International Trade and Labour Demand Elasticities: Is there Any Empirical Evidence from South Africa?

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Abstract

There are various pathways through which the impact of trade openness may be transmitted to the labour market. This study explores a relatively new linkage identified by the literature: the impact on labour demand *elasticities* via a substitution effect through increased factor substitutability and/or via a scale effect brought about by an increase in product market elasticities. More elastic factor demands have adverse implications for labourers vis-à-vis employers. Using an industry-level panel dataset covering the South African manufacturing sector spanning a period of over three decades, I empirically test for this relationship focusing primarily on the substitution effect. I am able to find, at best, only limited empirical support for my hypothesis of a positive and significant impact of trade liberalisation on labour demand elasticities. Whilst demand for labour appears to have become more elastic for manufacturing overall and in one of ten sectors within manufacturing, this result fails to hold for any of the other industries examined.

1 Introduction

It is almost two decades now since 1994, when the new democratically elected government of South Africa adopted an outward-oriented trade strategy as part of its economic reform package. Important components of these reforms included extensive tariff reductions and other liberalisation measures, and policies such as Free Trade Agreements (FTAs), etc. The main objective of this liberalisation programme was to foster a competitive economic environment conducive

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to sustain a high economic growth. The alleviation of poverty and unemployment, as well as achieving a more equitable distribution of income, was high on the agenda. From inception, the government's Reconstruction and Development Programme (RDP) and Growth, Employment and Redistribution (GEAR) strategies looked towards trade liberalisation as a mechanism for such redress (Republic of South Africa (RSA), 1996).

The country's significant commitment to embrace a free trade policy and reap its benefits, however, also implied a readiness to deal with the challenges of trading within a globalised economy. While most traditional trade models[1] predict an improvement in aggregate welfare under conditions of free trade, greater openness generally also requires adjustments and sacrifices on the part of trading partners. Given South Africa's acute poverty and persistent employment problems among a significant size of the population (Altbeker and de Villiers, 2011; Pauw and Leibbrandt, 2012), there has always been interest and concern on the part of researchers and policy makers on the extent to which trade liberalisation may have contributed towards alleviating or accentuating these problems bedevilling the national economy. For example, has sustained growth been achieved through employment creation and increased labour earnings? Have relative changes in product prices fed through to factor markets, as is outlined within the Stolper-Samuelson theorem? Although several empirical analyses on the impact of trade liberalisation on these and other economic variables have been undertaken, there is still no consensus amongst researchers on the extent to which trade and/or other influences might have been responsible for the observed relationships (Edwards, 2006, Cattenneo, 2011).[2]

Despite trade flows having rapidly increased post-liberalisation, with output experiencing modest increases, employment in the manufacturing sector during this period had actually declined (Barker, 2007). With production shifting towards capital-and-skill intensive sectors, the negative impact on unemployment has been particularly strong among semi-skilled and unskilled workers. In contradistinction, there has been a consistent rise in the wages of unskilled workers relative to skilled labour (Cassim et.al, 2004). Whilst these dynamics may be attributable to labour legislation, technological change and/or other labour market forces, it does pose a challenge of trying to identify whether trade liberalisation has had any influence on these changes. Within the context of the debate on the relative impact of trade versus technology on labour markets,[3] earlier studies by Fedderke (2001) and Edwards (2001) have indicated that skilled-biased technological change was responsible for (only) *some* of the losses in employment in South Africa. But even if technology can be proven to be unambiguously responsible for these labour market pressures, trade itself

[1] See Rangasamy (2003) for a review of the new trade theories, which no longer indicate the unambiguous optimality of free trade.

[2] See Edwards (2004, 2006) and Catteneo (2011) for some of the reasons for this divergence of opinion.

[3] The debate even within the international context, particularly on wage inequality, is far from over. See Cline (1999) for a critique of the issue and a survey of the various empirical studies undertaken).

may have acted as the conduit for such technical change. Subsequent research undertaken by Edwards and Behar (2006), Dunne and Edwards (2006), Bhorat et.al (2010), Chinembiri (2010) and more recently, Cattaneo (2011), Fedderke et.al (2011), Kucera and Roncolato (2011) and Smet (2011), have all attempted to disentangle the impact of these forces and a range of other factors impacting on labour demand and employment patterns. Despite their improved findings in some respects, the results are varied and no still broad consensus emerges; several of these analyses are constrained by data and other methodological limitations, a point also emphasised by Bhorat et.al (2010) and Cattaneo (2011).

Could there be any other channels then, through which trade might exert pressure on labour markets, which hitherto have not been considered and which could provide for an alternative approach to unravelling some of these puzzles? A careful examination of most studies conducted within the labour market context (in South Africa) thus far reveals that the primary focus of most of the research has appropriately (but only) been on the *direct* impact of trade on employment and wages. Consequently, they have examined the impact of trade on product prices and, via the Stolper-Samuelson theorem particularly, its resultant effect on factor prices. A second limiting implication of analysing labour market changes via this channel is that pressure on wages can only come from trade with countries that have different relative factor endowments.

This study explores another linkage between openness and labour demand which, as yet, has not been explored within the South African context: the impact of increased trade on the *elasticities* of the demand for labour; a relatively new aspect first emphasised by Rodrik (1997). He argues that one of the reasons why trade economists discount the (negative) effects of trade on factor markets is that the (predominant) mechanism through which its impact is empirically tested is through product prices. And if one considers that the bulk of developed countries' trade is with each other, then given the fact that they have similar factor endowments, the standard approach (vis-à-vis Hecksher-Ohlin) is unlikely to reveal that trade will have any bearing on factor prices. Rodrik goes on to prove, intuitively at least, that the main impact of economic integration on labour markets is more likely to be on elasticities rather than on prices. The consequences of more-elastic factor demands are then shown to lead to negative outcomes, especially for workers.

The two main channels through which trade can make demand more elastic was subsequently elaborated upon by Slaughter (1997). The first corresponds to the substitution effect: trade openness allows for increased substitution possibilities between domestic labour services and foreign factors of production[4], whilst the second is the scale effect: trade liberalisation leads to the greater availability of substitutes for many products which, through Hicks-Marshallian laws of factor demand, increases the sensitivity of factor demands.

The above arguments are intuitively appealing.[5] But do they have any the-

[4] This occurs directly and indirectly via factor and good markets' prices, respectively (see 2.2. below), but also through greater resource mobility, e.g. labour migration across borders.

[5] Panagariya (1999) contends that these arguments can be made only in a partial equilibrium model. See 2.2. below for his additional critique on Rodrik's propositions.

oretical underpinnings and have they been empirically tested and proven? This study explores these issues and reviews several of the international studies undertaken thus far. Whilst the vast majority of empirical literature has mainly a developed country focus, the possible linkage between trade and labour demand elasticities needs to be more thoroughly analysed within the context of developing countries (Haouas and Yagoubi, 2003). This research paper takes a step in that direction. Its key focus is to investigate empirically, this relationship between international trade and labour markets in South Africa. To the best of my knowledge, this paper is the first to undertake this kind of analysis within the South African context.

The rest of the paper is organised as follows. Section Two first provides the theoretical framework for the derivation of labour demand elasticities and then proceeds to show how trade openness can potentially impact on them. A succinct review of the several international studies in this regard is thereafter undertaken. In Section Four, I specify the model to be estimated in my study and elaborate on the data used for this purpose. The empirical methodology employed and estimation issues are then examined. Section Five presents and discusses the results from the regression analysis. The last section concludes and highlights important implications for further studies in this regard.

