UNDERSTANDING OFFSHORING: IS SPAIN A LOW-COST OFFSHORE PRODUCTION SITE?*

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ABSTRACT

Like in other advanced countries, offshoring of production is becoming a significant strategy in Spanish industries. However, the most commonly used indicator, the increase in imported intermediate inputs in relation to industry output, does not reveal the direction of the strategy. The aim of this paper is to examine that direction through the effects of offshoring on the relative demand for labour in Spanish industry during the nineties, specifically in relation to changes in the relative composition of employment and wage gaps. A GMM approach is used to estimate a dynamic panel data model which incorporates immigrant labour and temporary employment rate as explanatory variables. Our econometric results suggest that, as opposed to most developed countries, offshoring in Spain has favoured the demand for blue collar workers as well as it has contributed to a narrowing of the wage gap between white collar and blue collar workers. According to these findings, we can infer that global production networks are using Spain as a low-cost location in medium and high technology industries taking advantage of the lower labour cost in the European context.

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1. INTRODUCTION

This study examines the direction of the offshoring of production in Spanish industry through its effects on the relative demand for labour. Offshoring is a strategy involving the international fragmentation of production consisting of certain material or service inputs that were previously produced within the company and the domestic economy, but switch to being provided for from abroad either by independent suppliers or by companies that are associated in the form of shareholders.

Although public attention seems to be increasingly more focused on the offshoring of services, this research study is limited to the offshoring of materials (or production) in manufacturing industries and the motive is twofold. Firstly, because, as Amiti and Wei (2005) and Hijzen (2005), among others, comment, although the offshoring of services in developed countries has rapidly increased in recent years, its intensity is still low compared with the offshoring of production in the manufacturing sector. Secondly, because, as argued by Kirkegaard (2004), its effects on the demand for labour, i.e. most of the jobs lost between 1999 and 2002 in the category that the author calls “occupations with a risk of offshoring”, were not related to services but to manufacturing industries.

In Spanish industry, the offshoring of production has become an increasingly more implanted strategy in keeping with a trend that has arisen in recent decades in the most advanced economies. However, the most commonly used indicator of offshoring, the increase in imported intermediate inputs in relation to industry output, does not reveal the direction being adopted by the increasing internationalisation of production. It may reflect the displacement towards economies where there are advantages in terms of wages in the lower skilled jobs and labour intensive intermediate phases, thus being supplied from abroad with intermediate goods that are later transformed into the final product within the country itself (e.g. the relocation of the intermediate phases of dressmaking to low income countries); or on the other hand, it may reflect the localization in the country of assembly plants of imported components which are part of international production networks. Naturally, the economic consequences derived from this for the national industry are different in either case, hence the interest in determining the direction of offshoring.

Empirical analyses show how offshoring in the most advanced economies involves the displacement of the phases of the production process that are the most intensive in low skilled jobs and, by definition, more routine task, to low cost locations, thus having an adverse effect
on lower category workers. On the other hand, evidence from the less developed countries, such as those of Eastern Europe, suggests an effect that is biased in favour of that category of worker.

Spanish industry shares traits with those of both types of country. On the one hand, its lesser input into research has left it considerably adrift of the main European and world leaders in terms of technology and knowledge, and it forms part of a broad group of countries that characteristically base their competitive advantage on their having lower production costs than those of the more developed countries, offering a good price-quality ratio. Moreover, the model of Spanish growth has been based on overdependence on mature, labour intensive industries, in which there have been scarce gains in productivity. What is more, while offshoring is strongly connected to the development of Spanish industry’s propensity for export, the possibility has been suggested that Spain is, in some areas of production, participating in international production networks, being used by other advanced countries as an assembly plant and, therefore, for export to foreign markets. However, there is no doubt that in the world context, the Spanish economy possesses relatively high levels of income and wages, which has led to the disappearance of the labour advantages it held in Europe until expansion, and it is therefore quite feasible that one of the objectives of the internationalisation of its industrial companies should be to obtain cost-related advantages by displacing phases of production towards less developed countries.

In this research study we seek to explore the direction being taken by the offshoring of Spanish manufacturing by studying its effect on the labour market, specifically in relation to changes in the relative composition of employment and wage gaps. This is a new approach in the empirical literature that will tell us more about the role played by offshoring in industry in intermediately developed countries. Another contribution of the study is the incorporation of immigration as a factor that explains the alterations in the composition of labour, and which is perhaps being used as a substitute for offshoring strategies, mainly in the early years of the 21st century, when the major increase in flows of immigrants has happened together with a slowing down of offshoring.

The structure of this study is as follows: after this brief introduction, the following section summarises the main contributions that have been made previously in international empirical literature studying the impact of the offshoring of production on the demand for labour. We then provide a brief descriptive analysis of the existence and evolution of offshoring in
Spanish manufacturing industry since the early nineties, as well as the changes in the relative composition of labour and the wage gap between the different professional categories of workers. The fourth section presents the model to be estimated and the results of the econometric estimation. Finally, the fifth section presents the conclusions and final considerations that can be drawn from the study.

2. REVIEWING THE LITERATURE

The effects of offshoring on the level and composition of the demand for labour has especially been studied in the more developed countries where the possible loss of jobs associated to the displacement of parts of the production process has generated considerable concern. Unlike what happen to respect to its effects on the level of employment, there is wide consensus among the studies that analyse the changes in the composition of labour and the wage gap between workers.

The offshoring of production as a form of organising business production that involves the displacement to other countries of the most routine phases of production, which are generally the most labour intensive and least demanding of skilled labour, has a more intense effect on workers that are mainly linked to the physical production of goods (operators, manual or blue collar workers). So, as commented by the main contributors to theoretical literature on the topic (Feenstra and Hanson, 1996 and 1999; Kohler, 2001 and 2004), offshoring affects the labour market in the country from which part of the production process is relocated, increasing relative demand for high-skilled workers (non manual or white-collar employees) and increasing wage inequalities between white-collar and blue-collar workers.

