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I provide new empirical evidence on the direct and indirect impact of services offshoring on local employment and wages, using a unique dataset on firms in the UK for the period 2000-2015. Exploiting variation in firms' services offshoring across labour markets, I show positive aggregate local labour employment and wage elasticity to services offshoring. Spillovers from offshoring to non-offshoring firms explain the positive results, and services offshoring complementary to firms' production has a larger effect than the offshoring competing with firms' outputs. Finally, I show that services offshoring widens firms' employment and wage dispersion within local labour markets.

Keywords: Services Offshoring, Local Labour Market, Spillover Effect, Quantile Analysis.

JEL Code: F1, F16, J2.

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Disclaimer

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1 Introduction

New technologies and the globalisation of markets have opened further possibilities to increase services trade, including firms' offshoring activities. Services offshoring rose by 22% in the last two decades and firms traditionally located in the manufacturing industry are deriving a major share of their revenues from services and services trade. With increased offshorability of services, firms can hire consultants from abroad, have foreign subsidiaries program their software, or move their call centre to a country where labour is cheap.[1] Nonetheless, the literature examining the effects of services offshoring on the labour force is thin, and does not provide adequate evidence at the aggregate local labour market level. Thus, at a time when employment in services activities has increased to 75% among OECD countries, it is of new importance to understand how firms' offshoring affects importing firms and their competitors back home.[2]

Services offshoring can affect local labour markets through multiple channels. On the one hand, services offshoring substitutes jobs previously carried out in the offshoring firms or previously outsourced to a firm in the same local labour market. Hence, offshoring might increase competition among the firms in the provision of services, and lead firms to become smaller or force them to exit the market. On the other hand, the resulting higher productivity for offshoring firms can increase employment and average wages.[3] The positive effects might propagate, or "spillover", to the non-offshoring firms' employment and wages through supply chain linkages and cheaper production inputs. Higher productivity might increase labour demand and wages,

[1] Using data from the WIOD and in comparison, manufacturing offshoring increased by 12% between 2000-2014. I refer to Breinlich et al. (2018); Ariu et al. (2019a, 2020); Bernard et al. (2017); Ding et al. (2022) for manufacturing firms producing services, Baldwin (2016, 2019) for increased offshorability of services due to globalisation and new technologies.

[2] Using information provided by the OECD, more than 464 million workers were employed in services activities in 2019, against 85 million in manufacturing, 44 million in construction and 30 million in agriculture.

[3] Described in Grossman and Rossi-Hansberg (2008).

leading workers to relocate between firms.[4] From a distributional point of view, and especially if offshoring costs are high, more productive firms are more likely to offshore, enhancing their productivity and market power. Depending on the distribution of firms in the labour market, the positive effects from productivity gains and spillover effects may outweigh the negative ones, leading to improved domestic labour market outcomes.[5] Which of the suggested channels, substitution or spillover, prevail is *a priori* unclear, and determining the overall effects of services offshoring thus remains an empirical question.

I address this question and estimate the overall effects of services offshoring on the local labour market, accounting for general equilibrium mechanisms and highlighting the importance of the indirect impact of services offshoring. Hence, I construct a unique firm-level dataset from Great Britain that includes information on firms, their services trade and geographical locations from 2000 until 2015, using data from the UK's Office of National Statistics (ONS).[6] The data employed are ideal as services offshoring is widespread: 17% of firms in GB trade services, scattered across all sectors of the economy and throughout the country, trading mainly production intermediates such as computer services, telecommunication, professional services, and R&D.

I approach the research question of how services offshoring affects local labour markets in four steps. First, I estimate the relationship between services offshoring and aggregate local labour market outcomes using a shift-share design. I define local labour markets as per sector-local area where offshoring originates and measure services offshoring as the total imports of services from abroad of firms located in a sector-local area. I show that services offshoring

[4]Spillover effects are similar to the general equilibrium model in Adão et al. (2019a); Caliendo et al. (2019). Reallocation effects are similar to agglomeration effects in Helm (2020).

[5]Described in Egger et al. (2015).

[6]Great Britain includes the territories of England, Wales and Scotland, but, as opposed to the United Kingdom, excludes Northern Ireland. Country-level statistics in international databases typically refer to the UK, and for simplicity, I will sometimes refer to these statistics to describe general trends.

increases total employment and wages, implying positive reallocation and growth of offshoring firms, and that spillover effects exceed negative import substitution and competition effects within a local labour market. Unobservable time-varying factors might be affecting imports of services, employment and wages at the same time, e.g. a new production plant that might raise services offshoring, employment and wages. I address any potential endogeneity and reverse causality concerns by implementing a shift-share instrument. Specifically, I instrument services offshoring with changes in the trade flow of services of a selected pool of exporting (France, Germany, the US, Ireland) and importing (Australia, Canada, Japan, South Korea) countries by industry and type of services. The intuition is that new technologies and lower trade costs boost the production of services in France, Germany, the US and Ireland. The increased advantage in services production leads to higher shares of input services exported from France, Germany, the US and Ireland towards other high-income countries not part of the EU single market, with economies similar to the UK, such as Australia, Canada, Japan and South Korea. Therefore, the shock component of the instrument is the pattern of services import flows at the industry level, allocated to each local labour market depending on the initial services input or employment shares.

In the second step, I explore the channels through which services offshoring affects average labour market outcomes using firm-level information. I repeat the aggregate analysis at the disaggregate level and show positive employment elasticity on both firms that offshore services directly and those that do not. Importantly, however, I show that the average wage elasticity to services offshoring is positive for non-offshoring firms but negative for the one's offshoring. Same results are obtained when I account for potential endogeneity and omitted variable bias by implementing the instrumental variable strategy as in the aggregate analysis. To understand the discrepancy in the results, I distinguish between the offshoring of services

competing with firms' product portfolios (defined as narrow) and services complementary to the production (defined as input). For non-offshoring firms, rising input offshoring leads to higher employment and lower average wages, while narrow offshoring mitigates this effect. Conversely, input offshoring counterbalances the detrimental impact of narrow offshoring for offshoring firms. Hence, input services offshoring leads to higher employment for all firms, consistent with productivity spillover and firm-to-firm linkages. At the same time, the substitution effect is sizeable for offshoring firms compared to non-offshoring firms in terms of wages, highlighting the importance of spillover effects when estimating the overall impact of offshoring on local labour markets.

In the third step, I examine whether the effects of services offshoring effects on employment and wages are distributed homogeneously across firms and explicitly concerned with the distributional aspects of services offshoring within local labour markets. I keep exploiting firms' heterogeneity and show the different effects of services offshoring on firms' employment and wage distributions. Services offshoring increases employment and wages more at the top of the distribution, either when ordering firms by size, wages or productivity. The results suggest that services offshoring leads to an increase in size inequality and dispersion of firms' employment and wages distribution within a local labour market, also when conditioning the distribution on firms' composition and offshoring status.

The analysis carried out up to this point does not control for workers' characteristics due to a lack of information at the firm level. In the fourth and final step, I link local labour market services offshoring with workforce information from a different dataset and look at the variation of the effects based on workers' characteristics. Indeed, specific categories of workers could drive positive wage effects of services offshoring (Ariu et al., 2019b; Criscuolo and Garicano, 2010; De Lyon, 2021), as well, services offshoring might have an effect on those workers

employed in non-offshoring firms through the mechanisms highlighted before (firm-to firm linkages, competition).[7] I find that workers with higher levels of education or in professional occupations benefit the most in terms of higher employment and wages from the exposure to services offshoring. As in the case of quantile analysis, results suggest an increase in the differences between workers in employment levels and hourly pay due to services offshoring.

I relate and contribute to different branches of the literature, primarily to offshoring. A unique feature of this study is that I look at the economic dynamics at the level of local labour markets, firstly estimating the overall effects of offshoring and then discerning between the direct and indirect channels (see Hummels et al. (2018) for a complete review of the offshoring literature). The current study is closely related to the one conducted by Kovak et al. (2021) in looking at the impact of MNE's offshoring on parents' workforce and the implication for the sector and regional labour market. The authors find that decreasing offshoring costs lead to an increase in US parent firm employment, with lower positive effects at the industry and regional levels. Differently from their paper, I examine a larger sample including MNEs and non-MNEs, directly measuring their offshoring activities. What is most, I exploit the channels through which offshoring affects firms indirectly discerning between substitution and spillover effects. I extend the literature on services offshoring by studying firms' heterogeneity in offshoring status and using more refined-level data to capture general equilibrium dynamics (Amiti and Wei, 2005a,b, 2009b,a; Crinò, 2008; Gheishecker and Görg, 2011). Moreover, I advance the recent literature looking at changes in the offshoring firms' performance and the workforce composition (Ariu et al., 2019b; De Lyon, 2021; Eppinger, 2019; Girma and Görg, 2004; Hijzen et al., 2011; Liu and Trefler, 2019), accounting for spillover mechanisms on non-offshoring firms and the distribution of the effects.

[7] Egger et al. (2022) model the job polarisation between firms due to offshoring.

Further, I build a bridge between the literature on services offshoring and the burgeoning literature on the local labour market effects of trade. The existing literature focuses on increased import competition from China in the manufacturing industry and finds labour market outcomes to deteriorate with increasing trade exposure.[8] However, recent studies show how the overall effects change when taking into account the impact along with the supply chain of cheaper inputs of production (Acemoglu et al., 2016), when considering the rise of export opportunities (Dauth et al., 2014), including the spillover effects in non-manufacturing sectors (Donoso et al., 2015), and accounting for labour adjustment and agglomeration economics (Curuk and Vannoorenberghe, 2017; Dix-Carneiro and Kovak, 2017; Helm, 2020). In contrast with this literature, I focus on imports of intermediate inputs rather than final products, as well as on the spillover effects of trade, similar to Wang et al. (2018). However, besides focussing only on the manufacturing sector, Wang et al. (2018) examine a different type of spillover: While they identify gains that occur upstream and downstream of the value chain, I measure the indirect effects of trade on firms within the same sector-local area. Therefore, while Wang et al. (2018) highlights the "cascade" effects of trade, I shed light on the trade implications on firms' competitors.

The policy implications of the paper are twofold. First, I highlight the importance of the indirect effect of services offshoring. The economic mechanisms I explore are a novelty for the manufacturing and services offshoring literature and emphasise the relevance of general equilibrium adjustments in those studies. Second, since 2001 the share of trade agreements with chapters on services trade has increased, further elevating the importance of services for trade negotiations. The findings of this paper are highly relevant to policymakers shaping trade policies.

[8] Autor et al., 2013, Autor et al., 2014, for the US, Balsvik et al., 2015 for Norway, Malgouyres, 2016 for France, Keller and Utar, 2016; Utar, 2018 for Denmark.

The remainder of the paper is organised as follows. The next section discusses the conceptual framework driving the empirical analysis. Section 3 describes the employed datasets and provides an overview of the UK services trade. Section 4 presents the identification strategy and the aggregate results. The following section describes firm-level strategy and results. Section 6 includes the identification strategy and results of the quantile analysis, while section 7 provides an overview of the results for different groups of workers. Finally, section 8 discusses the results and concludes.

2 Conceptual Framework

As a conceptual framework, I use the cornerstone contribution by Grossman and Rossi-Hansberg (2008) to guide the empirical investigation. Following their model, firms offshore "tasks" if they are cost optimising. An offshoring firm faces three effects: productivity, labour supply and relative price. Since firms are now sourcing cheaper inputs, they can produce the same amount of output at a lower cost. The increase in overall productivity boosts the demand for firms' output and workers performing non-offshored tasks. The relative price of the final output using the offshore tasks decreases, and so does the workers' wage employed in the offshored tasks. At the same time, tasks offshoring works as a labour-supply shock for the other firms and effectively increases the supply of workers previously employed in the offshored task, pushing down their relative wages.

