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ABSTRACT

Using a dynamic general equilibrium model, the paper provides a quantitative assessment of the impact of the Multifiber Agreement dismantling on unemployment in Tunisia. The specification of intertemporal behavior of households and firms permits the analysis of the effects of the shock on consumption and investment in the long run. By including a multisectoral model of efficiency wages, the model allows for an endogenous determination of unemployment. The main findings are that unemployment and wage inequality will increase due to the MFA phase out, and that a deeper integration with the EU can soften the negative effects of the shock.

Keywords: Unemployment, dynamic general equilibrium model, efficiency wages, multifiber agreement, Tunisia;

JEL classifications: D58, D91, D92, F16, J41

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I INTRODUCTION

The Agreement on Textile and Clothing (ATC) signed in 1995 stipulates the abolition of quotas on imports of textile products from WTO member countries by 2005. This means a dismantling of the Multifiber Agreement (MFA) which allowed a privileged access of Tunisian textile and clothing products to the European market, and was behind the spectacular development of the Tunisian textile industry during the last twenty years. The MFA, signed in 1973 allowed developed countries to impose bilateral quotas on their imports from developing countries. Countries like Tunisia which took indirectly advantage from the protection of the European market will face a higher competition from countries characterized by lower labor costs, mainly China, world's largest exporter who adhered to WTO in 2001 (Fouquin, et al., 2002).

The weight of textile products in Tunisian exports of goods and services (47 % in 2002, according to IFM and CEPII (2004)) and the concentration of clothing exports on the European market (94 %) explain why the issue of the MFA phaseout is very sensitive economically and politically for Tunisian policymakers. A negative shock endured by the clothing and textile sector could be harmful for the unemployment situation in Tunisia since this sector employs about $1/7^{th}$ of the labor force. Unskilled workers and especially women who constitute the bulk of textile and clothing employees are the most vulnerable.

The *Institut d'Économie Quantitative* (2003) estimates that an alignment on Chinese prices will imply a decrease of Tunisian textile export prices by 5% every year from 2001 to 2005. The first objective of the study is to assess the dynamic impact of this shock on the Tunisian economy and mainly on unemployment and wage inequality. The second objective is to analyze the combined effects of this shock with the Free Trade Agreement signed between Tunisia and the European Union.

Most of the studies which dealt with the impact of the MFA dismantling had a global or regional scope (see OCDE (2003) for a survey of the existing quantitative studies)). These have the advantage of giving a wide view of the situation, but do not allow the analysis of the impact on a particular country, which is the main concern for policy makers. More recently, Martin and al. (2004) use a global general equilibrium model, but focus their analysis on a country, Pakistan, which will benefit from the quota dismantling and suffer from a greater competition of China and India. Since our study is on Tunisia we prefer to rely on a single-country model, which allows us to enrich the model with institutional detail and introduce dynamics in its functioning.

Therefore, the quantitative assessment is based of an intertemporal multisectoral general equilibrium model of the Tunisian economy which incorporates imperfect labor markets functioning. The model developed in this paper allows formalizing the adjustment path by dealing explicitly with intertemporal optimization of firms. The forward-looking behavior of firms appears in the investment demand function, which depends on the shadow price of capital. Any shock affecting the shadow price of capital will affect firms' investment decisions and therefore, the optimal path of output. The presence of an adjustment costs

function permits to formalize the installation costs linked to the process of capital accumulation. The model also incorporates the intertemporal preferences of households, which allows capturing demand side effects of trade liberalization. In addition, disaggregating the economy into industries allows for explicit dynamic analysis of the intersectoral reallocation of resources that is central to the policy debate.

One of the main innovations of the dynamic general equilibrium model developed is that it uses a non steady-state calibration procedure. As stressed by Francois, Nordstrom and Shiells (1999), empirical studies showed that considering developing countries in applied models as growing on a steady-state path is an invalid hypothesis.

Moreover, since we focus on the effects of the MFA dismantling on unemployment, a significant part of the modeling effort is devoted to the labor market. Thus, intersectoral wage differentials for workers of the same category are endogenous, and explained by efficiency considerations. We propose a multisectoral model of efficiency wages based on imperfect monitoring considerations. This model is developed in detail in Marouani (2000), and follows the work of Shapiro and Stiglitz (1984) and Walsh (1999). Two sectors receive a different treatment: the Government sector, where wages are set by the Government, and the agricultural sector where the rural / urban migration process is modeled through an extended Harris / Todaro function.

The paper is organized as follows: section two presents the efficiency wage model and its theoretical background, section three presents the general equilibrium model its calibration procedure and the database, section four presents the simulations and the results and section five concludes.

II IMPERFECT LABOR MARKETS AND EFFICIENCY WAGES

In the basic neoclassical model, unemployment is only temporary, engendered by frictions on the labor market that disappear in equilibrium. In this framework, long term unemployment is necessarily voluntary. This explanation has proven to be unrealistic when confronted with the empirical facts. Therefore, many models based on the concept of labor market segmentation tried to find a theoretical explanation of the existence of involuntary unemployment. Labor market segmentation could be defined as a situation where workers characterized by the same productive capacities receive different wages depending on the sector where they are employed. The Harris / Todaro model (1970) has been the most famous and prolific model in analyzing labor market segmentation in developing countries. However, its main limits are its postulate of fixed wages to explain unemployment (in reality wages are often rigid, but rarely fixed) and its failure to explain intersectoral wage differentials within multisectoral models.

