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ABSTRACT

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This paper investigates short and long-run effects of trade liberalization on employment and wages. Employment and wage equations are estimated using data (1971–96) for importable and exportable sectors in Tunisia. Causality tests show that causality is unidirectional. Wages strongly causes employment but employment does not cause wages. There is significant difference in the direction of responses in the short and long run. Results from empirical testing using the models find only support for the short-run theoretical predictions for the exportable sector. Similar results obtained for the importable sectors. We find the differences in the short and long-run wage and employment responses to changes in export to be explained by learning by doing, organizational changes and improved factor utilization and labour productivity. A possible reason for the divergence of theory and practice is that the theoretical model is premised on the basis of a fixed supply of labour. Exportable employment could therefore only rise if importable employment fell. However, as we have seen, the supply of labour increased dramatically in Tunisia as women entered the labour market. This allowed importable employment to be maintained (even slightly increased) as the exportable sector expanded.

JEL Classification: C23, E24, J23, J31, F10, L60

Keywords: trade, labour market, exports, imports, manufacturing, panel data, Tunisia

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1. Introduction

There are relatively few studies analyzing the effects of trade-induced shifts in the composition of employment and wage levels in developing countries economies in general, and in their manufacturing industries in particular. Analyses conducted by Wood (1994) indicate that the shift from import substitution to export promotion policies will, in the case of developing countries, expand the labour-intensive industries, increases the overall labour demand and increase real wages in the long-run, *ceteris paribus*. An increase in real wages has in turn negative impacts on the exportable sector's competitiveness.

However, it is important to note that trade liberalization and increased foreign competition may not only affect the composition of the tradable goods sectors (i.e. the distribution between exportables and importables), but it may also affect both the efficiency with which all firms use production factors (including labour) and the distribution of output within a sector between more and less efficient firms. Thus, the net long-run effects of trade liberalization on employment will depend upon the balance of structural and efficiency effects (i.e. the distribution of the output between firms and the factor returns) which cannot be identified from analyses of the composition of trade alone.

Furthermore, the short and long-run effects of trade liberalization on employment and wages may diverge. The difference is important in understanding the nature of the adjustment process and in the design and magnitude of policy measures undertaken to affect changes towards target levels. This divergence depends on the degree of factor mobility, the competitiveness of labour markets, organizational structure, learning by doing and the speed at which the wage and employment levels adjust towards equilibrium levels.

The objective of this paper is to determine the effects of trade liberalization on employment and wages using a specific factor model. We do so by using panel data evidence from Tunisia, an economy that has undergone significant trade liberalization and transformation since 1986. The data that we have used in this study have been gathered from two sources: the national accounts obtained from the Tunisian National Statistic Institute (INS), and statistics from the Quantitative Economy Institute (IEQ) (see Appendix). These two data sources provide a new industrial database for the labour market and statistics on trade covering the period 1971–96. The data is at an industrial level where industrial sectors are classified as tradeables (exportables and importables) and non-tradeables according to the share of exports and imports in the total production of each sector.

Indeed, Tunisia is viewed simultaneously as a successfully liberalized country and an economy with extensive government intervention in the labour market. As such, Tunisia provides a valuable case study for evaluation of labour market adjustments to trade liberalization, given that there is now sufficient information available relating to labour market conditions under both its pre and post-liberalization experience.

The main contribution of this paper to the literature is in investigating the direction of causality between wage and employment, in dynamic formulation of the model, and in testing the relationship between labour market adjustment and trade liberalization in developing countries being exposed to major trade liberalization. In the literature the

direction of causality is not investigated, biasing the result (Milner and Wright 1998 and Dong 1998).

The rest of the paper is organized as follows. In Section 2, the theoretical short- and long-run labour market responses to trade liberalization is outlined. Section 3 provides a brief description of the nature of trade liberalization and of labour market developments in Tunisia during the period of this study, 1971–96. In Section 4, we present the empirical model to test the effects of trade liberalization on sectoral labour and wages. The data is described in Section 5. The estimation procedure is discussed in Section 6. The empirical results are discussed in Section 7. Finally, Section 8 contains a summary and conclusions of this study.

2. The theory and empirics of labour market adjustment to trade liberalization

Edwards (1988) investigates labour market adjustment to trade liberalization for a small, two factor (capital (K) and labour (L)) economy that produces three goods (exportables (X), importables (M) and non-tradeables (N)). This specific factor model typically allows for short-run capital-specificity (i.e. the capital following investment is immobile between sectors in the short-run), labour mobility between sectors and inelastic aggregate factor supply (Mussa 1978). Production function is assumed to have conventional properties as follows. The ranking of factor intensities is assumed to be $(K/L)_M > (K/L)_N > (K/L)_X$. In addition it is assumed that there is incomplete specialization in production and factor supplies are fixed. Given a model with such characteristics we summarize some of the main findings of Edwards in Tables 1 and 2. The tables show the adjustment of employment and wage in the long and short-run due to trade liberalization.

Table 1. Long-run employment and wage adjustments following trade liberalization in traditional trade models.

Sectors	Production	Employment	Wage
Exportables	Increasing	Increasing	Increasing
Importables	Decreasing	Decreasing	Increasing
Non-tradeables	Increasing	Ambiguous	Increasing

Table 2. Short-run employment and wage adjustments following trade liberalization in traditional trade models.

Sectors	Production	Employment	Wages
Exportables	Increasing	Increasing	Decreasing
Importables	Decreasing	Decreasing	Decreasing
Non-tradeables	Ambiguous	Ambiguous	Decreasing

2.1 The long-run effects

In this type of model (a small open economy with three goods), when production factors can circulate freely between sectors, we conclude that:

- World prices, technology, and tariff determine domestic prices of the three goods.

- Equilibrium means that, without specialization, world prices of exportable and importable (plus tariffs) determine factor rewards, which in turn determine the price of non-tradeables (under competition).
- Non-tradeable demands determine factors used in their production as well as factors used in total production including tradeables.

The long-run effects of a fall in the relative price of importable following liberalization[1] are in line with those predicted by the Stolper-Samuelson theorem. Where exportables are relatively labour-intensive, tariff reduction increases demand for the economy's abundant factor, driving wages higher (and the return to capital lower).

The within-tradeables shift in production and employment is unambiguously towards exportables and away from importables, given the rise in the relative price of exportable.

In the case of non-tradeables there are opposing effects on long-run employment. On the one hand, production of non-tradeables can be expected to be higher, given the assumed pattern of factor intensities as demand grows (due to switching from tradeables and any positive income effects of a tariff reduction). On the other hand, production of non-tradeables will be more capital-intensive as a response to the rise in wages.

2.2 The short-run effects

Given that, in the short-run, the capital is sector-specific and that labour is mobile between sectors, Edwards' model must be based on four factors in order to produce the three goods (labour, capital in exportables, capital in importables, and capital in non-tradeables). Indeed, since the capital is supposed to be sector-specific in the short-run, the direct link between the price of tradeables and factor rewards is broken. Consequently, the price of non-tradeables will be determined by both demand and supply factors.

In the short-run, given that capital is sector-specific, reduction of importables price generates changes in non-tradeable price (Dornbusch 1974), which depend on the pattern of substitution and on the extent of income effect. If the three goods are substitutes in consumption and production and if substitution effect dominates income effect, non-tradeable price will decrease relative to exportable price and it increases relative to importables. In this case, output and employment must increase in the exportables sectors, while their adjustments in the non-tradeables are ambiguous. The ambiguous direction of effect depends on the pattern of substitution between tradeables and non-tradeables. By contrast the fall in the relative price of importables combined with capital-specificity reduces production, labour intensity and employment.

