The Impact of Trade and Outsourcing on Skilled and Unskilled Labour in France*

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Abstract:
This paper investigates the effect of trade and outsourcing on demand for labour in France, including the role of exports. We analyse the impact of outsourcing - imported inputs - on unskilled labour in manufacturing industry during 1990-2002 and find that outsourcing has a significant negative effect on the relative demand for unskilled labour. This could be potentially mitigated by exports in manufacturing, which are found to increase the demand for unskilled labour. Our analysis of economy-wide impact of trade over 1970-2003 finds that imported goods and services, as well as total exports, contribute to the skilled-unskilled differential by increasing the demand for skilled labour. These trade variables, however, have no statistically significant impact on the demand for unskilled labour.

Keywords: International trade, outsourcing, skill differentials, production theory

JEL classification: J31; F14

* The authors are grateful to Professor Jakob Madsen, Professor Bertrand Koebel, Professor Kevin Fox, Professor Felix Mavondo, Associate Professor Christis Tombazos, Professor Dietrich Fausten, Dr Svetlana Maslyuk and Dr Tine Olsen for their helpful comments and suggestions on earlier versions of this work. We acknowledge funding from the Department of Economics Monash University and suggestions and comments from participants at the 2008 Australian Conference of Economists. Esther Tsafack is currently employed as a Senior Project Officer with the Australian Competition and Consumer Commission (ACCC) in Melbourne, this research was carried out while she was a PhD candidate and Assistant Lecturer at Monash University. Views expressed in this paper do not represent the views of the ACCC.

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I. Introduction

Over the last three decades France has experienced a continued increase in foreign trade. Figure 1A illustrates the fact that trade (as a share of GDP) and the unemployment rate have remained higher than the OECD average over that period. During the same period, labour market conditions of unskilled workers have deteriorated (Adsera and Boix, 2000; Strauss-Khan 2003). Data used in this paper show that employment differential between skilled and unskilled workers began to widen in the 1970s and substantially increased in the following two decades (figure 1B). Not surprisingly, along with the debate on the effect of French labour market institutions on unemployment, the potential link between trade and unemployment has been intensely discussed in the media and policy circles.

Empirical research into the role of trade in the remarkable deterioration of labour markets conditions of unskilled workers that was observed from the 1970s in developed economies has shifted from traditional models of trade that emphasise trade in final goods, to production sharing models which account for trade in intermediate products (Tombazos, 2007). The bulk of this research has focussed on the US (Feenstra and Hanson, 2003) or European Union as a whole. Recent evidence indicates that national labour markets within the European Union exhibit substantial disparities (Nickell, 1997) which, presumably, are attributable to country-specific circumstances. This paper renders a contribution to that discussion by analysing systematically the effect of outsourcing and trade on the demand for skilled and unskilled labour in France.

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1 These authors provide brief review of production sharing models used in empirical investigations of labour market effects of trade.
Our paper contributes to the literature by comprehensively analysing the impact of openness on the demand for labour in France in a production sharing setting. We disaggregate labour into skilled and unskilled and systematically capture different dimensions of international trade by (i) incorporating trade in intermediate inputs in manufacturing –outsourcing- and (ii) investigating the impact of imported services as well as imported goods. In both analyses we explicitly account for the role of exports. The paper, therefore, addresses the concerns raised by Feenstra and Hanson (2003) that exports are consistently left out in empirical studies that investigate labour market effects of trade in the production sharing context; and by Falk and Wolfram (2008) that empirical work to quantify the impact of increased trade and international sourcing of service inputs on domestic labour markets has lagged behind the public debate. The approach allows for theoretically consistent specification and econometrically efficient estimation of labour demand.

We first concentrate on the impact of shifting parts of domestic production process overseas on unskilled labour. This analysis in (i) focuses on manufacturing sector, which has a high share of unskilled employment (Table 1) as well as its production processes are more amenable to specialization and fragmentation across countries. We then analyse the economy-wide impacts of imports and investigate whether imported goods and imported services have a differential impact on the demand for labour in (ii).

One of the most policy relevant implementation of production sharing models involves the disaggregation of imports by types and the incorporation of exports in the investigation of labour market effects of trade. Trade variables may have re-enforcing or opposing effect on labour demand, including the demand for skilled and unskilled labour. The literature suggest that imported services may have a different impact on labour relative to imported goods given that trade in services is of a different nature (Banga, 2005). It is also important to account for
exports because exports and final products destined for domestic consumption are likely to be different in terms of imported intermediate inputs (Hummels et al., 2001, p. 78-82). Further, the nature and characteristics of exports are likely to be different due to product adaptation, the process through which firms systematically account for consumer behaviour and market characteristics in various markets (Douglas and Wind, 1987; Leonidou, 1996). Also, as noted by Lawrence (1989, p. 504), exports are likely to proceed through different channels to those destined for domestic consumption. Extending production sharing models to capture the role of different trade variables would generate results of considerable policy relevance. Yet, this has not been explored in the literature on French labour demand.

The only previous empirical studies based on production sharing framework that investigate the role of trade on the labour markets outcomes using French data were undertaken by Strauss-Kahn (2003) for the manufacturing sector and Truett and Truett (2005) for the whole economy. Strauss-Kahn (2003) finds that the increase in outsourcing between 1977 and 1993 accounted for up to 25 per cent of the fall in manufacturing unskilled employment. Truett and Truett (2005) looked at the impact of imports on labour demand for the whole economy. They found that the increase in imports between 1970 and 1997 resulted in a contraction of labour demand. Both studies focussed on the role of imported inputs on the demand for labour and did not incorporate exports in the analysis.

In this paper the investigation of labour market effects of trade is carried out at two levels using two different models. Firstly, based on a variable cost function, the effect of outsourcing is assessed in the manufacturing industry over 1990-2002. Data on outsourcing and unskilled earnings reported in Table 1 show a rapid growth of outsourcing in the manufacturing sector. Outsourcing –in terms of share of imported intermediate inputs in the value added– grew from 16.4 percent in 1990 to 41.3 percent in 2002. At the same time, the
wage bill share of unskilled workers in the manufacturing sector fell at an annual rate of 0.47 percent, and unskilled employment as a percentage of total employment fell at an annual rate of 0.41. A recent economic survey by the OECD (OECD, 2009) suggests that the importance of outsourcing is unlikely to decline. Investigating the decline in French competitiveness compared to Germany, the report finds that Germany has benefitted from outsourcing to low cost emerging economies and suggests that French firms could improve their competitive position by making greater use of outsourcing.