2 Theoretical Framework

2.1 *Key Determinants of Labour Demand Elasticities and its Economic Significance*

Given that the demand for labour is a derived demand, on the basis of the Hicks-Marshallian rules of derived demand, Allen (1938) and Hamermesh (1993), assuming perfect competition and constant returns to scale, summarise the price elasticity of labour demand, η_{LL}, in the following relation:

$$\eta_{LL} = -[1-s]\sigma - s\eta, \tag{1}$$

where $s = w$ L/Y, the share of labour in total revenue, σ is the constant-output elasticity of substitution between labour and other factors of production, and η Is the product-demand elasticity for the firm's output market. The variables *s,* σ and η are all de?ned to be positive, so that η_{LL} is negative. The above equation consists of two important components reflective of the Hicks-Marshallian laws of factor demand. The first part,$-[1-s]\sigma$, captures the "substitution effect" whilst the second, $s\eta$, encapsulates the "scale/output effect". As Hamermesh (1993) explains, when labour's share in production, s, is high, η_{LL} is smaller (less negative) for a given technology, σ, since there is relatively less capital toward which to substitute when the wage increases. The ease of this substitution is also likely to be constrained by institutional factors such as union work rules and other factor market rigidities. Conversely, as technology changes over time, input substitutability may increase thereby leading to higher demand elasticities in the long run (Marshall et al., 1976).

Because the demand for labour is a derived demand, its elasticity is also impacted upon by the elasticity of demand for labour's output (Hicks, 1963). An increase in the wage rate causes an increase in the cost of producing a given output, and in competitive product markets firms will increase their product prices in order to maintain profit margins. If the demand for the product is very elastic, the result of this price increase will be a large decrease in the quantity of the product demanded, and consequently, a relatively large decrease in the demand for labour. This "scale/output effect", $s\eta$, is thus the factor's share times the product demand elasticity, which, together with the "substitution effect" gives the total demand elasticity for labour, constituting what Hamermesh (1993: 24) describes as "the fundamental law of factor demand".[6] When wages increase, both the substitution and scale effects reduce labour demand; firms substitute away from labour towards other factors, and as costs increase less output is produced such that fewer of all factors are demanded. Thus $\eta_{LL} < 0$: labour demand slopes downwards (Slaughter, 1997).

The elasticity of labour demand and its implications for workers is one of the most important concepts in the field of labour economics. Rodrik (1997) elaborates on three fundamental ways in which more-elastic factor demands can have negative implications for labour. Firstly, with an increase in the elasticity of demand for labour, a negative external shock to the labour market would induce more volatile responses in wages and employment than would otherwise be the case with an inelastic labour demand curve. Clearly, with a more elastic labour demand, workers are placed in a vulnerable position leading to fears of job insecurity, a rise in wage inequality and the concomitant tensions between the different sectors of society.

Secondly, higher elasticities also mean that the costs of implementing minimum labour standards (as insisted upon by the developed countries in the World Trade Organization (WTO) negotiations) would have to be borne primarily by workers, again in terms of both lower wages and decreased employment. In other words, employers are more easily able to shift or transfer the burden of the costs of higher labour standards and benefits on to workers themselves. The third important implication of increased labour demand elasticities, it can be shown, is that the bargaining power and negotiation strategies of labour unions are seriously undermined. Consequently, the ability of unions to bargain with employers on various aspects of the employment relationship is weakened. Not surprisingly, following their economic liberalisation, labour unions in several European and African countries have experienced declining membership and are finding themselves in a situation of survival rather than growth and influence (Schillinger, 2005, Nepgen, 2008).

South Africa has often been cited as an exception to this trend of diminishing labour union influence post trade-reform (Whiteley, 2001; Orr, 2004) by virtue of the labour movement's ability to continue to attract union membership. However, its strength derives predominantly from the important role that

[6] The same relation is also obtainable if one uses cost functions instead of production functions, as derived by Dixit (1990), who minimizes total costs instead of maximizing profits.

the trade unions played in the political transformation process and their subsequent alliance to the ruling ANC led government. With the persistent strong tensions that seem to characterise the alliance on some key economic issues e.g. privatisation, etc., it remains to be seen for how much longer the trade unions would be able to maintain their influential position in the various bargaining forums.

2.2 *Impact of Trade Openness on Elasticities*

Since the elasticity of labour demand depends both, on the scale effect $-s\eta$ and the substitution effect$-[1-s]\sigma$, it would be instructive to consider how trade impacts upon η'_{LL} through each of these two channels.

Most trade models, of both the neoclassical and the new trade theories, predict that a country's product markets would become more competitive with trade. Heightened competition increases consumers' ability to switch to alternative substitutes, making each firm's product demand curve more sensitive to the price it charges. Different models predict different magnitudes for η (Slaughter, 1997). In terms of the Heckscher-Ohlin neoclassical framework, the Factor Price Equalisation asserts that under conditions of perfect competition[7] η would be infinitely elastic and hence an infinitely elastic η'_{LL}, that is, trade would transform the "local labour demand curve into a global labour demand curve" (Leamer, 1995: 5). A similar result obtains in monopolistically-competitive industries when consumers who value product variety are likely, post-liberalisation, to switch some of their preferences for foreign varieties, triggering increases in η and consequently η'_{LL} (Slaughter, 1997).

Within a general equilibrium context, Leamer (1995), Wood (1995) and Panagariya (1999) also consider the impact of trade on labour demand elasticities (Mirza and Pisu, 2009). Whilst Leamer and Wood both demonstrate the positive impact of trade on elasticity values, Panagariya contends that such a conclusion is reached only under rather restrictive and unrealistic assumptions, and that, therefore, it need not necessarily hold. He also illustrates the possibility of a locally horizontal labour demand curve even in a closed economy, and under certain conditions, where the labour demand can be more elastic in a closed economy than in an open one. Conversely, it could be countered that Panagariya's assertions are also predicated upon exceptional circumstances (Mahomedy, 2008). Furthermore, Sen (2003) asserts that Panagariya's criticisms arise from a failure on his part to distinguish between an individual firm's labour demand and that of the national demand for labour.

The second mechanism through which international trade could increase labour demand elasticities is through the elasticity of substitution, σ, between labour and other factors. The pass-through from σ to η'_{LL} occurs directly through foreign direct investments (FDIs) by multinational enterprises (MNEs) and indirectly through the incentive to outsource (Riihimäki, 2005). Several

[7] Several new theoretical models of trade, which, even when they incorporate conditions of imperfect competition, also predict that trade liberalisation will make factor demands more elastic (Helpman and Krugman, 1989).

studies (Faini et al., 1998; Helpman, 1984) have demonstrated that when firms have greater access to foreign factors of production it enables them to become multinational by increasing their ability to decentralise production across geographic boundaries. Furthermore, with the removal of exchange controls and the consequent increase in capital mobility, any negative shock at home may induce firms to "pack up and leave for safer territory". In the South African clothing industry for example, certain large clothing enterprises have, post trade-liberalisation, relocated some of their low-value added production activities to foreign affiliates in Malawi, Botswana, etc.[8]

The second (albeit indirect) transmission channel through which trade openness can cause an increase in η'_{LL} is through outsourcing, i.e. the import of intermediate inputs by domestic firms. One of the features of globalisation is the fragmentation of production into discrete activities, whereby industries become vertically integrated into a number of production stages (Feenstra and Hanson, 1997). With international trade, firms can then "move abroad" by purchasing the output of certain stages from foreign enterprises. The archetypal example of this phenomenon in the South African context is that of the motor industry, which imports almost all of its component parts from parent firms based in Japan, Germany and the United States, and then uses local assembly plants to produce the finished product.[9] Similarly, over the past ten years many of the large retail clothing outlets in South Africa have opted to produce much of their merchandise as far afield as China. Several studies (e.g. Feenstra and Hanson, 1997) have shown that this form of outsourcing has contributed substantially to changes in the relative demand for certain types of labour and its consequent impact on wage shares.

To summarise then, international trade can, in theory at least, increase the elasticity of demand for domestic labour by increasing η (the scale effect) and/or σ (the substitution effect).

3 Review of Empirical Literature

Subsequent to Rodrik's (1997) emphasis on the potential impact of trade openness for factor demand elasticities, a growing body of the literature in international trade has tried to investigate this relationship. Various empirical analyses have been conducted, both within developed and developing country contexts, to test the hypothesis that greater openness increases labour demand elasticities. Since 1997, at least fifteen country studies have been reported in the literature.

