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**IMPACT OF TRADE REFORMS IN TUNISIA
ON THE ELASTICITY OF LABOUR DEMAND**

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Abstract

The impact of trade reforms on the labor market may transit through many channels. One of these is the effect on labor demand elasticity. No consensus has been established yet in the empirical literature regarding this relationship. This paper divides labor into skilled and unskilled categories in order to analyze the effects of trade policies on labor demand elasticities by skill in Tunisia. We use dynamic panel techniques to estimate a model of employment determination, which incorporates the effects of trade and takes into account the delay of labor adjustment. Our database covers 529 Tunisian firms from 6 manufacturing sectors over the period 1997-2002. Results suggest that a decrease in trade protection in Tunisia increases the elasticity of unskilled labor demand while it contributes to the decrease in the elasticity of skilled labor demand.

JEL Classification: F16; J23

Keywords: Trade liberalization; Trade and labor market interactions; skills; labor demand elasticities, Tunisia

ملخص

تأثير الإصلاحات التجارية على سوق العمل ممكن ان يتم من خلال قنوات عديدة. وأحد هذه القنوات هو التأثير على مرونة الطلب على الأيدي العاملة. و لم يتم حتى الآن أي توافق في الآراء التحليلية بشأن هذه العلاقة. يقسم هذا البحث العمالة إلى فئات منها الماهرة وغير الماهرة من أجل تحليل آثار السياسات التجارية على مرونة الطلب على اليد العاملة في تونس. نستخدم تقنيات تتبعية حيوية لتقدير نموذج تقرير العمالة، والتي تضم آثار التجارة وتأخذ في الاعتبار تأخير تكيف العمالة. تغطي قاعدة بياناتنا 529 شركات من 6 قطاعات صناعية في الفترة 1997-2002 و تشير النتائج إلى أن انخفاض الحماية التجارية في تونس يزيد من مرونة الطلب على العمالة الغير ماهرة في الوقت الذي يسهم في انخفاض مرونة الطلب على العمالة الغير ماهرة.

1. Introduction

The 1990s have witnessed a great deal of research emphasizing the rise of wage differentials between skilled and unskilled workers. This constitutes an important issue since growing inequalities contribute to weakening social cohesion by its effects on poverty, especially if unskilled workers are not enjoying improvements in their situation in relative and sometimes absolute levels. What emerges from theoretical and empirical studies is that these changes in wage structure are linked in several developed and developing countries to trade liberalization reforms via their effects on skilled and unskilled labor demand. For a long time however, the driving forces behind labor demand movements have been put forward in the light of the Heckscher-Ohlin model and skill-biased technological change. Yet, recently, a new issue of the trade-labor linkage has been highlighted in the context of imperfectly competitive market: trade liberalization might increase the own-price elasticity of labor demand, i.e. it makes the demand for labor more responsive to changes in its costs.

This new path was first emphasized by Rodrik (1997) who points out two main channels through which greater openness leads to an increase in labor demand elasticity. First, the substitution effect explains the employment variation due to substitution toward other inputs for constant output. Accordingly, trade liberalization leads to a release of input and equipment constraints that allows firms to use more imported capital and other intermediate inputs at lower prices. To the extent that these imports are substitutes for the services of domestic labor, substitution possibilities might increase.

Second, the scale effect depicts the employment variation due to the wage-induced change in the demanded output. The increased competition in the output market implies a rise in product market elasticity. This, in turn, increases labor demand elasticity given the Hicks 'fundamental law of factor demand', which states that "the demand for anything is likely to be more elastic, the more elastic is the demand for any further thing which it contributes to produce".

What are the implications of more elastic labor demand? Rodrik (1997) and Slaughter (2001) emphasize three important consequences. Rising elasticities imply more volatile reactions of employment to any exogenous shock to labor demand. They also shift the wage and/or employment incidence of non-wage labor costs towards labor and away from employers. Furthermore, greater elasticities imply a decline in labor bargaining power and thus, amplify income inequality. Openness is likely to put labor markets under greater pressure, a situation that is socially undesirable.

No consensus has been established yet in the empirical literature regarding the relationship between trade reform and labor demand elasticity. In many countries, including many of the developed ones, these effects have yet to materialize. For instance, Slaughter (2001) focuses on the U.S and Bruno et al. (2004) using a panel of developed countries present mixed evidences of the theoretically positive link between trade and labor demand elasticity. Krishna et al. (2001) and Fajnzylber and Maloney (2005) do not find empirical support in Turkey and Latin America respectively while Hasan et al. (2003) come upon a positive impact of trade liberalization on labor-demand elasticities in the Indian manufacturing sector. Our contribution to this debate is essentially an empirical issue.

Our paper investigates the impact of trade liberalization process in Tunisia on labor-demand elasticity by distinguishing different skills. The Tunisian economy should be an instructive case of study for at least two reasons. The first is that it would be complementary to current literature, which is widely focused on Latin American and Asian countries. It could improve the understanding of trade liberalization effects on labor demand elasticities in developing countries taking into account their specific economic liberalization processes. Second, Tunisia has been subject to an increase, however relatively moderate, in wage inequality

subsequent to trade reforms introduced in 1986¹. Furthermore, Ghazali (2009) emphasizes the existence of a positive and statistically significant relationship between trade openness and wage inequality between skilled and unskilled workers. Greater labor demand elasticities might be an indirect channel through which trade effects on wage differentials transit.

We use micro level data covering 529 firms from 6 manufacturing sectors over the period 1997-2002. The attempt is to extend the work of Hasan et al. (2003) by decomposing labor into skilled and unskilled categories in order to analyze the effects of trade policies on labor demand elasticities by skill. In fact, one could suspect that the absence of a statistically significant connection between these variables is due to the aggregation of employment that may hide compositional changes. Our empirical strategy consists in regressing a model of employment determination, which incorporates the effects of trade on labor-demand elasticities. We take into account the delay of adjustment of labor as we suppose the existence of labor market adjustment costs that prevent a simultaneous regulation of firms' employment to external shocks. We rely in the estimation of this dynamic model on the System Generalized Method of Moments (GMM) estimator as suggested by Blundell and Bond (1998).