However, the changes observed for the offshoring firms impact other firms sharing the same labour market. First, if offshoring firms become more productive and increase their demand, it increases their market shares. Competitors might face a reduction in their demand, leading to a decrease in their employment and or worker wages. On the other hand, an increase in productivity raises the demand for intermediate products supplied by firms in the same labour

market. Hence, non-offshoring firms face a demand shock leading to a further increase in the demand for workers. Moreover, dismissed workers that were previously employed in the offshoring firms can be re-employed in the non-offshoring firms. As the larger supply of workers pushes the wages down, this might affect non-offshoring firms, similar to the studies looking at the impact of cheaper intermediates, leading to higher productivity for non-offshoring firms. In the rest of the paper, I refer to the channels here highlighted as the generic "spillover" effect, which I later try to disentangle in each of the highlighted channels.

Up to here, I assume that offshored tasks are previously in-house produced. However, a plausible scenario is outsourced tasks in the labour market now sourced from abroad (see Eckert et al. (2019) for services outsourcing decisions). Offshoring would then further push the productivity of the offshoring firms while working as a substitute for the outsourcing firms.[9] The import substitution effect is similar to the one observed in the study by Autor et al. (2013), where increasingly cheaper imports compete with domestic supply, ultimately affecting employment and wages employed in the exposed industries.

At first, I look at the aggregate effects of services offshoring on the local labour market, hence the net effect accounting for adjusting mechanisms. Then, I decomposed the effects by firms' offshoring status and type of offshoring, focussing on the generic "spillover" and the import substitution effect. Exhausting the power of the data, I attempt to identify the channels driving the spillover effect decomposing it between changes in local labour market competition and firm-to-firms linkages, and further conduct a distributional analysis of the effects.

[9]See Chan (2017) for firms' decision between in-house production and outsourcing of tasks.

3 Data and Stylized facts

In this section, I provide a brief overview of the data employed in the empirical analysis, underlining the novelties of the information used. Which services firms commonly trade and with whom is often unclear; however, the data employed shed new light on the types and the origin/destination of the services traded by firms in Great Britain. Using these insights, I describe firms' behaviour towards services offshoring and their geographical distribution across local labour markets, highlighting the differences in terms of employment and wages between offshoring and non-offshoring firms.

3.1 Data

I combine three sets of data from the UK Office of National Statistics (ONS) to obtain information on trade in services flows and firms in Great Britain from 2000 until 2015. For firm-level data on trade in services, I employ the International Trade in Services Survey (ITIS), which contains information on the country of origin/destination and the types of services traded. The dataset contains services trade flows supply through cross border (mode 1), consumption abroad (mode 2) and movement of people (mode 4).[10] I then link the dataset with the Annual Respondent Database (ARD) and the Annual Business Survey (ABS), the official sources of information on firms in the UK used to construct national statistics. I refer to section A in the online appendix for a detailed description of the data and the methodology used to merge the information. The final dataset is a panel of firms and their detailed services trade activities. Information is available for all observations on geographical location, employment, turnover and the type of sector. Additional data on firms' characteristics and economic activities, such as expenditure on Computer Services, R&D activities, and value-added, are available for all

[10]Mode 4, movement of people, includes job posting as in Muñoz (2021).

large firms for the whole period, and a sample of small firms in a cross-section structure. I construct and employ population weights in the analysis, clearing potential sampling issues of small firms moving in and out of the surveyed sample. Section A in the online appendix further contains a complete description of the methodology used to construct the weights.

3.2 Stylised Facts

Services trade has shown an increasing trend compared to goods in the past 30 years, both in imports and exports, and is characterised by a high heterogeneity of services type, partner country and industry of origin/destination (see section B in the online appendix). High-skill intensive activities are among the most traded services as research and development, telecommunication and computer services, preceded by intra-firms services and royalties & licensing. (Figure A.1).[11] High volumes of services are exchanged with EU members and the US, accounting for a quarter of total trade and former colonies, such as India, Australia, United Arab Emirates (UAE) and Hong Kong (Figure A.2). When looking at the growth rates, the fastest growing countries between 2000 and 2015 are India, UAE, China and Poland. Within a ten years interval, the growth rates of the four countries have been around 3% in imports and exports, twice as much as for the other countries, suggesting an increase in the international competition in the services industry from these countries, frequently related only to goods or commodity trade (Figure A.3 in the online appendix). Section B in the online appendix contains further description of the country-service and sector-services pair traded by UK firms. As a brief summary, services trade reflects countries' comparative advantages and involves all

[11] According to the definition used in the survey, intra-firms trade is the flow of services across borders within the same company, a non-specified composite that firms declare to trade with their affiliates. Because of their blurred definition, I exclude trade in services between related businesses from the offshoring measure in the analysis. In a robustness check, I repeat the analysis accounting for intra-firms trade flows in the offshoring measure.

sectors of the economy, including manufacturing.

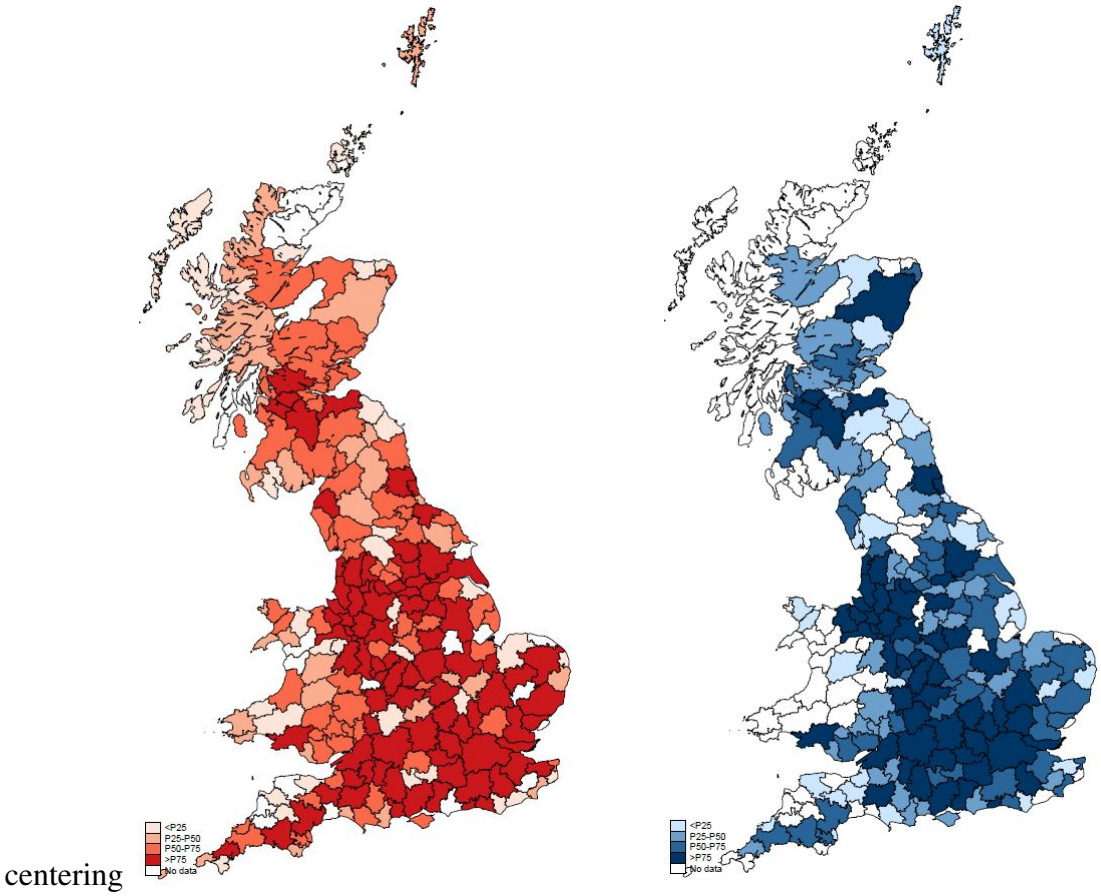
The share of firms involved in services trade is considerable: in 2018, there were 266,500 service traders compared to 282,900 businesses trading goods.[12] Overall, firms trade different types of services, with each product accounting for a fifth of all imports or export of the firms (Table A.1). These regularities in the trade portfolio persist even when distinguishing between firms' macro sectors, implying that both firms in manufacturing and services trade a wide range of services (Table A.1). A significant share of firms' input comes from services offshoring: imports of services from abroad increased from 53% in 2005 to more than 60% in 2015 in terms of total inputs; meaning that service inputs from abroad increased more than the domestic inputs, with potential effects on the domestic producers. Indeed, the services that firms are offshoring might be either complementary or substitutes to their production. I distinguish between broad and narrow offshoring, following the specification in Hummels et al. (2014). I define broad offshoring as the overall firms' services imports with no distinction on the type of services, including both complements and substitutes to the production. Instead, I consider narrow offshoring the services offshoring in the same category of the firm's outputs. In defining narrow offshoring, I address two caveats. First, the services trade classification differs from the standard industry classification. I construct a conversion table that allows for merging the types of services with firms' industry classification (Table B.4 in the online appendix). Second, the data available do not allow for the identification of the whole product-portfolio of a firm, but only the main product that corresponds to the industry classification where a firm is registered. Therefore, using only information on firms' industry leads to excluding all the non-services sectors, despite their involvement in services offshoring. I assume that if a firm exports a service, it is also producing that service. Given their nature (perishable, intangible

[12] Source: ONS

that often require the simultaneity of supply and consumption), it is reasonable to assume that the offshored services are often not for re-sell or storage. This methodology allows to account for firms' heterogeneity in the production process, similarly to Hummels et al. (2014), which I prefer to use an industry-level input-output table.

Narrow services offshoring accounts, on average, for 10% of the overall services offshoring, with higher shares among firms in the services industry (Table A.1). Broad offshoring outperforms the narrow one, however, they both have increased and doubled between 2000 and 2015 (Figure A.4).

Figure 1: **Services Production and Offshoring Distribution**



(a) **Services Producers** (b) **Services Offshoring**

centering

Source: Own computation using ARD/ABS and ITIS (ONS). Contains National Statistics data ©Crown copyright and database right (1991, 1981). Contain OS data ©Crown copyright and database right (1981, 1991). The figures refer to the period 2000-2015.

The dataset contains information on firms' geographical location, allowing me to map trade

in services flows and producers across the country. Services producers and offshores are sparse throughout the country, with different intensities across local areas (Figures 1(a) and 1(b)). Indeed, differences between local labour markets, defined as sector-local areas, are substantial also in terms of share of multinationals, firms' concentration and exposure to skill-biased technologies, thereby, impacting employment and wages (Table A.2). Moreover, firms have on average a higher market power within their local labour market compared to their market power at higher level of aggregation as sector or local-areas, a regularity that persists even when only considering the firms with the highest local power (Table A.3). Further, non-offshoring firms exposed to services offshoring perform better in terms of employment and wages than those firms that are not exposed. On the one hand, this might indicate self-selection of non-offshoring firm with higher employment and wages into local areas with higher labour market outcomes. On the other hand, the exposure to services offshoring firms might have spillover effects on non-offshoring firms' outcomes (Table A.4). In the rest of the analysis, I exploit how different intensities of services offshoring affects local labour markets, leveraging the geographical distribution of firms across the country and accounting for local labour market characteristics.

4 Effects of services offshoring on local labour markets

This section presents the empirical methodology to investigate the impact of services offshoring on local labour market outcomes. First, I exploit the variation in the levels of employment and average wage between local labour markets that stem from the fact that, depending on the characteristics of the firms it hosts, each local labour market has different exposure to services offshoring. I account for unobservable affecting at the same time local employment, wages and services offshoring, instrumenting services offshoring with service-industry imports from the US, Australia, France and Ireland to other high-income countries. Second, I leverage the

granularity of the data to exploit the channels through which services offshoring might affect firms both directly and indirectly.

I define local labour markets as the sector and geographical local area of the firms importing services, similar to Ottaviano et al. (2018) and Caliendo et al. (2019).[13] Hence, I assume that firms and workers do not move between local areas, consistent with the definition of travel to work areas. I compute services offshoring for each local area k and sector j aggregating firms' import of services following the specification:

$$OFF_{jkt} = \sum_{i} Imports_{ijkt} \tag{1}$$

where $Imports_{ijkt}$ indicates the overall imports of services of firm i located in sector j local area k at time t. Therefore, local labour market offshoring increases if firms in sector j local area k increase their imports of services at time t, thus differentiating between local areas whose firms have different trade behaviours.

