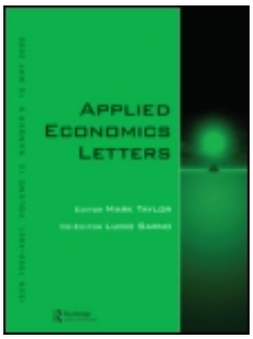

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The effect of international trade on labour-demand elasticities: empirical evidence from Tunisia

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This paper investigates the effects of trade liberalization on labour demand elasticities. The employment demand equation is estimated by using data for manufacturing industries in Tunisia covering the period from 1971 to 1996. The empirical results suggest a weak support for the idea assuming that trade liberalization will lead to an increase in labour demand elasticities: in the vast majority of industries considered, we cannot reject the hypothesis of no relationship between trade openness and labour-demand elasticities. This weakness of labour demand elasticity in practice is perhaps explained by the tight labour market regulations in place during the 1987–1996. However, these results are robust to the type of labour considered (contract labour and permanent labour). This supports the conclusion that under liberalization labour markets have become more flexible, and that employers prefer recruiting contract workers.

I. Introduction

Trade reforms, even though considered to be walfare enhancing in the aggregate, do not have a uniform impact on all sections of society. Most economists like to think about the impact of these reforms in terms of their consequences for capitalists and workers. For example, in the presence of intersectoral factor mobility, opening up an economy to international trade in goods will help labour and hurt capital or vice versa, depending on whether a country's comparative advantage is in labour- or capital-intensive products (Hasan *et al*., 2003). In fact, there is an important, ongoing debate on whether trade hurts or benefits unskilled labour relative to skilled workers (the owners of human capital), to which already many well-known scholars in the area have contributed to the literature.[1]

An aspect of the trade–labour linkage that has received some attention in recent years is the impact of international trade in goods on labour demand: the focus is on the possibility, particularly in imperfectly competitive contexts, for the elasticity of demand for labour to be higher with greater openness. The importance of this element of the labour-market impact of trade was first emphasized by Rodrik (1997). He argues that trade makes the demand for labour more elastic, which in turn leads to larger employment and wage shocks as a result of given vertical shifts in the labour-demand curve (arising

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[1] Important contributions to the literature on the impact of globalization on wages and wages inequality have been made by Feenstra and Hanson (1996, 1997) and Hanson and Harrison (1999).

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from shocks to productivity or to output demand). Also, this increase in elasticity leads to the erosion of the bargaining power of labour vis-à-vis capital in the sharing of supernormal profits. And finally, it also results in labour bearing a larger burden of the impact of non-wage labour costs. Thus, through this channel, workers are placed under greater pressure as a result of trade liberalization (see Slaughter (1997) for a detailed discussion of these effects). However, the vast majority of empirical literature has mainly a developed country focus. In contrast, the linkages between trade and labour markets are yet to be explored thoroughly in the context of developing countries. This paper takes a step in this direction by analysing the relationship between labour markets and international trade in the Tunisian context.

An important question to be asked is: Why does an increase in openness lead to an increase in labour-demand elasticity?

The benefits to Tunisia from this trade liberalization should be substantial, and should pass through various channels (Papi and Zazzaro, 2000). In addition, trade liberalization leads to lower prices for imported goods. Since Tunisia is an importer of capital equipment, and given complementarity between capital and employment, the employment rises. According to the standard theory of international trade, following integration, employment and total factor productivity should increase. First, the increases are a result of the better allocation of existing resources (the statistic effect) and the greater competitiveness of markets, goods, and factors, as well as the expansion of potential markets, and the full exploitation of scale and scope economies (the dynamic effect). Secondly, employment and efficient allocation of labour increase as a result of foreign and domestic investments stimulated by policies of trade liberalization. Thus, the advantages of foreign investments take the form not only of an immediate increase in aggregate demand, but also of knowledge transfers, opportunities to gain professional expertise, and commercial contracts.