Despite using different methodologies, the empirical studies for advanced economies find a considerable reduction in the participation of workers that perform roles that are more directly associated to the physical production of goods. This is corroborated by, among others, the studies by Feenstra and Hanson (1996) for the USA, Helg and Tajoli (2005) for Italy, Strauss-Kahn (2004) for France, Hijzen et al. (2005) for the United Kingdom and Dell’mour et al. (2000) for Austria. Similarly, the greater relative demand for non manual workers

1 Díaz-Mora et al. (2007).
2 Although this does not mean that the strategy is necessarily detrimental to blue-collar workers. Authors like Grossman & Rossi-Hansberg (2006) maintain that although it effectively increases the wage gap, in the long run increases can be obtained in the wages of both groups of workers if the savings in costs derived from offshoring lead to an improvement in the efficiency of production and the competitive position of the fragmented company. Other theoretical contributions such as that by Arndt (1997, 1999) and Jones and Kierzkowsky (2001) also show that, in certain and restrictive cases, offshoring can improve the employment conditions of blue-collar workers and narrow the wage gap between both groups of workers.
implies alterations to the relative costs of both types of labour in benefit of the job categories that are least affected by the relocation, in such a way that offshoring leads to a widening of the wage gap between the two sets of workers. Most of the empirical studies of this effect confirm this result. Such is the case with Feenstra and Hanson (1999) for the USA, Hijzen (2003) for the United Kingdom and Geishecker and Görg (2005) for Germany.

However, we have to consider, as indicated by most research studies, that technological progress works in the same direction as offshoring, stimulating the demand for more highly skilled workers, which principally means those of a higher labour category, and increasing the inequalities between the wages earned by skilled and unskilled workers. In fact, many of the studies find that technical progress is the primordial cause for the widening of the wage gap and changes in the composition of labour.

Meanwhile, the background literature also indicates that there have been different responses depending on the flexibility of national job markets. In economies that typically have highly rigid job markets, as is the case with most European economies\(^3\), the incidence of offshoring is basically manifested in the form of changes in the composition of labour, with very few alterations in terms of relative salaries; which is the opposite to what happens in countries with more flexible job markets.

According to the predictions of main stream economic theory, the consequences of offshoring are quite clear for the countries that receive offshored activities: since offshoring predominately involves low-skilled segments of productions, blue collar workers should benefit in destination countries\(^4\). However, there are few empirical analyses of the less developed economies that receive the relocated phases. One outstanding case is the study by Egger and Stherer (2003), which analyses the effect of offshoring on three eastern European countries (Czech Republic, Hungary and Poland) during the 1990s and they find a favourable bias in favour of the employment and wages of less qualified labour, which has led to a decrease in the wage gap. While the skill premium in all three countries has risen over the

\(^3\) According to OCDE data on Employment Protection Legislation (EPL), the countries with the highest level of labour rigidity are the USA, United Kingdom and Canada with values of around 0.2-0.8, so their labour markets can therefore be considered flexible; as opposed to most European economies with rigid labour markets, which include Portugal, Spain and France, whose indexes are over 3.

\(^4\) The relative increase in workers not associated directly to production and their wages as observed by Feenstra and Hanson (1997 and 1999) for the Mexican economy may pose a problem for this interpretation. Their estimation show that FDI into the maquiladora sector, that is closely associated with the offshoring activities, can account for a large portion of the increase in the skilled labour share of total wages and an associated shift in relative wages. However, the explanation for this behaviour, which is so different to theoretical predictions, that the phases relocated by North American companies are more intensive in skilled labour than the activities that were previously done in Mexico is not easily transferred to Spanish industry.
period, offshoring activities have helped to contain this rise\textsuperscript{5}.

A revision of the theoretical and empirical literature reveals a different impact of offshoring on the composition of labour and the wage gap in the countries that develop the strategy and the countries that receive the relocated phases; and we may therefore come closer to determining the direction taken by offshoring through an analysis of the effect of offshoring on the relative demand for labour and relative wages.

3. OFFSHORING AND EMPLOYMENT STRUCTURE

3.1 The offshoring phenomenon

Before making an empirical estimation of the effects of offshoring on the national labour market, it would be useful to learn how this strategy for organising production has been implanted in Spanish industry from the early nineties to the present. To measure it, we will use the narrowed indicator of offshoring, i.e. the variation in the import of intermediate goods by the same branch of industrial activity relative to industry output.

Thus defined, the offshoring of production has played an increasing role in the Spanish manufacturing industry from 1990 to 2005. The dependence on the import of intermediate goods in the manufacturing sector increased from 7.2\% in 1990 to 11\% in 2005, and experienced an increase of just over 50\% for the same period. The dynamics of this strategy were particularly intense in the late nineties when the rate increased by 2.5 percentage points to the extent that imported inputs reached the level of 10.4\% of production (graph 1).

\textbf{Graph 1: Dependence on Imported Inputs in the Spanish manufacturing industry}
\par (CIM/VP in percentage, 1990-2005)

\textsuperscript{5} Bruno \textit{et al.} (2005) find that FDI has not worsened inequality by favoring labor demand shifts in the three countries.
Moving down to an analysis by sectors, we find that for the five-year period from 1995-2000, the increase in offshoring was shared by most branches. The manufacturing industries where offshoring was most relevant for this period were, in descending order, the branches with high technological content, such as Office machinery and computer systems, Electric and Electronic machinery and materials, Motor vehicles and trailers, and more labour intensive manufacturing sectors, such as the Textile industry and the Wood and cork industry.\footnote{A thorough exploration of the offshoring of production in different branches of activity of Spanish industry from 1995 to 2004, the problems with measuring it and indicators, can be found in Díaz-Mora et al. (2007).}