The first systematic and rigorous empirical investigation of the hypothesised effect of trade on labour demand elasticities is that of Slaughter (1997). Using industry-level data for the United States he found that the demand for production labour became more elastic in manufacturing overall and in five of the

[8] See also, Van der Westhuizen (2007).

[9] Conversely, it could also be argued that outsourcing acts as a complement, rather than a substitute, to home country employment: See for example Faini et al. (1998), Slaughter (1995).

eight industries, whilst he detected no such trend for non-production labour. Drawing partly on Slaughter's approach, but using data from Italian industries, Faini et al. (1998), also found some support for the hypothesis that increased globalisation leads to larger elasticity values and consequently placed workers and unions in a weaker bargaining position. Adopting slightly different estimating techniques, Fabbri et.al (2002) and Mirza and Pisu (2009) were also able to demonstrate an increase in elasticities for United Kingdom firms operating within an internationally competitive global environment when compared to more domestically-oriented industries. In a somewhat different framework to that of the Allen-Hamermesh model, Jean (2000) found that trade openness has had a significant impact on labour demand elasticities for most industries in France. Later, Tcherkachine (2003) and Akhmedov et al., (2005) investigated the specific impact of Russia's trade liberalisation on labour demand. Both studies had found that elasticities had increased following greater exposure to foreign trade. Lastly, Hasan et al. (2007) also observed the positive impact of trade liberalisation on labour demand elasticities in the Indian manufacturing sector. They discovered that trade reforms not only impacted on these elasticities but also on wage and employment volatility, as predicted by trade-labour theory.

Whilst the above-mentioned studies tend to indicate an undeniable link between trade openness and labour demand elasticities, a different pattern begins to emerge when we examine similar studies conducted for less industrialised or developing countries. Various empirical analyses testing for this putative link in other economies, e.g. Brazil (Barros et al., 1999), Peru (Saavedra and Torero, 2000), Turkey (Krishna et al., 2001), Tunisia (Haouas and Yagoubi, 2003), Uruguay (Cassoni et al., 2004), Chile, Colombia, and Mexico (Fajnzylber and Maloney, 2005) and Pakistan (Akhter and Ali, 2007), have found only mixed and, in many cases, no evidence at all of any significant relationship. Cassoni et. al (2004) in particular, discovered, contrary to expectations, that an increase in sectorial trade actually led to a decrease in total own-wage elasticities.

The preceding synopsis thus illustrates that whilst the putative link between trade openness and factor demand elasticities has been observed in some of the larger, more industrialised countries this relationship has only weakly, if at all, been empirically established among the smaller, developing economies.[10]

Clearly, South Africa shares in many ways an economic architecture similar to most of its counterparts in the developing world with respect to the opportunities and challenges[11] of trade reform. If trade openness has not had any discernible empirical impact on labour demand elasticities per se for most of the smaller emerging economies, might the same hold for South Africa? Not

[10] See Mahomedy (2008) for a more detailed critique of the various studies undertaken in this regard.

[11] For example, despite their abundance of natural resources and labour, and the huge untapped potential for market and infrastructural development, developing countries continue to face the challenges of rural underdevelopment, low technology, high unemployment and poverty.

necessarily. Although cross-country studies are helpful in many ways, the considerable heterogeneity among these countries does not warrant any firm conclusions or any universal policy responses. The rest of the article consequently undertakes to test for this specific relationship between trade and labour for the domestic economy.

4 Empirical Methodology

4.1 *Model Specification and Data*

Various functional forms have been used in the literature to estimate labour demand elasticities, depending on the parameters of interest that researchers wished to estimate, the availability of data and suitability of estimation techniques.[12] One could, therefore, expect the estimates obtained to be particularly sensitive to the underlying assumptions of the alternative model structures. In an excellent study by Clark and Freeman (1980), they illustrate how the unrealistic but common imposition of certain constraints on various empirical 'experiments' could also lead to poor results, and that consequently, studies need to pay greater attention to appropriate empirical specifications.[13]

As Hamermesh (1993) shows, factor demand equations can be derived either from production or cost functions. But the one-to one correspondence between them can also be used quite effectively for the empirical implementation of theory. In view of these considerations I set up a model which will form the basis of my empirical analysis, and though simple, will enable me to capture the effects of trade liberalisation on labour demand elasticities.

Assume the existence of a representative firm for each sector of the economy. The firm's production function describes the use of the two inputs to the production process, labour L and capital K, for producing output Y. The remuneration for L and K are w, the wage rate and r, the user cost of capital, respectively. The firm faces exogenous prices for these factor inputs in perfectly competitive markets.[14] To maximise profits, the firm must produce its output at the lowest possible cost, which is assumed to be the sum of each input multiplied by its factor price i.e.

$$C = wL + rK. \tag{2}$$

If the firm's production function is characterised by a constant returns to scale technology constraint, then following standard methodology in this literature,

[12] See Hamermesh (1993) for an encyclopaedic survey of most of these studies.

[13] See also Edwards (2004) for a more recent critique of the implications of using specific production functions within the context of trade related studies.

[14] Given the labour market rigidity in South Africa, this assumption may not appear to be entirely valid. Notwithstanding this, even under conditions of imperfect competition, factor demands are predicted to become more elastic post trade liberalisation (Helpman and Krugman, 1989). On the practical side, the government has also recognised the need for labour reform and to find innovative ways to implement this (African National Congress (ANC), 2005).

the cost function can be denoted

$$C = c(w, r)\,Y\ ,\ C_i > 0,\ C_{ij} > 0,\ i, j = w, r. \tag{3}$$

Applying Shepherd's lemma and differentiating, the firm's factor demands can be derived directly from the cost function (3) above, as

$$L* = C_w, \tag{4}$$

and

$$K* = C_r. \tag{5}$$

If we take the ratio of these two conditional factor demands then

$$\frac{L*}{K*} = \frac{C_w}{C_r}, \tag{6}$$

and as Hamermesh (1993) rightly points out, one would intuitively expect the firm to use inputs in ratios equal to their marginal impact on costs.

More specifically then, (3) can be expressed as

$$L* = Y\frac{\partial c(w, r)}{\partial w}, \tag{7}$$

which, if rewritten in logarithmic form and linearised, will yield the following labour demand equation

$$\ln L = \beta_1 + \beta_2 \ln w + \beta_3 \ln r + \beta_4 \ln Y. \tag{8}$$

Form (8) then establishes the basis of my estimating equation.

The data used in this study has been constructed primarily from Quantec's EasyData[15] database, and the South African Reserve Bank (SARB) Quarterly Bulletin Time Series Data Set. I have extracted data for the 28 manufacturing industries at the 3-digit SIC level. The data is annual and spans the period 1970 to 2003[16], implying 34 observations per industry. These industries are then also pooled into ten different sectors (see Table 1). The Centre for the Study of African Economies (CSAE), part of Oxford University's Department of Economics[17], was also used as a data source to provide an additional openness/trade liberalisation indicator (see Table 1).

[15] There are, however, some concerns and controversy about the reliability of the South African Statistical series, in particular, that the employment data are manipulated to ensure consistency with those of Statistics SA and the national accounts.

[16] One of the reasons for not extending the data set beyond 2003, say up to 2010/2011, is that the method of collecting the employment data (by Quantec) during the early 2000s changed (e.g. the Standard Employment and Earnings series changed to the Quarterly Employment Series). Thus, using data beyond the early period would have resulted in distinct breaks in the employment series leading to errors in the employment series and thereby biasing estimates of the wage elasticity.

[17] Further information on the Centre can be found on CSAE's web-site at http://www.csae.ox.ac.uk/.

The variables required for the estimation of labour demand equations generally, and in particular for this study, are measures of employment, real wages, industry output, real factor prices other than wages (e.g. the user cost of capital), and indicators reflecting the degree of trade openness. Employment figures indicate the number of paid workers, and include both casual and seasonal employees.[18] Wages are defined as average annual remuneration (amount of money received) per employee. Although the inclusion of a measure for the user cost of capital in labour demand studies has been somewhat problematic and contentious (Hamermesh, 1981; Clark and Freeman, 1980; Krishna et al., 2001), I have included it in this study. The real prime overdraft interest rate charged by commercial banks to their clients was used as the user cost of capital.

