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Abstract
This paper investigates the impact of the offshoring of production activities on domestic jobs in Great Britain. The paper considers both the spatial heterogeneity across local labour markets and variations in the intensity of outward flows of investments abroad (OFDI) across industries in order to shed new light on the job creation/destruction implications of offshoring. The results suggest that offshoring may generate significant job losses in routine occupations in areas that have been more exposed to the relocation of production abroad, regardless of whether the relocation has been to developed or developing/emerging countries. Offshoring to developing/emerging countries has, by contrast, a positive effect on the generation of non-routine jobs. Efficiency gains accruing from the international reorganization of production increase in the long-run, with compensation mechanisms operating through growth of employment in higher value added activities at home. Overall, our results uncover important spatial and interpersonal inequalities in job creation, which provide new challenges for public policy.

Keywords: Offshoring, local labour markets, job creation and destruction, routine and non-routine occupations
JEL Classifications: F21; F66; J42; J23; J24

Introduction

Growing opposition to offshoring deals by Multinational Enterprises (MNEs) has been the norm in nearly all advanced economies (compare Mankiw and Swagel, 2004 for the US; and Abramovsky et al., 2004; Hiyzen et al., 2005 for the UK). Offshoring trends, especially towards lower-wage developing and emerging countries, are usually considered to be responsible for the destruction of low-skilled jobs and the progressive deterioration in the economic fortunes of those at the bottom of the employment ladder in developed countries.

The focus of these fears has been traditionally centred on job losses in manufacturing. However, recent data show that services – as they become more easily tradable due to improvements in technology – are increasingly subject to similar trends. Examples of these trends abound. In 2006 Barclays Bank was brought under the spotlight as the first UK bank to negotiate a framework with the unions over the outsourcing of jobs to low-cost countries. More recently, it was again a media-target for moving hundreds of back-office jobs to India.[1] Other firms, such as Adecco, a UK labour recruiting agency, or British Airways, were among an increasing number of British companies opening offices and/or call centres in India. These movements were greeted with hostility across the UK. In 2008 the BBC warned against the detrimental effect on new entries into the IT sector of low-skilled jobs to Asia.[2] However, not all the emphasis has been on offshoring, as, as claimed by the Financial Times, *"one in six UK manufacturers has brought production back from overseas during the past year or is in the process of doing so"*(FT, 2013),[3] pointing that a renewed focus on product quality may have become a driver for re-shoring.

Changes over time in the industry composition of offshoring have contributed to shape the distribution of benefits and costs of outward foreign direct investment (OFDI) within the home economies. While some production activities are less prominent abroad, or are even re-offshoring, others, which had been almost untouched by offshoring in the past, are destroying UK jobs in greater numbers nowadays.

This paper aims at investigating the impact of offshoring, proxied by OFDI carried out by Great Britain-based MNEs between 1998 and 2007, on domestic jobs. Local labour markets in Great Britain are treated as geographical units with different levels of exposure to the relocation of production depending on their industry specialization prior to the observed offshoring period. Variations in the intensity of OFDI across industrial sectors are interpreted as a proxy for differences in the exposure to relocation across space. Although there is a widespread consensus in the literature that changes in job composition have occurred within industries (see Crinò, 2009; Feenstra, 2010; Kemeny and Rigby, 2012, for reviews), the spatial implications linked to such processes have been largely overlooked. Therefore the

[1] Independent, 22/01/2013.

[2] BBC News: http://news.bbc.co.uk/1/hi/business/7419916.stm
See also the Report of the British Computer Society Working Party on Offshoring (2004), *Offshoring. A Challenge or Opportunity for British IT Professionals?* British Computer Society (BCS).

[3] Financial Times 25/11/2013 and 03/03/2014.

approach adopted in this paper has a threefold advantage over previous research: a) it focuses on the nature of the tasks effectively performed by workers, rather than relying on broad skilled/unskilled divisions; b) it uses a more direct measure of MNEs operations; and c) it pays far greater attention than hitherto to the geographical implications of offshoring.

Within each local labour market we look at how different types of job tasks (categorized, following Autor et al., 2003, and Acemoglu ad Autor, 2011, as routine versus non-routine occupations) have been affected by the relocation of production abroad. Our findings suggest that the impact of offshoring in places more exposed to these trends as a consequence of their pre-existing industry specialization is significantly negative on routine occupations. The results are consistent across cognitive and manual routine occupations, supporting recent studies that have gone beyond the traditional high- versus low-skilled dichotomy. The results are robust to testing for endogeneity by means of both shift-share and instrumental variable approaches.

The implications of this analysis call for a greater attention to the geographical consequences of offshoring. The empirical evidence suggests that, while the destruction of routine occupations takes place regardless of whether the offshoring is channelled towards developed or developing/emerging countries, job creation in non-routine occupations only happens when OFDI targets the latter. In addition, compensation effects of job creation in non-routine occupations are strengthened in the long term: once efficiency gains linked to the geographical rationalization of production on the basis of international differences in competitive advantages have been capitalized, the demand for workers performing non-routine tasks increases, leading to virtuous productivity cycles in Great Britain. Hence, transition costs may be particularly relevant for specific geographical segments of the labour markets, possibly exacerbating the spatial polarisation of the British labour market and contributing to generate hot spots of unemployment and social deprivation. While our findings are in line with recent evidence suggesting a modest overall labour market impact of offshoring due to differential effects on job composition (e.g. Barba Navaretti and Castellani, 2004; Castellani et al., 2008; Amiti and Wei, 2009; Barba Navaretti et al., 2010), they raise important questions about who wins and who loses from the globalisation of production in advanced economies (e.g. Kemeny and Rigby, 2012; Kemeny et al., 2013).

The paper is organized as follows: Section 2 presents some background evidence on Great Britain, and discusses how this study relates and contributes to existing research. Section 3 describes the data, while Section 4 illustrates the empirical framework for the investigation of the impact of offshoring on routine and non-routine occupations across local labour markets. Section 5 discusses the main results and robustness checks. Finally, Section 6 concludes, providing some tentative policy implications.

1. Offshoring in Great Britain and related research

1.1. Job Composition and offshoring trends in Great Britain

Job composition in Great Britain has undergone a deep transformation since the turn of the millennium. Routine occupations have declined rapidly, whereas there has been a slight overall increase in the number of non-routine jobs (Figure 1).[4] These trends have, however, not been uniform across the country, with the composition of the local workforce playing an important role in determining the dimension of the shift in the balance between routine and non-routine jobs. Routine occupations have traditionally been overrepresented in some parts of Britain, mainly in the Midlands, the North and the North-West, Wales, and parts of Scotland. There is an overwhelming concentration of non-routine activities in London and the South-East, with spokes in cities such as Aberdeen, Edinburgh, Harrogate, Manchester, or Bristol, as indicated in Figures 2 and 3 which include data for the beginning of the period of analysis (1999).[5]

The decreasing share of routine occupations has been matched by a within-industry raise in the relative skill intensity of production in almost all advanced countries (e.g. Berman et al., 1994, 1998; Machin, 1996; Bernard and Jensen, 1997; Osburn, 2001). For Britain this evidence is confirmed when comparing, over the period 1999-2008, the growth rate of routine occupations with that of non-routine occupations by industry (Figure 4). Whereas the former declined in almost every sector, the latter followed a more heterogeneous trend, with increases in service industries such as real estate, renting and business activities, hotel and restaurants, and transports, storage and communication. By contrast, non-routine activities underwent a pronounced decline in certain manufacturing industries, such as machinery, electrical and optical equipment, and transports, and in the construction industry.

The processes behind such profound transformations are still under scrutiny. One potential explanation comes from the international fragmentation of production. Firms may gain from the relocation of production towards less advanced economies by triggering specialization by function within each industry, rather than by sector (Robert-Nicoud, 2008). The offshoring of routine activities allows to capitalize on efficiency gains along the value chain, while retaining the higher value added activities at

[4] For the definition and classification of routine and non-routine occupations see Section 3 below and Appendix A1.

[5] Previous literature has reported an uneven pattern of employment change, due to aggregate trends in technological progress and shifts in international production advantages. The result has been a progressive de-industrialization in the UK in recent years. As reported by Turok and Edge (1999), during the 1980s and 1990s "Liverpool lost no less than a third of its jobs (83,000 altogether) while Manchester, Sheffield, Glasgow and Birmingham lost between 12-19% of their jobs (between 42,000 and 59,000 in each case)" (p. 41). Job losses were, however, not limited to old industrial hubs; over the same period Inner London lost nearly a quarter of a million jobs (Turok and Edge, 1999). Although job losses have been relatively spread across the country, the response of local markets to such changes has been significantly different. Sizeable and growing job gaps over time have become evident in cities like Glasgow, Liverpool and Sheffield, which have fared considerably less well than Edinburgh, Cardiff and London. This evidence is plausibly explained by differences in local capabilities to adapt their industrial structure to higher value added activities.

home, thus shifting upwards the demand for non-routine occupations (Grossman and Rossi-Hansberg, 2006).