4.1 Local labour market analysis

To begin, I seek to establish a causal impact of services offshoring on aggregate local labour market outcomes, taking as the unit of analysis sector local areas as previously defined. I consider as outcome variables overall employment (L_{jkt}) and average wages (w_{jkt}) in local

[13]The geographical areas are British Travel to Working Areas (TTWA). The ONS identifies 260 British Travel To Working Areas (TTWA) within Great Britain, each representing autonomous labour markets not confined to administrative boundaries."The current criteria for defining TTWAs is that at least 75% of an area's resident workforce, work in the area and at least 75% of the people who work in the area also live in the area. The area must also have a working population of at least 3,500. However, for areas with a working population over 25,000, self-containment rates as low as 66.7% are accepted. TTWA boundaries are non-overlapping, are contiguous and cover the whole of the UK. TTWAs cross national boundaries, although no account is taken of commuting between Northern Ireland and the Republic of Ireland." Source: ONS.

labour market jk at time t, while services offshoring measure follows the specification as in equation 1. Sector-local area employment (L_{jkt}) is the aggregate of firms' values at the sector j local area k level in each year t; the average wage is the ratio of the total wage bill and total employment by firms ($w_{ijkt} = \frac{W_{ijkt}}{L_{ijkt}}$), then averaged within sector-local area jk at time t.[14] The regression equation takes the form:

$$lny_{jkt} = \rho_0 + \beta_1 lnOFF_{jkt} + \mathbf{\Gamma x_{jkt}} + \varphi_{jt} + \psi_{kt} + \epsilon_{jkt}, \tag{2}$$

where $\ln y_{jkt}$ indicates the logarithm of labour market outcome y in sector j, local area k, at time t, $\mathbf{x_{jkt}}$ is a set of time-varying control variables at the unit level, while φ_{jt} and ψ_{kt} indicate local-area-time and sector-time fixed effects.[15]

The coefficient of interest β_1 indicates the elasticity to offshoring (OFF_{jkt}) in sector j local area k time t of either total employment or average wage. The sign and magnitude of the coefficient depend on the mechanisms that prevail in the aggregate. Positive β_1 indicates that a relative increase in services offshoring leads to a relative increase in aggregate employment or average wages within a sector-local area. Hence, positive elasticity implies that an increase in productivity and positive spillover overturn the adverse effects of offshoring. On the contrary, a negative elasticity suggests that import substitution and adverse concentration in a local labour market inhibit the positive gains from offshoring. In two subsequent specifications, I account for delays in the effects, lagging the offshoring measure by one to two years.

I account for skill-biased technological changes by augmenting the regression with firms' ex-

[14] All outcome variables are computed using population weights such that the results are, on principle, comparable to firm-level ones. To control for the large number of zeros, I implement an arcsino transformation for all the continuous variables.

[15] The explanatory variable contains a large number of zeros, for this reason I implement a arcsino transformation of the dependent and explanatory variables.

penditure on computer software as a proxy. The measure controls for the substitution between workers and computers that might reduce employment and wages of certain occupations, further lagging by one year to avoid correlation with the measure of offshoring. Moreover, since multinational firms tend to be more productive than domestic firms (Criscuolo and Martin, 2009), I include in the specification the share of British-owned firms within each sector-local area. Similarly, I control for changes in the competition at the local labour market level with the population of firms.

I include local area-year fixed effects (ψ_{kt}) to account for changes in employment and wages that might occur in a particular year in a local area, e.g. a regional policy or the opening of new infrastructures (airports, train stations enlargements) in the local area. Similarly, I add sector-year fixed effects (φ_{jt}) controlling for yearly changes at the sector level, e.g. new technologies or negative demand shocks sector-specific.

The set of fixed effects makes it unnecessary to normalise the offshoring measure by sector or local areas characteristics but does not control for pre-sample selection. E.g. firms self-selecting into areas with better infrastructures and facilities. Therefore, I cluster the residual at the local area and sector level using the specification as in Correia (2014), which allows for combining multi-way clustering with a wide range of fixed effects. The cluster accounts for error correlation at the sector-local area level and partially correct for the potential noise of the specification. On further specification I follow the recommendation of Adão et al. (2019b) and cluster the error at the macro-sector level to account for macro-sector-specific shocks.

A concern in the empirical strategy is that any sector-local area-time specific shock, simultaneously affecting employment, offshoring and wages, would invalidate the results, i.e. a migration shock concentrated in a local labour market or an economic shock affecting the financial sector in London. Fixed effects, together with error term clustering and the control variables,

can partially account for those types of shocks. As well, I conduct a battery of robustness checks, including the exclusion of the whole London area, to validate the results. However, to solve any endogeneity or reverse causality issues, I instrument services offshoring in the UK with other countries' services imports from the US, Germany, France and Ireland, which are among the biggest exporters of services in the World. I select importing countries Australia, Canada, Japan and South Korea as they are a selection of advanced economies similar to the UK but not a part of the EU single market. I assume that the expansion of the services sector in the exporting countries is attributable to new technologies (e.g. faster internet), lower trade costs (e.g. cheaper travel), and an increase in the agreements on trade in services, but not due to increased demand for service imports (Dauth et al., 2017 for Germany). The intuition is that as the exporting countries become more competitive in services production, they will export more, including to Australia, Canada, Japan and South Korea. At the same time, increases in industry imports of intermediate services in Australia, Canada, Japan and South Korea follow a path similar to the one in the UK. Therefore, the instrument captures changes and regularities in the trade pattern of services while unlikely to be caused by British sector-local area labour market outcomes. For e.g. the increase in the imports of engineering services from Germany in the car manufacturing sector reflects the expansion of German engineering services due to higher investment in R&D, trade agreements homogenising foreign engineering qualifications and the possibility for German engineers to travel more easily.

Two concerns threaten the validity of the instrument: shared supply or shared demand shock. The instrument assumes that technological changes facilitate the exports of services, leading advanced economies to shift their production towards services from manufacturing. The same technological changes might affect UK sectors and increase export opportunities for UK firms. Sector-time fixed effects absorb any sector-specific changes but do not account for local areas

with higher concentrations of sectors most affected by the changes in export. While the population of firms control for changes in competition, I further control services export flows at the sector-local area-time level aggregating the available information at the firm level and showing the robustness of the results.

The second concern is that the demand shock in the importing countries is common to the UK market, and thus changes import competition. Sector-time fixed effects control for the sector-specific trends measured at a four-digit level, which should solve the concern on changes in the demand driven by changes in the import competition in the manufacturing production (as it is in Autor et al. (2013)). At the same time, the set of time-varying control variables (share of British-owned firms, the population of firms, investment in automation) accounts for any sector-local area-time shock, e.g. the China shock affecting the manufacturing sector in Birmingham. Moreover, I select importing countries that are not part of the EU to exclude any shock specific to the single market and that have no colonial ties with the exporting countries.

I construct the offshoring measure using the information on export and imports of intermediates services from the World Input-Output Database (WIOD), publicly available from 2000 until 2014.[16] For each country- macro sector, the dataset contains information on the value and country of origin of each intermediate service used in the production process. I then use the sector-local area shares to allocate macro-industry level shocks at the sector-local area level:

$$OFF^{o}_{jkt} = \sum_{s} share_{sjkt0} M^{o}_{sJt-1}, j \in J \tag{3}$$

where M^{o}_{sJt-1} indicates imports of intermediate services s in macro-sector J at time t from the exporting countries to the importing countries listed above, lagging by one year.[17] I computed

[16] See Timmer et al. (2015).

[17] The correct specification is $OFF^{o}_{jkt} = \sum_{s} share_{sjkt0} M^{o}_{sJt-1} \times \mathbb{1}(share_{sjkt0}), j \in J$ since all the sector-local area without shares at the beginning of each period are excluded from the analysis.

the allocation shares $share_{sjkt0}$ at the sector-local area level using two specification: one leveraging on the different usage of the service s in each sector-local area jk compared to national macro-industry use of the service at the beginning of the analysis, and the one leveraging on the differences in terms of employment.[18] Usage shares imply that sector-local areas jk with higher imports of services s at time $t0$ get allocated larger shares of imports of services s at time t. Similarly, the employment share implies that areas with more employees have larger firms and attract larger shares of service imports. However, employment share does not account for variation across services, such that the intermediate import for each type of service is allocated to each local labour market jk with the same shares. To account for the variation in the imported services, I include in the computation of the instrument a dummy variable indicating whether the service was actually imported in a labour market at time $t-1$.[19] Hence, the import of service s is allocated to the local labour market jk, conditionally on importing service s at $t-1$. Recent literature on instrumental variables recommends computing the shares preceding the beginning of the analysis. However, the tradeability of services increased steeply during the period of analysis and fixing the shares to before 2000 would lead to a large selection of sector local areas. To overcome the problem, I define three periods of 5 years intervals each (2001-2005, 2006-2010, 2011-2015) and compute the shares one year before the beginning of each period. For e.g. the instrument for 2015 multiplies the imports of the intermediate service s in 2014 by the usage share of the service s in jk in 2010. As a robustness check, I fix for all year $t0$ in 1999, the first available year with detailed information on firms' services usage.

The instrument composes of a shock and a shared part, belonging to the group of shift-share or Bartik-style IVs as often in empirical studies. Recent econometric literature highlights

[18] $share_{sjkt0} = \frac{use_{sjkt0}}{use_{sJt0}}, j \in J$, $share_{sjkt0} = \frac{Employment_{jkt0}}{Employment_{Jt0}}, j \in J$.

[19] $share_{sjk} = \frac{Employment_{jkt0}}{Employment_{Jt0}} \times \mathbb{1}(M^o_{sJt-1}), j \in J$

the potential limitations of this class of instruments and clarifies the necessary condition to satisfy the assumptions the methodology is based on (Adão et al., 2019b; Borusyak et al., 2022; Goldsmith-Pinkham et al., 2020; Jaeger et al., 2018). I devote appendix C to discuss the instrument validity, employing mainly the approach by Borusyak et al. (2022) and briefly discussing the implications of the other studies for my empirical strategy.

4.2 Results

Based on the theoretical predictions, the net effect of services offshoring on employment and average wages in a sector-local area is ambiguous: I expect positive elasticity to services offshoring if the gains from firms' higher productivity and positive spillover are enough to overcome the losses generated by the negative substitution effects. First, I implement the regression as specified in equation 2, estimating the impact of services offshoring on employment and average wages, accounting for local labour market characteristics. As shown in Table 1, a 10% increase in broad offshoring exposure of a sector-local area corresponds to a 1.3% rise in employment, everything else equal (column 3, panel A). The sample of analysis contains local areas having null and positive services offshoring; therefore, the positive elasticity indicates that the more exposed a local area is to services offshoring, the higher its rate of employment growth. Similarly to employment, the average wage responds positively to changes in services offshoring: a 10% increase in broad offshoring corresponds to a rise in average wages by 0.5% (column 3, panel B).

As specified in the methodology section, the OLS regression might fail to account for time-varying unobservables affecting simultaneously the services offshoring and the outcome variables leading to biased results. Accordingly, the two stages least squares approach outlined in section 4 is implemented, instrumenting the broad offshoring with the imports of services

in other high-income countries. The instrument is economically and statistically significant in explaining services offshoring exposure, and the F-tests are well above 10, the conventional threshold value (bottom panel in Table 1). The estimated elasticity is higher when implementing the instrument for all specifications: a 10% increase in services offshoring leads to a 1.4% rise in employment and 0.6% in average wages (column 2, panels A and B). As a back-of-the-envelope computation, a 10% increase in services offshoring is equal to a 0.3 percentage point of the standard deviation of the broad offshoring measure, which leads to an employment elasticity of 2.1 corresponding roughly to 80 workers or 0.2 p.p. of the standard deviation in *each sector-local area*. As for average wage, the elasticity to increased services offshoring is 0.6%, which corresponds to an increase of £297.