However, employment benefits will pass through new investment, and the reallocation of production factors, to sectors with greater competitive advantages, and consequently, a general strategy for reform and modernization. A striking example of this is the plan for industrial restructuring and modernization (mise à niveau program). The aim of this plan is to prepare Tunisian manufacturing firms for the liberalization of markets and the greater competition that will arise. This programme has been accompanied by generous tax breaks for investment in the exporting sector, progressive rationalization of the regulatory framework, and infrastructure development. To increase the flexibility of labour regulations, the labour code was revised in 1994, and again in 1996, to clarify the conditions under which workers can be laid off for cost saving reasons and to establish guidelines for financial compensation.

This paper attempts to investigate the link between trade openness and factor demand elasticities empirically.[2] We start by specifying an econometrically implementable theoretical model of an industry operating in an imperfectly competitve context and derive predictions about the implications of changes in trade policy for labour demand elasticities. This is then tested using data from the Tunisian manufacturing sector from a period when there were scale changes in the level of trade protection (specifically, the trade reforms of 1986). This data set provides a unique opportunity to test the impact of trade policy on labour demand elasticities. The study has several appealing features: first, if it is the case that greater openness generally results in larger factor demand elasticities, we should expect to see its effects after this particular reform.[3] Second, the data are of higher frequency than is typical: since manufacturing censuses are typically only conducted once every 3 or 5 year in most countries, such data allow one only to obtain two or three observations per industry in about a decade – a period over which there may typically be multiple shifts in trade policy. Thus, in most cases, extracting information about the impact of a single shift in trade policy on industries is difficult. Our data, however, are annual, thus mitigating this concern. Third, this data set has already been used previously by Haouas *et al*. (2003) to examine labour use efficiency in manufacturing industries. It, thus, permits an industry-by-industry comparison and concilitation of speed of adjustment with impact on labour markets (Krishna *et al*., 2001).

This study suggests that the linkage between greater trade openness and labour demand elasticities as suggested by the theory may be empirically quite

[2] There have, of course, been other studies of linkages between trade policy and labour markets: Revenga (1992), Harrison and Revenga (1995), Kambhampati *et al*. (1997) and Curie and Harrison (1997) are recent examples. Each of these papers focuses on the relationship between trade policy and employment and wage levels rather than on elasticities. Slaughter (1997), on the other hand, uses industry level US data to investigate the link between variations in openness in the recent decades and labour demand elasticities.

[3] In this regard, our study is set in a better context than the one examined by Slaughter (1997) whose focus instead is on US trade policy changes over recent decades, which were rather less pronounced and more difficult to measure.

weak: in the vast majority of industries considered, we are unable to reject the hypothesis of no relationship between these variables. As we discuss in detail in the paper, this finding remains robust to changes in the type of labour considered (all production workers, femal labour, etc.) and quite robust to changes in specification as well.

The rest of the paper is structured as follows. In Section II some recent applications to developing countries are presented. Section III describes the Tunisian reforms briefly. Section IV outlines the basic theoretical structure and derives the estimating equation. Section V describes the data. Section VI discusses the primary econometric concerns and presents the econometric results. Section VII discusses how we can reconcile our results with the finding of Haouas *et al.* (2003). Section VIII concludes.

II. Some Recent Applications to Developing Countries

There are a few studies which in one or another way are relevant to the relationship between labour demand elasticities and trade liberalization in developing countries. In the following we briefly review a number of such studies.

Using industry-level data disaggregated by states, Hasan *et al.* (2003) find a positive impact of trade liberalization on labour-demand elasticities in the Indian manufacturing sector. These elasticities turn out to be negatively related to protection levels that vary across industries and over time. Furthermore, they find that these elasticities are not only higher for Indian states with more flexible labour regulations; they are also impacted to a larger degree by trade reforms. Finally, they find that after reforms, volatility in productivity and outputs is translated into larger wage and employment volatility, theoretically a possible consequence of larger labour-demand elasticities.

Fajnzylber and Maloney (2000) use establishment-level data to provide consistent dynamic estimates of labour demand functions for three Latin American countries (Chile, Colombia, and Mexico) across trade policy regimes. The results show that estimates of elasticities do change greatly in magnitude, if not significantly so, over time and that comparisons across countries should take this into account when attempting to make inference about the flexibility or efficiency of labour markets. But more importantly, the data provide only very mixed support for the idea that trade liberalization has an impact on own wage elasticities and no consistent patterns emerge.