Data for Great Britain show that over the period 1998 to 2007 the total flow of OFDI remained fairly stable, but that the share of investments toward developing and emerging countries increased steadily, especially after 2002 (Figure 5). In addition, investments abroad over this period were particularly concentrated in service industries (Figure 6). These figures are consistent with the evidence on the steady increase in the "offshorability" of services (e.g. Freund and Weinhold, 2002; Lipsey, 2006; Crinò, 2010) and call for greater attention to how the industry dimension explains heterogeneity in the effects of offshoring on home economies.

In sum, whereas the impact of offshoring on jobs is of general interest, Great Britain represents a particularly attractive case for analysing how offshoring alters job composition. First, the country has undergone a progressive job polarisation (Goos and Manning, 2007), with labour market disadvantages increasingly concentrated in specific occupational categories. Second, as seen above, labour market disadvantages are increasingly concentrated geographically, with a strong spatial clustering at the extreme of the occupational distribution. Third, Britain has also experienced sizable offshoring trends, with a growing percentage of OFDI concentrated in the service sectors (e.g. Abramovsky et al., 2004; Hijzen et al., 2005; Sako, 2006). This allows for the investigation of offshoring across a wide spectrum of industries.

1.2. Advantages of our approach relative to related research

This study contributes to a growing body of empirical literature analysing and quantifying the impact of offshoring on domestic labour market outcomes. This literature has engendered a general consensus around the idea that the international fragmentation of production affects domestic labour market outcomes, but strong disagreements remain over the nature, magnitude, and composition of this effect.

Early theoretical contributions focused on the effect of offshoring on total employment and wages (e.g. Feenstra and Hanson, 1996, 1999; Feenstra, 1998). More recently theorists have become concerned with the impact of offshoring across types of workers (e.g. Baldwin and Robert-Nicoud, 2007; Grossman and Rossi Hansberg, 2008). Incentives to offshoring are generally expected to be higher in low-skilled labour-intensive industries, leaving workers in these industries more exposed to the relocation of production. Empirical research has however pointed out that the skilled/unskilled dichotomy may be far too coarse to adequately capture the complex effects of offshoring. This has led numerous studies to use more detailed disaggregation indicators, often based on either three or more skill levels (Morrison and Siegel, 2001; Falk and Koebel, 2002; Hijzen et al., 2005, 2010; Ekholm and Hakkala, 2006), or on a classification based on the job tasks effectively performed. In fact, the tasks performed by the worker seem a more relevant factor behind the probability of offshoring than the skill level of the worker (Leamer and Storper, 2001; Levy and Murmane, 2004; Markusen, 2005; Jensen and Kletzer, 2005, 2010; Blinder, 2006, 2009; Robert-Nicoud, 2008; Becker et al., 2013). Our research contributes to the

empirical literature by investigating the impact of offshoring in the light of the nature of the job tasks effectively performed. Unlike previous studies, however, the paper does not focus on the relationship between offshoring and the onshore workforce composition within the same MNE, but aims at capturing broader sectoral and spatial dynamics.[6]

A second relevant dimension with respect to previous research regards the definition of offshoring. We define 'offshoring' as the relocation of production abroad within the same MNE. This excludes from the definition 'international outsourcing', which has normally been included alongside offshoring in most past analyses (see, for example, for manufacturing industries, Feenstra and Hanson, 1996, 1999; Anderton and Brenton, 1999; Anderton et al, 2002; Egger and Egger, 2005; Hsieh and Woo, 2005; Geishecker, 2006; Minondo and Rupert, 2006; Yan, 2006; Kemeny and Rigby, 2012; Kemeny et al., 2013; and, for services, Amiti and Wei, 2005; 2009; Gorg and Hanley, 2005; OECD, 2007; Crinò, 2007, 2010). Few studies have, by contrast, considered explicitly production transfer within the same MNE. Most of these studies are being conducted at the firm level (e.g. Head and Ries, 2002; Mariotti et al., 2003; Hansson, 2005; Becker et al., 2005; Castellani et al., 2008; Becker and Muendler, 2010; Becker et al., 2013). Offshoring and outsourcing are, however, two conceptually different phenomena, which imply alternative modes of internationalization: within the same firm in the case of the former, and outside the firm – generally through licence contracts – in the latter. Work on offshoring tends to use the share of affiliate employment in total MNE employment as its main indicator. The advantage of our approach relative to past work is that we employ a more direct measure of MNE operations based on the actual amount of investments abroad, rather than on import competition or affiliate employment measures. This allows us to look at the impact of the actual relocation of production abroad or "offshoring" only, capturing trends in both manufacturing and services simultaneously. Furthermore, our analysis is not restricted to the impact of offshoring within the same MNE carrying out the investment abroad, but looks at changes in the workforce composition of local labour markets exposed to offshoring trends.

The third advantage of our approach is related to the attention paid to the geographical dimension of offshoring in the country of origin. Many theoretical and empirical studies on the overall impact of offshoring indicate that shifting jobs overseas does not necessarily translate into jobs losses at home (e.g. Robert-Nicoud, 2008; Amiti and Wei, 2009; Barba Navaretti et al., 2010). Countries offshoring low value added, routine activities, and retaining at home the higher echelons of the value chain, can be better off overall, as job losses in routine occupations may be over-compensated by new jobs in non-routine occupations. However, when differences in the degree of exposure of local labour markets to offshoring trends are taken into account, heterogeneity in local industry structures and linkages may generate significant spatial imbalances (Elia et al., 2009). Offshoring may simultaneously lead to international convergence, while, at the same time, generating substantial subnational divergence. This is already in evidence in a number of developed countries when considering the adoption of new technologies. For example, US cities with an abundance of skills in 1980 have experienced a progressive

[6] Our analysis is more closely related to recent work by Autor et al. (2013), who analyse the effect of the internationalization of production measured by rising Chinese import competition on US local labour markets, exploiting cross market variations in import exposure on the basis of initial differences in industry specialization.

concentration of skills (Beaudry et al., 2010). Similarly, the adoption of IT technologies has led to polarisation in both employment (lower skills in service jobs) and wages (earnings growth at the tails of the distribution) (Autor and Dorn, 2013). The *routinization hypothesis*, popularised by Autor, Levy and Murnane (2003), serves as a base for explaining the geographical polarization of employment. Differences in the historical skill composition or occupational mix across cities contribute to subsequent polarisation. We follow this approach, explicitly testing for the concurrence and interdependence of computerization and offshoring trends across subnational labour markets.[7]

2. Data

In order to analyse the job implications of offshoring, the paper merges different microdata sources to create a balanced panel for British local labour market areas (Travel to Work Areas - TTWAs).[8] TTWAs are defined as self-contained labour markets. As such, the use of TTWAs minimizes the potential bias coming from commuting flows. TTWAs are groups of wards, including both urban and non-urban areas, for which at least 75% of the resident economically active population works in the area, and for which at least 75% of individuals working in the area live there.

Data for job occupations are extracted from the Annual Survey of Hours and Earnings (ASHE), sampled using 1% of the total population of workers on the PAYE register The ASHE is considered the most reliable British data on levels, distribution, and make-up of earnings and hours worked for employees by industry and occupation.[9] Data contain detailed geographical information on the location of each employee, allowing for the identification of those workers who live in each TTWA. Occupational categories – i.e. routine and non-routine – come from the *Standard Occupational Classification (SOC)* revised in 2000,[10] which relies on two main criteria: 1. type of job task performed; 2. type of competences (skills) required for the tasks and duties.[11] Routine occupations or jobs refer to those which are not necessarily mundane (as, for example, washing dishes), but rather sufficiently well understood/codified that tasks can be fully specified as sequential series of instructions. Routine tasks

[7] Following Autor et al. (2013b), who investigate the geographic overlap between international trade and computerization trends in the US, our results allow to separately identifying the impact of the internationalization of production from that of technological change.

[8] Consistent information was compiled for 229 out of 232 TTWAs in Great Britain. The remaining 3 TTWAs coincide with remote rural areas in Scotland for which data on one or more of the main variables of interest were not available.

[9] The Office of National Statistics (ONS) provides ASHE microdata under restricted access.

[10] For more information, see:
http://www.ons.gov.uk/ons/guide-method/classifications/archived-standard-classifications/standard-occupational-classification-2000/about-soc-2000/index.html

[11] The SOC 2000 classification is the result of an in-depth revision process that focused upon areas where changes in the organization and type of work performed have been particularly significant. These include mainly jobs related to information and communication technologies, culture, media, sports, and leisure.

can qualify as both cognitive and manual. Non-routine occupations, also defined as 'abstract' jobs, are activities that require problem-solving, intuition, persuasion, and creativity. They can also be divided into cognitive and manual. Workers performing non-routine tasks normally have high or specialist levels of education and analytical capabilities.[12] Following Acemoglu and Autor (2011), managerial, professional, creative, and technical occupations are abstract, non-routine cognitive tasks; clerical, administrative and trade occupations are jobs specialized in routine cognitive tasks; production and operative occupations are specialized in routine manual tasks; and service occupations are specialized in non-routine manual tasks. The list of occupations in each broad group according to the *SOC2000* is reported in Appendix A1.