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[1] In fact Edwards (1988) investigates a fall in the price of importables induced by a change in the world price i.e. terms of trade change. He points out that this is almost equivalent to an import tariff change resulting in a change of the same magnitude in the domestic price of imports. The exogenous shock generates, however, a higher income effect than the trade policy change.

Real wages in the Edwards model are defined in relative terms, i.e. relative to the numeraire, i.e. the price of exportables. In the long-run, wages increase in all of the three sectors of exportables, importables and non-tradeables.

On the other hand, in the short term, the above changes in the relative prices of tradeables and non-tradeables following import liberalization, means that wages have increased relative to the domestic price of importables, but decreased relative to the price of exportables and non-tradeables.[2] Consequently, the real wage effects in the short-run may be viewed as ambiguous, depending on the relative importance of importables, exportables and non-tradeables in the total consumption basket. In order to eliminate this ambiguity, we define the real wage effects in Table 2 in terms of non-tradeables.

Although, it captures a great number of characteristics that are typical of several developing countries, including Tunisia, the preceding analysis is conducted in a relatively simple context, based on restrictive assumptions (fixed) regarding factor supplies. Indeed, employment and wage adjustments will be affected by the following variables:

- The heterogeneity of sectors and factors.
- Competitiveness and efficiency effects that can be caused by trade liberalization in products market and which affect employment levels.
- The sensitivity of short-run wage effects to the scope for increasing capital stocks through foreign direct investment.
- The presence of unemployed or non-participating labour that could be used to meet the increase in demand for exportables. For example, in Tunisia, as well as in many developing countries, expansion of certain exportable sectors may encourage female participation. This elasticity in aggregate labour supply can affect both the magnitude and direction of sectoral wage and employment responses.

2.3 Some recent applications

There are several studies which in one or another way are relevant to the relationship between wages and employment. However, most of these studies are non-dynamic but deal with current study relevant issues like: non-profit objectives of firms, allocative inefficiency of labour, association between lowering wages and productivity of labour, wage dispersions impact on allocation of jobs, the impacts of increased wages on hiring temporary labour and flexible work time, cost of adjustment of labour, firm size and trade orientations effects on employment responses, economics reforms, effects of exchange on exporting sector, the link between trade liberalization and wage inequality. In the following we briefly review a number of such studies.

The employment and wage behaviour of a panel of Chinese rural industries for the years 1984–90 is examined by Dong (1998). A static single equation model is used. The

[2] The overall increase in the demand for labour, given the shift in production from importables to exportables, is with fixed capital stocks and therefore implies a falling marginal product of labour in the short-run.

results indicates that enterprises pursued non-profit objectives. The firms value both income and employment, but emphasizing income above employment. Inoptimality of employment results in allocative inefficiency.

The importance of reform measures, market development, and insider forces in wage and employment determination in China's state sector is evaluated by Lee (1999) using firm-level panel data 1980–94. The state sector labour market in China is different in behaviour than in rural industry. The results for the state sector show that corporatization lowered wages and improved productivity, with insignificant change in employment. Wages and employment are positively correlated with initial productivity, initial capital per worker. Responses for production and non-production workers are different, the latter are more responsive.

Levinsohn (1999) investigates employment responses to substantial trade liberalization in Chile using plant-level employment data for 1979–86. The patterns of job creation and job destruction are related to firms' size and trade orientation. Results show that firm size and firms in the exportables sector matter. Macroeconomic shocks affected firms in import and exporting sectors similarly, but exchange rate reform impacted the firms in trade and non-trade sectors differently. The joint effects of macroeconomic shocks and trade liberalization resulted in net employment in manufacturing falling by about 8 per cent. However, firms are heterogeneous in behaviour. In order to separate the two effects it is necessary to use disaggregated firm-level data.

The link between trade liberalization and wage inequality in Chile 1960–96 is investigated by Beyer et al. (1999). They estimate the long-run relationship between the skill premium, product prices, openness and factor endowments. A fall in relative prices of labour-intensive goods helps explain the increase in wage inequality. Higher education decreases inequality. Openness widens the wage gap between skilled and unskilled labour.

Heyman (2001) studies the relationship between wage dispersion and allocation of jobs using Swedish manufacturing establishment-level panel data. The results show that the effect of wage dispersion on job turnover is negative and significant in the manufacturing sector. A high proportion of temporary labour and flexible work time negatively affect job turnover. The largest parts of variation in gross job flows is explained by differences in the cost of adjusting labour, rather than differences in wage dispersion.

3. Trade liberalization and labour market development in Tunisia

3.1 Tunisia as a case study

We seek now to test the model of our labour market adjustment to trade liberalization in the context of a specific, small and developing economy. Tunisia provides a case that agrees closely enough with Edwards' model. It has a relatively undiversified economic structure with homogeneous and clearly identifiable tradeable and non-tradeable sectors. Indeed, the low dimensionality of the Edwards model is more acceptable in this context than in larger, and more diversified developing countries.

Factor mobility characteristics and the relatively low levels of measured unemployment are also in line with the assumptions set out in Section 1.[3] Further, Tunisia has undertaken significant and discernible trade liberalization that has been associated with substantial structural adjustment to the economy (Boudhiaf 2000). Given that Tunisia did not have political instability or other sources of shock during the period of trade liberalization, the analysis is not vulnerable to the obvious criticism that structural adjustment has been contemporaneous with a number of other significant influences besides trade liberalization.

Before the structural adjustment, Tunisia opted for a trade policy oriented toward the protection of the domestic market (Belkhiria 1994). The trade policy was based on:

- an industrial policy of import substitution, and
- export promotion since 1972 with specific measures encouraging and targeting exporting industries by granting enterprises fiscal advantages.

Despite the mixed measures of import substitution and export promotion, the exportable sectors (essentially textile) are more labour intensive than the importable industrial sectors. For example, textile industries, and industries producing construction materials, have between 1975–84 created nearly 1400 jobs per year compared with 1500 in other industries.[4] In terms of production, the situation is less lucid since the share of all manufacturing industries in the total gross domestic product (GDP) is 10.4 per cent during 1972–81.

3.2 Trade liberalization

During 1978–86, Tunisia adopted a policy of macroeconomic stabilization and exchange rate adjustment. Indeed, during this period taxes on imports progressively increased and often exceeded 100 per cent of the import prices.

Since 1986, numerous measures have been taken to further liberalize international trade: the Structural Adjustment Programme (1986), adherence to the General Agreement on Terms of Trade (GATT) (1989), adherence to the World Trade Organization (WTO) (1994), and signing of a free-trade agreement with the European Union (1995). According to Boudhiaf (2000), the consequences of these measures on international trade liberalization for Tunisia spread over three periods.[5]

During the initial period of trade liberalization (1986–90), the level of protection for the economy was greatly lowered. During the second period (1990–95) the nominal and effective rate of protection increased in general except for some products. This increase is explained by the consequences of the Uruguay Round that transformed non-tariff protection into their tariff equivalent. Finally, during the third period (1995–98), the