Using Turkish plant level data spanning the course of dramatic trade liberalization, Krishna *et al.* (2001) investigate empirically the link between trade openness and factor demand elasticities. Their analysis suggests that the putative linkage between greater trade openness and labour demand elasticities may be quite week. They explain this weakness by the variety of frictions that affect the labour demand decisions of firms.

III. The Tunisian Reforms

Like many countries in the region, Tunisia pursued a policy of macroeconomic stabilization and exchange rate adjustment until the mid-1980s, in which taxes on imports progressively increased and often exceeded 100% of import prices. During this period manufacturing evolved through a highly regulated economic environment. These controls had a direct and indirect bearing on how the manufacturing sector used resources. In the labour market, for example, the government introduced minimum wages and adopted a rigid wage structure, which prevented close linkage between base wages and performance-based bonusus. Additionally, employers were prohibited from dismissing workers. Dismissal of workers could only take place following administrative approval by government employment authorities. The effect is that laziness and absenteeism have become difficult to punish, resulting in lower productivity. Other than labour market controls, there were controls on prices, foreign currency and investment as well.

However, the situation became less favourable, notably between 1984 and 1986, because of several negative factors (the fall in oil prices, the return of 30 000 workers who had emigrated to Libya, the conflicts between government and trade unions). These events and the emergence of a strong radical 'Islamic group' constituted an obstacle to economic development. The political instability scared foreign and Tunisian investors and deterred them from creating projects, a fact which has affected negatively growth and job creation. In addition, as the state continued a very important public investment policy, it was obliged to borrow massively, including from commercial banks, so that Tunisia was threatened with a financial crisis. This situation resulted in the eviction of the President Bourguiba and his replacement by Prime Minister Ben Ali in November 1987. This political change allowed Tunisian authorities to

Table 1. Tunisian manufacturing industries: effective protection rate and import volumes

	Effective protection rate[a]			Imports (millions of dinars)[b]		
Industry	1986	1990	1995	1986	1990	1996
Food	421%	100%	115%	236	272.7	321.9
Construction material & ceramic	40%	82%	85%	53.7	69.8	76.8
Mechanical electric industry	88%	101%	169%	1683.2	1952.8	1973
Chemical	88%	78%	65%	524.5	619.6	585.6
Textile, clothing & leather	194%	73%	132%	612.6	991.2	1316.2
Other manufacturing	101%	80%	102%	244.3	486.8	439

Sources: [a]Boudhiaf (2000), "Politique tunisienne d'ouverture commerciale". IRD, 9 juin.
[b]National accounts from the Tunisian National Statistic Institute (INS) and statistics from the Quantitative Economy Institute (IEQ).

accept conditions imposed by the World Bank and the IMF on exchange for financial assistance.

Since 1987, numerous measures have been taken to further liberalize international trade: the structural adjustment programme (1987), adherence to the General Agreement on Terms of Trade (1989), participation and signature to the Uruguay Round agreement (1993), adherence to the World Trade Organization (1994), and signing of a Free-trade Agreement with the European Union (1995). According to Boudhiaf (2000), the consequences of these measures for international trade liberalization for Tunisia were spread over three periods.[4] During the initial period of trade liberalization (1987–1990), the level of protection for the economy was greatly lowered. During the second period (1990–1995) 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 (1995–1998), the nominal protection rate on agriculture increased, while the nominal protection rate for industrial products decreased significantly. The GATT 1994[5] review of Tunisia's trade policies estimates the unweighted average legal tariff rate (including surcharges) at 33%, and the range 0–73%. This compares to ranges prior to reform of 5–236% and an average tariff rate of 36% for the period 1981–1986. The second liberalization period introduced major changes, mainly in import trade volume[6] (see Table 1). It is against the background of policy changes outlined above that a study of the adjustment process of the impact of these reductions in trade protection on labour markets becomes essential.[7]