Descriptive statistics on occupations by broad industrial sector and region are reported in Table 1. Routine occupations represent more than a half of total occupations in almost every sector (except for financial intermediation, real estate, renting and business activities, and wholesale and retail trade). They are particularly overrepresented in some manufacturing industries, such as basic metals, mining and quarrying, and in some services, such as hotels and restaurants. As mentioned earlier, they also tend to be overrepresented in the Midlands, the North and the North-West, Wales, and parts of Scotland. London and the South East are, by contrast, the main geographical hubs for non-routine jobs. The evolution over time in the occupational composition of different sectors and regions is also interesting (Table 1, Columns 3 and 4). Routine jobs have declined in almost every industry, with different degrees of intensity; the exceptions are construction and real estate, renting and business activities. The pattern is more heterogeneous looking at non-routine occupations, which show a greater polarisation across sectors. At the regional level, despite some differences in intensity, routine jobs have mostly declined, while non-routine ones have increased almost everywhere.

Additional demographic controls by TTWA, such as share of manufacturing employment, youth population, and highly educated population, come from the UK Labour Force Survey (LFS). The LFS, conducted by the ONS, is a quarterly representative survey of households living at private addresses in the UK. The quarterly data, sampling around 60,000 households, was pooled to construct annual figures.

The data for investments abroad come from the ONS Annual Survey into Foreign Investments (AFDI). The survey contains data on direct investment abroad carried out by Great Britain based MNEs for the period 1998–2007.[13] Firms are asked to provide information on a variety of aspects of their business abroad, such as geographical destination and industrial sector of the OFDI (SIC2003 classification), profits and losses, earnings, tax credits, sales/purchases of shares/loans, and gains/losses resulting from movements in exchange rates. The information measures the direct investment as a financial flow, covering only the financial amount invested in an affiliate enterprise by the parent company. Hence, a

[12] One essential feature of non-routine tasks – beyond educational levels – is the extent to which the task requires interpersonal interactions (see also Blinder, 2009; Kemeny and Rigby, 2012).

[13] Although AFDI data are available since 1996, observations for 1996 and 1997 were excluded from the analysis due to a major coding change for waves before 1998. As the investments abroad variable is entered in a lagged form, only data until 2007 are used in the empirical analysis (see section 4.1 below).

direct investment abroad is recorded when it is made for a "lasting interest", and only when the firm owns more than a 10% equity stake in the company in which it is investing.[14] The investment indicator depicts net figures: investments net of disinvestments.[15] FDI flows include acquisitions/disposals of equity capital, reinvestment of earnings,[16] and inter-company debt. This definition of OFDI is in accordance with the international standards set out in the third edition of the OECD Benchmark Definition of FDI (BD3) and the fifth edition of the IMF Balance of Payments Manual (BPM5), ensuring that UK FDI statistics are comparable with those of other countries.

Data on investments flows by broad industrial sector and geographical area of destination show that outflows between 1998 and 2008 have been mainly concentrated in financial intermediation and transports, storage and communications, which together account for more than 40% of total flows (Table 2). When comparing information on the financial flows with that on the number of investments, sectors such as real estate, renting and business activities, with 23% of the total number of OFDI, only account for 0.5% of total financial flows. This points to a huge heterogeneity across industries with respect to both the intensity to which they have been affected by offshoring and industry-specific investment modes, with some sectors characterised by a large number of small – at least in financial terms – outward activities, and others performing fewer, but financially larger, operations abroad. Relevant insights also come from the geographical destination of foreign activities of British MNEs. The majority of outward investments, both in terms of number and amount, were still directed to developed and transition economies; however, more than 1/3 of the total number of operations (accounting for almost 13% of the total financial amount) has targeted developing and emerging countries.[17]

[14] The definition reported in the AFDI questionnaire states: "an immediate foreign affiliate company is the first investment in a chain of investments, or the only investment, that is not resident in the UK in which the UK company has a holding of 10% or more of the issued voting share capital. This holding will give the UK parent company the equivalent voting rights in the foreign company or group of companies". For the purposes of FDI statistics, an effective voice is taken as equivalent to holding 10% or more of the equity share capital in the direct investment enterprise. Other investments, in which the investor does not have an effective voice in the management of the enterprise, are mainly portfolio investments and are not covered by AFDI.

[15] If a foreign firm owns more than 50% of the equity share capital of another firm, it is identified as a foreign subsidiary. If only 10–50% of capital is foreign-owned, then the firm is labelled as a foreign associate/affiliate. Unfortunately, the data files do not differentiate between associates and subsidiaries – they are both classified as 'foreign subsidiaries'. Consequently, the analysis takes into account both categories as one.

[16] Reinvestment of earnings, or reinvested earnings, refers to earnings on equity accruing to direct investors, minus the value of distributed earnings. Reinvested earnings are included in direct investment income because the earnings of the subsidiary, associate, or branch are deemed to be the income of the direct investor (proportionate to the direct investor's holding of equity), whether they are reinvested in the enterprise or remitted to the direct investor. Reinvested earnings are also treated as a flow of direct investment from the direct investor to their overseas enterprise.

[17] Developed and transition economies include EU27, Iceland, Norway, Switzerland, Australia, Canada, Japan, New Zealand, United States, Albania, Bosnia-Herzegovina, Croatia, Montenegro, Serbia, the former Yugoslav Republic of Macedonia, Armenia, Azerbaijan, Belarus, Kazakhstan, Kyrgyzstan, Republic of Moldova, Russian Federation, Tajikistan, Turkmenistan, Ukraine, and Uzbekistan. Emerging economies include Brazil, India, China, and South Africa. All remaining countries are classified as either developing or less-developed economies. The classification is taken from the *World Economic Situation and Prospects (WESP).*

The full list of variables used in the analysis and their sources is reported in Appendix A2.

3. Empirical Framework: Econometric Model and Identification Approach

3.1. Econometric model

The estimation strategy for the effect of offshoring on types of domestic jobs across British local labour markets is based on panel data techniques to control for time and area specific characteristics. The estimation equation takes the following form:

$$Jobs_t^c = \alpha_c + \mu_t + \beta_1 Offshoring_t^c + \beta X_t^c + \varepsilon_t^c \quad (1)$$

Where $Jobs_t^c$ is the dependent variable measuring the number of routine or non-routine occupations in each TTWA *c* at time *t*.[18] The variable is standardized using the standard deviation across all periods and TTWAs. This definition allows us to look at variations in the number of routine/non-routine jobs in local labour markets relative to the rest of the country,[19] providing useful insights on the evolution over time in the spatial distribution of different types of occupations.

The independent variable of interest, $Offshoring_t^c$, accounts for the local labour market impact of the relocation of production abroad by modelling the degree of exposure of different local labour markets to offshoring trends. We draw from the econometric literature on common shocks (Bai, 2009) to model the impact of an observable time trend component (i.e. offshoring) on different population units (i.e. TTWAs) by means of a factor loading (i.e. the share of workers by sector). The regressor of interest is thus constructed as an interaction term, which for identification purposes keeps the factor loading as a time invariant component (Gobillon and Magnac, 2015). Local labour markets are supposed to be heterogeneously exposed to the offshoring of production activities on the basis of their pre-existing industry specialization. This assumption further implies that areas specialised in sectors that have been more affected by the relocation of production are expected to experience more intensely the consequences of offshoring. The variable is constructed as follows:

$$Offshoring_t^c = \sum_s (Employment_{c,1997}^s \times Outward\ FDI_{t-1}^s) \quad (2)$$

The amount of outward foreign investments by 2 digits sector *s* (SIC2003 classification) at *t-1* is attributed to each TTWA *c* by means of the share of people employed in sector *s* in 1997. This variable reflects the exogeneity conditions of the shift-share approach (e.g. Moretti, 2010; Faggio and Overman, 2014), since it attributes the impact of a national trend (i.e. offshoring) to local labour markets on the

[18] Our dependent variable could also be constructed as employment rate in routine/non-routine occupations. Unfortunately ASHE data are restricted to people in employment, preventing us from setting-up an appropriate denominator.

[19] Our dependent variable is interpreted in terms of relative variation in the number of routine/non routine occupations across TTWA.

basis of their industry specialization before the time window of analysis. This implies assuming that each TTWA is exposed to offshoring as if its industry mix had remained unchanged since 1997. In this way we are able to limit concerns about simultaneous changes in the industry specialization of TTWAs, which may be potentially correlated with offshoring. Gagliardi (2014) uses a similar strategy to investigate the impact of changes in technology on local labour markets outcomes in the UK.

3.2. Endogeneity concerns

The possibility of estimating the causal effect of offshoring on jobs relies on the absence of any additional source of bias that may affect the relation of interest. In other words it assumes that $E(\varepsilon_{ct}/Offshoring_{c,t}, X_{ct}) = 0$.

As mentioned above, the construction of the independent variable of interest by means of a shift-share methodology limits concerns associated to the simultaneity between local labour market responses and global trends. Nonetheless it is still plausible that an omitted variable bias may drive the identification of the effect. This is the case if our regressor of interest captures the endogenous evolution of local labour markets over and beyond the causal effect of offshoring.