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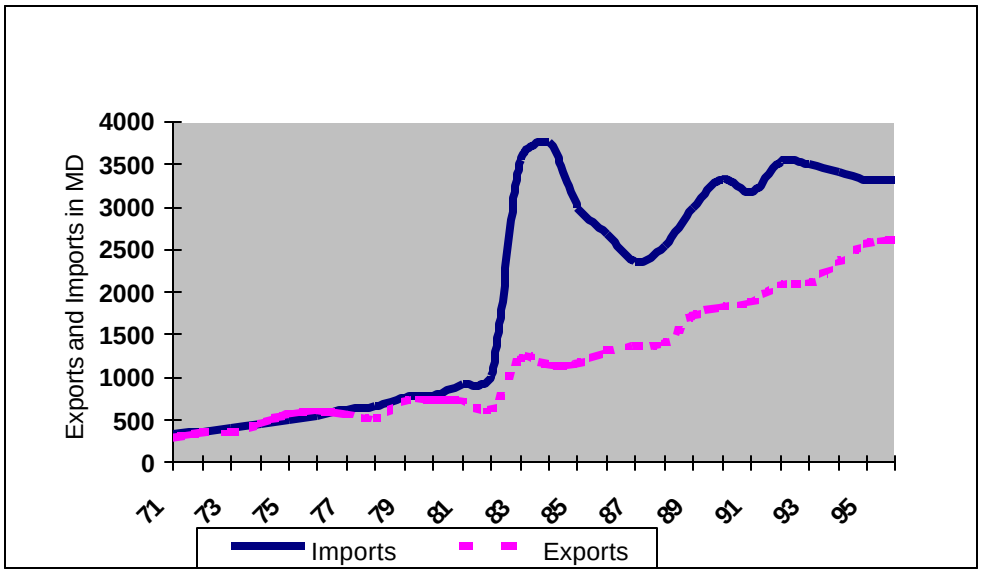
3 In particular high levels of labour utilization do not characterize a 'labour surplus' economy where one might anticipate very high elasticities of sectoral labour supply.

4 For a detailed description of labour market evolution see Dimassi (1998).

5 For evaluation of the effects of trade liberalization on employment and wages in other developing countries, see Brecher (1974), Levinsohn (1999), and Beyr et al. (1999).

nominal protection rate on agriculture increased, while the nominal protection rate for industrial products decreased significantly (see details in the contribution of Boudhiaf 2000). The second liberalization period introduced major changes, mainly in import trade volume[6] (see Figure 1).

Figure 1. Export (in exportables sectors: MCCV, THC, Mining, HYDRO) and import (in importable sectors: IAA, IME, ICH, IMD) evolutions*



Source: INS (1997) *Les comptes de la nation*.

Note: *See Appendix for classifications.

3.3 Labour market evolution

A complex network of institutional and legal arrangements that influence wage determination and work conditions (minimum wage) characterizes the Tunisia labour market. Trade union activity and collective bargaining are protected, but subject to elaborate conciliation and dispute settlement procedures, including provision for compulsory arbitration.

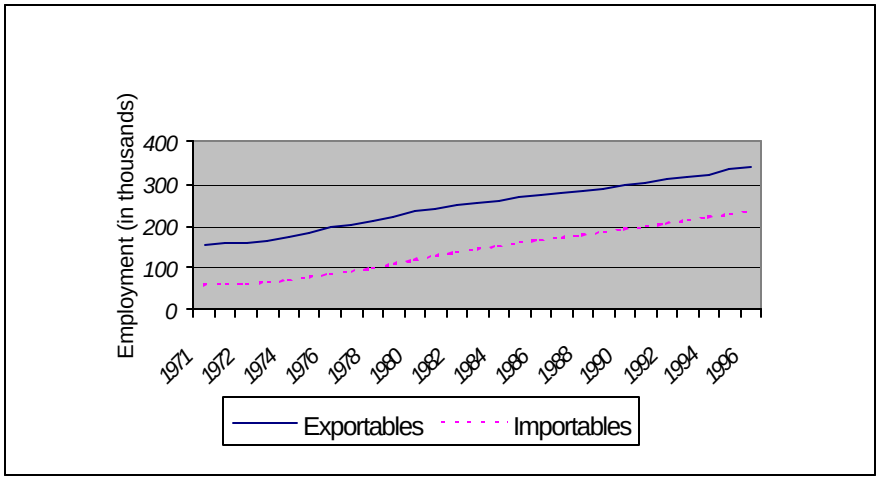
As a major employer, the government exercises a direct and indirect influence on the labour market through various employment policy decisions and periodic salary revisions. Changes of level and structure of employment in Tunisia through recent years are presented in Figure 2.[7] Wages in the exportables are higher than those in the importables. However, the relative difference declines over time.

6 Of course issues of counterfactuals and causality arise. The expansion of exports may have been positively influenced (in part at least) by other external and non-policy factors.

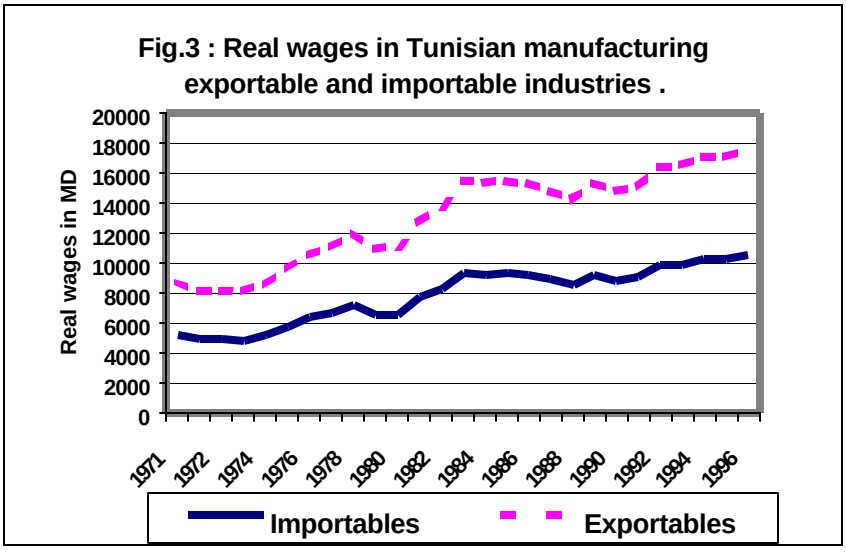
7 Figure 2 describes the evolution of employment in all sectors. While this evolution must not screen the decrease of employment in some sectors (for instance mining) and quality of the data set (based on IEQ estimations).

From Figure 2 we can identify two different phases of employment evolution in the exportable and importable sectors: weak growth until 1974, and stronger growth between 1975 and 1996. The increase in employment in the second phase is explained by two reasons: the dominant role of the exportable sector, particularly textile, clothing and leather, a sector that has an important role in the Tunisian economy in terms of job creation. The second reason is related to the rise in participation of women in the labour market. Female labour participation was encouraged by the important diffusion of female education and training since independence, and especially since 1980 (Dimassi 1998). However, after 1986 employment in importables witnessed a slight increase. This absence of employment reduction effects in the importables sector was due in part at least to the ability of exportables to grow through increase in female participation.

Figure 2. Importables and exportables employment within Tunisian manufacturing industries



Source: IEQ (1998) Database.



Source: QEI (1998) Database.

The effect of changing domestic and external demand conditions on real wages is illustrated in Figure 3. From 1974, wages increased to compensate for the decline of salaried workers purchasing power. However, these increases only served to fuel the inflationary pressures building from increases in the price of international raw materials. The social unrest of 1978 and the bread rations of 1984 grew out of this strife and economic duress. After the adoption of the structural adjustment programme (1986) one observes a real wage reduction until 1988, then a continuous increase up to the present time. However, this increase is stronger in the exportable sectors than in the importable goods sector.

4. The empirical model

Several studies use regression techniques to look directly at employment determination within less developed countries (LDC). However, the existing econometric studies that directly examine the impact of trade on labour market outcomes are mainly based on US data and experience. For example, Abowd and Lemieux (1990) examine the effect of import competition on collectively bargained wage and employment outcomes in the United States, in comparison with Canada.

