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Review Article

Trade Openness Sectoral Impact on the Labor Market: Case of Tunisian Manufacturing Industries

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Abstract: This paper dealt with the role of trade openness in the changes occurring in the Tunisian labor market over the period from 1983 to 2012. Tunisia's foreign trade orientations opted for a gradual opening up, causing a redistribution of resources within the industry and a reallocation of employment and real wages. Empirically, an error correction model (time series) was adopted in order to estimate the long- and short-run effects of international trade on labor demand and real wage levels in each manufacturing industry. The obtained results differentiated between the short and long-runs and the studied industries due to the divergence of the companies' reaction. This difference of the Tunisian manufacturing industries might be the result of a dissimilarity of their nature (exportable or importable), size, degree of integration into the international economy, productivity level of their skilled and unskilled workers, and so on. Such differences reflect the complexity of the problems that the Tunisian authorities may face in the implementation of sectoral policies aimed at creating jobs and/or raising the workers' wages.

Keywords: Trade Openness, Real Wages, Imports, Exports, Productivity of Skilled and Unskilled Workers.

JEL Classification: E24, F16, J23, J24, J31.

1. INTRODUCTION

The Tunisian economy is a favorable ground for analyzing the impact of trade openness on the level of employment and wages. In fact, the last-1980s witnessed the emergence of several new economic and political stakes closely tied to some fundamental factors that characterize the economy of this country. First, following the serious economic difficulties of the 1980s, Tunisia adopted a structural adjustment program under the supervision of the World Bank and the International Monetary Fund, enabling the country to access a Free trade with Europe at the beginning of the 21st century. Besides, the Tunisian economic history is marked by the growing and sustained liberalization of the international trade with the support of the General Agreement on Tariffs and Trade (GATT) and then the World Trade Organization (WTO). Tunisia was, then, considered an economic development model among the developing countries. It has prepared the creation of a free trade area with its main trading partner, the European Union, and a series of measures have been put in place to accompany the Tunisian economic openness.

However, the world trade growth would certainly have an impact on the labor market, that is, on employment and wage distribution in different countries. Several theoretical and empirical studies have been carried out within this framework in order to investigate the trade flows increasing role in the economic, employment and wage effects in both developed and developing countries. We cite for example the works of; Arif, A., and Ahmad, H. (2012**),** Monia GHAZALI and Rim MOULHI (2013),Tahir, M., and all (2014), Mazhikeyev, A., and all (2015), Ousmanou Njikam (2016), Anjum, N. and Pervaiz, Z. (2016), Asaleye, A. J. and all (2017), Madanizadeh, and all (2017), Siyakiya (2017), Selwaness and Chahir (2017) and Burange, L. G. and all (2019).

In this research work, we tried to analyze the role of trade openness in the changes occurring in the labor market. The theoretical foundation of our work relied on Sebastian Edwards' theory (an extension of the HOS model from Heckscher-Ohlin-Samuelson) based on the firm belief that commercial openness must not be undertaken blindly and dogmatically. Indeed, this is in the heart of our study adopting the empirical validation of the S. Edwards model (1988) by Milner and Wright (1998).

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The major endeavour of this study was to sectorally assess the positive and negative consequences of trade openness on the Tunisian labor market, highlighting the beneficiary sectors and those who had difficulty to adjust and restructure.

The remainder of this paper was structured as follows: In the second section, the theoretical foundations of this study were developed and tied to the main results of the empirical literature. The third section presented an analysis of the long-run trade openness differential effects by sector before dealing with the short run impacts in the same way in section four. In the fourth section our main conclusions about such long and short-run differentiated effects were drawn. The last one concludes the paper.

2. Theoretical Modelling

The theoretical and empirical literature on the topic is abundant. However, this paper should by no means be considered as a synthesis of all the previous theories. Instead, we have rather opted for the theoretical approach that seemed most relevant to the Tunisian economic context, namely Sebastian Edwards' model.

The adopted econometric analysis in this work follows the work of Milner and Wright (1998) using simple static models of firms' profit maximization. In these models, we assumed a Cobb-Douglas type production function of the form:

$$Q_{it} = A^{\gamma}.K_{it}^{\alpha}.L_{it}^{\lambda} \quad (1)$$

We assumed that the markets for goods and labor are in perfect competition. The different variables of this equation are defined as follows: Q is the real output, K is the capital stock, L is the labor used (there is labor mobility between sectors (Edwards, 1988), i and t are the respective indices of the sectors and periods of time, α and λ are the coefficients that represent the inputs share and γ is a coefficient that allows taking into account the phenomena that influence the production process efficiency (Milner and Wright, 1998).

In order to understand the effects of trade openness on employment and wages the following equations were used:

$$Log\,L_{it} = \lambda_i + \beta_1.Log\,W_{it} + \beta_2 Log\,Q_{it} + \beta_3 X_{it} + U_{it} \quad (2)$$

$$Log\,W_{it} = \gamma_i + \alpha_1 Log\,X_{it} + \alpha_2 Log\,Q_{it} + \alpha_3 Log\,L_{it} + \alpha_4 Log\,W_{it-1} + V_{it} \quad (3)$$

Where L_{it}, W_{it} and Q_{it} denote respectively the total employment, the real wage determined in relation to the general price index (2005 basis), and the real output in industry i at time t.

