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Offshoring, Employment and Wages

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Abstract

This paper reviews the debate on the economic effect of the international fragmentation of production, also known as "offshoring", and provides a preliminary investigation of the impact of intermediate imported inputs on employment and wages in five European countries (Germany, Spain, France, Italy, the United Kingdom). Data are obtained from the Sectoral Innovation Database (SID) of the University of Urbino, a large database that merges statistical material from various sources (LFS; CIS; WIOD). The first part of this work provides a review of the empirical literature that discusses the economic effects of offshoring on domestic labor demand and wages. The second section of the paper presents offshoring trends and discusses the results of the econometric analysis. Results suggest that offshoring has a general negative impact on employment and wages although more careful examination reveals that high-tech offshoring has a positive effect on wages of medium- and high-skilled workers.

Keywords: Offshoring, Innovation, Employment, Wages

JEL Classification: F1, F2

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1 Introduction

Over the last decades, globalization has led to an unprecedented reorganization of production activities in a rapidly changing political and technological context. Phenomena such offshoring and international outsourcing - the relocation of production processes abroad, either to a foreign affiliate or to an external supplier - have dramatically increased[1]. Thanks to dropping transportation costs and better technologies, firms are able to reorganize their production network on a global scale. Firms can profit from relocating production to developing and transition countries where factor prices are lower compared to their origin country. In industrialized countries, this phenomenon has fueled the fear of deindustrialization and of a "race to the bottom" of domestic wages and working conditions. Fears surrounding offshoring have spurred a long-lasting debate involving companies, consulting agencies, trade unions, politicians and economists.

The empirical literature dealing with the effect of offshoring on home activities in developed economies is extensive and controversial. Indeed, thanks to production offshoring, firms can improve domestic productivity and raise wages in their home establishments. Firms can increase domestic operations and employment when offshore activities help to raise competitiveness and to boost profits. However, while the economic benefits of offshoring may be to the advantage of some, others may suffer in terms of lower employment levels and wages. Offshore operations require additional activities of supervision and coordination that are most likely located in the country of origin. Firms may very well expand domestic core activities such as marketing, design, R&D and highly specialized functions that require highly skilled personnel such as managers, supervisors and engineers. On the contrary, the activities that are relocated abroad are highly routinized tasks with lower value added content that can be easily replaced by the low paid workforce available in less advanced economies.

The aim of this paper is to explore the impact of offshoring on employment and wages in the domestic economy for four different groups of workers. A model that relates changes in home employment and wages with offshoring, technology and demand variables is developed and empirically tested on a small group of five EU countries (Germany, Spain, France, Italy and the United Kingdom). The novelty of the approach resides in the fact that employment is divided into four different occupational groups: managers, clerks, craft and manual workers. While there are many studies that relate offshoring to the labor demand of white-collar and blue-collar workers, or high-skilled and low-skilled workers, there are no empirical studies that proposed a more detailed differentiation of employment categories. The model proposed here uses 2-digit NACE Rev.1 industry-level data collected from various statistical sources and matched after a careful elaboration[2].

[1] The specificity of the terms offshoring and outsourcing is well acknowledged (see for example OECD 2007). However, in this paper the term offshoring is used to indicate both the partial or total relocation of the activities abroad to a company's own affiliate and the purchase of intermediate inputs from non-affiliated foreign suppliers.

[2] The acronym NACE stands for the French *Nomenclature generale des Activites economiques dans les Communautes europeennes* and refers to the industrial classification used by Eurostat.

The paper is structured as follows. Section two will provide a short review of literature discussing the economic effects of offshoring on the domestic labor market. Section three will present the model, the econometric strategy and the data used for the empirical analysis. Section four will present the results and section five will conclude.

2 The Effects of Offshoring on the Domestic Economy

2.1 The Debate Around Offshoring

Over the last decades, improved communication technologies and revolutionary changes in the international political landscape opened up the way for a large outflow of offshoring investment from industrialized countries towards developing and transition economies. The partial opening of China to foreign investments together with the end of the Soviet Union and the enlargement of the European Union to include countries of the former Eastern bloc, offered new opportunities for the relocation of manufacturing activities to low-wage countries. India, a former British colony with its English speaking, highly educated population, instead offered the opportunity for the relocation of investments in the ICT and service industry.

While it seems that international competition and offshoring could bring benefit to firms and consumers in terms of lower production costs and lower prices thanks to the gains deriving from specialization and exchange, on the other hand, it may result in large employment losses and in increasing wage differential between skilled and unskilled labor. This is the challenge faced by less skilled workers in industrialized countries carrying out routinized activities in the manufacturing industry but also in the service sector where telecommunications technology made possible the performance of specific functions such as data entry, bookkeeping and customer care related services from remote locations.

In the US, the debate about offshoring entered the national political arena when in 2004 Gregory Mankiw, Harvard Professor and former chairman of the White House Council of Economic Advisers, stated that "offshoring (referring to service offshoring) is only the latest manifestation of the gains from trade that economists have talked about at least since Adam Smith (...). More things are tradable than were tradable in the past, and that's a good thing" (Mankiw and Swagel 2006, p.8). Mankiw's words caused great confusion among policymakers and voters who perceived offshoring simply as the loss of national jobs. Mankiw argued that offshoring represents a new form of international trade that fits perfectly within Ricardo's intellectual framework of comparative advantage. Just as international trade, offshoring generates winners and losers, but at the same time it leads to productivity gains and increases in income levels (Mankiw and Swagel 2006).

Despite the long debate about offshoring, assessing the economic impact of these controversial practices on domestic employment and wages is not an easy task. Offshoring is the result of firms' strategies, directly investing abroad in new plants or subcontracting the production of additional inputs to non-affiliated suppliers. While offshoring could replace de facto home production with foreign production, it could also complement home activities by enhancing domestic production and allowing the long term expansion of domestic operations. So it seems that offshoring dynamics can have either positive or negative effects on the home economy.

Milberg and Winkler (2013) indicate four possible channels through which offshoring can affect labor demand: the substitution effect, the scale effect, the productivity effect and the markup effect. With the substitution effect offshoring is expected to have a negative impact on domestic labor demand as domestic production is replaced by foreign production. If the productivity effect prevails, offshoring is expected to have a negative effect on domestic labor demand as the same quantity of output is now produced with fewer workers. The scale effect derives from lower prices for intermediate inputs that if passed on to consumers might lead to higher demand for final goods. In this case, offshoring is expected to increase domestic demand for labor. Lastly, the mark-up effect considers the possibility for the offshoring firm to maintain its oligopolistic position in the final goods market by controlling the price of intermediate goods in the suppliers market. The mark-up effect might have a positive effect on domestic labor demand, assuming that the profit generated thanks to the higher mark-up will be used to finance new productive investment (Milberg and Winkler 2013).

While the consequences of offshoring on employment are subject to controversy and debate, in the literature there is much more consensus around the fact that offshoring might lead to an increasing wage differential between high- and low-skilled workers. Due to the offshoring of unskilled intensive tasks to countries with abundant low-skilled workers, firms in developed countries depress domestic demand for unskilled workers and hence their relative wage premium. By contrast, in developed countries offshoring increases the demand of high-skilled laborers, driving up the wage premium for this group of workers. Offshoring can also widen the wage differential in developing countries. Even though from the perspective of the investing country offshoring activities are labor intensive, from the developing economy viewpoint offshoring drives up demand for skilled workers as the skill content of the offshored tasks is much above the local capability (Bottini et al. 2007). Following these theoretical explanations, it is left to empirical analysis to further investigate the impact of offshoring on labor demand and wages.

2.2 A Short Review of the Empirical Literature

A first group of contributions estimated the impact of offshoring on domestic labor demand[3]. In a set of widely cited papers, Amiti and Wei (2004; 2005) investigated

[3]Due to the scope of this work, this section focuses on the results obtained from studies using industry-level data although a number of contributions have used firm and individual level data.

the effect of service and material offshoring on employment in the United Kingdom and the United States. The authors affirmed that in large advanced economies, the fear of job losses is largely misplaced. Official data from the IMF Balance of Payment Statistics show how industrialized countries are net receivers of large inflows of intermediate inputs, particularly in the computer and ICT industry, inflows so large that they have offset the outflow of the same kind of foreign investments.

