alpha_j^m M_j^{-\rho_j^m} + (1-\alpha_j^m)D_j^{-\rho_j^m}]^{-\frac{1}{\rho_j^m}} \tag{A57}$$

$$M_j = [(\frac{\alpha_j^m}{1-\alpha_j^m})(\frac{Pd_j}{Pm_j})]^{\sigma_j^m} D_j \tag{A58}$$

$$CAB = e\sum_{j=1}^{16} Pwm_j M_j + TR_{G,ROW} - TR_{ROW,h} - TR_{ROW,G} - TR_{ROW,f} - e\sum_{j=1}^{16} Pfob_j EX_j \quad (A59)$$

7- Equilibrium Equations Bloc

$$LS = \sum_{j=1}^{16} LD_j + LD_G \quad (A60)$$

$$Q_i = DIT_i + \sum_{h=hu}^{hr} C_{i,h} + INV_i + G_i \quad (A61)$$

$$IT = \sum_{h=hu}^{hr} SH_h + SF + SG + CAB \quad (A62)$$

$$IT = Pinv.\sum Ind_i \quad (A63)$$

$$ITVOL = \frac{IT}{Pinv} \quad (A64)$$

$$EXD_j = EX_j \quad (A65)$$

$$EV_h = (\prod_i (PCO_i/PC_i)^{\gamma_{i,h}} * YH_h) - YHO_h \quad (A66)$$