In the eighties, various models called “efficiency wage models” have been developed to explain the intersectoral wage differentials observed. They are based on the principle stipulating that the productivity of a worker depends on his wage (Akerlof (1982), Shapiro and Stiglitz (1984) and Bulow and Summers (1986)). This means that in order to elicit effort from their workers, employers may find it optimal to pay more than the going wage.

II 1 The model of imperfect monitoring or “shirking model”

The efficiency wage theory provides an alternative analytical framework to the standard model describing the labor market as perfectly competitive, free of information problems, and where firms face perfectly elastic labor supply (Summers, 1988). The main interest of the different efficiency wage models is that they explain involuntary unemployment while allowing at the same time for an endogenous determination of wages (Cahuc and Zylberberg, 1996). Their aim is to study the microeconomic foundations

explaining why a firm facing an adverse shock chooses to fire workers rather than reducing wages (Summers, 1988).

Among the different models of efficiency wages, we will focus on the model based on the imperfect monitoring of the workers' effort by the firm, developed by Shapiro and Stiglitz in their seminal paper: "*Unemployment as a Worker Discipline Device*" (1984).

In the Shapiro and Stiglitz model, the involuntary unemployment level acts as an incentive for workers to provide a certain level of effort[1]. This is equivalent to a principal-agent problem with rationing at equilibrium, since some individuals proposing to work at a lower wage will not be hired. Indeed, by giving them less than the efficiency wage, the firm would not be sure that they will not shirk.

The utility function of the employees is increasing with wages and decreasing with the level of effort they provide. In its simplest form it could be expressed as: $U = w - e$. The effort variable e takes two values, 0 if the worker shirks and $e^*>0$ otherwise. If he shirks, there is a probability q that he be caught and fired. If he provides the level of effort required, the probability of loosing his job reduces to b, the exogenous separation rate.

To summarize the functioning of this model, we can say that level of unemployment and of wages are complementary to elicit effort from employees. Indeed, if the level of unemployment is low, loosing a job will not be very constraining since it is easy to find another one. Likewise, loosing a badly-paid job will not cause a big loss in utility.

II 2 A multisectoral model of efficiency wages

The principal contribution on efficiency wages in a general equilibrium framework is the work of Thierfelder and Shiells (1997). On multisectoral models of efficiency wages, we can cite mainly the article of Walsh (1999).

If we rewrite the utility functions defined by Shapiro and Stiglitz (1984) in a multisectoral framework and disaggregate the labor factor in various skills of qualification, we obtain:

$$rV_{if}^{ns} = w_{if} - e_{if} + b_{if}(V_f^u - V_{if}^{ns}) \quad (1)$$

for a non shirker (ns), and,

$$rV_{if}^{s} = w_{if} + (b_{if} + q_{if})(V_f^u - V_{if}^{s}) \quad (2)$$

for a shirker (s), and,

$$rV_f^u = \sum_{j=1}^{n} a_f (V_{jf} - V_{jf}^u) \quad [2] \quad (3)$$

for an unemployed (u),

where r is the discount rate, V the utility function, i the sector, f the level of qualification, w is the wage, e is the disutility of effort, b is the exogenous separation rate, q is the probability of being caught shirking and a the probability for an unemployed worker to find a job.

Equalizing the expected utilities of shirkers and non shirkers we obtain the non shirking condition (NSC)[3] :

[1] The term effort is used here in its broadest meaning.

[2] We assume no unemployment benefits, as is the case in Tunisia.

$$V_{if} = \frac{e_{if}}{q_{if}} + V_f^u \tag{4}$$

Moreover, at equilibrium the flow of workers leaving unemployment is equal to the flow entering into unemployment (Shapiro and Stiglitz, 1984):

$$a_f U_f = \sum_i b_{if} L_{if}$$

or:

$$a_f = \sum_i \frac{b_{if} L_{if}}{U_f} \tag{5}$$

By subtracting equation (3) from equation (1) and taking account from equations (4) and (5) we obtain the following expression of the efficiency wage at equilibrium:

$$w_{if}^* = \left(1 + \frac{b_{if} + r}{q_{if}}\right) e_{if} + \sum_{j=1}^{n} \frac{b_{jf} L_{jf}}{q_{jf} U_f} e_{jf} \tag{6}$$

This expression characterizes the evolution of wages in the multisectoral general equilibrium model applied to Tunisia.

III A DYNAMIC GENERAL EQUILIBRIUM MODEL OF THE TUNISIAN ECONOMY

In this section we present the intertemporal general equilibrium model of the Tunisian Economy. The model built for this purpose draws upon the work of Goulder and Eichengreen (1992), Go (1994), Keuschnigg and Kohler (1997), Mercenier and Yeldan (1997), Devarajan and Go (1998) and Dissou (2002). Its main differences consist in its detailed and innovative treatment of the labor market and its non-steady state calibration procedure.

In presenting the model we will first describe its dynamic dimension, which is intended to capture the intertemporal allocation of investment and consumption, and then the intra-period dimension, which is equivalent to a one-year static CGE model.

III 1 The dynamic setting

Consumption

Households allocate expenditure across time so as to maximize lifetime utility subject to a dynamic budget constraint. The intertemporal additively separable utility function of the representative household is of the form (Devarajan and Go, 1998):

$$\max U_o = \sum_{t=0}^{\infty} \left(\frac{1}{1+\rho}\right)^{t+1} \frac{1}{1-\nu} (C_t)^{1-\nu} \tag{7}$$

where ρ is the consumer's constant rate of time preference, ν is the constant elasticity of marginal utility and C_t is aggregated consumption.