Turning to employment, for the purposes of the present paper, we have adopted a fairly simple statistic profit-maximizing model of firm behaviour. Milner and Wright (1998), which assumed a Cobb-Douglas production function of the following form, use this model:

$$(1) \qquad Q_i = A^g K_i^a L_i^b$$

where Q is real output, K is capital stock and L is units of labour used in production. Here, as Edwards (1988), we assume that employment is mobile between various sectors of the economy. The a and b represent the capital and labour factor input share coefficients, g allows for factors changing the efficiency of the production process, and i represent the industrial sectors ($i = 1, 2, \ldots, N$).

A profit-maximizing firm will employ labour and capital at such levels that the marginal revenue product of labour equals wage W and the marginal revenue product of capital equals the user cost C. Solving this system simultaneously to eliminate capital from the expression for firm output allows us to obtain the following expression:

$$(2) \qquad Q_i = A^g \left(\frac{a L_i}{b} \times \frac{W}{C} \right)^a L_i^b$$

Taking the logarithms and rearranging Equation (2) allows us to derive the firm's, and therefore the industry's, derived demand for labour as:

$$(3) \qquad \ln L_i = q_0 + q_1 \ln \left(\frac{W}{C} \right) + q_2 \ln Q_i$$

where $q_0 = -(g \ln A + a \ln a - a \ln b)/(a+b)$, $q_1 = -a/(a+b)$ and $q_2 = 1/(a+b)$. Equation (3) will form the basis of the estimation conducted in this paper. Since the data

set will be used as a cross-sectional and time series element, the estimating labour equation for the panel of industries in our study is of the form:

$$(4) \qquad \ln L_{it} = b_0 + q_1 \ln W_{it} + q_2 \ln Q_{it} + q_3 \boldsymbol{X}_{it} + u_{it}$$

where L_{it} is total employment, W_{it} is average real wage (determined with regard to the general price index), Q_{it} is real output in industry i in time t (t=1, 2, …, T), and $\boldsymbol{X}_{it}$ is a vector of variables which affect the efficiency of the production. a_0 is the overall intercept and q_1, q_2 and q_3 are unknown slope parameters to be estimated. The error term $u_{it} = m_i + l_t + n_{it}$ is decomposed into industry-specific (m_i), time-specific (l_t) and random error term (v_{it}) components.

Wages may be determined by the inverse labour supply function and other factors such as: efficiency wage considerations, union bargaining and 'insider-outsider' effects. To summarize these effects we estimate a wage equation of the following form:

$$(5) \qquad \ln W_{it} = b_0 + b_1 \boldsymbol{X}_{it} + b_2 \ln Q_{it} + b_3 \ln L_{it} + b_4 \ln W_{it-1} + u_{it}$$

where W_{it}, Q_{it} and L_{it} are defined as above and $\boldsymbol{X}_{it}$ are exogenous variables.

In the above model, $\boldsymbol{X}$ represents a vector of variables, which may either be internal or external to individual firms engaged in the wage-setting process. For the purpose of our study, the key influences in this context are taken to be the extent of the foreign competition (and the moderating influence on the ability of firms to pay large wage increases) and the degree of employee market power. These effects are captured respectively by the inclusion of trade share term to the wage equation.[8] For the introduction of the trade share, we assume that the lowering of import barriers and increased competition on the domestic market will be reflected in increased import volumes or import penetration in the domestic market. Similarly, growth in export shares results in greater exposure of production in a particular sector to international competition.

Estimation of the effects of trade liberalization on the sectoral employment and wages is conducted in the following way. First, employment and wage functions are estimated separately for exportable and importable sectors for the whole sample period. From this we are able to report short-run and long-run employment and wage elasticities. These provide a basis for identifying the direction and the magnitude of direct and indirect effects of the inferred output changes associated with trade liberalization. Second, we investigate how changes in trade effects, additional to output effects, influence the demand for labour and wages by directly including terms (exports and imports) of trade in some of the equations. The rationale for these terms is that an increase in the openness of the economy may induce either efficiency effects in the case of the labour demand or discipline effects in the case of wage determination.

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8 Milner and Wright (1998) capture these effects by including trade-share and gender ratio (female/male employment) terms to the wage equation. In the current study we do not include the female ratio in the specification of the wage equation, because there is a lack of data on employment by sex.

5. The data

The data set used in this study has been assembled using a diversity of sources (national accounts produced by the Tunisian National Statistic Institute [INS] and statistics from the Quantitative Economy Institute [IEQ]). We did so in order to allow the construction of an integrated database of industrial, labour market and trade statistics. Thus we have a panel of 11 manufacturing industries observed during 1971 to 1996. Industries are classified as 4 exportable and 4 importable on the basis of information about market orientation and the policy regimes. The remaining 3 industries are non-tradeable and include electricity, water and public construction utilities. For a list of manufacturing industries and classification of industries see the Appendix. The total number of observations is 286 (11x26). Due to use of changes and two lagged values in the estimation a total of 253 (11x23) observations are used in the estimation.

Employment (L) and wages (W) are considered as decision (dependent) variables. Employment is defined as number of full time equivalent employees at sector level. Wages is the sum of all wages and salaries including payroll taxes. It is converted to fixed 1971 prices using consumer price index.[9] Product (PROD) is measured as the value of total product produced during a calendar year. Value added (VA) is the total product less material and energy use. Both PROD and VA variables are transformed to fixed 1971 prices using consumer price index.

The industry is divided into two main exportable and importable sectors. The distinction is based on the relative share of export to respective imports of the total production. In addition to the size of the import and export share, market orientation is also used in the classification. Textiles; clothing and leather; construction materials; ceramics and glass; mining; and hydrocarbon are among the exportable sectors, while food processing; electrical and mechanical industries; chemical industries; and other manufacturing industries comprise the importable (see Appendix). The period of study is divided into pre- and post-liberalization (LIBERAL) periods. A sub-sample of industries and periods is labelled at sample periods of import/export penetration. Here export (EXP) and import (IMP) are measured as constant total value of respective variable in 1971 prices.

Summary statistics of the data is given in Table 3. The mean employment is 54300 employees with standard deviation of 6600. Textile is the main employer. Employment in the textile industry increased from 118000 in 1971 to 264000 in 1996. Total wages in the textile industry have increased from 335 to 1150 million Tunisian dinars. The corresponding values transformed to annual labour cost show an increase in the labour cost from 2840 in 1971 to 4340 dinars in 1996. The value added on average is 35 per cent of the total product value. It differs by industry and over time due to differences in material and energy use intensities in production.

Pearson correlation coefficients are given in Table 4. All variables show an increasing trend over time. The dependent variables employment and wages are as expected negatively (-0.42) correlated, while production and value added are as expected positively (0.79) correlated. In the specification of employment and wage equations, either production or value added is used. Value added and employment are positively

[9] In the absence of an industry level producer price index covering the entire period of study we have used comsumer price index to transform the variables of interest.

correlated (0.49) with each other indicating presence of collinearity in the wage equation. Similar correlation patterns are found in the remaining sub-samples of exportable, importable and non-tradeable.

6. Estimation procedure

The employment and wage relationships are dynamic in nature. The panel data have the advantages that they allow better understanding of the dynamics of adjustment. These dynamic relationships are characterized by the presence of a lagged dependent variable among the regressors. In addition, here we allow for inclusion of lagged explanatory variables. These are predetermined or exogenous variables. Estimation of error component models is developed in two directions. First, the fixed effects (FE) model, where m_i and l_t are assumed to be fixed and correlated with the explanatory variables. Second, the random effects (RE) model, where m_i and l_t are assumed to be random and uncorrelated with the explanatory variables. Efficiency, unbiasedness and consistency are properties affecting the choice of model (see Hsiao 1986 and Baltagi 2001). In this study we assume the effects being fixed. The random error component n_{it} is assumed to be independent and identically distributed with mean zero and constant variance, s_v^2.