### 3.2 Relative wages and employment

Although most earlier studies identified workers associated to production as being the least skilled\footnote{A thorough exploration of the offshoring of production in different branches of activity of Spanish industry from 1995 to 2004, the problems with measuring it and indicators, can be found in Díaz-Mora et al. (2007).}, given the peculiarities of the Spanish economy and the predictable lack of correspondence between the level of training and the professional activity of the workforce, in this study we have adopted the distinction between the categories of “Employees” and “Operators” that the Instituto Nacional de Estadística (National Institute of Statistics) used in the Encuesta de Salarios en la Industria y los Servicios (Survey of Salaries in Industry and Services). Therefore, “Employees” are identified with work that is not directly associated to production tasks (non-production or white-collar workers) while “Labourers” are those that do jobs that are directly related to the physical production of goods (production or blue-collar workers).
When we analyse the evolution of the relative employment according to the professional categories considered in Spanish industry (measured as the average number of Employees compared to the number of Operators), we observe how the occupations of Employees increased at a faster rate than those of Operators over the 1990-2000 period, which suggests an increase in relative employment in favour of workers in the higher professional categories (1.24% in total) (table 1). This evolution is a common trend in many advanced countries. However, the profile over time shows that there was a break in this increasing tendency midway through the decade and there has been a change in the relative composition of employment since then in favour of blue collar workers (table 1 and graph 2). So although for the first five years of the nineties there was a very slight increase in the employment of higher labour categories (0.42% annual cumulative) while there was a major decrease in the number of blue-collar workers (-3.64%), in the second half of the decade there was a significant increase in both groups of occupations, although the most pronounced of these increases was that of workers in the lower professional category (increase of 4.01% as opposed to 2.3%) which altered the relative structure of employment in favour of blue-collar workers in the latter part of the period. This is, without any doubt, a peculiar aspect of Spanish industry that is not shared by other advanced economies.

### Table 1: Employment by categories of worker

<table>
<thead>
<tr>
<th>(Annual cumulative variation rates)</th>
<th>Employees (LE)</th>
<th>Labourers (LO)</th>
<th>(Employees / Labourers) (LE / LO)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990-2000</td>
<td>1.35</td>
<td>0.11</td>
<td>1.24</td>
</tr>
<tr>
<td>1990-1995</td>
<td>0.42</td>
<td>-3.64</td>
<td>4.21</td>
</tr>
<tr>
<td>1995-2000</td>
<td>2.30</td>
<td>4.01</td>
<td>-1.64</td>
</tr>
</tbody>
</table>

Source: Authors’ own work based on ESIS, Contabilidad Nacional and EIE (INE)

Meanwhile, the evolution of the relative wages over the period of study was not uniform either (graph 3). While in the eighties major increases were noted in the wage gap in favour of white-collar workers, in the nineties the tendency for wages to drift apart slowed down although there was a slight increase after 1995.  

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7 This approach was widely used in the literature showing that the correlation between workers that are more skilled, non manual and not linked to production was very high (Berman et al, 1994 and 1998; Machin and Van Reenen, 1998; Head and Ries, 2002; Egger and Stherer, 2003).

8 A thorough revision of the national and international empirical evidence of the development of the wage gap is provided by Carrasco (2006). According to the author, in most countries in the eighties, relative wages increased in favour of more skilled workers or those situated in the highest percentiles in terms of wage distribution, thus increasing the wage gap; however, in the nineties these inequalities did not increase or only did so very slightly. However, some studies of the Spanish economy that distinguish between skilled and unskilled workers
Graph 2: Evolution of the ratio (No of Employee workers / No of Operators workers) for Spanish industry, 1990-2000

Graph 3: Evolution of the ratio (Employees’ wages / Operators’ wages) for Spanish industry, 1981-2000

Source: Authors’ own work based on ESIS, Contabilidad Nacional and EIE (INE)

The changes in the relative employment in industry may be the result of alterations in the composition of employment in the different manufacturing sectors derived, for example, from technological progress or the offshoring of production and labour associated to more routine task; i.e. a greater relative demand for labour in the higher labour categories “within” each of depending on the education level of the employees find that in the eighties there was barely any variation in the distribution of salaries (Minondo, 2000) or that it even decreased (Abadie, 1997).
the industries. But trade of final goods, as argued by the *Stolper-Samuelson* theorem, also generates alterations in the composition of labour “between” industries because it enables developed countries to specialise in those final products with higher levels of skills. In order to delimit the extent to which they can simply be attributed to structure productive changes, and following Berman *et al.* (1994), the change in the aggregated participation of blue-collar workers (Labourers) in the total employment in the industry is broken down into two factors: the change in the distribution of employment that occurs “within” industries (“within” component) and the change in the distribution of employment that occurs “between” sectors (“between” component).

\[
\Delta \left( \frac{L^o}{E} \right) = \sum_{i=1}^{n} \Delta \left( \frac{L^o}{E} \right)_i \times E_i + \sum_{i=1}^{n} \Delta E_i \times \frac{L^o}{\overline{E}}
\]

*Within Component*  
*Between Component*

where \( L^o \) is the number of *Operators* workers and \( E \) represents the total manufacturing employment; the line over the variable denotes the average value for the period analysed and \( n \) is the number of manufacturing activities considered.

By using a shift-share analysis, the results presented in table 2 show that between 1990 and 2000 the decrease in the relative participation of lower category workers in Spanish industry was of 1.41 percentage points, of which 1.38 percentage points can be attributed to changes in the composition of labour that occurred “within” industries, while only 0.03 percentage points are attributable to alterations “between” industries. Therefore, the changes in the relative composition of labour are common to most industrial sectors. This evidence, in which other economies also participate\(^9\), is confirmed for both five-year periods; although, unlike what happened in the early years of the decade, in the second half there was an increase in the participation of Labourers in the total labour force of Spanish manufacturing industries, mainly “within” the sectors of the industrial activity itself.

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Table 2: Intra and inter-sector breakdown of changes in the participation of Operators in total manufacturing employment

<table>
<thead>
<tr>
<th></th>
<th>Within</th>
<th>Between</th>
<th>Total</th>
<th>Within / Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990-2000</td>
<td>-1.38</td>
<td>-0.03</td>
<td>-1.41</td>
<td>97.7 %</td>
</tr>
<tr>
<td>1990-1995</td>
<td>-3.77</td>
<td>-0.27</td>
<td>-4.04</td>
<td>93.4 %</td>
</tr>
<tr>
<td>1995-2000</td>
<td>2.40</td>
<td>0.23</td>
<td>2.63</td>
<td>91.3 %</td>
</tr>
</tbody>
</table>

Source: Authors’ own work based on ESIS, Contabilidad Nacional and EIE (INE)

Once we have discarded the idea that the alterations in the demand for labour in Spanish industry over the last decade were the consequence of structural changes, we have to ask what factors do lie behind these changes in the structure of the relative demand for labour between white-collar and blue-collar workers. Many studies investigating this behaviour in employment structure seek to interpret its evolution in terms of two doctrinal viewpoints. The first of these maintains that it is technological progress that has carried the greater weight in said tendency: given that new technologies are a complementary element to more skilled workers but a substitute for unskilled labour, its effects on the labour market tend to favour higher category occupations 10.