Some TTWAs may experience the consequences of offshoring with greater intensity due to unobserved local labour market specific trends (e.g. changes within each sector in the make-up of local skills, meaning that areas with the same industry specialization may carry out different types of activities). This is a particularly relevant concern if the internationalisation of production is not independent from other aggregate trends that may potentially drive changes in the local composition of jobs. As discussed in Section 1.2, technological trends – e.g. computerization and ICT diffusion – may contribute to the reduction of routine occupations (Autor et al., 2003). In addition, also international trade may affect labour market outcomes thus operating as powerful concurrent factor (Author, Dorn and Hanson, 2013). Recent research has questioned whether the impact of the internationalisation of production and that of technological change can be separately identified, suggesting that this is possible in the case of the US (Autor et al., 2013b).

We use three different approaches to tackle endogeneity concerns. First, we include in our baseline estimation a control for both recent investments in ICT and for import competition as proxy for international trade.[20] We look at the concurrent impact of computerization trends by assuming that different local labour markets heterogeneously adopted ICT technologies on the bases of the pre-existing industry mix. We expect computerization to be negatively correlated to routine occupations. The regressor of interest is constructed following a structure similar to that adopted for our main independent variable:

[20] Data on ICT investments, measured by means of cross industry differences in the value of acquisitions of new or existing fixed assets in ICT in the last 3 years, come from the EU-KLEMS database. It provides a wide range of technology indicators for most European countries. Alternative specifications using 5 and 1 years were also used for robustness checks. Data for import flows by industry comes from the UN-COMTRADE database. Data refers to the share of import over total trade flows (import plus export) from China and India due to their role as world exporting leader (see also Autor, Dorn, and Hanson 2013 for evidences on China) and, particularly in the Indian case, to their traditional trade relations with the UK.

$$ICT_{c,t} = \sum_s (Employment^s_{c,1997} \times ICT\ Investments^s_{T,t-3}) \quad (3)$$

Similarly we construct a proxy for import competition attributing its impact to each TTWA on the basis of their pre-existing industry mix. In this case the direction of the correlation with the dependent variable is more difficult to predict. In fact, although trade theory argues that expanded trade between developed and developing countries will come at the expenses of less skilled workers, more recent studies finds conflicting results since developed and developing countries have specialized in products and tasks that are highly imperfect substitutes (Edwards and Lawrence, 2010).

$$Import\ Competition_{c,t} = \sum_s (Employment^s_{c,1997} \times Import\ flows^s_{T,t-3}) \quad (4)$$

Second, we control more generally for unobserved area specific trends. This augmented specification should factor out any additional unobserved determinants of the endogenous evolution of local labour markets.

Third, we adopt an instrumental variable approach exploiting information on changes in product level tariffs over time. Tariffs are used to construct an industry level instrumental variable (IV) on the basis of information on imports by sector.[21] The instrument is constructed as follows:

$$Tariffs_{c,t} = \sum_s (Employment^s_{c,1997} \times MinimumTariffRate^s_{t-(t-3)}) \quad (5)$$

As above, we assume that changes in industry level tariffs affect different local labour markets by means of their pre-existing industry mix. The rationale behind the IV strategy exploits the relation between changes in tariffs and firm offshoring decisions as both provide incentives for firms to exploit the benefits coming from the fragmentation of their value chain. Unlike offshoring, however, changes in tariffs mirror international financial, macro, and policy determinants that should not reflect with specific trends in Great Britain (Mion and Zhu, 2013). As such, they hardly correlate with any local labour market dynamics. More in detail we look at cross industry variations in the previous three years in the minimum tariff rate for imports in Europe from the rest of the world. Trade literature suggests that trade flows respond to variations in tariffs levels at a continuously diminishing rate until tariffs reach a certain minimum level that is prohibitive and at which the level of production coincides with the pre-trade equilibrium (Mion and Zhu, 2013). In a context in which the bulk of international trade nowadays is explained by intra-firm exchanges an increase in the minimum tariff level should reduce firms' incentives to offshore their activities. We thus expect the instrument to be negatively correlated with the instrumented variable.

[21] Data on tariffs come from the UN-COMTRADE database, providing information on product level tariffs by year, which can be aggregated at industry level by means of information on import flows. Records provide simple and weighted average tariffs, minimum and maximum rate by reporter and partner countries.

4. Results

4.1. Main findings

The results for our main specification are reported in Table 3. Panel I relates to routine occupations while Panel II estimates the model adopting non-routine occupations as dependent variable. Offshoring is negatively and significantly associated at 1% to variations in the number of routine occupations (Panel I, Column 1). This implies that a one per cent increase in the amount of financial investments abroad leads to a 0.006 standard deviation reduction in the number of routine occupations across TTWA.[22] Hence, places more exposed to offshoring on the basis of their pre-existing industry specialisation have witnessed a significant decline in routine jobs, as a consequence of MNE relocation strategies during the period of analysis. This result holds also after controls for wage (Column 2) and demographic characteristics (Column 3) are included in the analysis. The evidence on non-routine occupations shows that the impact of offshoring, although positive, is not statistically significant.

Our baseline model is also estimated by looking at offshoring across countries of destination (Table 4), distinguishing between developing and emerging countries, on the one hand, and developed and transition economies, on the other. The negative impact of offshoring on routine occupations is confirmed in both cases, although sensibly lower when considering developed countries. In contrast, a significant positive effect on non-routine occupations emerges for OFDI towards developing and emerging countries (Column 1). Such evidence is consistent with a number of studies showing similar findings (e.g. see Anderton and Brenton, 1999, for the UK; Hansson, 2000, and Anderton et al., 2002, for Sweden; Liu and Trefer, 2008, and Harrison and McMillan, 2006, for the US).

We re-estimate our main specification by further decomposing the dependent variable. In Table 5 (Panel I) we look at the impact of offshoring, distinguishing between cognitive and manual routine occupations. Cognitive routine tasks are overrepresented in services and may capture a relevant dimension in the analysis of the impact of recent offshoring trends. The negative impact of the relocation of production on routine jobs is equally significant in the case of both cognitive and manual occupations. This suggests that recent offshoring trends affect both workers performing standardized manual job tasks as well as those who are responsible for codified and routinized cognitive activities. This evidence supports the relevance of the occupational dimension, with respect to differences in skill levels, when investigating the impact of offshoring on jobs.

Panels II and III looks at differences in the "tradability" of jobs across industries. Traditionally, jobs in services and construction are considered as non-tradable, while tradable jobs are mainly associated with manufacturing industries and mining. This classic distinction is adopted in Panel II (Columns 3 and 4). However, more recent literature has looked in greater detail into the degree of "tradability" within the

[22] Note that the standard deviation in Y is equal to 651.5074. Therefore a 1% increase in the amount of offshoring generates a reduction of 4.17 routine jobs.

service industry. Bradford et al. (2005) – comparing the geographical concentration of US industries – define the categories of tradable and non-tradable jobs on the basis of a "tradability" index. Their categorization suggests that "a significant share of total employment is in tradable service industries" and that "more workers are in tradable industries in the service sectors than in manufacturing sector" (Bradford et al., 2005, p. 88). Following this scheme, in Panel III (Columns 5 and 6) jobs in construction are classified as non-tradable and jobs in manufacturing and mining as tradable. Greater nuance is introduced in the service sector. Wholesale trade, transportation and warehouses, information, finance and insurance, real estate, professional, scientific, and technical services and management are classified as largely tradable. Retail trade, administrative support, accommodation, entertainment and recreational activities fall in the non-tradable category. The overall results demonstrate a certain degree of heterogeneity in the impact of offshoring across routine occupations in tradable and non-tradable industries. Offshoring in occupations in tradable industries – which are more exposed to the relocation by MNEs – generally destroys jobs. However, in the case of non-tradable industries results are mixed. Whereas a positive and significant effect emerges when adopting the traditional classification (Column 4), a negative effect persists – although the coefficient is smaller than in the case of tradable industries – when differences in the "tradability" of services are taken into account.

Finally we look at differences in the impact of offshoring across male and female routine occupations (Panel IV). We find that job relocation affects male employment negatively. This finding is explained by the overrepresentation of men in industries with a greater degree of "tradability". Bradford et al. (2005) find in fact that more than 60% of total male employment is concentrated in tradable occupations. These results also correlates with recent findings from Kongar and Price (2010), who look at gender gaps in employment and wages by grouping occupations with respect to the probability of being offshored. The authors find that occupations at risk are disproportionally concentrated in industries in which female, especially low-wage, employment has declined between 1995 and 2005.

4.2. Endogeneity and IV estimates

The credibility of the result that offshoring has generated significant job losses in routine occupations in places which have been more exposed to MNE relocation crucially relies on the condition that our regressor of interest does not capture alternative dimensions, which may contribute to determine the economic performance of different labour market areas. Differences in the aggregate amount of OFDI may, for example, reflect distinctive spatial patterns of disinvestments: activities may be relocated from places undergoing economic decline, deindustrialization, and de-agglomeration. These areas could plausibly experience a progressive polarization of the local workforce (with concentration of job losses among workers performing intermediate, highly routinized job tasks), fundamentally as a result of technological change. Alternatively job losses may also be the result of the concurrent impact of international trade. In this case our variable of interest may reflect forces other than the causal effect of offshoring, ranging from the interdependent effect of technological progress and international trade to more general area trends.