In a static case the model can be estimated using least square dummy variables (LSDV), within estimation or first difference methods (Anderson and Hsiao 1981). In a dynamic case the estimation procedure is more complicated. For the purposes of estimation, equations (4) and (5) are differenced so as to transform out the fixed time-invariant country effects, m_i, and dynamic labour demand and wage equations are implemented. The estimated employment and wage equations are:

$$\begin{aligned}\Delta \ln L_{it} = {} & b_0 + b_1 \Delta \ln L_{it-1} + b_2 \Delta \ln W_{it} + b_3 \Delta \ln W_{it-1} + b_4 \Delta \ln W_{it-2} \\ & + b_5 \Delta \ln Q_{it} + b_6 \Delta \ln Q_{it-1} + x_m \Delta \ln X_{mit} + z_j D_{jit} + v_{it}\end{aligned} \tag{6}$$

$$\begin{aligned}\Delta \ln W_{it} = {} & b_0 + b_1 \Delta \ln W_{it-1} + b_2 \Delta \ln L_{it} + b_3 \Delta \ln L_{it-1} \\ & + b_5 \Delta \ln Q_{it} + b_6 \Delta \ln Q_{it-1} + x_m \Delta \ln X_{mit} + z_j D_{jit} + v_{it}\end{aligned} \tag{7}$$

where Δ indicate change, for instance $\Delta \ln L_{it} = \ln L_{it} - \ln L_{it-1}$. The industry-invariant time-specific effect l_t is traditionally represented by a time trend or time dummies.[10] In this study we have chosen the later alternative. Transformation of the relation to changes eliminated the industry-specific effects but transforms the time trend to a vector of 1 absorbed in the overall intercept. Hence, the intercept b_0 does not represent the intercept but the time-effect. The intercept is eliminated following the first difference transformation.

[10] The use of time-dummies to represent the time-specific effects is to be preferred to a time trend. The former allows a better modelling of year to year changes in employment and wages. However, unlike the industry-specific effects the time-specific effects are not eliminated following a transformation of the relationship to changes. A transformation of time dummies to changes makes interpretation of the time-specific effects very complicated.

Inclusion of lagged dependent variable introduces a number of problems to the estimation of the model. The main one is that the lag dependent variable is correlated with the error term since it is a function of the industry-specific effects. An OLS estimation of the model results in biased and inconsistent estimates of the coefficient on the lagged dependent variable. The bias of the OLS estimator stems from the correlation of the lagged dependent variable with the individual specific effects. For this reason we have used the endogenous variables dated $t-2$[11] (cf. Jennifer Smith 1999). Since the OLS method does not solve the problem (the differencing will induce a bias in the coefficient on the lagged dependant variable), an instrumental approach must be adopted.

The use of instrumental variable method leads to consistent but not necessarily efficient estimates of the parameters in the model because it does not make use of all available moment conditions and it does not take into account the differenced structure on the residual disturbances (see Baltagi 2001). As with Milner and Wright (1998), the method used here is the generalized method of moment's (GMM) technique of Arellano and Bond (1991) which uses differences $\Delta \ln L_{i,t-2} = (\ln L_{i,t-2} - \ln L_{i,t-3})$ rather than levels, $\ln L_{i,t-2}$ for instruments. But the GMM estimator needs a large number of observations, while our estimation is based on eight sectors only. For this reason, we used a particular case of GMM that is the two stage least squares (2SLS) method as well. For sensitivity analysis we have, however, estimated the models with both 2SLS and GMM methods. This GMM technique uses lags of the endogenous variables dated $t-2$ and earlier as instruments. In the case of wage equation, employment and real output are also treated as endogenous variables and suitably instrumented.

7. The results

7.1 Causality between employment and wages

The issues of causality relationship between employment and wages are examined by regressing the log of employment and log wages on their past values and testing for their joint significance as follows:

$$\ln L_{it} = a_0 + \sum_{m=1}^{M} a^1_m \ln L_{i,t-m} + \sum_{n=1}^{N} a^2_n \ln W_{i,t-n} + w^1_{it} \quad (8)$$

$$\ln W_{it} = b_0 + \sum_{m=1}^{M} b^1_m \ln W_{i,t-m} + \sum_{n=1}^{N} b^2_n \ln L_{i,t-n} + w^2_{it} \quad (9)$$

where non-zero values of a^2_n and b^2_n are indications of causality relationships between the two variables. Granger's concept of causality is that a variable L causes a variable W if taking account of past values of L leads to improved predictions for W, all other things being equal. The most common approach to answer the question of relationship between L and W is to regress L on W and test the coefficient of W for significance. In the current case it is important to establish and test for the direction of causality. Using the relation in Equations 8 and 9 for the test of causality between employment and

11 The dependent variable here is transformed first to changes and then lagged one period.

wages the values of the maximum lag length, M and N, were set to 2 respectively. The choice of minimum lag structure was based on significance of lag values.

The test results presented in Table 5 indicate the presence of a unidirectional causality from wages to employment, but not from employment to wages. Hence, the employment and wages models can be estimated as single equations as is done in this study.[12] It is to be noted, although, that the causality is found to be unidirectional, yet we account for the endogeneity of regressors.

This finding of a unidirectional causality relationship is complient with the hypothesis that we have tested in other work (Haouas 2002) using a computable general equilibrium model. This implies that the salary workers wage is fixed and the non-salaried workers wage is flexible. With the presence of employment mobility concerning the later category of labour, all the unemployed salaried workers will be able to find appropriate employment.

7.2 Parameter estimates

The pooled data is divided into a number of sub-samples: importable sector, exportable sector, liberalization period, and export/import penetration period. Results of estimations of our employment and wage models based on the pooled and four sub-samples are presented in Tables 6 and 7. As mentioned previously the product and value-added explanatory variables are highly correlated (0.79). We found the results sensitive to the choice of variables representing production in Tunisian manufacturing industries. The value-added is to be preferred because it generates more significant parameter estimates.

The employment and wage models are dynamic and presence of lagged dependent variables implied the use of an instrumental variable approach to estimate the parameters of the models consistently. We used both GMM and 2SLS estimation methods. The GMM is more efficient. The results showed minor differences in the standard errors. We have used 2SLS in all five cases, and as illustration GMM in the pooled data as well. The use of GMM requires a large number of instruments. The employment and wages models estimated using product value are reported in Tables 6.A and 7.A, respectively. The corresponding results for wages equations are reported in Tables 6.B and 7.B.

The fit of employment models, measured as adjusted R^2, when product represents production, varies in the interval 0.0356 to 0.6269. The corresponding values are 0.041 to 0.6374, when product is replaced by value-added. The highest concerns the importable sector and the lowest, export/import penetration sub-samples. The R^2 of the wage models when product enters the relation varies in the interval 0.0796 to 0.3717. The corresponding values are 0.1020 to 0.3830, when value-added is used. Unlike the employment equation, the highest value here concerns the export/import penetration sub-sample.

[12] We have also estimated the two equations jointly in a simultaneous equation system using 3SLS method. The results are not reported here due to limited space. The results, however, can be obtained from the corresponding author upon request.