This paper is organized as follows: Section 2 describes the Tunisian trade liberalization process. Section 3 focuses on the link between trade liberalization and firm's own price labor-demand elasticity. Section 4 and 5 lay down the framework of the empirical analysis as well as the database used. Section 6 presents the main econometric results. Section 7 concludes.

2. The Tunisian Trade Liberalization Process

Tunisia initiated a structural adjustment plan in 1986 that signalled the start of the trade liberalisation process. It entailed a process of lowering and setting uniform tariffs such that the average import duties declined from 41% in 1986 to 33% in 1987 and to 29% in 1990. The highest duty rate was reduced from 200% to 43% (Bechri and Lahouel 1999). The effective rate of protection (ERP) relative to all outputs excluding Hydrocarbon fell from 70% in 1986 to 44% in 1990. The trade reform pattern was not uniform across manufacturing industries over the period 1986-1991. For instance, unskilled intensive sectors as the food-processing and textile industries that benefited from a relatively higher protection level prior to trade liberalisation, observed a decrease of their effective protection rates by about 300 and 150 percentage points respectively. However, skill intensive sectors underwent either an increase of their rate of protection or a minor decrease within the same period. The ERP shifted from 40% to 82% in the construction materials, glass and ceramics industry and from 88% to 101% in the electrical and mechanical industries. Concerning the chemical industries, the ERP moved from 88% to 78% between 1986 and 1991. Overall, skill intensive industries were less protected prior to the reforms. Therefore, they were subject to smaller reductions in tariff protection. Similar patterns of protection are reported in Colombia (Attanasio et al. 2004), Mexico (Hanson and Harrison 1999) and Morocco (Currie and Harrison 1997). In 1990, Tunisia signed the GATT agreements. The adherence to the WTO was achieved in 1995. Reflecting the government's objective to comply with the GATT/WTO negotiated rates; Tunisia witnessed over the period 1990-1998 an increase in the nominal protection rates on agricultural final goods because of non-tariff protection transformation. The nominal protection rates on industrial final goods increased for the same reason while the nominal protection rates on industrial intermediate goods decreased due to the focus of the openness

¹ Ghazali (2009) demonstrates that the 1970s and the first half of the 1980s were characterised by a reduction in wage inequality in the Tunisian non-agricultural productive sector. Then, wage inequality increased from 1986 to 1991. During the following years, it displayed a slight decrease.

² Les Cahiers de L'Institut d'Economie quantitative (IEQ), n°9, p 51.

process at this stage on equipment and inputs. This led to an increase of the effective rate of protection for a majority of products (the ERP attained 56% in 1995 and 71% in 1998). The trade liberalisation process has become more active since 1997 given that the effective rate of protection decreased from 71% to 49% in 2002.

3. Theoretical and Eempirical Background

Hamermesh (1993) considers the case of a representative firm which faces a perfectly competitive product market, constant returns to scale and variable inputs. He derives a firm's demand for labor from a profit-maximising model of firm behaviour and he summarizes what determines a firm's equilibrium own price labor-demand elasticity³ as following:

$$E_{Lw} = -(1 - s_L)\sigma - s_L \varepsilon \quad (1)$$

Where s_L is labor's share in firm total revenue σ is the elasticity of substitution between labor and other factors of production and ε is the product-demand elasticity faced by the firm. All these variables are defined to be positive.

Equation (1) has two components. The first, $-(1 - s_L)\sigma$ represents the substitution term, which indicates for a given level of output, how much, the firm substitutes labor for other factors when wages rise. International trade may affect labor-demand elasticity through its effect on the elasticity of substitution σ . It expands the range of substitutes to new domestic and foreign factors of production acting either directly in foreign multinationals affiliates or indirectly through intermediate inputs (Slaughter 2001).

Differentiating (1) with respect to σ shows that as the firm substitution possibility set increases, labor demand becomes more elastic (i.e. E_{Lw} rises in absolute value).

$$\frac{\partial E_{Lw}}{\partial \sigma} = -(1 - s_L) < 0 \quad (2)$$

The second part of equation (1) $-s_L \varepsilon$ corresponds to the scale term. It points out how much labor demand changes after a wage change due to shifts in a firm's output. The increased availability of substitutes for the final good due to trade openness will make the output demand more elastic and reduces the scale of production consequently to higher costs.

Differentiating (1) with respect to ε shows that an increase in product-demand elasticity yields to a more elastic labor demand (i.e. E_{Lw} rises in absolute value).

$$\frac{\partial E_{Lw}}{\partial \varepsilon} = -s_L < 0 \quad (3)$$

The greater is labor's share in the firm's costs s_L , the stronger is the pass-through from ε to E_{Lw} (Slaughter 2001).

Accordingly, when wages rise, both the substitution and scale effects reduce labor demand. The industry substitutes labor for other factors and with higher costs the industry produces less output such that it demands less of all factors.

³ This elasticity is defined to be negative.

⁴ This model assumes that the firm output is endogenous. If we assume a constrained (constant), output the elasticity will be $E_{Lw} = -(1 - s_L)\sigma$ and will represent purely the substitution effect. (See Hasan *et al.* 2003 for more details)

The share of labor in total output may also decrease in response to trade openness, which can make the direction of movement of labor-demand elasticity ambiguous. This makes empirical investigation in this area all the more important (Hasan and *al.* 2003).

The theoretically positive link between trade and labor demand elasticity remains elusive in empirical studies. A disagreement persists among analysts on the nature of recent trade reforms impact on labor-demand elasticity. Exploring this link using data from the Turkish manufacturing sector, Krishna *et al.* (2001) do not find empirical support for the supposed theoretical relationship. Fajnzylber and Maloney (2005) use dynamic panel techniques to test the hypothesis that trade liberalisation yields to higher own-wage elasticities of labor demand for manufacturing establishments in Chile, Colombia, and Mexico. The results do not provide evidence of a direct impact of trade liberalisation on own-wage elasticities. Investigating the Indian case using data decomposed by state and industry, Hasan *et al.* (2003) find a positive impact of trade liberalisation on labor-demand elasticities in the Indian manufacturing sector. For the United States, however, Slaughter (2001) finds mixed results. Proceeding in two stages, he first estimates a time series of own-price demand elasticities for production and non-production labor for manufacturing overall and for manufacturing decomposed into eight industries. Second, he regresses the estimated elasticities on measures of trade, technology and institutional factors. The author finds that the U.S. production labor becomes more elastic in manufacturing overall and in five of eight industries within manufacturing from 1961 through 1991. Nevertheless, the elasticity of non production-labor demand does not exhibit the same trend during that period. Finally, the second stage results concerning the impact of trade on labor demand elasticities do not seem to be statistically robust to the inclusion of time controls.

