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Offshoring, industry heterogeneity and employment[1]

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Abstract

Economies and production systems are subject to incessant processes of structural change fuelled by the dynamics of demand, technology and international competition. The increasing international fragmentation of production, also known as "offshoring", is an important element of such a (global in scale) process of structural change having important implications for employment and on the way employment gain and losses are distributed across firms, industries, national economies and components of the labour force. This paper assesses the employment impact of offshoring, in five European countries (Germany, Spain, France, Italy, the United Kingdom), distinguishing between different types of inputs/tasks offshored, different types of offshoring industries and types of professional groups affected by offshoring. Results provide a rather heterogeneous picture of both offshoring patterns and their effects on labour, and the presence of significant differences across industries. Along with this variety of employment outcomes, the empirical evidence suggests that offshoring activities are mainly driven by a cost reduction (labour saving) rationale. This is particularly the case of the manufacturing industry where offshoring is found to exert a negative impact among the less qualified (manual) or more routinized (clerks) types of jobs, while the main difference between high and low technology industries has to do with the type of labour tasks that are offshored and the types of domestic jobs that are affected. In high-tech industries the negative effects of offshoring on employment are concentrated among the most qualified professional groups (managers and clerks). A specular pattern is found in the case of the low-tech industries where job losses are associated to the offshoring of the least innovative stages of production and penalise mostly manual workers.

Keywords: Offshoring, Technological change, Employment

JEL Classification: F16, O33, F11

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1. Introduction

In recent years, the nature of international trade has been deeply transformed by the rapid growth and geographical expansion of international production networks. The international fragmentation of production activities and their functional integration along global value chains has been facilitated by the fall of transportation costs and the opportunities offered by ICTs. Today, about 80 percent of trade involves intermediate inputs, that is goods and services that instead of being consumed as final goods re-enter the production process in another country (UNCTAD, 2015). A large section of these trade flows are the result of firms decisions to relocate business functions abroad or subcontracting the production of additional inputs to non-affiliated suppliers. This phenomenon commonly labelled as "international outsourcing" or "offshoring"[2] has far-reaching effects, both at a micro and macroeconomic level, contributing to reshape the structural characteristics and performances of firms, industries, and the position of national economies within the new patterns of the international division of labour.

So far, the policy concerns on offshoring focussed on the effects of international delocalization of production activities carried out by firms located in advanced countries on their domestic labour market. In this respect, offshoring has in fact been seen as a process consisting of the relocation production capacities (labour tasks) to developing and transition countries where factor prices (and in particular labour costs) are lower compared to their origin country. This phenomenon has been increasingly associated, and seen as the main cause of, deindustrialization, massive job losses and the activation of a "race to the bottom" of domestic wage levels and working conditions. These concerns have spurred a new stream of empirical contributions aiming at assessing the effects of offshoring on employment and wages. As it will be discussed in the following section, however, this literature provides controversial evidence.

The inconclusiveness of the empirical literature on the employment effects of offshoring is related to various factors, the most important being the lack of appropriate indicators of offshoring and the difficulty of capturing the aggregate impact of such a complex phenomenon. The latter is in fact the result of a complex array of direct and indirect effects of the delocalization strategies of firms. From a micro-economic perspective, it has indeed been argued that thanks to production offshoring, firms can improve domestic

[2] For a more detailed definition of the terms "outsourcing" and "offshoring" see Radło (2016).

productivity, gain market shares, raise wages and even eventually create new jobs in their home establishments. Other types of indirect effects of offshoring need to be taken into consideration when a more aggregated perspective is adopted. In fact, offshoring activities can exert their effects in industries and areas other than the ones where offshoring firms operate and in which the direct effects are visible.

The difficulty of assessing the impact of offshoring on employment, wages and working conditions has also to do with the heterogeneous nature of offshoring activities, the existence of different possible drivers and motivations behind firms offshoring decisions, the presence of very different "structural contexts" in which offshore strategies are implemented and exert their effects on labour. As we show in the next section, the existing literature dealing with offshoring fails to recognize the heterogeneous nature of such a phenomenon, its structural characteristics and its very different outcomes. The existence of a "skill-bias" effect of offshoring has indeed already been recognized by several empirical contributions; however, the differentiated impact of offshoring on the different components of the domestic labour force has rarely been associated to the heterogeneous nature of offshoring activities and to the very different competitive environments, industrial and technological contexts in which they take place. This paper aims at shedding new empirical light precisely on this point, exploring the industry specific nature of offshoring strategies and the extent to which nature, drivers and employment effects of offshoring are conditioned by the production and technological regimes in which firms operate. In this respect, the adoption of an industry level analysis appears an appropriate methodological choice allowing, on the one hand, to take in due account the main structural differences in technological regimes, patterns of international production and composition of labour force influencing the offshoring phenomenon and its employment impact; and, on the other hand, to interpret the relationship between the dynamics of offshoring and employment as part of the broader process of structural change. In fact, we move from the assumption that there is nothing like a "representative" offshoring firm or industry, type of production stage and labour task offshored, type of job or professional profile affected by offshoring activities. Along with the role played by firms' specific managerial choices, interdependent features such as the type of industry (technological regime and competitive environment) in which offshoring firms operate, the hierarchical/strategic positioning of the firm, sector, and even country, within the international production arena, the composition and quality of the labour force, are considered in this contribution as "structural" (i.e. path dependent, highly inertial and

relatively time invariant) elements conditioning the extent to which, and how, firms get into global value chains as well as the effects of offshoring on employment, wages and working conditions. This approach is broadly consistent with the notion of "relative structural invariance" developed by Landesmann and Scazzieri (1990) and with a structural view of economic change as discussed in the contribution of Scazzieri in this special issue. In the same vein, and in a more dynamic framework, offshoring activities and their economic effects are seen here as intertwined with the broader process of structural change fuelled by the asymmetric and out-of-equilibrium dynamics of firms' behaviours, demand and technology within competitive contexts characterized by unbalanced and hierarchically structured power relationships.

The aim of the empirical evidence presented in the following sections consists therefore of exploring the differentiated effects of offshoring on employment in this "structural perspective". The employment impact of offshoring processes is investigated distinguishing between different types of production inputs offshored, different types of offshoring industries and assessing the effects of the different offshoring patterns on four main professional groups: Managers, Clerks, Craft and Manual workers. The empirical analysis is based on a unique industry-based dataset obtained by merging various sources of information and covering five major EU countries (Germany, Spain, France, Italy and the United Kingdom).

The paper is organised as follows: Section 2 discusses the existing literature on offshoring and its effects on employment. Section 3 introduces the dataset and descriptive evidence on the different dynamics of employment across professional groups as well as on major differences across industries and countries (and over time) in the level and type of offshoring activities. Section 4 presents the econometric estimates of the employment impact of offshoring while the concluding section synthesizes the main findings and discuss possible research developments.