In the employment equation (2), X_{it} represents a vector of variables that influence the production function efficiency. λ_i and U_{it} represent the specific effect of different industries and the random error term, respectively.

In the wage equation (3), X_{it} is a vector of exogenous variables that can be either internal or external to individual firms engaged in the process of wage fixing in the labor market. γ_i, and V_{it}, represent the specific effect of the different industries and the error term, respectively.

These equations make it possible to emphasize the effect of time on the evolution of employment and wages over the long-run. We, therefore, suggest defining the explanatory variables of the model, first and then, the long-run error correction model.

2.1. Constructing the Explanatory Variables

In Milner and Wright's (1998) work, the exogenous variables vector in the employment equation is the direct inclusion of the terms of trade in the penetration of imports and exports. Thus, in the wage equation, Milner and Wright incorporated the same variables that represent the trade terms, while summing the ratio relationship, such as the gender ratio (male employment / female employment).

The employment and wage equations were developed while integrating new variables that further explain the variables to be analyzed over time and through individual sectors. There is a general agreement among the theoretical research works on the interpretation of increased demand for skilled and unskilled labor and wage inequalities between these two types of workers in the developed countries. This inequality is mainly attributed to the effects of trade with developing countries and biased technological changes (Wood, 1995, Berman *et al*., 1998, Sachs and Shatz, 1994, Lerner-Pearce, 1996, Baldwin and Cain, 2000, Haskel and Slaughter, 2001).

In the same framework, Wood (1997) suggests in the case of developing countries (East Asian sample countries) that "most empirical evidence supports the classic prediction that adopting more outsourcing increases the demand for low-skilled workers compared to that for skilled workers. The evidence is also consistent with the theoretical prediction that a change in trade policy causes a change in the demand composition, whose effects on wage differentials appear to be spread over a period of about ten years".

Our database consists of the trade openness variables and those related to the labor market. Our model explanatory variables are those that directly or

indirectly reflect trade liberalization. Following the commercial openness, these variables of interest affect the production function efficiency in the labor demand equation, on the one hand, and the process of wage fixing in the labor market, on the other. Moreover, a significant proportion of imported equipment goods into Tunisia involves intensive technology and skilled labor in the various sectors, particularly, in the manufacturing industries.

The introduction of highly developed technologies within the Tunisian manufacturing industry testifies for the crucial role of trade openness in the spread of technology and therefore of skilled labor. As a result, both of the production and the wage-fixing processes would necessarily claim the use of skilled labor. By analogy, the need to link variables that reflect the skill level of the worker was assumed in our model in both employment and wage equations. This hypothesis is consistent with the literature (Saggi, 2002).

Increased trade liberalization is found to be consistent with inter-industry change as it is likely to reallocate labor across industries (Berman *et al*., 1994). This allows us to know how the workers qualification level affects the demand for labor and the wage level differently in the considered manufacturing industries after the trade openness. The workers' qualification level was represented in the labor demand and wage equations by the number of active workers according to their level of qualification: nil (NL), primary education level (LP), secondary education level (LSE) and higher education level (LSU). Consequently, we can assume that the labor force homogeneity hypothesis is too restricted. Indeed, following the evolution of the labor market policies and reforms initiated by the Tunisian authorities after the trade openness, the manufacturing industries engaged the skilled and unskilled labor force differently depending on their needs and integration degrees into the external market.

In the same explanatory trend, the skilled and unskilled workers' productivity in the manufacturing industries is clearly related to foreign trade. Indeed, the Tunisian State has set up some promoting policies for access to education in order to create a population based on know-how to satisfy the trade openness needs, particularly after the ratification of the Agreement with the EU.

Labor demand and compensation are influenced by changes in productivity and in technology (Feenstra and Hanson, 1999). Just like the return on factor productivity and the investment rate are directly influenced by trade policy, industry orientation and resource allocation are quite sensitive to the protection structure and the exchange rate (Krueger, 1984). The productivity of the unskilled labor factor (GDP / LN + LP + LSE) and that of the skilled labor factor (GDP / LSU) are to be incorporated into the labor demand and wage functions. The educational level should enable job-providers to acquire knowledge and skills in order to understand, manipulate and interpret the new standards required by trade openness and to adapt to the economic environment changes and transformations.

The data on the labor market variables as well as foreign trade variables were collected from the National Institute of Statistics (NIS) and the Tunisian Institute of Competitiveness and Quantitative Studies (TICQS). Tunisia.

Our database covers the following Tunisian Manufacturing Industries (Building Materials, Ceramics & Glass Industry (BMCGI), Mechanical & Electrical Industry (MEI), Textile, Clothing & Leather Industry (TCLI), Chemical Industry (CHI) and Diverse Manufacturing Industry (DMI)) except for the agricultural and food industry. We did not study the trade openness effect on the labor market within the agricultural industry sector. The agricultural products are not taken into account in the agreement with the EU. They will be the subject of further negotiations to liberalize them.

