

OFFSHORING: WE KNOW HOW, LET US NOW DECIDE WHERE

María Ángeles Cadarso Vecina, Nuria Gómez Sanz, Luis Antonio López
Santiago*, María Ángeles Tobarra Gómez

*Facultad de Ciencias Económicas y Empresariales de Albacete, Universidad de
Castilla – La Mancha, Plaza de la Universidad nº 1, 02071, Albacete (Spain)*

ABSTRACT

Firms must take two fundamental decisions: how and where to produce. Traditional measures of offshoring include information on both decisions. In this paper we attempt to distinguish the evolution of the requirement of inputs per unit of output (how to produce) from the delocalisation of production to others countries. We will call global technical change to the first element and net offshoring to the second. We further decompose net offshoring into net inter-industry substitution and intra-industrial offshoring (replacement of a domestic input for the imported from the own sector). This last measure quantifies better the delocalisation of production to other countries looking for lower costs and it is more likely to affect employment.

This decomposition allows us to further investigate on whether it is technical change or net offshoring the main factor in recent Spanish industrial employment changes.

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KEYWORDS: Outsourcing; Offshoring; Fragmentation; Labour demand; Dynamic panel data

* Corresponding author. Tel.: +34 969 179 100 ext. 4214; + 34 967 599200 ext. 2382; fax: +34 902 204 130.

E-mail address: Luis.LSantiago@uclm.es

1. INTRODUCTION

The rising economic integration has increased not only trade in final goods but also the flows of intermediate goods, as a result of the fragmentation of production and/or the search for new and cheaper providers. As a consequence, the productive structure of the involved countries is changing with effects on production and employment for all sectors, within a general tendency to sectoral specialization. While some see this phenomenon as a threat to domestic employment, it also represents a chance to reduce costs, increase flexibility and open new markets, all of which can raise sales and employment.

The phenomenon of domestic to international inputs substitution is reflected in Spanish trade figures. In a previous paper (Gómez *et al.*, 2006) we found that for the Spanish economy: a) inter-industry domestic input purchases over production have decreased by 24% over the period 1995-2000, while their foreign counterpart increased by 32%; b) intra-industrial domestic input purchases increased by 10% between 1995 and 2000, while intra-industrial imports grew by 41%.

At the international perspective, the literature has put forward a number of reasons to explain this issue. The more generally accepted is that firms respond to competition transferring low-skilled stages of production to low-wage countries. However this is not the only factor behind this evolution: 1) not only low-skilled labour, but also some types of skilled labour may be cheaper abroad (e.g. software industry in Ireland and India), 2) there might be economies of scale of specialised providers (e.g. automobile parts, transport), and 3) the existence of market uncertainty or uncertainty inherent to some product characteristics (changes in tastes, product innovation, etc) might give value to a greater flexibility in obtaining inputs.

The aim of this paper is to distinguish the evolution of the requirement of inputs per unit of output (how to produce) from the delocalisation of production to others countries. We will call global technical change to the first element and net offshoring to the second. We further decompose net offshoring into net inter-industrial substitution and intra-industrial offshoring (replacement of a domestic input for the imported one from the own sector).

We will illustrate this decomposition with the following example: glass vs. plastic in bottles for milk. Let us assume we observe an increase in the imported coefficient for plastic in the dairy products sector. This is what the traditional measures of offshoring include. This increase can be due to three factors: 1) imported plastic in this sector might increase because the general share of inputs on production is increasing (our measure of global technical change isolates this effect); 2) imported plastic in dairy products might also increase because imported plastic substitutes domestic plastic (net intra-industrial offshoring); and 3) imported plastic in the dairy products might increase because plastic is substituting glass in bottles (inter-industrial substitution). This decomposition allows us to further investigate on whether it is technical change or net offshoring the main factor in recent Spanish industrial employment changes.

The original contribution of this empirical analysis is: 1) our data comes directly from the import and domestic use matrices of input-output tables, rather than being indirectly estimated through weighted trade data; 2) we estimate a labour demand function at sector level, instead of focusing on skills or wages as most of the literature¹; 3) we decompose offshoring into global technical change and net offshoring; 4) we consider a dynamic specification for our model and use dynamic panel data econometric techniques (GMM). Our results indicate that when offshoring is decomposed there is a negative effect of global technical change on Spanish employment and a negative, but no significant effect of intra-industrial offshoring.

The remainder of this paper is as follows. In section 2 we review the main literature about the topic. In section 3 we outline the basic model used and the calculation of offshoring measures. Section 4 comments on the data and a number of important econometric issues. Section 5 contains the main empirical results and section 6 concludes.

2. OUTSOURCING AND EMPLOYMENT IN PREVIOUS LITERATURE

Fragmented production is nowadays considered as a key element in the design of production organisation and it is extensively analysed. The literature analysing the specific impact of outsourcing on the labour market originates mainly in the leading

¹ We are only aware of one study by Görg and Hanley (2005) that studies the effect of outsourcing on employment but at firm-level and using survey rather than input-output data.

papers by Feenstra and Hanson (1996, 1999), that focused on sector wage inequality by skills. Later empirical developments on the topic substitute relative wage with relative labour demand in terms of skill, especially for European data. The original framework has evolved through time by including technological variables, distinguishing different outsourcing measures or introducing geographical aspects.

Feenstra & Hanson (1996) analyse the way trade affects the relative demand for skilled labour by estimating a relative labour cost equation (see Berman et al. 1994) augmented by an outsourcing measure built by combining import data from U.S. manufacturing industries with input purchases. Here outsourcing is considered as “an index of the extent to which U.S. firms contract non-skill-intensive production activities to foreigners.”² They work with data for 435 industrial sectors and find that during the period 1979-1990 outsourcing has contributed substantially to the increase in relative non-production wage share, as a proxy for high-skilled wages share. However, results for the period 1972-1979 are non-significant.

In a later paper, Feenstra & Hanson (1999), the authors develop a similar model enhanced by including technological variables, since these two factors, trade and technical change, are expected to alter wage inequality. Another novelty of this paper is the differentiation between three types of outsourcing, depending on whether the purchases come from the same sectors, narrow outsourcing, or from other sectors, difference outsourcing; or the sum of the two, broad outsourcing. This distinction allows the authors to show that the effects of intermediate inputs purchases are different depending on their origin: Narrow outsourcing has a greater effect than difference outsourcing.