IV. Empirical Assessment

For the purpose of the present paper we work with a model of monopolistic competition (Krishna *et al.*, 2001), where each firm faces its own less than infinitely elastic demand curve and where there is assumed to be no strategic interaction between firms.[8] Thus, any firm i in industry j is assumed to face an inverse demand curve of the type:

$$P_{ij} = \theta \bar{P}_j Q_{ij}^{-1/\epsilon} \tag{1}$$

where P_{ij} denotes own price, $\bar{P}_j$ denotes industry average price, θ is a scaling factor, Q_{ij} denotes firm output and ϵ denotes the (constant) price elasticity of demand. The production function is assumed to be a Cobb–Douglas type (in variable inputs), and given by:

$$Q_{ij} = \prod_{k=1}^{n} V_{kij}^{\alpha_k} \tag{2}$$

where V_{kij} denotes the kth input in use here.

[4] For evaluation of the effects of trade liberalization on employment and wages in other developing countries, see Brecher (1974), Beyer *et al.* (1999), and Levinsohn (1999).
[5] GATT (1994), TPRM, for unweighted average tariff rates and ranges.
[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] According to Lakhoua (1998) these reforms have been accompanied by important social achievements; these include intensification of job creation, income seems to be more evenly distributed than in most comparable countries and the incidence of poverty to be correspondingly low.
[8] This approximates a situation in which there are a large number of varieties and each firm is an infinitesimal player but has some power over the pricing of its product.

The firm is assumed to face infinitely elastic factor supplies, i.e., it takes factor prices as given. Partially differentiating profits with respect to the lth input and equating it to zero gives us the following first-order condition:

$$\theta \bar{P}_j Q_{ij}^{1-1/\in}\left(1-\frac{1}{\in}\right)\alpha_l V_{lij}^{-1} = w_l \tag{3}$$

where w_l denotes the price of the lth input. In log form, (3) can be rewritten as:

$$\ln V_{lij} = \gamma_0 + \gamma_1 \ln\left(\frac{w_l}{\bar{P}_j}\right) + \sum_{k\neq 1}\gamma_k \ln V_{kij} \tag{4}$$

where the γ values are each a function of $\in$. Substituting the FOC for other inputs back into (4) above, we get:

$$\ln V_{lij} = \delta_0 + \sum_{k=1}^{n}\delta_k \ln(w_k/\bar{P}_j) \tag{5}$$

which is a demand function for the lth input expressed in terms of the variables the firm takes as exogenous – factor prices and the industry average price. The coefficients in the above equation are function of $\in$. The own price elasticity of an input is given by:

$$\frac{\partial \ln V_{lij}}{\partial \ln(w_l/\bar{P}_j)} = \delta_l = \frac{-\left[1-(1-(1/\in))\left(\sum_{k\neq 1}\alpha_k\right)\right]}{\left[1-(1-(1/\in))\left(\sum_{k=1}^{n}\alpha_k\right)\right]} \tag{6}$$

The derivative of the absolute value of the own price elasticity of input demand with respect to the product demand elasticity is given by:

$$\frac{\partial|\delta_1|}{\partial \in} = \frac{\alpha_l}{\in^2\left[1-(1-(1/\in))\left(\sum_{k=1}^{n}\alpha_k\right)\right]^2} > 0 \tag{7}$$

which shows the magnitude of the own price elasticity of factor demand is increasing in the product demand elasticity (thus proving that the effects predicted by Hick's Law are relevant in this context). The cross-price elasticity of demand for inputs may be analogously derived and is given by:

$$\frac{\partial \ln V_{lij}}{\partial \ln(w_s/\bar{P}_j)} = \delta_s, \quad s \neq 1 \tag{8}$$

We now specialize to the case where the only inputs are labour, capital, and energy. Additionally, we let w, r, m and f denote the logs of the wage rate, the rental rate, capital price and energy price, respectively, and each deflated by the industry-level average output price. Finally, we focus our attention on the demand for labour alone (as opposed to that for other factor inputs).[9] The labour demand function is then given by:

$$l_{ijt} = \delta_0 + \delta_w w_{ijt} + \delta_r r_{ijt} + \delta_m m_{ijt} + \delta_f f_{ijt} \tag{9}$$

where l is the log of labour demanded. Thus, our final estimating equation is

$$l_{ijt} = \delta_0 + \delta_w w_{ijt} + \delta_r r_{ijt} + \delta_m m_{ijt} + \delta_f f_{ijt} + e_{ijt} \tag{10}$$

where the error term e_{ijt} allows for random shocks to affect the firm's demand for labour.