Using data from 1995 to 2001 on 78 sectors (69 manufacturing industries and 9 service industries), Amiti and Wei (2004) found no evidence of service offshoring lowering job growth in the United Kingdom. In the following contribution, Amiti and Wei (2005) used US manufacturing data from 1992 to 2000 to estimate productivity and employment effects of material and service offshoring. The authors found that both material and service offshoring have positive effects on productivity, accounting for, in the case of service offshoring, a 11 to 13 percent increase in productivity and, in the case of material offshoring, a 3 to 6 percent productivity increase. Concerning employment, a small negative effect (less than one percentage point) is detected when industries are highly disaggregated (i.e. 450 industries). However, this effect disappears when the analysis is performed with aggregate data (i.e. 96 industries). According to the authors, this finding indicates that the growth in demand has completely offset the negative impact of offshoring on employment.

Hijzen and Swaim (2008) used industry-level data from 1995 to 2000 to evaluate the impact of intra-industry and inter-industry offshoring on domestic employment for 17 OECD high-income countries. In line with the findings of Amiti and Wei (2004; 2005), the authors found that offshoring has no negative effect on domestic employment but rather a slightly positive effect. More specifically, while intra-industry offshoring appears to reduce the labor intensity of production without affecting industry employment, inter-industry offshoring does not influence labor intensity but does positively influence the overall industry employment. Hijzen and Swaim (2008) argued that productivity gains obtained through offshoring have completely offset any possible job losses caused by offshoring.

OECD (2007) comes to a rather different conclusion. In this large and well documented research, material and service offshoring appear to be detrimental to domestic employment. The study used cross-sectional data for 12 OECD countries from 1995 to 2000. Offshoring is measured with industry-level data obtained from standard I-O tables and is calculated as the share of imported intermediate inputs on total non-energy inputs. For all three model specifications proposed in the paper, the coefficients sign for manufacturing and service offshoring is found to be negative.

More recently, Milberg and Winkler (2013) estimated the impact of offshoring on labor demand in the United States using industry-level data from 1998 to 2006. Regression results show that service and material offshoring has had a negative impact on employment. Results are in contrast with previous findings of Amiti and Wei (2005) that with the same data but in a different time range have found no evidence of a negative effect of service offshoring on employment. The authors suggest that if previous results are correct, three possible leakage effects have impeded offshoring to positively influence labor demand: (i) foreign lower input prices have not reduced domestic output prices; (ii) lower output prices have not stimulated output demand; (iii) higher output demand has not stimulted higher labor demand.

The international fragmentation of production not only affects total labor demand in sourcing countries but also changes the international division of labor influencing the skill composition of domestic employment. The transfer abroad of labor-intensive tasks requiring unskilled workers may very well increase the level of domestic high-skilled workers where most reasonably high-skilled intensive functions are located. A number of empirical studies investigated the impact of production offshoring on the change in the skill-composition of domestic employment. Feenstra and Hanson (1996) paved the way in emphasizing the role that material offshoring has in influencing the dynamics of labor demand. The authors computed broad material offshoring measures for 435 US industries from 1972 to 1992. The research found that offshoring was responsible for a 31 to 51 percent increase in the wage bill of non-production workers, used here as proxy for high-skilled laborers (Feenstra and Hanson 1996). In a following contribution (Feenstra and Hanson 1999), results showed that narrow material offshoring explains 11 to 15 percent of the increase in the wage share of non-production high-skilled workers.

Similar results are found for France by Strauss-Kahn (2003). The paper found that in the period from 1977 to 1993, international outsourcing contributed to the decline in the wage share of less-skilled workers, in particular in the manufacturing industry. In the period from 1977 to 1985, outsourcing was responsible for 11 to 15 percent of the decline in the wage share of unskilled workers. In the period from 1985 to 1993, outsourcing had a very strong negative impact on unskilled workers, this time accounting for 25 percent of the decline in the relative wage share of less skilled workers.

Hijzen et al. (2005) investigated the impact of international outsourcing in the UK on the domestic skill structure of labor demand for three different skill groups of workers, high, medium and low-skilled. This study departed from the approach adopted in Feenstra and Hanson (1996; 1999) and Strauss-Kahn (2003). The study estimated with panel data a SUR system of variable factor costs equations. The authors conclude that international outsourcing is a fundamental component in explaining the evolving skill structure of labor demand in the country and that international outsourcing had a strong negative effect on labor demand for all types of workers, in particular for unskilled workers. The research concluded indicating that the negative impact of offshoring on labor demand is stronger the lower the workers' skill level.

Geishecker (2006) investigated the impact of international outsourcing on the relative demand for manual workers in Germany from 1991 to 2000. The author was able to differentiate between the geographical destination of outsourcing, namely Central and Eastern European Countries (CEEC), the EU15 memeber states and the rest of the world (RoW). The empirical investigation showed that outsourcing towards the CEEC and to a minor extent towards the RoW has lowered the relative wage share for manual workers in Germany while outsourcing towards the EU15 seems to have had no negative effect.

Recent contributions used data collected in the World Input Output Database (WIOD)[4]. Foster et al. (2012) focused on the impact of offshoring on labor demand elasticity in a sample of 40 countries in the period from 1995 to 2009. Using broad and narrow offshoring measures, both for manufacturing and service industries, the research employed a conditional and unconditional labor demand to find that offshoring has an overall neutral or slightly positive effect on employment. In a further analysis, the paper provided evidence of differences across industry types and employment categories. Negative effects are found for service offshoring in low-skilled and high-skilled service industries while positive effects appeared in high-tech manufacturing industries for high qualified workers (Foster et al. 2012).

Using the same data, De Vries et al. (2012) examined the effect of broad and narrow offshoring from 1995 to 2009 on the skill structure of labor demand for 40 countries. Similarly to Hijzen et al. (2005), the paper adopted a system of three variable factor demand equations (SUR) to find that both narrow and broad offshoring measures have reduced the relative labor demand for all skill-groups, especially in the sample of manufacturing industries. From a closer perspective, it appears that medium educated workers have paid the highest price while the remaining skill-groups in the service industry were left relatively unaffected.

To conclude, the studies that analyzed the impact of offshoring on the relative composition of labor demand have proposed a basic classification of skilled versus unskilled workers. In this paper, a more detailed classification of professions is proposed, obtained from data from the Labor Force Survey (LFS) database. Furthermore, while the majority of these studies have proposed the traditional separation of the offshoring indicators (e.g. narrow and broad offshoring, manufacturing and service offshoring), the indicators used in this paper capture the technological content of offshoring reflecting the technological level of the industry from which inputs are sourced.

[4]See Timmer (2012) for a detailed presentation of the WIOD project and data.

3 The Model and the Econometric Strategy

The approach followed in this paper departs from previous models used in the offshoring literature. In order to explore the relationship between employment, wages and offshoring this research builds on the previous work of Bogliacino and Pianta (2010) and Cirillo (2014). These models combine elements from the Keynesian tradition, that emphasizes the role of demand in driving employment growth, and from the Schumpeterian school, that roots economic growth in the technological endeavor of the capitalist economy.

Technology is often seen as an undifferentiated process affecting employment. Pianta (2001) suggests a key distinction between technological competitiveness and cost (or price) competitiveness (see also Bogliacino and Pianta 2010; Crespi and Pianta 2008; Pianta and Tancioni 2008). This approach is firmly rooted in the theorical framework delineated almost a century ago by the Austrian economist Joseph Schumpeter. Schumpeter distinguished between product and process innovation. Product innovation consists in the creation of new and better goods that stimulate firms' output and sales. Process innovation consists instead in the development of more efficient technologies that allow firms to lower production costs. Bogliacino and Pianta (2010) made a consistent effort to show that technological competitiveness (TC) and cost competitiveness (CC) exert contrasting effects on employment. The former, associated with product innovation strategies, requires that firms are strongly oriented towards innovative activities such as R&D, designing and investment in new equipment and machineries. These strategies are expected to yield a positive effect on employment. The latter, implying the introduction of new technologies aiming at increasing production efficiency, are expected to have negative effects on employment.