The wealth equation of the representative household is:

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[3] The NSC in reality is $V^{ns} \geq V^s$, but we suppose that the equalization is enough to induce cooperative behavior.

$$W_o = \sum_{t=0}^{\infty} \frac{Y_t}{(1+r_c)^{t+1}} \tag{8}$$

Then we have to define his intertemporal budget constraint, which requires that the present value consumption expenditures not exceed the household's wealth:

$$\sum \frac{PC_t C_t}{(1+r_c)^{t+1}} \leq W_o \tag{9}$$

Therefore, we can derive[4] the forward change of consumption between two successive periods as a function of the relative prices of the two periods, the rate of time preference, and the discount rate for consumption r_c:

$$\frac{C_{t+1}}{C_t} = \left(\frac{PC_{t+1}(1+\rho)}{PC_t(1+r_c)} \right)^{-\frac{1}{\nu}} \tag{10}$$

Investment behavior

Unlike static CGE models where investment is savings driven, the investment decision in dynamic models follows a forward looking optimization rule. The manager chooses the investment path that maximizes the firm's value V_t, defined as the discounted value of net income (Devarajan and Go, 1998):

$$V_0 = \sum_{t=0}^{\infty} \frac{R_t}{(1+r_c)^{t+1}} \tag{11}$$

subject to the capital accumulation equation :

$$K_{t+1}^i = (1-\delta_i) K_t^i + ID_t^i \tag{12}$$

where R_t is equal to the marginal revenue product of capital less investment expenditures, K is the capital stock of sector i at time t, δ is the depreciation rate and ID represents sectoral investment at period t.

Investment expenditures (INVCOST) include both acquisition and adjustment costs. The knowledge of the structure of adjustment costs is essential for predicting the complex path of responses of capital demand to external shocks. These shocks will have differing impacts on individual firms depending on how rapidly firms can optimally adjust their input demands. However, the problem in dealing with adjustment costs is how to measure them. Indeed many of these costs are implicit, in that they result in lost output and are thus not measured and consequently don't appear in the firms' accounts. Hamermesh and Pfann (1996) distinguish two kinds of adjustment costs: net adjustment costs are those associated with changing the level of capital services as disruptions to production occur and tasks are reassigned and restructured, and gross adjustment costs arise when the delivery of newly purchased equipment takes time. The learning-by-doing of the workers with the newly installed capital also takes some time. The lack of a secondary capital market for many capital

[4] See Devarajan and Go (1998) for a detailed presentation of the optimization process.

goods is another source of capital adjustment costs which makes firms hesitant before purchasing new capital.

The vast majority of investment demand models rely on symmetric convex adjustment costs functions. The convexity means that the marginal cost of varying the factor demand is increasing with the size of the variation, whereas symmetry imposes that the marginal cost of raising the factor demand is equal to that of a similar-size cut of input. As a particular form of convex functions, the quadratic adjustment cost function has been the most used because of its analytical tractability. Quadratic adjustment costs imply that large and rapid changes are extremely costly, so that firms respond to positive shocks by making continuous small investments (Bigsten and al., 1999).

Investment expenditures in our model are given by:

$$INVCOST_t^i = (ID_t^i(1-dist_i) + AJC_t^i)PK_t^i \tag{13}$$

where *AJC* are adjustment costs, *PK* is the price of capital, and *dist* is a parameter which captures the existence of distortions or incentives to investment. The adjustment cost function is increasing with investment and decreasing with the capital stock accumulated by the firm:

$$AJC_t^i = \frac{\beta_i}{2}\frac{ID_t^{i\,2}}{K_t^i} \tag{14}$$

The intertemporal optimal conditions imply that:

$$ID_t^i = \frac{K_t^i}{\beta_i}\left(\frac{q_t^i}{PK_t^i} - (1-dist_i)\right) \tag{15}$$

and

$$(1+r_p^i)q_t^i = (1-\delta_i)q_{t+1}^i + RK_t^i + \frac{\beta_i}{2}\left(\frac{ID_t^i}{K_t^i}\right)^2 PK_t^i \tag{16}$$

where q is the shadow price of capital, r_p is the discount rate of the producer in sector i, and *RK* is the marginal revenue product of capital. The interpretation of equation (15) is that investment will be positive if the ratio of tobin's q to the replacement cost of capital is greater than one. Equation (16) gives the dynamic rule of growth of the shadow price of capital.

Debt evolution

Following Diao, Roe and Yeldan (1998), the two components of public debt (internal and external) and the two components of external debt (private and public) are modeled. However, yearly public deficit is allocated to the two components of public debt (in fixed proportions), whereas the authors allocate it exclusively to public external debt.

$$DEBT_t = DEBTP_t + DEBTGE_t \tag{17}$$

where *DEBT* is the stock of total external debt, *DEBTP* is private external debt and *DEBTG* public external debt.

$$DEBTP_{t+1} = DEBTP_t + BCDEF_t \tag{18}$$

where *BCDEF* is the current account balance net of foreign direct investments.

$$DEBTGE_{t+1} = DEBTGE_t - (1 - shrdebtg) * GOVSAV_t \quad (19)$$

where *shrdebtg* is the share of internal debt in total public debt and *GOVSAV* corresponds to the public deficit in year *t*.

Total public debt *DEBTG* is composed of internal debt, *DEBTGI* and external public debt, *DEBTGE*:

$$DEBTG_t = DEBTGE_t + DEBTGI_t \quad (20)$$

with

$$DEBTGI_{t+1} = DEBTGI_t - GOVSAV_t * shrdebtg \quad (21)$$

The stock of foreign private capital in Tunisia (*CAPEX*) grows every year through the arrival of foreign direct investment (*IDE*).

$$CAPEX_{t+1} = CAPEX_t + IDE_t \quad (22)$$

This stock of capital is rewarded the average rate of return of investment in Tunisia.