To construct the instrument in Table 1, I use usage shares at the beginning of each period. To check whether the results depend on the allocation term, I implement the instrument using different shares: usage, employment and shares fixed in 1999.[20] Consistent throughout all the specifications, services offshoring leads to an increase in employment (1.4%) and average wages (0.7%)(Table D.1). Although with a lower magnitude, the different IVs show an underestimation of the OLS results, confirming the necessity to control for the potential endogeneity of the offshoring measures. Thus, unobservables simultaneously affecting services offshoring exposure and local labour market outcomes are working towards a decrease in employment and average wages. E.g. a positive productivity shock in a sector-local area generates an increase in labour productivity, leading to a rise in local employment and a simultaneous decrease in the imports of services. Further, it might be the case that OLS analysis contains measurement errors of the variable of interest, explaining why the regression coefficients are smaller than the ones obtained through IV. If reverse causality drives the discrepancy between the OLS and IV, the

[20]Section D in the online appendix contains all the tables of the robustness and sensitivity checks.

results suggest that an increase in sector local area employment reduces offshoring exposure, e.g. firms increasing the local number of workers as substitutes for services offshoring.

Table 1: **Employment and average wage elasticity to services offshoring**

	(1) OLS	(2) IV	(3) OLS	(4) IV
A. Employment				
Broad Offshoring	0.1803***	0.2466***	0.1324***	0.1479***
	(0.0025)	(0.0086)	(0.0021)	(0.0067)
Share British Owned firms			-0.1689***	-0.1654***
			(0.0035)	(0.0038)
ICT			0.1575***	0.1556***
			(0.0017)	(0.0019)
Firms population			0.5439***	0.5441***
			(0.0084)	(0.0084)
B. Average Wage				
Broad Offshoring	0.0794***	0.1089***	0.0505***	0.0640***
	(0.002)	(0.0075)	(0.002)	(0.0073)
Share British Owned firms			-0.0940***	-0.0910***
			(0.0035)	(0.0039)
ICT			0.0974***	0.0958***
			(0.0021)	(0.0022)
Firms population			0.0178**	0.0180**
			(0.0079)	(0.0079)
First Stage				
IV		1.0512***		1.0777***
		(0.0271)		(0.0257)
F stat (Kleibergen-Paap)		1,848		1,753
AR2	0.4609		0.5505	
TTWA # Year	√	√	√	√
Sector # Year	√	√	√	√
N	203,669	203,669	203,669	203,669

Source: Data obtained combining ARD/ABS, ITIS datasets (ONS). Standard errors in parentheses are clustered at the sector-local area level. Dependent variable: Logarithm of Employment (panel A), Logarithm of Average Wage (Panel B). IV is the offshoring of services in Australia, Canada, Japan and South Korea from the US, Germany, France and Ireland. The instrument is constructed with usage share computed in different periods (2000,2005,2010). * ($p < 0.10$), ** ($p < 0.05$), *** ($p < 0.01$)

To control whether the results depend on the construction of the services offshoring measure,

I use ARD/ABS as a source of information to compute sector local area imports of intermediate services from abroad. The data contains values of firms' service imports for each firm that are self-reported and include transitions below the £10,000 trade threshold. However, ARD/ABS do not distinguish services trade flows by country of origin or type of services, differently from the ITIS. At the same time, since information on the type of services traded is not required, imports include financial, travel and education services, previously excluded, with higher aggregate values at the local labour market level. The elasticities are still positive when implementing the regression with the alternative offshoring measure: an increase of 10% in services offshoring leads to a rise in aggregate employment by 2.2% and by 0.7% in average wages (column 3, panels A and B, Table D.2). Hence the results are robust to a different source of information to construct the services offshoring measure.

Services might be complements or substitutes of local services production. Accordingly, I estimate the employment and average wage elasticity of services offshoring competing with local production, which I define as narrow offshoring. A 10% increase in narrow offshoring leads to a 1.2% increases in employment and a 0.5% increase in average wages, everything else equal (column 5, panels A and B, Table D.2). The elasticity to narrow offshoring is smaller than the broad offshoring one, as it is the gap between OLS and IV estimation. The smaller coefficients imply that the substitution between services offshoring on the local labour market overcomes the positive impact of offshoring. In the next section, I exploit further the differences in the offshoring flows, distinguishing whether services offshoring substitute or complements firms' production.

The scale of the results is consistent with previous studies on services offshoring. The already cited works by Amiti and Wei (2005a,b) find that for the period 1990-2004, a 10% raise in services offshoring is associated with a 0.01 % increase in the US total labour market pro-

ductivity and an increase of 0.6% in UK overall employment. Analysis at the national level shows that a 10% increase in services offshoring in the US leads to a rise in high-skilled employment by 5% while decreasing low and medium-skill ones by 0.1% and 0.4% respectively (Crinò, 2010). More recently, Eppinger (2019) finds that firms importing services directly in Germany increase employment by 7% to a 10% increase in services offshoring. Similarly, Ariu et al. (2019b) estimate the elasticity of the same order of magnitude when exploiting the heterogeneities of the effects of services offshoring across workers using the case of study Finland.

Adding to the existing literature, the first results of the paper show that local employment and average wages have positive elasticity to services offshoring. Hence, the aggregate adjustment mechanisms overtake the negative impact of offshoring.

Result 1. *Local area employment and average elasticity are positive to services offshoring* ($\hat{\beta}_1 > 0$).

The specification lacks accounting for services exports in a local labour market that might boost employment and wages, therefore biassing the main findings.[21] For this reason, I repeat the analysis and control for service exports in each local labour market, delayed by one year to restrain any simultaneity issues (Table D.3). The impact of broad offshoring on local employment and average wages is still positive and statistically significant when including the lagged export of services in the regression equation (columns 4-6). The magnitude of the offshoring coefficient is slightly smaller than the one in the base specification, suggesting that the offshoring measure is over-estimated without the export variable. However, when including services exports, the coefficient is within the confidence interval of the one from the main specification, and we can consider the overestimation negligible.

I run a battery of checks on the sample of analysis to assess the robustness of the results.

[21] In a recent paper, Berlingieri et al. (2021) show how exporters are more likely to offshore services.

First, I repeat the analysis for each year separately to control for outlier years that might be driving the results (Figure D.1). I then exclude 2008 as it coincides with the financial crisis in the UK (panel A, Table D.6), and the years 2014 and 2015, as in figure D.1 have a higher coefficient of employment elasticity to services offshoring (panel B). Then, I drop the whole area of London to rule out the possibility that this local area might be driving the results (panel C). I also exclude from the offshoring flows royalties and licensing trade as part of the trade can be associated with the balance sheet exercise (panel D). Subsequently, I include in the services offshoring flows the trade between related firms, previously excluded because of their blurred definition (panel E). Finally, I use the local units and not the reporting unit as the source of information for employment and average wages (panel F). With a more methodological aim, I repeat the analysis with robust standard errors instead of clustering it at the sector-local area level, clustering the error at the macro-sector level (2-digit ISIC classification) instead of sector-local area one, using ONS population weights and without sample weights (panels A, B, E and F, Table D.7). Further, I conduct two more sensitivity tests on the instrument averaging the flows of services for all the importing countries and then excluding Ireland from the exporting countries (panels C and D, Table D.7). The results from all the above robustness and sensitivity checks are comparable to the main ones.

To account for the possible delay in the labour market's response to services offshoring, I implement the specification as in equation 2 with a lag of one and two years for the offshoring measure. The main results do not change: aggregate employment and average wages have positive elasticity to services offshoring as in the main specification (Table D.4 in the online appendix). The theory predicts that one channel through which services offshoring affects employment and wages is productivity: services offshoring increases firms' productivity, leading to firms' expansion and higher employment and average wages. To test this theoretical pre-

diction, I estimate the elasticity of productivity to services offshoring. I measure productivity as aggregate gross value-added at market price, a variable in the ARD/ABS computed as the difference between output value produced and acquired inputs. The coefficient is positive and significant, with a larger magnitude when implementing the instrument: a 10% increase in services offshoring exposure leads to a 1.7% increase in productivity using OLS specification and around 2% increase using IV specification (columns 1-3, Table D.5). As for aggregate employment and average wages, I control for measurement errors using the information in the ARD/ABS dataset. The results are still positive, showing an increase of 1.3% and 2.8% in productivity to a 10% increase in services offshoring (columns 4-5).

To summarise the results, higher services offshoring leads to a relative increase in local labour market employment and wages. I dedicate the rest of the paper to exploring the channels through which the positive effects occur.

5 Importers, non-importers and the spillover effect

Within each local area and each sector, two types of effects occur: A direct one on the firms directly importing services, and an indirect one on the firms that are not importing services directly but are in the same sector and local area as the importing firms. In what follows, I look at the variation of employment and average wages at the firm level and exploit whether local area services offshoring affects offshoring and non-offshoring firms differently. As in the rest of the analysis, I account for potential endogeneity issues by implementing an instrumental variable strategy described more extensively in the previous section.

For consistency, I first implement the specification as in equation 2 at the firm level and extend the regression with information on firms' characteristics and trade status ($Importer_{it}$,

dummy variable) and interact the former with the offshoring measure ($lnOFF_{jkt}$), as follows:

$$lny_{it} = \rho_0 + \gamma_1 Importer_{it} + \gamma_2 lnOFF_{jkt} + \gamma_3 lnOFF_{jkt} * Importer_{it} + \boldsymbol{\kappa\alpha_{it}} + \boldsymbol{\Gamma x_{jkt}} + \varphi_{jt} + \psi_{kt} + \epsilon_{it}, \tag{4}$$

where y_{it} indicates the labour market outcome y of firm i located in sector j, local area k, at time t, and $\boldsymbol{\alpha_{it}}$ is a set of time-varying firms characteristics. γ_2 still indicates the effects of services offshoring on firms' outcomes, for which I expect comparable coefficients as in the aggregate specification. I compute the local labour market offshoring measure as the net of firms' services imports if a firm is directly offshoring, highlighting the *spillover* effect within local labour markets. The interaction coefficient γ_3 indicates the difference in the magnitude of offshoring elasticity depending on whether a firm is offshoring services directly. In a further specification, I substitute the dummy variable with the continuum of services offshoring at the firm level.

The data is a combination of panel and cross-sectional information and does not allow to control for firms' fixed effects. Therefore, I incorporate a set of firm time-varying control variables as productivity at time t, which controls for firms' varying performances affecting employment and wages; ownership, to account for multinationals companies performing better than domestic firms; and firms' exporting status, to control for exporters having higher employment and wages than non-exporters. A firm's productivity is measured as gross value-added at market price, provided in the dataset and computed as the difference in the output value produced and the acquired inputs. Firms' ownership status and exporting status are dummy variables taking the value of one if firm i is foreign-owned or exports at time t.

First, I implement the specification as in the aggregate analysis (equation 2) augmented by an importer dummy to check if the results hold when accounting for firms' trade status. The

employment elasticity to the broad offshoring remains positive and significant when excluding and including firms' time-varying characteristics (columns 1-4, Table A.5). To a 10% increase in services offshoring in a local labour market, it corresponds an increase of 0.2% in employment when implementing the OLS and the IV specifications. The regression includes a dummy variable for importers, which has a positive and significant sign explained by the higher employment of importers as in the rest of the literature. I then substitute the dummy variable with the continuous services offshoring at the firm level and obtain similar results (columns 5-6) and interact the offshoring measure with the dummy variable on firms' offshoring status (columns 7-8). The elasticity of the specification at the firm level is consistent with the aggregate analysis: positive and statistically significant. The lower magnitude is explained by the measure of firm-level employment, an order of magnitude smaller than the local labour market. When implementing the OLS specification average wage elasticity to services offshoring is still positive, but no longer statistically significant when including firm-level control variables and fixed effects. On the contrary, when implementing the specification with firms' controls and the IV, average wage elasticity to local area services offshoring is negative. At the same time, firms' own offshoring leads to higher average wages. Therefore, it seems as if direct offshoring is driving the positive elasticity at the aggregate (Table A.5, panel B).

Combining γ_2 and γ_3 in equation 4 further allows estimating the net employment and wages elasticity to services offshoring depending on firms' trade status. The results suggest that higher local labour market offshoring raises the employment and average wages of non-offshoring firms, albeit the latter is imprecisely estimated (Table 2). Therefore, the spillover mechanism (e.g. supply chain linkages) overcome the substitution and competition effects for offshoring firms.