2. Offshoring and employment: a review

The increasing tendency to international fragmentation of production occurred in the last three decades has stimulated a theoretical and empirical debate concerning the impact of offshoring on domestic employment and wages.

A first group of neoclassical offshoring models, based on Ricardian comparative advantage and Heckscher-Ohlin theories, reach the conclusion that international fragmentation of production leads to more efficient patterns of specialization, or "intra-product" specialization across countries. Depending on their factor intensity, intermediate production stages are localized according to country's relative factor endowments (capital, labour and skills). Following this approach, offshoring would have the same effects predicted in the standard trade literature by the Stolper-Samuelson theorem, where the price of factors that are more intensively used tend to rise, while the opposite occurs to those used less intensively (Arndt, 1997; Arndt and Kierzkowski, 2001; Deardorff, 2001; Jones and Kierzkowski, 2001).

Departing from the "comparative advantage tradition", another stream of contributions has proposed an analysis of offshoring based on what is defined as the "trade in tasks" approach (Grossman and Rossi-Hansberg, 2008). International trade is not exclusively seen as a pure exchange of final goods or "wine for clothes", using the famous Ricardian example, but also, and more importantly, as the exchange of intermediate production tasks that, thanks to technological improvements, can be internationally traded. According to the Grossman and Rossi-Hansberg model, offshoring exerts various types of effects on low-skilled workers, through different mechanisms having differentiated effects on the wage level of this labour category. In contrast with the Heckscher-Ohlin model, Grossman and Rossi-Hansberg (2008) point to the fact that production processes involve a large number of tasks requiring different units of low-skilled or high-skilled labour. Tasks vary in their offshoring costs ("offshorablity"): while high level tasks cannot be offshored, low-tasks can be offshored although to a varying degree depending on the offshoring costs. In fact, firms benefit from offshoring decision when wages are lower abroad, but they face some costs in terms of loss in productivity depending on the amount of low-skilled labour necessary to perform the same task abroad. In the Grossman and Rossi-Hansberg model, the final effect of offshoring on unskilled workers is ambiguous due to the coexistence of three different mechanisms deriving from the fall in

offshoring costs of low-skilled tasks: the productivity effect, the relative price effect and the labour-supply effect.[3]

Despite recognizing the importance of skills heterogeneity, the "trade in tasks" approach maintains the mainstream assumption regarding the existence of a full-employment equilibrium, which is guaranteed by shifts in relative prices and by labour reallocation processes.

The theoretical debate on the employment effects of offshoring has been paralleled by a large stream of research directly devoted to empirically assess the real effect of the international delocalization of production on total labour demand as well as on the relative skill structure of the domestic workforce. One of the fundamental problems faced by this literature has to do with the measurement of offshoring. In fact, official statistics do not provide data on offshoring activities, and this is due to the fact that firm-level information regarding managerial decisions to substitute domestic with foreign production are not collected. Given this data-constraint, and taking into account that offshoring generates trade flows of production inputs between "domestic" and "host" countries, data on trade in intermediates have often been used as a proxy of offshoring. The majority of the empirical analyses have however built offshoring indicators using national input-output (I-O) tables (extended to cover the international flows of intermediate inputs).[4] One of these indicators, known as the Feenstra and Hanson *broad offshoring*, divides the industry's sum of non-energy intermediate imported inputs from all foreign industries by the total sum of imported and homely produced intermediate goods. Feenstra and Hanson have proposed a second and well-known offshoring indicator − called *narrow offshoring* −, in which the numerator of the index is restricted to intermediate goods imported exclusively from the same industry. Following this approach, several other indicators measuring the intermediate import content of imports,

[3] The three different mechanisms described in Grossman and Rossi-Hansberg (2008) model can be summarized as follows. The productivity effect occurs when unskilled workers gain from offshoring due to the growth in the unskilled-intensive sector which dominates the substitution away from unskilled workers. This has the effects of increasing productivity for the remaining domestic low-skilled workers driving up their wage premium. The relative price effect derives from a decline in the price of low-skilled intensive tasks and the improvement in the country's terms of trade. If the country is sufficiently large, a fall in offshoring costs reduces the world price of the labour-intensive good and the wages of low-skilled workers. The labour supply effect implies the increase in the number of available low-skilled workers as low-skilled workers demand has shifted abroad, therefore reabsorbing unskilled workers in the labour force reduces their wages.

[4] According to Hijizen (2005), I-O tables are subject to a number of shortcomings. First, they ignore the possibility of outsourcing of the final production stage such as assembly lines. Secondly, I-O data do not necessarily reflect the relocation of production and do not capture outsourcing when products are not re-imported but rather exported to third markets (Hijizen, 2005, p. 48).

value added, exports, and output, have been proposed, each one being potentially associated to offshoring.[5]

The empirical literature on offshoring and its impact has so far produced mixed results. A good deal of empirical studies have estimated the impact of offshoring on domestic aggregate labour demand. Amiti and Wei (2005; 2009) found no evidence of service offshoring negatively influencing labour demand in the cases of United Kingdom and US, where service and material offshoring have been found to be responsible for an increase in productivity. In line with these findings, Hijzen and Swaim (2007) found that in 17 high-income OECD countries, broad offshoring or "inter-industry offshoring", does not affect labour-intensity, but has a positive effect on overall industry employment. According to the authors, the productivity gains from offshoring are sufficiently large that the jobs created by higher sales completely offset the jobs lost by relocating certain production stages abroad (Hijzen and Swaim, 2007, p. 6). Other studies have reached different conclusions. An OECD study performing an econometric analysis on a group of 12 countries found that material and service offshoring activities are detrimental for domestic industry employment (OECD, 2007).

Feenstra and Hanson (1996; 1999) paved the way to a new branch of empirical research aiming at assessing the role played by offshoring in shifting - to a different extent – the relative demand for skilled and un-skilled labour. In particular, they found that offshoring drives up high-skilled workers' wage share. These results were confirmed by other contributions providing converging evidence on the existence of a sort of "skill bias" effect of offshoring (Strauss-Kahn, 2003; Hijzen et al., 2005; Falzoni and Tajoli, 2012 and Crinò, 2012). The destination of offshoring activities seems also to play a role, in this respect. Intermediate inputs imported from low-income countries have in fact been found to penalize medium and low qualified workers (Anderton and Brenton, 1999; Egger and Egger, 2003; Ekholm and Hakkala, 2006; Geishecker, 2006; Minondo and Rubert, 2006; Falk and Wolfmayr, 2008).[6] Studies using the World Input Output Database, moreover, have provides non-converging evidences on the existence of a skill-bias effect of

[5] The properties, the pro and cons of these different indicators have been examined and discussed in several contributions (Formentini and Iapadre, 2008; Breda and Cappariello, 2012). Horgos (2009) compared the descriptive qualities and the econometric performances of different indicators while Castellani et al. (2013) questioned the reliability of some typical offshoring indices suggesting that for business services structural change, rather than international fragmentation, might be behind the variability of these indicators.