The second view considers that the origin of the changes lies in the increasing expansion of international trade11. The increase in trade liberalization, competitiveness and technological progress has made it possible for there to be progressive integration of markets and reassignment of productive capacity on an international scale. Companies in advanced countries can consider improving their efficiency by replacing their national suppliers of intermediate inputs or more labour intensive components with cheaper foreign suppliers, or otherwise might transfer their more routine and labour intensive phases of production to countries with lower relative wages to then re-import the segmented production. By doing so, they seek to find the best location for their production, or part of it, by placing it where the costs, and fundamentally labour costs, are comparatively lower and, moreover, offer a good setting (good transport infrastructures and communications, healthy economic climate, political stability, access to international markets, etc.); and even more so when the indicated conditions arise in markets that are notoriously expanding (e.g. China, India or the Eastern

10 Berman et al. (1994, 1998), Autor et al. (1998)
11 Feenstra (1998) states that the previous studies of the negative effects on less qualified workers in developed countries centred their debate on two explanations considered to be substitutive, technological change and international trade, but if there is also trade of intermediate goods, he considers the two explanations to be complementary, hence generating similar effects on employment.
European economies that have recently entered the EU). So, while the classic theory of international trade has traditionally focused on the foreign exchange of final goods (exchanges “between” industries), the trade in intermediate inputs and the offshoring of production imply intra-industrial and intra-product exchange, which could lead to very different results in terms of the effects on variations in the relative structure of employment “within” industries, between workers of different levels of skills and/or categories of jobs.

The econometric analysis made in the following section, apart from delimiting the direction of offshoring, will enable us to discern the incidence of technological change and offshoring on changes in the composition of labour and the wage gap.

4. ECONOMETRIC ANALYSIS

4.1 Model and methodology

In the formulation of the model to be evaluated we followed a similar specification to that originally adopted by Berman et al. (1994). The starting point for obtaining the econometric model is a cost function for each industry. If firms seek to maximise profits and the isoquants of the production function are convex, there is a variable unit cost function for each industry that, in this case, can be affected by two different types of structural variable: offshoring of production and technological change:

\[ CV_i = CV \left( w_i^E, w_i^O, Y_i, \frac{K_i}{Y_i}, \text{OFFS}_i, \frac{(I + D)_i}{Y_i} \right), \]

This unit cost function can be approached, in the short term, by a general translog cost function, with variable and quasi-fixed inputs, developed by Brown and Christensen (1981). So, considering that industry \( i \) produces an output \( Y \), the variable production factors are the workforce in the two categories considered (white collar Employees (E) and blue collar Operators (O)) and the capital is the quasi-fixed input, after a series of derivations and applying Shepard’s Lemma\(^{12}\), we obtain the following equation for the relative demand for labour:

\[ S_i^E = \beta_E + \beta_w \ln \frac{w_i^E}{w_i^O} + \beta_Y \ln Y_i + \beta_K \ln \frac{K_i}{Y_i} + \beta_I \ln \frac{(I + D)_i}{Y_i} + \beta_O \text{OFFS}_i + u_{it}, \]

\(^{12}\)The application of the Shepard lemma makes it possible to derive the function of the demand for labour, on the basis of a cost function, through a partial differentiation with respect to \( w \). That is to say, \( L = \frac{\partial CV}{\partial w} \)
where $S_{it}^{E}$ is the participation in labour costs of the *Employee* salary costs:

$$
\left( \frac{w_{it}^{E} \times L_{it}^{E}}{w_{it}^{E} \times L_{it}^{E} + (w_{it}^{O} \times L_{it}^{O})} \right).
$$

$W_i$ the wages per worker; $L_i$ the number of workers; $Y_i$ is the real production; $(K_i/Y_i)$ expresses the quasi-fixed input that expresses the intensity of capital; $(I+D)/Y_i$ is the research and development investment made by each industry $i$ over production as a measure of technical change and, OFFS$_i$ is the indicator of offshoring of production, i.e. the changes in the percentage of intermediate inputs imported over product unit.

In many applications of the translog cost function the prices of the variable inputs $(w_{it}^{E}/w_{it}^{O})$ are excluded from the estimations. According to Feenstra and Hanson (2003) and Berman *et al.* (1994), it is possible to eliminate the term for relative wages from the right hand part of the equation because the wages of a certain type of worker in a specific industry are based on the inherent characteristics of the workers in that industry, in such a way that they will have little impact on the wages of workers in another industry. Also, their inclusion is based on the assumption that wages are an exogenous variable to the industry, which is what would occur if the workforce were perfectly mobile between sectors but if that is not the case, and there are specific salary gains in each industry, wages cannot be considered exogenous. However, excluding the costs of productive factors from the estimations would mean incurring upon a potential problem with omitted variables. Moreover, although the definition the relative salary variable is correlated with the dependent variable, including it in the specification of the model enables us to control for any variation in the composition of the dependent variable, leaving the remainder of the variations in reference to relative labour to be explained by other exogenous variables specified in the equation. Therefore we opted to include them.

From the original equation of the relative demand for labour, two specifications can be deduced for estimation. First there is equation (1) which can be used to compare the effect of offshoring on changes in the relative labour between categories of workers and, secondly, there is specification (2), which considers the effects on the wage gap between *Employees* and *Operators*.

$$
\frac{L_{it}^{E}}{L_{it}^{O}} = \beta_{w} + \beta_{w} \Delta \ln \frac{W_{it}^{E}}{W_{it}^{O}} + \beta_{Y} \Delta \ln Y_{it} + \beta_{K} \Delta \ln K_{it} + \beta_{Y} \frac{(I+D)_{it}}{Y_{it}} + \beta_{O} \text{OFFS}_{it} + \beta_{INM} + \beta_{T} \Delta \text{TEMP}_{it} + \Delta u_{it} \tag{1}
$$
Given that our interest is focused on examining the effect of offshoring on alterations to
the relative structure of labour and wages, the variables in the model have been entered in
differences, approximated on the basis of the annual variation rates except for the variable that
measures technical change. The measurement of the variables and statistical sources from
which the information is taken from are detailed in the statistical annex.