As explained in section 4.2 above, we test the robustness of our results by performing a number of checks, which are reported in Table 6. Column 1 controls for investments in ICT, our proxy for technological change. As expected, the variable is negatively associated to employment in routine occupations: highly codified and routinized job tasks are more easily replaced by computers. Nonetheless, the impact of offshoring remains negatively and significantly associated to routine jobs, although the magnitude of the coefficient is slightly lower than that reported in Tables 3-5. Hence, despite being complementary, offshoring and technological trends may be separately identified, (see also Autor et al., 2013, for similar results in the US). Column 2 includes a control for import competition as a proxy for the concurrent role of international trade. Also in this case the impact of offshoring remains negative and significant with no changes in the magnitude of the coefficient.

Column 3 controls for area trends by interacting year and TTWA dummies. This augmented specification is likely to fully capture the endogenous evolution of local labour markets. The regressor of interest remains negatively and significantly correlated at the 1% level to the relative variation across TTWAs in the number of routine occupations. The coefficient is, again, reduced relative to Tables 3-5, suggesting that our main specification captures to some extent other unobservable time-specific, area-specific trends. However, the results are qualitatively consistent with our baseline estimates.

Finally, Column 4 adopts the instrumental variable approach discussed in section 4.2, where offshoring is instrumented by industry level variations in the minimum rate of tariffs. The results confirm that offshoring is negatively and significantly correlated to variations in routine occupations at the 5% level[23]. The Hausman test does not reject the null hypothesis that the relation of interest is adequately estimated by OLS, confirming the reliability of our baseline results.[24] Column 4 reports the first stage statistics. The instrumental variable is, as expected, negatively and significantly correlated to offshoring, indicating that the estimates do not suffer from weak instrument biases. Consistently, the Kleibergen-Paap Wald F statistics for weak identification is well above the rule of thumb proposed by Staiger and Stock (2002), and in line with the Stock and Yogo (2005) threshold values.

4.3. The effect of offshoring over the long run

The analysis so far suggests that the effect of offshoring on jobs is negative and significant for routine occupations and generally non-significant – albeit with a positive coefficient – for non-routine occupations. This evidence is robust to endogeneity concerns. In addition, some heterogeneity emerges when considering investments in different areas of destination.

[23] Note that the IV estimation has also been replicated by including among the controls the variable for import competition reported in equation 3. That is to rule out the concern that our instrument correlates with international trade more in general rather than with offshoring trends. The first stage with an F statistics of 13.74, against 14.02 for the baseline specification, confirms that this is not the case.

[24] With a p-value of 0.9975, the Hausman test suggests that we cannot reject the null of "difference in coefficient not systematic".

In this last section we aim at providing insights on the longer run impact of offshoring on jobs. Table 7 estimates our main specification in long difference looking at the impact of MNE offshoring taking place between 1998 and 2007 on the variation in the number of routine/non-routine occupations at the end of the period with respect to their initial level. Panel I reports the result for routine occupations and Panel II those for non-routine ones. Over the long run the positive impact on non-routine jobs is significant at 5%, while the negative effect on routine occupations remains only weakly significant at 10%.

These results provide support to previous findings on the long-term benefits of the international rationalization and restructuring of production activities. Offshoring, despite mixed effects in the short run depending on the industry structure of the area of origin, is associated in the medium and long-term with greater opportunities for workers performing non-routine job tasks.

5. Conclusions

The debate on the consequences of offshoring has become a hot topic in recent years. Outward investment flows have multiplied and some distinctive trends, such as offshoring in services, have progressively emerged. Changes in the sectorial composition of OFDI, as well as the raising importance of developing and emerging economies as recipients, have shaped the distribution of benefits and costs at home across both geographical areas and typologies of workers.

The analysis of offshoring by British-based MNEs indicates that offshoring has generally led to job destruction in routine occupations. This evidence has been significantly more pronounced in those areas of the country that were more exposed to MNE relocation due to their initial industry specialization. This result points to a highly heterogeneous impact of offshoring at both the spatial and individual level.

The findings of this study also suggest that the impact of offshoring is mediated by the strategies pursued by MNEs deciding to offshore their activities abroad. Whereas investments toward both developed and developing/emerging countries are associated with job reduction in routine occupations, compensating benefits may emerge in the latter case. Investments towards developing and emerging markets may spur over time the capitalization of efficiency gains related to the possibility of concentrating the most productive activities at home. This process may trigger virtuous cycles of increasing domestic productivity and employment.

There is, however, nothing in the results indicating that, as the overall impact of offshoring on labour markets is at best modest and helps sustain non-routine job creation in the areas of origin, automatic compensation mechanisms acting through the increase in the demand of domestic skill intensity eliminate any costs in the home economy. Specialisation following offshoring has been mainly ‘functional’ within industry, rather than across the industry mix (e.g. Robert-Nicoud, 2008; Crinò, 2009). This implies that adjustments in industry structures within each local labour market may take

time. Therefore, the consequences of these processes have been severe in the short and medium-term in specific areas of Britain with a high initial specialisation in more routine activities. The extent to which this may generate hot spots of job market disadvantages for specific typologies of workers employed in such activities and in locations more exposed to offshoring trends has relevant distributional consequences that need to be carefully analysed to provide conclusive evidence on the overall impact of offshoring. The same forces that are likely to spur international convergence – i.e. globalisation of production and technology diffusion – are also seemingly spurring subnational polarisation and divergence (Iammarino and McCann, 2013).

Spatial and individual heterogeneity in the impact of offshoring trends poses relevant challenges and deserves more careful policy consideration. As also indicated by other studies (e.g. Elia et al., 2009; Kemeny et al. 2013), the changes induced on domestic employment and job composition imply systematic and flexible adjustments concerning "a greater supply of higher vocational profiles and the consequent need of additional investment in human capital" (Elia et al. 2009, p. 369). Initiatives targeting the mitigation of the negative consequences of offshoring are deemed necessary in geographical areas characterized by greater risks of exposure to the relocation of production, and in these spatial contexts to specific categories of workers. Examples of these initiatives coincide with income support schemes for specific vulnerable groups, coupled by both effective industrial policy interventions to reconvert and revitalize old industrial areas towards higher value added activities, and new approaches to training and re-training programmes.

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Appendix A1

Routine Occupations		Non Routine Occupations	
Cognitive	**Manual**	**Cognitive**	**Manual**
1. Administrative and Secretarial Occupations ADMINISTRATIVE OCCUPATIONS - *Administrative Occupations: Government And Related Organisations* - *Administrative Occupations: Finance* - *Administrative Occupations: Records* - *Administrative Occupations: Communications* - *Administrative Occupations: General* SECRETARIAL AND RELATED OCCUPATIONS - *Secretarial And Related Occupations* **2. Skilled Trades Occupations** SKILLED AGRICULTURAL TRADES - *Agricultural Trades* SKILLED METAL AND ELECTRICAL TRADES - *Metal Forming, Welding And Related Trades* - *Metal Machining, Fitting And Instrument Making Trades* - *Vehicle Trades* - *Electrical Trades* SKILLED CONSTRUCTION AND BUILDING TRADES - *Construction Trades* - *Building Trades* TEXTILES, PRINTING AND OTHER SKILLED TRADES - *Textiles And Garments Trades* - *Printing Trades* - *Food Preparation Trades* - *Skilled Trades n.e.c.*	**1. Process, Plant and Machine Operatives** PROCESS, PLANT AND MACHINE OPERATIVES - *Process Operatives* - *Plant And Machine Operatives* - *Assemblers And Routine Operatives* - *Construction Operatives* TRANSPORT AND MOBILE MACHINE DRIVERS AND OPERATIVES - *Transport Drivers And Operatives* - *Mobile Machine Drivers And Operatives* **2. Elementary Occupations** ELEMENTARY TRADES, PLANT AND STORAGE RELATED OCCUPATIONS - *Elementary Agricultural Occupations* - *Elementary Construction Occupations* - *Elementary Process Plant Occupations* - *Elementary Goods Storage Occupations* ELEMENTARY ADMINISTRATION AND SERVICE OCCUPATIONS - *Elementary Administration Occupations* - *Elementary Personal Services Occupations* - *Elementary Cleaning Occupations* - *Elementary Security Occupations* - *Elementary Sales Occupations*	**1. Managers and Senior Officials** CORPORATE MANAGERS - *Corporate Managers And Senior Officials* - *Production Managers* - *Functional Managers* - *Quality And Customer Care Managers* - *Financial Institution And Office Managers* - *Managers In Distribution, Storage And Retailing* - *Protective Service Officers* - *Health And Social Services Managers* MANAGERS & PROPRIETORS IN AGRICULTURE AND SERVICES - *Managers In Farming, Horticulture, Forestry And Fishing* - *Managers And Proprietors In Hospitality And Leisure Services* - *Managers And Proprietors In Other Service Industries* **2. Professional Occupations** SCIENCE & TECHNOLOGY PROFESSIONALS - *Science Professionals* - *Engineering Professionals* - *Information & Communication Technology Professionals* HEALTH PROFESSIONALS - *Health Professionals* TEACHING AND RESEARCH PROFESSIONALS - *Teaching Professionals* - *Research Professionals* BUSINESS & PUBLIC SERVICE PROFESSIONALS - *Legal Professionals* - *Business And Statistical Professionals* - *Architects, Town Planners, Surveyors* - *Public Service Professionals* - *Librarians And Related*	**1. Personal service Occupations** CARING PERSONAL SERVICE OCCUPATIONS - *Healthcare And Related Personal Services* - *Childcare And Related Personal Services* - *Animal Care Services* LEISURE AND OTHER PERSONAL SERVICE OCCUPATIONS - *Leisure And Travel Service Occupations* - *Hairdressers And Related Occupations* - *Housekeeping Occupations* - *Personal Services Occupations n.e.c.* **2. Sales and Customer Service Occupations** SALES OCCUPATIONS - *Sales Assistants And Retail Cashiers* - *Sales Related Occupations* CUSTOMER SERVICE OCCUPATIONS - *Customer Service Occupations*