[6] Presenting a comprehensive review of this literature lies beyond the scope of this analysis. An excellent review is provided in Crinò (2009).

offshoring. In particular, Foster-McGregor et al. (2013) found that both "narrow" and "broad" offshoring activities reduce the relative cost share of all skill-groups, while a penalizing effect of offshoring on low and medium-educated workers has been found by Foster-McGregor et al. (2016). Interestingly enough, in the latter study, the effects of offshoring on employment and skills have been found to be associated to the level of development of the offshoring country. In developed countries, the negative effects of offshoring is unexpectedly larger for high-educated labour. The authors associate this result to the fact that firms located in developed countries are increasingly offshoring high-technology parts of the production processes – performed by high-skilled workers - beside low-skill intensive ones.

Relevant for the assessment of the impact of employment effects of offshoring is the recent emphasis put on tasks (rather than skills). Tasks are usually classified according to the degree of routinisation and cognitiveness of jobs (Acemoglu and Autor, 2011), a distinction which might bear important implications for differentiating offshoring strategies and their effects on labour. In fact, Becker et al. (2013) found that offshoring is associated with a downward shift of labour demand towards less-routinized and interactive tasks, and with an upward shift towards highly qualified workers. Similar results have been found by Hogrefe (2013) showing that offshoring has shifted domestic labour demand towards complex tasks, in particular when offshoring is directed towards non-OECD countries. Different results are found by Akcomak et al. (2013) showing that offshoring changes the level of employment without affecting the way in which tasks are organized. Baumgarten et al. (2013)'s analysis, moreover, confirms that a higher degree of interaction and non-routine jobs protects low-skilled workers from the negative effects of offshoring on their wage level. Hummels et al. (2014) show that wage losses are greater for workers displaced by offshoring firms than for workers displaced for other reasons, and that such effect holds for both unskilled and skilled (college-educated) workers. Finally, Ottaviano (2015) has shown that non-routine abstract tasks, as well as non-routine manual tasks, are less likely to be offshored due to the involvement in activities intensive in problem solving or in-person interactions.

As this brief review shows, the empirical literature assessing the employment impact of offshoring is far from providing univocal or converging results. It has already been recalled that this is partly due to the difficulty of finding effective measures of offshoring activities, as well as to the difficulty of disentangling the complex array of direct and

indirect effects of such a complex phenomenon. However, the inconclusiveness of these results can also reflect the heterogeneous nature of offshoring activities, an aspect that has been largely neglected by the bulk of the studies reviewed above. The only heterogeneity element taken into account in this literature is in fact the presence of a "skill-(or task)bias" effect of offshoring. However, such a "structural bias" has rarely been associated to the existence of different possible drivers and motivations behind firms' offshoring decisions, and to the presence of different types of competitive environments, institutional contexts and technological regimes in which firms operate.

There are nonetheless notable exceptions in this respect, that is contributions adopting a more holistic perspective on offshoring, its determinants and effects. Among these, the contribution of Milberg and Winkler (2013) is worth to be quoted. These authors highlight the limits of contemporary mainstream offshoring models, and emphasize the role played by national institutions, corporate strategies and power relationships along the global supply chain. Markets are seen as embedded in a set of institutions – labour, government, corporations – that mould power asymmetries and influence the distribution of the gains and losses from offshoring. Their empirical analysis sheds lights on the negative effects of service and material offshoring on employment in the US suggesting that the gains obtained from offshoring have not been translated into investment in new productive capacity but have been invested in financial assets. Milberg and Winkler also show that offshoring has increased income inequality especially in countries lacking institutions supporting workers' interests.

A structural approach to offshoring, developed within a geo-political economic framework, can be found in the works of Simonazzi et al. (2013) and Celi et al. (2017). These studies interpret offshoring as the result of a broader process of hierarchical re-organization of production chains among firms, sectors and, more importantly, geographically identifiable areas. Focusing on Europe, these authors interpret offshoring as a specific strategy implemented by the EU core – i.e. the German-led manufacturing network – to strengthen its productive capacity and enlarge its international market shares. Such a process occurs through both a cost channel – i.e. with the inflow of cheap intermediate inputs stemming from the East and feeding the German manufacturing VCs – and a technological one – i.e. using part of the accumulated surplus to technologically strengthen the core's industrial structure. Offshoring strategies can have, therefore, differentiated employment effects, the latter being country and sector specific and with

different effects on the various components of the workforce. In fact, in the EU core countries high-skill employment is likely to rise as a consequence of the expansion of more complex activities, while low-skill employment is expected to contract due to the outsource of the more labour intensive parts of the production process. The periphery, on the contrary, may experience an overall weakening of its industrial structure leading to a reduction of both low and high-skill employment in manufacturing and a rise of low-skill employment in low-tech services (see, Cirillo and Guarascio, 2015 and Celi et al., 2017 for an empirical validation of such hypothesis). On a similar ground, the works of Landesmann and Stehrer (2000) and Altzinger and Landesmann (2008), by taking explicitly into account the role of technological specialization and the technological characteristics of industries as factors influencing the patterns of international production, highlight another important structural dimension of offshoring.

We are fully sympathetic with the holistic and structural perspective on offshoring conveyed in this last set of conceptual and empirical works and the objective of this paper is to provide an additional empirical contribution in this direction by further exploring the heterogeneous nature of offshoring activities and their differentiated impact on employment. This will be done by merging different (industry level) information sources that will allow us to distinguish between different types of inputs offshored, different types of offshoring industries and types of professional groups affected by offshoring. The joint consideration of all these different sources of variety of the offshoring phenomenon represents the main value added of the empirical analysis presented in the next two sections. An additional original element of this contribution is the use of employment data broken down according to the International Standard Classification of Occupations – ISCO (ILO, 2102). Compared to the classifications based on the high-low skill dichotomy or on the routinized non-routinized distinction, the ISCO categories provide a more comprehensive classification of professional groups and a more effective classification to assess the differentiated effects of offshoring on employment.

3. Data and descriptive evidence

3.1 Data

The analysis carried out in this paper relies on the Sectoral Innovation Database (SID) developed at the University of Urbino.[7] In particular, this study benefits from the availability of detailed information contained in SID concerning: i) innovation activities and their objectives; ii) employment dynamics distinguished by industry and professional categories; iii) international production fragmentation tracing intermediate input flows across countries and industries and capturing differences in terms of the technological intensity of these trade flows.