[INSERT TABLE 1 HERE]

Secondly, in a broader approach, the economy-wide production is represented by a variable profit function to estimate the impact of trade on labour demand including skilled and unskilled labour demand. This model distinguishes between imported goods and imported services and estimates the effect on skilled and unskilled labour during 1970-2003.

We find that outsourcing accounts for up to 73.3 percent of the annual decline in the wage share of unskilled labour in manufacturing that occurred between 1990 and 2002. Our results also suggest that imported goods, imported services and to some extent, exports stimulate the demand for skilled labour; with imported goods and imported services doing so by disproportionately complementing skilled labour. This suggests that an increase in these variables has contributed to the increase of the employment differential between skilled and unskilled labour. Our findings are in contrast with the findings for the United States based on production sharing studies. Studies consistently suggest that the downward trend in the relative price of imports compressed, rather than augmented, the wage differential between skilled and unskilled workers in the United States by disproportionately stimulating wages in favour of unskilled workers (Tombazos, 2003; 2007). Thus, trade appears to narrow the skill-
unskilled wage differential in the United States but contributes to widening the demand gap between skilled and unskilled workers in France.

The rest of the paper is divided as follows. Section II contains the analysis of the effect of outsourcing on labour demand in the manufacturing industry. The economy-wide impact of trade on skilled labour and unskilled labour is analysed in section III. In both sections, the econometric framework relies on a strong theoretical foundation but at the same time, accounts for specific features of the French labour market. In France, institutional features such as, strong unionism, minimum wage legislations and the requirement that prevailing terms of employment (including the nominal wage) be changed only by mutual consent, make it difficult for labour markets to adjust efficiently (Abraham and Brock, 2003; Holden, 2004). Hence, labour market adjustments occur primarily in the form of changes in employment rather than wages. Section IV concludes.

II. Outsourcing and the Relative Demand for Unskilled Labour in France

Given the dramatic increase in outsourcing activity in France and the potential for a further increase, there is a suggestion that the use of more recent data set could yield greater labour market effect of outsourcing than those reported previously in the literature. In fact, Strauss-Kahn (2003) reports that the increase in outsourcing from 9 per cent in 1977 to 14 per cent in 1993 accounted for 11 to 15 per cent of the decline in the share of unskilled workers in French manufacturing employment between 1977 and 1985, increasing to 25 percent of the decline between 1985 and 1993.

2.1 Measuring Outsourcing

Outsourcing is generally understood as contracting out some activities, that were previously performed within a given production unit. This phenomenon is also known as production sharing, delocalization, vertical integration and super-specialization in the literature and is
associated with several definitions and measures (Arndt and Kierzkowski, 2001; Feenstra and Hanson, 2003; Hummels et al., 2001). In this paper, the focus is on outsourcing that involves foreign entities (Feenstra and Hanson, 2003; Hijzen et al., 2005). International outsourcing is defined as the extent of foreign content in domestic production, that is, as the share of imported intermediate inputs in production (Feenstra and Hanson, 1996; 2003). This definition is particularly useful for evaluating the extent to which domestic workers have been replaced by workers in other countries.

We employ a narrow measure of outsourcing. This measure is restricted to imported intermediate inputs purchased from the same sector as the final good. This restriction explicitly captures the idea that foreign outsourcing represents the transfer overseas of production activities that were previously undertaken within the domestic sector. The narrow measure outsourcing (OUTS) is calculated as:

\[ \text{OUTS} = \frac{O_{t-j,t}}{VA_{j,t}} \]

where \( O \) represents imported intermediate inputs in sector \( j \) which originate from a similar sector abroad, \( VA \) is the value added of sector \( j \) and subscript \( t \) denotes time.

Following Feenstra and Hanson (1996), Geishecker (2006) and Anderton and Brenton (1999), we approximate industry production technology by the short run cost function. It is expressed as a function of skilled and unskilled wages, real output, capital and structural variables which include a measure of outsourcing and a measure of research and development

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2 A different measure of outsourcing has been used by Hummels et al. (1998) and Hummels et al. (2001). Their measure concentrates on the foreign content of exports. It captures the extent to which the production of a good involves more than one country through importing and re-exporting activities. One should note that this measure is relatively narrower than the common measure which refers solely to imported inputs (Hijzen et al., 2005, p. 49) because it adds the condition that some of the resulting output must be exported.
that are likely to shift the production function and hence affect costs. Further, we allow the cost function to account for exports as discussed earlier.

2.2 Methodology and estimation

The cost function for manufacturing production is approximated by a Translog variable cost function. Time subscripts have been omitted for clarity.

\[
\ln C_i(w, x, z) = \alpha_0 + \sum_{j=1}^{J} \alpha_j \ln w_j + \sum_{k=1}^{K} \beta_k \ln x_{ik} + \sum_{s=1}^{S} \gamma_s \cdot z_{is}
\]

\[
+ \frac{1}{2} \sum_{j=1}^{J} \alpha_j \ln w_j \ln w_i + \frac{1}{2} \sum_{k=1}^{K} \beta_k \ln x_{ik} \ln x_{ij}
\]

\[
+ \frac{1}{2} \sum_{s=1}^{S} \sum_{q=1}^{S} \gamma_{sq} \ln z_{is} \ln x_{iq} \ln x_{ij} + \frac{1}{2} \sum_{j=1}^{J} \sum_{k=1}^{K} \delta_{jk} \ln w_{ij} \ln x_{ik}
\]

\[
+ \frac{1}{2} \sum_{j=1}^{J} \sum_{s=1}^{S} \delta_{js} \ln w_{ij} \cdot z_{js} + \frac{1}{2} \sum_{k=1}^{K} \sum_{s=1}^{S} \delta_{ks} \ln x_{ik} \cdot z_{is}
\]

(2)

\(C_i\) represents total variable cost in sector \(i\) \((i=1, ..., N)\) and is a function of prices \((w)\) of optimally chosen factor \(j\) \((j=1, ..., J)\) employed in sector \(i\), quantities of fixed inputs and outputs \(x_{ik}\) \((k=1, ..., K)\) and structural variables \(z_{is}\). We assume there are two optimally chosen factors – skilled (S) and unskilled labour (U). Capital (K) and outputs (domestic output denoted by DOM and exports denoted by EXPT) are treated as fixed in the short run. The structural variables (z) include the calculated measure of outsourcing (OUTS) and research and development intensity (RND/Y). The following restrictions ensure linear homogeneity of the cost function in wages.