The manufacturing industry sectors are classified according to two criteria: exchangeable (exportable, importable) and non-tradable (Edwards, 1988).

The indicator $T_i = (C_i - P_i)/C_i$ is the criterion used to specify the nature of the various manufacturing sectors and which reflects the market orientation and policy regimes, where P_i and C_i, respectively, represent production sector and the apparent consumption of sector i with $C_i = P_i + M_i - X_i$; where M_i and X_i are sector i imports and exports.

To achieve our study, we calculated the indicator T_i corresponding to each manufacturing industry in the Tunisian economy, yielding the following results:

- A $T_i < 0$ indicates that the sector is exporter (BMCGI, TCLI)
- A $T_i > 0$ indicates that the sector is importer (MEI, DMI and CHI);
- A $|T_i| < 0.05$ means that the trade flow is negligible for the considered sector.

2.2. Specification of the Error Correction Model of Labor Demand and Wage

In this section, we took the same equations presented in the theoretical approach. Nevertheless, we focused our analysis only on the temporal data by sector. These equations made it possible to highlight the effect of time on the evolution of employment and wages over the long-term.

We assume the multiplicative models where the variables *L*, *W*, *Q*, *Expp*, *Impp*, *GDP/LSU*,

GDP/(LN+LP+LSE) relate to each sector and refer respectively to labor demand, real wage, the penetration of exports, the penetration of imports, the productivity of skilled workers (higher level) and the productivity of unskilled workers (nil, primary and secondary levels).

To this end, we estimated a job demand function and a wage function for each sector allowing us to determine the external exchange impact on the labor market. Therefore, the below theoretical specifications were retained:

$$\begin{aligned} Log\,L_{it} &= \lambda_i + \beta_0 Log\,L_{it-1} + \beta_1 Log\,W_{it} + \beta_2 Log\,Q_{it} + \beta_3 Log\,Expp_{it} + \beta_4 Log\,\mathrm{Im}\,pp_{it} \\ &+ \beta_5 Log\,LNE_{it} + \beta_6 Log\,LPR_{it} + \beta_7 Log\,LSE_{it} + \beta_8 Log\,LSU_{it} + \beta_9 Log\left(\frac{GDP}{LSU}\right)_{it} \quad (4) \\ &+ \beta_{10} Log\left(\frac{GDP}{LN+LP+LSE}\right)_{it} + \beta_{11} Log\left(\frac{SectoralGDP}{GlobalGDP}\right)_{it} + U_{it} \end{aligned}$$

$$\begin{aligned} Log\,W_{it} &= \gamma_i + \alpha_0 Log\,W_{it-1} + \alpha_1 Log\,L_{it-1} + \alpha_2 Log\,Q_{it} + \alpha_3 Log\,Expp_{it} + \alpha_4 Log\,\mathrm{Im}\,pp_{it} \\ &+ \alpha_5 Log\,LNE_{it} + \alpha_6 Log\,LPR_{it} + \alpha_7 Log\,LSE_{it} + \alpha_8 Log\,LSU_{it} + \alpha_9 Log\left(\frac{GDP}{LSU}\right)_{it} \quad (5) \\ &+ \alpha_{10} Log\left(\frac{GDP}{LN+LP+LSE}\right)_{it} + \alpha_{11} Log\left(\frac{SectoralGDP}{GlobalGDP}\right)_{it} + V_{it} \end{aligned}$$

The non-stationarity of the economic variables might yield artificial regressions and thus meaningless models. A stationarity test of the variables of econometric equations (4) and (5) was therefore a must. The Augmented Dickey-Fuller (ADF) and Kwiatkowski, Phillips, Schmidt and Shin (KPSS) tests take into account the autocorrelation problem of the model residuals. These tests therefore consist in directly controlling autocorrelation in the model by including one or more differentiated autoregressive terms.

This method allowed us to achieve a white noise, just after determining the required number of delays. Indeed, the ADF and KPSS tests show that all the variables of the above equations are non-stationary in level but stationary in first difference.

This made us resort to use the econometrics of non-stationary variables and develop error-correction models (ECMs) of labor and wages. The equations econometric estimation method is based on the specification of the error correction models. This approach has the advantage of distinguishing between short-run and long-run elasticities of labor demand and real wage.

The development of these models requires, in a first step, the search for possible long-run relationships between the variables of equations (4) and (5). Once the variables non-stationarity hypothesis is confirmed, we have to check if there is a cointegration relation. It is worth mentioning that the tested null hypothesis is the absence of a cointegration relation between the variables. Consequently, we estimate the employment (4) and wage (5) equations by the ordinary least squares method, at the considered threshold. An estimated t-statistic lower than the tabulated critical value (-1.95) will lead to the rejection of the null hypothesis of absence of cointegration.