Terminal period and steady state conditions

To solve an infinite-horizon model like ours, we need to truncate the time horizon by imposing steady-state conditions at some future terminal period. Devarajan and Go (1998) have found forty years to be a reasonable time-horizon.

On the capital growth side, the required condition is that the ratio of investment to the stock of capital equals the depreciation of capital plus the exogenous growth rate of the labor force (*g*) and the growth rate of technical progress (*prt*):

$$ID^i_{tp} / K^i_{tp} = \delta_i + g(t) + prt(t) \quad (23)$$

On the consumption growth side, the transversality condition imposes that consumption at the terminal period is equal to the household income (*YH*) net of investment expenditures financed by households:

$$PCT_{tp} CT_{tp} = YH_{tp} - (\sum_i INVCOST^i_{tp} - FSAV_{tp} - GOVSAV_{tp}) \quad (24)$$

FSAV are foreign savings and *GOVSAV* corresponds to the Government surplus or deficit.

A transversality condition is also imposed on foreign debt to avoid *ponzi games*. The growth rate of external debt is the same as that of capital:

$$BPDEF_t / DEBTP_t = g(t) + \mathrm{p}rt(t) \quad (25)$$

Many variables (not described above) grow at an exogenous rate, imposed by the modeler on the basis of their historical evolution (migrants' remittances, foreign direct investment) or their forecasted evolution (labor force, technical progress).

Having described the dynamics of growth of the jumping variables, we now turn to describe the intratemporal dimension of the model.

III 2 Structure of the intra-period model

The Tunisian Economy is disaggregated into ten sectors. The model distinguishes four inputs: three categories of labor and capital, and four types of agents: a representative household, firms, the Government and the Rest of the World.

The production and factor demand block

The production function is a nested one which permits to capture the substitution and complement relations among the various inputs. At the highest level, output is a Leontief of value added and intermediate input. Aggregate intermediate input is a Leontief function of intermediate input from different sectors, whereas value added (VA) is a nested Constant Elasticity of Substitution (CES) function with two stages. At the first stage, VA is a CES of two composite bundles. At the second stage, the first bundle is a CES function of unskilled and skilled labor whereas the second bundle is a CES of capital and highly skilled labor, which are supposed to be highly complementary. Concerning the Government sector, capital and the three labor categories are set in fixed proportions.

The three categories of workers are supposed to be mobile across sectors, but the workers are not allowed to look for a job requiring more or less qualifications then they have. The wages and the unemployment level at equilibrium are obtained through the equalization of the marginal productivity of labor with the efficiency wage in all but two sectors. In the agricultural sector the wage is linked to the average urban wage through an extended Harris-Todaro function[5] capturing the difficulty of getting an urban job for a rural worker. Concerning civil servants, we suppose that the Government set their wages as a fixed proportion of the urban average wage. Labor supply increases from one period to another at a fixed rate. Physical capital is sector-specific in the short run. It grows from one period to another through investment, following the path defined by the intertemporal optimization rule.

Income and expenditure block

Households earn their income from wages, returns to capital, interests on Government bonds and transfers (public or migrants' remittances). Their expenditures are composed of interest payments on private external debt and of consumption of goods and services. After determining the optimal path of total consumption and savings (equation 10), households choose the optimal composition of their basket of goods and services at each period. Total consumption is a Cobb-Douglas function of different consumption commodities.

The Government earns income from various taxes (income taxes, corporate taxes, tariffs and value added taxes) and from foreign transfers. Its expenditures consist in Government consumption (mainly civil servants wages), social transfers and interest

[5] The extension in The Harris-Todaro function consists in adding an elasticity of mobility for rural workers, calibrated from the base year values.

payments on public debt. The Government closure chosen is to allow public spending to grow at the GDP growth rate, which seems more realistic than fixing total spending or the nominal value of deficit. In the simulations where taxes will be endogenized to compensate for tariff losses, the ratio of public deficit to GDP is also fixed.

The foreign trade block

The allocation of output between domestic and foreign markets is modeled as a Constant Elasticity of Transformation (CET) function. On the demand side, the Armington assumption is adopted to describe imperfect substitution between domestic products and imports, and between imports originating from different geographical areas. At the first stage, a composite product results from a CES aggregation of domestic and imported commodities. At the second stage, total imports are disaggregated into imports from the EU and from the Rest of the World, which permits to simulate the reduction of tariffs on products originating from the EU. The small country assumption holds for imports, which implies that world import prices are exogenous. However, an export demand function is modeled according to Decaluwé, Martens and Savard (2001):

$$EXD_i = EXDP_i \left(\frac{PED_i}{PWE_i} \right)^{\eta i} \tag{26}$$

where *EXD* is the demand for export of product *i*, *EXDP* is a sectoral scale parameter, *PED* is the sectoral price of Tunisian exports, *PWE* the world price of the same products and η the elasticity of demand of exports.

The existence of an export demand function means that Tunisian exporters need to lower their prices if they want to increase the volume of their exports.

The current account balance is composed of the foreign trade balance, of net transfers from abroad and of interest payments on foreign debt. The ratio of external debt to GDP is fixed to its first year level, and the nominal exchange rate adjusts to equilibrate the current account balance.

The equilibrium conditions and macroeconomic closure

Agents in our model are assumed to form rational expectations, and since we do not take into account uncertainty, they are thus supposed to have perfect foresight. This means that their expectations are assumed to be conform to actual future values.