\[
\sum_{j=1}^{J} \alpha_j = 1 \quad \text{and} \quad \sum_{j=1}^{J} \alpha_{ij} = \sum_{j=1}^{J} \alpha_{ji} = \sum_{j=1}^{J} \delta_{jk} = \sum_{j=1}^{J} \delta_{js} = 0
\]

(3)

Differentiating (2) with respect to variable factor prices yields the following cost share of factor \(j\) in total variable costs:
\[ S_{ij} = \alpha_j + \sum_{h=1}^{J} \alpha_{jh} \ln w_{ij} + \sum_{k=1}^{K} \delta_{jk} \ln x_{ik} + \sum_{s=1}^{S} \delta_{js} z_{is}, \] 

where \( S_{ij} = \partial \ln C_i / \partial \ln w_{ij} = (w_{ij} / C_i) \cdot (\partial C_i / \partial w_{ij}) = (w_{ij} \cdot x_{ij}) / C_i \) and \( \sum_{j=1}^{J} S_{ij} = 1 \)

Since the sum of cost shares is equal to one, only one cost share equation needs to be estimated. In the present study we focus on the cost share of unskilled labour,

\[ S_{U_i} = \alpha_0 + \alpha_{US} \ln w_{USi} + \alpha_{DOM} \ln DOM_i + \alpha_{EXPT} \ln EXPT_i + \alpha_k \ln K_i + \alpha_{OUTS} OUTS_i + \alpha_{RND} \frac{RND_i}{Y_i} + \epsilon_i \]

where \( S_{U_i} \), \( w_{USi} \) and \( \epsilon_i \) respectively represent the cost share of unskilled labour, the relative wage (unskilled labour relative to skilled labour) and the error term.

This cost share is a function of both wages and employment. In practice, changes in relative labour demand are observed only after wages and/or employment have adjusted. In case of a translog cost function, it is not possible to distinguish between adjustment through changes in factor prices or through changes in factor quantities. Studies such as Strauss-Kahn (2003) for France, Egger and Egger (2005) for Austria, and Gorg and Hanley (2005) for Ireland have employed a variant of this approach by estimating the unskilled employment share rather than their cost share. As noted by Anderton and Brenton (1999, p. 274), this approach is “less satisfactory from a theoretical point of view”. We adopt the cost shares estimation in this paper.

When equation (5) is estimated by pooling data across sectors, the cross-sector variation in wages has little information. As noted by Berman et al. (1994) and Feenstra and Hanson (2003), wages differ across sectors principally due to quality variation of workers, so high-wage sectors are not expected to economize on those high-quality workers. Accordingly, following Feenstra and Hanson (1996), Anderton and Brenton (1999), as well
as Berman et al. (1994) the wage ratio term is dropped from the right-hand side of (5). This leaves us with domestic output, exports and structural variables. Differencing equation (5) for the cost share of unskilled labour in sectors \( i (i = 1, \ldots, I) \), we have the following expression:

\[
\Delta S_{ui} = \alpha_{DOM}\Delta \ln DOM_i + \alpha_{EXP} \Delta \ln EXPT_i + \alpha_k \Delta \ln K_i + \alpha_{OUTS} \Delta OUTS_i + \alpha_{RND} \Delta \frac{RND}{Y_i} + \Delta \epsilon_i \tag{6}
\]

When the cost share of unskilled labour is decreasing (increasing), a regression attempts to determine how much of that decrease (increase) is due to changes in domestic output, exports, capital, outsourcing and research and development intensity.

Following Feenstra and Hanson (2003, p. 163) and Anderton and Brenton (1999, p. 273), equation (6) is estimated in differenced form, pooling data across 15 sectors of the French manufacturing industry for the period 1990-2002.\(^3\) The model is also estimated controlling for fixed effects.

### 2.3 Data

The outsourcing model employed in this paper requires data on domestic output, exports, capital stock, outsourcing measure, research and development intensity and cost share of unskilled labour. Data on domestic output and exports is obtained from OECD Input-output database (1995 and 2002). Capital stock is derived according to the perpetual inventory method as per Egger and Egger (2006) using the investment data from the OECD STAN Database. Outsourcing variable is constructed as per (1), by dividing the diagonal term of imported intermediate inputs in Input-Output tables by the sector value-added. Research and development intensity (RND/Y) is calculated as research and development expenditure (RND) divided by sector gross output (Y), both sourced from the OECD ANBERD database.

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\(^3\) This pooling imposes a strong assumption that all sectors incorporated in the analysis have the same cost function. However, this cross-industry approach is common in the empirical literature on outsourcing (Feenstra and Hanson 2003, p.162).
Labour data (employment and compensations of employees) by sector is sourced from OECD STAN database (2004). For the breakdown of employment data into skilled and unskilled categories, we adopt the ISCO-88 classification of skill level⁴ following OECD (1998) that provides information on the skilled structure by sector. OECD (1998) uses the ISIC-Rev 2 classification of 1 and 2-digit sectors. Gross annual earnings by skill categories are used as a proxy for skilled/unskilled labour costs. These gross annual earnings by skill category are derived from the Structure of Earnings Surveys (SES) available at EUROSTAT.⁵ We define skilled labour as categories 1, 2 and 3 of ISCO-88 for each sector; the other categories (4 to 9) are classified as unskilled labour (Tombazos, 2003). A measure of industry skilled labour cost is obtained by Tornqvist aggregation of gross annual earnings for these skill categories (1 to 3). The corresponding industry skilled labour cost share is constructed by dividing skilled labour cost with rescaled total labour compensations. A similar procedure is used to derive the labour cost share of unskilled labour.

2.4 Impact of outsourcing

Table 2 reports the results for the impact of outsourcing in manufacturing on the demand for unskilled labour relative to skilled labour (equation 6).

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Focusing on outsourcing, our findings suggest that outsourcing reduces the wage bill share of unskilled workers in the manufacturing sector. The effect is negative and statistically significant irrespective of econometric specification (pooled and fixed effects) and treatment

⁴ The ISCO 88 provides a way to measure skill by relating job types to skill requirements. It reports ten 1-digit occupational categories which are the following: (1) legislators, senior officials and managers; (2) professionals; (3) associate professionals; (4) clerks and service workers; (5) shop and sales workers; (6) skilled agricultural and fishery workers; (7) craft and related trade workers; (8) plant machine operators and assemblers; (9) elementary occupations; (0) armed forces.