At the same time, offshoring firms have positive employment and negative average wage

Table 2: **Firm Level**

	Offshoring		Non Offshoring	
	Employment	Average Wage	Employment	Average Wage
Broad Offshoring	0.029***	-0.018*	0.063***	0.025
	(0.005)	(0.009)	(0.011)	(0.018)
Narrow Offshoring	0.048**	-0.021	0.024***	-0.015
	(0.017)	(0.025)	(0.005)	(0.014)
Input Offshoring	0.101***	0.071**	0.044***	-0.018
	(0.018)	(0.008)	(0.028)	(0.015)

Source: Data obtained combining ARD/ABS, ITIS datasets (ONS). Linear combination of regression coefficients from Table A.5 columns 7 and 8 for Broad Offshoring. Linear combination of regression coefficients from Table A.6 columns 2 and 4 for Narrow and Input Offshoring. * ($p < 0.10$), ** ($p < 0.05$), *** ($p < 0.01$)

elasticity to services offshoring. Offshoring firms benefit further from other firms' services offshoring located in the same local labour market in terms of employment but not for wages. On the one hand, workers can experience a decrease in their wages due to the labour supply effect, where the supply of workers performing the offshored services increases but their wages decreases. On the other hand, it could be that services offshoring affects the workforce composition of the firms, a channel I explore in the last section of the paper.

Result 2. *Non-offshoring firms have positive employment and and wage elasticity to services offshoring within a local labour market* ($\hat{\gamma_2} + \hat{\gamma_3} > 0$).

I then distinguish between narrow and input offshoring, disentangling whether offshored services are complements or substitutes to firms' production. I define narrow offshoring as the offshoring competing with firms' portfolios, highlighting the substitution effect of services offshoring on firms. Instead, input offshoring is a composite of services that does not compete with firms' production. The elasticity to input offshoring is a proxy for the spillover effect, an aggregate of firm-to-firm linkages effects, changes in the market competition and imitation effects that I later try to disentangle.

For non-offshoring firms, employment elasticity to input offshoring is twice as large as the

elasticity to narrow offshoring. Average wage elasticity is at the same time negative with a lower magnitude to input offshoring than to narrow offshoring. Therefore, the results in Table 2 suggest that the positive net effect of services offshoring on non-importing firms is driven by what I have previously defined as spillover effects (Input offshoring).

The same is true for importers, with employment elasticity to input offshoring larger than narrow offshoring. On the contrary, average wages have a positive elasticity to input offshoring and negative elasticity to narrow offshoring. The positive sign of employment elasticity to narrow offshoring is consistent with the findings of Bernard et al. (2020), where the narrow offshoring might not capture differences in the quality of the offshored services that lead to reallocate workers in services with higher quality.

Result 3. *Input offshoring leads to relatively higher employment, while narrow offshoring attenuates the decreases in relative wages by input offshoring* ($\hat{\gamma}_2^{Input} + \hat{\gamma}_3^{Input} > \hat{\gamma}_2^{Narrow} + \hat{\gamma}_3^{Narrow}$).

In what follows, I try to disentangle the spillover effects within three components: firms-to-firms linkages, market competition and imitation. The impact of services offshoring on non-offshoring firms might depend on whether a firm supplies to, or buys from, an offshoring firm in each period. Ideally, the dataset employed in the analysis would contain information on between-firm trade within the UK. Unfortunately, this is not possible, and to exploit the firm-to-firm linkages, I leverage a variable included in the original dataset that indicates the firms' enterprise group. Therefore, I include in equation 4 an interaction term indicating whether a firm belongs to the same group as a firm offshoring services within a local labour market or not. The interaction term proxy for firms' supply chains and firm-to-firm links, assuming that the effects of a firm importing services propagate to all the other firms in the same enterprise group. Employment and average wage elasticity to services offshoring do not change when

including the interaction term with the same group (columns 1 and 2, panels A and B, Table A.7). Implying that, belonging to the same enterprise group of offshoring firms within a local labour market does not affect on non-offshoring firms.

However, firm-to-firm linkages might extend beyond the local labour market boundaries. I relax the restriction of enterprise links within the same sector-local areas and exploit the firm-to-firm links with offshoring firms within the entire GB. The magnitude of employment and average wage elasticity to broad offshoring is consistent with the previous analysis. However, when non-offshoring firms belong to the same enterprise group as an offshoring firm, they have higher employment but lower wages (columns 3 and 4, panels A and B, Table A.7). Consistent with the firm-to-firm channel, firms linked through enterprise laces with offshoring firms, reacts to indirect offshoring.

Indeed, services offshoring impacts firms' productivity which might change the competition within a local labour market and ultimately the other firms. To exploit this channel, I use information from the population of firms and measure local labour market competition as firms' labour and value-added share.[22] Positive value-added share elasticity within a local labour market due to services offshoring indicates an increase in the market power of firms more affected by offshoring, leading to a decrease in the competition in the local labour market. Labour share elasticity to services offshoring shows how workers' concentration across firms change at different exposures. The regression specification includes the population of firms within local labour markets, hence it computes the effects at the net of changes in the number of firms in the market. Services offshoring decreases the competition in a local labour market and increases firms' labour and value-added share. At the same time, importing firms have a higher concentration consistent with previous findings in the literature (Table A.8). However,

[22] Value-added is here measured as gross value-added at market price, as in the productivity measure.

when interacting the two terms, it appears as if offshoring firms decrease their market power due to offshoring compared to non-offshoring firms. This result suggests that the increase in performance of non-offshoring firms due to the exposure to services offshoring counterbalances the rise in market power within a local labour market of offshoring firms. As well, higher increase in labour market share for non-offshoring firms are consistent with reallocation of workers within local labour markets to non-offshoring firms.

Moreover, I explore the imitation channel by implementing a probit model and using the probability of a firm switching importing status as an outcome variable (from non-offshoring to offshoring). The specification aims to establish whether a link exists between the decision of a firm to start offshoring services and being exposed to offshoring in previous periods. I implement the specification using as a sample of firms only those that appear in the dataset for at least two consecutive years, exploiting the panel dimension of the data and accounting for firm fixed effects. The potential sample bias from excluding a large share of small firms should be limited, as firms engaging in services trade are larger than the average and appear multiple times in the dataset. Limiting the sample to incumbent firms, I show that services offshoring increases the probability of offshore services in the subsequent period, consistent with the imitation channel (Table E.2 in the online appendix).

Finally, I extend the analysis estimating the effects of services offshoring on firms' employment and wages when changing the definition of local labour market and distinguishing by the country of origin of the service. Section E in the online appendix discusses the methology applied and the results.

To summarise the findings of the present section, firms in a local labour market benefit from services offshoring spillover. Unfortunately, the available data do not allow for empirically testing the driving channels of the spillover effects. I shed some light and find results consistent

with the firm-to-firm linkages and workers reallocation driving the spillover effect. Further, the services classification is wide such that the definition of narrow offshoring may still include services complementary to firms' production. In the future, improvements in data availability on services trade will make it possible to extend this current analysis further.

6 Quantile analysis

In the previous section, I show a positive relation between services offshoring and local labour market outcomes. However, the positive elasticity is the positive *average* effect of services offshoring on local labour markets' employment and wages. Hereafter, I explore this relationship further, seeking to establish whether services offshoring has heterogeneous effects on different quantiles of employment and wage distribution across firms. Consistent with the aggregate analysis, I estimate the effects of services offshoring on the employment and average wage distributions within the labour market where the importing firms are, and consider the spillover effects of services offshoring.

Crucially, I exploit the fact that there is variation in the degree to which sector-local areas are affected by services offshoring depending on the characteristics of the firms it contains. Within each unit, all firms are affected by services offshoring regardless of their involvement in the services trade. I expect firms' employment (wages) to be affected differently by services offshoring depending on the point of distribution the firms are, as modelled by Egger et al. (2015). If the fixed costs of trade are high and only a few firms in each local labour market are involved in services imports, the effects of services offshoring are to increase the dispersion of firms in terms of employment and wages. On the opposite, if more firms are involved in services offshoring, it should decrease the dispersion of firms.

Moving the analysis from aggregate to quantile estimation comes with two methodological

constraints. First, conditional quantile analysis does not allow to account for error correlation. Second, conditional quantile analysis only allows for computing the effects of services offshoring on the quantiles of the *overall* distribution of employment and wages across sectors and local areas. However, each local labour market has a different pool of firms, and their distribution might vary: firms at the 10^{th} percentile of the employment (wage) distribution in the professional services industry in London may employ a much higher number of employees (pay higher wages) than those at the 10^{th} percentile in, say, Cardiff. I, therefore, carry out the analysis implementing the model proposed by Chetverikov et al. (2016). The model accounts for differences in the distribution of firms within each local labour market and allows for estimating quantile effects when the treatment occurs at the group level; that is, exposure to services affects the entire sector local area and not only individual firms. On a more statistical note, the methodology can account for the heteroscedasticity of the error and potential endogeneity, supporting the instrumental variable strategy. For each local labour market, I compute the employment and wage distributions each year. E.g. I compute the exact employment and wage distributions for professional services in London and Cardiff. Then, for each year, I obtain the value of each percentile of the employment and wage distribution in the professional service sector both in London and Cardiff. For each quantile, I estimate the following regression:

$$lny^{u}_{jkt} = \beta^{u} lnOFF_{jkt} + \boldsymbol{\beta\theta_{jkt}} + \varphi_{kt} + \lambda_{jt} + \epsilon^{u}_{jkt} \tag{5}$$

where u indicates the quantile, y the outcome variable in local area k sector j at time t, OFF the sector-local area jk exposure to offshoring at time t and ϵ^{u}_{jkt} the error, which is clustered at the sector-local area level.

The coefficient of interest is β^{u}, the elasticity of the outcome variable to services offshoring, now computed for individual quantiles u within each sector-local area. It implies that for each

sector-local area, I first compute the distribution of the outcome variable y and then proceed to estimate β^u at different quantiles u of that distribution. E.g., the distribution of the outcome variable would be computed once for the professional services industry in London at time t and once for the professional services industry in Cardiff at time t. The 10^{th} percentiles *within* each local labour market are then used to compute the quantile-specific elasticity of the outcome variable to services offshoring $\beta^{10^{th}}$.

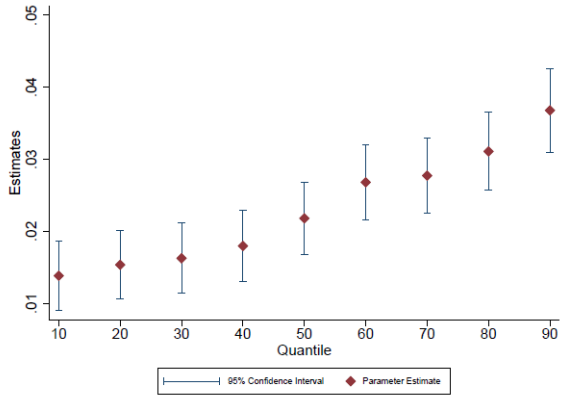
Equation 5 includes local area-time fixed effects (φ_{kt}) to account for changes in the outcome variable specific to a local area in a certain period, and sector-time fixed effects (λ_{jt}), controlling for shocks at the sector level. The vector $\theta_{\mathbf{jkt}}$ is similar to the one given in equation 2 and contains time-varying control variables, including the share of foreign-owned firms, the number of firms and the logarithm of expenditure in computer services. As in the previous section, the generic outcome variable y stands for either employment or average wage.