4. The Model

In order to assess the impact of openness on the elasticity of labor demand in Tunisia we rely on a model of employment determination which incorporates the effects of trade on labor-demand elasticities taking into account the delay of labor adjustment. The labor demand function for the category j ($j =$ skilled s , unskilled us) can be written as the subsequent equation:

$$\ln L_{it}^j = (1 - \lambda^j) \ln L_{it-1}^j + \lambda^j \theta_1^j \ln y_{it} + \lambda^j \theta_2^j \ln K_{it} + \lambda^j \theta_3^j \ln(w^j)_i + \lambda^j \theta_4^j \ln(w^k)_i + \lambda^j \theta_5^j \ln(w^j)_i TP_{it} + \lambda^j \theta_6^j TP_{it} + \lambda^j \theta_4^j D_i + \alpha_i^j + v_{it}^j$$

(4)

The dependent variable is the employment level L_{it}^j . Explanatory variables are respectively, the initial employment level L_{it-1}^j , the firm value added y_{it} , and the capital stock K_{it} . The average real wage associated to each skill category (skilled and unskilled workers) is noted respectively w_i^s and w_i^{us} . These variables are time invariant in our case. Time effects D_i and fixed effects α_i are included to capture the impact of omitted variables that are specific to a year t or a firm i . We assume a delay between demand shocks and firm's level of employment adaptation. λ represents the labor adjustment parameter. Furthermore, we suppose that the speed of adjustment depends on the skill level j . One would expect that the higher the skill of workers, the higher the hiring costs, since training costs are expected to be lower for unskilled labor. Furthermore, since severance pay depends on the worker's earnings and these depend on his skill, firing costs will increase with the worker's skill (Borrego 1998); v_{it} is a random error term. All variables are expressed in logarithm.

As our main objective is to investigate trade liberalisation effects on labor demand elasticities in Tunisia by skill category, we introduce interactive terms between wages and a trade

protection measure TP_{it} . Our favourite measure is the effective rate of protection (ERP), which presents at least two advantages as emphasized by Goldberg and Pavcnik (2004) in their discussion on tariffs. The first is that ERP changes during trade liberalisation reform episodes are not sector-uniform. They enable us to distinguish the effects of trade reforms from those of other economic reforms. The second advantage is that ERP movements in Tunisia, as in many other developing countries such as Brazil and Columbia, result from a governmental decision to fulfil the GATT and WTO directives. This would have the effect of minimising the endogeneity risk. The interactive term captures several effects exerted by trade openness such as broadening the set of firm's production techniques and inputs and increasing the productivity of existing inputs by new foreign knowledge and useful information, (Yasmin and Khan 2005).

We also choose to include our trade protection indicator without interaction with other variables of interest in order to capture the direct effect of openness as a labor demand shifter.

Highlighting the difficulty to conceive a perfectly satisfactory openness measure, Edwards (1998) suggests different proxies as robustness checks⁵. Therefore, in order to measure trade liberalisation, we have attempted to rely on another indicator; the ratio of custom duties to imports CD/M , which is considered a good proxy variable for trade protectionism (Edwards 1992). The rationale for both interacted trade terms (with ERP and CD/M respectively) is that a decrease in trade protection (that is an increase in the openness of the economy) raises the absolute value of labor demand elasticities. Hence, we expect a positive sign for the related coefficients.

5. The Database

Our current firm-level database is the only firm-level data available in Tunisia. It was drawn from the national annual survey report on firms (NASRF) carried out by the Tunisian National Institute of statistics (TNIS) over the period 1997-2002. After the elimination of extreme outliers and observations that could be seen as erroneous, we have obtained an unbalanced panel consisting of a sample of 529 firms from 6 manufacturing sectors⁶. We consider the period 1997-2002 as an interesting episode to capture the effects of trade reforms. Indeed, economic impacts of the numerous measures that have been implemented by Tunisia to further liberalize trade, since 1986, were generally not perceptible before 1997.

As shown in Table 1, the data include variables about value added (VA) and offers a labor decomposition by skill. Skilled labor activities include engineering, management, administration, and general office tasks while the activities of unskilled workers include machine operation, production supervision, repair, maintenance and cleaning⁷. Data on the total wage bill are available, though, without skill distinction. This is unfortunate, since these data are essential to the current study. In order to overtake this problem, we followed the decomposition technique of Maurin and Parent (1993) to decompose the total wage bill by skill, given the skilled and unskilled shares on total employment⁸. Table 1 confirms that, on average, skilled workers annual wage bill is larger than that of unskilled workers. Besides, we notice that unskilled workers are prevailing in the total workforce as they present the most important average share in firm's employment. We computed a capital stock proxy since the available data provided by the TNIS for this variable regard a small balanced sample. We

⁵ In order to study the impact of trade openness on economic growth, Edwards (1998) regressed total factor productivity on nine trade liberalization indexes.

⁶ These sectors are: Agro-food, Pottery, glass and non-metallic mineral industry, Mechanical, Electrical and electronic industry, Chemical industry, Textile, Wearing apparel, Leather and footwear industry, other manufacturing industries.

⁷ This is nearly the white-collar/blue-collar workers classification applied by Hanson and Harrison (1995).

⁸ This decomposition technique is presented in appendix.

followed Mairesse and Bronwyn (1996) by considering the tangible fixed assets deflated by the gross fixed capital formation deflator as a capital stock proxy.

The ratio of customs duties to total imports used to proxy trade protection is available at the sector-level. It is provided, as well as the other openness measures applied in this study, by the Tunisian Institute of Quantitative Economics (IQE) and expressed in 1990 constant Tunisian Dinar. Some variables, however, have missing points, which means that when estimating the econometric model, the number of available firms may decline somewhat.