⁵ For more information on this source of data, please refer to:
of exports. The following discussion uses the results from the specification including exports. Outsourcing accounts for up to 73.3 percent of the annual decline of the wage share of unskilled labour\(^6\) that occurred between 1990 and 2002. Thus, outsourcing has been a dominant driver of the fall in the demand for unskilled labour (represented by the decline in the wage bill share) for France. This finding is consistent with the trend identified by Strauss-Kahn (2003) for France. She noted that vertical integration (her term for outsourcing) accounted for 10 percent of the decline in the less-skilled employment share prior to 1985 accelerating to 25 percent towards the end of the 1977-1993 period. Our estimate of an even stronger impact of outsourcing reflects the increasing share of imported inputs in value added in manufacturing since 1990. Further, the sizeable effect on the wage bill share encapsulates both, the effect of outsourcing on unemployment - as captured by Strauss-Kahn (2003), as well as the pressure on the relative wages of unskilled workers.

Recent empirical research for other countries corroborates our finding that outsourcing exerts a substantial impact on the relative wage shares and employment of unskilled workers. For instance, Hijzen et al. (2005) find a statistically significant negative effect of outsourcing on the demand for unskilled labour for manufacturing in the United Kingdom. For the period 1982 – 1996, they estimate an elasticity of demand for unskilled labour relative to outsourcing to be equal to -0.639. Geishecker (2006) reports that a one percentage point increase in aggregate outsourcing in German manufacturing industry lowers the wage bill share of manual workers by one third of a percentage point between 1993 and 2000. Thus, the negative impact of outsourcing on unskilled labour demand is not a phenomenon specific to France; it is supported by strong evidence from other European countries.

\(^6\)Multiplying the coefficient estimate of $\Delta \text{OUTS}$ (-0.043) by the change in the variable (8.01) and dividing by the change in unskilled wage share (-0.42).
Turning our attention to the role of exports, we find that the coefficient on exports is positive and statistically significant. Total differentiation of equation (6) with respect to exports yields the impact of exports on the relative wage bill share of unskilled labour (Geishecker, 2006).\footnote{Total differentiation of (6) is given by: \( \left( \partial S_{ij} / \partial \text{EXPT} \right) = \alpha_{\text{EXPT}} \left(1/ \text{EXPT} \right) - \alpha_{\text{OUTS}} S_{\text{EXPT}} \left( \cdot \right) - \alpha_{\text{RND}} S_{\text{EXPT}} \left( \cdot \right). \)

Given that \( \alpha_{\text{EXPY}} \) is positive and significant and, \( \alpha_{\text{OUTS}} \) and \( \alpha_{\text{RND}} \) are negative and statistically significant, the whole expression is likely to be positive.}

The marginal effect of exports on the relative unskilled wage bills share is positive, indicating that increasing exports stimulate the relative demand for unskilled labour in French manufacturing industry. Thus, to the extent that outsourcing enhances the competitiveness of French manufacturing exports, some direct adverse effect of outsourcing on the demand for unskilled labour could be mitigated by the indirect positive impact of improved export performance. This result underlines the importance of including exports in the analysis.

The estimated negative coefficients indicate that research and development (RND) intensity has contributed to the reduction of the unskilled wage bill. Our findings echo the results of Hijzen et al. (2005) who report that RND intensity has a negative (positive) effect on the demand for semi-skilled and unskilled (skilled) labour in the United Kingdom. These findings are consistent with studies such as Machin and Van Reenen (1998), Haskel and Heden (1999) and Berman et al. (1998) who find evidence that technological change tends to be skill-biased in European countries.

It is important to note that results discussed in this section are confined to the manufacturing industry. The outsourcing model is limited in the sense that it not capture the impact of other imports and exports – those that originates from industries other than the manufacturing. This issue is addressed in the economy-wide model discussed in the next section.
III. Trade and the Demand for Labour in France

The impact of cross-border trade is studied further by employing an economy-wide (covering all industries) production theory framework. It is assumed that all imports, including those of so called final products, are inputs into the production process (Burgess, 1974; Kohli, 1991). The model incorporates exports into the analysis and specifically differentiates between imported goods and imported services. The popular perception that trade hurts the domestic demand for labour, especially unskilled labour, is closely examined.

A variable profit function is used to characterise the underlying technology as it allows some inputs to be fixed and others to be variable. The function is expressed using a Symmetric Normalized Quadratic (SNQ) functional form. This functional form is flexible since it does not restrict a priori the signs or sizes of the estimated coefficients. Further, it allows global curvature conditions to be imposed without compromising its flexibility (Kohli, 1991; Tombazos, 2003). The variable profit function is given by

\[
\pi = \frac{1}{2}(\beta'x)p'Ap/(\alpha'p) + \frac{1}{2}(\alpha'p)x'Bx/(\beta'x) + p'Cx + p'\Delta x + \frac{1}{2}(\alpha'p)(\beta'x)\zeta_{\alpha,\beta}t^2 \quad (7)
\]

where \(x\) is a vector of fixed inputs; \(p\) a vector of output prices, including variable input prices; \(\beta \equiv [\beta_j]\) and \(\alpha \equiv [\alpha_i]\) are predetermined non-negative parameters vectors of order \(J\) (number of fixed inputs) and \(I\) (number of output and variable inputs) respectively\(^8\), \(A \equiv [a_{ij}]\) and \(B \equiv [b_{ij}]\) are unknown symmetric parameter matrices of dimension \(I \times I\) and \(J \times J\), \(C \equiv [c_{ij}]\) and \(\Delta \equiv [\delta_{ij}]\) are unknown parameter matrices of dimension \(I \times J\) and \(\zeta_{\alpha,\beta}\) is an unknown scalar. The assumptions made on the production possibilities set \(T'\) as well as the

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\(^8\) Following Diewert and Wales (1987) and according to the standard practice in the literature these parameters are set as \(\alpha_i = 1/1\) and \(\beta_j = 1/1\).
characteristics of the SNQ functional form require that the parameters satisfy the following restrictions.

\[ a_{ih} = a_{hi} \quad \text{and} \quad \sum_h a_{ih} = 0; \quad b_{jk} = b_{kj} \quad \text{and} \quad \sum_k b_{jk} = 0; \quad \sum \alpha_i = 1 \quad \text{and} \quad \sum \beta_j = 1 \]

These restrictions ensure that the variable profit function satisfies the regularity conditions of linear homogeneity and symmetry. The requirement that the variable profit function must be convex with respect to prices of variable quantities and concave with respect to fixed input quantities are not necessarily satisfied by the SNQ function form and the estimated model must be checked for satisfying these conditions.