(Table 1 around here)

In SID employment data are broken down by four professional categories – Managers, Clerks, Craft and Manual workers – based on the ISCO 1 digit classification (Table 1). The ISCO classification organises professions on the basis of a wide range of information related to the level of autonomy in the workplace, the average education required, the typology of work and the labour compensation levels. Moreover, this categorization takes explicitly into account the hierarchical structure of the workforce in terms of power, income and relative autonomy in carrying out labour tasks (ILO, 2012).

Regarding innovation variables, two basic indicators are considered: the share of innovative firms – used as a rough proxy of the level of innovativeness of the industry – and the share of firms involved in innovation with the objective of reducing labour costs. This variable will be used as a proxy measuring the relevance played by process – labour saving – innovation strategies. Innovation data are drawn from four Community Innovation Surveys (CIS) waves: 1998-2000, 2002-2004, 2006-2008. The innovation variables have been matched to industry-level data drawn from the Eurostat Labour Force Survey and from WIOD Nace Rev. 1 databases.[8]

(Table 2 around here)

[7] For a more detailed description, see Bogliacino and Pianta, 2010. A preliminary analysis of the effects of offshoring on wages and employment based on the use of SID is contained in Bramucci, 2016.

[8] In order to establish the requisite condition for comparability, innovation variables taken from CIS6 have been converted into Nace Rev.1 using the conversion matrix found in Perani and Cirillo (2015).

I-O tables – i.e. the WIOD database[9] – are used to build offshoring indicators. As a benchmark we use a "strict" definition of international outsourcing that considers only imported intermediates in a given industry from the same industry (corresponding to the diagonal terms of the import-use matrix). Feenstra and Hanson (1996) refer to this measure as a "narrow" offshoring indicator. Moreover, we detail intermediate input flows according to the technological intensity of the supplier industry in order to capture the technological content of offshoring strategies. In this regard a gross distinction between high and low-technology offshoring is used. Following Guarascio et al. (2015, 2016), we rely on the revised Pavitt taxonomy (Bogliacino and Pianta, 2016) proxying high-technology offshoring with the share of intermediates (on total purchased inputs) inflowing from Science Based and Specialized Suppliers sectors; and low-technology offshoring with the share of intermediates inflowing from Scale Intensive and Supplier Dominated industries. The same classification criteria is used to distinguish between High and Low technology offshoring industries. Offshoring industries belonging to the Science Based (SB) and Supplier Specialized (SS) are included in the high-technology industrial group while Supplier Dominated (SD) and Scale Intensive (SI) in the low-technology one. The list of the high a low technology sectors is reported in the Appendix.

All data have been converted into euros at constant prices. Data are available for the two-digit NACE classification for 20 manufacturing and 17 service sectors. The country coverage of the database includes five major European countries (Germany, France, Italy, Spain and the United Kingdom) representing a large part of the European economy.[10] Table 2 reports the set of variables included in the analysis.

3.2 Descriptive evidence

In what follows, we explore the dynamics of employment over the 2000-2011 period at an aggregate level and distinguishing between different professional categories, macro-sectors (manufacturing, service, high e low-tech industries). Data on the level and dynamics of offshoring activities across country and industry groups will be also analysed.

[9] For a description and a "user guide" of the WIOD Database see Timmer et al., 2015.
[10] The selection of countries has been made to reduce the number of missing values, particularly concerning information on innovation activities in the service sector.

Figure 1 shows that the dynamics of total employment is considerably heterogeneous both over time and across countries. In the first two sub-periods taken into account in this study – i.e. 2000-2003 and 2003-2007 – employment increases in France, Italy and Spain, while the opposite occurs in the UK. A reduction of jobs is registered in Germany in 2000-2003, while a positive trend is found in the second period. A generalized drop in employment occurs in all countries but Germany during the third period – i.e. 2007-2011 – mirroring the strong impact of the 2008 crisis in Europe. The asymmetric employment performance of Germany as opposed to Southern European countries during the economic downturn reflect the widening of a "core-periphery" divide and, more broadly, a hierarchical reorganization of the European industrial structure (Simonazzi et al. 2013). In this respect, the core – Germany and its manufacturing network – tends to over-perform Southern economies – and, to a lower extent, France - not only in terms of competitiveness and industrial production but also in terms of employment dynamics and post-crisis resilience (Simonazzi et al. 2013; Celi et al. 2017). Industry level data (not reported) signal the presence of marked sectoral differences in the dynamics of employment, in particular between manufacturing, service industries and between high and low-technology sectors. A contraction of manufacturing employment in parallel with a rise of employment in services has in fact occurred in the period examined in this paper. Moreover, employment has risen comparatively more in high-technology rather than in low-innovative sectors, suggesting a process of structural change that has penalised traditional industries. Such a pattern of structural change has characterized also the period of deep economic crisis started in 2008. In this period, characterized by a weak or negative dynamics of aggregate demand, investment, production output and employment have continued to increase (although at a slower pace) in services and high-tech industries while decreasing everywhere else.

(Figures 1 around here)

The analysis of employment data broken down by the four ISCO professional categories (Figure 2) reveals the presence of rather asymmetric patterns. Looking at the data referring to the total business sector, a clear-cut "professional divide" emerges in particular between the categories of managers and clerks (experiencing positive growth rates of employment) and the categories of crafts and manual workers (characterized by a reduction of employment levels). A similar pattern is found in both high and low

technology industries; in the latter industrial category the asymmetric dynamics of employment among the four professional groups appear as particularly pronounced. Once again relevant differences between manufacturing and service sectors emerge. In the manufacturing industry, employment grows only in the category of managers, while employment in the professional categories of manual workers and crafts drops at more than a 2% annual rate. In the service sectors, the only professional category experiencing job losses is clerks. A rather surprising result is the high rate of employment registered in the service sector by the manual workers category. This might be explained by the notorious poor productivity performances characterizing the most traditional service sectors along with a still limited possibility for these sectors to offshore the most labour intensive tasks.

(Figure 2 around here)

Figure 3 shows the level (and dynamics) of offshoring across the five countries considered in this study. Three offshoring indexes are used. The "narrow" offshoring indicator and the offshoring indexes referring, respectively, to the import of intermediate inputs from high and low-technology foreign industries. The table allows to identify the following stylized facts: a) the dominant role of Germany as the main outsourcing country, a dominance that has increased over time (changes in the levels of the indexes between 2000-03 and 2008-2011 are reported in brackets); b) high and low technology offshoring activities seem to have broadly the same relevance, although the latter tend to increase much faster than the former. This suggests that in all countries reducing production costs is not only one of the main drivers behind the diffusion of offshoring practices but that this strategy is increasing its relevance over time. This pattern characterizes also the most advanced European economy, that is Germany and provides further support to the hypothesis formulated by Simonazzi et al. (2013) identifying offshoring as a key driver of the increasing core-periphery divide in Europe. According to such hypothesis, in fact, one of the strongholds of Germany's competitiveness has been the massive inflow of imported low cost intermediates (also in the fuelling its productive system from the 2000s onwards).