To this end, we used the two-step method of Engel and Granger (1987) which proposes to reconsider the problem of stationarity in a multi-varied framework. It consists in studying the problem of integration between the short-run dynamics and the long-run equilibrium through the short-run non-stationary processes relationship with those of the long-run. Indeed, the application of the Engel and Granger method allowed us to identify the long-run results displayed in Table 2.

It can be concluded that there is only one long-run relationship of demand for employment in the five considered sectors: IMD, THC, IME, MCCV and ICH. From the econometric point of view, the verification of the existence of a long-run relation of employment or wage was based on a stationarity test of the residues released from this relationship. The last column of **Table 2** enabled us to validate the achieved long-run relationships.

Table 1: ADF and KPSS stationarity test

Test Variables	ADF		KPSS	
	Student Statistic	Theoretical values	LM Statistic	Critical values
Log L	-1.95	-2.96	0.88	0.46
ΔLog L	-4.22	-2.96	0.33	0.46
Log Q	-0.92	-1.95	0.92	0.46

Test Variables	ADF		KPSS	
	Student Statistic	Theoretical values	LM Statistic	Critical values
ΔL Q	-2.89	-1.95	0.21	0.46
Log W	-1.12	-1.95	0.75	0.46
ΔLog W	-3.01	-2.96	0.23	0.46
Log impp	-0.82	-1.95	0.75	0.46
ΔLog impp	-2.99	-1.95	0.33	0.46
Log expp	-0.45	-1.95	0.98	0.46
ΔLog expp	-3.22	-2.96	0.36	0.46
Log (PIB/LN+LP+LSE)	-1.22	-2.96	0.74	0.46
ΔLog (PIB/LN+LP+LSE)	-3.55	-2.96	0.22	0.46
Log (PIB/LSU)	-1.011	-2.96	0.84	0.46
ΔLog (PIB/LSU)	-3.85	-2.96	0.14	0.46
Log (LN+LP+LES)	-1.55	-2.96	0.77	0.46
ΔLog (LN+LP+LES)	-4.22	-2.96	0.11	0.46

It can be deduced from table 1 that the student statistics are all below the theoretical value (-1.95) for a threshold of 5% and for a stationarity test based on a model without constant and without trend, confirming the stationarity of the residuals and the existence of a long-run relationship with wages or employment.

3. Estimation of Long-Run Labor Demand and Wage Relationships

In this section we presented the econometric results of the impact of international commerce on the demand for employment level and the long-run wage level in each of the manufacturing industries.

Table 2: Long-run labor demand and wage relationships

Sector	Equation	L	W	Q	Expp	Impp	GDP/(LN+LP+LES)	GDP/ LSU	Cointegration Test	
									T statistic	Critical Value
IMD	D.TRAV	-	-0.06	0.98	-	0.013	-0.85	-0.06	-5.2	-1.95
		-	-0.05	0.99	0.005	-	-0.86	-0.05	-4.2	-1.95
	SALAI	-7.21	-	7.52	-	-	-5.21	-0.36	-4.3	-1.95
THC	D.TRAV	-	0.01	0.91	-0.03	0.02	-0.88	-0.04	-3.2	-1.95
	SALAI	3.20	-	-2.19	0.14	0.04	2.88	-	-4.5	-1.95
IME	D.TRAV	-	0.05	0.95	-	-	-0.88	-0.06	-2.8	-1.95
		-	0.13	0.74	0.08	-0.04	-0.03	-0.14	-3.1	-1.95
	SALAI	-6.105	-	0.25	-0.102	0.19	6.57	-0.31	-5.2	-1.95
MCCV	D.TRAV	-	-0.02	0.91	-0.006	0.023	-0.85	-0.11	-3.5	-1.95
	SALAI	1.117	-	-0.72	0.011	0.088	-	-	-4.8	-1.95
ICH	D.TRAV	-	-0.014	0.96	0.023	0.019	-0.860	-0.165	-4.1	-1.95
	SALAI	2.84	-	-2.37	-0.03	-0.23	2.40	-0.633	-3.2	-1.95

What is really worth noting is the strong elasticity of the labor demand in relation to the output of the different sectors, an empirical result that remains in line with the economic theory. On average, the elasticity of employment in relation to the output is around 1. Wage seems to be an insensitive variable towards employment; i.e. a variable that has had no effect on labor demand in all the manufacturing industries (DMI, TCLI, MEI, BMCGI and CHI).

As for the wage equation, we first notice that production has very different effects through the sectors. It is positively and strongly linked to wage in the DMI sector but negatively linked in the CHI and TCLI sectors. Second, the proportion of unskilled labor productivity that affects the wage level is remarked to differ from one sector to another (-5.21 in the DMI sector, 2.88 in the TCLI sector, 6.57 in the MEI sector and 2.40 in the CHI sector). Finally, the skilled workers productivity leads to lower real wages.

Our econometric results, displayed in table 2, show that for a long time foreign trade did not have a significant effect on labor demand. It can be seen that the employment long-run elasticities in the different sectors relative to exports as compared to imports are low at around 0.06 on average.