The model proposed here builds upon this theoretical background and includes the offshoring element. In the first model, employment depends on technological and cost competitiveness factors, labor cost, demand and the level of offshoring. The empirical specification of the model looks as follows:

$$L_{i,t} = \alpha_0 + \alpha_1 VA_{i,t} + \alpha_2 W_{i,t} + \alpha_3 TECH_{i,t} + \alpha_4 OFF_{i,t} \quad (1)$$

$$W_{i,t} = \beta_0 + \beta_1 VA_{i,t} + \beta_2 L_{i,t} + \beta_3 TECH_{i,t} + \beta_4 OFF_{i,t} \quad (2)$$

In equation 1, $L_{i,t}$ stands for total employment, $VA_{i,t}$ for sectoral value added (used here as proxy for aggregate demand), $W_{i,t}$ for labor cost, $TECH_{i,t}$ for the technological level embodied in the industry and $OFF_{i,t}$ for the offshoring level. Since the model is estimated at the industry level, the subscript i stands for industry and t for the time. A potential negative effect of offshoring on employment, particularly for less qualified occupations, is expected. Predicting the effect of offshoring on wages is less straightforward. While a certain type of offshoring might in effect raise wages for certain groups of workers, especially when the offshoring content complements domestic production, offshoring may very well push down wages of less skilled workers, especially when the content of offshore production substitutes for the activities previously performed in the home industry. This interpretation follows the idea that wages for some categories of workers must now compete in a global market where cheap labor in developing economies and unregulated labor markets can drive down the wage premium for unskilled workers in industrialized countries. The following labor demand curve can be used as the baseline equation for the model:

$$y_{i,t} = \gamma_0 + \beta_1 x_{i,t} + u_{i,t} + v_{i,t}$$

In the equation above, $y_{i,t}$ represents the employment variable, $x_{i,t}$ indicates the vector of regressors, $u_{i,t}$ the individual unobserved effect and $v_{i,t}$ the random disturbance where the subscript i stands for the industry and t for time. The equation above can be assumed to be a standard firm's translog cost function where both dependent and independent variables are expressed in log-scale. The time-invariant industry-specific effect is eliminated by taking the first difference of the equation above:

$$y_{i,t} - y_{i,t-1} = \gamma_0 + \beta_1(X_{i,t} - X_{i,t-1}) + (u_{i,t} - u_{i,t-1}) + (v_{i,t} - v_{i,t-1})$$

$$\Delta y_i = \gamma_0 + \beta_1 \Delta X_i + \Delta u_i$$

Since the log difference approximates the variation in rate of changes, it is possible to express both regressors and regressand as rate of growth. Innovation and offshoring variables are included in the model in percentage points referring to the first year in the variation period emphasizing the lagged impact of technology and production fragmentation on home employment and wages. The estimating equation is expressed as follows:

(1)

$$\Delta L_{i,t} = \alpha_0 + \alpha_1 \Delta VA_{i,t} + \alpha_2 \Delta W_{i,t} + \alpha_3 TC_{i,t} + \alpha_4 CC_{i,t} + \alpha_5 OFF1_{i,t} + \alpha_6 OFF2_{i,t} + D_c + D_t + \varepsilon_{i,t}$$

(2)

$$\Delta W_{i,t} = \beta_0 + \beta_1 \Delta VA_{i,t} + \beta_2 \Delta L_{i,t} + \beta_3 TC_{i,t} + \beta_4 CC_{i,t} + \beta_5 OFF1_{i,t} + \beta_6 OFF2_{i,t} + D_c + D_t + \varepsilon_{i,t}$$

In equation 1 and 2, $\Delta L_{i,t}$ indicates the growth rates in labor demand, $\Delta VA_{i,t}$ the rate of growth in value added and $\Delta W_{i,t}$ the rate of growth in labor compensation. $TC_{i,t}$ and $CC_{i,t}$ indicate respectively the technological and cost competitiveness variables. As in Cirillo (2014), total employment is replaced in turn by employment by occupational categories, namely managers, clerks, craft and manual workers. In equation 2, $W_{i,t}$ is replaced in turn by the wage level of high-, medium- and low-skilled workers. Fixed year effects D_t are inlcuded to control for any unobserved effect common across all industries, such as changes in the overall economic conditions. In some specifications, country fixed effects D_c are also included. The five countries under investigation differ strongly in terms of industrial relations, labor market institutions, welfare institutions and other industrial and economic characteristics. Country dummy variables are included in the model to check whether the relationships hold when specific country effects are accounted for. Offshoring variables are included in pairs, which can be either inter-industry (differential) and intra-industry (narrow) or high-tech and low-tech offshoring. Including offshoring variables in this fashion does not raise multicollinearity issues since the information contained in the two indicators differ significantly[5].

The model is estimated by using OLS. Since industries differ strongly in terms of value added, employment, technology and offshoring levels, Weighted Least Squares (WLS) estimation is adopted. Weights used in the regressions are calculated as the arithmetic average of the employment variable from 1999 to 2011. Robust standard errors are applied in order to account for heteroskedasticity. The robustness of the model is tested by running the regressions on a subset of manufacturing industries. The model for total labor demand and labor demand by occupational group is additionally tested with country dummy variables in order to take into account country specific effects. Before running the regressions, outlying observations were carefully removed. Table 1 below reports preliminary summary statistics.

TABLE 1. Descriptive Statistics

Variables	N	Mean.	St.Dev.	Min	Max
Value Added Growth	546	.7137	4.194	-14.62	14.95
Productivity Growth	551	1.791	3.537	-12.17	18.12
Share of Firms Performing Innovation	520	41.89	18.20	.2267	89.44
Share of Firms Innovating Reducing Production Cost	514	16.71	13.00	1.005	68.68
Labor Cost Rate of Change	540	.6080	6.312	-19.58	19.18
Wage Growth Low-Education Workers	528	1.532	13.96	-49.58	48.31
Wage Growth Medium-Education Workers	539	3.209	10.17	-39.20	38.66
Wage Growth High-Education Workers	547	.7837	9.691	-37.76	32.09
Total Employment Rate of Change	549	-.6204	5.718	-18.71	18.78
Managers Rate of Change	553	2.114	8.657	-39.28	33.39
Clerks Rate of Change	552	-1.254	10.27	-49.51	44.06
Craft Workers Rate of Change	498	-2.792	10.49	-34.38	33.28
Manual Workers Rate of Change	532	-1.809	12.11	-49.09	45.22
Inter-Industry Offshoring (Differential)	555	.1111	.0532	.0293	.3356
Intra-Industry Offshoring (Narrow)	555	.0805	.0772	.0000	.3178
High-Tech Offshoring	555	.0961	.0800	.0109	.3519
Low-Tech Offshoring	555	.0932	.0645	.0132	.3644

Source: Own Elaboration

[5]There is a very low degree of correlation between the differential and the narrow offshoring indicator (0.1441) and a slightly negative correlation between the high-tech and low-tech offshoring index (-0.0421). See Table 2 in the Appendix for the complete correlation matrix.

4 Data

4.1 The Sectoral Innovation Database

This section describes the data used for the econometric analysis. This work focuses on five European countries, namely Germany, Spain, France, Italy and the United Kingdom. It was decided to focus on a relatively small group of European countries for two reasons. First, data sources from which information are drawn have a wider coverage level for this relatively small set of countries. Second, the selected countries reflect similar industrial dynamics that make the aggregated analysis consistent[6].