I have captured the effect of trade liberalisation in two ways. As described earlier, South Africa firmly committed itself to adopting an open-oriented economy upon its membership of the WTO in 1995. I thus use a liberalisation dummy that takes the value of 0 up to 1994 and 1 thereafter. I have also used an alternative indicator for trade openness obtained from CSAE. The indicator was derived using a model first adopted by Aron and Muellbauer (2002) and incorporates the effects of surcharges, tariffs, quotas, and sanctions. The model also captures certain demand side influences such as the growth rate of gross domestic product (GDP), the exchange rate and a lag in the terms-of-trade.

4.2 *Empirical Specification and Econometric Issues*

The econometric model is based on equation (8) derived in the previous section. Following the notation of Hassan et al. (2007), let N be the number of sectors and T the number of time periods for which the $i.th$ sector is observed, I=1, ..., N . Thus, the empirical baseline equation is as follows

$$\ln L_{it} = \sum_f \beta_f \ln f_{it} + \beta_Y \ln Y_{it} + \beta_{TP} TP_{it} + \sum_f \beta_{fTP} (\ln f_{it}) TP_{it} + \mu_i + \varepsilon_{it}. \quad (9)$$

Equation (9) is, however, static in nature and does not incorporate labour adjustment costs. To allow for this dynamic relationship, I include into the baseline equation the presence of a lagged dependent variable among the regressors:

$$\ln L_{it} = \lambda \ln L_{it-1} + \sum_f \beta_f \ln f_{it} + \beta_Y \ln Y_{it} + \beta_{TP} TP_{it} + \sum_f \beta_{fTP} (\ln f_{it}) TP_{it} + \mu_i + \varepsilon_{it}. \quad (10)$$

where L denotes the employment of workers in industry i and year t,f represents factor prices (w, wages; r, the user cost of capital), and Y, industry output. TP stands for trade policy and varies over time. The effect of a change in trade policy on labour demand elasticity is captured by the coefficient of the

[18] Although it was possible to disaggregate employment by skill level, there was no point in doing so since I was not able to obtain a breakdown of other variables such as labour remuneration by skill as well. Had this been possible, it would have enriched the results of the study significantly.

interaction term involving w and TP. I accommodate sector heterogeneity by allowing μi to vary across sectors, and εit is a white-noise error term.

There are several specification issues relevant to estimating equation (10) above. The first concern is the problem of identification. Ideally, the production or cost functions ought to be embedded within a model characterised by a complete system of labour demand *and* labour supply relations. Due to the unavailability of suitable data describing workers' supply behaviour, the identifying assumption made in this study is that labour supplies at the industry level is perfectly elastic. Consequently, wages are treated as exogenous.

How plausible is the above assumption? As Hamermesh (1993) contends, the appropriateness of this assumption rests on the degree of disaggregation of the data.[19] Since our study uses employment data that is fairly disaggregated, i.e. at the industry level, it might be argued that (these) industries are "closer" to firms (which usually face perfectly elastic labour supplies) than the entire economy (whose labour supply is perfectly inelastic)[20]. Additionally, a further mitigating factor for the validity of this assumption is that as long as the industry is small relative to the whole economy, the elasticity of labour supply can be treated as infinite (Gibson and Patabendige, 2001). In our data, the largest industry in terms of employment is "Food" (with approximately 207,000 employees). Since this represents less than 2.5% of total (formal sector) employment in South Africa our assumption of an infinitely elastic labour supply should be fairly reasonable in this context.

The second specification issue is that relegating industry effects, μ_i, to the error term and estimating labour demand functions by OLS is likely to lead to inconsistent estimates. This is because $\ln L_{it}$ is a function of μ_i and consequently, the lagged value of the dependent variable, $\ln L_{it-1}$, will also be a function of μ_i. As Wooldridge (2002) explains, whenever the explanatory variables (in panel data analysis) are not independent of the error term, this would lead to biased estimates. Although a common solution to correct for this problem is to employ the fixed effects estimator, this may not necessarily remove the bias (Kennedy, 2003)[21]. There are yet others such as Attanasio et.al (2000) who assert that if T is greater than 30, as in our case, the greater precision of the fixed effects estimator (compared to the IV and GMM estimators (see below)) more than offsets the bias it creates. Additionally, Judson and Owen (1996) have also shown through Monte Carlo experiments that apart from the lagged dependent variable, the bias of the coefficient on the other right-hand-side variables may be small for the fixed effects estimator. Since it is these other variables that are of primary concern, it will be useful to present these estimates using the fixed effects model nonetheless.

An alternative approach to obtain consistent and efficient estimates is to use the generalised method of moments (GMM) IV estimator suggested by Arellano and Bond (1991). This estimator essentially involves two steps: first, carrying out a first differencing transformation of equation (10) in order to eliminate the

[19] In fact, he also asserts that the problem of identification in many instances can be ignored.
[20] See also Slaughter (2001) for a more detailed critique of this assumption.
[21] He also illustrates why the random effects estimator will to lead to even larger biases.

individual industry effects (the heterogeneity) and hence remove the correlation between μ_i and $\ln L_{it-1}$ (and other right-hand-side variables); and second, finding a suitable instrument to apply IV estimation, i.e. finding a variable that is correlated with the first differenced lagged value of the employment term, $\ln L_{it-1} - \ln L_{it-2}$ (since it is correlated with the first differenced error term, $\varepsilon_{it} - \varepsilon_{it-1}$), but uncorrelated at the same time with the differenced error term. As long as the error terms, ε_{it}, are not serially correlated, an obvious choice of an instrument for $\Delta \ln L_{it-1}$ is $\ln L_{it-2}$, as suggested by Anderson and Hsiao (1981).

Due to the relatively attractive asymptotic properties of the above estimator compared to others in its class,[22] various studies in this context (e.g. Fajnzylber and Maloney, 2005; Bruno et. al, 2004) have adopted it, and reported fairly robust results. Consequently, I also carry out an estimation of the labour demand equation using the one-step GMM estimator of Arellano and Bond.[23] Since the validity of the instrument selected depends on the absence of serial correlation, the test of autocorrelation as derived by Arellano and Bond also needs to be executed (StataCorp, 2003).

The choice of the data set raises an additional specification issue: measurement error. How serious is this problem? Although the data set, as outlined previously, has been collated and reconciled from various sources, a *potential* source of measurement error could come from the wage rate variable used as a proxy for labour costs. The problem arises because in calculating remuneration of employees, non-wage labour costs (such as employer payments towards worker fringe benefits, etc.) need to be included in order to obtain a true marginal factor price. And it appears (through information obtained from the source) that these costs have not been factored into the wage variable.

One way of alleviating this problem somewhat, as suggested by the literature in this context (Griliches and Hausman, 1986), is to take long time differences of the underlying data.[24] Accordingly, I also provide estimates of equation (9) using OLS applied to five-year differences. Given that the data set spans a period of 34 years this ought not to affect the results qualitatively to any significant extent. Another advantage of differencing the data over a relatively long period is that firms are then effectively allowed considerable time to make adjustments to a given shock to their optimal levels of employment (Hasan et. al, 2007). Consequently, this also obviates the need to include the lagged employment term, the source of the potential bias in my previous estimating equation (10).

Finally, as in many other studies of this kind, the concern about bias introduced by the endogeneity of the right-hand-side variables is often expressed (see for example, Cardenas and Bernal, 2003; Krishna et. al, 2001). However, there are various factors that help to assuage this concern. As Hasan et. al (2007: 21) explain, the usage of estimators that control for industry specific effects by

[22] For example, the standard LSDV and AH estimators.

[23] Although the two-step procedure may also be used, making inferences on the basis of these estimates obtained have to be treated with caution in some cases (Arellano and Bond, 1991: 291).