Trade openness directly and indirectly influences the labor market, in particular on the labor demand level and on the real wage level. Our empirical study shows that the international trade effects are quite differentiated according to whether the sectors are mainly exporters or importers and from the analysis perspective distinguishing between short-run and long-run effects. In what follows, we interpreted the long-run labor demand and wages relationships.

From the error-correction model estimation results of the employment and wage equations by the method of Engel and Granger, the following conclusions can be drawn.

For the real wage level determination:

- Imports and exports have no effect on the real wage level.
- Imports negatively and weakly affect the real wage level in the MEI and CHI.
- Employment is the most explanatory variable in the determination of real wages, but there is no sectoral specification.
- The unskilled workers productivity (PTNQ) is very significant in all sectors, so there is no sectoral specification in the relationship between the NTBP and wages. The PTNQ is negative in the IMD sector but positive elsewhere.
- Production does not affect in the MEI and BMCGI sectors, but it does intervene for the DMI, THC and even strongly within the DMI and CHI sectors.

We can deduce that there is a differentiation in the wage level following the trade openness. Indeed, the most significant variables in the determination of the wage level for each sector can be summarized in the **table 3** below.

Table 3: Determinant variables of wage level

Variables	**Labour**		**Production**		**PTNQ**	
Sectors	***Sign***	***Effect***	***Sign***	***Effect***	***Sign***	***Effect***
DMI	Negative	Strong	Positive	Strong	Negative	-
EMI	Negative	Strong	Positive	Marginal	Positive	Strong
TCLI	Positive	-	Negative	-	Positive	-
BMCGI	Positive	-	Negative	Marginal	NS	-
CHI	Positive	-	Negative	-	Positive	-

Note: *PTNQ: Unskilled workers productivity. NS: Non significant.*

For the labor demand level determination:

- Production is the most significant variable and therefore the sectors are not differentiated by production;
- Imports and exports have a marginal effect on labor demand;
- Import is the least significant variable and there is no sector specificity with respect to the relationship between imports and labor demand;

It can be retained that there is a sectoral homogeneity in the determination of the demand for labor after the trade openness.

Relying on the achieved long-run relationships, the labor demand and salary deviations from their equilibrium level are obtained (the observed value is equal to the estimated value) and we calculated the residuals (deviations) of these Long-run relationships.

3.1. Employment Equation Case

The development and estimation of the error-correction models of labor demand and wage of the studied sectors allow us to highlight the long-run effect of trade liberalization on these two aggregates. To this end, we started by clearing the long-run relationships residuals to calculate the error correction terms.

All the long-run employment relationships (labor demand) indicate that the calculated residuals from these relationships are stationary and that their dynamics reflect the employers' behavior in terms of labor demand.

The graphical analysis of the employment deviations in the CHI, TCLI, DMI, MEI and BMCGI sectors shows that they revolve around zero in a stationary way. Indeed, the positive deviations indicate that the demand for labor in a given sector has increased more than anticipated, which suggests that the employment policy is good. While the negative deviations show a decline in the demand for labor more than it should have been, which implies that the adopted employment policy in the industry is bad.

What is worth noting from the above deviations is the importance of the negative values that have dominated the residual dynamics in the CHI and BMCGI sectors. In the DMI, TCLI and MEI sectors, the deviations are not so enormous in respect to the equilibrium and show a similarity in their long-run employment policies.

3.2. Wage Equation Case

As far as the wage differentials in the five sectors are concerned, we remarked that wage deviations from equilibrium in the MEI, DMI and CHI sectors revolved around zero and had almost the same dynamics, as we dealt with three importable sectors. As for the exportable sectors, TCLI and BMCGI, their observed deviations are more or less large in respect to the equilibrium. We can also observe that in these two sectors, there is a policy that establishes salaries, especially during the period 1994-2000. This confirms that each sector has its own regulatory dynamics.

4. Trade differentiated Short-Run Effects on the Labor Market by Sector

This section was subdivided into three main subparts, as follows:

- The short-run error correction model (ECM);

- Presentation and interpretation of the econometric results of the short-run employment equation;
- Presentation and interpretation of the econometric results of the short-run wage equation.

4.1. The Error Correction Model (ECM)

As already stated, the error-corrected models estimation of labor demand and wage in the different sectors under study requires a priori the calculation of the error correction terms with respect to the equilibrium in the CHI, MEI, DMI, TCLI and BMCGI manufacturing sectors that are noted respectively ECT_CHI, ECT_EMI, ECT_DMI, ECT_TCLI and ECT_BMCGI.

These terms are calculated from the short-run relationships presented in Table 4. Indeed, according to the representation theorem of Engel and Granger (1987), the existence of a long-run relation allows us to write an ECM model.