Output supply (and variable input demand) functions are derived using Hotelling’s Lemma. Differentiating the variable profit function with respect to output (and variable input) prices,

\[ y = (\beta'x)Ap/(\alpha'p) - \frac{1}{2}a(\beta'x)p'Ap/(\alpha'p)^2 + \frac{1}{2}ax'Bx/(\beta'x) + Cx + \Delta x + \frac{1}{2}a(\beta'x)\zeta_n t^2 \]  (8)

where \( y \) is a vector of all variable quantities; some components of \( y \) are positive (output quantities) and others negative (input quantities).

Under competitive conditions, the inverse fixed input demand functions can be derived from the marginal product conditions that the marginal revenue of a fixed input equals its cost.

\[ w = \frac{1}{2}bp'Ap/(\alpha'p) + (\alpha'p)Bx/(\beta'x) - \frac{1}{2}b(\alpha'p)x'Bx/(\beta'x)^2 + C'p + \Delta'p + \frac{1}{2}(\alpha'p)b\zeta_n t^2 \]  (9)

where \( w \) is a vector of fixed input price.

Substitution possibilities between inputs and outputs can be explored by estimating the elasticity matrix given by (Kohli, 1991):
\[
E = \begin{bmatrix}
\frac{\partial \ln y_h}{\partial \ln p_i} & \frac{\partial \ln y_i}{\partial \ln x} & \frac{\partial \ln y_i}{\partial t}
\end{bmatrix}
\]

(10)

3.1 Data and estimation

The data required to implement the SNQ variable profit function include economy wide prices and quantities for: domestic output, exports, imports, labour and capital. Our primary data sources are: the Compendium of National Accounts Statistics (OECD, 2004a), the National Accounts of OECD Countries volume I and II (OECD) and the STAN database (OECD, 2004). Raw data are annual and expressed in current and constant levels. They cover the period 1970 to 2003.

Our series are constructed following the double GDP accounting method. As in Kohli (1991) and Tombazos (2003), we define domestic output as the sum of the money value of private and public consumption and investment goods. The implicit price of each of these categories is derived by dividing the adjusted nominal value by the value at constant price. A representative domestic output price is therefore derived as a Tornqvist index at the base year 1990 over price indices of all these categories. We define exports as exports of goods and services. The implicit exports price is obtained by dividing the adjusted nominal exports by exports at constant price and normalized to one for 1990. Implicit prices of imported goods and imported services are obtained by dividing the adjusted nominal imported goods and imported services by imported goods and imported services at constant level respectively and normalized to one for 1990. We assume that capital input is directly proportional to the amount of accumulated stock of capital after adjusting for depreciation. Since the GDP identity requires that the sum of the money value of domestic output and exports equalizes the money value of payments made to domestic primary factors (capital and labour) and all
imports categories; we calculate the value of capital expenditure as a residual using GDP identity. Capital expenditure is therefore derived as the sum of domestic output plus exports net of the compensation of employees and imports purchases, (Kohli, 1991; Tombazos, 2003). Hence the implicit price of capital for each year is derived by dividing capital expenditure by capital input and normalized to one for 1990.

Economy-wide data on employment and compensations for skilled and unskilled labour is not readily available for France. To construct a representative index, we rely on the ISCO-88 classification of occupations. We then use this classification and the occupational breakdown across sectors that are shown in OECD (1998). Our skilled definition includes white-collar high-skilled workers made up of senior officials, managers and professionals (Tombazos 2003). Using this definition, we then calculate the percentage of skilled workers over the total employment in each one and two digits sectors identified in OECD (1998). Then we classify sectors as high-skill intensive or low-skill intensive. If a sector employs a higher percentage of skilled labour relative to the average of all the sectors, that sector is considered to be high skill intensive. A representative employment level and associated compensation for all high (low) skill intensive sectors is derived using Tornqvist aggregation. These are used as proxies for the representative economy-wide employment level and compensation for skilled (unskilled) respectively.

The system of equations represented by (8) and (9) is estimated simultaneously using Zellner’s Nonlinear Seemingly Unrelated Regression (NSUR). Two versions of the model are estimated. The first model consists of five equations (NSUR-1): domestic output supply function (O); exports supply function (E); labour demand function (L); imports demand function (M) and capital inverse demand function (K). The second model consists of seven equations (NSUR-2): domestic output supply function (O); exports supply function (E);
skilled labour demand function (S); unskilled labour demand function (U), imported goods demand function (G), imported services demand function (Z) and capital inverse demand function (K).

Following our earlier discussion on the main feature of the French labour market, labour is treated as a variable input with price (wages) given exogenously while the level of employment is determined endogenously.

Preliminary estimations of NSUR-1 and NSUR-2 indicated the presence of serial autocorrelation which was corrected with Cochrane-Orcutt method. Eigen values calculated for models, NSUR-1 and NSUR-2, indicated that these models violate the curvature conditions – namely the convexity of the variable profit function with respect to the prices of variable quantities. This necessitated global enforcement of these conditions. The models were then reparameterised following Wiley et al. (1973) as modified by Tombazos (2003) and subsequently estimated. Eigen values for the two models, after correcting for serial correlation and curvature, are reported in Table 3 along with parameter estimates, associated t-values and adjusted r-square ($\tilde{R}^2$).

Using the parameter estimates reported in Table 3, we can evaluate the impact of trade on aggregate and disaggregated labour demand by deriving the relevant elasticities.

Four sets of elasticities can be computed using the estimated parameters: (i) elasticities of transformation between different outputs (O and E) (ii) the equivalent of Hicksian elasticities of complementarity between different inputs (iii) elasticities between inputs and outputs and (iv) elasticities with respect to technical change (time trend). For the purpose of this analysis

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9 Since the specification includes only one fixed input, concavity with respect to the fixed input is not enforced.
we focus on elasticities related to the impact on labour. Selected elasticities for labour demand based on estimates for NSUR-1 and NSUR-2 are reported in Table 4.