Most of the coefficients are statistically significant at less than 10 per cent of the significance level and the signs are as expected. A division of the data to smaller sub-samples makes the results sensitive to the sample size. The 2SLS and GMM methods produce identical parameter estimates, but the standard error of the former is upward biased. Thus, the GMM show somewhat higher frequency of statistically significant parameter estimates. The change in employment was shown to weakly serve as a determinant of employment. In the wage equation we excluded the change in employment lagged two periods. The excluded second lagged employment serves as an identification variable when the two equations are estimated jointly. As previously mentioned, the change transformation eliminates the industry effects and the time effect represented by a time trend following its difference transformation serves as the overall intercept in the two models. These equations allow us not only to distinguish between the short-run and the long-run, but also to distinguish between the *ceteris paribus* responses of exportable and importable sectors.

Generally, the estimated coefficients (sign and magnitude) are significant, and are in line with previous studies. Increases in industry output or value-added raise the demand for labour, whereas increases in average wage rates lower the employment level. Also it could be seen that employment exhibits persistence as the change of employment depends significantly on its lagged value.

As compared to the pooled regression, the results of exportable and importable sectors show a significant persistent effect of the wage and the output on the level of employment. This effect is more important for the importable sectors than the exportable sectors. For the period 1986–96 (period of transition) there is an amortization effect (i.e. coefficient for the lags endogenous variables), in the sense of the effects of wages and output declines. This change of tendency for the period 1986–96 denotes a change on the level of the economic structure that appears to be more flexible.

Results for the first three sub-samples of Table 8 present the results for the estimated wage equation for the period 1971–96. The estimated coefficients are also generally in line with theoretical priors. Increases in output cause a rise of wages as firms take on more labour to meet their production needs, while expansions in employment independent of increased output generally cause a fall of wages.

Positive coefficients of the lags endogenous variables translate a persistence effect of the employment and output on wage. This effect is more important in the exportable sector than in the importable sector. The period 1986–96 has a persistence effect more important than the period 1971–86, which implies that for the later period there was a weak effect of amortization.

As discussed in Section 7.1, an important element in the theoretical model is that there will be differing wage and employment responses between importable and exportable sectors. Thus in the exportable and importable models (Tables 6 and 7), intercept, the employment and wage responses vary between the two sectors following the trade liberalization reform (i.e. (t), (t–1), and (t–2)).

7.3 Long-run and short-run effects

These equations allow us not only to distinguish between the short-run and the long-run, but also allow us to distinguish between the responses of importable and exportable sectors to changes in production.

For example, Edwards' (1988) model suggests that the impact of tariff reductions would serve to reduce the price of importables relative to that of exportables, and lead to switch of production in favour of exportables. Such a reform will have output, wage and employment implications for the economy being considered.

Since the initial shift in production will have both employment and wages effects, the implied change in employment in each of the exportable and importable sectors ($j = x, m$) is given by:

$$(10) \qquad \frac{d \ln L_j}{d \ln Q_j} = \frac{d \ln L_j}{d \ln Q_j} + \frac{d \ln L_j}{d \ln W_j} \times \frac{d \ln W_j}{d \ln Q_j}$$

where L_j is employment, Q_j real output, and W_j real wage rates in sector j. The corresponding change in wages is given by:

$$(11) \qquad \frac{d \ln W_j}{d \ln Q_j} = \frac{d \ln W_j}{d \ln Q_j} + \frac{d \ln W_j}{d \ln L_j} \times \frac{d \ln L_j}{d \ln Q_j}$$

The results of this analysis are presented in Table 8. Three sets of responses are calculated. The impact effects are the contemporaneous, current-year (period t), responses. The short-run effects are the responses taking into account contemporaneous and lagged responses (period (t) and (t–1)). The long-run effects take into account the full adjustment process.[13]

For the matters of sensitivity analysis, the calculations are conducted for both production and value added measures. With the exception of one case, long-run exportable employment, the results coincide.

First we can conclude that in the case of exportables, the estimated short-run effect and increase in production is increasing, while the long-run is decreasing in both employment and wage cases. The resultant responses' direction with the exception of the short-run in employment is not corresponding to those predicted by Edwards (1988) and shown in Tables 1 and 2. Beyer et al. (1999) found positive link between trade liberalization and wage inequality in Chile. Openness widens the gap between skilled and unskilled labour.

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[13] For instance the impact effect, the short-run and the long-run effects in the case of employment equation using product as measure of production (Table 6.A) are calculated as follows:

- impact=(0.0529+0.0048)(-0.1210)=0.0523,
- short-run=(0.0529+0.0250)+(0.0048+0.0373)(-0.1210+0.1143)=0.0776,
- long-run=(0.0529+0.0250)+(0.0048+0.0373-0.0446)(-0.1910+0.1143)=0.0779.

The corresponding values in the case of wage equation (Table 7.A) are:

- short-run=(-0.1210+0.1143)+(0.0134)(0.0529+0.0250)=–0.0056,
- long-run=(-0.1210+0.1143)+(0.0134-0.1435)(0.0529 +0.0250=–0.0168.

In the latter case the short-run is based on change value, while the long-run on the lagged value one period.

Employment in exportables rises in the short-run but declines in the long-run. Similar patterns are found for wages. In the short-run an increase in production is feasible only if employment is increased or capital intensity changes. However, in the long-run labour become more productive and efficient in production through process of learning-by-doing. The organization, better planning, and management over time are factors that distinguishes the short-run from the long-run effects concerning changes in the direction of the effects from positive to the negative. This pattern might be more evident in the case of the exportable sector. Heyman (2001) found that the effect of wage dispersion on job turnover is negative. A high fraction of temporary labour and flexible work time lower job turnover. Levinsohn (1999) found that economic shocks and exchange rate affects foremost the exportable sector.

Turning now to the employment and wages responses to changes in production in importables sector, the estimated impact results imply that employment and wages change in different directions. The former decreases, while the latter increases. This is in contrast with predictions of theory where employment is predicted to fall both in the short-run and the long-run, while wages rise in the long-run but fall in the short-run. However, our finding of declining wage in the short-run is consistent with the theory's prediction. The reason for this divergence is that the Edwards' model is premised on the basis of a fixed supply of labour. Thus exportable employment could therefore only rise if importable employment fell. Another factor of divergence could be the fact that the calculated impacts are partially based on insignificant parameter estimates. We cannot make inference about their significance.

In addition we have seen that the supply of labour increased in Tunisia as women entered the labour market. This allowed employment in importables to be maintained (even to slightly increase) as the exportable sector expanded. Furthermore, the real wage effects in the short-run may be viewed as ambiguous, depending on the relative importance of importables, exportables and non-tradeables in the total consumption/ production basket.

7.4 Trade liberalization

Finally we investigate the effects of introducing trade variables directly into wage and employment equations, but for the restricted period 1986–96 (during which Tunisia adopted its structural adjustment programme). In Model 5 of Tables 6 and 7 we have attempted to see the impact of export/import penetration on wage and employment equations.

As a matter of fact, we notice that import effect on employment and wages is positive but it is not significant in the employment equation and highly significant in the wage equation. This can be explained by the fact that Tunisia is an importer of manufactured goods.

The complementarity between capital and employment is a factor that explains the rise in employment following an increase in export. Required adjustment in response to export increases is met in the short-run through better utilization of capital and labour. For instance overtime and shift work are temporary measures. In the long-run the changes in export are met by investment in physical capital, increased employment, or improved productivity of labour.

Turning to exports, we notice that the coefficient is very close to zero and statistically insignificant. There is therefore a concentration of exports on a small number of industries (textile and clothing in the case of Tunisia) and the domination of exports in output in those sectors. The influence of trade on wages comes about primarily via the export variable. We conclude that wages rise especially in sectors where export increases.