(Figure 3 around here)

Figure 4 reveals the existence of significant differences across industries in the levels, types and dynamics of offshoring activities. Offshoring plays a much more important role in manufacturing than in services and such a gap does not seem to be closing over time. This last results is somewhat unexpected, especially taking into account the increasing role played by services in all economies and in the international trade flows and signal a persistent structural difficulty of these sectors to organize production and delivery activities on an international scale.

Concerning the difference between high and low-technology sectors, the picture emerging from Figure 4 is less clear-cut. Highly innovative sectors are characterized by high volumes of imported intermediates from the same sector (narrow offshoring) or, more broadly, from high-technology industries while the import of low-technology intermediates appears as less relevant. In low-technology industries, a specular pattern emerges. Independently form the specific offshoring indicator, the inflow of high-tech intermediates turns out to be half of the one registered in high-technology sectors. This result is once again likely to be connected to the large presence within the low-technology industry cluster of low innovative services such as retail activities, restaurants, hotels. The low level of internationalisation of these industries might drive down the overall offshoring intensity of the low technology industrial group. Not surprisingly, the prevalence of cost competitiveness strategies – signalled by the relatively stronger intensity of low-tech intermediate inflows – dominates in low-technology sectors.

Summing up, Figure 4 provides a set of remarkable insights: first, a relatively stronger offshoring intensity seems to characterize manufacturing and low-technology sectors. This result points to the still overwhelming relevance of tangible intermediate inputs in international trade flows and offshoring strategies. Second, the outsourcing of labour intensive tasks and production stages emerge as a major driver of offshoring activities. Third, a (largely expected) broad complementarity between the technological features of the imported intermediates and the technological level of the offshoring industry emerges. All in all, the descriptive analysis presented in this section confirms the interaction of a number of structural heterogeneity sources affecting the dynamics of employment in the European industries as well the level and types of offshoring strategies. Offshoring is likely to play some role in explaining these different employment outcomes. The next section aims at shedding new empirical light on this point.

(Figure 4 around here)

4. The employment effects of offshoring

4.1. The empirical strategy

The employment effects of offshoring are estimated using the following basic specification:

$$EMP_{ijt} = \beta_0 + \beta_1 * \Delta VA_{ijt-1} + \beta_2 * \Delta LABCOST_{ijt} + \beta_3 * INNOV_{ijt} + \beta_4 * PROCINN_{ijt} + \beta_5 * OFFSH_{ijt} + \beta_6 * X_{ijt} + \varepsilon_{ijt} \quad (1)$$

where *i* stands for the two digit level industry, *j* for the country and *t* for time. The overall 11 years (2000-2011) time span covered by our data set has been split in three sub-periods (2000-03; 2003-07; 2007-11) and all variables computed with reference to the same time intervals. The EMP variable measures the rate of change of employment in each industry; with the EMP variable we will measure both the dynamics of total employment and the rates of growth of employment in each one of the four ISCO professional groups (Managers, Clerks, Craft and Manual workers). VA is the change in the industry-level value added while LABCOST is the change of labour compensation. Innovation is plugged in using two different CIS variables: INNOV – i.e. the share of firms within the sector performing any type of innovative activity (product, process or organizational innovation), used as a proxy of the overall innovative intensity of the sector; PROCINN – i.e. the share of firms introducing a process innovation explicitly aimed at reducing costs – used as a proxy of the relative intensity of 'labour saving' innovations. The key variable of the specification in (1) is OFFSH, the share of imported intermediate inputs over total intermediates used in the production process. Such variable proxies the offshoring intensity of the sector and is observed at the first year of each considered period. Consistently with the evidence presented in the previous sections, three different offshoring indicators are (alternatively) used as regressors: *narrow* (OFFSH_NAR), *high* and *low-tech* (OFFSH_HT and OFFSH_LT). Finally, we include a set of time, geographical – i.e. a North (Germany, France and the UK) – South (Italy and Spain) -, and sectoral – i.e. manufacturing/services – dummies in order to control for

other potential sources of observable heterogeneity. The last term is the standard error component.

In order to get partially rid of both the autoregressive character of variables as well as to further control for country-level fixed effects we consider three-years long compound average annual rate of change as regards to the variables EMP, VA and LABCOST. In order to account for the different size and economic relevance of sectors we have opted for the use of weighted least squares (WLS).[11] We control for endogeneity related to country-industry observable characteristics relying, on the one hand, on our data time structure (see above) and, on the other, on a set of time and country dummies likely to capture such observable characteristics. In order to soften the presence of endogeneity biases related to simultaneity or unobservable characteristics the values of the variables INNOV, PROCINN refer to the periods 1998-2000, 2002-2004, 2006-2008. A two years time lag between the innovation variables and our dependent variable (the rate of change of employment) has therefore been imposed. With the same logic the variable OFFSH refers to the first year of each sub-period and the change in VA at its first (three years) lag. Finally, robust standard errors are used in order to control for the presence of heteroskedastic error terms.

4.2. Results

To start with, we estimate equation (1) regressing the rate of growth of total employment against the set of covariates included in our model and using the narrow offshoring indicator (OFFSH_NAR). The estimations are carried out both using data for all industries and for manufacturing and service sectors separately (Table 3). The results of these estimates provide a set of relevant insights. Looking at the results obtained on the pulled sample (first column), employment growth turns out to be (as expected) positively associated to the innovation intensity of the sector and negatively correlated to both the dynamics of labour cost and to the presence of strategies consisting of the introduction of labour-saving processes. When the all sample of industries is considered, offshoring does not seem to exert any significant effect on employment.

[11] Through a specific weighting procedure, the WLS allows to take into account the heterogeneous relevance of sectors avoiding biases in the estimations. As regards the weights, the choice is usually limited to value added and number of employees. Statistical offices tend to use the latter since the former is more unstable and subject to price variations, and we follow them in the use of employees as weights.

Results partly change when the manufacturing-services distinction is introduced. In the case of the manufacturing sector (second column), innovation intensity is confirmed to exert a positive effect on employment and the dynamics of wages a negative one. In services (third column), employment is negatively associated with the introduction of labour saving process innovations. The loss of significance of the innovation intensity variable in services can be explained by the fact that in these sectors innovation activities tend to be less formalized and linked to the exploitation of tacit knowledge and immaterial assets, that is sources of innovation not effectively captured by CIS. Interestingly enough, offshoring has a statistically significant (and positive) employment impact only in services.