6. Estimation Results

Our dynamic model specified in Eq (4) is characterized by the presence of the lagged dependent variable in addition to time-variant and time-invariant variables among the regressors. Since L_{it} is a function of α_i , L_{it-1} is also a function of α_i . Therefore, L_{it-1} , a right-hand side regressor is correlated with the error term. This renders the classical estimator biased and inconsistent (Baltagi 1995). The widely used estimator in this context is obtained by GMM after first differencing to eliminate the correlated individual specific effects. Lagged levels of L_{it} are used as instruments for equations in first differences, as long as the idiosyncratic shocks v_{it} are not correlated (Arellano and Bond 1991). However, the first difference transformation wipes out the time-invariant variables. Furthermore, Blundell and Bond (1998) demonstrate that difference GMM presents a statistical shortcoming with persistent series. Lagged values of the variables are weak instruments for subsequent changes⁹. More recently, Arellano and Bover (1995) and Blundell and Bond (1998) have shown that, under further and quite reasonable conditions relating to the properties of the initial condition process, there are additional moment conditions that are available for equations in levels. Exploiting these extra moment restrictions offers efficiency gains (Blundell and Bond 1998) and allows for controlling time invariant variables in estimating efficiency. These restrictions imply that values of the dependent variable, which lagged two or more periods, are valid instruments in the first differenced equations. This is possible given the assumption that changes in the instrumenting variable are uncorrelated with the fixed effects α_i ¹⁰. Blundell and Bond (1998) propose a system estimator, which uses first differences as instruments for levels as well as the usual levels as instruments for first differences. In addition, we can exploit the exogeneity or the predetermined assumptions about some or all of the explanatory variables outside the lagged dependent variable (Arellano and Bond 1991). To summarize, this implies a set of moment conditions relating to the equations in first differences and a set of moment conditions relating to the equations in levels, which need to be combined to obtain more efficient GMM estimator. This GMM estimator is consistent for large N and finite T . This linear GMM estimator obtained from a system estimator is more efficient than the one obtained from the standard first-differenced model and allows for the presence of time-invariant regressors.

However, recently, Roodman (2008) has emphasized the risks of instrument proliferation in the difference and system GMM that may weaken the Hansen test of the instruments' joint validity and overfit endogenous variables. The author has recommended testing the results for sensitivity to reductions in the number of instruments.

In all the following tables relative to system GMM estimates, we report the results of the Hansen test that checks for the validity of instruments used. We also consider a test of no-serial autocorrelation that examines whether the residual of the regression in differences is second-order serially correlated. In all specifications, these tests give evidence for, respectively, the pertinence of instruments used and the absence of second-order

⁹ We have estimated the AR(1) coefficient on total labor, skilled labor and unskilled labor using OLS. Results indicate a highly persistent series with AR(1) coefficients on the order of 0.70-0.95.

¹⁰ $E(L_{it-1}\alpha_i)$ is time invariant.

autocorrelation. In line with Roodman (2008), we also examine in the appendix the sensitivity of previous estimation results to reducing the number of instruments.

The empirical results based on system GMM estimates of equation 4 with the total labor demand as dependent variable are reported in Table 2. Columns 1-2 report the results for the estimation without time and sector dummies. Trade liberalization impact on labor demand may transit through two channels: the direct effect and the effect via elasticity. The negative and significant coefficient of the interaction between the logarithm of the average wage rate and the logarithm of the effective protection rate suggests evidence that the absolute value of labor demand elasticity decreases in response to a decrease in *ERP*. This is confirmed when we use *CD/M* as the trade policy variable and when we include time and/or sector dummies. A decline in the customs duties to imports ratio from 50% to 10% is associated with a decrease in the absolute value of the elasticity from 0.52 to 0.42.

Hence, the hypothesis that labor demand elasticities go up with trade openness is not supported at this stage of the analysis. Besides, trade openness does not seem to have a direct effect on labor demand given the statistically insignificant coefficients on *ERP* and *CD/M* respectively. These results appeal for a deeper investigation through the desegregation of the labor demand depending on skill.

Distinguishing two types of labor in Tables 3-4 reveals differences in employment response to the trade liberalisation shock. Table 3 considers the unskilled labor demand as a dependent variable. The positive and significant coefficient of the interaction between the logarithm of the unskilled wage rate and the effective protection rate in all columns suggests evidence that the absolute value of unskilled labor demand elasticity increases in response to a decrease in *ERP*. Using the second proxy for trade protection, which is *CD/M*, corroborates the previous findings. A decline in the customs duties to imports ratio from 50% to 10% implies an increase in the absolute value of the elasticity from 0.03 to 0.1. Explaining the rise in labor demand elasticity, Rodrik (1997) underlines that: “Employers and the final consumers can substitute foreign workers for domestic workers more easily either by investing abroad or by importing the products made by foreign workers”. Accordingly, trade might have exerted a pressure on the total own-price labor demand elasticity relative to the unskilled labor category via the substitution effect by modifying the firm production possibility set and facilitating the replacement of this type of workers. Trade effect might also have transited via the scale effect due to the increased competition on the output market.

Table 4 shows a negative and statistically significant coefficient on the interaction term between the logarithm of the skilled wage rate and the effective protection rate. This suggests that the absolute value of skilled labor demand elasticity decreases in response to a decrease in *ERP*. Similar results are found when we use the customs duties to imports ratio. A decline in this ratio from 50% to 10% is associated with a decrease in the absolute value of the elasticity from 0.11 to 0.01.

Sensitivity tests are presented in appendix. Tables A, B and C display respectively system GMM estimates of the total labor demand, skilled labor demand and unskilled labor demand equations. We present original results for the preferred specification¹¹ in column 1. Column 2 collapses the instruments. Column 3 reduces the number of lags regarding the instrument set. Results seem robust for controlling the risk of too numerous instruments. As Roodman (2008) considers that when system GMM is valid, collapsed instruments cause less bias, we retain corresponding results in column 2.

¹¹ The preferred specification includes the effective rate of protection as proxy for trade protection.