8. Summary and conclusion

This paper seeks to test empirically a model of labour market response to trade liberalization. The specific-factor model of labour response utilized in this paper predicts that there may be differentials between importable and exportable sectors, between the short-run and the long-run effects. In order to determine these differential responses we estimate dynamic models of employment and wages using panel data estimation technique.

Two equations have been estimated in the case of Tunisia that in the 1980s adopted a trade liberalization policy followed by the signing of a free-trade agreement with the European Union in 1995. For this case we find support only for Edwards' theoretical model. Prior to the estimation we have tested for the nature of causality between employment and wages. We found that causality is unidirectional going from wages to employment. Hence the two equations accounting for endogeneity of causal variables can be estimated separately.

Indeed, employment and wages in exportable sectors increase in the short-run, but they decrease in the long-run probably due to the process of learning-by-doing and improved productivity and organizational capacity. In the case of importable sectors the estimated effects indicates increase in employment both in the short-run and long-run, while decreases in wages. In the real world, employment and wages have expanded in this sector following liberalization.

Globally, we notice that trade liberalization has been favourable for Tunisian labour market progress, thanks to government efforts to prepare the Tunisian economy to this liberalization. These efforts result in institutions and services progress, in the enhancement of infrastructure quality, and to an adaptation of competence to concrete employer needs. Finally, this has led to an increase of foreign and national investments that are very favourable to employment creation. Therefore, the positive and significant effects of trade liberalization on employment and wages will persist in the long-run if the Tunisian economy is able to attract investors and to increase exports.

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Appendix

Classification of Tunisian manufacturing industries 1971–96

Exportable sectors

Textiles, clothing and leather (TCL).

- construction materials, ceramics and glass (CMCG)
- Mining
- Hydrocarbon (HYDRO)

Importable sectors

- Food processing (IAA)
- Electrical and mechanical industries (IME)
- Chemical industries (ICH)
- Manufacturing industries diverse (IMD)

Other sectors

- Electricity utilities
- Water utilities
- Public construction utilities

Data sources

- Institut National de la Statistique (INS), les comptes de la nation, février 1997.
- Institut d'Economie Quantitative (IEQ) (1998 database).

Table 3. Summary statistics of Tunisian manufacturing industries.

	Pooled data		Exportable industries		Importable industries		Liberalization period		Import/export penetration	
Variables	Mean	Std dev	Mean	Std dev	Mean	Std dev	Mean	Std dev	Mean	Std dev
Employment	54256.40	65961.91	65661.03	82776.97	38940.27	19577.59	63282.89	72901.41	65476.56	72111.51
Wage	1057.38	676.10	1382.80	934.40	852.67	292.00	1141.09	746.41	1243.90	828.97
Product	178.94	146.97	184.66	155.05	199.41	121.83	223.97	164.33	259.81	167.36
Value added	63.31	56.14	83.73	67.81	45.95	22.52	75.70	55.86	82.24	49.96
Export									101.86	96.25
Import									142.84	141.73
Period	1974–96		1974–96		1974–96		1986–96		1989–96	
Industries	11		4		4		11		8	
Number of observations	253		92		92		121		64	

Note: The period is from 1971 to 1996. The first three observations are dropped because of the use of one change and two lag values.

Table 4. Pearson correlation matrices based on different sub-samples of manufacturing industries.

A. All Industries and periods

	Year	Employment	Wage	Production	Value-added
Year	1.0000				
Employment	0.1585[a]	1.0000			
Wage	0.1764[a]	-0.4241[a]	1.0000		
Production	0.3659[a]	0.6534[a]	0.0493	1.0000	
Value-added	0.2830[a]	0.4875[a]	0.3622[a]	0.7895[a]	1.0000

B. Exportable industries

	Year	Employment	Wage	Production	Value-added
Year	1.0000				
Employment	0.1414	1.0000			
Wage	0.2523[b]	-0.4634[a]	1.0000		
Production	0.3700[a]	0.6348[a]	0.2459[b]	1.0000	
Value-added	0.2747[a]	0.1285	0.6619[a]	0.8148[a]	1.0000

C. Importable industries

	Year	Employment	Wage	Production	Value-added
Year	1.0000				
Employment	0.6409[a]	1.0000			
Wage	0.0842	-0.4626[a]	1.0000		
Production	0.5568[a]	0.2949[a]	0.3997[a]	1.0000	
Value-added	0.6806[a]	0.7588[a]	-0.0396	0.7896[a]	1.0000

D. Liberalization period

	Year	Employment	Wage	Production	Value-added
Year	1.0000				
Employment	0.0637	1.0000			
Wage	0.1031	-0.4157[a]	1.0000		
Production	0.1549[c]	0.7405[a]	-0.1089	1.0000	
Value-added	0.1452	0.6408[a]	0.2072[b]	0.7650[a]	1.0000

E. Import/export penetration

	Year	Employment	Wage	Production	Value-added	Export	Import
Year	1.0000						
Employment	0.0572	1.0000					
Wage	0.0781	-0.3279[a]	1.0000				
Production	0.0973	0.7111[a]	-0.0671	1.0000			
Value-added	0.0808	0.5932[a]	0.3729[a]	0.6816[a]	1.0000		
Export	-0.0137	0.8040[a]	0.1585	0.7676[a]	0.7618[a]	1.0000	
Import	-0.0635	0.3893[a]	-0.0874[b]	0.2908	0.2038	0.4656[a]	1.0000

Note: Significant at less than 1% (a), 1%-5% (b), and 5%-10% (c).

Table 5. Employment and wage causality test based on various sub-samples of manufacturing industries.

	Employment		Wage	
	Coefficient	Std error	Coefficient	Std error
A. Pooled data, levels				
le1	1.2156[a]	0.0637	0.9814[a]	0.0647
le2	-0.2268[a]	0.0628	-0.0216	0.0633
lw1	0.0849[b]	0.0394	-0.0060	0.1046
lw2	-0.1059[a]	0.0385	-0.0037	0.1032
R^2	0.9984		0.9753	
RMSE	0.0552		0.0906	
B. Pooled data, changes				
de1	0.2287[a]	0.0649	0.0219	0.0646
de2	0.1266[c]	0.0645	-0.0854	0.0629
dw1	0.0964[b]	0.0393	0.0569	0.1068
dw2	0.0515	0.0383	0.0429	0.1062
R^2	0.0968		0.0112	
RMSE	0.0558		0.0917	
C. Exportables industries				
le1	1.4444[a]	0.0930	0.9088[a]	0.1048
le2	-0.4557[a]	0.0913	0.0349	0.1035
lw1	0.0004	0.0527	-0.0510	0.1847
lw2	-0.0285	0.0521	0.0377	0.1814
R^2	0.9993		0.9807	
RMSE	0.0446		0.0887	
D. Importables industries				
le1	1.7108[a]	0.0773	0.8416[a]	0.1044
le2	-0.7169[a]	0.0762	0.1121	0.1023
lw1	0.0507[b]	0.0251	-0.1790	0.3209
lw2	-0.0550[b]	0.0246	0.1440	0.3163
R^2	0.9988		0.9655	
RMSE	0.0202		0.0840	
E. Liberalization perio d				
le1	1.2990[a]	0.0860	1.1985[a]	0.0859
le2	-0.2992[a]	0.0860	-0.2027[b]	0.0875
lw1	0.0035	0.0414	-0.1358	0.1784
lw2	-0.0054	0.0422	0.1342	0.1785
R^2	0.9995		0.9887	
RMSE	0.0299		0.0620	
F. Import/export penetration				
le1	1.1332[a]	0.1275	0.5661[a]	0.1001
le2	-0.1361	0.1272	0.4318[a]	0.1004
lw1	-0.0288	0.1003	-0.0737	0.12727
lw2	0.0194	0.1005	0.0782	0.12696
R^2	0.9992		0.9958	
RMSE	0.0377		0.0377	

Note: Significant at less than 1% (a), 1%-5% (b), and 5%-10% (c). le, le2, lw1 and lw2 are one and two lag values of employment and wages. Root mean square errors (RMSE).