However, we have found a long-run relationship for all the manufacturing sectors, which allows us to specify the error correction models of labor demand and wage for the different sectors which are specified as follows:

Labour Equation

$$\begin{aligned}\Delta Log\, L_t = {} & \lambda_0 + \sum_{i=0}^{3}\lambda_{1i}\Delta Log\, L_{t-i} + \sum_{i=0}^{3}\lambda_{2i}\Delta Log\, W_{t-i} + \sum_{i=0}^{3}\lambda_{3i}\Delta Log\, Q_{t-i} + \sum_{i=0}^{3}\lambda_{4i}\Delta Log\, Expp_{t-i} \\ & + \sum_{i=0}^{3}\lambda_{5i}\Delta Log\, \mathrm{Im}\, pp_{t-i} + \sum_{i=0}^{3}\lambda_{6i}\Delta Log\, LNE_{t-i} + \sum_{i=0}^{3}\lambda_{7i}\Delta Log\, LPR_{t-i} \\ & + \sum_{i=0}^{3}\lambda_{8i}\Delta Log\, LSE_{t-i} + \sum_{i=0}^{3}\lambda_{9i} Log\, \Delta LSU_{t-i} + \sum_{i=0}^{3}\lambda_{10i}\Delta Log\left(GDP/LSU\right)_{it} \\ & + \lambda_{11i}\Delta Log\left(GDP/LN + LP + LSE\right)_{it} + \sum_{i=0}^{3}\lambda_{12i}\Delta Log\left(SectoralGDP/GlobalGDP\right)_{it} \\ & + \rho_1 ECTX_{t-1} + u_{it}\end{aligned} \tag{6}$$

Wage Equation

$$\begin{aligned}Log\, W_{it} = {} & \alpha_0 + \sum_{i=0}^{3}\alpha_{1i}\Delta Log\, L_{t-i} + \sum_{i=0}^{3}\alpha_{2i}\Delta Log\, W_{t-i} + \sum_{i=0}^{3}\alpha_{3i}\Delta Log\, Q_{t-i} + \sum_{i=0}^{3}\alpha_{4i}\Delta Log\, Expp_{t-i} \\ & + \sum_{i=0}^{3}\alpha_{5i}\Delta Log\, \mathrm{Im}\, pp_{t-i} + \sum_{i=0}^{3}\alpha_{6i}\Delta Log\, LNE_{t-i} + \sum_{i=0}^{3}\alpha_{7i}\Delta Log\, LPR_{t-i} \\ & + \sum_{i=0}^{3}\alpha_{8i}\Delta Log\, LSE_{t-i} + \sum_{i=0}^{3}\alpha_{9i} Log\, \Delta LSU_{t-i} + \sum_{i=0}^{3}\alpha_{10i}\Delta Log\left(GDP/LSU\right)_{it} \\ & + \alpha_{11i}\Delta Log\left(GDP/LN + LP + LSE\right)_{it} + \sum_{i=0}^{3}\alpha_{12i}\Delta Log\left(SectoralGDP/GlobalGDP\right)_{it} \\ & + \rho_2 ECTX_{t-1} + v_{it}\end{aligned} \tag{7}$$

The above ECM model was estimated for the CHI, EMI, DMI, TCLI and BMCGI sectors using Hendry's General to Specific (GETS) method (1995). This estimation method retains only variables with statistically significant estimators. Economically speaking, the ECM model explains the cyclical dynamics of labor demand and wages. This justifies the appearance of all the variables of equations (6) and (7) in terms of absolute variation. ECT_X indicates error correction terms that change with the nature of the sector. Thus, in our estimated equations the letter X changes with the nature of the estimated equation. For example, ECT_TCLI deal with labor demand and wage equations for the TCL industry.

4.2. Estimates and Interpretations of the Short-Run Employment and Wage Equations

The results of the short-run employment and wage equations estimates are given in Tables 4 and 5. The effects of our short-run econometric estimation in all sectors are obtained by summing the different effects of short-run results obtained at different times in each equation of the tables (3 and 4). All these effects are noticed to be statistically significant.

Table 4: Estimation of Short-run Employment ECM Models by Sector

Variables	CHI		TCLI		DMI		EMI		BMCGI	
	Coef	T.Stat	Coef	T.Stat	Coef	T.Stat	Coef	T.Stat	Coef	T.Stat
$\Delta L\ L_{t-1}$	0.262	9.770	0.690	13.259	-1.386	-13.704	0.344	6.907	0.679	4.638
$\Delta L\ L_{t-2}$	-5.399	-4.371			2.413	14.218	1.389	43.394		
$\Delta L\ L_{t-3}$	5.673	4.978					-0.833	-10.535		
$\Delta L\ W_t$	-0.001	-0.308	0.0005	0.360					0.002	2.765
$\Delta L\ W_{t-1}$	0.009	1.513					-0.0009	-2.891	-0.002	-0.802
ΔLW_{t-2}	0.003	0.680			0.0001	0.095				