In an attempt to explain this negative association between trade liberalisation and skilled labor-demand elasticity, we reconsider the output-constrained labor demand elasticity that is given by:

$$E_{Lw} = -(1 - s_L)\sigma$$

This elasticity increases in absolute value when substitution possibilities increase in response to trade openness. But, for a given σ , this also increases in response to a fall in the share of labor. In order to explore how the share of labor responds to trade openness, we regress these shares on our key trade variable *ERP*. Related results are reported in Table 5. We can observe that the unskilled labor share has fallen in response to a decrease in *ERP*. In contrast, the skilled labor share has increased in response to trade openness. This is confirmed in Table 6, which displays firms' relative employment in 1998 and 2002. The compositional shift towards a decreased use of unskilled workers relatively to skilled ones is fairly visible in this table.

In sum, one possible explanation of the decrease in labor demand elasticity for skilled labor is the increase in the share of this employment category in response to trade openness, which could be more important than the increase in substitution possibilities¹².

The rise in unskilled labor demand elasticity implies notably the alteration of the bargaining power of unskilled workers and an amplified pressure on this category relative to other production factors. In contrast, relaxation of trade barriers leads to a shift towards capital and its complement of skilled labor. This may aggravate unskilled job insecurity and increase wage inequality between skill categories. According to Rodrik (1997): "This is because less-educated workers face considerably worse when they are displaced from a job than more educated workers".

Figure 1 summarises the basic results regarding the relationship between labor demand elasticities and trade protection. Three regression lines are reported related respectively to skilled labor and unskilled labor. Unskilled labor demand becomes markedly more elastic as the ratio of customs duties to imports decreases. Furthermore, in absolute value, the higher slope of the unskilled labor demand elasticity curve comparative to that of the skilled labor suggests a greater impact of trade openness shock on the first category.

Regarding the contribution of other variables in equation (6) to labor demand changes, we notice that the coefficient on the output variable which controls notably for business cycle fluctuations is positive and statistically significant in almost all specifications, independent of the skill category. This means that an increase in output raises the labor demand. The coefficient on workers average wage in Table 2 is negative and statistically significant even after controlling for time and sector dummies, which confirms the standard labor demand theory. In Table 3 regarding unskilled labor employment, we introduce both skilled and unskilled workers average wage. The related coefficients are respectively positive and negative which suggests, among other things, that an increase in unskilled labor cost results in factor substitution towards skilled labor and vice versa (if we consider Table 4). The coefficient on capital stock appears to be statistically insignificant after controlling for sector and time dummies when we consider total labor demand as a dependent variable. However, the disaggregation of labor depending on skill reveals a more complex relationship between both variables. In fact, results in Tables 3 and 4 show respectively negative and positive

¹² Although trade reforms are generally implemented at a sector level, their effects may vary significantly across firm characteristics such as ownership (public vs. private), output orientation and foreign participation in capital. Hence, we also tried to measure the effects of trade policy on labour demand elasticity according to different types of firms. Results, available upon request, suggest that firm export orientation and other firm characteristics do not significantly affect the sign and the magnitude of elasticities responses to trade policy.

coefficients on capital stock that are statistically significant in many specifications. This suggests that capital is a substitute for unskilled labor while skilled labor is complementary to the use of machines and equipment.

The test of hypothesis $\lambda = 1$ that adjustment costs are null rejects it at a high level of significance in all tables¹³. This confirms the importance in using a dynamic specification for the employment equation. Results suggest that firms do not adjust their deviations from the optimal in one year and confirm the existence of important labor reallocation costs in Tunisia. The coefficient estimates associated to total employment shows that the coefficient on the lagged dependent variable is in the order of 0.4 and strongly significant. Thus, firms seem to adjust less than 60 percent of their deviations off the optimal in one year, which is consistent with the existence of restrictive labor market regulations. However, observing results in Tables 3 and 4 confirms the fact that adjustment costs are different depending on skill as pointed out by Mouelhi (2007). The speed of adjustment is more important for unskilled workers (approximately 0.6) than for skilled workers (0.9). This may be justified by the particular abilities and expertise of the last category making it a firm-specific human capital.

7. Conclusion

This paper attempts to explore whether the Tunisian trade liberalisation process leads to an increase in labor demand elasticity. We distinguish different skills using a firm level database covering 529 firms from manufacturing sectors over the period 1997-2002. Our empirical results are based on GMM estimates of a model of employment determination, which incorporates the effects of trade on labor-demand elasticity taking into account the delay of labor adjustment. The findings do not support the theoretical hypothesis that total labor demand elasticities increase with trade openness. As these results appeal for a deeper analysis, we proceed to the disaggregation of the labor demand depending on skill. We give evidence that the elasticity of unskilled labor demand increases in response to a decrease in trade protection: a decline in the customs duties to imports ratio from 50% to 10% is associated with an increase in the absolute value of the elasticity from 0.03 to 0.1. Thus, trade might have exerted a pressure on the total own-price unskilled labor demand elasticity by including additional inputs, enlarging the firm production possibility set and increasing the competition in the output market. At the opposite, the elasticity of skilled labor demand decreases in response to openness. A decline in the customs duties to imports ratio from 50% to 10% implies a decrease in the absolute value of the elasticity from 0.11 to 0.01. One possible explanation for such a result is the increase in the share of this employment category in response to trade openness, which could be more important than the increase in substitution possibilities.

The impact of liberalization on labor demand may transit through two channels: the direct effect and the effect via elasticity. However, findings suggest that openness does not have a direct effect on labor demand given the statistically insignificant coefficients on *ERP* and *CD/M*. This may explain the “muted” employment response to trade liberalisation shock in many studies on developing countries omitting the elasticity channel.

The rise in unskilled labor demand elasticity implies notably the alteration of the bargaining power of unskilled workers. In contrast, trade-induced skill biased technological change leads to an increase of skilled workers relative demand. This may exacerbate wage inequality between skill categories. Thus, the current study shows that the pace of the trade liberalisation process may determine the force of the impact exerted on wage inequality. The

¹³ In order to test this hypothesis, a Student test of significance of the coefficient associated to the lagged variable, that is $1 - \lambda$, is sufficient.

choice of the Tunisian government to perform a relatively gradual openness process¹⁴ might have had a less pronounced bias against unskilled workers.

¹⁴ What emerges from the available descriptive studies is that the overwhelming majority of Latin American countries have conducted intensive trade liberalisation reforms within a short period of time contrasting with the Tunisian and Moroccan processes.