		Professionals **3. Associate Professional and Technical Occupations** SCIENCE & TECHNOLOGY ASSOCIATE PROFESSIONALS - *Science And Engineering Technicians* - *Draughtspersons And Building Inspectors* - *IT Service Delivery Occupations* HEALTH & SOCIAL WELFARE ASSOCIATE PROFESSIONALS - *Health Associate Professionals* - *Therapists* - *Social Welfare Associate Professionals* PROTECTIVE SERVICE OCCUPATIONS - *Protective Service Occupations* CULTURE, MEDIA AND SPORTS OCCUPATIONS - *Artistic And Literary Occupations* - *Design Associate Professionals* - *Media Associate Professionals* - *Sports And Fitness Occupations* BUSINESS & PUBLIC SERVICE ASSOCIATE PROFESSIONALS - *Transport Associate Professionals* - *Legal Associate Professionals* - *Business And Finance Associate Professionals* - *Sales And Related Associate Professionals* - *Conservation Associate Professionals* - *Public Service And Other Associate Professionals*	

Source: ONS-SOC 2000

Note: Classification reported at 3 digits level. Jobs in Agriculture and Fishing reported for completeness but excluded from the analysis (http://www.ons.gov.uk/ons/guide-method/method-quality/specific/labour-market/soc-2000-and-ns-sec-on-the-lfs/index.html).

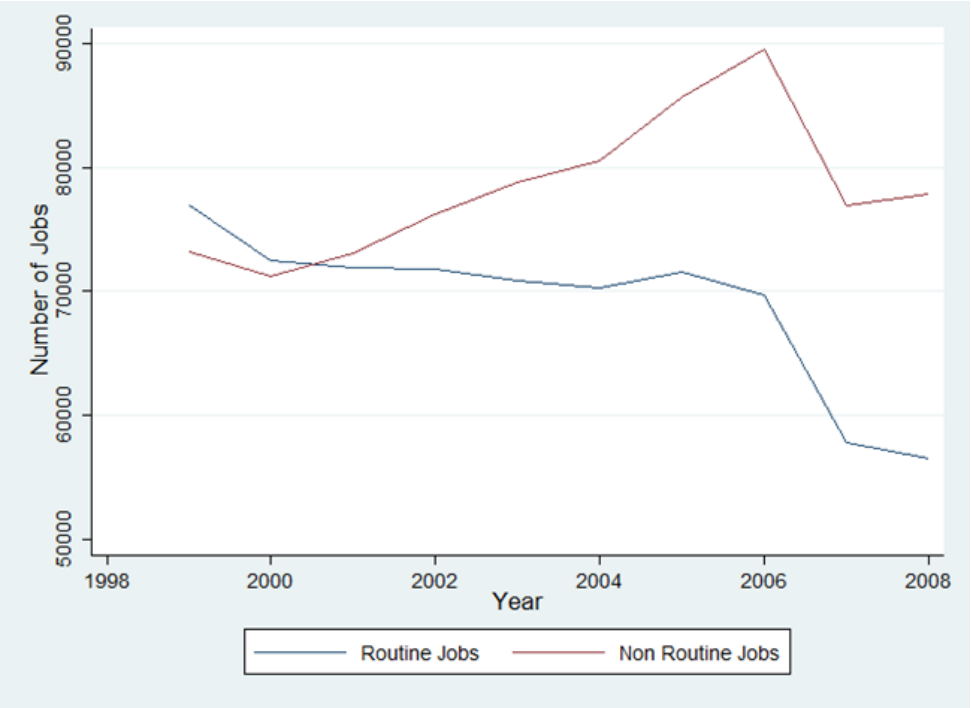
Appendix A2

Variable Name	Description	Source
Routine Jobs	Standardised number of jobs in routine occupations by year and TTWA	ASHE
Non-Routine Jobs	Standardised number of jobs in non-routine occupations by year and TTWA	ASHE
Manufacturing	Share of employment in manufacturing over total working age population by year and TTWA	LFS
Skilled Population	Share of population with NVQ4-degrees / HE qualification over total population by year and TTWA	LFS
Youth Population	Share of population below 29 years old over total population by year and TTWA	LFS
Wage Routine Jobs	Hourly wage in routine occupations	ASHE
Wage Non-Routine Jobs	Hourly wage in non-routine occupations	ASHE
Routine Jobs (Cognitive)	Standardised number of jobs in routine cognitive occupations by year and TTWA	ASHE
Routine Jobs (Manual)	Standardised number of jobs in routine manual occupations by year and TTWA	ASHE
Routine Jobs (Tradable)	Standardised number of jobs in routine occupations and tradable industries by year and TTWA	ASHE
Routine Jobs (Non-Tradable)	Standardised number of jobs in routine occupations and non-tradable industries by year and TTWA	ASHE
Routine Jobs (Females)	Standardised number of jobs in routine occupations and for female employees by year and TTWA	ASHE
Routine Jobs (Males)	Standardised number of jobs in routine occupations and for male employees by year and TTWA	ASHE
Outward FDI	Financial amount of outward investments abroad by year and 2-digits industry	AFDI
Computerization	Financial value of acquisitions of new or existing fixed assets in Information and Communication Technologies (ICT)	EU-KLEMS
Import Competition	Share of imports over total trade flows from China and India	UN-COMTRADE

Source: ONS/ASHE, LFS, AFDI; EU-KLEMS database.

Figures and Tables

Figure 1: Routine and Non Routine Jobs – 1999-2008



Source: ONS/ASHE

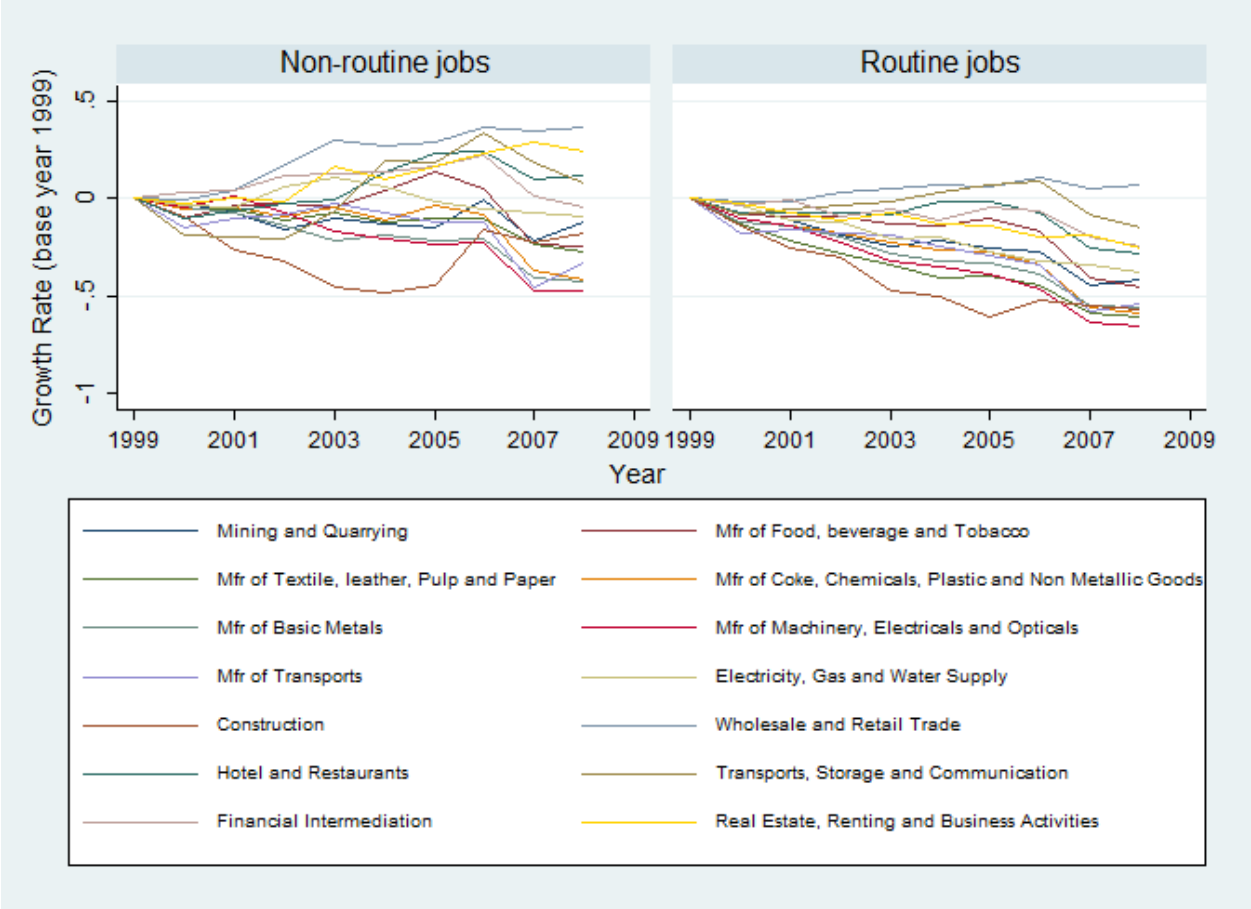
Figure 2: Spatial distribution of Routine Jobs across local labour markets (TTWAs) in 1999