Data are obtained from the Sectoral Innovation Database (SID) collected at the University of Urbino[7]. This database includes 21 manufacturing sectors (sector 15 to 36) and 17 service industries from (sector 50 to 74) classified according to the international 2-digit classification NACE Rev.1 (see Table 1 in the Appendix for the list of sectors). The SID contains detailed information on innovative activities, economic performance, education and professional qualification combined from different international sources (Eurostat Community Innovation Survey CIS and Labor Force Survey LFS, OECD Structural Analysis survey STAN, WIOD Socio-Economic Account SEA)[8]. In order to avoid possible outliers, industry 23 (i.e. Coke, Refined Petroleum and Nuclear Fuel) has been dropped in advance as the economic activity of this sector might not be appropriately captured with offshoring variables. Monetary variables have been deflated using the respective sectoral value added deflator. Data extracted from I-O tables are converted using the official IMF euro/dollar exchange rates. For this work, only data for the United Kingdom had to be converted using the exchange rate in purchasing power parity (PPP).

Industry-level is the most appropriate level of analysis for three fundamental reasons[9]. First, micro-level data are not representative of the whole economy and results are hardly generalizable. Sectoral-level data instead better capture the structural change of the economy and the results are representative of the economy as a whole. Second, technological factors are better captured by industry-level analysis given that firms in the same industry are likely to share similar characteristics in terms of technological opportunities and market dynamics. Third, industry-level data better identify overall economic trends. While individual firms might experience a positive growth period during a recession, industry-level data offer a better appreciation of the general economic activity beyond the performance of the single firm.

[6]This set of countries has been the subject of previous analysis concerning the impact of technological change on employment (see Cirillo 2014).

[7]See Lucchese and Pianta (2011) for the methodological notes on the construction of the database.

[8]Data used for this work represents a small portion of the information available in the SID.

[9]See Guarascio et al. 2015 for a similar explanation.

4.1.1 Employment and Wages

Employment data are obtained from the Eurostat Labor Force Survey. LFS data extracted from the SID provides information on employment and education from 1999 to 2011 based on the ISCO88COM nomenclature. Four macro groups are created, namely managers, clerks, craft workers and manual workers[10]. LFS data have been converted from NACE Rev.2 into NACE Rev.1 through the use of a specific conversion matrix[11]. Table 2 summarizes the typology of workers included within each macro professional group.

TABLE 2. Typology of Employees by Professional Group

Macro Professional Groups	ISCO88Classification
MANAGERS	Legislators, Senior Officials and Managers, Professionals, Technicians and Associate Professionals
CLERKS	Clerks, Service Workers, Shop and Market Sales Force
CRAFT WORKERS	Skilled Agricultural and Fishery Workers, Craft and Related Trades Workers
MANUAL WORKERS	Plant and Machine Operators, Assemblers, Elementary Occupation

Source: Cirillo 2014

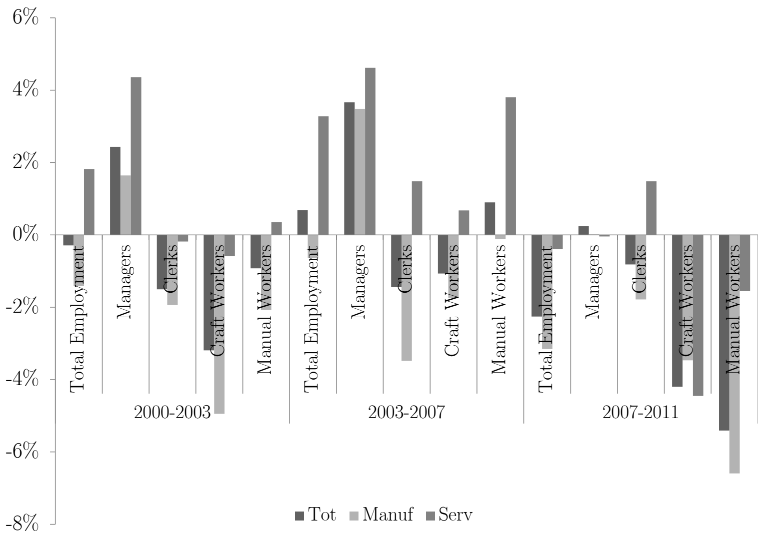
Figure 1 looks at the trends of employment growth by professional group. From a general standpoint, it is possible to notice that all professional groups experienced a very sharp contraction during the years of the recent economic crisis. This negative trend seems to be particularly pronounced for the less skilled professional categories such as craft and manual workers. By contrast, managers did not experience negative growth rates even though in the period 2007-2011 their growth rates fell almost to zero. The comparison between the manufacturing and service industries adds an important element to the analysis. Service industry experienced less negative growth rates across all employment groups and in some periods registered even positive trends vis-à-vis the declining tendency of the manufacturing industry.

Data on wages are calculated with the information available from WIOD SEA. First, a variable measuring industry labor cost is obtained. This piece of information is computed by dividing total labor compensation by the total number of employees in the industry. A similar procedure is followed for the calculation of wages by educational group. The WIOD SEA database contains relevant information on labor compensation and the relative wage share by educational categories. From these variables it is possible to back-calculate the individual wage per skill-group. The total wage bill for each skill-group is obtained by multiplying total labor compensation by the corresponding wage share. The wage bill by skill-group is then dived by the number of workers with the corresponding educational level (using LFS data). The WIOD SEA database includes information on three educational

[10] This approach follows the previous work on employment, skills and innovation by Cirillo (2014).

[11] See Cirillo and Perani (2015) for further details on the construction of the conversion matrix.

FIGURE 1. Employment Growth Rates by Professional Group (Pool of Countries)



Source: Own Elaboration

groups: low-skilled for workers with lower secondary education, medium-skilled for workers with upper secondary education and high-skilled workers for workers with university and post-university education[12].

4.1.2 Innovation

Innovation variables are drawn from the Eurostat Community Innovation Survey (CIS)[13]. For this work two technological variables have been used: "share of firms introducing innovation" and the "share of firms aiming at reducing production costs". These two variables can be considered good proxies for technological competitive strategies, strategies aiming at developing and producing new products to open up new markets, and cost competitive strategies, targeted to increase profit by reducing production costs.

This approach builds on previous work carried out by Pianta (2001) and Pianta and Bogliacino (2010) where the difference between technological and cost competitiveness is thoroughly investigated. Table 3 provides first descriptive evidence of the technological patterns for the five countries under investigation. It is possible to notice that Germany has the largest share of innovators both in the manufacturing and service sector followed by France, Italy and the UK. The UK has the

[12]Data available in SEA follow ISCED nomenclature. The ISCED classification collect information on the basis of the educational level attained by the worker.

[13]SID technology variables capturing the evolution of technological patterns, expenditure on innovation, the effects and the sources of the innovative process, the amount of R&D as well as other factors have been extensively applied in the recent literature. See for example Bogliacino and Pianta 2010; Bogliacino and Pianta 2013a; 2013b; Guarascio et al. 2015).

TABLE 3. Descriptive Statistics for Innovation Variables

Country	Industry	Innovators (%)	Reducing Prod. Costs (%)
Germany	Manufacturing	64.58	19.56
	Service	57.65	15.30
Spain	Manufacturing	37.90	11.90
	Service	32.46	9.54
France	Manufacturing	43.01	17.83
	Service	36.28	10.74
Italy	Manufacturing	42.68	13.58
	Service	30.63	7.379
UK	Manufacturing	42.09	33.40
	Service	32.21	22.59

Source: Own Elaboration

largest share of firms whose innovative strategy aims at reducing production costs, both in the manufacturing and service industries[14].