A number of authors have followed Feenstra & Hanson’s work and, in most cases, have found a positive effect of outsourcing on skilled labour, pointing to firms contracting out production phases that are intensive in low-skilled labour. Among the papers we focus on are Hijzen et al. (2005), Strauss-Kahn (2003) and Görg & Hanley (2005). All these works use for their analysis a labour demand function different to the original labour cost function introduced by Feenstra and Hanson. This is mainly due to the specific characteristics of the European labour market, where wage differentials are lower than in the US labour market.

² Feenstra and Hanson (1996), pp. 244.

Hijzen et al. (2005) extend Feenstra & Hanson's framework by estimating a system of four variable factor demand functions, including relative demand for skilled workers, for 50 U.K. industrial sectors for the period 1982-1996. The relative demand function is augmented by an inter-industrial outsourcing measure and shows that international outsourcing has had a strong negative effect on the demand for unskilled labour.

A similar result is found by Strauss-Kahn (2003), who analyses 50 French industries for the period 1977-1993 and focuses on relative unskilled demand. The author finds that outsourcing has a negative effect on unskilled labour. However, this is not the only element affecting labour, as skilled-biased technological progress seems more important than outsourcing in explaining the reduction in unskilled labour demand, so that, as pointed out by Feenstra and Hanson (1999) the effect of technical change has to be controlled for in order to properly understand the effect of outsourcing on labour.

Görg & Hanley (2005) propose a microeconomic focus and analyse the absolute effect of outsourcing on total labour. They estimate a dynamic labour demand function for 652 plant level data for the Irish electronic sector during the period 1990-1995, and find that, in the short run, outsourcing is linked to a reduction in labour demand. Nonetheless different kinds of outsourcing affect employment in different way, so greater negative effects appear from the outsourcing of materials than from the outsourcing of services.

Recent developments of Feenstra and Hanson have also considered the effect of inter-sectoral spillovers in the relationship between outsourcing and labour demand. Egger and Egger (2005) show, in a geographical outsourcing framework, that inter-sectoral relationships affect notably the effect of outsourcing on labour, so that models ignoring the spillover effect underestimate the role of outsourcing.

Our approach combines characteristics already considered in previous literature and adds a new perspective. We work with a labour demand equation such as studies in the European context, and consider the equation to be dynamic, as in Görg and Hanley. We also work with total labour as in Görg and Hanley, and calculate different measures of offshoring decomposing the traditional ones, since we consider that each of them can have a different effect on labour demand. Our measure of offshoring is calculated from original input-output data (as in Hijzen et al) instead of being approximated by weighted trade data.

3. DECOMPOSITION OF OFFSHORING: NET OFFSHORING VERSUS TECHNICAL CHANGE

We prefer the term “offshoring” (to “outsourcing”) because it properly reflects the substitution of domestic intermediate inputs for imported inputs since it «implies that tasks formerly undertaken in one country are now being performed abroad» (Grossman & Rossi-Hansberg, 2006) and these changes are more likely to affect employment at home. Moreover, along with the discussion about words to refer to this phenomenon there is another debate about which measure is closer to it. Splitting up the traditional measure of outsourcing (imported intermediate inputs) we try to contribute to this issue.

There are two main reasons that can lead to the change in the imported technical coefficients between two periods, t and the base year 0 : a) input substitution is taking place; b) a different amount of inputs are required per unit of output. Our aim is to isolate both elements to make it possible to distinguish, in the coefficients of imported intermediate inputs at period t (\mathbf{A}^m_t), two components: a) Pure or net offshoring t (\mathbf{A}^{off}), that requires to build a matrix able to account for the value of imported technical coefficients at year t by keeping constant the total intermediate consumption per unit of output between t and 0 ; b) global technical change (\mathbf{A}^{tc}), that requires to build a matrix where the distribution of technical coefficients is held constant and each coefficient varies in the same proportion as the sum by columns of the total (domestic + imported) coefficients³. This latter matrix controls for the change in total intermediate consumption for each sector during the period. Certainly, whenever both matrices are added the result will equal the total of imported intermediate consumption at year t :

$$\mathbf{A}^m_t = \mathbf{A}^{off} + \mathbf{A}^{tc}$$

The previous decomposition allows us to differentiate the decision on the most efficient technique (least inputs requirement per unit of output) and decision on the localisation of production. Within this framework it is possible to distinguish the offshoring linked to reduction in costs suggested by Feenstra and Hanson (1996), collected in \mathbf{A}^{off} , since it comprises the stages of production that are located in a low-wage countries (based on

³ This technical change assumes that each imported coefficient increases at the same rate than the average of total intermediate inputs.

the hypothesis of no changes in the production technique). On this scheme, once the technique for a good has been decided at year $\mathbf{0}$, production stages intensive in non-qualified labour can be taken away to those countries where it is an abundant factor.

The imported intermediate inputs matrix \mathbf{A}^{off} is defined so that it contains the same amount of total intermediate inputs used on the base year $\mathbf{0}$ together with the imported technical coefficient distribution on year \mathbf{t} . It is calculated by dividing each element of the imported intermediate coefficient matrix (\mathbf{A}^m_t) by the total of technical coefficients at year \mathbf{t} (\mathbf{uA}_t) and multiplying by the total at year $\mathbf{0}$ (\mathbf{uA}_0). This process allows us to obtain a *net offshoring* measure, once technical change has been taken off (since intermediate consumption per unit of output is forced to be constant). Our measure cannot distinguish between them, but it can isolate the change in imported intermediate inputs due to technical change. For the Spanish context, where more inputs are required on average for production, net offshoring would grow slower than the usual offshoring measure. We can calculate (\mathbf{A}^{off}) in a matrix form and for a unique element:

$$\mathbf{A}^{off} = \mathbf{A}^m_t \langle \mathbf{uA}_0 \rangle \langle \mathbf{uA}_t \rangle^{-1} \quad a_{ij}^{off} = \frac{a_{ijt}^m}{\sum_{i=1}^n a_{ijt}} \sum_{i=1}^n a_{ij0}$$