Source : ONS/ASHE

Figure 3: Spatial distribution of Non-Routine Jobs across local labour markets (TTWAs) in 1999

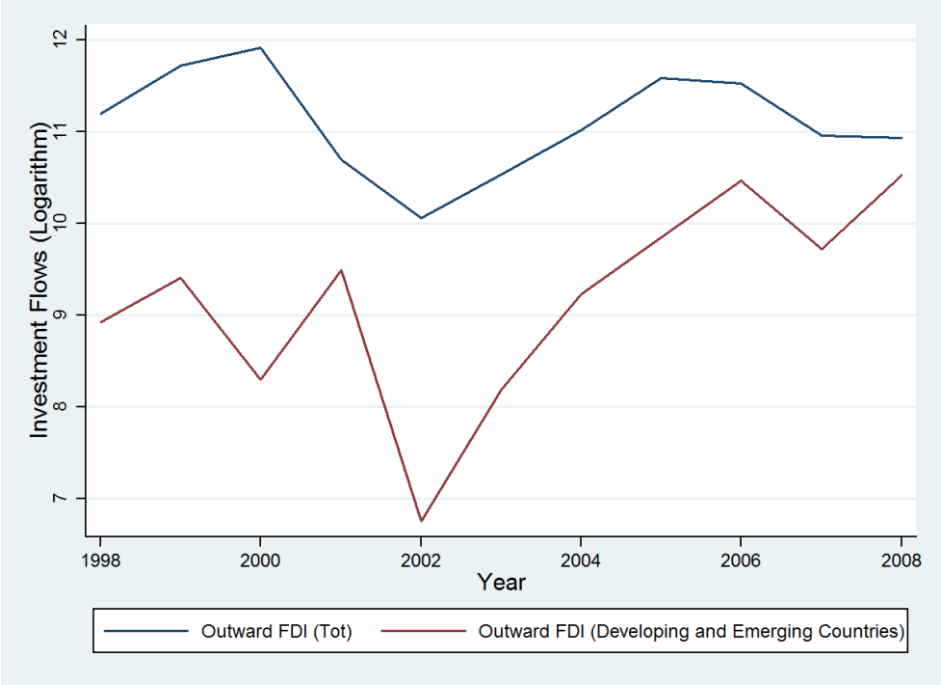
Source: ONS/ASHE

Figure 4: Routine/Non-Routine Jobs across industries – 1999-2008



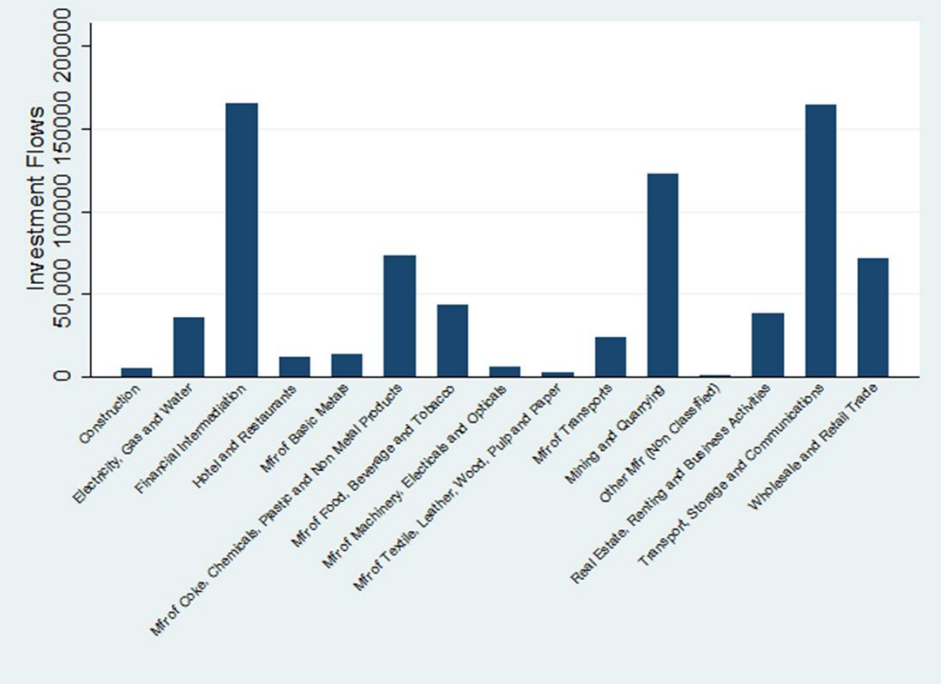
Source: ONS/ASHE. Note: Sectors classified by broad industrial groups.

Figure 5: Outward Investments Abroad (OFDI) – 1998-2008



Source: ONS/ASHE

Figure 6: OFDI by Industry – 1998-2008



Source: ONS/AFDI. Note: Data in millions of GBP. Sectors classified by broad industrial groups.

Table 1: Further Descriptive Statistics on Non-Routine/Routine Jobs by industry and region – 1999-2008

Sector	Share of Non-Routine Jobs	Share of Routine Jobs	Growth Rate in Non-Routine Jobs	Growth Rate in Routine Jobs
Construction	0.31	0.69	0.37	0.07
Electricity, Gas and Water	0.47	0.53	-0.17	-0.57
Financial Intermediation	0.54	0.46	0.24	-0.25
Hotel and Restaurants	0.25	0.75	0.08	-0.15
Mfr of Basic Metals	0.23	0.77	-0.43	-0.56
Mfr of Coke, Chemicals, Plastic and Non Metal Products	0.36	0.64	-0.42	-0.59
Mfr of Food, Beverage and Tobacco	0.25	0.75	-0.25	-0.45
Mfr of Machinery, Electrical and Optical Equipment	0.37	0.63	-0.47	-0.65
Mfr of Textile, Leather, Wood, Pulp and Paper	0.37	0.63	-0.27	-0.61
Mfr of Transports	0.32	0.68	-0.33	-0.55
Mining and Quarrying	0.26	0.74	-0.14	-0.43
Other Mfr (Not Classified)	0.24	0.76	-0.09	-0.38
Real Estate, Renting and Business Activities	0.55	0.45	0.37	0.14
Transport, Storage and Communications	0.35	0.65	-0.05	-0.25
Wholesale and Retail Trade	0.65	0.35	0.12	-0.28
Region				
East	0.47	0.53	0.10	-0.20
East Midlands	0.41	0.59	0.09	-0.32
London	0.60	0.40	-0.02	-0.32
North East	0.41	0.59	0.17	-0.35
North West	0.44	0.56	0.14	-0.30
Scotland	0.45	0.55	0.20	-0.28
South East	0.53	0.47	0.01	-0.29
South West	0.46	0.54	0.15	-0.23
Wales	0.40	0.60	0.20	-0.31
West Midlands	0.41	0.59	0.02	-0.32
Yorkshire and The Humber	0.41	0.59	0.12	-0.32

Source: ONS/ASHE. Note: The shares of Non Routine/Routine Jobs are constructed as the number of Non-Routine/Routine jobs by industry for the period 1999-2008 over the total number of jobs. Growth Rates in Non-Routine/Routine Jobs are constructed as the variation between 1999 and 2008 in the number of Non-Routine and Routine Jobs over the number of Non-Routine and Routine Jobs in 1999 respectively by industry. Sectors classified by broad industrial groups. Regions defined at Governmental Office Regions (GORs) level.

Table 2: Further Descriptive Statistics on OFDI – 1998-2008

Sector	Total Number of Investments	Total Amount of Investments	Share of Investments (Number)	Share of Investments (Amount)
Construction	4037	5472.742	0.03	0.01
Electricity, Gas and Water	1334	35722.03	0.01	0.05
Financial Intermediation	11464	165650.6	0.09	0.21
Hotel and Restaurants	1922	12169.03	0.01	0.02
Mfr of Basic Metals	3889	14067.2	0.03	0.02
Mfr of Coke, Chemicals, Plastic and Non Metal Products	12289	73190.75	0.09	0.09
Mfr of Food, Beverage and Tobacco	5387	43231.59	0.04	0.06
Mfr of Machinery, Electricals and Opticals	13569	5745.015	0.10	0.01
Mfr of Textile, Leather, Wood, Pulp and Paper	7273	2397.547	0.05	0.00
Mfr of Transports	3612	23523.09	0.03	0.03
Mining and Quarrying	4087	122465.8	0.03	0.16
Other Mfr (Not Classified)	1288	820.037	0.01	0.00
Real Estate, Renting and Business Activities	30159	38140.97	0.23	0.05
Transport, Storage and Communications	8679	164516.9	0.07	0.21
Wholesale and Retail Trade	23808	71204.62	0.18	0.09
Recipient Countries				
Developed and Transition Countries	83138	675094.6	0.63	0.87
Developing Countries	43403	85816.5	0.33	0.11
Emerging Countries	4766	16442.23	0.04	0.02
Least Developed Countries	1490	964.461	0.01	0.00

Source: ONS/AFDI. Note: The Share of OFDI Number and Amount are calculated as the number and financial amount of OFDI for the period 1998-2007 by industry/recipient country over the total number and total amount of OFDI over the same period respectively. Sectors classified by broad industrial groups. Groups of recipient countries defined based on the World Economic Situation and Prospects (WESP) classification.