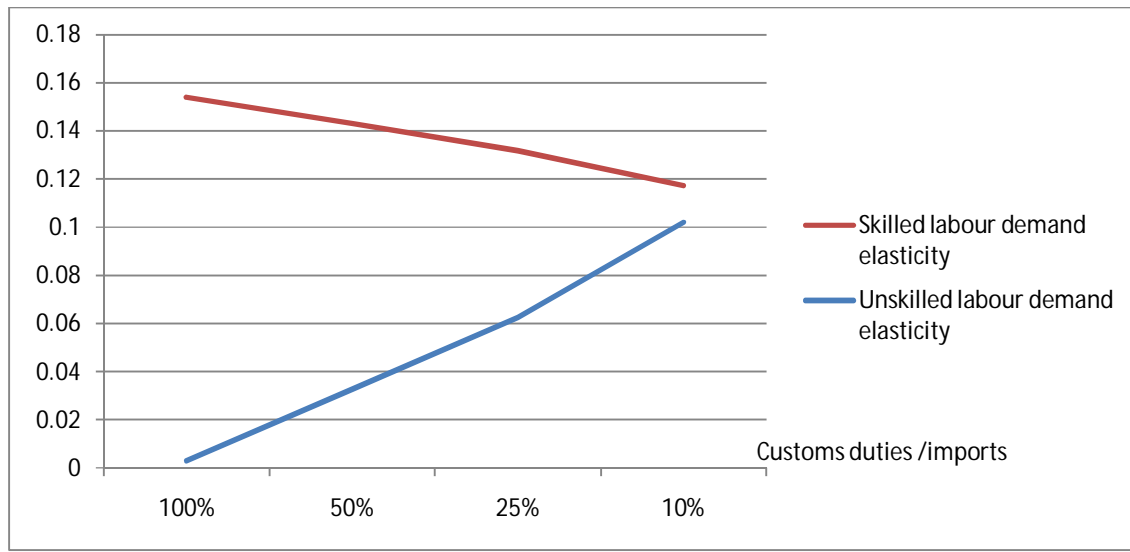
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Appendix

Figure 1: Trade Protection and Labor Demand Elasticities



Source: Authors computations on the basis of previous regression results as following: $EL/w =$ the coefficient on the logarithm of the given labor category average wage + the coefficient on the interaction term between the logarithm of the unskilled wage rate and CD/M ratio * the logarithm of CD/M. Labor demand elasticities are expressed in absolute values.

Table 1: Variables Description

Variables	Number of Observations	Mean	Standard Deviation
Total employment	2451	130.8352	188.8646
Skilled labor	2451	11.011	36.62
Unskilled labor	2451	119.82	175.56
Capital Stock	2433	2774692	9059208
Value added	2451	675874.4	1511921
Skilled worker average wage bill	2451	39538.7	58868.2
Unskilled worker average wage bill	2451	3280.524	3411.111

Source: Authors' computations on the basis of firm level data provided by the national annual survey report on firms carried out by the National Institute of Statistics (NIS), 1998-2002.

Table 2: GMM Estimates for Labor Demand Equation

	Dependent variable: Total employment				
	(1)	(2)	(3)	(4)	(5)
Lag of total employment	0.498 (0.116)***	0.198 (0.116)*	0.434 (0.127)***	0.441 (0.134)***	0.344 (0.061)***
Output	0.286 (0.082)***	0.428 (0.080)***	0.170 (0.058)***	0.166 (0.072)**	0.395 (0.045)***
Capital stock	-0.086 (0.139)	-0.055 (0.126)	0.076 (0.083)	0.059 (0.090)	0.062 (0.047)
Workers Average wage	-0.255 (0.106)**	-0.372 (0.096)***	-0.354 (0.088)***	-0.365 (0.111)***	-0.562 (0.040)***
Workers average wage*ERP	-0.016 (0.005)***		-0.016 (0.005)***	-0.012 (0.006)*	
Lag of ERP	0.008 (0.049)		0.053 (0.044)	0.076 (0.135)	
Workers average wage*CD/M		-0.052 (0.013)***			-0.060 (0.022)***
Lag of CD/M					0.171 (0.169)
Year effects	No	No	No	Yes	Yes
Sector Fixed effects	No	No	Yes	Yes	Yes
1 st order serial correlation p-level	0.001	0.002	0.001	0.002	0.001
2 nd order serial correlation p-level	0.896	0.368	0.844	0.828	0.669
Hansen instrumental validity test	0.676	0.831	0.783	0.747	0.183
Instruments count	25	25	39	39	80
Observations	1792	1792	1792	1792	1792
Number of firms	520	520	520	520	520

Note: Standard errors between parentheses: * Significant at 10%; ** significant at 5%; *** significant at 1%. The regressions include a constant term. All variables are in log form. In all columns, levels of employment dated t-2 and earlier are used as instruments for the difference equations and differences dated t-1 and earlier are used for the level equations.

Table 3: GMM Estimates for Unskilled Labor Demand Equation

	Dependent Variable: Unskilled workers employment				
	(1)	(2)	(3)	(4)	(5)
Lag of Unskilled Workers Employment	0.435 (0.038)***	0.599 (0.114)***	0.339 (0.084)***	0.311 (0.054)***	0.174 (0.031)***
Output	0.269 (0.041)***	0.148 (0.047)***	0.165 (0.039)***	0.547 (0.055)***	0.112 (0.039)***
Capital stock	-0.190 (0.061)***	-0.168 (0.087)*	-0.101 (0.088)	-0.074 (0.031)**	-0.041 (0.065)
Skilled Workers Average Wage	0.623 (0.129)***	0.063 (0.051)	0.174 (0.057)***	0.036 (0.023)	0.226 (0.058)***
Unskilled Workers Average Wage	-0.225 (0.111)*	-0.472 (0.125)***	-0.317 (0.109)***	-0.058 (0.031)*	-0.003 (0.108)
Unskilled Workers Average Wage*ERP	0.008 (0.005)*		0.005 (0.003)*	0.0003 (0.000)***	
Lag of ERP	-0.047 (0.031)		-0.001 (0.029)	-0.212 (0.066)***	
Unskilled Workers Average Wage*CD/M		0.001 (0.019)			0.043 (0.009)***
Lag of CD/M		0.010 (0.138)			-0.007 (0.070)
Year effects	No	No	No	Yes	Yes
Sector Fixed effects	No	No	Yes	Yes	Yes
1 st order serial correlation p-level	0.000	0.000	0.000	0.000	0.008
2 nd order serial correlation p-level	0.341	0.469	0.279	0.339	0.177
Hansen instrumental validity test	0.249	0.258	0.154	0.175	0.581
Instruments count	63	37	55	55	96
Observations	1778	1778	1778	1778	1778
Number of firms	520	520	520	520	520

Note: Standard errors between parentheses: * Significant at 10%; ** significant at 5%; *** significant at 1%. The regressions include a constant term. All variables are in log form. In all columns, levels of unskilled employment dated t-1 and earlier are used as instruments for the difference equations and differences dated t and earlier are used for the level equations.