where \mathbf{u} is a unitary vector ($1 \times m$), “ $\langle \rangle$ ” denotes that the matrix it includes is a diagonalized vector, \mathbf{A}^m_t is the imported technical coefficient matrix for year \mathbf{t} , and \mathbf{A}_0 and \mathbf{A}_t are the total (imported + domestic) coefficient matrix for year $\mathbf{0}$ and \mathbf{t} . The element a_{ijt}^m is the imported technical coefficient for year \mathbf{t} and $\sum_{i=1}^n a_{ijt}$ the total technical coefficient (domestic and imported) for sector \mathbf{j} on year \mathbf{t} . \mathbf{A}^{tc} is calculated as:

$$\mathbf{A}^{tc} = \mathbf{A}^m_t \langle \mathbf{uA}_t \rangle^{-1} (\langle \mathbf{uA}_t \rangle - \langle \mathbf{uA}_0 \rangle) \quad a_{ij}^{tc} = \frac{a_{ijt}^m}{\sum_{i=1}^n a_{ijt}} \left[\sum_{i=1}^n a_{ijt} - \sum_{i=1}^n a_{ij0} \right]$$

By adding net offshoring and net technological change we obtain the imported technical coefficient for sector \mathbf{j} at year \mathbf{t} (the usual offshoring measure in literature):

$$a_{ij}^m = a_{ij}^{off} + a_{ij}^{tc} = \frac{a_{ijt}^m}{\sum_{i=1}^n a_{ijt}} \sum_{i=1}^n a_{ij0} + \frac{a_{ijt}^m}{\sum_{i=1}^n a_{ijt}} \left[\sum_{i=1}^n a_{ijt} - \sum_{i=1}^n a_{ij0} \right] = a_{ij}^m$$

It is also possible to decompose the total technical coefficients matrix that accounts for imported and domestic inputs required for production. Domestic coefficients are found in a similar fashion to imported ones. They can be expressed as:

$$\mathbf{A}_t = (\mathbf{A}^{\text{off}(m)} + \mathbf{A}^{\text{tc}(m)}) + (\mathbf{A}^{\text{off}(d)} + \mathbf{A}^{\text{tc}(d)})$$

Decomposition of net offshoring: Net intra-industrial offshoring and inter-industrial substitution

We further decompose net offshoring into two components: net intra-industrial offshoring and inter-industrial substitution (or net inter-industrial offshoring). Net intra-industrial offshoring quantifies the evolution of offshoring when there is substitution of domestic inputs by imported inputs inside the sector, keeping constant the substitution between inputs of different sectors and the global technical change. Inter-industrial substitution shows that the increase in imported inputs reduce the purchases of inputs from other sectors. This decomposition can be expressed as follows:

$$a_{ij}^{\text{off}} = (a_{ij}^{\text{offIntra}} + \text{sustInter}_{ij})$$

We can express the net intra-industrial offshoring coefficient as:

$$a_{ij}^{\text{offIntra}} = \frac{a_{ijt}^m}{(a_{ijt}^m + a_{ijt}^d)} (a_{ij0}^m + a_{ij0}^d) \quad a_{ij0} = (a_{ij0}^m + a_{ij0}^d)$$

The inter-industrial substitution can be expressed as:

$$\text{sustInter}_{ij} = a_{ijt}^m \left[\frac{\sum_{i=1}^n a_{ijo}}{\sum_{i=1}^n a_{ijt}} - \frac{a_{ijo}}{a_{ijt}} \right]$$

The results presented in this paper are referred to narrow offshoring, that is, to the coefficients in the diagonal. This is the measure that has traditionally received most attention, as these studies try to estimate its impact on employment. Changes in off-

diagonal coefficients (difference offshoring) will affect employment in the inputs producing sectors and not in the one that is using them.

In this line, we can say that Feenstra and Hanson offshoring, where firms respond to import competition from low-wages countries, “by moving non-skill-intensive activities abroad” (Feenstra and Hanson, 1996, p. 24) is better measured by (narrow) net intra-industrial offshoring ($a^{offintra}_{ij}$). This coefficient quantifies the purchase of goods within a sector that is no longer bought domestically but brought from abroad because of cost reductions.

Evolution of Narrow offshoring in Spanish industry

We can observe an important growth in narrow offshoring for the average of industrial sectors in Spain between 1993 and 2002 (Figure 1). Breaking down this evolution, data show that the substitution of domestic inputs for imported inputs (net offshoring) is the main explaining factor of change. Technical change, that appears in the figures as the difference between offshoring and net offshoring, implies an increase in imported intermediate inputs by unit of production.

The breaking down of net offshoring, into net intra-industrial offshoring and inter-industrial substitution, points out a dual behaviour across the time. Net intra-industrial offshoring measures how offshoring would evolve if there were substitution of domestic for imported inputs from the same sector (this would be the case, for example, if the sector Fabricated metal products buy the metal lids of food containers to foreign suppliers instead of the regular domestic ones), keeping constant the substitution between inputs from different sectors (is to say, the possibility that Fabricated metal products use now plastic for making food containers and that input must be imported so they stop buying metal inputs from domestic suppliers) and global technical change. Between 1993 and 1998, the increase in intra-industrial imported inputs implies the reduction of intermediate consumption from the same sector. Nevertheless, since 1998, the intra-industrial substitution between domestic and imported inputs remains nearly constant and the observed growth in intra-industrial imports seems to be cutting down the inputs purchases from other sectors or inter-industrial inputs.

Figure 1. Decomposition of Narrow offshoring in the industry (average).