[24] See also Dunne and Roberts (1993) and Slaughter (2001).

means of a "within" transformation and/or time differencing, etc., should "take care of the bulk of the problem associated with (the) endogeneity" issue. Likewise, with regard to the endogeneity of output more specifically, since output is simultaneously determined with labour, Slaughter (2001) explains why they are only weakly correlated, citing as evidence the study by Quandt and Rosen (1989: 400). In the latter's study, they found that the assumption of output exogeneity could not be rejected and that it is "likely to produce results that are just as good as those generated by the more theoretically attractive assumption of endogeneity". Lastly, since this study aims to establish whether a change in trade policy has impacted on labour demand elasticities per se, even if there is some remaining bias in the estimates there is no reason to expect the bias in the estimates to be significantly different in one regime (pre- or post-liberalisation) than the other (Krishna et. al, 2001).

5 Estimation Results and Analysis

I first report and analyse the estimates obtained by pooling data across all ten industrial categories, yielding estimates for the manufacturing sector overall. I then consider and examine results obtained when I allow coefficients of the own factor price and output terms to vary across industries and I report on these.

5.1 *Results Using Data Pooled Across Sectors*

The estimated labour demand equations for the full sample across all sectors are presented in Table 2 below. Below the coefficients the standard errors are shown in parentheses. The diagnostics tests results for the GMM-IV model, as suggested by Arellano and Bond (1991), reject the null hypothesis of second-order serial correlation in the residuals.[25] With few exceptions, the estimated coefficients (sign and magnitude) are generally consistent across all specifications and are in most cases highly significant, even with White robust standard errors (used in the five-year differenced model). See Table 2.

The pre-reform labour demand elasticities (the coefficients of the log wage term), with one exception, have the expected signs in all the models estimated (see row 1 of Table 2), whether we use the post-reform dummy (columns 1, 3 and 5) or the index of openness variable (columns 2, 4 and 6). This is in line with theoretical priors of a negative relationship between employment and wages. How do we then account for the positive sign on the log of the wage term in the fixed effects model, when we use the index of openness trade liberalisation indicator? As explained in section 4.1, the index of openness variable also incorporates quite significantly, demand side factors such as GDP growth rate, terms of trade and economic performance of the country during our period of study. The index thus also captures effects other than just trade openness

[25] With regressions in first differences, first-order serial correlation is to be expected by construction and hence the relevant test is that of second-order serial correlation (Fajnzylber and Maloney, 2005).

and a more open trade policy. Given that both employment and real wages increased for most of the period under study (Barker, 2007), and the potential endogeneity problem afflicting the fixed-effects model within this context (as referred to earlier),[26] this could be a possible reason for the positive relationship noted in this specification. To confirm this, when the GMM-IV or the five-year differenced model is estimated with the same index, the coefficient turns up with the correctly hypothesised sign (columns 4 and 6), though they are statistically insignificant at the conventional levels.

It is also noteworthy that the estimated elasticities (post-liberalisation) across the methodologies yield an average of -0.19 – that lies within the range of [-0.15, -0.75] that Hamermesh (1993:95) proposes as credible based on his literature survey.[27] One plausible explanation for our relatively low elasticity value is that these are short-run estimates. Given that labour markets in South Africa are tightly regulated in favour of workers and the rights that they enjoy vis-à-vis retrenchments and dismissals (e.g. minimum notice periods), etc., employers are fairly restricted in their responses (in the short run) to given shocks. With time, however, employers would have greater flexibility to adjust employment levels, and one could then expect these elasticities values to rise in the medium to long run. To be sure, I then calculate the long-run wage elasticity values by adjusting the (short-run) wage coefficient using the coefficient on the lagged dependent variable (λ), which represents an (inverse) measure of the speed of adjustment. Without exception, all estimates now show a marked increase in wage elasticity values (in absolute terms) for the long run. This result holds for both the pre- and post-reform periods.

Next, the user cost of capital appears to have a negative impact on the demand for labour in four of the six specifications estimated, and quite (statistically) significantly so in the GMM-IV approach. Although the estimates for the five-year differenced model turn out to be positive, neither of them is significant at the 1% level of significance.[28] A probable explanation for this negative relationship (i.e. as the price of capital increases the demand for labour decreases) is that as the price of capital increases, firms cut back on production and hence demand less labour. This, quite importantly, suggests that labour and capital are sometimes, within certain thresholds, likely to serve as complements in the production processes rather than as substitutes. This conclusion also helps to dispel the commonly held notion that capital formation necessarily leads to a reduction in the demand for labour.

The estimated coefficients on the log of output all have the correctly predicted sign in line with our priors, and are statistically significant at all conventional levels. Although their magnitudes seem to be somewhat sensitive to the

[26] See also Hallak and Levinsohn (2004) for a more detailed discussion of this issue.

[27] If we include the (one) implausible positive estimate into our calculations, which I have excluded due to the endogeneity problem, our average increases to -0.14 which is just outside of the international norm.

[28] Additionally, this negative cross price elasticity (of labour demand) finds support in earlier studies (e.g. Fedderke and Mariotti, 2002) of the South African labour market, but conducted within a different context.

estimation strategy used, their positive signs clearly indicate that an increase in output increases the level of derived labour demand, and consequently, could counter the claim of jobless growth in the manufacturing sector in South Africa.

Most importantly, we turn to our parameter of particular interest, i.e. the parameter that captures the impact of trade liberalisation on labour demand elasticities. As described in Section 2.2, a more liberal trade policy may be expected to raise the labour demand elasticity by increasing substitution possibilities among factor inputs and making product demand more elastic. We now examine the evidence for this possibility.

The relevant parameter that we therefore consider corresponds to the wage variable interacted with the trade liberalisation indicators – *lnwPost94* and *lnwIdxop*. Based on our estimating equation (10) the elasticity in year t in industry i is just $\beta_f + \beta_{TP} TradePolicy_{it}$.[29] We begin by considering the fixed effects (FE) estimates. The labour-demand elasticity is found to increase (in absolute value) in the post-1994 period. This can noted from the negative and significant coefficient of the interactive term (column 1). Although the interactive term in column 2 is also negative and significant, because the pre-reform elasticity coefficient turned out positive (see above) this might be interpreted as a decline in the labour demand elasticity value. However, as explained previously, the FE estimates do suffer from potential endogeneity bias and we therefore turn to the other two sets of parameter estimates that deal with this problem.

Both sets of estimates preserve the first result that trade liberalisation has made labour demand more elastic. Thus we find that in the GMM-IV model and the five year differences model, the elasticity values (in absolute terms) again increase when we use the post-1994 dummy indicator (columns 3 and 5), and even when we switch to the index of openness trade liberalisation indicator. It is also noteworthy that across all specifications these parameter estimates are quite tightly estimated, and in most cases are statistically significant at the 1% level of significance. Given the above, one is therefore inclined to conclude fairly confidently that the demand for labour, in the aggregate at least, has become more elastic with an increase in international trade.

At the same time however, one has to admit that in most cases, especially in our preferred specification, i.e. the GMM-IV model, the change in elasticity is small in magnitude, indicating that it is *economically* insignificant. But more importantly, there are also some caveats associated with the pooling of data across sectors. As pointed out by Krishna et. al (2001), by pooling data the implicit assumption is that all industries respond to the same extent in magnitude if the degree to which openness increased was similar across sectors.[30] Given that labour demand elasticities depend on both production technologies and product demand elasticities there are no a priori reasons to expect them to be similar across industries. Consequently, if labour demand elasticities differ across sectors, imposing common coefficients in a pooled regression raises the

[29] I could not include own terms for the liberalisation indicators due to the high level of collinearity between them and the interactive terms.

[30] See also Fedderke, et al. (2011) and Section 6 below for a further explication of this point.

problem of biased estimates (Greene, 1993).

To address these valid concerns, we therefore turn to our next set of results: regression estimates that allow for elasticities to vary across industrial sectors, to evaluate whether the results obtained for the aggregate continue to hold at the sectorial level.