As for the signs of the variables entered in the model and in accordance with the results
obtained by many of the empirical studies made in this respect, the following econometric
results are expected. The expected sign for the relative coefficient of relative wages in
equation (1) is negative ($\beta_w<0$); i.e. relative increases in the costs of Employee workers will
favour a greater demand for Operators. However, this will depend on the complementariness
between both types of worker.

With respect to the sign of the effect of real production, a priori it may seem ambiguous.
If $\beta_Y$ is positive it would mean that an increase in the scale of manufacturing production
would lead to a relative increase in Employees and their salary. If $\beta_Y<0$ the increase in labour
is generated in favour of Operator workers, which does not mean that when an industry
increases its scale of production, it does not need more highly skilled workers if these
correspond to those of a higher job category; it will possibly demand more labour from higher
job categories, but in the same proportion as that in which production is increasing, for
example, if production doubles, it does not necessarily have to require twice as many directors
or advisors, but will need more Operators. Most studies find a positive correlation between an
increase in the scale of production and an increase in more skilled labour, therefore, we expect
a positive sign of the effect of real production on changes in labour and relative wages.

The sign of the coefficient of capital ($\ln \frac{K}{Y}$) is, a priori, uncertain; it depends on
whether the labour that is less linked to physical production complements ($\beta_k > 0$) or
substitutes ($\beta_k < 0$) capital in the industrial production process. Generally, it acquires a
complementary nature$^{13}$ and, in this sense, the coefficient is expected to be positive.

\[ \Delta \frac{w^p_{it}}{w^O_{it}} = \beta_w \Delta \ln Y_{it} + \beta_k \Delta \ln \frac{K_{it}}{Y_{it}} + \beta_Y (1+D)_{it} + \beta \Delta \text{OFFS}_{it} + \beta_1 \Delta \text{INM}_{it} + \beta_2 \Delta \text{TEMP}_{it} + \Delta u_{it} \]
The $\beta_T$ parameter reveals the effects of technological change, in such a way that a positive value of the same ($\beta_T > 0$) will indicate that a greater investment in R+D has a positive effect on the increase in the employment and wages of Employees. Authors like Berman et al. (1994) among others, defend the idea that new technologies are a complementary factor of skilled labour such that technical progress will favour the relative demand for workers in higher labour categories. The empirical literature has commonly employed as a proxy measure of technological change the investment in research and development for each branch over the production value or added value.

The impact of the offshoring of production in changes in the relative structure of labour is revealed by parameter $\beta_O$. As has been shown, a positive impact is expected in the economies that displace the most routine and labour intensive parts of the production process to geographical locations where there are lower relative costs, generally the more developed countries, and a negative sign in the countries that receive that displaced production either for it to be assembled and then exported or for it to be incorporated in later stages of the process of manufacturing the final goods.

A relevant contribution to this work in the literature on offshoring is the inclusion of immigrant labour (INM) and the temporary employment rate as variables that explain the changes in the composition of labour.

The study by Borjas, Freeman and Katz (1997) could to a certain extent be considered a precedent given that, although it does not specifically consider offshoring, it takes into account the joint incidence of trade and immigration on the wage gap. Spanish industry in the analysed period has experienced a major increase in the presence of immigrant workers in the employed population (it has risen from 0.26% in 1990 to almost 2% in 2000 and a little over 8% in 2005). The intense incorporation of immigrants in the supply of labour has basically favoured the expansion of the most labour intensive occupations and those which require low qualifications, so this variable is expected to be negative ($\beta_I < 0$) leading to a relative demand for labour of a lower category. Moreover, immigrant labour seems to have been more of a complement than a substitute, in other words, the increase in the rate of

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14 Borjas, Freeman and Katz (1997) considered that “trade, immigration and the flow of international capital” are potentially substitutive methods for making up for the lack of factors in an economy. They suggest that although empirical studies of trade and immigration have traditionally been made independently, this is not the most adequate method if they are substitutive ways of altering the national proportion of factors. Hence, they examine the influence of immigration and trade with less developed countries on the United States employment market between 1980 and 1995, finding that immigrant labour explains between 27-55% of the increase in the wage gap between skilled and unskilled workers, while trade accounts for 10%.
employment of immigrant workers has not led to a reduction in the rate of employment of 
Spanish workers, which excludes any phenomenon by which some workers are being 
replaced by others. The hypothesis being considered is that immigrant employment could be 
being used as a substitute for offshoring strategies\textsuperscript{15}. If that is the case, it might help explain 
the slowing down of the offshoring of production since 2000.

As for the temporary employment ratio, since the introduction of temporary contracts not 
associated to the causality principle in the labour reform of 1984, said type of contract has 
undergone considerable expansion, going from 3\% of total manufacturing employment in 
is the lower cost of finishing contracts and greater flexibility that make it possible to make 
adjustments in cases of possible fluctuations in the demand for their products. However, the 
little analysis that has been made of this indicates that the resource of temporary contracts 
does not affect all workers in the same way. Davia and Hernández (2004) find an inverse 
relation between the temporary employment rate and the professional category of workers, 
such that in higher categories, which correspond to our definition of non manual workers, 
there are substantially lower temporary employment rates than those more associated to 
physical work. The causes can be attributed to fewer requirements for training in manual jobs 
which make it more feasible for there to be a larger amount of job rotation. However, 
company managers are more reticent to opt for temporary contracts in the categories that 
generate a higher added value per product unit and that have higher skills (generally, those 
that are not manual) in order to guarantee that the worker will stay linked to the company. So, 
a negative sign is expected for this variable, given that increases in the percentage of 
temporary workers will generate a higher proportion of manual workers.

The specifications proposed for the model are considered for the 1990-2000 time period 
and for an industrial desegregation that considers the 19 manufacturing activities at 2-digit 
level of NACE Rev.3. In this model’s estimation of panel data, different econometric 
difficulties can arise. The first is the existence of “unobserved heterogeneity”, i.e. the 
presence of unobserved characteristics or individual effects in the different branches that each 
contain intrinsic differences and that the explanatory variables are not able to reflect. The 
Breusch-Pagan test made after enables us to reject the null hypothesis of the absence of

\textsuperscript{15} This hypothesis has been used by Navaretti, Bertola and Sembenelli (2008) for a set of Italian companies. 
Other studies that have tried to analyse the relation of complementariness or substitutability between flows of 
immigrant labour, foreign investment and offshoring are those by Murat and Paba (2004) also for the Italian 
economy; Buch et al. (2005) for Germany and Kirkegaard (2005) for the USA.
heterocedasticity; hence there is a need for estimation techniques that can correct this\textsuperscript{16}. The second is the possible endogeneity of some of the regressors. Moreover, the explanatory variables included the delayed dependent variable to make the model dynamic. These difficulties suggested that the technique to be used to consider the model should be the Generalized Method of Moments (GMM) developed by Arellano and Bover (1995) and Blundell and Bond (1998)\textsuperscript{17}.