4.1.3 Economic Performance and Offshoring

The last group of variables provides information on economic performances. Data for value added are directly available from the WIOD SEA database. Data for the construction of the offshoring indicators are extracted from National Input-Output Tables (NIOT)[15]. The construction of offshoring indicators follows the methodology adopted in Feenstra and Hanson (1996; 1999). The broad offshoring indicator ("inter-industry offshoring") measures the sum of non-energy imported intermediate goods over the sum total of intermediate goods, whereby total is meant as the sum of home and foreign purchased intermediate inputs (inputs from energy sectors excluded). The narrow offshoring indicator ("intra-industry offshoring") restricts the numerator to the imports of intermediate goods from the same sector abroad. The differential offshoring indicator (also named inter-industry offshoring) is a variant of the broad offshoring index and is the arithmetic difference between the broad and the narrow offshoring indicator.

$$Inter - Industry = \frac{\sum_k \sum_j m^i_{j \neq k}}{\sum_k \sum_j (d^i_{jk} + m^i_{jk})}$$

$$Intra - Industry = \frac{\sum_k m^i_{j=k}}{\sum_k \sum_j (d^i_{jk} + m^i_{jk})}$$

The construction of the high-tech and low-tech offshoring indicator follows the same logic. The numerator includes intermediate inputs imported exclusively from foreign high-tech sectors. Likewise, the low-tech offshoring indicator includes

[14] Table 3 reports the total industry average.

[15] See Timmer et al. (2012) for additional details on the construction of NIOT tables.

intermediate inputs imported exclusively from foreign low-tech sectors. The classification of industries in high-tech and low-tech sectors relies on the classification of industries originally proposed for manufacturing industries by Pavitt (1984) and recently extended to service sectors on the basis of information contained in Eurostat innovation surveys by Pianta and Bogliacino (2010)[16]. Table 3 in the Appendix summarizes the variables used for the empirical analysis with the original data sources and their respective time period.

The final database is a pooled cross-section with three different time periods 2000-2003, 2003-2007 and 2007-2011. This provides two major advantages. First, it is possible to control whether the economic relationship under investigation holds during phases of economic growth and phases of economic recession. This was the case from 2000 to 2003 and to a larger extent from 2007 to 2011. Second, by pooling three different time periods, it is possible to increase the number of available observations so that the model can be eventually tested on a restricted group of industries. Employment, wages, and economic performance variables are expressed in compound annual rate of growth. This procedure approximates the utilization of logarithmic differences that are widely used in econometric studies on offshoring.

TABLE 4. Offshoring Averages from 1999 to 2011 (in %)

	Inter-Industry (Broad)		**Inter-Industry (Differential)**		**Intra-Industry (Narrow)**		**High-Tech Offshoring**		**Low-Tech Offshoring**	
	Manuf	*Serv*	*Manuf*	*Serv*	*Manuf*	*Serv*	*Manuf*	*Serv*	*Manuf*	*Serv*
Germany	31	12	15	8	15	2	14	5	16	5
Spain	25	12	13	10	11	2	12	7	12	5
France	24	9	12	7	12	2	12	5	12	4
Italy	19	9	10	7	8	1	8	5	10	3
UK	29	12	13	9	15	3	14	6	14	5

Source: Own Elaboration

[16]Pavitt identified four groups of industries on the basis of the particular technological, productive and market characteristics: Science-Based (SS), Specialized-Supplier (SS), Scale and Information Intensive (SI) and Supplier Dominated (SD). Low-tech offshoring measures the quantity of imported inputs from foreign low-tech sectors that belongs to Scale-Intensive and Science-Dominated classes. High-tech offshoring include the import of intermediate inputs from foreign Science-Based and Specialized Supplier industries. Table 1 in the Appendix provides a detailed list of the 38 NACE Rev.1 industries classified according to the Revised Pavitt Taxonomy.

5 Results

5.1 The Model for Total Employment

Table 5 reports the results of the regression on total employment[17]. The model is tested with and without country-dummy variables. Value added and labor compensation coefficients confirm expectations. Value added has a positive and statistically significant impact on total employment while labor compensation has a negative and statistically significant effect. The share of firms performing innovation has a positive and statistically significant coefficient at the 10 percent significance level but only when country dummies are excluded from the model. By contrast, and very much in line with expectations, the variable representing the share of firms in the industry introducing technologies that reduce production costs is found to have a negative and statistically significant effect on employment when country dummy variables are excluded from the regression. Offshoring coefficients largely reflect expectations according to which offshoring substitutes domestic with foreign jobs (OECD 2007; Milberg and Winkler 2013). All offshoring coefficients are negative and statistically significant for all model specifications.

Regressions from 5 to 8 report the results of the model tested on the subsample of manufacturing industries. Results are broadly in line with the findings above, with the only exception that the coefficient of the cost competitiveness variable (share of firms innovating to reduce production costs) is positive. In this case, results obtained are quite surprising and in contradiction with the general findings of previous studies presented above that did not differentiate between manufacturing and service industries (Bogliacino et al. 2013a; Cirillo 2014). Cost competitiveness strategies seem to have a positive and statistically significant effect on the employment rate of growth but only when country-dummy variables are included in the model. One possible explanation could be that all countries adopt a similar strategy whereby technological innovation aimed at optimizing production costs might favor emplyoment growth, at least for certain groups of workers. Further analysis is provided within the next section where the model is tested on four different professional groups.

5.2 The Model for Professional Groups

Table 6 reports the results of the regressions on managers and clerks. In Table 6, coefficients of the offshoring indicators in the model for managers are statistically insignificant, while clerks seem to be negatively influenced by the increase in international fragmentation of production, in particular by low-tech offshoring. The coefficients of technology variables appear negative, in particular in manufacturing industries where the increase in the share of firms implementing cost competitiveness technologies yields positive returns on the rate of growth of managers and clerks.

Table 7 reports the results of the regression on craft and manual workers. Valued added growth is a major component in determining employment growth of

[17]See section 8 for the econometric tables.

these groups of workers while labor compensation is found to have a negative and statistically significant effect only on craft workers. For the professional category of craft workers, offshoring coefficients are not statistically significant, with the sole exception of high-tech offshoring in manufacturing industries. Results change dramatically for manual workers that are negatively affected by intra-industry and low-tech offshoring. This result is consistent with the view that sees offshoring replacing domestic production, especially of labor-intensive production. It is also important to note that differently from the previous professional groups, the share of firms introducing cost competitiveness technologies has now a negative and statistically significant effect on the rate of growth of manual workers. These findings confirm our expectations that the implementation of strategies aimed at optimizing production costs penalizes low-skilled workers carrying out highly routinized tasks while favoring managerial and supervisory functions.

To summarize, it is possible to say that: (1) none of the offshoring coefficients is statistically significant in the regressions on managers; (2) clerks are negatively affected by all types of offshoring and stronger statistical significance is shown for the coefficient of low-tech offshoring; (3) regressions on craft workers reveal no significant information on the impact of offshoring on this professional group with a single minor exception (high-tech offshoring in the manufacturing industry); (4) manual workers are heavily hit by low-tech offshoring and intra-industry offshoring both in the full sample and in the sample of manufacturing industries. It is possible to conclude that offshoring has a negative effect on employment, in particular on highly-routinized and labor-intensive tasks where the substitution effect seems to prevail.

5.3 The Model for Labor Compensation and Wages by Skill-Group

The analysis now turns to the investigation of the impact of offshoring and innovation on wages by skill-group of workers. Much in line with expectations, value added growth has a positive, statistically significant effect on wages and a negative, statistically significant effect on employment growth (and employment growth by professional group). Considering the coefficients of offshoring, low-tech offshoring has a positive and statistically significant impact on labor cost per employee while high-tech offshoring has a negative but not statistically significant effect. Looking at the results of the regression by skill-groups, sign coefficients are inverted. High-tech offshoring has positive and statistically significant coefficients on wages of high-skilled and medium-skilled workers. Low-tech offshoring has a negative and statistically significant coefficient in the model for low-skilled workers.