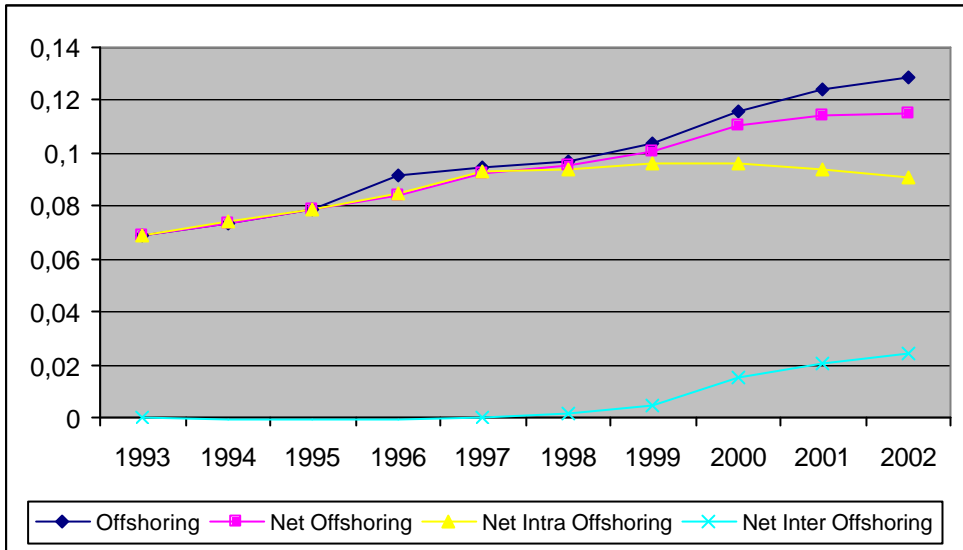
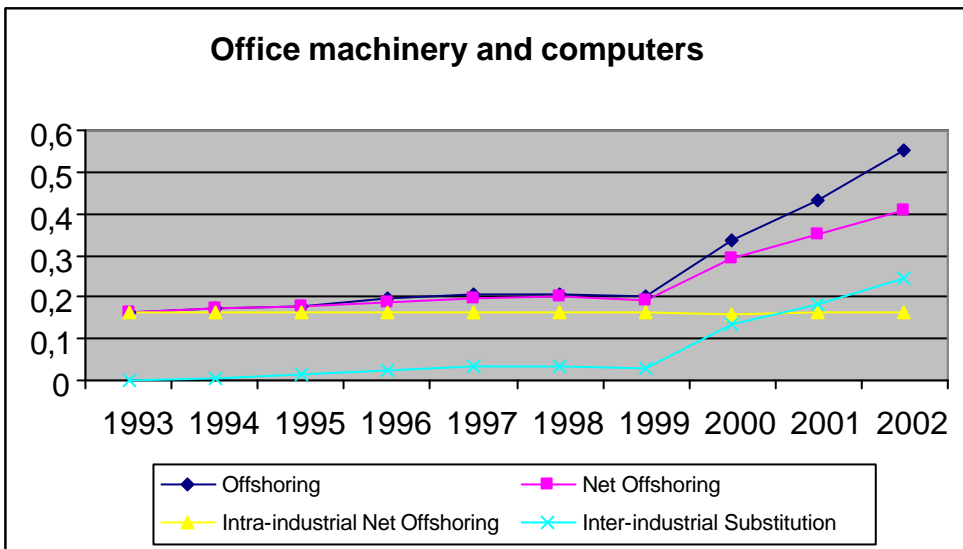


Figure 2. Decomposition of offshoring in Office machinery and computers.



In high and medium-high technology industries, the impact of technical change in intermediate input consumption from the same sector and that of the input substitution, or net offshoring, are both positive. The positive coefficient of technical change (Figure 3) points out that, in the period 1993-2002, these industries require more intra-industrial inputs from the same sector per unit of output. In other industries, mainly in medium-low technology industries, technical change allows to save inputs in the production process.

Figure 3. Decomposition of offshoring for industries with positive technical change, 2002.

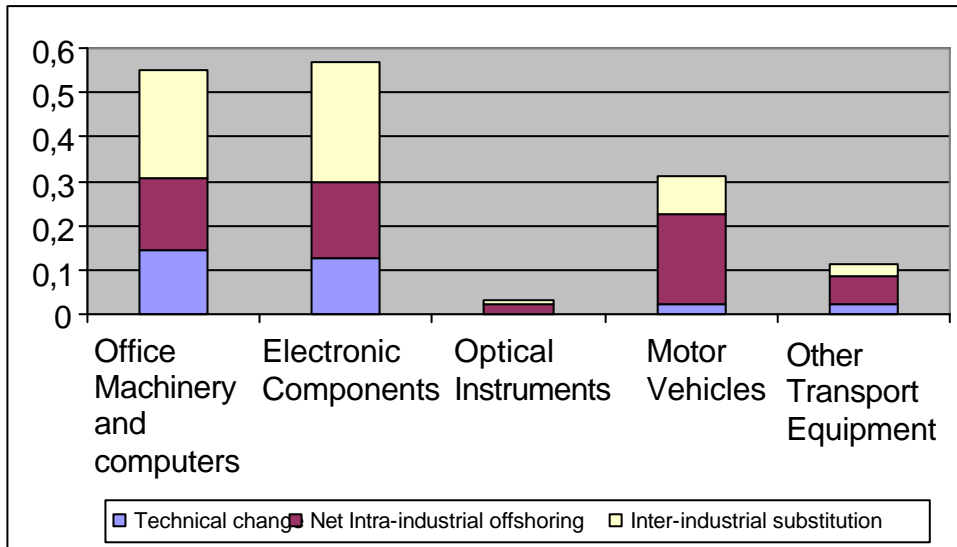


Figure 4. Decomposition of offshoring for industries with negative technical change, 2002.