As mentioned above, it is possible to implement the instrumental variable strategy and account for potential unobservable factors affecting the dependent and the explanatory variables at the same time. I instrument services offshoring with total imports of services from selected exporting countries (the US, Germany, France and Ireland) in selected importing countries (Australia, Canada, Japan and South Korea). I refer to section 4 for a more detailed discussion of the validity of the instrument.[23]

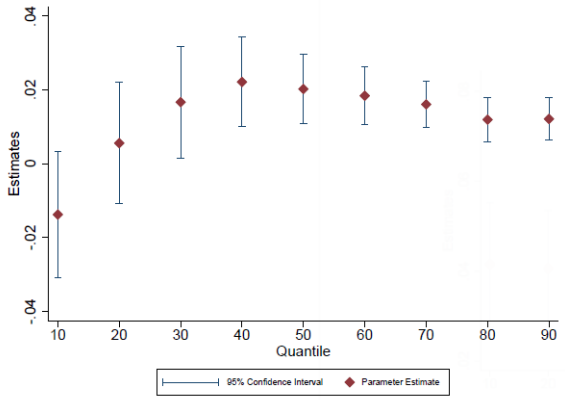
Figure 2(a) shows that the employment elasticity increases monotonically towards the upper quantiles of the distribution: a 10% increase in sector-local area exposure to services offshoring

[23]Differently from the average analysis, the quantile one is at the two-digit sectoral level. For instance, the civil engineering sector is one sector, instead of being divided into roads and railways construction and utility projects construction. This way, I increase the number of observations in each sector-local area, allowing me to compute precise distributions of employment and wages in each unit. Further, all sector-local areas with less than ten observations are excluded from the analysis to obtain a meaningful distribution of employment and wages.

Figure 2: **Employment and Average Wage Elasticity to services offshoring by quantile**



(a) Employment - OLS



(b) Average Wage - OLS

Source: Data obtained combining ARD/ABS, ITIS datasets (ONS). The two graphs show the regression coefficients of employment and average wage elasticity to services offshoring by quantile. Each regression contains sector-year and local area-year fixed effects. Control variables LLM: log of share of British-owned firms, log population of firms and the log of expenditure in computer service, lagged one year.

comes with a 0.1% increase in employment for small firms, i.e. for those at the 10^{th} quantile of the employment distribution. This effect is about three times larger for large firms, or those at the 90^{th} percentile of the employment distribution. The pattern of employment elasticities is similar when implementing the instrumental variable, pointing at an exacerbation of the differences between smaller and larger firms (Figure 3(a)). At the same time, wage elasticity to services offshoring is similar across quantiles above the median of the distribution and has lower or negative values at the bottom of the distribution (Figure 2(b)). The results from the IV specification amplify the difference between the two parts of the distribution: firms below the median of the wage distribution react less to services offshoring in terms of wages compared to the high-pay firms (Figure 3(b)).[24] Further, as the coefficients are elasticities, the results suggest that increases in services offshoring lead to higher absolute wage gains for the top firms in terms of wage distribution compared to those at the bottom.

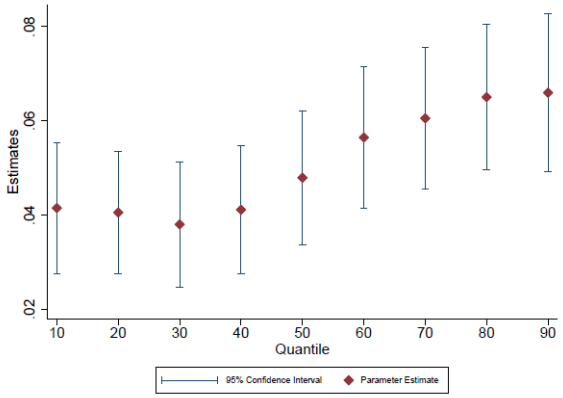
One would expect an overlap between the employment and wage distributions and productivity: the most productive firms have the highest number of workers and pay the highest salaries. To control for this regularity, I estimate the elasticity at different quantiles of the *productivity* distribution. The regression specification is that described by equation 5; in this case, the coefficient of interest β^u refers to the elasticity of employment (wages) to services offshoring at the u^{th} decile of the productivity distribution.

The number of firms used to compute the distribution in each unit year varies as firms enter and exit the sample. To control for any bias caused by particularly highly (or scarcely) populated units of analysis, I follow Backus (2020) in including the number of firms used to compute the distribution as an additional variable in the regression analysis.[25]

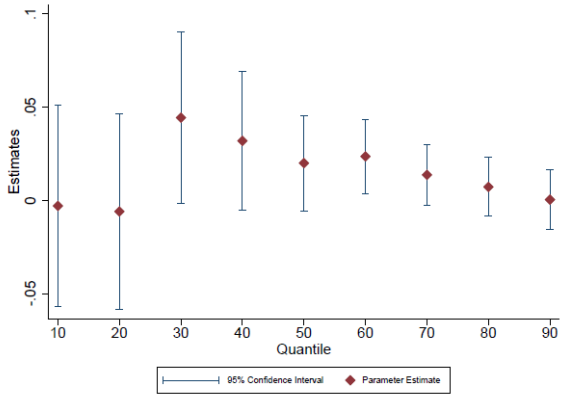
[24] Here, wages are the firm's wage bill divided by the total number of employees. I now refer to them as "wage" instead of "average wage" to avoid confusion with the aggregate analysis.

[25] Backus (2020) faces a similar problem when investigating the causal relationship between productivity and competition in a case of study of the ready-mix concrete industry in the US.

Figure 3: **Employment and Average Wage Elasticity to services offshoring by quantile**



(a) Employment Elasticity - IV



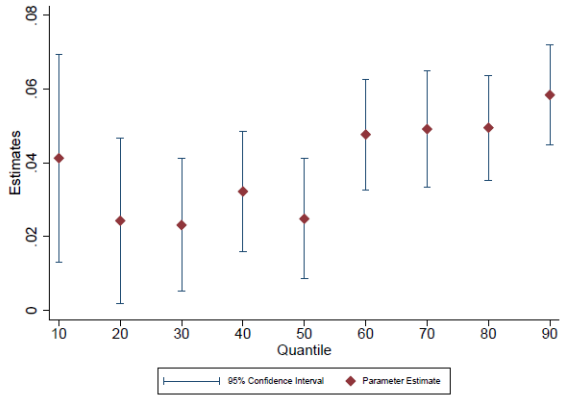
(b) Average Wage Elasticity - IV

Source: Data obtained combining ARD/ABS, ITIS datasets (ONS). The two graphs show the second stage regression coefficients of employment and average wage elasticity to services offshoring by quantile. IV is the offshoring of services in Australia, Canada, Japan and South Korea from the US, Germany, France and Ireland. The instrument is constructed with usage share computed in different periods (2000, 2005, 2010). Control variables LLM: log of share of British-owned firms, log population of firms and the log of expenditure in computer service, lagged one year.

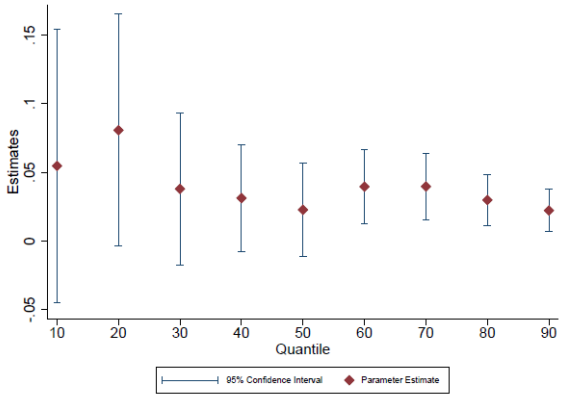
The employment elasticity to services offshoring is more stable along the productivity deciles, but still, more productive firms have a higher employment elasticity to services offshoring, indicating higher employment gains in absolute terms for the firms at the top of the productivity distribution (Figure 4(a)). At the same time, wage elasticity to services offshoring decrease with the productivity decile and firms at the bottom of the productivity distribution have higher wage elasticities than those above the median, albeit not statistically significant (Figure 4(b)). Therefore, the least productive firms are those more sensitive to services offshoring in terms of wages (have higher wages elasticity) but not in terms of employment. The results further imply that services offshoring increases the dispersion of employment and average wages across the productivity distribution, despite the lack of statistically significant differences in elasticity.

The distributions of employment, wages and productivity are computed yearly in each local labour market. Firms are then allowed to move between quantiles such that the characteristics of firms on each quantile of the distribution might change over time. Hence, the analysis presented so far indicates the effects of services offshoring *at* the quantiles of the outcome variable distribution, but it is silent about the changes *in the composition* of the quantiles. E.g. I observe that firms' employment at the 90^{th} percentile of the productivity distribution increases with an increase in services offshoring. However, the increase in employment might be by changes in firms' composition at the 90^{th} percentile of the productivity distribution due to services offshoring. Similarly to Juhn et al. (1993), I abstract from the compositional effects and keep the composition of each quantile fixed at the beginning of the analysis. Since firms frequently enter and exit the dataset, fixing the composition of firms to the initial productivity distribution would lead to a substantial distortion of the sample, potentially biasing results. To overcome the problem, I proceed as follows: I compute the productivity distribution for all observations within a given sector-local area, irrespective of the period to obtain time-invariant

Figure 4: **Employment and Average Wage Elasticity to services offshoring by productivity decile**



(a) Employment Elasticity



(b) Average Wage Elasticity

Source: Data obtained combining ARD/ABS, ITIS datasets (ONS). The two graphs show the regression coefficients of employment and average wage elasticity to services offshoring by productivity quantile. IV is the offshoring of services in Australia, Canada, Japan and South Korea from the US, Germany, France and Ireland. The instrument is constructed with usage share computed in different periods (2000, 2005, 2010). Each regression contains sector-year and local area-year fixed effects. Control variables LLM: log of share of British-owned firms, number of firms use to construct the distribution and the log of expenditure in computer service, lagged one year.

thresholds for the quantiles. Hence, I assign each firm to a productivity decile based on its productivity in the first year when it appears in the dataset and remains in that decile in all the following periods. I then implement the regression specification mentioned before fixing the productivity composition (equation 5). E.g., in Cardiff, firms within the professional service sector might move along the productivity distribution over time. I firstly compute the deciles of the productivity distribution of the professional services sector in Cardiff for the entire period. Then I assign each firm to a productivity decile depending on its productivity in the year the firm enters the dataset and implement the regression for each quantile of the fixed productivity distribution.

Coefficient β^u in regression 5 hence quantifies the elasticity of employment or wages to services offshoring at the u^{th} quantile of the productivity distribution, abstracting from changes in the composition of the decile.

Employment elasticity at different quantiles of the productivity distribution is still different once binding firms' composition at the beginning of the analysis (Figure 5(a)). Firms in the middle of the conditional productivity distribution are almost inelastic to services offshoring, while low and high-productive firms have strong positive elasticity. Hence, services offshoring increases differences in firms' employment even when controlling for the composition effect. Moreover, changes in the composition of firms along the productivity distribution can explain the positive elasticity at the median of the unconditional distribution. On the opposite, firms belonging to lower productivity decile bins at the beginning of the analysis have a higher wage elasticity to service offshoring than more productive ones (Figure 5(b)). Therefore, in the case of wage elasticity, once accounting for the composition effect, services offshoring weakens differences between firms at different points of the productivity distribution.

To summarise the findings of this section, the effects of services offshoring are heterogeneous

along the employment and wage distributions. Larger firms gain more than small firms from an increase in services offshoring in terms of employment both in absolute and relative terms. As for wages, firms that are paying higher wages seem to gain more in absolute terms from services offshoring, although the nature of the data does not allow to control of workers' characteristics, a limitation I address in the next section. However, the analysis is silent on the selection of less productive firms as in Melitz (2003) and only controls for the number of firms at each time at each quantile. Accounting for selection of firms would be possibile with a complete panel of firms, a topic I leave to future research.

Overall, it is reasonable to conclude that:

Result 4. *Services offshoring increases the dispersion of firms' employment and wages within local labour markets.*

7 Winners and losers

The analysis has been conducted using firm-level information on employment and wages, therefore assuming homogeneity of the workforce in each firm. As the last step, I employ information on the labour markets obtained from the British Labour Force Survey (QLFS) to account for workers' characteristics. The dataset collects UK labour force information on employment status, economic activities, individuals and household characteristics and geographical location. Although smaller than other labour surveys, QLFS is closer to a random sample (Goos and Manning, 2007). Unfortunately, it is impossible to merge workers in the QLFS with the respective employer in the ARD/ABS, such that the exposure of each individual to services offshoring depends only on the sector and local area of employment. Albeit imperfect, including information provided in the QLFS helps shed light on the heterogeneous effects of services offshoring depending on workers' characteristics. From a policy perspective, this may

be particularly relevant.