Variables	CHI		TCLI		DMI		EMI		BMCGI	
	Coef	T.Stat	Coef	T.Stat	Coef	T.Stat	Coef	T.Stat	Coef	T.Stat
$\Delta L\ W_{t-3}$	0.005	1.047								
$\Delta L\ Q_t$	0.994	365.935	0.997	313.888	0.984	183.826	0.998	2130.589	0.990	450.363
$\Delta L\ Q_{t-1}$	-0.260	-10.342	-0.696	-13.728	1.386	13.925	-0.345	-6.878	-0.679	-4.592
$\Delta L\ Q_{t-2}$	5.399	4.3652			-2.427	-14.536	-1.389	-43.399		
$\Delta L\ Q_{t-3}$	-5.673	-4.985					0.834	10.545		
$\Delta L\ Expp_t$					-0.0002	-1.255			-0.001	-1.377
$\Delta L\ Expp_{t-1}$					-0.0002	-1.068				
$\Delta L\ Expp_{t-2}$					-0.0007	-3.955				
$\Delta L\ Expp_{t-3}$					-0.0007	-3.334				
$\Delta L\ Impp_{t-3}$			-0.001	-1.364						
$\Delta L\ (GDP/LN+LP+LSE)_t$	-0.760	-108.14	-0.931	-236.384	-0.895	-135.203	-0.856	-727.311	-0.888	-256.855
$\Delta L\ (GDP/LN+LP+LSE)_{t-1}$	0.264	10.085	0.704	14.900	-1.438	-15.782	0.113	2.635	0.707	5.485
$\Delta L\ (GDP/LN+LP+LSE)_{t-2}$	-4.976	-4.474			2.380	14.540	1.509	44.499	-0.090	-3.021
$\Delta L(\ GDP/LN+LP+LSE)_{t-3}$	5.262	5.035					-0.844	-10.862	0.042	2.090
$\Delta L\ (GDP/LSU)_t$	-0.234	-33.454	-0.060	-53.344	-0.092	-42.463	-0.143	-125.269	-0.110	-37.753
$\Delta L\ (GDP/LSU)_{t-1}$			-0.006	-2.038	0.044	5.348	0.231	31.536	-0.029	-1.671
$\Delta L\ (GDP/(LSU)_{t-2}$	-0.418	-3.309			0.035	5.643	-0.120	-16.844	0.090	3.011
$\Delta L\ (GDP/LSU)_{t-3}$	0.412	4.318					0.010	4.962	-0.042	-2.148
ECT_{t-1}	-0.107	-1.603	-0.029	-2.666	-0.192	-1.975	-0.028	-3.765	-0.133	-2.186
Constant	-0.006	-7.4600	-0.005	-18.070	0.0006	1.0720	-0.0003	-4.1498	-0.0038	-2.4825
R-squared	0.999		0.999		0.999		0.999		0.999	
Durbin-Watson Stat	1.609		1.904		1.457		1.782		2.099	

In order to evaluate the sectoral trade short-run differential effects on the labor market, we presented an error correction model. Using this model, we analyzed the employment and wage equation for each manufacturing industry, namely (CHI, TCLI, DMI, EMI and BMCGI).

The labor demand specification leads us to conclude that:

- Delayed employment is the most explanatory variable for determining labor demand; the sectors are not differentiated by prior (delayed) employment and there is therefore no sector L_{t-i} specificity;
- The least significant variables are those corresponding to foreign trade (imports and exports).

Table 5: Estimation of the short-run ECM Wage models by sector

Variables	CHI		TCLI		DMI		EMI		BMCGI	
	Coef	T.Stat	Coef	T.Stat	Coef	Coef	T.Stat	Coef	T.Stat	Coef
$\Delta L\ L_{t-3}$	0.061	0.443	2.286	3.637			0.749	1.429		
ΔLW_{t-2}					0.300	1.729	-0.537	-2.392		
ΔLW_{t-3}			0.415	3.077	0.329	2.1960				
$\Delta L\ Q_t$							-0.485	-1.337		
$\Delta L\ Q_{t-2}$	0.912	2.029	3.072	6.363	0.932	3.084	0.975	2.887	0.663	3.573
$\Delta L\ Q_{t-3}$	0.187	1.356							0.771	4.666
$\Delta L\ Expp_t$					0.052	1.525			0.050	1.777
$\Delta L\ Expp_{t-1}$			1.050	4.578	0.060	1.814				
$\Delta L\ Expp_{t-2}$			0.159	1.501					-0.088	-4.378
$\Delta L\ Expp_{t-3}$			1.723	5.287			0.042	0.354	-0.064	-3.255
$\Delta L\ Impp_t$			-0.453	-2.900	-0.040	-0.464				
$\Delta L\ Impp_{t-1}$			-0.947	-5.587	-0.071	-0.796			-0.149	-3.851
$\Delta L\ Impp_{t-2}$			-0.183	-1.172					-0.075	-2.117
$\Delta L\ Impp_{t-3}$			-1.560	-5.511			0.202	1.299		
$\Delta L\ (GDP/(LN+LP+LES))_t$	-0.172	-2.833	0.650	2.897						
$\Delta L\ (GDP/(LN+LP+LES))_{t-1}$					1.212	3.069	0.994	1.386	0.804	4.211
$\Delta L\ (GDP/(LN+LP+LES))_{t-2}$	-0.108	-0.939			-1.240	-3.054			-4.473	-4.418
$\Delta L\ (GDP/(LN+LP+LES))_{t-3}$	-0.536	-1.001	1.342	5.292					6.386	5.253
$\Delta L\ (GDP/LSU)_t$			-0.447	-3.225	0.313	1.883	0.280	0.838	0.189	2.235
$\Delta L\ (GDP/LSU)_{t-1}$			-0.870	-4.272	-0.647	-2.332	-0.799	-1.129	-0.297	-2.643
$\Delta L\ (GDP/LSU)_{t-2}$	0.398	0.824			0.875	1.986	-0.810	-2.260	4.066	4.342
$\Delta L\ (GDP/LSU)_{t-3}$			-0.717	-3.923	-0.507	-2.153	0.290	1.487	-7.168	-5.586
ECT_{t-1}	-0.777	-3.535	-1.586	-8.023	-0.677	-2.930	-0.337	-1.105	-0.543	-2.720
C	0.033	1.464	-0.386	-5.735	-0.030	-1.264	-0.057	-1.225	-0.213	-4.363