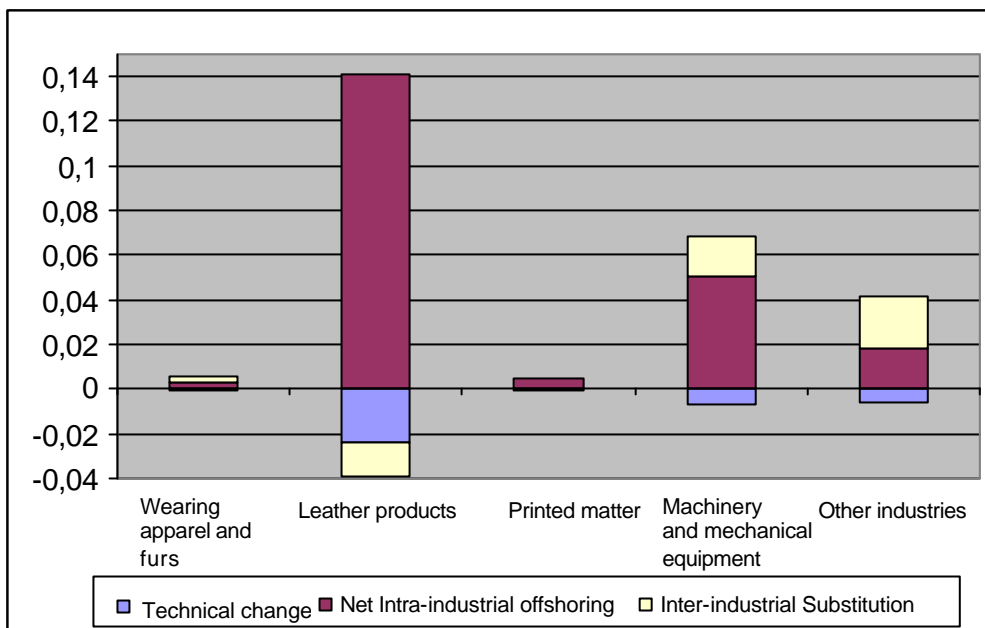


Figure 5a. Industries with greater offshoring, 2002.

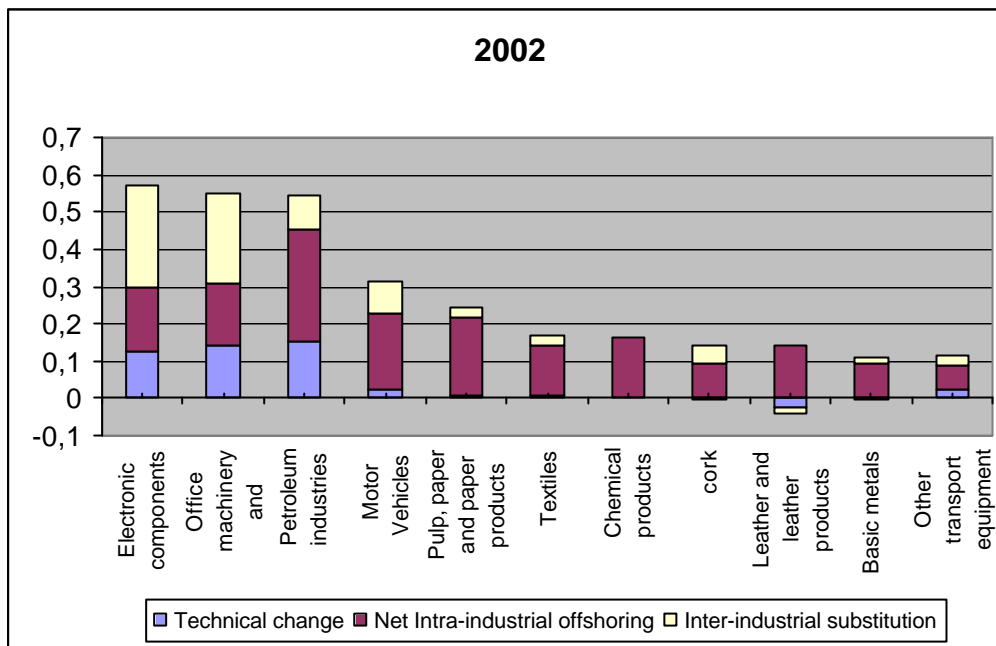
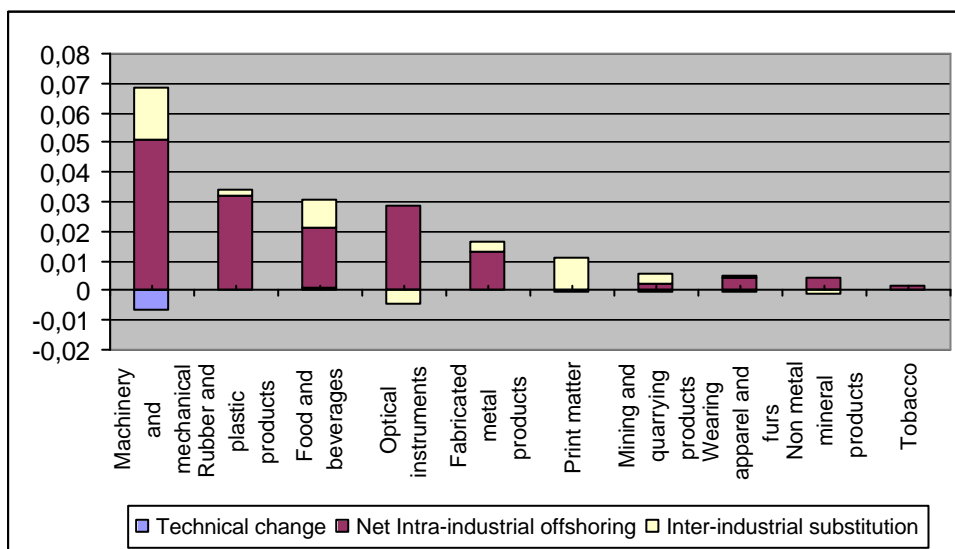


Figure 5b. (continued).



The increase of narrow offshoring in Electronic Components is remarkable, it goes from 0,1 to more than 0,5 and Figure 5 shows that it is explained mainly by the change in inter-industrial substitution and technical change and not by net intra-industrial offshoring.

Figures 6 to 9 show examples of sectors for which technical change is positive and increase (Electronic components), changing signs in the period (Optical instruments) or negative (Wearing apparel and furs and Leather products).

Figure 6. Evolution of offshoring in Electronic components.