I divide workers by gender, education level and occupation using the information contained in the QLFS.[26] I then aggregate within each sector-local area and group of workers, employment and average hourly pay. I repeat the analysis by each group of workers implementing the econometric specification defined by equation 3, using the broad offshoring measure as the explanatory variable.

Across occupations, managers, professionals, and technical and associate professions have the highest employment elasticity and similar wage elasticity to services offshoring (Figures 6(a) and 6(b)). At the same time, both employment and wages are inelastic to changes in services offshoring for those workers employed in sales and customers occupations (e.g. sales assistants), elementary occupations, leisure and caring (e.g. hospitality, hairdresser, travel agency), process and plant machinery occupations. Note that the results refer to full-time employment and that the years of analysis coincide with the introduction of zero-hour contracts, which might have disproportionately affected these latter occupational categories. The point estimate of employment elasticity to services offshoring appears to be similar for male and female workers, although the latter have slightly higher wage elasticity than the former (Figures 7(a) and 7(b)). The sample includes only full-time workers; therefore, the higher female wage elasticity to services offshoring might have to do with lower-paid workers moving out

[26] Employment information is obtained by aggregating the number of individuals registered as employed or self-employed in a sector-local area. Wages are obtained by averaging workers' hourly pay in each unit of analysis. Differently from the rest of the analysis, sectors are at a one-digit level, and local labour markets are larger (NUT2 of the international classification). Lastly, the period considered is between 2000 and 2012. As it is common in the literature, I divide level of education into four categories: low (to O-levels and equivalent), medium-low (up to A-levels), medium-high (up to two years of higher education) and high (those with a university degree). It is important to note that dividing workers by their levels of education removes from the sample those workers not British born, as information on the level of education is absent until 2009 for this group. Workers' occupation is defined based on the broad one-digit SOC 2010 classification, provided by the ONS. See SOC10.

of full-time employment or employment altogether. Consistent with findings in the literature that indicate an increase in skill polarisation due to offshoring, employment elasticity appears to differ depending on the level of education (Becker et al., 2013; Malgouyres, 2016). Workers with a medium level of education have lower employment elasticity to services offshoring than those with lower and higher education (Figure 7(a)). As for the average wage, the estimated elasticities are close to zero for all the educational categories (Figure 7(b)). The results in the present section suggest that, overall, highly skilled workers and those in professional occupations gain more from services offshoring in employment and wages, potentially increasing the inequalities within the labour force.

Overall the results are consistent with the recent study by Ariu et al. (2019b), analysing the impact of services offshoring on workers employed in services importing firms. Using a detailed set of employer-employee data from Finland, the authors find that services offshoring increases the employment of high-skill workers and those in managerial occupations while decreasing the low-skilled workers. Differently, from Ariu et al. (2019b), the present study includes workers employed both in offshoring and non-offshoring firms. Indeed, the results of the present section suggest that workers in non-importing firms, which experience spillover effects, are indirectly affected by services offshoring.

Further, this last part of the analysis is closely related to Costa et al. (2019) and Javorcik et al. (2022), using the Brexit vote as a trade shock affecting workers' wages and firms' demand for labour. Costa et al. (2019) find that the depreciation of the sterling after the Brexit vote lead to an increase in input prices that ultimately affected the most the workers more exposed to foreign inputs. Consistent with their study, I find heterogeneous impact of services offshoring depending on workers characteristics and occupation. At the same time, Javorcik et al. (2022) finds that those areas in the UK more exposed to trade, hence more affected by the Brexit vote,

decline the demand of high skilled labour. A result consistent with the higher employment elasticity to services offshoring for highly skilled workers shown in this section.

8 Conclusions

During the last three decades, trade in services increased significantly for all economies, boosting the offshoring of services. Based on a novel detailed firm-level dataset, I investigate the impact of services offshoring on local labour markets employment and average wages in Great Britain between 2000 and 2015.

Existing literature shows that for firms directly involved in services offshoring, the increase in productivity and the reallocation of workers within the firms lead to the positive overall effects of offshoring. However, the manufacturing and services offshoring literature are silent in studying the indirect effect of offshoring on the firms sharing the same local labour market but not directly involved in offshoring. Offshoring leads to an increase in the productivity of the offshoring firms, leading to a potential increase in employment and average wages. At the same time, non-offshoring firms might be affected by the offshoring of the other firms through spillover effects, such as production linkages or changes in the competition in the local labour market, or by import competition from abroad. Which of the channels prevails at the aggregate and disaggregate level is the empirical question I answer in this paper.

I conduct the analysis in four steps, each corresponding to a contribution to the literature. First, I establish a relationship between local labour market outcome and services offshoring, showing positive aggregate employment and average wages elasticity to services offshoring. To account for any biases resulting from unobservable factors that may simultaneously affect local labour markets and services offshoring, I instrument services offshoring with offshoring in Australia, Canada, South Korea and Japan from the US, Germany, France and Ireland. The

intuition of the instrument is that it captures changes and regularities of services trade flows within the period of analysis. The results are consistent when implementing the IV and conducting a battery of robustness and sensitivity checks.

Second, I exploit the heterogeneity of the data and show the spillover effect of services offshoring on non-offshoring firms: Firms located in the same local labour market as offshoring firms have positive employment and average wage elasticity to services offshoring. Further, I show that the offshoring of services complementary to non-offshoring firms' production leads to higher elasticity than the offshoring competing with firms' portfolios. At the same time, offshoring firms benefit from the offshoring of other firms in the same local labour markets in terms of employment if the offshoring is complementary to their production. Therefore, spillover effects seem to compensate for the import substitution effects of services offshoring.

The nature of the data does not allow us to pinpoint the channels driving the effects. However, I shed some light and zoom into the spillover effects of non-offshoring firms investigating whether a link exists between services offshoring, firms-to-firms linkages and local labour market competition. I control for firms' ownership structure to test whether services offshoring directly affects offshoring firms and indirectly its affiliates. I find an increase in employment and wages on non-offshoring affiliates with offshoring firms within Great Britain. Further, I look at how services offshoring affects the competition within a local labour market using the information on the population of firms within each local labour market. I show that service offshoring decreases the competition within a local labour market, but the spillover on non-offshoring firms counterbalance the increase in market power of offshoring firms.

Third, I examine the distributional effects of services offshoring and implement a quantile analysis using the methodology by Chetverikov et al. (2016). I show that services offshoring enhances employment and wage differences across firms. When controlling for firms' produc-

tivity distribution and changes in the firms' composition through time, services offshoring leads to an increase in the dispersion of firms' employment and average wages.

Finally, I carry out the analysis by workers' characteristics and occupations, showing further heterogeneities in the effects. Both employment and wage elasticity to services offshoring follow a U-shaped pattern across educational levels suggesting that services offshoring leads to an increase in inequality across workers. Because of data limitations, it is not possible to identify the job types gaining and losing within each firm.[27] However, it would be worthwhile to quantify the impact of services offshoring on workers' inequality. This information might shed further light on the interpretation of the results and constitutes a topic of my research agenda.

General equilibrium models as Caliendo and Parro (2015) assume input-output linkages when estimating the welfare effects of trade. In this study, I include these linkages within sector-local areas and show further indirect complementarity of services offshoring and labour market outcomes not considered in the class of theoretical models above. Integrating general equilibrium models with the indirect effects of offshoring presented might shed further light on the overall welfare effects of trade. A topic that I leave to future research.

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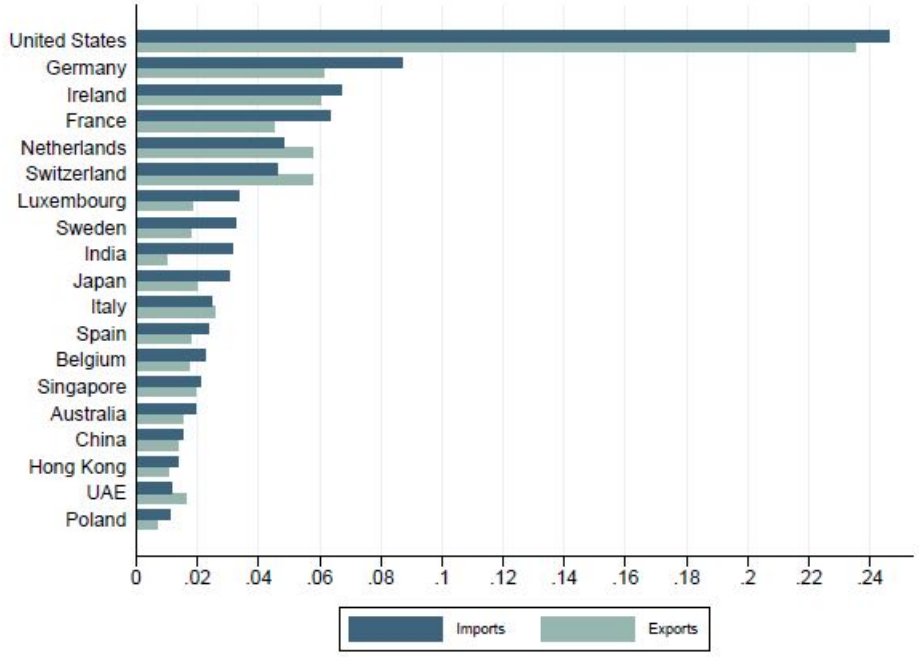
A Additional figures and tables

Figure A.1: **Trade shares by type of service.**

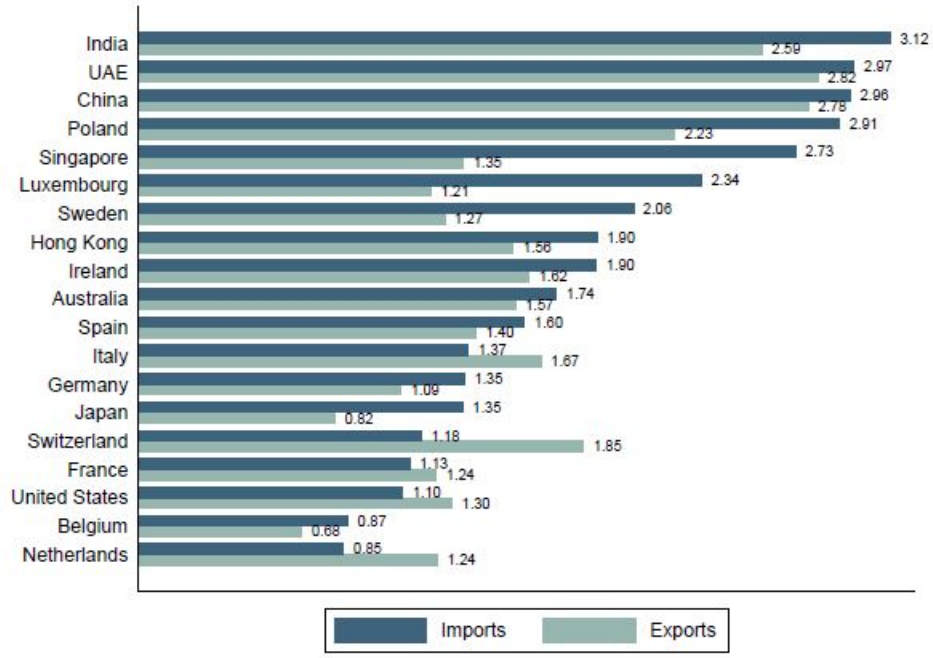
Source: Own computation using ITIS (ONS). Share of import and export of services by type of service on total flows in 2015. Graph shows services for which the share of imports is grater than 1% of total imports in 2015.