5.2 *Estimation Results by Industrial Sectors*

This section estimates labour demand equations with data disaggregated by ten common industrial categories, using the same econometric techniques that were utilised for the pooled data analysis. The results are presented in Tables 3 to 5.

First, in the fixed effects model (Table 3), the pre-reform individual industry labour demand elasticities (column 2) using the postreform dummy range between 0.31 and -0.51, with a mean of 0.47. When I use the index of openness indicator, the coefficient values of the log wage term (column 7) range from 0.54 to -0.28, with a mean of 0.16. Additionally, it is noticeable that most of the estimates across both specifications turned out positive. This is in contrast with the predictions of theory. Whilst some positive elasticity values at the sectorial level have also been reported in other country studies,[31] and even in studies within the domestic context (Bhorat and Leibbrandt, 1998), their preponderance in this set is probably due to the endogeneity problem afflicting the FE model alluded to earlier.

We therefore turn to our preferred GMM-IV and five-year differenced models (see Tables 4 and 5, respectively) to test for the hypothesised negative relationship between the wage rate and quantity of labour demanded. The (labour demand) estimates are reported in columns 2 and 8 of Table 4 and columns 1 and 5 of Table 5, respectively. Across the various specifications, on average, the vast majority of the elasticity estimates are now negatively signed as expected (although not *all* of them are estimated very precisely). And of the positive estimates, most are not statistically significantly different from zero at the conventional 5% level of significance. We thus find that there is a remarkable improvement in the estimation of these elasticity values in terms of our theoretical expectations.

I then calculate the long-run wage elasticity values for each of the different sectors by adjusting, once again, the short-run coefficient using the coefficient on the lagged dependent variable (λ). In both the fixed effects and the GMM-IV models all the long-run coefficients, on average, turn out to be negative, as expected.[32]

Next, we analyse the cross capital- price labour demand elasticity estimates as presented in column(s) 3 and 8 of Table 3, column(s) 3 and 9 of Table 4, and column(s) 2 and 6 of Table 5. Across the different sectors the complementarity between labour and capital continues to hold quite notably (at the industry level), but only in the GMM-IV model (see Table 4, (as it also did in the pooled

[31] See for example, (Hasan et.al, 2007) for India, and Slaughter (1997) for the US.

[32] This result also holds for the post-reform period as well.

regression results)). In the fixed effects and five-year differences models (Tables 3 and 5, respectively) the results were fairly mixed across the different industries, depending on which trade liberalisation indicator was used. In any case, however, the vast majority of coefficient values were not estimated with great precision and hardly any of the estimates were significant at the conventional 5% level or even at higher levels. At best, the only statistically significant estimate that showed some degree of consistency across the different specifications was the "other non-metallic mineral products" sector.[33] The lack of precision in calculating cross-price elasticities (at a disaggregated level) is not surprising, given that this has also been encountered in various other econometric studies of this kind.[34]

In order to take into account the possible fixity of capital in the short run, an alternative specification was also attempted, in which all terms corresponding to the rental rate of capital were dropped. The results remained more or less the same, in terms of its impact on the coefficients of the other variables and their associated standard errors. This result also tends to confirm the findings of Clark and Freeman (1980), as alluded to in section 4.1.[35]

Looking next at the estimated response of labour demand when output increases (see column(s) 4 and 9 of Table 3, column(s) 4 and 10 of Table 4, and column(s) 3 and 7 of Table 5)), it can be seen that in all sectors across all estimation methodologies, increases in industry output increases the demand for labour. All coefficients (with the exception of just one statistically insignificant estimate) have the correctly hypothesised sign, the majority of which are statistically significant at even the 1% level of significance. Although their magnitudes are (as previously noted) somewhat sensitive to the estimation technique, the positively signed coefficients across all specifications again point to the positive relationship between output and labour demand, even at the industry level.

Lastly, turning to the key parameter of interest: the wage variable interacted with the trade liberalisation indicators (see column(s) 5 and 10 of Table 3, column(s) 5 and 11 of Table 4, and column(s) 4 and 8 of Table 5)). Our results on the whole are somewhat surprising and at divergence to the strong and robust estimates observed for manufacturing overall. In only one of the 10 sectors (metals, metal products, and machinery and equipment) do we find strong support for the hypothesis that labour demand elasticities go up with trade openness. Thus, the negative and significant estimates of the interactive term for this sector in both the fixed effects and five-year differences models (Tables 3 and 5) are higher (in absolute terms), whether we use the post-reform dummy or the indicator of openness. (In the GMM-IV model (Table 4), the relevant coefficients for this sector are negligible and statistically not significantly different from zero.)) In four sectors[36] the results appear to be mixed across

[33] The estimated coefficient was in fact positive, thus pointing towards substitutability of factors rather than these being regarded as complements.

[34] See for example, Haouas and Yagoubi (2003).

[35] See Hamermesh (1981) for further details on this issue.

[36] I.e. textiles, clothing and leather; petroleum products, chemicals, rubber and plastic; other non-metallic mineral products; and transport equipment.

different specifications: the fixed effects model shows a decline in elasticities post-liberalisation whilst the other two sets of estimates reveal no consistent pattern of change either way.

What is perhaps more surprising, and even contrary to our theoretical expectations, is that in three sectors (food, beverages and tobacco; wood and paper, publishing and printing; and furniture and other manufacturing) most estimates across the different specifications show a statistically significant *decrease* in labour demand elasticities when trade openness increases. This finding, though counter-intuitive, is not uncommon and has also been reported in some sectors for other countries such as Japan (Bruno et.al, 2004), Turkey (Krishna et.al, 2001) and to a lesser extent, the United States (Slaughter, 1997). But the reason why it is so significant in our case is that in the aggregate, elasticities were found to have increased with international trade but at the sectorial level this conclusion, in the main, seems to have collapsed.

This divergence in the results brings to the fore, once again, a critical distinction emphasised by both Slaughter (2001) and Leamer (1995), but sometimes overlooked[37] in analyses of this kind: industry (specific) labour-demand elasticities and national (or aggregate) labour demand elasticities are two conceptually distinct ideas. Whilst the former relates to how "a single industry responds to a wage change which is exogenous to that industry", the latter "describes how endogenously determined national wages respond to an exogenous change in national factor endowments" (Slaughter, 2001: 33-34). He then illustrates how under differing circumstances these elasticities may diverge in their response to trade openness.

6 Conclusions

From the foregoing results several important conclusions emerge. Firstly, in a study of this kind it is immensely useful, especially as a check of robustness, to utilise where available, alternative but suitable estimating techniques. One sometimes encounters studies in which conclusions are arrived at on the basis of just a single estimating strategy, which though appropriate, might still be lacking in econometric rigorousness. This is particularly serious when important policy decisions are to be predicated on such findings. In this study, the use of alternative strategies certainly helped to refine some of our conclusions vis-à-vis the labour demand elasticity values, for example. This, I believe, is in fact critical in this case because as expressed by Bhorat and Leibbrandt (1998: 75), "Given the volatility of the South African economy and labour market over the last three decades, the possibility of unstable elasticity estimates is highly likely" and that consequently, such estimates needed "to be rigorously derived".

Secondly, although estimates for the manufacturing sector overall are a convenient summary of the data, the level of aggregation might be too large and consequently might hide important inter-industry variation which the sector-by-sector estimates allow for. This observation is particularly exemplified in

[37] This is the thrust of Sen's (2003) objection against Panagariya's criticism of Rodrik (1997).

several of the estimated parameters including the key parameter of interest. The upshot of this remarkable finding is that studies within the trade debate need to shift emphasis from a macro- to a more micro-context, as is also being increasingly emphasised by some of the literature on this issue. It is appropriate to quote the very succinct words of Hallak and Levinsohn (2004:16): "Countries do not produce anything and countries do not trade with one another. Firms and consumers do these things". Consequently, although it might feel quite gratifying to "find" solutions to "big" problems typically addressed at the macro-level, since we are interested in how various policies impact on the actual participants in the economy (viz. firms and households), the emphasis and the corresponding data usage need to focus at this level. What this means is that whilst aggregated data analyses do merit study in their own right, there are certain important inter- – and quite likely – even intra-industry differences that become masked with macro-level data. The usage of more disaggregated data, e.g. detailed plant-level studies, will enable researchers to hone in on the specific impact of alternative policies, given that firms (and households for that matter) vary in their responses to such policies.