(Table 3 around here)

As already discussed and highlighted by a large number of contributions, offshoring activities might have differentiated effects on employment depending on the specific qualitative content of jobs. We have therefore estimated equation (1) for each ISCO professional group and again separately for manufacturing and service industries. Table 4 confirms the existence of a variety of employment effects of offshoring activities. In the manufacturing industry offshoring penalizes the less qualified (or more routinary) components of the labour force (clerks and manual workers) suggesting that for manufacturing firms the international delocalization of production activities is driven by a cost reduction strategy. In the case of services, offshoring seems to have a positive effect on managers. This last result suggests on the one hand the presence in the tertiary sector of a mix of different offshoring strategies (related in turn to the very heterogeneous nature of services) and, on the other hand, that the increasing internationalization of service activities often require the expansion of management coordinating functions in the home country and consequently a more intense use of high-skilled workers (i.e. the skill channel effect described in Bogliacino et al. 2016). As far as the role played by the other variables, innovation intensity is confirmed to exert a positive effect on jobs only in manufacturing industries and for all categories but managers. What is also interesting is that process innovation (PROCINN) penalizes (as expected) manual workers in both manufacturing and in service industries. In services, also the highly qualified category of managers seems to be negatively affected by cost-saving innovation strategies, probably

the result of the reduction of a certain number of managerial and coordinating labour tasks made possible by the introduction of ICTs.

(Table 4 around here)

Distinguishing offshoring activities on the basis of the technological content of the input imported and type of offshoring industry allows to explore even further the heterogeneous nature of delocalization strategies and their differentiated effects on the different components of the labour force, namely across professional groups characterized by different skills, levels of autonomy and hierarchical positioning in the labour process. Table 5 shows the results of the estimates of the employment effects of two different types of offshoring strategies (import of high and low-tech intermediate inputs), in high and low technology offshoring industries and across the four ISCO professional groups. The table shows, once again, a very heterogeneous picture, confirming that the employment effects of the two offshoring strategies (HIGH e LOW-TECH) are industry specific. Low technology offshoring is negatively correlated only with manual workers and only in the case of the low-technology industries. Symmetrically, the delocalization of the most innovative stages of production negatively affects only the most qualified component of the labour force (managers and clerks). All in all, the results presented in Table 4 and 5 seem to show that offshoring activities are driven by a cost reduction rationale and this (by and large) independently from the industry or technological regime in which firms operate. The main difference between high and low technology industries has to do with the type of labour tasks that are offshored and the types of domestic jobs that are affected.

(Table 5 around here)

5. Conclusions

The main empirical objective of this contribution has consisted of highlighting the differentiated effects of offshoring on employment and in connecting this variety of employment outcomes to different drivers fuelling the process of international production,

different technological and competitive contexts in which offshore strategies are implemented, to the heterogeneous nature of labour processes, tasks and skills characterizing the different industries.

The descriptive evidence presented in section 3 has confirmed the presence of a large degree of "structural heterogeneity" in the dynamics of employment (across countries, industries and professional categories) and in the level, types and dynamics of offshoring activities.

As far as the effects of offshoring on employment, the results of the econometric estimations presented in section 4 can be synthesised as follows:

a) Offshoring exerts a negative impact on employment in the manufacturing sector, in particular among the less qualified (manuals) or more routinized (clerks) types of jobs. In the case of services a positive effects has been found only for the category of managers;

b) The employment effects of offshoring are strongly connected to the type of offshoring strategy. Manual jobs are negatively affected by low-technology offshoring while hi-technology offshoring penalizes clerks.

c) A clear dichotomy between high and low technology industries has emerged: in hi-tech industries the negative effect of offshoring on employment is found when firms delocalize the most innovative stages of production processes. In this case, job losses are concentrated among the most qualified professional groups (managers and clerks). A specular pattern is found in the case of the low-tech industries where job losses are associated to the offshoring of the low innovative stages of production and penalise mostly manual workers. These two pieces of evidence suggest that most of offshoring activities are driven by a cost reduction (labour saving) rationale and this (almost) independently from the industry or technological regime in which firms operate. The main difference between high and low technology industries has to do with the type of labour tasks that are offshored and the types of domestic jobs that are affected.

All in all the results presented in this paper confirm that the employment effects of offshoring depend on a complex array of (interdependent) structural factors with technology playing a rather important role in influencing levels, types and employment outcomes of offshoring activities. Translated in a more dynamic framework, our results indicate that offshoring should be analysed as an integral part of the broader process of

structural change, one fuelled by the asymmetric and out-of-equilibrium dynamics of firms' behaviours (in line with an evolutionary perspective of this process), but also one shaped by competitive contexts characterized by technological asymmetries and unbalanced and hierarchically structured power relationships (in line with a more structural view of offshoring). Pushing further the research in this direction represents indeed a rather challenging task. The difficulties are both of an empirical and conceptual nature. On the empirical ground a more appropriate and effective set of offshoring indicators is needed. In fact, data and indicators commonly used in empirical analysis (especially in the case of industry level studies, and including those used in this study) are rather imperfect and biased proxies of offshoring. However, the most difficult challenge is theoretical and conceptual in nature. In this regard, a preliminary and promising avenue to follow would be the integration of the traditional (largely) micro-level and mainstream literature on offshoring with two main heterodox bodies of literature and namely: a) the studies developed in the Schumpeterian tradition emphasising the existence of different technological regimes and their differentiated impact on employment; b) the studies that have examined the recent changes in the international division of labour and global production using a (geo)political-economic framework, that is emphasising the role of hierarchies and the issue of power relationships in an holistic fashion.

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Table 1. ISCO professional categories

Professional groups	ISCO 1 digit classes
Managers	Managers, senior officials and legislators
	Professionals
	Technicians and associate professionals
Clerks	Clerks
	Service and sales workers
Craft workers	Skilled agricultural and fishery workers
	Craft and related trade workers
Manual workers	Plant and machine operators and assemblers
	Elementary occupations

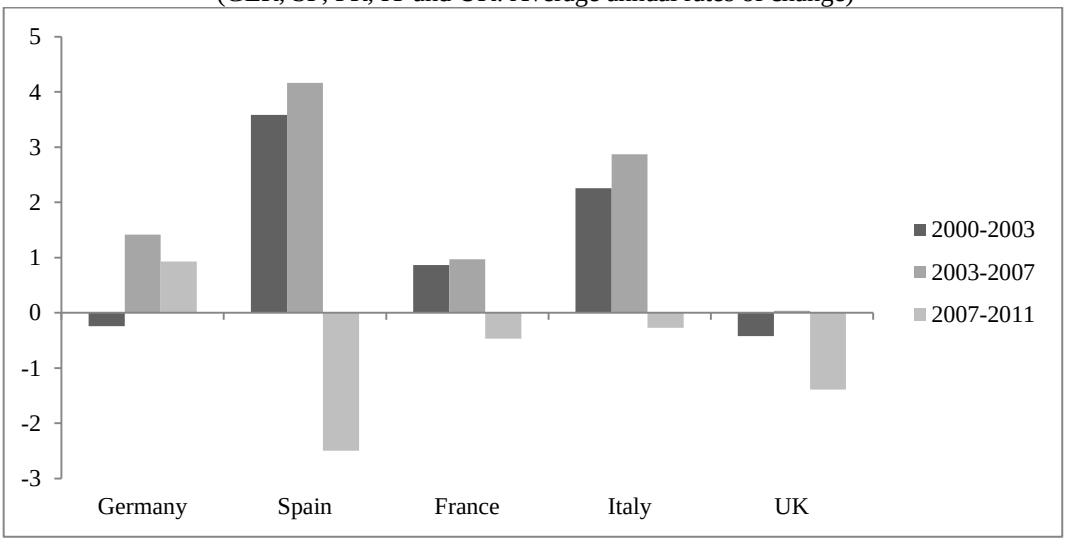
Source: Cirillo (2016a)