The consideration of the endogenous nature of the explanatory variables is resolved by recurring to economic logic and one’s own intuition as, in principle, it is not easy to know which variables are endogenous. That is not the case with relative wages, which we clearly consider to be of an endogenous nature. So, while in Spanish manufacturing wages and the relative employment of workers are determined simultaneously, even in a rigid labour context like the Spanish job market, the relative wage variable cannot be considered exogenous, demanding the use of instrumental variables to guarantee that consistent estimators are obtained. For other variables like offshoring or immigration the endogenous nature is more questionable and hence there is no consensus in the empirical literature. The offshoring of production has been considered to be an exogenous variable in many empirical analyses. The justification lies in the fact that other external factors such as the deregulation of trade and progress in information and communication technologies have determined the evolution of this strategy for organising production in recent years. However, in our estimation for the Spanish economy its endogenous nature could be defended as occurs with the other variable, immigration, on the basis of the fact that the greater relative demand for labour of lower professional category could be favouring a greater use of offshoring strategies in the Spanish economy, on the one hand, and greater attraction of immigrants, on the other. Finally, technological change will be considered endogenous\textsuperscript{18}.

4.2 Econometric results

The results of the econometric analysis on the basis of Generalized Method of Moments of the changes in the composition of labour (specification 1) and the wage gap (specification 2) are shown separately in Table 3. Column (1) of the first specification of the model, which only considers the endogeneity of the relative wages, enables us to verify the significance of

\textsuperscript{16} For the specification (1): $\chi^2 (1)= 23,15 \ p(\text{value})=0,0000$; for the specification (2): $\chi^2 (1)= 2,81 \ p(\text{value})=0,093$.

\textsuperscript{17} In the presence of heterocedasticity, the estimation of the model using the Instrumental Variables technique is not consistent while the GMM estimator is (Baum et al., 2003)
relative wages, real production, capital intensity, technical change and the offshoring of production. In the first four variables the expected signs are obtained, in line with those obtained by the empirical literature on the subject. The same does not occur with the incidence of offshoring, where the results reveal an adverse impact on Employee workers. In other words, the international fragmentation of production in Spanish industry during the nineties favoured an increase in workers of lower job categories, as opposed to what happened in other developed countries. This result leads us to deduce that the main direction adopted by offshoring strategies in Spanish industry is different to that of more advanced countries.

As for the immigrant labour variable, as was to be expected, the negative and significant coefficient shows that the increasing presence of immigrant workers in the industry has led to changes in employment in favour of lower job categories (Hanson and Slaughter, 1999). From the perspective of international trade theory, the international flow of the labour factor from underdeveloped countries towards highly developed countries should generate in the latter a substantial increase in labour resources, altering their capital-labour ratio and leading to a tendency towards lower wages and the reinforcement of specialisation in labour intensive production. The absolute value of the coefficient also indicates to us that its impact on the Spanish manufacturing labour market in the nineties was less than that caused by the offshoring of production. With this in mind, we should consider that the phenomenon of immigrant labour started to gain in importance in the late nineties.

The temporary employment rate, according to the predictions, also presents a significant and negative effect indicating that the increases in the proportions of temporary workers favoured changes in employment in favour of manual employees.

Finally, given that a dynamic specification has been adopted, the econometric results for the Spanish manufacturing labour market show that the changes in the relative structure of employment are not persistent, in other words, the increases in the relative amount of skilled

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18 The empirical literature has no clear criteria when it comes to considering the endogenous or exogenous nature of technological change. In considering it an exogenous variable we also find the studies by Geishecker (2006) and Ekholm and Hakkala (2006) among others.

19 This result is opposed to those presented by Minondo and Rubert (2006); the only estimation for Spanish industry about the effects of offshoring on relative employment composition. But we should indicate the uneven analysis period, 1986-1994, and the fact that the authors consider qualifications rather than job categories when distinguishing between the groups of workers affected by offshoring.

20 This will, however, depend on the number of migratory flows, the relative level of qualifications of the immigrant population with respect to the national active population in the host country, and the employment rate and level of rigidity or flexibility in terms of wages, both for the job market as a whole and for the special occupational categories.
labour in a certain year do not have any effect on the variations in the following period.

Table 3: Offshoring and Labour structure in Spanish industry  
(GMM system estimation in one step21)