V. The Data

The data used in this study has been assembled using a diversity of sources (national accounts from the Tunisian National Statistic Institute (INS) and statistics coming from the Quantitative Economy Institute (IEQ) and central bank of Tunisia). We did so in order to allow the construction of an integrated database of industrial, labour market and trade statistics feasible. Thus we have a panel on six manufacturing industries from 1971 to 1996. The data are annual. These six industries are included in the free trade agreement of 1995 between Tunisia and the European Union. The industries included are food industry, textiles, clothing and leather industry, chemical industry, construction material, ceramic and glass industry, mechanical electric industry, and other manufacturing industry (including paper and pulp, plastics, etc.). Table 1 lists the volume of import and effective protection rate by industry.

Our interest in this paper is in labour market effect of trade liberalization. To estimate Equation 10, we need data on input prices faced by the firm and labour employed. The dependent variable is measured as total employment in each industry (L). For robustness, we also estimate (10) using other categories of labour, specifically, contract workers, and permanent workers.[10] The independent variables in the labour demand part of the model are average wages (w), capital price (m),[11] and energy price (f).

[9] The theory clearly applies to all input factors. However, we focus only on labour demand since any effort estimating demand equations for other factors would be frustrated by the fact that firm-level data on the use of the other factors and/or factor prices is not available.

[10] Using the annual survey on firms made by the INS derived permanent and contract workers.

[11] Capital price is assumed equal to the price of acquiring new capital or PFCFB ('prix de formation de capital fixe par branche d'activité').

Table 2. Labour demand elasticities with respect to wages

	Fixed effects		OLS estimates	
Industry	δ_w	$\Delta\delta_w$	δ_w	$\Delta\delta_w$
Food	−0.302	−0.010	−0.223	0.011
	(0.031)	(0.038)	(0.021)	(0.070)
Construction material and ceramics	−0.396	0.007	−0.295	−0.012
	(0.042)	(0.024)	(0.035)	(0.092)
Mechanical electric industry	−0.312	−0.002	−0.293	0.009
	(0.047)	(0.212)	(0.057)	(0.070)
Chemical	−0.453	−0.046	−0.448	−0.053
	(0.024)	(0.021)	(0.029)	(0.026)
Textile, clothing and leather	−0.213	0.029	−0.197	0.042
	(0.080)	(0.012)	(0.038)	(0.013)
Other manufacturing	−0.263	0.003	−0.201	−0.008
	(0.020)	(0.070)	(0.024)	(1.254)
R^2	0.776	0.667	0.698	0.453

Figures in parentheses are standard errors.

Economy-wide interest rate data (borrowing costs) were used as rental costs.[12]

Wages are defined as average annual wage per worker at the industry level. It is obtained by dividing total wages in each industry by the total number of employees in that industry. Thus, the wage variable is industry specific. The average wages are then transferred to fixed 1971 prices using the producer price index. Wages, material price and energy price are given in Tunisian Dinars.

VI. Estimation Results

As described in the introduction, a more liberal trade policy may be expected to raise labour-demand elasticity. We now examine the evidence for these possibilities. Equation 10 is our basic estimating equation. We begin by considering OLS estimates of the own price labour demand elasticity, the cross capital price labour demand elasticity, and the own price labour demand elasticity by worker type separately for each industry. However, without adequately controlling for other policies, one risks confounding the effects of trade liberalization with other structural reforms. Also, there may be severe endogeneity problems – unobserved demand shocks may not be orthogonal to trade intensity so that OLS estimates may be biased and inconsistent. This requires that we use a fixed effects model. To take into account the unobserved sectoral variation we use industry-specific fixed effect dummies. We capture the effects of trade liberalization on the parameters in (10) by the use of a liberalization dummy, which takes the value 0 up to 1986 and 1 thereafter.