[INSERT TABLE 4 HERE]

3.2 Imports and Labour Demand

Results for the aggregate model reported in Table 4 suggest that the price-elasticities of labour demand with respect to imports (\( \varepsilon_{LM} \)) are statistically insignificant. This qualitative finding is common in the literature. Truett & Truett (2005) report a weak but statistically significant substitution between aggregate labour and imports. Their estimates of the elasticity of aggregate labour demand with respect to the price of aggregate imports ranges from 0.002 to 0.056 for the period 1970 to 1997. Qualitatively, our results are also in line with the comprehensive investigation by Boyle and McCormack (2002) who find no significant effect on the demand for aggregate labour across 22 OECD countries.

However, the results of the aggregate model could be driven by the level of aggregation where opposing forces may obscure the significance of the impact of aggregate imports on aggregate labour. The potential for such opposing forces is investigated in our second model (NSUR-2) by disaggregating labour into skilled and unskilled labour and distinguishing between imported goods and imported services. Elasticities of skilled and unskilled labour with respect to imported goods and services reported in Table 4 (model NSUR-2) provide a richer insight. We find that the impact of imported goods on labour demand differs with the skill level. The estimated effect of a change in the average price of imported goods on skilled labour (\( \varepsilon_{SG} \)) is negative and statistically significant while the

---

10 The full set of calculated elasticities can be made available upon request.

11 It is important to note that the model estimated by these authors violates the curvature conditions related to the cost function, (Truett and Truett 2005, p. 310). Hence, the estimations may not be theoretically consistent.
corresponding impact on unskilled labour ($\varepsilon_{UG}$) is statistically insignificant. A one percent fall in the price of imported goods results in a small increase (of 0.207 percent) in the demand for skilled labour but has no effect on the demand for unskilled labour.

Estimated elasticities of skilled and unskilled labour with respect to imported services are denoted by $\varepsilon_{SZ}$ and $\varepsilon_{UZ}$, respectively. While both elasticities are negative, only $\varepsilon_{SZ}$ is statistically significant. The average value suggests that a fall of one percent in the price of imported services results in an increase in the demand for skilled labour of 0.094 but has no significant effect on the demand for unskilled labour. This effect of imported services on the relative demand for skilled labour in France is qualitatively consistent with the results of Gregory et al. (2001) for the United Kingdom. Using a growth accounting methodology for 87 sectors of the UK economy between 1979 and 1990 they conclude that growth in imported services – excluding business services – widened the gap between skilled and unskilled labour by increasing the demand for skilled labour disproportionately at a ratio of three to one. In terms of magnitude, our finding relative to imported services is in sharp contrast with Wood (1995) who suggested that the impact of increased imported services on unskilled labour is “...too big to ignore”.

Our results show that imported services and imported goods disproportionately complement skilled labour. This appears to suggest that increase in imported services and imported goods contributed to expand the demand gap between skilled and unskilled labour.

This appears to be contrary to findings reported in US studies that use production sharing models. These studies consistently report that systematic decreases in import prices stimulated the wage rates of both types of labour and compressed the differential by
disproportionately stimulating the wage rate in favour of unskilled workers (Tombazos, 2003, 2007). However, these studies do not disaggregates imports into services and goods.

3.3 Exports and Labour Demand

The average value of the aggregate labour elasticity with respect to exports ($E_{LE}$) is positive and significant. On an average, a one percent increase in the price of exports stimulates aggregate labour demand by 0.215 percent. Turning our attention to heterogeneous labour demand, the elasticity of skilled labour relative to exports ($E_{SE}$) continues to be positive and significant but the elasticity for unskilled labour ($E_{UE}$) is insignificant. This finding suggests that at the national, economy-wide level, exports do not seem to have any impact on unskilled labour. This appears to be in contrast with our findings of the outsourcing model where exports have a positive impact on relative cost share of unskilled labour in the manufacturing industry. However, the two results can be reconciled on the ground of the difference in the level of analysis. In the SNQ variable profit function model, the measure of exports and unskilled labour is broader in the sense that it includes all industries in the economy including the manufacturing industry. In that sense, SNQ variable profit function model is likely to capture economy-wide dynamics that are not accounted for in the outsourcing model. Thus, while exports in manufacturing have a favourable impact on unskilled labour; overall, French exports favour the demand for skilled labour.

Our results in regard to exports reinforces the general conclusions reported by Goux and Maurin (2000), Egger and Egger (2005) and Koebel (2006). Goux and Maurin (2000) estimate a total cost function using French economy-wide data from 1970 to 1993. They report that exports have a positive effect on male and female employment of skill levels equal to or greater than “Baccalaureat + two years” while their effect on lower skill level employment is not significant. Again, evidence for other countries is consistent with the
findings reported here. Egger and Egger (2005) consistently find that the export openness parameter is positive and significant. They conclude that export openness significantly contributes to expand the demand gap between skilled and unskilled labour in Austria. Koebel (2006) implements the production theory approach for German manufacturing for 1976-1994 and finds that the correlation between exports and shifts in labour markets favours highly skilled workers, \( \varepsilon(I_h, y_s) > \varepsilon(I_s, y_s) > \varepsilon(I_u, y_s) \); where the first, second and last term represent, respectively, the elasticities of high-skilled, skilled and low-skilled labour relative to the supply of exports.

Evidence that exports stimulate skilled labour can be understood in the context of international trade theory. The standard theory of international trade predicts that a country will specialize in the production of goods intensive in its relatively abundant factor of production. If we assume that France is relatively abundant in skilled labour, it is likely to specialize in skilled intensive commodities. Such a specialization would imply an increasing demand for skilled labour. Further, as about 80 percent of trade in the European Union is intra-union trade (Abraham and Brock, 2003), France trades primarily with other European Union countries, some of which are also relatively abundant in skilled labour. Hence, to the extent that the European Union trade flows involve substantial flows of intra-industry trade, there is a need for continued specialization in skill-intensive commodities to remain competitive in export markets. This is consistent with the argument put forward by Greenaway et al. (1999) that there are trade induced efficiencies in the use of labour in export oriented industries. These authors note that the replacement of relatively low-skilled production processes by intermediate imported inputs reduces the demand for unskilled labour.
Unlike exports, increases in the price of the final good for domestic consumption stimulate the demand for both types of labour – elasticities $\varepsilon_{SO}$ and $\varepsilon_{UO}$ are highly significant. This underscores the relevance of the distinction between exports and final good for domestic consumption in this paper. It is also important to note that changes in the demand for unskilled are related to other factors such as technical change. Though a full investigation of this factor is beyond the scope of this paper, the time semi-elasticities reported in Table 4 denote the impact of technical change. Estimates of this effect indicate a statistically significant impact, positive for skilled labour ($\varepsilon_{St}$) and negative for unskilled labour ($\varepsilon_{Ut}$). However, these elasticities are much smaller in magnitude than those related to trade variables.