Thirdly, and also related to the above, whilst we encountered (at the sectorial level) fairly mixed results with regard to the response of the labour demand elasticity parameter to greater openness, there could be several idiosyncratic factors that may have contributed to this finding. These factors include, inter alia, differing union representation both within and across sectors, labour market rigidities within specific industries, as well as other labour market dynamics. For example, for the Indian manufacturing sector Hasan et.al (2007) found that states with inflexible market regulations produced post-liberalisation parameter estimates that were statistically insignificant whilst those with flexible markets reflected changes that were significant at even the 1% level of confidence. This also emphasises the need to factor these firm/industry specific effects into our labour demand equations and estimate them accordingly.

Finally, we note that the index of openness variable that was used as a measure of trade openness did produce in some instances incorrectly predicted signs and/or coefficient magnitudes that may have been implausibly large (e.g. the cross price labour demand elasticities). Whilst this concern has already been addressed in the preceding section I need to add further that it is precisely this definition of what constitutes "openness" that is a key reason for disagreement amongst trade economists (Baldwin, 2003). Whilst this debate[38] is an interesting one indeed, for which the jury is still out, there is an additional issue which also needs to be considered. The use of an economy-wide index of openness implicitly assumes that all sectors of the economy had liberalised to the same extent. As Fedderke, et al. (2011) emphasise, sectors may differ substantially with respect to their response to liberalisation and that this heterogeneity needs to be factored into any analysis. Whilst this in itself has also been somewhat contentious[39], in terms of the country's stated commitments to its trading part-

[38] See Baldwin (2003) for an insightful review and critique of this issue.

[39] See for example, Fedderke and Vaze (2001) and Rangasamy and Harmse (2003) for op-

ners (e.g. to the WTO and the EU) there was to be a phased and gradual process with some sectors opening up more quickly and extensively than others. Consequently, a more appropriate measure of openness will be to use industry-year specific tariff rates, which would then produce more industry-specific outcomes referred to earlier.

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Appendix of Tables

Table 1. Manufacturing Sectors

INDUSTRIES	SECTOR
Food, Beverages, Tobacco	Food, beverages and tobacco
Textiles, Wearing Apparel, Leather & Leather Products, Footwear	Textiles, clothing and leather
Wood & Wood Products, Paper & Paper Products, Printing, Publishing & Recorded Media	Wood and paper; publishing and printing
Coke & Petroleum Products, Basic Chemicals, Other Chemicals & Fibres, Rubber Products, Plastic Products	Petroleum products, chemicals, rubber and plastic
Glass & Glass Products, Non-metallic Minerals	Other non-metallic mineral products
Basic Iron & Steel, Basic Non-ferrous Metals, Metal Products , Machinery & Equipment	Metals, metal products, machinery and equipment
Electrical Machinery & Apparatus	Electrical machinery and apparatus
Television, Radio & Communication Equipment, Professional & Scientific Equipment	Radio, TV, instruments, watches and clocks
Motor Vehicles, Parts & Accessories, Other Transport Equipment	Transport equipment
Furniture, Other manufacturing	Furniture and other manufacturing

Table 2. Labour Demand: Regressions Using Data Pooled Over All Industries

	FIXED EFFECTS MODEL		**GMM-IV MODEL**		**FIVE-YEAR DIFFERENCES MODEL**	
	Post 94 ***(1)***	**Indxop** ***(2)***	**Post 94** ***(3)***	**Indxop** ***(4)***	**Post 94** ***(5)***	**Indxop** ***(6)***
$\ln L_{t-1}$	.553 (5.89)***	.507 (5.55)***	.906 (69.61)***	.893 (65.87)***		
lnw	-.023 (0.96)	.171 (5.45)***	-.045 (4.77)***	-.014 (1.10)	-.059 (1.93)*	-.045 (1.35)
Intrstrt	-.064 (0.32)	-.238 (1.58)	-.363 (5.53)***	-2.73 (3.13)***	.321 (2.58)**	.064 (0.49)
lnY	.437 (20.64)***	.454 (21.90)***	.090 (7.58)***	.093 (7.89)***	.319 (9.52)***	.339 (9.67)***
lnwPost94	-.054 (12.21)***		-.003 (1.98)**		-.142 (2.41)**	
lnwIdxop		-.062 (8.79)***		-.009 (3.66)***		-.546 (3.44)***
constant	.697 (1.51)	.208 (0.46)	-.003 (6.89)***	-.003 (5.78)***	-.025 (3.08)***	-.037 (4.42)***
No. of Observations	924	924	896	896	812	812
R^2	0.40	0.44			0.19	0.16
s-corr 1#			11.55	11.59		
s-corr 2#			1.25	1.36		

Notes: Absolute values of t or z statistics in parentheses. (*) significant at the 10% level; (**) significant at the 5% level; (***) significant at the 1% level. (1# and 2#) Test statistic for first- and second-order serial correlation, respectively. The variables which were included in the estimation but omitted from the tables for brevity are the interaction of the non-wage factor variables.

Table 3. Labour Demand: Fixed Effects Model

	LnL_{t-1} (1)	Lnw (2)	Intrstrt (3)	lnY (4)	lnwPost94 (5)	LnL_{t-1} (6)	Lnw (7)	Intrstrt (8)	lnY (9)	lnwIdxop (10)
Food, beverages and tobacco	.503 (2.37)**	.161 (2.62)**	-.532 (1.57)	.329 (5.56)***	-.062 (8.87)***	.701 (3.66)***	.405 (6.20)***	-2.041 (0.47)	.325 (5.95)***	-.070 (6.60)***
Textiles, clothing and leather	.771 (3.94)***	.033 (0.56)	.415 (0.83)	.398 (6.30)***	-.075 (6.46)***	.721 (3.96)***	.300 (3.99)***	-3.500 (0.55)	.428 (7.14)***	-.089 (5.07)***
Wood and paper; publishing and printing	.395 (1.53)	-.082 (1.94)*	.586 (2.00)**	.395 (10.08)***	.003 (0.47)	.434 (1.68)*	-.118 (2.09)**	4.538 (1.12)	.388 (9.61)***	.011 (1.03)
Petroleum products, chemicals, rubber and plastic	.580 (2.05)**	.127 (1.90)*	.046 (0.09)	.456 (9.19)***	-.059 (5.17)***	.647 (2.38)**	.368 (4.21)***	.390 (0.06)	.489 (10.10)***	-.073 (4.12)***
Other non-metallic mineral products	.956 (3.20)***	.310 (4.40)***	.885 (1.53)	.151 (1.24)	-.082 (6.15)***	.329 (1.68)*	.544 (9.23)***	13.793 (2.60)**	.180 (2.24)**	-.072 (5.25)***
Metals, metal products, machinery and equipment	.490 (2.40)**	-.506 (8.38)***	-.810 (2.07)**	.287 (5.23)***	-.068 (7.84)***	.358 (1.83)*	-.277 (4.14)***	-7.559 (1.45)	.299 (5.58)***	-.081 (6.09)***
Electrical	…	…	…	…	…		…	…	…	…
Radio, TV, instruments, watches and clocks	.311 (1.83)*	.113 (2.08)**	1.112 (1.89)*	.369 (6.65)***	-.004 (0.30)	.260 (1.48)	.147 (1.69)*	-5.039 (0.56)	.366 (6.44)***	-.017 (0.73)
Transport equipment	.394 (1.73)*	.093 (0.82)	-.586 (1.03)	.570 (12.03)***	-.087 (6.96)***	.135 (0.72)	.402 (4.22)***	.517 (0.07)	.595 (14.94)***	-.092 (5.42)***
Furniture and other manufacturing	.802 (2.70)***	.173 (2.75)***	.954 (1.58)	.371 (7.04)***	-.035 (2.81)***	.611 (2.22)**	.366 (4.09)***	1.867 (0.27)	.408 (7.92)***	-.047 (2.45)**

Notes: Absolute values of t statistics in parentheses. (*) significant at the 10% level; (**) significant at the 5% level; (***) significant at the 1% level. (…). For the electrical sector there are no fixed effects estimates since it only comprises of one industry (i.e. there is no panel of data). The variables which were included in the estimation but omitted from the tables for brevity include the constant and the interaction of the non-wage factor variables.