R-squared	0.654	0.959	0.869	0.739	0.917
Durbin-Watson Stat	2.131	1.188	2.437	2.333	2.880

The most significant variables in the determination of labor demand for each sector are summarized in **table 6**.

Table 6: Determinant variables of short-run labour demand

Variables	**Employment / Labour**		**Production**	
Sectors	***Sign***	***Effect***	***Sign***	***Effect***
DMI	Positive	**Strong**	Negative	Marginal
EMI	Positive		Positive	Marginal
TCLI	Positive		Positive	
BMCGI	Positive		Positive	
CHI	Positive		Positive	

For the wage level characterization (table 7), it can be concluded that there is a high sector specificity to determine the short-run salary evolution of the error-correction model.

Table 7: Determinant variables of the short-run wage level

Variables	**Production**		**PTNQ**		**PTQ**		**Employment**		**X**		**M**	
Sector	***Sign***	***Amp***	***Sign***	***Amp***	***Sign***	***Amp***	***Sign***	***Amp***	***Sign***	***Amp***	***Sign***	***Amp***
CHI	+		-		+		+		NS		NS	
TCLI	+	S	+		-		+		+	S	-	S
DMI	+		-		+	M	NS		+		-	
EMI	+		+		-		+		+		+	
BMCGI	+		+	S	-	S	NS	S	-		-	

Note: **PTNQ**: Productivity of unskilled workers; **PTQ**: Productivity of skilled workers, **X**: Export, **M**: Import, S: Strong; **M**: Marginal, **NS**: Not significant.

Thus, it can be remarked that:

- The explanatory variables (production, PTNQ, PTQ, employment, X and M) in the exportable sectors (TCLI and BMCGI), strongly affect the real wage level.
- The wage in the TCLI sector is very sensitive to the delayed employment, production, export and import variables.
- The wage in the DMI sector is highly sensitive to the unskilled and skilled workers productivity variables.
- The wage in the TCLI sector is sensitive to all the explanatory variables but insensitive to the delayed wage.

5. CONCLUSION

This paper proposed to test the effect of the commercial openness on Tunisian data, by means of the error correction models. The econometric study showed that there is no general theory on how trade liberalization affects the wage structure and employment level in the Tunisian manufacturing industries. Trade liberalization does not have a uniform effect on wages, nor on the employment level and welfare.

It is worth noting that the labor demand elasticity relative to previous years' employment is lower in the short-run than in the long-run in all the Tunisian manufacturing industries. This confirms the rigidity of the short-run labor market in each sector. Nevertheless, the requirements of labor law has often been seen as a disruptive factor in the market mechanisms.

Further, the labor demand elasticity relative to trade openness shows that export promotion will lead to long-run job creation in importable manufacturing industries, yet the exportable ones will suffer long-run job losses because of increased exports in these exportable industries. Over the short-run, the increase in exports will reduce the job creation opportunities of in the export sector of MCCV and increase them in the IMD sector.

Imports intensification will result in long-term job creation in each manufacturing industry, which demonstrates the complementarity between capital and employment explaining the job creation increase following imports growth. In addition, the increased competition in the export market, as well as foreign imports, have prompted firms in the manufacturing sector to import new technologies to support labor demand in their own industries except for the EMI which will suffer long-run job losses as a result of increased imports. On the other hand, , imports are noted to have a negative effect on job creation in the TCF sector in the short-run, but this effect is not significant in the other manufacturing sectors.

Through trade openness, Tunisian companies are expected to be obliged to adopt more adequate technologies to international competition and modernize their behavior. This could be concretized by an increase in their productivity and therefore by an increase of their competitiveness and the subsequent growth of the Tunisian economy.

However, Tunisia's economic growth does not seem to answer such expectations in its manufacturing industries. A strong and sustainable growth generating a high potential of job creation, in the context of a rapidly growing active population, is a major challenge for Tunisia. Nevertheless, the international trade does not seem to be a job creation enhancer. Therefore, it is recommended that Tunisia challenge the foreign trade economic policies, as well as the involved socio-economic stakes and negotiate again the contribution of the international community, mainly that of the EU, in this respect.

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