While technology, both in terms of process and product innovation, appears to have no effect on labor compensation per employee, wages by skill-group are affected to differing degrees. Results suggest that the increase in the share of firms performing product innovation has a negative and significant effect on wages of high and medium educated workers. Low educated workers seem not to be affected by this type of technological process. One plausible explanation could be that when companies implement innovation strategies aiming at developing and launching new products on the market, they must invest in research and other innovative activities that constrain the wage growth of certain groups of workers. Conversely, the increase in the share of firms performing process innovation yields positive returns on the wages of low-skilled workers. One can reasonably assume that the optimization of production processes, while leading to the decline in the low-skilled workforce (as shown above), increases wages for the remaining workers.

Results are in line with expectations and in general with the literature that sees offshoring as one of the major factors driving wage inequality between skill groups of workers[18]. The analysis conducted here adds an important element to the puzzle. The technological content of sourced inputs helps to explain the increasing differential in the economic fortune of workers in industrialized countries. Results indicate that high-tech offshoring drives up the wages of highly qualified employees while low-tech offshoring drives down the wages of less qualified workers.

[18]See Bottini et al. (2007) for a more detailed review of this literature.

6 Conclusions

This paper investigated the impact of offshoring on employment and wages using 2-digit NACE Rev.1 industry-level data for five European countries. Three main results have emerged. First, the distinction proposed between professional groups (managers, clerks, craft and manual workers), revealed its explanatory power. Offshoring is detrimental for total employment, in particular for less qualified workers exposed to international competition such as clerks and manual workers. Second, the distinction of the offshoring indicators based on the technological level of the foreign industry from which inputs are sourced revealed its great relevance, in particular in the regression on wages by educational group. Third, this work has confirmed the importance of the distinction between product and process innovation in determining the impact of technological change on employment and wages.

Inter-industry and intra-industry offshoring, as well as high-tech and low-tech offshoring, have a negative effect on total employment. Results from the subsample of manufacturing industries confirmed these conclusions. The division of employment in four professional groups added important elements to the puzzle. Offshoring has an overall neutral effect on managers and craft workers while clerks, and to a larger extent manual workers, are heavily hit by international fragmentation of production, in particular by low-tech offshoring. It is possible to conclude that highly routinized functions, both in the service industry and in the manufacturing sectors, that can be easily relocated in regions with lower labor costs, are hit the hardest by offshoring practices.

The results of the regressions on wages by educational groups confirm the heterogeneity of the relationships analyzed. Low-tech offshoring is found to have a positive effect on labor compensation per employee. Since low value added tasks are carried out by external partners, firms can concentrate internal resources on more profitable operations with a higher value added content, thus increasing productivity and wages. The picture is reversed in the analysis of labor compensation by skill-group. Here, imports of intermediate inputs from foreign high-tech industries have positive effects on wage growth of high- and medium-skilled workers while low-tech offshoring has a negative effect on wage growth of low-skilled workers. It is likely that while imports of high-tech intermediate goods increase productivity and hence wages of more advanced skill-groups, low-tech offshoring exposes less qualified workers to international competition with countries where the cost of unskilled labor is comparably lower. In this sense, further research is required to identify the geographical origin of the imported intermediate inputs.

To conclude, this study confirmed the polarization of employment in Europe towards high-skilled professions and the general downsizing of domestic manufacturing industry. Furthermore, the key distinction in the technological content of imported intermediate inputs revealed its explanatory power, opening up possibilities for further research. Additional research is also needed in terms of the econometric strategy. The single equation approach used in this analysis might not capture the complexity of the existing interrelationships between production factors and professional groups. Further research should account for this aspect.

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8 Econometric Tables

TABLE 5. Determinants of Total Employment

	Dependent variable: Total Employment							
	All Sectors				*Manufacturing Sectors*			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Value Added	0.233***	0.334***	0.207***	0.302***	0.286***	0.348***	0.292***	0.358***
	(3.34)	(4.79)	(2.74)	(3.98)	(3.38)	(4.09)	(3.50)	(4.24)
Labor Cost per Emp.	-0.128***	-0.150***	-0.122***	-0.144***	-0.109**	-0.0919**	-0.109***	-0.0943**
	(-2.75)	(-3.19)	(-2.58)	(-2.99)	(-2.56)	(-2.04)	(-2.65)	(-2.13)
Share of Innovators	0.0262**	-0.00288	0.0276*	-0.00392	0.0652***	0.0443	0.0669***	0.0686**
	(1.77)	(-0.17)	(1.87)	(-0.23)	(3.53)	(1.54)	(3.32)	(2.02)
Reducing Prod. Cost	-0.0771***	-0.0207	-0.0768***	-0.0194	-0.0160	0.0435**	-0.0150	0.0407*
	(-3.61)	(-1.02)	(-3.64)	(-1.00)	(-0.89)	(1.97)	(-0.88)	(1.87)
Inter-Industry Off.	-0.158***	-0.154***			-0.199***	-0.146***		
	(-3.98)	(-3.83)			(-4.33)	(-3.18)		
Intra-Industry Off.	-0.0938***	-0.0872***			-0.114***	-0.0885**		
	(-2.72)	(-2.65)			(-3.05)	(-2.21)		
High-Tech Off.			-0.0965***	-0.0848***			-0.151***	-0.131***
			(-3.14)	(-2.78)			(-4.13)	(-3.16)
Low-Tech Off.			-0.154***	-0.156***			-0.0984**	-0.0568
			(-3.32)	(-3.39)			(-2.06)	(-1.17)
Constant	1.203	1.623*	0.953	1.328*	-0.192	-1.382	-1.123	-3.623
	(1.51)	(1.44)	(1.30)	(1.46)	(-0.19)	(-0.75)	(-0.98)	(-1.60)
time_0003	1.907***	1.646***	1.932***	1.678***	0.633	0.231	0.616	0.306
	(2.88)	(2.77)	(2.92)	(2.81)	(1.10)	(0.39)	(1.06)	(0.51)
time_0307	2.053***	1.913***	2.106***	1.985***				
	(2.89)	(3.00)	(2.96)	(3.08)				
time_0710					-0.525	-0.308	-0.702	-0.485
					(-0.74)	(-0.42)	(-0.99)	(-0.67)
Country Dummy	No	Yes	No	Yes	No	Yes	No	Yes
Observations	488	488	488	488	286	286	286	286
R^2	0.224	0.275	0.226	0.279	0.190	0.246	0.185	0.250

Note: *t-Statistics in Parenthesis with* *p<0.1; **p<0.05; ***p<0.01 *Significance Level*

TABLE 6. Determinants of Managers and Clerks

	Dependent variable: Managers				*Dependent variable: Clerks*			
	All Sectors		*Manufacturing*		*All Sectors*		*Manufacturing*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Value Added	0.166	0.213*	0.410***	0.423***	0.212**	0.211**	0.262*	0.283*
	(1.38)	(1.67)	(3.09)	(3.22)	(2.09)	(2.00)	(1.73)	(1.88)
Labor Cost per Emp.	-0.192**	-0.211**	-0.0549	-0.0616	-0.112	-0.113	-0.0926	-0.103
	(-2.10)	(-2.26)	(-0.66)	(-0.76)	(-1.54)	(-1.53)	(-1.05)	(-1.17)
Share of Innovators	-0.0126	0.00494	-0.113***	-0.0823*	-0.0475	-0.0445	-0.0312	0.0160
	(-0.42)	(0.16)	(-2.66)	(-1.66)	(-1.50)	(-1.44)	(-0.59)	(0.26)
Reducing Prod. Cost	-0.0412	-0.0419	0.101***	0.0963***	0.0770*	0.0773*	0.166***	0.159***
	(-0.87)	(-0.90)	(3.09)	(3.04)	(1.81)	(1.82)	(3.22)	(3.07)
Inter-Industry Off.	-0.0684		-0.0270		-0.180**		-0.129	
	(-0.97)		(-0.32)		(-2.12)		(-1.13)	
Intra-Industry Off.	0.0724		-0.0418		-0.128**		-0.147*	
	(1.19)		(-0.63)		(-2.41)		(-1.70)	
High-Tech Off.		-0.0424		-0.0734		-0.150**		-0.195**
		(-0.82)		(-1.16)		(-2.45)		(-2.09)
Low-Tech Off.		0.0782		0.00427		-0.148**		-0.0730
		(1.03)		(0.05)		(-2.55)		(-0.77)
Constant	3.759*	4.134***	7.574	5.648	5.974***	5.553***	0.840	-2.243
	(3.90)	(3.00)	(2.51)	(1.53)	(3.67)	(4.23)	(0.24)	(-0.56)
time_0003	-0.787	-0.730	-1.531*	-1.410	-2.210**	-2.181**	0.195	0.379
	(-0.98)	(-0.90)	(-1.74)	(-1.57)	(-2.08)	(-2.09)	(0.16)	(0.31)
time_0307					-1.496	-1.458		
					(-1.53)	(-1.49)		
time_0710	-3.197**	-3.217**	0.722	0.635			3.710**	3.549**
	(-2.45)	(-2.47)	(0.60)	(0.53)			(2.53)	(2.46)
Country Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	493	493	287	287	492	492	287	287
R^2	0.129	0.128	0.160	0.164	0.157	0.157	0.132	0.137