Table 4. Labour Demand: GMM-IV Model

	Post 1994 Reform Dummy						Index of Openness Indicator					
	LnL_{t-1} (1)	Lnw (2)	Intrstrt (3)	lnY (4)	lnwPost94 (5)	Sargan Test (6)	LnL_{t-1} (7)	Lnw (8)	Intrstrt (9)	lnY (10)	lnwIdxop (11)	Sargan Test (12)
Food, beverages and tobacco	.833 (16.71)***	.009 (0.29)	-.151 (0.92)	.098 (2.47)**	-.013 (3.09)***	84.26 (1.00)	.869 (15.77)***	.039 (0.97)	-3.107 (1.41)	.086 (2.11)**	-.012 (1.80)*	86.35 (1.00)
Textiles, clothing and leather	.925 (24.57)***	-.014 (0.56)	-.725 (3.63)***	.101 (2.48)**	-.007 (1.32)	154.74 (1.00)	.915 (23.44)***	-.025 (0.69)	-4.515 (1.70)*	.098 (2.42)**	-.013 (1.54)	160.35 (1.00)
Wood and paper; publishing and printing	.875 (16.65)***	.028 (1.67)*	.011 (0.09)	.035 (1.17)	-.004 (1.67)*	96.04 (1.00)	.892 (16.36)***	.055 (2.46)**	-2.097 (1.34)	.042 (1.42)	-.008 (2.00)**	96.40 (1.00)
Petroleum products, chemicals, rubber and plastic	.974 (44.26)***	-.068 (3.54)***	-.269 (1.97)**	.105 (3.53)***	-.003 (0.86)	157.20 (1.00)	.979 (42.19)***	-.047 (1.72)*	-4.062 (2.19)**	.096 (3.24)***	-.007 (1.27)	154.93 (1.00)
Other non-metallic mineral products	.955 (17.43)***	-.067 (1.97)**	-.402 (1.68)*	.252 (3.97)***	-.009 (1.28)	57.72 (1.00)	.763 (11.18)***	.033 (0.60)	6.770 (2.21)**	.258 (4.59)***	-.007 (0.71)	60.75 (1.00)
Metals, metal products, machinery and equipment	.888 (25.24)***	-.133 (4.10)***	-.427 (2.70)***	.059 (2.09)**	.006 (1.41)	123.42 (1.00)	.866 (24.92)***	-.148 (4.54)***	.502 (0.24)	.065 (2.37)**	.003 (0.53)	131.18 (1.00)
Electrical machinery and apparatus	.754 (8.41)***	-.225 (2.50)**	-.528 (1.94)*	.085 (1.43)	-.002 (0.27)	31.32 (1.00)	.725 (7.32)***	-.161 (1.54)	-2.557 (0.79)	.087 (1.51)	-.012 (1.12)	32.14 (1.00)
Radio, TV, instruments, watches and clocks	.657 (8.73)***	-.016 (0.45)	-.029 (0.07)	.016 (0.25)	-.029 (2.87)***	63.87 (1.00)	.641 (8.36)***	.138 (2.49)**	-11.581 (2.09)**	.030 (0.50)	-.052 (3.47)***	58.43 (1.00)
Transport equipment	.789 (14.14)***	-.141 (2.68)***	-.333 (1.27)	.160 (4.28)***	-.001 (0.02)	61.41 (1.00)	.688 (12.18)***	-.049 (0.82)	-2.684 (0.78)	.224 (6.01)***	-.021 (2.00)**	65.28 (1.00)
Furniture and other manufacturing	.941 (13.23)***	.007 (0.23)	-.734 (2.98)***	.013 (0.30)	.002 (0.25)	61.25 (1.00)	.813 (10.44)***	.087 (1.81)*	-1.399 (0.46)	.018 (0.44)	-.015 (1.59)	64.67 (1.00)

Notes: Absolute values of z statistics in parentheses. (*) significant at the 10% level; (**) significant at the 5% level; (***) significant at the 1% level. ($1^{\#}$ and $2^{\#}$) Test statistic for first and second order serial correlation, respectively. Sargan test of overidentifying restrictions is distributed as a χ^2 with as many degrees of freedom as the number of overidentifying restrictions, under the null of the validity of the instruments (the p value is in parenthesis). The variables which were included in the estimation but omitted from the tables for brevity include the constant and the interaction of the non-wage factor variables

Table 5. Labour Demand: OLS on Five Year Differences

	Post 1994 Reform Dummy				Index of Openness Indicator			
	Lnw *(1)*	**Intrstrt** *(2)*	**lnY** *(3)*	**lnwPost94** *(4)*	**Lnw** *(5)*	**Intrstrt** *(6)*	**lnY** *(7)*	**lnwIdxop** *(8)*
Food, beverages and tobacco	.160 (1.60)	.121 (0.40)	.474 (5.25)***	.030 (0.24)	.242 (2.62)**	-.073 (0.22)	.510 (5.73)***	-.638 (1.88)*
Textiles, clothing and leather	-.217 (2.35)**	.002 (0.00)	.499 (4.12)***	.007 (0.04)	- .302 (3.32)***	-.489 (1.68)*	.560 (4.43)***	0.521 (1.07)
Wood and paper; publishing and printing	-.027 (0.67)	.131 (0.67)	-.020 (0.25)	.232 (2.24)**	-.049 (1.38)	.062 (0.28)	.006 (0.08)	.574 (3.06)***
Petroleum products, chemicals, rubber and plastic	-.085 (1.39)	.276 (1.03)	.140 (1.70)*	-.103 (0.86)	-.034 (0.46)	.013 (0.04)	.157 (1.82)*	-.694 (2.00)**
Other non-metallic mineral products	.264 (1.25)	1.459 (2.51)**	.438 (3.52)***	-.173 (0.66)	.365 (1.86)*	1.296 (2.32)**	.445 (3.37)***	-1.442 (2.04)**
Metals, metal products, machinery and equipment	-.170 (1.22)	.119 (0.38)	.271 (2.95)***	-.596 (4.28)***	-.075 (0.69)	-.303 (1.07)	.288 (3.01)***	-2.407 (6.35)***
Electrical machinery and apparatus	-.543 (2.96)***	-.201 (0.23)	.348 (2.13)**	.557 (1.97)*	-.207 (0.91)	.371 (0.55)	.282 (2.00)*	-1.335 (2.73)**
Radio, TV, instruments, watches and clocks	-.116 (1.16)	1.127 (1.62)	.401 (2.33)**	.128 (0.81)	-.192 (1.39)	.844 (0.97)	.411 (2.61)**	.826 (1.35)
Transport equipment	.151 (1.96)*	.445 (1.26)	.360 (5.51)***	-.312 (1.58)	.150 (1.62)	.169 (0.42)	.386 (5.48)***	-1.268 (2.41)**
Furniture and other manufacturing	-.183 (3.14)***	.050 (0.15)	.082 (1.60)	.294 (2.73)***	-.248 (3.25)***	-.222 (0.71)	.103 (1.73)*	.620 (1.89)*

Notes: Absolute values of robust t statistics in parentheses. (*) significant at the 10% level; (**) significant at the 5% level; (***) significant at the 1% level. The variables which were included in the estimation but omitted from the tables for brevity is the constant and the interaction of the non-wage factor variables.