<table>
<thead>
<tr>
<th>Dependent Variable: $\Delta \left( \frac{L^E}{L^O} \right)_t$</th>
<th>Parameters</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Delta \left( \frac{L^E}{L^O} \right)_{t-1}$</td>
<td>0.141</td>
<td>0.010</td>
<td>-0.012</td>
<td></td>
</tr>
<tr>
<td>(0.136)</td>
<td>(0.076)</td>
<td>(0.048)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta \ln \left( \frac{W^E}{W^O} \right)_t$</td>
<td>-9.466***</td>
<td>-7.301***</td>
<td>-6.744***</td>
<td></td>
</tr>
<tr>
<td>(2.597)</td>
<td>(2.103)</td>
<td>(1.928)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta \ln Y_t$</td>
<td>6.054**</td>
<td>4.851**</td>
<td>4.488*</td>
<td></td>
</tr>
<tr>
<td>(2.738)</td>
<td>(2.573)</td>
<td>(2.489)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta \ln \left( \frac{K}{Y} \right)_t$</td>
<td>3.345***</td>
<td>2.867***</td>
<td>2.698**</td>
<td></td>
</tr>
<tr>
<td>(1.166)</td>
<td>(1.032)</td>
<td>(1.059)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$(I+D/Y)_t$</td>
<td>1.040*</td>
<td>1.000*</td>
<td>0.947</td>
<td></td>
</tr>
<tr>
<td>(0.606)</td>
<td>(0.588)</td>
<td>(0.603)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OFFS$_t$</td>
<td>-0.194**</td>
<td>-0.264**</td>
<td>-0.232**</td>
<td></td>
</tr>
<tr>
<td>(0.087)</td>
<td>(0.120)</td>
<td>(0.098)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta \ln \left( \frac{K}{Y} \right)_{t-1}$</td>
<td>-0.017*</td>
<td>-0.021**</td>
<td>-0.018**</td>
<td></td>
</tr>
<tr>
<td>(0.009)</td>
<td>(0.008)</td>
<td>(0.008)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta \ln Y_{t-1}$</td>
<td>1.181</td>
<td>1.032</td>
<td>1.096</td>
<td></td>
</tr>
<tr>
<td>(1.038)</td>
<td>(0.955)</td>
<td>(0.969)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta \ln \left( \frac{K}{Y} \right)_{t-1}$</td>
<td>0.944**</td>
<td>0.771*</td>
<td>0.780*</td>
<td></td>
</tr>
<tr>
<td>(0.500)</td>
<td>(0.458)</td>
<td>(0.467)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$(I+D/Y)_{t-1}$</td>
<td>0.107</td>
<td>0.081</td>
<td>0.012</td>
<td></td>
</tr>
<tr>
<td>(0.163)</td>
<td>(0.126)</td>
<td>(0.116)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OFFS$_{t-1}$</td>
<td>-0.057**</td>
<td>-0.089***</td>
<td>-0.086**</td>
<td></td>
</tr>
<tr>
<td>(0.022)</td>
<td>(0.032)</td>
<td>(0.038)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta \ln \left( \frac{K}{Y} \right)_t$</td>
<td>-0.017*</td>
<td>-0.021**</td>
<td>-0.018**</td>
<td></td>
</tr>
<tr>
<td>(0.009)</td>
<td>(0.008)</td>
<td>(0.008)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta \ln Y_{t-1}$</td>
<td>0.003*</td>
<td>0.003**</td>
<td>0.004**</td>
<td></td>
</tr>
<tr>
<td>(0.002)</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta \ln \left( \frac{K}{Y} \right)_{t-1}$</td>
<td>-0.024</td>
<td>-0.031</td>
<td>-0.034</td>
<td></td>
</tr>
<tr>
<td>(0.026)</td>
<td>(0.028)</td>
<td>(0.027)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta \ln Y_t$</td>
<td>0.010</td>
<td>0.010</td>
<td>0.016</td>
<td></td>
</tr>
<tr>
<td>(0.010)</td>
<td>(0.008)</td>
<td>(0.008)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta \ln \left( \frac{K}{Y} \right)_t$</td>
<td>0.420</td>
<td>0.550</td>
<td>0.553</td>
<td></td>
</tr>
<tr>
<td>(0.041)</td>
<td>(0.032)</td>
<td>(0.054)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta \ln Y_{t-1}$</td>
<td>0.867</td>
<td>0.755</td>
<td>0.934</td>
<td></td>
</tr>
<tr>
<td>(0.757)</td>
<td>(0.712)</td>
<td>(0.971)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta \ln \left( \frac{K}{Y} \right)_{t-1}$</td>
<td>0.986</td>
<td>1.000</td>
<td>1.000</td>
<td></td>
</tr>
<tr>
<td>(0.97)</td>
<td>(0.99)</td>
<td>(1.00)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:
- Robust standard errors in parenthesis. * Statistically significant at 10%, ** at 5%, *** at 1%.
- AR(1) and AR(2) are first and second order tests of serial correlation. The Sargan-Hansen test identifies the restrictions: p-values < 0.05 involves rejecting the validity of the instruments used in the estimation. The problem of over-identification of restrictions suggests the need for a limit on the number of instruments used.

The consistence of our estimations depends on the validity of the instruments used. There are different tests that make it possible to explore said validity. The Sargan-Hansen test of over-identification of restrictions analyses the significance of the set of instruments used to identify the model and in our case the comparison meant not rejecting the validity of the instruments used in the estimations. Other tests examine the existence or not of first and second order serial correlation and, as can be seen in the estimations, the null hypothesis of the absence of second order correlation is accepted.

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21 The estimation can be made in two stages in such a way that it will be asymptotically more efficient if the errors are heterocedastic. However, in the specification of our model the GMM only allows the estimation to be made in one stage.
Finally, columns (2) and (3) repeat the estimations by considering offshoring and immigration, respectively, to be endogenous, obtaining very similar results to those commented earlier and thus guaranteeing the robustness of the model.

As for the effect of the international fragmentation of production on the wage gap between workers (specification 2) the results show that we once again have an opposite sign to what was expected, i.e. in the Spanish economy, as opposed to in other developed economies, offshoring has contributed to a narrowing of the wage gap between higher and lower category workers. Moreover, when the immigration variable is introduced, which presents an increased positive and significant coefficient, hence the relative salaries of white-collar workers, the offshoring of production still has unfavourable effects on the wage gap (column 1). This result is maintained when, as we did with specification 1, offshoring and immigration are considered endogenous (columns 2 and 3).

In this case it is surprising to note the lack of significance of technical change. Because of this result and to find out whether the problem had anything to do with an inadequate choice of indicator, measured on the basis of variations in investment in R+D with respect to GDP\textsuperscript{22}, a broader measure was tried: changes in the percentage of companies that innovated their production and processes out of the total number of companies in each branch, a variable obtained from statistical information provided by the Encuesta sobre Estrategias Empresariales (Business Strategy Survey – ESEE-). However, the econometric results barely changed. Therefore, technological effort made by Spanish industry in the nineties, although increased, was an irrelevant factor with regard to changes in the wage gap.

5. FINAL REMARKS

According to the most common indicator for estimating the existence and evolution of offshoring, the increase in imported intermediate inputs in relation to industry output, Spanish industry has experienced notable expansion in the strategy since the early nineties, especially in the second half of said decade. On the previous pages we have sought to explain the origin of this increasing dependence on imported intermediate inputs, in order to be able to provide further insight into the main direction being adopted by offshoring strategies in Spanish industrial enterprises.