General equilibrium is equivalent to a sequence of temporary equilibria linked by backward looking and forward looking variables. Each temporary equilibrium requires market clearing for all commodities as well as the labor market (Keuschnigg and Kohler, 1996). As previously established, the labor market is cleared through a joint determination of (efficiency) wages and the level of unemployment. By Walras' Law, commodities and labor market clearing, plus the restriction on Government budget (defined above) also imply equilibrium on the capital market.

III 3 The database

The model is calibrated from a 1994 database for the Tunisian economy. The advantage of using 1994 data is to be able to perform a dynamic calibration of the model by comparing the path of evolution of the main variables produced by the model with the actual path observed in the national accounts (1994-2001). The social accounting matrix (SAM) has been built on the basis of the Input-Output table provided by the Tunisian National Institute of Statistics. Aggregate investment by sector is provided in the national accounts (INS, 1997). Information on the different components of private and external debts and on transfers comes from the annual Central Bank report (BCT, 1995). The data on employment and labor supply are from the population and employment census. Wage differentials by level of qualification in each sector are determined using tables appended to industrial collective agreements.

Calibration of the model involves selecting certain parameters from external sources (from the literature or fixed a priori) and deriving the remainder from identifying restrictions (Goulder and Eichengreen, 1992).

The elasticities of substitution and transformation of the CES and CET functions of the trade block come from the econometric estimations of Devarajan, Go and Li (1999). Derivation of the scale and share parameters of these functions follows the usual procedure. The interest rates are those practiced by the Tunisian Central Bank.

The disutility of effort parameter of the efficiency wages function is calibrated using the base year values of wages, employment, unemployment, the turnover rate and the probability of being detected shirking. The elasticity of mobility of rural workers in the Harris-Todaro function is calibrated from the benchmark data on agricultural and urban (average) wages, on employment in agricultural and non agricultural sectors, and on urban unemployment.

The depreciation rate of capital, the household elasticity of intertemporal substitution of consumption and the sectoral adjustment cost function scale parameters are calibrated following a *tâtonnement* process described in the next section.

Table 1: Value of some key parameters of the dynamic model

$\mathbf{r_c}$	Consumer discount rate	0,06
ρ	Time preference rate	0,06
$\mathbf{1/\nu}$	Households intertemporal elasticity of substitution	1,2
$\mathbf{r_{pi}}$	Firms discount rate	0,06
δ_i	Capital depreciation rate	0,05
β_i	Sectoral adjustment cost function scale parameters	$1 < \beta_i < 7$
$\mathbf{Prt_i}$	Exogenous technical progress (per year)	0,016

III 4 The dynamic calibration procedure

Most of the existing dynamic general equilibrium models rely on a steady-state calibration procedure (Wendner, 1999). It has the advantage of being relatively simple since it consists in manipulating the data to impose a steady-state growth of the jumping variables. However, it relies on a false hypothesis, especially in developing and transition countries (Francois, Nordstrom and Shiells, 1999).

The procedure used in this model consists in implementing a dynamic calibration in three steps.

First we calibrate the parameters which determine the evolution of the main macroeconomic variables (total household consumption, total investment, the external debt and the GDP growth rate). These parameters are the elasticity of intertemporal substitution of consumption, the capital depreciation rate and the annual growth rate of technical progress. They are calibrated by implementing many simulations until the main macroeconomic variables are close to their actual value during the 1994-2001 period.

The second step consists in calibrating sectoral parameters, and mainly the adjustment cost function scale parameter. In this case we use the historical evolution of sectoral investment to obtain the value of the parameters. In some cases the value of the stock of capital has been slightly modified to obtain reasonable values.

The third step consists in recalibrating the macro parameters to take into account the impact of the second step modifications. After several iterations we obtain relatively satisfactory values for macro and sectoral parameters.

IV SIMULATIONS AND RESULTS

IV 1 The scenarios

Two shocks are simulated to analyze the impact of the MFA phaseout on unemployment and on several macroeconomic and sectoral variables.

1. The first scenario consists in implementing a gradual decrease of world textile price products (5% per year from 2001 to 2005). This shock is called SIM_{mfa}.

2. The second scenario adds to the first one a dismantling of tariffs on imports from the EU, following the Euro-Tunisian Free Trade Agreement[6]. Moreover, the fiscal losses due to the tariff dismantling are compensated by a uniform increase of the different taxes (VAT , income tax and corporate tax[7]). This shock is called $SIM_{mfa\text{-}eu}$.

6 The tariff dismantling scenario is implemented at a very disagreggated level, than we aggregate at the sectoral level.

7 See Marouani (2004) for non uniform tax reforms and their effects on unemployment in Tunisia.

IV 2 The results

Table 2: Evolution of the main variables characterizing the textile sector, 1994-2014 (change in % of the reference scenario level)

	t+5		t+7		t+11		t+20	
	SIM_{mfa}	SIM_{mfa-eu}	SIM_{mfa}	SIM_{mfa-eu}	SIM_{mfa}	SIM_{mfa-eu}	SIM_{mfa}	SIM_{mfa-eu}
Production	-7.4	-6.2	-16.1	-14.4	-41.9	-39.9	-47.5	-45.0
Exports	-7.3	-6.0	-17.1	-15.2	-45.9	-44.3	-51.5	-48.8
Investment	-51.8	-47.6	-67.1	-62.8	-70.4	-66.3	-57.2	-52.8
Unskilled labor	-4.4	-3.3	-14.6	-12.8	-46.8	-44.9	-48.3	-46.2
Skilled labor	-4.3	-3.1	-14.9	-13.0	-47.5	-45.6	-49.2	-47.1
Highly skilled labor	-9.3	-7.3	-17.5	-15.9	-39.2	-37.2	-47.7	-45.1