Note: *t-Statistics in Parenthesis with* *p<0.1; **p<0.05; ***p<0.01 *Significance Level*

TABLE 7. Determinants of Craft and Manual Workers

	Dependent variable: Craft Workers				*Dependent variable: Manual Workers*			
	All Sectors		*Manufacturing*		*All Sectors*		*Manufacturing*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Value Added	0.382*	0.405*	0.232*	0.261**	0.347**	0.212	0.353***	0.320**
	(1.87)	(1.94)	(1.88)	(2.15)	(2.56)	(1.55)	(2.75)	(2.55)
Labor Cost per Emp.	-0.436***	-0.447***	-0.137*	-0.147**	0.103	0.143	-0.0286	-0.0163
	(-3.27)	(-3.25)	(-1.89)	(-2.17)	(1.07)	(1.50)	(-0.33)	(-0.20)
Share of Innovators	-0.0247	-0.0104	0.0734*	0.136***	-0.0471	-0.0757	0.00401	-0.0631
	(-0.45)	(-0.18)	(1.68)	(2.91)	(-0.92)	(-1.45)	(0.09)	(-1.01)
Reducing Prod. Cost	0.0658	0.0666	-0.00699	-0.0142	-0.108**	-0.106**	-0.0142	-0.00657
	(0.98)	(0.99)	(-0.17)	(-0.36)	(-2.13)	(-2.16)	(-0.29)	(-0.14)
Inter-Industry Off.	-0.115		-0.0704		-0.132		-0.155*	
	(-1.15)		(-1.01)		(-1.46)		(-1.81)	
Intra-Industry Off.	0.0121		-0.0168		-0.205**		-0.149**	
	(0.16)		(-0.28)		(-2.97)		(-2.44)	
High-Tech Off.		-0.0759		-0.106*		-0.0268		-0.0659
		(-0.94)		(-1.88)		(-0.37)		(-0.85)
Low-Tech Off.		-0.0157		0.0654		-0.356***		-0.236***
		(-0.18)		(0.92)		(-4.80)		(-3.72)
Constant	1.041	-2.473	-5.857***	-9.027***	3.279	7.088***	-5.675*	-3.119
	(0.43)	(-0.88)	(-2.59)	(-3.58)	(1.76)	(4.69)	(-1.98)	(-1.03)
time_0003	-0.853	-0.779	-0.265	0.234	3.077*	0.590	5.698***	5.279***
	(-0.58)	(-0.53)	(-0.25)	(0.23)	(2.39)	(0.56)	(4.00)	(3.69)
time_0307	1.126	1.156	0.518	0.797	2.337		4.996***	4.840***
	(0.64)	(0.66)	(0.50)	(0.81)	(1.87)		(3.91)	(3.76)
time_0710						-2.461**		
						(-2.02)		
Country Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	446	446	279	279	471	471	285	285
R^2	0.120	0.119	0.151	0.167	0.151	0.171	0.283	0.294

Note: *t-Statistics in Parenthesis with* *p<0.1; **p<0.05; ***p<0.01 *Significance Level*

TABLE 8. Determinants of Wages by Skill-Group

	Labor Cost		*High-Skill*		*Medium-Skill*		*Low-Skill*	
	All Sec	*Manuf*	*All Sec*	*Manuf*	*All Sec*	*Manuf*	*All Sec*	*Manuf*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Value Added	0.0545	0.0162	0.893***	0.934***	0.824***	0.932***	1.037***	1.223***
	(0.61)	(0.11)	(13.34)	(9.92)	(9.38)	(8.07)	(9.02)	(11.28)
Total Employment	-0.256***	-0.211**						
	(-2.75)	(-2.18)						
Managers			-0.928***	-0.853***				
			(-31.61)	(-20.98)				
Clerks					-0.750***	-0.498***		
					(-13.47)	(-8.98)		
Manual W.							-0.991***	-1.110***
							(-25.32)	(-23.45)
Share of Innovators	0.0225	-0.00654	-0.0469***	-0.0947**	-0.0351	-0.145***	-0.00554	-0.0159
	(0.88)	(-0.14)	(-2.88)	(-2.18)	(-1.62)	(-3.39)	(-0.21)	(-0.50)
Reducing Prod. Cost	-0.0192	-0.0167	0.0159	0.00328	-0.0603*	-0.0174	0.0729**	0.114***
	(-0.47)	(-0.52)	(0.83)	(0.10)	(-1.77)	(-0.52)	(2.49)	(4.17)
High-Tech Off.	-0.0208	-0.0647	0.0808**	0.118***	0.149***	0.141***	-0.0406	-0.0464
	(-0.47)	(-1.04)	(2.56)	(2.66)	(3.53)	(2.61)	(-0.99)	(-1.15)
Low-Tech Off.	0.154**	0.0410	0.0101	-0.0224	0.0779	-0.0434	-0.107**	-0.0366
	(2.17)	(0.44)	(0.31)	(-0.44)	(1.61)	(-0.74)	(-2.60)	(-0.80)
Constant	-5.427***	2.891	4.290***	7.126***	1.638	8.850***	-5.755***	-0.891
	(-2.84)	(0.90)	(3.18)	(4.04)	(1.48)	(3.17)	(-3.39)	(-0.53)
Time Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	488	286	501	292	493	288	477	290
R^2	0.277	0.115	0.799	0.733	0.634	0.601	0.830	0.874

Note: *t-Statistics in Parenthesis with* *p<0.1; **p<0.05; ***p<0.01 *Significance Level*