Labour demand elasticities with respect to wages

Table 2 presents results for labour demand elasticities and their changes in each of the six industries, under the fixed effects and OLS estimation. The estimated elasticities (δ_w) lie within the range −0.213 to −0.453. This falls well within what Hammermesh (1993) has identified as being a reasonable range of values for labour demand elasticities. In the six cases, across both types of estimates, the elasticity estimates are quite tightly estimated and in line with previous studies.

The parameter of interest here is elasticity change, i.e. the parameter corresponding to the wage variable interacted with the liberalization dummy ($\Delta\delta_w$). As columns 2 and 4 in Table 2 indicate, our estimates of the interaction term involving wages and the post-1986 dummy are small in magnitude and largely insignificant. In four out of six cases, under both OLS and fixed effects estimates, the null hypothesis that the change in elasticity after the reforms is zero cannot be rejected at the 5% level or indeed in most cases at even a higher level of significance. The two industries where the null hypothesis of no elasticity change is rejected are chemical and textile, clothing and leather. In these cases the $\Delta\delta_w$ estimate is negative and positive, implying that the absolute value of the own price labour demand elasticity goes up. It appears thus in the vast majority of the

[12] We find that the results are mostly invariant to the assumptions regarding interest rates. This is discussed in more detail in the next section.

Table 3. Labour demand elasticities with respect to capital price

	Fixed effects		OLS estimates	
Industry	δ_m	$\Delta\delta_m$	δ_m	$\Delta\delta_m$
Food	3.172	2.007	3.125	1.836
	(3.127)	(1.869)	(3.138)	(1.184)
Construction material and ceramics	0.234	0.017	0.214	0.013
	(0.932)	(0.980)	(0.920)	(0.635)
Mechanical electric industry	−8.047	−2.033	−7.045	−2.036
	(3.014)	(1.015)	(2.015)	(1.011)
Chemical	−2.213	−1.717	−2.002	−1.058
	(1.124)	(0.673)	(0.828)	(0.370)
Textile, clothing and leather	1.458	0.558	1.326	0.226
	(0.851)	(0.381)	(0.727)	(0.474)
Other manufacturing	0.012	0.007	0.011	0.004
	(0.017)	(0.020)	(0.055)	(0.081)
R^2	0.753	0.592	0.665	0.489

Figures in parentheses are standard errors.

industries considered separately we are unable to find statistically and economically significant relationship between these variables.

This lower responsiveness of labour demand elasticities to trade liberalization was expected because of the job security regulations in force. Employers could not easily fire workers, even if there were increases in wage costs. Despite recent progress, the government role is still important and the number of layoffs is still controlled for both private and public firms. Despite the recent reform of the labour code the time required to obtain a retrenchment for economic reasons remains long in practice, hampering necessary restructuring.

Some issues regarding the validity of the estimation framework and the interpretation of the results arise. The first concerns the familiar issue of possible simultaneity and correlation between the error term and the right-hand side variable. Since both labour demand and labour supply depend upon the wage, shocks to the labour demand will result in shocks to the wage.[13] Thus the wage and the disturbance term in our estimating equation may be correlated, thereby raising the possibility of bias in our estimates.

The second is about timing and lagged responses. It is assumed in our estimation of (10) that firm demand response to changes in wage occurred without lags. As Hammermesh (1993) has noted, much of the adjustment in firm labour demand takes place within 6 months to 1 year. Thus, given that our data are annual, this is not a serious problem.

A third issue is that data indicate that the measured wage is quite different across industries. We believe that this reflects unobserved differences in worker quality across industries or to a smaller extent due to differences in the number of hours on the job put in by workers in different industries. Given such differences, it will be reasonable to expect that labour demand itself could be somewhat different across industries. Of course, to the extent that the differences are simply in levels and are fixed over time – our industry-specific intercept should take care of the problem (Krishna *et al.*, 2001).

Labour demand elasticities with respect to capital price

OLS and fixed effects estimates of the cross capital price labour demand elasticity estimates are presented in Table 3. The estimated elasticities range 'between' 0.012 and −8.047, but only three cases are statistically significant. We are not greatly surprised by these estimates and their lack of significance – with few exceptions; the literature has traditionally found cross-price elasticities to be rather difficult to estimate. According to Krishna, Mitra and Chinoy (2001), "This is additionally difficult in our case since in our data, factor prices for materials and fuel are only specific to the industry (i.e. are not available at the level of the firm) and thus they exhibit insufficient variation over the sample."