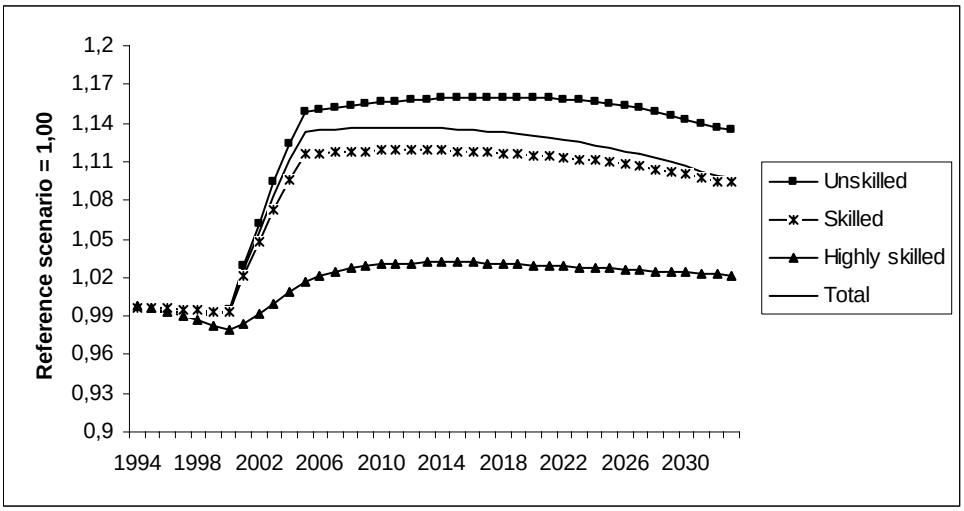
As shown by table 2, the decrease of the world prices of textile products is very harmful for the Tunisian textile and clothing sector. Investment is the first variable that reacts strongly to the shock, due to the forward looking behavior of firms in terms of capital accumulation. The results of the second scenario are very close to those obtained in the first. The slight improvement is due to the positive effects of the FTA with the European Union on the competitiveness of the Tunisian textile and clothing sector (Marouani, 2004).

The decrease of labor demand becomes dramatic in 2005, and does not recover afterwards. Highly skilled employees in the textile sector are more affected than the other labor categories before 2005 due to the complementarity of capital with highly skilled labor.

These negative effects on the textile sector were expected due to the nature of the shock. What is less obvious is to which extent this shock is transmitted to the rest of the economy and its effects on unemployment.

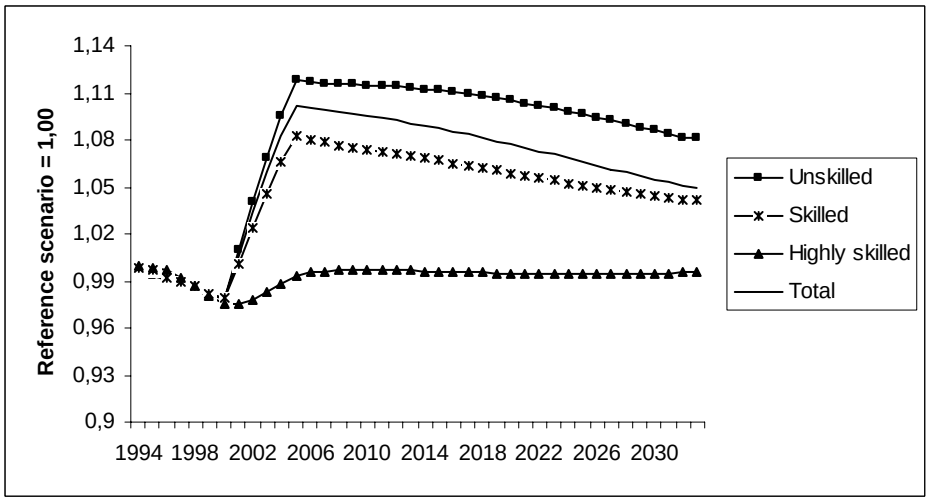
The first shock induces a rise in total unemployment, which harms mainly unskilled workers, due to the labor composition of the textile and clothing sector.

Graph 1: Evolution of unemployment in the scenario SIM_{MFA}



In the second scenario unemployment rises as well, but its increase is lower than in the first scenario (graph 2). Moreover, if unemployment rates remain stable after 2005 in the first scenario, they decrease in the second. This is due to the positive effect of the agreement with the EU on unemployment in Tunisia (Marouani, 2004).

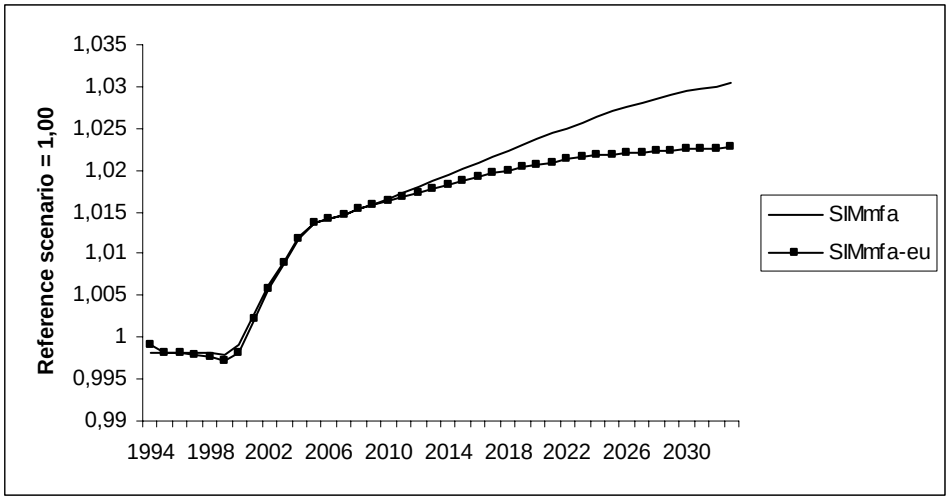
Graph 2: Evolution of unemployment in the scenario $SIM_{MFA\text{-}EU}$