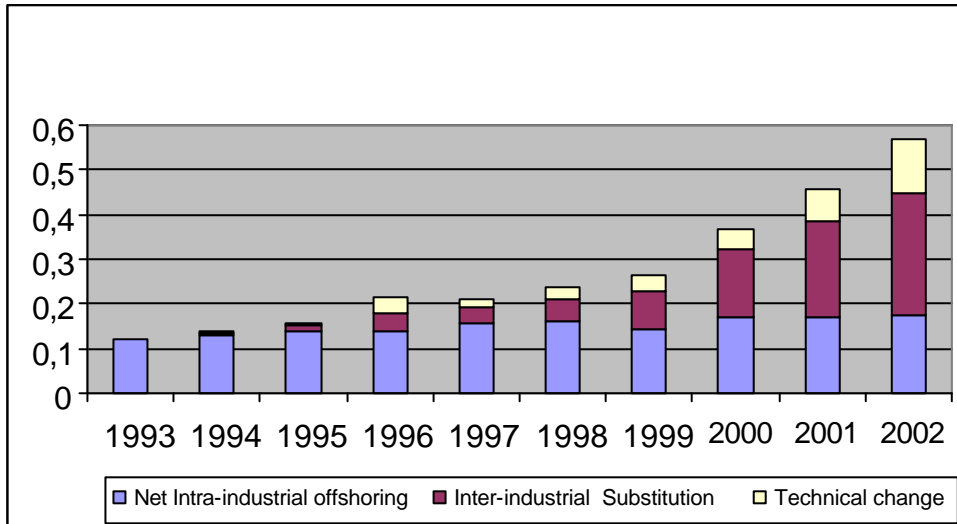
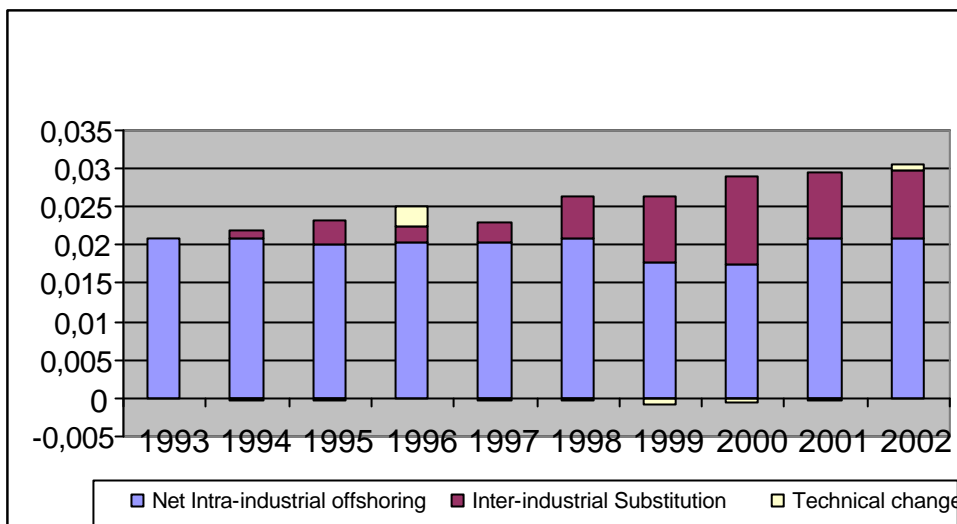


Figure 7. Evolution of offshoring in Optical instruments.



On the contrary, there is a group of industries, mainly traditional, for which technical change implies saving in intermediate consumption from the same sector per unit of output. But, this has not been enough to offset the increase in consumption of imported inputs that are replacing inputs produced inside the country (net intra-industrial offshoring).

Figure 8. Evolution of offshoring in Wearing apparel and furs.

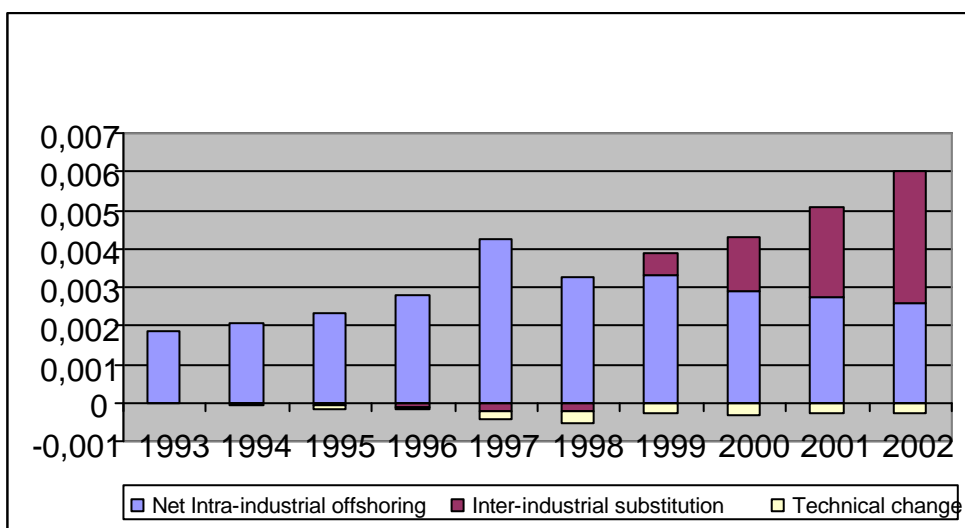
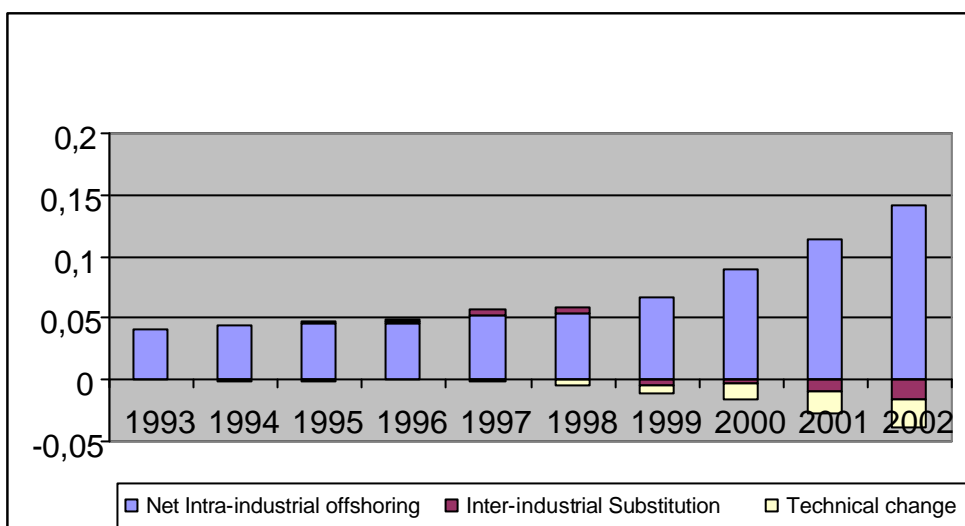


Figure 9. Evolution of offshoring in Leather products.