Table 4: GMM Estimates for Skilled Labor Demand Equation

	Dependent variable: Skilled workers employment				
	(1)	(2)	(3)	(4)	(5)
Lag of skilled workers employment	0.105 (0.032)***	0.104 (0.059)*	0.102 (0.033)***	0.211 (0.073)***	0.092 (0.056)*
Output	0.237 (0.068)***	0.101 (0.104)	0.206 (0.077)***	0.202 (0.071)***	0.073 (0.070)
Capital stock	0.043 (0.085)	0.329 (0.119)***	0.173 (0.113)	0.254 (0.063)***	0.338 (0.068)***
Skilled workers Average wage	-0.341 (0.175)*	-1.195 (0.320)***	-0.496 (0.210)**	-0.090 (0.052)*	-0.151 (0.090)*
Unskilled Workers Average Wage	0.203 (0.107)*	0.464 (0.244)*	0.297 (0.142)**	0.063 (0.058)**	0.373 (0.157)**
Skilled Workers Average Wage*ERP	-0.012 (0.006)*		-0.011 (0.006)*	-0.017 (0.007)**	
Lag of ERP	-0.087 (0.057)		-0.073 (0.061)	-0.088 (0.070)	
Skilled Workers Average Wage*CD/M		-0.116 (0.053)**			-0.059 (0.034)*
Lag of CD/M		0.713 (0.549)			0.342 (0.320)
Year effects	No	No	No	Yes	Yes
Sector Fixed effects	No	No	Yes	Yes	Yes
1 st order serial correlation p-level	0.000	0.000	0.000	0.000	0.000
2 nd order serial correlation p-level	0.265	0.281	0.279	0.442	0.227
Hansen instrumental validity test	0.190	0.255	0.152	0.1	0.098
Instruments count	78	39	78	67	87
Observations	1746	1746	1746	1746	1746
Number of firms	517	517	517	517	517

Note: Standard errors between parentheses: * Significant at 10%; ** significant at 5%; *** significant at 1%. The regressions include a constant term. All variables are in log form. In all columns, levels of skilled employment dated t-1 and earlier are used as instruments for the difference equations and differences dated t and earlier are used for the level equations.

Table 5: Fixed Effects Regressions of Labor Shares on Trade Protection Indicator

	Unskilled Labor Share	Skilled Labor Share
ERP	0.087* (0.042)	-0.096* (0.05)
Number of observations	2095	2069
Number of firms	527	527

Note: the labor share is calculated as the ratio of total wage bill of the labor category j to firm value added: labor share = $\ln \left(\frac{w_j^L \times L_j^L}{VA_f} \right); j = 1, 2$.

All variables are in log form. Standard errors between parentheses: * Significant at 10%; ** significant at 5%; *** significant at 1%.

Source: Authors' computations on the basis of firm level data provided by the national annual survey report on firms carried out by the National Institute of Statistics (NIS), 1997-2002.

Table 6: Skilled Workers Ratios

	Ratio of skilled to unskilled workers $\frac{L_1}{L_2}$	Ratio of skilled to total workers $\frac{L_1}{L}$	Capital per worker ratio $\frac{K}{L}$
1998	0.17	0.08	19214
2002	0.25	0.1	25893

Source: Authors' computations on the basis of firm level data provided by the national annual survey report on firms carried out by the National Institute of Statistics (NIS), 1997-2002.

Firm total wage bill decomposition technique of Maurin and Parent (1993)¹⁵ :

We define the following variables:

TWB : Total wage bill in firm i

L : Total employment in firm i

L_Q : Number of firm's skilled workers.

L_{NQ} : Number of firm's unskilled workers.

l_Q : Skilled workers share of total employment relative to a firm i

l_{NQ} : Unskilled workers share of total employment relative to a firm i

WB : Average wage bill per worker in firm i

WB_Q : Skilled worker's average wage bill in firm i

WB_{NQ} : Unskilled worker's average wage bill in firm

The (TNIS) firm level database provides firm data on total wage bill, as well as skilled and unskilled workers employment. Unskilled workers are considered as our category of reference. Assuming that Q indexes the skilled workers category and NQ the unskilled workers category, we obtain the following expression of the average individual wage bill relative to a firm i :

$$\begin{aligned} \frac{TWB}{L} &= WB = WB_Q l_Q + WB_{NQ} l_{NQ} \\ &= WB_Q l_Q + WB_{NQ} (1 - l_Q) \\ &= l_Q (WB_Q - WB_{NQ}) + WB_{NQ} \end{aligned} \quad (1)$$

Our objective is to estimate skilled and unskilled wage bills, over the period 1997-2002, for each firm of the sample provided by the national annual survey report on firms. To this purpose, we regress the following random coefficient model using the Swamy's estimator, where v_{it} is an error term.

$$WB_{it} = \underbrace{WB_{NQi}}_{\beta_{0i}} + \underbrace{(WB_Q - WB_{NQ})_i}_{\beta_{1i}} \cdot l_{Qit} + v_{it} \quad (2)$$

The parameter β_{0i} corresponds to the average unskilled workers wage bill WB_{NQ} relative the firm i , for the entire period 1997-2002. Then, given estimated values of β_{0i} and β_{1i} , we may deduce the average skilled workers wage bill WB_Q associated to the firm i , for the entire period 1997-2002. Note here, that this estimation provides only firm heterogeneity: we do not obtain estimates for each year of our observation period. To this aim, we multiply average firms' wage bills corresponding to each category of workers by the corresponding workers' numbers available for each year. Hence, we find skilled and unskilled total wage bills, for each company of the sample and each year of observation.