9 Appendix

TABLE 1. NACE Rev.1 Sectors

	SECTORS	Nace	Pavitt
Nr.	**MANUFACTURING**		
1	FOOD PRODUCTS, BEVERAGES AND TOBACCO	15-16	SD
2	TEXTILES	17	SD
3	WEARING APPAREL, DRESSING AND DYEING	18	SD
4	LEATHER, LEATHER PRODUCTS AND FOOTWEAR	19	SD
5	WOOD AND PRODUCTS OF WOOD AND CORK	20	SD
6	PULP, PAPER AND PAPER PRODUCTS	21	SI
7	PRINTING AND PUBLISHING	22	SI
8	COKE, REFINED PETROLEUM PRODUCTS AND NUCLEAR FUEL	23	SI
9	CHEMICAL AND CHEMICAL PRODUCTS	24	SB
10	RUBBER AND PLASTIC PRODUCTS	25	SI
11	OTHER NON-METALLIC MINERAL PRODUCTS	26	SI
12	BASIC METALS	27	SI
13	FABRICATED METAL PRODUCTS (EXCEPT MACH. AND EQUIPMENT)	28	SD
14	MACHINERY AND EQUIPMENT, NEC	29	SS
15	OFFICE, ACCOUNTING AND COMPUTING MACHINERY	30	SB
16	ELECTRICAL MACHINERY AND APPARATUS, NEC	31	SS
17	RADIO, TELEVISION AND COMMUNICATION EQUIPMENT	32	SB
18	MEDICAL PRECISION AND OPTICAL INSTRUMENTS	33	SB
19	MOTOR VEHICLES, TRAILERS AND SEMITRAILERS	34	SI
20	OTHER TRANSPORT EQUIPMENT	35	SS
21	MANUFACTURING NEC AND RECYCLING	36	SD
Nr.	**SERVICE**		
22	SALE, MAINTENANCE AND REPAIR OF MOTOR VEHICLES (& FUEL RETAIL)	50	SD
23	WHOLESALE, TRADE & COMM. EXCLUDED MOTOR VEHICLES	51	SD
24	RETAIL TRADE, EXCL. MOTOR VEHICLES; REPAIR OF HOUSEHOLD GOODS	52	SD
25	HOTELS AND RESTAURANTS	55	SD
26	LAND TRANSPORT	60	SD
27	SEA TRANSPORT	61	SD
28	AIR TRANSPORT	62	SD
29	SUPPORTING AND AUXILIARY TRANSPORT ACTIVITY	63	SD
30	POST AND TELECOMMUNICATION	64	SB
31	FINANCIAL INTERMEDIARIES (EXCEPT INSURANCE AND PENSION FUND)	65	SI
32	INSURANCE AND PENSION FUNDS (EX. COMPULSORY SOCIAL SECURITY)	66	SI
33	ACTIVITIES RELATED TO FINANCIAL INTERMEDIARIES	67	SI
34	REAL ESTATE ACTIVITIES	70	SS
35	RENTING OF MACHINERIES AND EQUIPMENT	71	SS
36	COMPUTER AND RELATED ACTIVITIES	72	SB
37	RESEARCH AND DEVELOPMENT	73	SB
38	OTHER BUSINESS ACTIVITIES	74	SS

TABLE 2. Correlation Matrix

	Value Added	Productivity	Intra-Ind	Inter-Ind	High-Tech	Low-Tech	Innovators
Value Add							
Productivity	0.40***						
Intra-Industry Offshoring	-0.13**	0.22***					
Inter-Industry Offshoring	-0.11*	0.11**	0.14***				
High-Tech Offshoring	0.04	0.23***	0.63***	0.53***			
Low-Tech Offshoring	-0.30***	0.07	0.55***	0.35***	-0.04		
Share of Innovators	0.09	0.21***	0.38***	0.10*	0.39***	0.05	
Reducing Production Costs	0.03	0.20***	0.35***	0.11*	0.30***	0.13**	0.34***

Note: significance level at $^{*}p<0.5$, $^{**}p<0.01$, $^{***}p<0.001$;

TABLE 3. List of Data Sources

Variables	Sources	Periods
Value Added Growth	WIOD-SEA	00-03; 03-07; 07-11
Productivity Growth	WIOD-SEA	00-03; 03-07; 07-11
Share of Firms Performing Innovation	CIS	2000; 2003; 2011
Share of Firms Innovating Reducing Production Costs	CIS	2000; 2003; 2011
Labor Cost Rate of Change	WIOD-SEA	00-03; 03-07; 07-11
Wage Growth Low-Education Workers	WIOD-SEA	00-03; 03-07; 07-11
Wage Growth Medium-Education Workers	WIOD-SEA	00-03; 03-07; 07-11
Wage Growth High-Education Workers	WIOD-SEA	00-03; 03-07; 07-11
Total Employment Rate of Change	LFS	00-03; 03-07; 07-11
Managers Rate of Change	LFS	00-03; 03-07; 07-11
Clerks Rate of Change	LFS	00-03; 03-07; 07-11
Craft Workers Rate of Change	LFS	00-03; 03-07; 07-11
Manual Workers Rate of Change	LFS	00-03; 03-07; 07-11
Inter-Industry Offshoring (Differential)	WIOD-NIOT	2000; 2003; 2011
Intra-Industry Offshoring (Narrow)	WIOD-NIOT	2000; 2003; 2011
High-Tech Offshoring	WIOD-NIOT	2000; 2003; 2011
Low-Tech Offshoring	WIOD-NIOT	2000; 2003; 2011

Source: Own Elaboration

TABLE 4. Synopsis of the Literature

Study	Country	Sample	Offshoring Measure	Methodology	Findings
Amiti and Wei (2004)	United Kingdom	69 manufacturing and 9 service industries from 1995 to 2001	1) imports of computing and business services; 2) share of input service on total non-energy inputs	One-period and two-period differencing estimated with OLS	Job growth not negatively related to service outsourcing
Amiti and Wei (2005)	United States	450 and 96 manufacturing industries from 1992 to 2000	Share of inputs purchases of material and service inputs on total non-energy inputs	One-period and two-period differencing estimated with OLS; IV regression; GMM	Small negative effect of offshoring on employment in the 450 industries sample but not significant in the 96 industries sample
Hijzen and Swaim (2008)	17 OECD Countries	Manufacturing and service industries from 1995 to 2000	Share of imported intermediate inputs over value added (intra-industry and inter-industry)	OLS and outlier robust regression over five-years differences	Intra-industry offshoring reduces labor-intensity of production but not employment; inter-industry offshoring has no effect on labor-intensity but a small positive effect on employment
OECD (2007)	12 OECD Countries	24 manufacturing and service industries from 1995 to 2000	Share of import of intermediate inputs (manufacturing and service) on total non-energy inputs	One-period differencing estimated with OLS	An increase in manufacturing and service offshoring causes a small reduction in employment with slighlty stronger effect for manufacturing offshoring
Milberg and Winkler (2013)	United States	Manufacturing and service industries from 1998 to 2006	Share of import of intermediate inputs (manufacturing and service) on total non-energy inputs	Estimation of panel data with fixed effects regression models	Service and manufacturing offshoring have negative effect on labor demand in the full sample and manufacturing sample of industries

Study	Country	Sample	Offshoring Measure	Methodology	Findings
Feenstra and Hanson (1996)	United States	435 manufacturing industries from 1972 to 1992	Share of import of intermediate inputs on total non-energy inputs (broad)	Cross-sectional one-period and two-period differencing estimated with OLS	Positive effect for wage share of high-skilled workers
Feenstra and Hanson (1999)	United States	447 industries from 1979 to 1990	Share of import of intermediate inputs on total non-energy inputs (narrow)	Cross-sectional one-period and two-period differencing estimated with OLS	Positive effect for wage share of high-skilled workers
Geishecker (2004)	Germany	20 industries from 1991 to 2000	Purchase of inputs as a share of industry's production (narrow and wide) diffrentiated by country of origin	GMM using one- and two-period lags	Negative effect of outsourcing to CEEC for manual workers
Hijzen et al. (2005)	United Kingdom	50 manufacturing industries from 1982 to 1996	Share of import of intermediate inputs on industry value added (narrow measure only)	SUR method with panel data (pooled and fixed effects)	Negative impact on unskilled workers, not significant for skilled and medium-skilled workers
Strauss-Kahn (2003)	France	50 industries from 1975 to 1993	Share io import of material inputs (narrow and broad) on industry output	Weighted least-squares estimation	Positive effect for the wage share of high-skilled workers
De Vries et al. (2012)	40 Countries	35 manufacturing and service industries from 1995 to 2009	Share of import of intermediate inputs (manufacturing and service) on value added (broad and narrow)	SUR method	Offshoring has impacted negatively upon all skill levels but the largest impact is for medium-skilled workers
Foster et al. (2012)	40 Countries	35 manufacturing and service industries from 1995 to 2009	Share of import of intermediate inputs (manufacturing and service) on value added (broad and narrow)	First differencing with OLS	Neutral or slightly positive effect on total employment; for service offshoring negative in low and high-skilled service industries; positive in high-tech manufacturing for high-skilled workers

Source: Own Elaboration

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