4. LABOUR DEMAND EQUATION, DATA AND ESTIMATION ISSUES

Our paper differs from most of the existing literature in that we study the link between outsourcing and employment at sector level. The labour demand equation development starts from a CES production function, from this function we follow the usual steps⁴ (see Van Reenen 1997, Barrell and Pain 1997 or Piva and Vivarelli, 2004) to find an augmented labour demand function fitted to panel data:

⁴ From the assumption of firms maximising profits in a perfect competition environment, it is possible to obtain the demand function for the labour factor from the first order condition, which states that each factor's marginal product has to equal its real price.

$$n_{it} = \mathbf{a}_0 y_{it} + \mathbf{a}_1 w_{it} + \mathbf{a}_2 \text{offshoring}_{it} + (\mathbf{e}_i + u_{it}) \quad (1)$$

for $i = 1, \dots, N$ sectors or firms and $t = 1, \dots, T$ years or periods, while y is log output, n is log employment, w is log real wage, and outsourcing is calculated as explained below; \mathbf{e} are firm – specific (time – invariant) effects and u is the usual error term.

We extend this framework in two features: first we decompose the measure of offshoring; second, we consider that changes in labour demand as a result in any of the variables considered in equation (1) is not automatic, labour requires time to adapt so that a dynamic relation shall be considered instead.

The new equation considering a dynamic relationship and including both outsourcing and innovation activities is:

$$n_{it} = \mathbf{a}_0 n_{it-1} + \mathbf{a}_1 y_{it} + \mathbf{a}_2 w_{it} + \mathbf{a}_3 \text{offshoring}_{it} + (\mathbf{e}_i + u_{it}) \quad (2)$$

In order to analyse the relationship between outsourcing and employment, we use data for 28 Spanish manufacturing sectors for the period 1993-2002⁵. Variables are standard: **Employment** is measured by thousands of worked hours yearly for each sector; **Production** is added value (net sales minus intermediate goods) in € thousands; **Labour cost** is measured by labour related expenditure per worked hour in euros. These data are provided by the *Encuesta Industrial* (INE) and they are deflated for each sector by its industrial price index.

We now analyse which is the most appropriate estimation method. Our panel is short in terms of observations (28 sectors and 10 years) and it also has an important dynamic component. The existence of a lagged dependent variable among the regressors generates problems in standard OLS and within estimations. Furthermore our model contains endogenous and predetermined variables which point to the use of GMM techniques as the most suitable ones, more specifically GMM system technique (SYS-GMM) that also avoids problems of weak instruments due to short panel or autocorrelation in the variables (see Blundell and Bond, 1998). SYS-GMM estimator

⁵ To calculate different offshoring measures we employ the use matrices of the Spanish input-output tables, instead of the inter-industry symmetrical (commodity by commodity) matrices. Our decision is justified by data availability for the period 1993-2002, as we have at our disposal six use tables (1995-2000)⁵ for one symmetrical table, which allow us to take into account changes in the table coefficients. Also, we measure offshoring directly from the use matrices. It is possible to observe a very important change in the coefficients from 1995 to 2000. This is why to fill the gaps we estimate the data for 1993 and 1994 by extrapolating the growth rates of 1995-1998, and for 2001 and 2002 we apply the growth rates of 1998-2000

uses all possible lags of regressors as instruments to generate orthogonality restrictions. This estimation technique combines an equation in differences that uses suitable lagged levels as instruments, with an additional equation in levels with suitable lagged first-differences as instruments. The order and number of lags included for each variable depends on whether they are considered endogenous, predetermined or exogenous. The validity for this estimation technique is tested through the use of the Sargan test of over-identifying restrictions and m_1 and m_2 Arellano and Bond (1991) tests. We must be cautious about results: these techniques are optimal for large samples, while in sectoral studies like this one we only have at our disposal a limited number of observations.

5. EMPIRICAL ANALYSIS

Table 1 summarizes the results from our empirical application. For the standard determinants of labour demand, Table 1 shows consistent coefficients for added value, wages and the lag of labour. All three coefficients keep approximately constant in all regressions, with values close to those found by previous empirical studies and are significant in all cases.

We discuss in detail results for the decomposed offshoring variables. Three different proxies have been tried to capture offshoring effects. Column (1) considers the total offshoring variable (technical change + net offshoring). Column (2) shows the results for a part of the previous variable, technical change, while column (3) considers the other component of offshoring, net offshoring. Columns (4) and (5) include net intra- and net – inter offshoring, respectively. Finally, column (6) further investigates technical change and net offshoring decomposed jointly.

<Table 1 around here>

From these preliminary results we observe that offshoring seems to have a negative but not significant impact on employment (column 1). When we decompose this measure of offshoring into its different components, we can conclude that it is the element of technical change that is significantly reducing employment (column 2). In these years, technical change has increased the requirements of inputs per unit of output in industrial sectors on average. Spanish firms substitute direct employment by intermediate inputs

between 1993 and 2002, while it can generate indirect employment in other sectors and/or countries, especially in low-wage countries.

The impact of technical change becomes even clearer when we introduce the different variables together in the regression, as in column (6). Technical change becomes even more negative and significant while the measures of net intra-industry offshoring and inter-industry substitution are not significant.

The inter-industrial substitution, in column (6), has a positive coefficient, but it is not significant, probably because it collects a number of different structural changes, not all of them related to outsourcing (secondary production, energy, raw materials, etc), so its effect gets blurred. This measure implies the reduction of these inputs (domestic or imported) and the increase of the consumption of imported inputs in the main diagonal. The impact on sectoral employment is not clear theoretically, since these changes are not reducing the consumption of inputs previously produced inside the sector. This seems consistent with Feenstra and Hanson (1999) that point out narrow measures as being the most important.