[13] To the extend that, say, aggregate demand or productivity shocks increase product demand and raise labour demand and increase wages (or any other factor prices for that matter) at the same time, the elasticity estimates delivered from Equation 6 would be biased due to the correlation between the error term and the right-hand side variable.

Table 4. Labour demand elasticities by worker type

	Contract worker		Permanent worker	
Industry	δ_w	$\Delta\delta_w$	δ_w	$\Delta\delta_w$
Food	−1.282	0.246	−0.761	−0.242
	(0.231)	(0.113)	(0.408)	(0.072)
Construction material and ceramics	−2.618	−0.502	−0.374	−0.381
	(0.405)	(0.487)	(0.234)	(0.263)
Mechanical electric industry	−0.832	−0.099	−0.247	0.577
	(0.052)	(0.063)	(0.155)	(0.847)
Chemical	−1.883	−0.163	−0.359	0.277
	(0.199)	(0.071)	(0.147)	(0.157)
Textile, clothing and leather	−2.915	1.187	−1.112	−0.050
	(1.303)	(0.638)	(0.134)	(0.367)
Other manufacturing	−1.144	0.154	−0.856	−0.231
	(0.155)	(0.053)	(0.262)	(0.261)
R^2	0.786	0.656	0.776	0.623

Figures in parentheses are standard errors.

As Table 3 indicates, our estimates of the changes in labour demand elasticities ($\Delta\delta_m$)[14] are largely insignificant. Under both the OLS and fixed effects estimates, there are only two industries were the null hypothesis of no elasticity change is rejected. These industries are Chemical and Mechanical electric industry.

Labour demand elasticities by worker type

To view variations in labour demand elasticities across worker types we estimate Equation 10 by considering the demand for contract workers and permanent workers separately. The elasticities again are quite tightly estimated (see Table 4). However, as expected, their values are higher in magnitude than the ones for overall labour as substitution possibilities are higher when we look at specific kinds of labour than in the case of labour in general. For contract workers, most elasiticity estimates are between −1 and −3, while for permanent workers, labour demand seems to be inelastic. Changes in elasticity are again mostly insignificant following the reforms: significant negative value for $\Delta\delta_w$ are produced in food for permanent workers, and significant positive values are produced in Food, Textile, clothing and leather, and Other manufacturing for contracts workers.

The positive association between wage and contract labour in these sectors can be explained by labour regulation reforms. In fact, to increase flexibility of labour regulations, the Tunisian labour code was revised in 1994 and 1996. As a result, in some sectors, fixed term contracts and sub-contractual arrangements now account for 90% of labour contracts.[15] Contract labour seems to be the obligated passage to enter in labour markets and it is absolutely correlated with the unemployment of young people in Tunisia.

Labour demand elasticities estimates over industries

Our penultimate set of regressions used data pooled across all six manufacturing industries. The results are presented in Table 5. As noted earlier, this was done with the intention of using instrumental variables techniques to control for any remaining simultaneity problems in the framework.[16] Pooling the data also allows us to use variations in cross-industry changes in import penetrations ratios as proxies for the reform dummies.[17]

[14] This parameter correspond to the capital price variable interacted with the liberalization dummy.
[15] Indeed, we indicate that Tunisian labour regulations allow firms to recruit by fixed term contracts and seasonal personnel, and to dismiss them without any indemnity at the end of their contract.
[16] While instrumental variables estimation is perhaps a more satisfactory approach, it proves a little less feasible in this context: other than lagged endogenous variables, we have no variable in the data set that we may regard as being exogenous. Estimating (10) using lagged variables as IVs resulted in highly insignificant (and sometimes meaningless) estimates of the parameters of interest. One option that presents itself then is the pooling of data across industries to use lagged variables as instruments. These results are presented in Table 5 and are discussed later along with other results from the pooled sample.
[17] We are should to note some caveats associated with pooling data across industries.