Table 3: Offshoring and the Geography of Jobs - Main Results

Dependent variable: Standardized number of routine/non-routine jobs

	(1)	(2)	(3)	(4)	(5)	(6)
	Routine Jobs			Non-Routine Jobs		
	PANEL I			PANEL II		
Offshoring	-0.0064***	-0.0064***	-0.0063***	0.0007*	0.0007*	0.0007
	(0.0014)	(0.0014)	(0.0014)	(0.0004)	(0.0004)	(0.0004)
Manufacturing	0.0023	0.0022	0.0012	-0.0082**	-0.0082**	-0.0061*
	(0.0091)	(0.0090)	(0.0094)	(0.0035)	(0.0035)	(0.0035)
Wage Non-Routine Jobs					0.0026	0.0050
					(0.0120)	(0.0120)
Wage Routine Jobs		0.0038	0.0038			
		(0.0034)	(0.0034)			
Skilled Population			-0.0096			0.0202***
			(0.0095)			(0.0064)
Young Population			-0.0051			0.0097**
			(0.0081)			(0.0048)
Observations	2290	2290	2290	2290	2290	2290
R2	0.1613	0.1614	0.1616	0.1885	0.1885	0.1905
TTWA dummies	YES	YES	YES	YES	YES	YES
Time dummies	YES	YES	YES	YES	YES	YES

Note: N=2290 (229 TTWA x 10 years). All variables expressed in logs. Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 4: Offshoring and the Geography of Jobs – By recipient area

Dependent variable: Standardized number of routine/non-routine jobs

	(1)	(2)	(3)	(4)
	Routine Jobs	Non-Routine Jobs	Routine Jobs	Non-Routine Jobs
Offshoring	-0.0065***	0.0043***		
(Developing and Emerging)	(0.0017)	(0.0013)		
Offshoring			-0.0036***	0.0002
(Developed)			(0.0011)	(0.0004)
Manufacturing	0.0015	-0.0063*	0.0013	-0.0061*
	(0.0095)	(0.0035)	(0.0095)	(0.0035)
Wage Non-Routine Jobs		0.0081		0.0046
		(0.0122)		(0.0120)
Wage Routine Jobs	0.0034		0.0033	
	(0.0034)		(0.0033)	
Skilled Population	-0.0088	0.0191***	-0.0101	0.0203***
	(0.0094)	(0.0065)	(0.0095)	(0.0064)
Young Population	-0.0040	0.0087*	-0.0054	0.0097**
	(0.0081)	(0.0048)	(0.0081)	(0.0048)
Observations	2290	2290	2290	2290
R2	0.1615	0.1950	0.1598	0.1904
TTWA dummies	YES	YES	YES	YES
Time dummies	YES	YES	YES	YES

Note: N=2290 (229 TTWA x 10 years). All variables expressed in logs. Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 5: Offshoring and Routine Jobs – Alternative specifications

Dependent variable: Standardized number of manual/cognitive Routine jobs; Standardised number of Routine jobs in Non-Tradable/Tradable industries; Standardised number of Routine jobs for female/male employees

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Routine Jobs (Manual)	Routine Jobs (Cognitive)	Routine Jobs (Tradable)	Routine Jobs (Non Tradable)	Routine Jobs (Tradable)	Routine Jobs (Non Tradable)	Routine Jobs (Female)	Routine Jobs (Male)
	PANEL I		PANEL II		PANEL III		PANEL IV	
Offshoring	-0.0065***	-0.0061***	-0.0103***	0.0012***	-0.0084***	-0.0040***	0.0018***	-0.0012***
	(0.0014)	(0.0014)	(0.0024)	(0.0004)	(0.0016)	(0.0015)	(0.0007)	(0.0005)
Manufacturing	0.0069	-0.0030	0.0137	-0.0019	0.0087	-0.0038	-0.0007	0.0004
	(0.0082)	(0.0107)	(0.0159)	(0.0031)	(0.0098)	(0.0111)	(0.0045)	(0.0027)
Wage Routine Jobs (Manual)	-0.0062							
	(0.0066)							
Wage Routine Jobs (Cognitive)		0.0038						
		(0.0039)						
Wage Routine Jobs			0.0097*	0.0021	0.0045	0.0020	0.0007	0.0041***
			(0.0050)	(0.0020)	(0.0059)	(0.0029)	(0.0031)	(0.0011)
Skilled Population	-0.0157	-0.0050	-0.0141	0.0044	-0.0247*	-0.0039	0.0056	0.0004
	(0.0113)	(0.0096)	(0.0226)	(0.0054)	(0.0128)	(0.0138)	(0.0075)	(0.0046)
Young Population	-0.0090	-0.0020	0.0027	0.0067	-0.0123	-0.0047	0.0109*	0.0040
	(0.0088)	(0.0086)	(0.0177)	(0.0041)	(0.0107)	(0.0094)	(0.0058)	(0.0038)
Observations	2290	2290	2290	2290	2290	2290	2290	2290
r2	0.1770	0.1310	0.1597	0.1135	0.2132	0.0338	0.1042	0.0956
TTWA dummies	YES	YES	YES	YES	YES	YES	YES	YES
Time dummies	YES	YES	YES	YES	YES	YES	YES	YES

Note: N=2290 (229 TTWA x 10 years). All variables expressed in logs. Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 6: Offshoring and Routine Occupations – Endogeneity Checks and IV Estimation

Dependent variable: Standardized number of routine jobs					
	(1)	(2)	(3)	(4)	(5)
Dep.Var.	Routine Jobs	Routine Jobs	Routine Jobs	Routine Jobs	Offshoring
Offshoring	-0.0050***	-0.0064***	-0.0017***	-0.0419**	
	(0.0013)	(0.0014)	(0.0006)	(0.0199)	
Wage Routine Jobs	0.0081**	0.0038	0.0019	0.0071	0.0933
	(0.0038)	(0.0034)	(0.0036)	(0.0096)	-0.2299
Manufacturing	0.0046	0.0013	-0.0083*	0.0006	-0.0054
	(0.0086)	(0.0092)	(0.0050)	(0.0090)	-0.1729
Skilled Population	-0.0072	-0.0099	0.0091	-0.0032	0.1261
	(0.0092)	(0.0097)	(0.0065)	(0.0110)	-0.1835
Young Population	-0.0015	-0.0052	0.0067	-0.0018	0.0803
	(0.0078)	(0.0081)	(0.0059)	(0.0094)	-0.1778
Computerization	-0.0296***				
	(0.0087)				
Import Competition		0.0021			
		(0.0038)			
Tariffs					-2.2081***
					(0.5922)
Observations	2290	2290	2290	2290	2290
R2	0.1708	0.1617	0.7907	0.0673	0.2998
TTWA dummies	YES	YES	YES	YES	YES
Time dummies	YES	YES	YES	YES	YES
Area trends	NO	NO	YES	NO	NO
F(1, 2047)					13.91
P-Val					0.0002

Note: N=2290 (229 TTWA x 10 years). All variables expressed in logs (except for computerization and import competition). Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 7: The Long Run Impact of Offshoring

Dependent variable: Standardized number of routine/non-routine jobs

	(1)	(2)	(3)	(4)	(5)	(6)
	Routine Jobs			Non-Routine Jobs		
	PANEL I			PANEL II		
Offshoring	-0.5022*	-0.4942*	-0.5071*	0.2862**	0.2683**	0.2905**
	(0.2711)	(0.2647)	(0.2765)	(0.1225)	(0.1202)	(0.1244)
Manufacturing	0.7957	0.8569	0.6077	0.3958	0.9046	1.3270
	(1.2478)	(1.2069)	(1.4092)	(0.8471)	(0.8918)	(0.9474)
Wage Non-Routine Jobs		-0.1083	-0.1181			
		(0.0995)	(0.1060)			
Wage Routine Jobs					0.1547***	0.1542***
					(0.0413)	(0.0397)
Skilled Population			-1.0912			2.7499**
			(1.1951)			(1.0610)
Young Population			-1.7684			1.6854
			(1.8370)			(1.5960)
Observations	229	229	229	229	229	229
R2	0.0334	0.0357	0.0389	0.0104	0.0267	0.0416
TTWA dummies	YES	YES	YES	YES	YES	YES
Time dummies	YES	YES	YES	YES	YES	YES

Note: N=229 (229 TTWA x 2 years – estimation in difference). All variables expressed in logs. Robust standard errors in parentheses.

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

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