The intra-industrial net offshoring, in column (4), with a negative coefficient, is not significant. We recall net intra-industrial offshoring is the measure we consider closer to the concept of substitution of domestic production for imported inputs. The fact that net intra-industrial offshoring does not appear to affect employment significantly might be explained by several reasons. First, there is a compensation effect within each sector between the providing domestic firms that reduce production and employment and the using firms that might increase their sales and employment due to the rise in competitiveness allowed by the offshoring. Secondly, the labour market in Spain is relatively rigid. Institutions and legal framework make dismissals difficult and encourage reassignments of employment to other tasks. Thirdly, and related to the previous point, offshoring moves industrial employment while it generates other services activities in the home country: sales, marketing, design, transport, trade, etc. Some of these tasks are included in the production of the industry where offshoring takes place.

6. CONCLUDING REMARKS

In this paper we have estimated the effects of offshoring on Spanish employment for 28 manufacturing for the period 1993-2002. Most of the recent literature focuses on foreign (or international) offshoring, as they consider that the major reason for contracting out some activities is to benefit from lower wages in other countries. In particular, some of those papers point to the substitution of low-skilled labour for imported inputs from abroad. We directly estimate the impact of offshoring on the level of manufacturing employment. Offshoring can decrease not only low-skilled labour but also some types of skilled labour that are cheaper abroad or provide flexibility in uncertainty scenarios.

We distinguish the evolution of the requirement of inputs per unit of output (how to produce) from the delocalisation of production to others countries. We call global technical change to the first element and net offshoring to the second. We found that technical change implies an increase in the imported intermediate inputs on average in the Spanish industry. We further decompose net offshoring into two factors: inter-industry substitution and net intra-industrial offshoring. This last one better quantifies the delocalisation of production to other countries looking for lower costs and it is more likely to affect employment. In Spain, it shows slow growth in the period observed.

From our results, offshoring seems to have a negative but not significant impact on employment. This is a result that we have already found in a previous study (Cadarso *et al.*, 2007). When we decompose this measure of offshoring into its different components, we can conclude that it is the element of global technical change that is significantly reducing employment. Spanish firms substitute direct employment by intermediate inputs between 1993 and 2002, while it can generate indirect employment in other sectors and/or countries, especially in low-wage countries. The factors of intra-industrial offshoring and inter-industrial substitution have no significant effect on employment. We explain this result as technical change affects firms in the same sector in a similar way, net offshoring has a different impact in employment: negative for domestic firms producing inputs and positive for firms increasing their competitiveness via offshoring.

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Table 1: Main results for different outsourcing variables

Estimation	SYS-GMM					
	Dependent variable: employment L_t					
L_{t-1}	0.8247 (11.0)***	0.8278 (11.7)***	0.8240 (10.8)***	0.8152 (9.90)***	0.8286 (12.0)***	0.8192 (12.7)***
$(Q-CI)_t$	0.1907 (2.46)**	0.1857 (2.43)**	0.1934 (2.46)**	0.2100 (2.48)**	0.1928 (2.51)**	0.1986 (2.98)***
GPH_t	-0.2163 (2.71)***	-0.2224 (2.84)***	-0.2130 (2.65)***	-0.2089 (-2.58)***	-0.2138 (2.92)***	-0.2170 (3.26)***
Offshoring _t	-0.1906 (1.31)					
Technical change _t		-0.5889 (1.80)*				-0.9708 (3.40)***
Net offshoring _t			-0.2459 (1.19)			
Net intra-ind offshor _t				-0.4611 (1.35)		-0.3070 (1.03)
Net inter-ind offshor _t					-0.0794 (0.321)	0.3795 (1.32)
Sargan test	0.024	0.019	0.039	0.239	0.052	0.058
m (1)	-3.546 (0.000)	-3.544 (0.000)	-3.549 (0.000)	-3.542 (0.000)	-3.576 (0.000)	-3.537 (0.000)
m (2)	-0.0598 (0.952)	0.0102 (0.992)	-0.0790 (0.937)	-0.0420 (0.967)	0.0073 (0.994)	0.0676 (0.946)

Notes:

1. Test shown are: p values for the null hypothesis of joint validity of the instruments for Sargan test of overidentified restrictions, and autocorrelation tests m (1) and m (2) (they are tests - with distribution $N(0,1)$ - on the serial correlation of residuals; p values in parentheses). The Sargan-test has a χ^2 distribution under the null hypothesis of validity of the instruments.

2. The GMM-SYS estimates shown are *one-step*, consistent with possible heteroscedasticity and more reliable than the *two-step* ones.

3. Asymptotic standard errors, asymptotically robust to heteroskedasticity, are reported in parentheses.

4. Data for 28 sectors and 10 years.

5. Year dummies are included in all specifications.

6. The equations are estimated using DPD for PcGive

7. The instruments used in column 1: $L_{i,t-2}$, $L_{i,t-3}$, $L_{i,t-4}$, $(Q-CI)_{i,t-2}$, $(Q-CI)_{i,t-3}$, $(Q-CI)_{i,t-4}$, $W_{i,t-1}$, $W_{i,t}$, $offshoring_{it}$, ? $L_{i,t-1}$ and ? $(Q-CI)_{i,t-1}$.

8. Instruments for column 2: same as in column 1 but $Technical\ change_{it}$ instead of $offshoring_{it}$.

9. Instruments for column 3: same as in column 1 but $Net\ offshoring_{it}$ instead of $offshoring_{it}$.

10. Instruments for column 4: same as in column 2 but $Net\ intra-ind\ offshoring_{it}$ instead of $Net\ offshoring_{it}$.

11. Instruments for column 5: same as in column 2 but $Net\ inter-ind\ offshoring_{it}$ instead of $Net\ intra-ind\ offshoring_{it}$.

12. Instruments for column 6: same as in column 2 and $Net\ intra-ind\ offshoring_{it}$ and $Net\ inter-ind\ offshoring_{it}$.

13. *** denotes the variable is significant at 1% level, ** significant at 5%, and * significant at 10%.

Variables:

- L: (log) total worked hours in each considered sector, thousands.
- VA (Q-CI): (log) net sales minus intermediate consumption (inputs) (€thousands).
- GPH: (log) labour cost per worked hour (€).