**IV. Conclusion**

This paper analyses the impact of openness on the demand for labour and its components, the demand for skilled and unskilled labour, in France. It extends previous work that ignored the heterogeneity of trade flows and the potentially divergent labour market implications of the component flows. The basic analytical premise, confirmed by our results from the outsourcing model, is that outsourcing in manufacturing lowers the relative demand for unskilled labour by replacing domestic unskilled production processes by imports of intermediate inputs (within the same industry) from overseas. The effect of outsourcing on French unskilled labour is substantial. While such outsourcing has a direct adverse effect on unskilled labour, it could increase the competitiveness of French manufacturing exports. An expansion of exports mitigates the adverse direct impact of outsourcing on unskilled labour in manufacturing. The impact of exports on labour market outcomes has been overlooked in recent empirical research. Our findings contribute to a better understanding of complex interactions between outsourcing, exports and manufacturing labour demand.
Our results from the economy-wide analysis of the impact of trade on labour demand reveals that imported goods, imported services and exports stimulate skilled labour. However, these variables have no statistically significant effect on the demand for unskilled labour. While the elasticities are small in magnitude, our results suggest that consistent increases in these trade variables contribute to widen the demand gap between skilled and unskilled worker in France.

While total imports of goods and services have no significant, economy-wide impact on unskilled labour, targeted imported inputs, in form of direct outsourcing, are found to compete directly with unskilled labour in manufacturing. This suggests that unskilled labour in particular sectors of the economy may be vulnerable to direct competition from imports. Such competition can, however, increase the competitiveness of French manufacturing. The results also suggest that technology, in form of research and development expenditure and technical change, is a potentially important driver of the decline in the demand for unskilled labour in France.
Figure 1: Trade and Unemployment – skilled and unskilled labour dispersion in France

A: Trade and unemployment

B: Skilled and unskilled employment dispersion in France

Source: A – Authors’ calculation using data from OECD Compendium of National Accounts Statistics; B – Authors’ calculations based on STAN data base and OECD (1998)
Table 1: Outsourcing and unskilled earnings in manufacturing: France (1990 – 2002)

<table>
<thead>
<tr>
<th>Year</th>
<th>Imported inputs as share of Value Added (%) (OUTS)</th>
<th>Unskilled earnings as percentage of labour compensations (SU)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>16.40</td>
<td>33.00</td>
</tr>
<tr>
<td>1995</td>
<td>21.77</td>
<td>32.26</td>
</tr>
<tr>
<td>2000</td>
<td>32.09</td>
<td>31.43</td>
</tr>
<tr>
<td>2002</td>
<td>41.37</td>
<td>31.20</td>
</tr>
</tbody>
</table>

Average percentage change (1990-2002)

|                                   | 8.01  | -0.47 |

Source: Authors’ calculations from OECD STAN and Input-Output databases
Table 2: The impact of outsourcing on the relative demand for unskilled labour in manufacturing in France (1990-2002)

<table>
<thead>
<tr>
<th></th>
<th>Including Exports</th>
<th>Excluding Exports</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pooled</td>
<td>Fixed effects</td>
</tr>
<tr>
<td>Δln DOM</td>
<td>-0.002 (-0.329)</td>
<td>-0.002 (-0.324)</td>
</tr>
<tr>
<td>Δln EXPT</td>
<td>0.028&lt;sup&gt;a&lt;/sup&gt; (4.575)</td>
<td>0.027&lt;sup&gt;a&lt;/sup&gt; (4.335)</td>
</tr>
<tr>
<td>Δln K</td>
<td>-0.054&lt;sup&gt;a&lt;/sup&gt; (-5.025)</td>
<td>-0.054&lt;sup&gt;a&lt;/sup&gt; (-4.857)</td>
</tr>
<tr>
<td>ΔOUTS</td>
<td>-0.043&lt;sup&gt;a&lt;/sup&gt; (-8.689)</td>
<td>-0.042&lt;sup&gt;a&lt;/sup&gt; (-8.367)</td>
</tr>
<tr>
<td>ΔRND/Y</td>
<td>-1.464&lt;sup&gt;a&lt;/sup&gt; (-6.168)</td>
<td>-1.484&lt;sup&gt;a&lt;/sup&gt; (-5.959)</td>
</tr>
<tr>
<td>No. of obs</td>
<td>195</td>
<td>195</td>
</tr>
<tr>
<td>R²</td>
<td>0.584</td>
<td>0.589</td>
</tr>
<tr>
<td>DF</td>
<td>190</td>
<td>175</td>
</tr>
</tbody>
</table>