\textsuperscript{22} Given that the case could arise that expenditure in R+D in the different branches of manufacturing made in a certain year could be given in a period where there is time lag, the estimations were made considering one or two lags of the variable but the results were unaltered.
To do this, we estimated using econometric techniques the effect of offshoring on the composition of the labour market and relative wages in the industry, considering two groups of workers, Operators and Employees, depending on their association to the physical production of goods.

The results obtained show that, as opposed to most developed countries where offshoring has stimulated the employment and wages of more highly skilled labour, offshoring in Spanish manufacturing favoured the demand for blue collar workers and contributed to a narrowing of the wage gap between white collar and blue collar workers in the nineties.

This result has more in keeping with those for the countries forming part of European expansion, and seems to indicate that, at least until the year 2000, Spanish industry held advantages with respect to the development of more manual labour intensive phases of production. In the process of geographical reorganization of industrial activity associated to the increasing international fragmentation of production processes, Spanish industry has been incorporated by foreign companies in its shared production networks, with this country being used as the location for more labour intensive phases of production.

Some facts seem to support this point. In such a sense, studies that have analysed the vertical specialisation of Spanish manufacturing have noted a significant increase in the late nineties. The value of the imported component in exports has increased most of all in the branches of motor vehicles, electronic components and office machinery, where offshoring has been more dynamic (Cadarso et al, 2007). These are medium and high technology intensive activities that have a relatively small presence in our industrial structure, and that have based their development on attracted foreign capital, among other reasons due to the relative cost advantages derived from relatively cheap labour in the European context but with an acceptable level of skills and infrastructures (Álvarez et al. 2007). It would not be too daring to deduce that foreign investments in the more advanced Spanish industries, at least in part significant, are the consequence of the international fragmentation of its production processes, localising in our country the phases involving most manual labour either for the assembly of imported intermediate goods or for their subsequent transformation.

In the same sense, the absence has been noted of a solid technological capacity to provide advantages in terms of more advanced production and the significant increase in the importance of importing parts and components in relation to the total imports of “Machinery and transport material” (group 7 of the CUCI). We should also remember that, as noted by
Yeats (2001), in the localisation of the intermediate phases of the production process of high technological content industries, the differences in the number and costs of production factors are not a primordially explanatory element. What do gain in importance are such elements as a qualified workforce, the existence of certain capacities such as good infrastructures and communication networks to assist with transport, the provision of distribution and trade channels, and the availability of key services to guarantee the continuity of the value chain while meeting the required quality standards. Therefore, especially in the European context, Spanish industry has enjoyed advantages for the relocation of parts of the production process of the aforementioned branches.

The results of the analysis also show the relevance of immigration and the large amount of temporary labour in the changes in the relative demand for labour in favour of blue collar workers.

Finally, the study we have made helps explain some of the features of Spanish industry such as the slow growth in productivity that has undoubtedly led to the intensification of stages of production of less added value and the higher presence in the years after the study period of relocations in intermediate and advanced branches and the concentration of job losses caused by relocation processes in the branches of transport, electrical machinery and material and electronic material in the period from 2000-2005 (Myro and Fernández-Otheo, 2008). The character that offshoring, in accordance with the analysis, adopted in Spanish manufacturing in the nineties has made our industry much more vulnerable to the incorporation of Eastern European countries, which offer similar attractions for relocation as the Spanish economy, with the addition of clear advantages in terms of labour.


The information used to obtain the employment and relative wages ratios according to professional category were taken from the Encuesta de Salarios en la Industria y los Servicios made by the Instituto Nacional de Estadística (INE) for the 1989-2000 period. The INE considered an Employee to be any worker registered for Social Security in groups 1 to 7, both inclusive, and Operators to be those in the groups from 8 to 11. The main limitation of this Survey is that it does not provide information on the number of workers. But, given that it does do so for the average wage earnings of the total workers, for the Employee group and the Operators group and that the INE’s National Accountancy provides sector employment, the number of Employee and Labourer workers can be deduced on the basis of the following expressions: (1) \( (w^e \times L) = (w^E \times L^E) + (w^O \times L^O) \) y (2) \( L = L^E + L^O \), \( w \) being wages and \( L \) the number of employees.

The basic source of information for the construction of the narrowed indicator of offshoring was the input-output (TIO) tables produced by the INE. The different methodology used to produce the most recent TIO made available (1995-2000), based on 1995, required a laborious construction of the series of imported intermediate inputs over product unit for the period before 1990-1994 and also the extrapolation of the indicator until 2005 using data from the INE’s Encuesta Industrial de Empresas.

The statistical information on real production (at constant prices for 1995) by branches of manufacturing was obtained by deflating the production to the current prices in the Índice de Precios Industriales based on 2000. The data for the production value from 1995 to 2000 was obtained from the INE’s National Accountancy and coincides exactly with the information offered by the TIO. The change in TIO methodology led us to estimate the production values for the following period (1990-1994), for which we used the production data provided by the INE’s Encuesta Industrial de Empresas and by the TIO themselves for the 1990-1994 period.

The basic source for net capital stock was the series offered by the Fundación BBVA-Ivie for 43 branches of activity, of which 13 were manufacturing industries. However, the higher level of statistical desegregation used in this study obliged us to calculate series of capital stock for certain branches on the basis of the permanent inventory method using data on the gross investment of fixed capital provided by the OCDE’s Stan Data Base for Industrial Analysis. Once the complete series of stock capital had been obtained, we calculated the percentages for the different branches out of their aggregate and applied the corresponding
aggregate of the Fundación BBVA-Ivie series to obtain the disaggregate series of net capital stock. The intensity of capital for 1990 to 2000 was obtained on the basis of the capital stock ratio over the production value at constant 1995 prices.

The data for investment in R+D was taken from the INE’s R+D statistics for Spain, which detail the total internal expenditure on R+D by branch of activity including running costs (personnel costs and other running costs) and capital costs (expenditure on equipment and instruments and expenditure on plant and buildings).

The statistical information on immigrant labour by branches of manufacturing was taken from the INE’s Encuesta de Población Activa. To deal with the limitations in relation to the level of statistical desegregation, we also used data for the percentage foreign workers registered for employment by branches of activity with respect to the total workers actively registered for employment taken from the Ministerio de Trabajo y Asuntos Sociales.

The temporary employment variable was obtained on the basis of information provided by the Encuesta sobre Estrategias Empresariales (ESEE) measured as the percentage number of temporary workers out of the total number employed.