Wage inequality also increases after the MFA phaseout (graph 3), due to the high intensity of the textile and clothing sector in unskilled labor. The pace of the rise of inequality does not decrease after 2005 in the first simulation, while it decreases in the second simulation due to the positive effects of the agreement with the EU on unskilled labor demand.

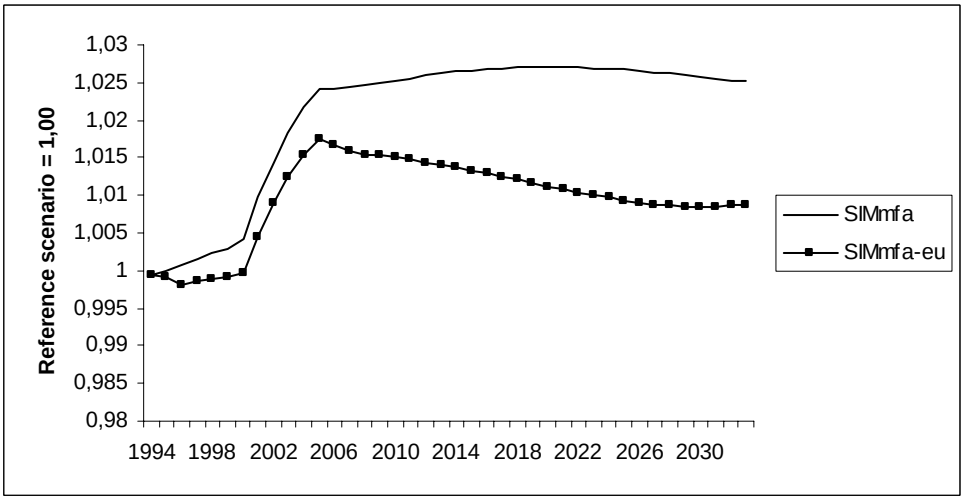
Moreover, the rise in wage inequality would have been higher if labor markets were modeled as perfect. The decrease of unskilled labor unemployment shifts some burden on unskilled wages.

Graph 3: Evolution of the ratio WF_s/WF_{uns}[8]



Inequality between skilled and highly skilled wages also increases in the two scenarios until 2005, and decreases after 2005 in the second scenario (graph 4).

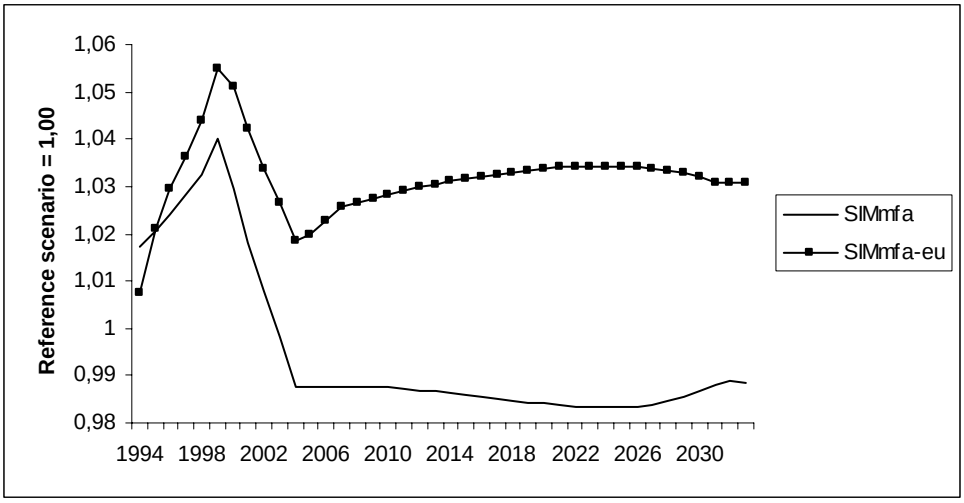
Graph 4: Evolution of the ratio WF_{hs}/WF_s



To understand the evolution of unemployment, we need to look at the evolution of investment, which is the main vector of change in a dynamic model.

[8] WF_{uns} is the average wage of unskilled workers, WF_s is the average wage of skilled workers and WF_{hs} is the average wage of highly skilled workers.