Notes: Dependent variable: wage bill share of unskilled labour ($S_{ui}$). Variables: capital (K), domestic output (DOM), exports (EXPT), measure of outsourcing (OUTS) and research and development intensity (RND/Y). Superscripts a, b and c indicate significance at 1%, 5% and 10% level, t-statistics in parentheses. Source: Authors’ estimations.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Aggregate Model (NSUR-1)</th>
<th></th>
<th>Parameter</th>
<th>Disaggregated Model (NSUR-2)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>(t-statistics)</td>
<td></td>
<td>Coefficient</td>
</tr>
<tr>
<td>$a_{LL}$</td>
<td>1.158 $^a$</td>
<td>(13.846)</td>
<td></td>
<td>$b_{GG}$</td>
</tr>
<tr>
<td>$a_{LM}$</td>
<td>0.095</td>
<td>(1.547)</td>
<td></td>
<td>$b_{GZ}$</td>
</tr>
<tr>
<td>$a_{LE}$</td>
<td>-0.293 $^a$</td>
<td>(-3.913)</td>
<td></td>
<td>$b_{GS}$</td>
</tr>
<tr>
<td>$a_{MM}$</td>
<td>-0.362 $^a$</td>
<td>(-4.188)</td>
<td></td>
<td>$b_{GU}$</td>
</tr>
<tr>
<td>$a_{ME}$</td>
<td>-0.278 $^a$</td>
<td>(-2.810)</td>
<td></td>
<td>$b_{GE}$</td>
</tr>
<tr>
<td>$a_{EE}$</td>
<td>0.000</td>
<td>(0.000)</td>
<td></td>
<td>$b_{ZZ}$</td>
</tr>
<tr>
<td>$c_{LK}$</td>
<td>-1.447 $^a$</td>
<td>(-92.584)</td>
<td></td>
<td>$b_{ZS}$</td>
</tr>
<tr>
<td>$c_{EK}$</td>
<td>-0.675 $^a$</td>
<td>(-25.914)</td>
<td></td>
<td>$b_{ZU}$</td>
</tr>
<tr>
<td>$c_{OK}$</td>
<td>0.6090 $^a$</td>
<td>(27.652)</td>
<td></td>
<td>$b_{ZE}$</td>
</tr>
<tr>
<td>$c_{MK}$</td>
<td>2.504 $^a$</td>
<td>(69.459)</td>
<td></td>
<td>$b_{SS}$</td>
</tr>
<tr>
<td>$\delta_{LK}$</td>
<td>-0.005 $^b$</td>
<td>(-1.959)</td>
<td></td>
<td>$b_{SU}$</td>
</tr>
<tr>
<td>$\delta_{MK}$</td>
<td>-0.009 $^a$</td>
<td>(-2.854)</td>
<td></td>
<td>$b_{SE}$</td>
</tr>
<tr>
<td>$\delta_{EK}$</td>
<td>0.019 $^a$</td>
<td>(8.518)</td>
<td></td>
<td>$b_{UU}$</td>
</tr>
<tr>
<td>$\delta_{OK}$</td>
<td>0.007</td>
<td>(1.276)</td>
<td></td>
<td>$b_{UE}$</td>
</tr>
<tr>
<td>$\delta_{tt}$</td>
<td>-0.000</td>
<td>(-0.825)</td>
<td></td>
<td>$b_{EE}$</td>
</tr>
<tr>
<td>$\bar{R}^2$</td>
<td>0.999</td>
<td></td>
<td></td>
<td>$c_{GK}$</td>
</tr>
<tr>
<td>df</td>
<td>155</td>
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<td></td>
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<td>$\delta_{GK}$</td>
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<td>$\delta_{OK}$</td>
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<td></td>
<td></td>
<td></td>
<td>$\delta_{tt}$</td>
</tr>
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</table>

Eigen values

<table>
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<tr>
<th></th>
<th>Aggregate Model (NSUR-1)</th>
<th></th>
<th></th>
<th>Disaggregated Model (NSUR-2)</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>2.528</td>
<td>0.449</td>
<td>0.000</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Notes: L = Labour; M = Imports; E = Exports; O = Domestic Output; K= Capital; t = time trend. S = Skilled; U = Unskilled; G = Imported Goods; Z = Imported Services; E = Exports; O = Domestic Output; t = time trend. Superscripts a, b and c denote significance at 1%, 5% and 10% respectively. Source: Authors’ estimations.

<table>
<thead>
<tr>
<th></th>
<th>1971</th>
<th>1980</th>
<th>1990</th>
<th>2000</th>
<th>Average (t-statistics)</th>
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<td><strong>Aggregate model (NSUR-1)</strong></td>
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<tr>
<td>Price elasticities of labour demand</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\varepsilon_{LM}$</td>
<td>-0.032</td>
<td>-0.074</td>
<td>-0.075</td>
<td>-0.065</td>
<td>-0.064 (-1.139)</td>
</tr>
<tr>
<td>$\varepsilon_{LE}$</td>
<td>0.074</td>
<td>0.234</td>
<td>0.232</td>
<td>0.222</td>
<td>0.215 ($^{4.309}$)</td>
</tr>
<tr>
<td>$\varepsilon_{LO}$</td>
<td>0.028</td>
<td>0.702</td>
<td>0.762</td>
<td>0.821</td>
<td>0.689 ($^{4.891}$)</td>
</tr>
<tr>
<td>Time semi-elasticities of labour demand</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\varepsilon_{Lt}$</td>
<td>0.001</td>
<td>0.003</td>
<td>0.003</td>
<td>0.003</td>
<td>0.003 ($^{1.933}$)</td>
</tr>
</tbody>
</table>

|       |      |      |      |      |                        |
| **Disaggregated model (NSUR-2)** |      |      |      |      |                        |
| Price elasticities of labour demand |      |      |      |      |                        |
| $\varepsilon_{SG}$ | -0.078 | -0.263 | -0.221 | -0.198 | -0.207 ($^{2.596}$) |
| $\varepsilon_{SZ}$ | -0.037 | -0.098 | -0.110 | -0.094 | -0.094 ($^{3.056}$) |
| $\varepsilon_{SU}$ | 0.011 | 0.115 | 0.095 | 0.102 | 0.097 ($^{1.535}$) |
| $\varepsilon_{SE}$ | 0.154 | 0.323 | 0.283 | 0.254 | 0.268 ($^{4.902}$) |
| $\varepsilon_{SO}$ | 0.068 | 1.287 | 1.160 | 1.120 | 1.096 ($^{4.216}$) |
| $\varepsilon_{UG}$ | -0.011 | -0.147 | -1.180 | -0.229 | -0.147 ($^{1.537}$) |
| $\varepsilon_{UZ}$ | -0.012 | -0.017 | -0.030 | -0.037 | -0.020 ($^{4.301}$) |
| $\varepsilon_{US}$ | 0.029 | 0.406 | 0.453 | 0.641 | 0.416 ($^{1.535}$) |
| $\varepsilon_{UE}$ | 0.056 | -0.001 | -0.004 | -0.036 | -0.004 ($^{3.033}$) |
| $\varepsilon_{UO}$ | 0.020 | 0.933 | 1.181 | 1.633 | 0.990 ($^{3.085}$) |
| Time semi-elasticities of labour demand |      |      |      |      |                        |
| $\varepsilon_{St}$ | 0.001 | 0.005 | 0.006 | 0.007 | 0.005 ($^{4.388}$) |
| $\varepsilon_{Ut}$ | -0.005 | -0.024 | -0.023 | -0.021 | -0.021 ($^{10.409}$) |

Notes: Calculated using estimated parameters reported in Table 2. L = Labour; M = Imports; E = Exports; O = Domestic Output; K = Capital; t = time trend. S = Skilled; U = Unskilled; G = Imported Goods; Z = Imported Services; E = Exports; O = Domestic Output; t = time trend. Superscripts a, b and c denote significance at 1%, 5% and 10% respectively. Source: Authors’ estimations.
References


OECD (2005) ANBERD Database.