Table 5. Results of estimation using data pooled across industries

Regression 1 (Instrumental variable estimates with time dummy interactions		Regression 2 (Instrumental variable estimates with import penetration)	
δ_w	−0.634 (0.650)	δ_w	−0.711 (0.098)
$\Delta\delta_w$	−0.263 (0.178)	$\partial\delta_w/\partial(impp)$	−0.213 (0.014)

We start first with estimates of Equation 10 using pooled data and using lagged right-hand side variables as instruments (Regression 1). The IV estimates for the pooled sample gives us an elasticity that is not as precisely estimated (although the point estimate appears to be in a reasonable quantitative range) and again we cannot reject the null that the trade reform did not have any effect on the labour demand elasticity. The point estimate of change in elasticity is economically insignificant.

Regression 2 uses import penetration interactions (impp). The coefficient of the cross-product of *impp* and the log of wage gives us $\partial\delta_w/\partial(impp)$, the derivative of the labour demand elasticity with respect to the import-penetration ratio. The labour demand elasticity at zero import penetration, δ_w, is significantly estimated to be −0.711. The estimate for $\partial\delta_w/\partial(impp)$ is −0.213 and is significant at 1%. Surprisingly and counter-intuitively, the sign of this coefficient shows that higher imports are associated with higher magnitude of labour demand elasticities. In this regard, Haouas *et al*. (2002) find a positive effect of import on employment. They explain this result 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 import.

VII. Reconciliation with the Haouas *et al*. (2003) Results

The finding that greater trade openness did lead to significant labour demand elasticities in Tunisia at first thought seems consistent with Haouas *et al*.'s (2003) finding. In fact, if the two industries for which the null hypothesis of no elasticity change is rejected are chemical and textile, clothing and leather, this is no surprise. Haouas *et al*. (2003) find that chemical and textile, clothing and leather are the most inefficient in the use of labour.[18] This inefficiency can be explained by the extensive utilization of human capital. The technical infrastructure is used only partially. Less efficient industries would be expected to adjust faster (as they try to eliminate their inefficiency faster) than those most efficient. In other words, industries closer to the labour requirement frontier would be expected to have a lower speed of adjustment after liberalization than industries farther away from it.

Results from Haouas *et al*. (2003) indicate that chemical and textile, clothing and leather adjust faster during the liberalization period than other sectors.[19]

In fact the negative correlation between labour and capital price in chemical and mechanical electric industry industries after trade liberalization can be explained by the structural change favourable to branches that made intensive use of skilled worker and technology as opposed to sectors with intensive use of unskilled labour. Consequently, the number of production workers – a large category of workers in Tunisian industries – decreased, while skilled labour – a small category – increased. As Haouas *et al*. (2003) indicate, the production process in these sectors becomes capital intensive after trade liberalization.

VIII. Conclusions

In this paper, we have vigorously looked at how major trade reforms initiated in India in 1987 affected the industry-level elasticity of the labour demand in the manufacturing sector. Our analysis suggests that the putative linkages between greater trade openness and labour demand elesticities (as suggested by theories of the type we present in this paper) may be empirically quite weak: in the vast majority of industries considered separately; we are unable to find a statistically and economically significant relationship between these variables. The results are robust to the type of labour considered (contract labour and permanent labour). This non-responsiveness of labour demand elasticity in practice is perhaps explained by the tight labour market regulations in place during the 1987–1996 period. However, the results support the conclusion that during the liberalization period labour markets became more flexible, and that employers are able to recruit contracts worker in some sectors.

[18] For a given level of value added, chemical could be better of by reducing employment by 63.8% and textile by 59.8%.
[19] Employment adjustment is 23% in chemical industry and 6.1% in textile industry.

These findings have important implications for public policy and highlight some challenges for policy-making. Although our results suggest that tighter labour regulations can dampen change in labour elasticities, it is hard to believe that more widespread use of such regulations is the desirable policy response. Particularly in the context of Tunisia's growing integration with the international economy, allowing Tunisian firms to be exposed to import competition but constraining their ability to adjust their inputs in response is likely to put domestic firms at a serious disadvantage in terms of their ability to compete.

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