Graph 5: Evolution of total investment (volume)

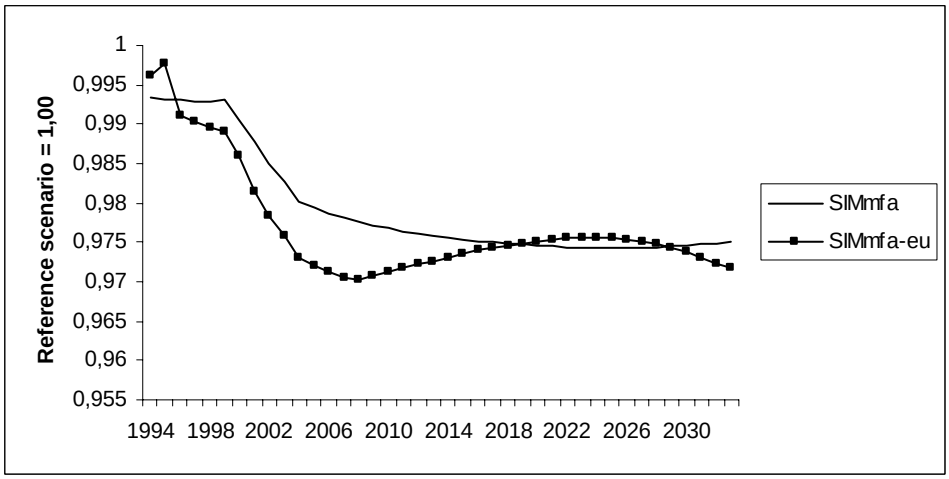


Total investment is higher than its reference scenario level until 2001, than it decreases in the first scenario (-1.0 to -2.0 percentage points). This evolution is due to the intertemporal arbitrage of households who prefer to invest more during the first period and consume less (graph 6) because they expect a negative impact on the whole economy after 2001.

In the second scenario, we obtain a similar evolution until 2003, then, investment recovers due to the agreement with the EU that exerts a downward pressure on capital goods prices and enhances exports.

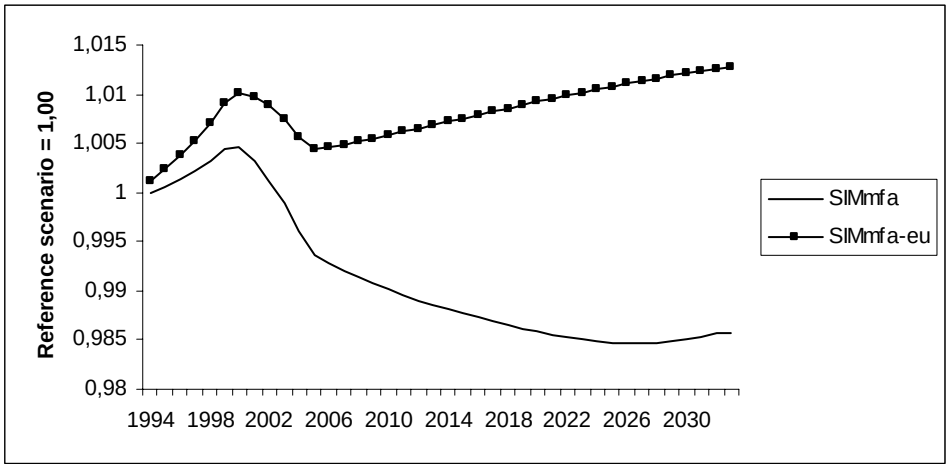
The negative effects on investment in the first scenario are not only due to the direct effects of the MFA dismantling on the textile sector. They are also due to the indirect effects on the sectors providing it with intermediate inputs and capital goods.

Graph 6 : Evolution of total household consumption



Total household consumption decreases during the whole period and for the two scenarios. As we said previously it decreases first, then remains stable (SIM_{mfa}) or increases slightly ($SIM_{mfa\text{-}eu}$).

Graph 7: Evolution of GDP at 1994 prices



The evolution of GDP is negative for the first shock, except during the 1994-2001 period (before the implementation of the MFA dismantling). The agreement with the EU more than compensates the negative effects of the MFA dismantling on GDP, due to its positive effects on investment in Tunisia[9].

V CONCLUSIONS

The MFA phaseout appears as a very negative shock for the Tunisian economy and for unemployment which is already relatively high in Tunisia. It also raises wage inequality due to the high intensity of the textile and clothing sector in unskilled labor. The free trade agreement with the European Union softens these effects by lowering capital goods prices and increasing the competitiveness of the Tunisian economy.

To be able to analyze more relevantly the effects of the MFA dismantling we would need disaggregated data on the textile and clothing industry. As shown by Martin and al. (2004), the real effects will depend on the degree of substitutability between each country's exports and those of its competitors. If for example the Tunisian and Chinese products are very different, Tunisia could be less affected by the MFA phaseout. Since the Tunisian textile and clothing sector is mainly constituted by European offshore companies, the amplitude of the shock will also depend on the capacity of these companies to switch to the highest segment of the clothing sector.

[9] Tunisia imports mainly capital goods from the EU, which explains why investment rises when it dismantles its tariffs on imports originating from the EU.

The main innovation of this paper is its focus on unemployment and wage inequality through a dynamic analysis of the effects of the MFA dismantling. It showed how a shock affecting a sector can impact the rest of the economy through indirect links (by affecting intermediate inputs and capital goods providers).

One of the main limits of the model is that it does not take into account heterogeneity since the model is a representative agent one. It would be interesting to link the CGE model to a microsimulation model to be able to analyze the effects of the shock on individual firms and households[10]. Another issue raised at the beginning of the article is the gender dimension of the shock. Indeed, the textile and clothing sector relies mainly on female labor, which will consequently be the most affected by the MFA dismantling. If data were available it would be very interesting to study the impact of this shock on women's employment and income[11].

[10]See Cogneau (1999) and Bourguignon, Robilliard et Robinson (2003) for microsimulation models in a CGE framework with heterogeneous households and Van Tongeren (1995) for heterogeneous firms.

[11] See Fontana and Wood for an analysis of this kind in the context of trade liberalization.

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