Table 2. List of Variables

Label	Description	Source
EMP	Compound annual rate of change of total employment	LFS
INN	Share of firms within the sector introducing innovations	CIS
PROCINN	Share of firms within the sector introducing innovations aimed at reducing labour cost	CIS
LABCOS	Compound annual rate of change of sectoral wages	WIOD I-O
VA	Compound annual rate of change of value added	WIOD I-O
OFFSHORING NARROW (OFFSH_NAR)	Share of imported intermediates (from the same industry) in total inputs	WIOD I-O
OFFSHORING HI-TECH (OFFSH_HT)	Share of imported high-tech intermediates in total inputs	WIOD I-O
OFFSHORING LOW-TECH (OFFSH_LT)	Share of imported low-tech intermediates in total inputs	WIOD I-O

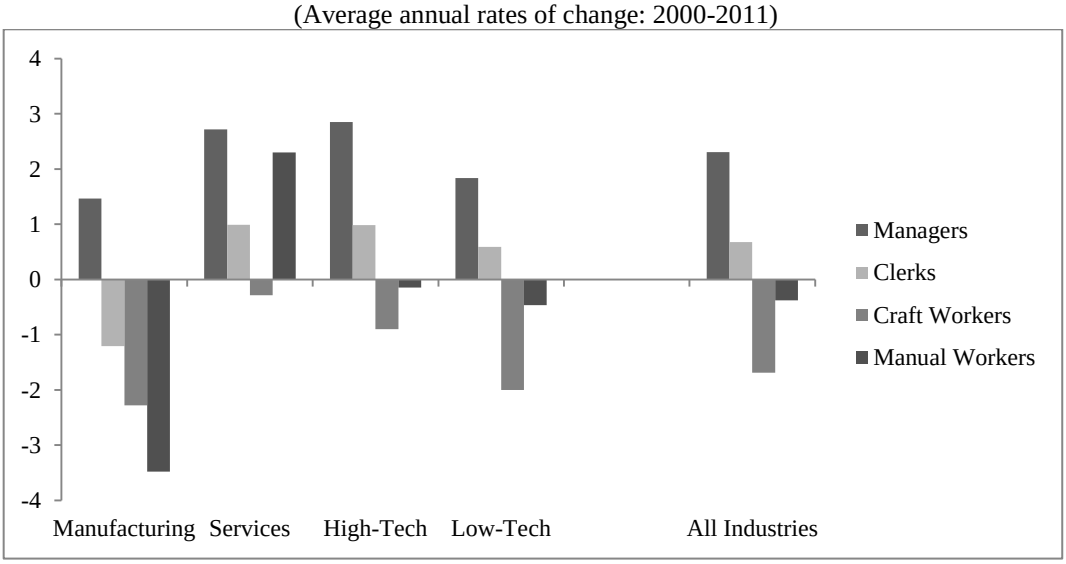
Source: SID database.

Figure 1. The dynamics of employment across countries (2000-2011)
(GER, SP, FR, IT and UK. Average annual rates of change)



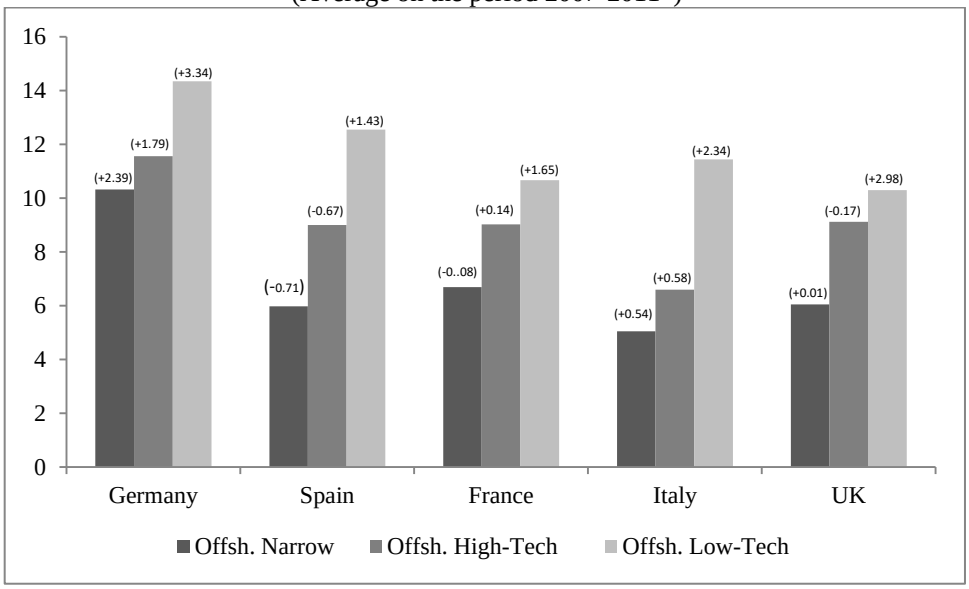
Source: elaboration on the SID database

Figure 2. The dynamics of employment across professional groups
(Average annual rates of change: 2000-2011)