¹⁵ Maurin. E et Parent. M.C (1993), « Productivité et coût du travail par qualifications » in « Actes de la 18^{ème} journée des centrales de bilans sur le thème : Croissance, emploi, productivité », Association Française des Centrales de bilans AFCB, Paris, 23 novembre 1993.

Tab A. Total Labor Demand Equation

	(1)	(2)	(3)
Lag of total employment	0.441 (0.134)***	0.323 (0.154)**	0.546 (0.159)***
Output	0.166 (0.072)**	0.265 (0.087)***	0.177 (0.073)**
Capital stock	0.059 (0.090)	0.066 (0.112)	0.180 (0.167)
Workers Average wage	-0.365 (0.111)***	-0.283 (0.104)***	-0.393 (0.093)***
Workers average wage*ERP	-0.012 (0.006)*	-0.015 (0.008)*	-0.017 (0.010)*
Lag of ERP	0.076 (0.135)	0.030 (0.052)	0.064 (0.058)
Year effects	Yes	Yes	Yes
Sector Fixed effects	Yes	Yes	Yes
1 st order serial correlation p-level	0.002	0.004	0.001
2 nd order serial correlation p-level	0.828	0.681	0.953
Hansen instrumental validity test	0.747	0.544	0.645
Instruments count	39	30	30
Difference-Hansen Tests (p values)			
All system GMM instruments	0.252	0.542	0.441
Those based on lagged employment only	0.703	0.488	0.117
Observations	1792	1792	1792
Number of firms	520	520	520

Note: Standard errors between parentheses: * Significant at 10%; ** significant at 5%; *** significant at 1%. The regressions include a constant term. All variables are in log form. All regressions are two-step system GMM. In column (1), the instruments used for equation in differences include observations of lagged employment, output and capital stock dated T-2 and earlier and differences dated T-1 and earlier are used for equation in levels. In column (2), instruments are collapsed. In column (3), observations of lagged employment and output dated T-3 and earlier are used for equation in differences and differences dated T-2 and earlier are used for equation in levels

Table B: Unskilled Labor Demand Equation

	(1)	(2)	(3)
Lag of total unskilled employment	0.311 (0.054)***	0.336 (0.074)***	0.321 (0.057)***
Output	0.547 (0.055)***	0.488 (0.066)***	0.455 (0.079)***
Capital stock	-0.074 (0.031)**	-0.043 (0.032)	-0.010 (0.051)
Skilled workers average wage	0.036 (0.023)	0.054 (0.029)**	0.010 (0.027)
Unskilled workers average wage	-0.058 (0.031)*	-0.052 (0.033)	-0.113 (0.053)**
Unskilled workers average wage*ERP	0.0003 (0.000)***	0.0003 (0.000)***	0.0003 (0.000)**
Lag of ERP	-0.212 (0.066)***	-0.186 (0.067)***	-0.030 (0.096)
Year effects	Yes	Yes	Yes
Sector Fixed effects	Yes	Yes	Yes
1 st order serial correlation p-level	0.000	0.000	0.000
2 nd order serial correlation p-level	0.339	0.334	0.368
Hansen instrumental validity test	0.175	0.222	0.50
Instruments count	55	46	45
Difference-Hansen Tests (p values)			
All system GMM instruments	0.046	0.100	0.119
Those based on lagged unskilled employment only	0.324	0.263	0.397
Observations	1778	1778	1778
Number of firms	520	520	520

Note: Standard errors between parentheses: * Significant at 10%; ** significant at 5%; *** significant at 1%. The regressions include a constant term. All variables are in log form. All regressions are two-step system GMM. In column (1), the instruments used for equation in differences include observations of lagged unskilled employment dated T-1 and earlier in addition to output, lagged ERP and unskilled workers average wage*ERP dated T-2 and earlier. Differences dated respectively T and earlier for the first variable and T-1 and earlier for the other variables are used for equation in levels. In column (2), instruments are collapsed. In column (3), observations of lagged ERP and unskilled workers average wage*ERP dated T-3 and earlier are used for equation in differences and differences dated T-2 and earlier are used for equation in levels.

Table C: Skilled Labor Demand Equation

	(1)	(2)	(3)
Lag of total skilled employment	0.211 (0.073)***	0.203 (0.043)***	0.193 (0.041)***
Output	0.202 (0.071)***	0.296 (0.109)***	0.264 (0.099)***
Capital stock	0.254 (0.063)***	0.200 (0.084)**	0.236 (0.077)***
Skilled workers average wage	-0.090 (0.052)*	-0.130 (0.069)*	-0.131 (0.056)**
Unskilled workers average wage	0.063 (0.058)**	0.144 (0.112)	0.015 (0.088)
Unskilled workers average wage*ERP	-0.017 (0.007)**	-0.021 (0.009)**	-0.017 (0.008)**
Lag of ERP	-0.088 (0.070)	-0.036 (0.074)	-0.075 (0.075)
Year effects	Yes	Yes	Yes
Sector Fixed effects	Yes	Yes	Yes
1 st order serial correlation p-level	0.000	0.000	0.000
2 nd order serial correlation p-level	0.442	0.441	0.421
Hansen instrumental validity test	0.1	0.29	0.38
Instruments count	67	48	59
Difference-Hansen Tests (p values)			
All system GMM instruments	0.107	0.1	0.01
Those based on lagged skilled employment only	0.321	0.123	0.30
Observations	1746	1746	1746
Number of firms	517	517	517

Note: Standard errors between parentheses: * Significant at 10%; ** significant at 5%; *** significant at 1%. The regressions include a constant term. All variables are in log form. All regressions are two-step system GMM. In column (1), the instruments used for equation in differences include observations of lagged skilled employment and lagged ERP dated T-1 and earlier in addition to skilled workers average wage and skilled workers average wage * ERP dated T-2 and earlier. Differences dated respectively T and earlier for the two first variables and T-1 and earlier for the other variables are used for equation in levels. In column (2), instruments are collapsed. In column (3), observations of skilled workers average wage*ERP dated T-3 and earlier are used for equation in differences and differences dated T-2 and earlier are used for equation in levels.