Table 6.A Employment equations for Tunisian manufacturing industry (based on production).

Variables	Model 1 (2SLS)	Model 1 (GMM)	Model 2	Model 3	Model 4	Model 5
Constant	0.0458[a]	0.0458[a]	0.0160	0.0333[a]	0.0086	0.0222[b]
Δln Empl $_{t-1}$	0.1107[c]	0.1107	0.4269[a]	0.5519[a]	0.2211[b]	0.1400
Δln Wage $_{t}$	-0.1901[a]	-0.1901[c]	0.0048	-0.0359	0.0330	-0.0126
Δln Wage $_{t-1}$	0.0586	0.0586b	0.0373	0.0229	-0.0061	-0.0198
Δln Wage $_{t-2}$	-0.0004	-0.0004	-0.0446	-0.0177	0.0055	0.0010
Δln Output $_{t}$	0.0343	0.0343	0.0529[c]	-0.0268[c]	-0.0313	0.0319
Δ ln Output $_{t-1}$	0.0414[c]	0.0414[c]	0.0250	0.0192	0.0305	0.0016
Export	-0.0034	-0.0034			0.0031	
Import	0.0125	0.0125[c]			0.0169[b]	
Liberalization	-0.0305[a]	-0.0305[a]	-0.0079	-0.0194[a]		
Δ ln Export $_{t}$						0.0006
Δln Import $_{t}$						0.0237
No. of industries	11	11	4	4	11	8
No. of obs	253	253	92	92	121	64
Period	1974–96	1974–96	1974–96	1974–96	1986–96	1989–96
R^2 adjusted	0.2519	0.2519	0.3529	0.6269	0.1606	0.0356
RMSE	0.6389	0.6389	0.1672	0.0296	0.0962	0.0836

Note: Significant at less than 1% (a), 1%-5% (b), and 5%-10% (c). The period of studies is from 1971 to 1996. The first three observations are dropped because of the use of one change and two lag values. Model 1: all the period and industries; Model 2: exportable industries; Model 3: importable industries; Model 4: trade liberalization period; Model 5: import and export penetration.

Table 6.B Employment equations for Tunisian manufacturing industry (based on value-added).

Variables	Model 1 (2SLS)	Model 1 (GMM)	Model 2	Model 3	Model 4	Model 5
Constant	0.0476[a]	0.0476[a]	0.0201c	0.0316[a]	0.0096[c]	0.0224[b]
Δln Empl$_{t-1}$	0.1085[c]	0.1085	0.4367[a]	0.5631[a]	0.2214[b]	0.1441
Δln Wage$_{t}$	-0.1918[a]	-0.1918[c]	-0.0126	-0.0351	0.0282	-0.0214
Δln Wage$_{t-1}$	0.0606	0.0606b	0.0264	0.0227	-0.0048	0.0114
Δln Wage$_{t-2}$	-0.0025	-0.0025	-0.0465	-0.0211	0.0092	-0.0102
Δln Output $_{t}$	0.0347[b]	0.0347	0.0299	-0.0221c	-0.0128	0.0369
Δln Output $_{t-1}$	0.0325[c]	0.0325c	0.0243	0.0232c	0.0132	-0.0244
Export	-0.0032	-0.0032			0.0022	
Import	0.0133	0.0133[c]			0.0157[b]	
Liberalization	-0.0331[a]	-0.0331[a]	-0.0117	-0.0185[a]		
Δln Export $_{t}$						0.0013
Δln Import $_{t}$						0.0243
No. of industries	11	11	4	4	11	8
No. of obs	253	253	92	92	121	64
Period	1974–96	1974–96	1974–96	1974–96	1986–96	1989–96
R^2 adjusted	0.2571	0.2571	0.3447	0.6364	0.1457	0.0411
RMSE	0.6345	0.6345	0.1693	0.0289	0.0979	0.0832

Note: See Table 6.A.

Table 7.A Wage equations for Tunisian manufacturing industry (based on production).

Variables	Model 1	Model 2	Model 3	Model 4	Model 5
Constant	0.0585[a]	0.0690[a]	0.0911[b]	0.0088	0.0363[a]
Δln Wage $_{t-1}$	-0.0095	-0.1328	-0.1001	0.2047[b]	-0.3895[a]
Δln Empl$_t$	-0.5378[a]	0.0134	-0.6224	0.1217	-0.0107
Δln Empl$_{t-1}$	0.0021	-0.1435	-0.2089	-0.1797	-0.0749
Δln Output $_t$	0.0181	-0.1210[b]	0.0708	0.0891[c]	0.0456
Δln Output $_{t-1}$	0.0706[c]	0.1143[b]	-0.1006	-0.0304	0.0158
Export	0.0091				
Import	-0.0006				
Liberalization	-0.0433[a]	-0.0520[b]	-0.0582[b]		
Δln Export $_t$					0.0173
Δln Import $_t$					0.0981[a]
No. of industries	11	4	4	11	8
No. of obs	253	92	92	121	64
Period	1974–96	1974–96	1974–96	1986–96	1989–96
R^2 adjusted	0.1432	0.1743	0.1107	0.0796	0.3717
RMSE	1.8075	0.6024	0.5908	0.4318	0.0705

Note: See Table 6.A.

Table 7.B Wage equations for Tunisian manufacturing industry (based on value-added).

Variables	Model 1	Model 2	Model 3	Model 4	Model 5
Constant	0.0610[a]	0.0657[a]	0.0882[b]	0.0048	0.0351[a]
Δln Wage $_{t-1}$	-0.0091	-0.1047	-0.1075	0.2263[a]	-0.3412[a]
Δln Empl$_t$	-0.5398[a]	-0.0497	-0.6183	0.0843	-0.0167
Δln Empl$_{t-1}$	-0.0044	-0.1320	-0.2041	-0.1456	-0.0684
Δln Output $_t$	0.0084	-0.0701[c]	0.0562	0.1551[a]	0.0638
Δln Output $_{t-1}$	0.0713[b]	0.1001[a]	-0.0648	-0.0158	-0.0090
Export	0.0089				
Import	2.64E-06				
Liberalization	-0.0458[a]	-0.0474[b]	-0.0562[b]		
Δln Export $_t$					0.0169
Δln Import $_t$					0.1005[a]
Nb. of industries	11	4	4	11	8
Nb. of obs.	253	92	92	121	64
Period	1974–96	1974–96	1974–96	1986–96	1989–96
R^2 adjusted	0.1520	0.1842	0.1020	0.1244	0.3830
RMSE	1.7887	0.5952	0.5965	0.4107	0.0692

Note: See Table 6.A.

Table 8.A Short-run and long-run elesticities (based on production).

	Impact	Short-run	Long-run
Response to changes in employment			
Exportables	0.0523	0.0776	0.0779
Importables	-0.0293	-0.0072	-0.0067
Response to changes in wages			
Exportables	-0.1202	-0.0056	-0.0168
Importables	0.0874	-0.0250	-0.0361

Table 8.B Short-run and long-run elesticities (based on value-added).

	Impact	Short-run	Long-run
Response to changes in employment			
Exportables	0.0307	0.0546	0.0532
Importables	-0.0240	0.0012	0.0013
Response to changes in wage			
Exportables	-0.0716	0.0273	0.0174
Importables	0.0698	-0.0092	-0.0095

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