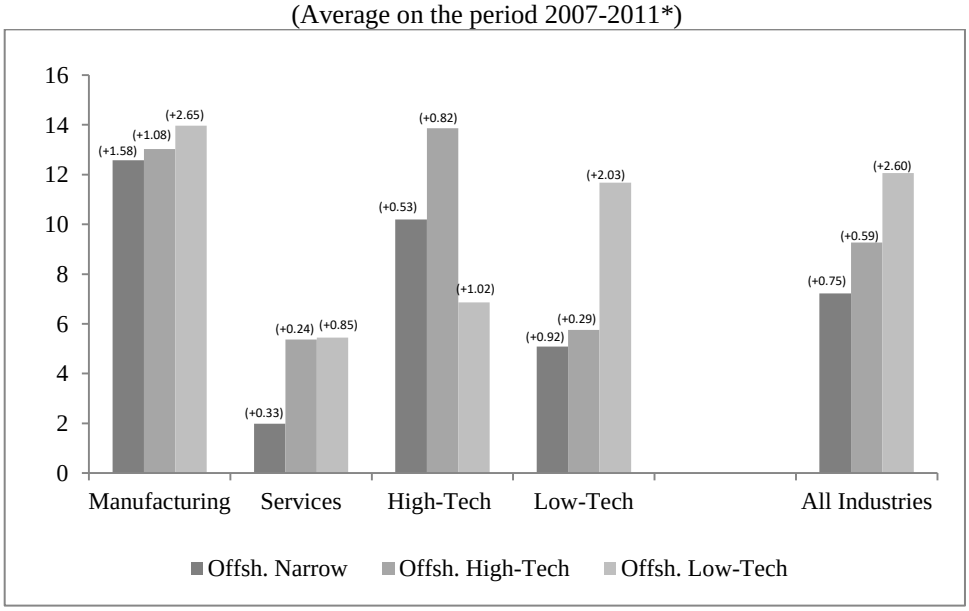
Source: elaboration on the SID database.

Figure 3. Offshoring intensity by country and type of indicator
(Average on the period 2007-2011*)



*Figures in brackets show the change of the level of the indicator between the periods 2000-2003 and 2007-2011
Source: elaboration on the SID database.

Figure 4. Offshoring intensity by type of industry and indicator
(Average on the period 2007-2011*)



*Figures in brackets show the change of the level of the indicator between the periods 2000-2003 and 2007-2011
Source: elaboration on the SID database.

Table 3. The employment impact of offshoring
WLS estimations with robust standard errors

	(1)	(2)	(3)
	ALL INDUSTRIES	MANUFACTURING	SERVICES
	Δ EMP	*Δ EMP*	*Δ EMP*
ΔVA (first lag)	0.0582	0.0950	-0.00237
	(0.0516)	(0.0645)	(0.0746)
ΔLABCOST	-0.126**	-0.107**	-0.0978
	(0.0502)	(0.0470)	(0.0757)
INNOV	0.0415***	0.0692***	0.00531
	(0.0153)	(0.0182)	(0.0229)
PROCINN	-0.0507**	0.000641	-0.0770**
	(0.0220)	(0.0187)	(0.0368)
OFFSH_NAR	0.0196	-0.0437	0.393**
	(0.0400)	(0.0389)	(0.184)
Observations	480	280	200
R-squared	0.242	0.164	0.224
Time Dummies	Yes	Yes	Yes
South Dummy	Yes	Yes	Yes
Manufact. Dummy	Yes	No	No
Constant	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4. The employment impact of offshoring across ISCO professional categories.
WLS estimations with robust standard errors

	MANUFACTURING				SERVICES			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Δ Managers	*Δ* Clerks	*Δ* Craft	*Δ* Manual	*Δ* Managers	*Δ* Clerks	*Δ* Craft	*Δ* Manual
ΔVA (first lag)	0.212**	0.193	0.0369	0.0946	-0.0384	-0.260	0.0718	-0.0168
	(0.100)	(0.120)	(0.0897)	(0.112)	(0.136)	(0.228)	(0.256)	(0.201)
ΔLABCOST	-0.104	-0.182**	-0.112	-0.00946	-0.228*	-0.126	-0.643***	0.408**
	(0.0908)	(0.0886)	(0.0755)	(0.0956)	(0.128)	(0.126)	(0.215)	(0.187)
INNOV	-0.0242	0.0797**	0.109***	0.105***	-0.0488	0.0339	-0.0320	-0.0556
	(0.0300)	(0.0328)	(0.0231)	(0.0340)	(0.0359)	(0.0403)	(0.0708)	(0.0689)
PROCINN	-0.0205	0.0404	0.00425	-0.0833**	-0.104*	-0.0834	0.105	-0.132**
	(0.0276)	(0.0393)	(0.0263)	(0.0385)	(0.0606)	(0.0506)	(0.0915)	(0.0664)
OFFSH_NAR	-0.0429	-0.125*	-0.000907	-0.131**	0.671**	0.137	0.0662	0.427
	(0.0659)	(0.0655)	(0.0570)	(0.0566)	(0.336)	(0.339)	(0.566)	(0.333)
Observations	285	285	277	283	207	206	168	188
R-squared	0.061	0.081	0.126	0.231	0.181	0.103	0.120	0.095
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
South Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5. The impact of high and low technology offshoring across ISCO professional categories and type of industry.

WLS estimations with robust standard errors

	HIGH-TECH INDUSTRIES				LOW-TECH INDUSTRIES			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Δ Managers	Δ Clerks	Δ Craft	Δ Manual	Δ Managers	Δ Clerks	Δ Craft	Δ Manual
ΔVA (first lag)	0.103	-0.170	0.0819	-0.312*	0.157	0.164	0.147	0.0960
	(0.132)	(0.182)	(0.217)	(0.181)	(0.142)	(0.124)	(0.231)	(0.162)
ΔLABCOST	-0.339***	-0.270**	-0.951***	-0.121	-0.146	-0.0616	-0.105	0.318***
	(0.118)	(0.104)	(0.257)	(0.232)	(0.103)	(0.0933)	(0.112)	(0.104)
INNOV	0.00230	0.0438	0.0503	0.0611	-0.0153	0.0727*	-0.0387	-0.0210
	(0.0299)	(0.0405)	(0.0490)	(0.0749)	(0.0404)	(0.0373)	(0.0747)	(0.0396)
PROCINN	-0.0282	-0.0420	0.155**	-0.223***	-0.0993*	-0.00795	0.0288	-0.0315
	(0.0478)	(0.0608)	(0.0636)	(0.0648)	(0.0546)	(0.0400)	(0.0693)	(0.0509)
OFFSH_HT	-0.189*	-0.282	-0.331*	0.253	-0.0217	-0.0761	0.0714	0.0329
	(0.103)	(0.188)	(0.189)	(0.195)	(0.0781)	(0.0740)	(0.0890)	(0.0830)
OFFSH_LT	-0.608	-0.681	-0.448	0.0917	0.0620	-0.00241	0.120	-0.210**
	(0.463)	(0.619)	(0.423)	(0.486)	(0.0957)	(0.0857)	(0.101)	(0.0845)
Observations	176	177	165	168	316	314	280	303
R-squared	0.229	0.205	0.267	0.186	0.096	0.068	0.055	0.172
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
South Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

APPENDIX

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

* The high and low-tech classification is made relying on the revised Pavitt taxonomy for manufacturing and services (Bogliacino and Pianta, 2016). Industries belonging to the Science Based (SB) and Supplier Specialized (SS) are included in the high-tech group while Supplier Dominated (SD) and Scale Intensive (SI) in the low-tech one.