Figure A.2: **Trade in services by partner country**



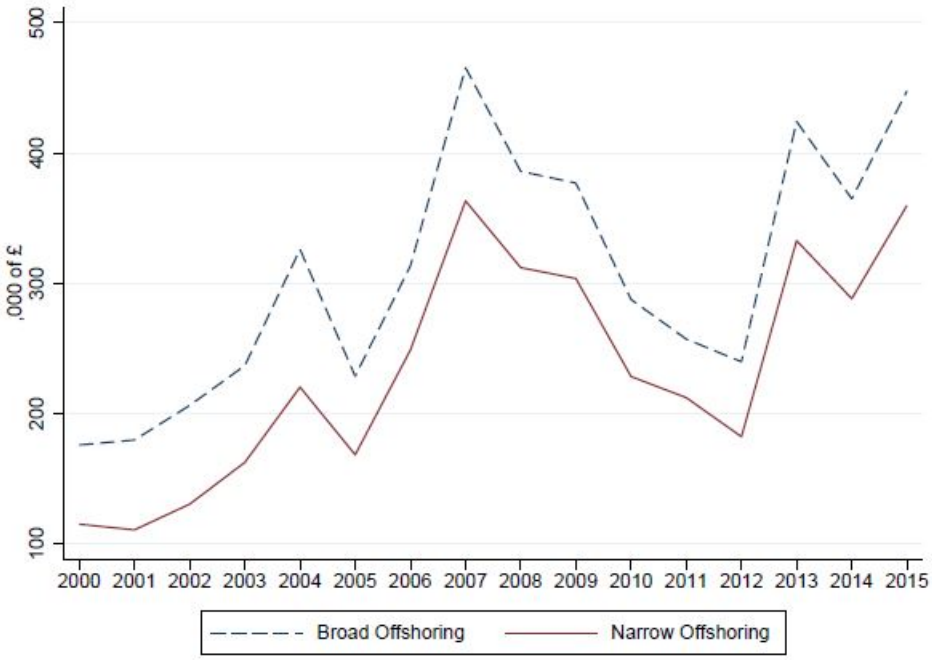
Source: Own computation using ITIS (ONS). Share of imports and exports of services on total flows by partner country in 2015. Graph shows only the largest 15 partners with imports of services of more than 1% of total imports in 2015.

Figure A.3: **Trade in services by partner country, growth rate**



Source: Own computation using ITIS (ONS). Growth rate of imports and exports of services by countries included in figure A.2. The growth rate refers to the period 2000-2015. For Luxembourg, the growth rate is within the period 2005-2015 due to data restrictions.

Figure A.4: **Broad and Narrow Trade**



Source: Own computation using ITIS (ONS). Pattern of average broad and narrow offshoring at the firm level for the period 2000-2015. Broad offshoring is defined as the overall imports of services from abroad. Narrow offshoring is defined as the services competing with firms' output portfolio. Graph shows the mean offshoring, all the observation are weighted using population weights included in the ARD/ABS dataset.

Table A.1: **Imports and Exports of services at the firm level**

	Exports		Imports		
	By Service	**Intra-firms**	**By Service**	**Intra-firms**	**Narrow**
Overall					
Mean	21.93%	38.97%	18.48%	39.37%	10.27%
St. Dev	0.381	0.4137	0.3294	0.366	0.2709
N	255,561	12,151	282,468	13,341	258,092
Manufacturing, Low					
Mean	15.67%	40.92%	16.44%	40.60%	5.14%
St. Dev	0.3263	0.4212	0.2991	0.3442	0.1789
N	6,0183	2,941	78,748	3,772	72,880
Manufacturing, High					
Mean	23.69%	43.79%	23.37%	46.01%	7.96%
St. Dev	0.3859	0.4192	0.3465	0.3754	0.2335
N	17,746	1,060	22,722	1,369	20,737
Services					
Mean	23.87%	37.64%	18.74%	37.69%	12.83%
St. Dev	0.3952	0.4096	0.339	0.3727	0.3037
N	177,632	8,150	180,998	8,200	164,475

Source: Own computation using ITIS, ARD/ABS (ONS). Average values in the period 2000-2015. Column "By Service" indicates the average firms' share of each service import/export on total flows. Column "Intra-firms" refers to average firms' share of intra-firms services on total imports and exports. Column "Narrow" refers to average firms' share of narrow offshoring on total services imports. Firms are divided between macro sector: manufacturing using low technology (industry SIC07 between 10 and 25, and between 31 and 35); manufacturing using high technology (industry SIC07 between 26 and 31); services (industry SIC07 between 45 and 98).

Table A.2: **Descriptive Statistics Local Area Sample**

	Mean	St.Deviation
Total Employment (Number)	3,732.90	(41,054.9)
Average Wage (£)	42,477.50	(3,333,979.2)
Broad Offshoring (,000 £) from ARD	11,453.50	(301,211.7)
Broad Offshoring (,000 £) from ITIS	868.60	(17,538.8)
Narrow Offshoring (,000 £)	722.90	(17,026.8)
Expenditure ICT(,000 £)	2,345.60	(206,777.2)
Share of British firms (Percentage)	91.29	(25.7)
Average Gross Value Added (,000 £)	10,486.50	(179,230.4)
Total population of firms (Number)	49.96	(276.2)
Observations	315,292	315,292

Source: Own computation using ARD/ABS, ITIS (ONS). Sector-local area descriptive statistics for the period 2000-2015. All statistics include population weights.

Table A.3: **Descriptive Statistics Local Labour Maket Competition**

	(1)	(2)	(3)	(4)
	GVA Share	Largest GVA Share	Labour Share	Largest Labour Share
Sector	0.597	3.9	0.546	3.41
	(4.1)	(11.2)	(3.33)	(9.08)
Local Area	0.186	1.21	0.156	0.946
	(2.11)	(5.97)	(1.63)	(4.64)
Sector Local Area	14.5		14.4	
	(27.6)		(27.2)	
N	442,523	26,723	472,480	27,764

Source: Own computation using ARD/ABS, ITIS datasets (ONS). The table indicates the share of Gross Value-Added shares and the Labour shares of firms within the sector, local area and sector-local area. "Largest GVA" and "Largest Labour" only account for firms that have the highest (top 10%) share in their own sector-local area.

Table A.4: **Descriptive Statistics Offshoring and non-Offshoring firms**

	Non Offhoring, not Exposed	**Non Offhoring, Exposed**	**Offshoring**
Employment, Number			
Mean	144.86	254.44	454.59
SD	1,095.66	2,980.56	3,806.42
N	530,637	106,409	96,026
Average Wage, £			
Mean	24,932.14	28,107.83	207,622.5
SD	2,563,716	395,244.4	3,004,675
N	530,502	106,351	95,401
Employment Growth			
Mean	0.12	0.21	0.11
Sd	7.01	9.52	3.62
N	131,281	23,898	36,836
Wage Growth			
Mean	0.32	0.39	0.41
Sd	17.45	16.92	32.04
N	129,023	22,847	36,334

Source: Own computation using ITIS, ARD/ABS (ONS). Mean values for the period 2000-2015. "Non Offshoring, not Exposed" refer to firms not involved in services offshoring that are not located in local labour markets affected by services offshoring. " Non Offshoring, Exposed" refers to firms not involved in services offshoring but located in local labour market affected by services offshoring. "Offshoring" refers to firms involved in services offshoring.

Table A.5: **Firm Level Analysis**

	(1) OLS	(2) IV Use	(3) OLS	(4) IV Use	(5) OLS	(6) IV Use	(7) OLS	(8) IV Use
A. Employment								
Offshoring,	0.0231***	0.0234***	0.0143***	0.0175***	0.0143***	0.0174***	0.0241***	0.0291***
LLM	(0.0027)	(0.0082)	(0.0017)	(0.0053)	(0.0017)	(0.0053)	(0.0016)	(0.0051)
Importer	1.9957***	1.9949***	0.2981***	0.2923***			0.1085***	0.0649
	(0.0899)	(0.0878)	(0.0687)	(0.0673)			(0.0272)	(0.0471)
Offshoring,					0.0421***	0.0413***		
firm					(0.0092)	(0.009)		
Importer#							0.0260***	0.0342***
Offshoring LLM							(0.0051)	(0.0098)
B. Average Wage								
Offshoring,	0.0213***	0.0113	0.0045	-0.0093	0.0044	-0.0096	0.0011	-0.0182*
LLM	(0.0052)	(0.0158)	(0.0041)	(0.0114)	(0.0041)	(0.0114)	(0.0033)	(0.0098)
Importer	0.0131	0.0332	0.2426**	0.2680**			-0.2133***	-0.2031**
	(0.2359)	(0.2448)	(0.1199)	(0.1218)			(0.0478)	(0.0853)
Offshoring,					0.0404**	0.0439**		
firm					(0.0168)	(0.0171)		
Importer#							0.0421***	0.0434**
Offshoring LLM							(0.0106)	(0.0200)
Control LLM	√	√	√	√	√	√	√	√
Control Firm			√	√	√	√	√	√
TTWA # Year	√	√	√	√	√	√	√	√
Sector # Year	√	√	√	√	√	√	√	√
N	452,880	452,880	452,810	452,810	452,810	452,810	452,837	452,837

Source: Own computation. Data obtained combining ARD/ABS, ITIS datasets (ONS). Standard errors in parentheses are clustered at the sector-local area level. Dependent variable: Logarithm of Employment (panel A), Logarithm of Average Wage (Panel B). IV is the offshoring of services in Australia, Canada, Japan and South Korea from the US, Germany, France and Ireland. "IV Use" is the instrument constructed with usage share computed in different periods (2000, 2005, 2010). Control variables LLM: log of share of British owned firms, log population of firms and the log of expenditure in computer service, lagged 1 year. Control variables firms: productivity measured as gross value added at market price, dummy variable on ownership status, dummy variable on exporting status.* ($p < 0.10$), ** ($p < 0.05$), *** ($p < 0.01$)

Table A.6: **Narrow and Input Offshoring**

	Narrow Offshoring		Input Offshoring	
	(1)	(2)	(3)	(4)
	OLS	IV Use	OLS	IV Use
A. Employment				
Offshoring	0.0255***	0.0239***	0.0261***	0.0436***
	(0.0018)	(0.0051)	(0.0018)	(0.0082)
Offshoring #	0.0220***	0.0244*	0.0350***	0.0576***
Importer	(0.0057)	(0.0147)	(0.006)	(0.0166)
B. Average Wage				
Offshoring	-0.0016	-0.0147	0.0070**	-0.0176
	(0.004)	(0.0145)	(0.0033)	(0.015)
Offshoring #	0.0450***	-0.0068	0.0353***	0.0884***
Importer	(0.012)	(0.0325)	(0.013)	(0.0271)
First Stage		0.8200***		0.4634***
		(0.0771)		(0.0371)
First Stage,				
interaction		-0.0484*		-0.0814***
		(0.0284)		(0.0212)
F stat (Kleibergen-Paap)		67		81
Control LLM	√	√	√	√
Control Firm	√	√	√	√
TTWA # Year	√	√	√	√
Sector # Year	√	√	√	√
N	452,837	452,837	452,837	452,837

Source: Own computation. Data obtained combining ARD/ABS, ITIS datasets (ONS). Standard errors in parentheses are clustered at the sector-local area level. Dependent variables: Logarithm of Employment (panel A), Logarithm of Average Wage (Panel B). IV is the offshoring of services in Australia, Canada, Japan and South Korea from the US, Germany, France and Ireland. "IV Use" is the instrument constructed with usage share computed in different periods (2000, 2005, 2010). Control variables LLM: log of share of British owned firms, log population of firms and the log of expenditure in computer service, lagged 1 year. Control variables firms: productivity measured as gross value added at market price, dummy variable on ownership status, dummy variable on exporting status. Input offshoring is defined as the imports of services from abroad not competing with firms' output portfolio. Narrow offshoring is defined as the services competing with firms' output portfolio. * $(p < 0.10)$, ** $(p < 0.05)$, *** $(p < 0.01)$

Table A.7: **Firms-to-firms linkages**

	(1) OLS	(2) IV Use	(3) OLS	(4) IV Use
A. Employment				
Broad Offshoring	0.0160***	0.0218**	0.0135***	0.0168***
	(0.0021)	(0.0103)	(0.0017)	(0.0051)
Same group LLM# Broad Offshoring	0.0907	-1.8265		
	(0.1207)	(3.7415)		
Same group UK			0.8792***	0.8786***
			(0.0623)	(0.0622)
B. Average Wage				
Broad Offshoring	0.0083*	-0.0004	0.005	-0.0042
	(0.0043)	(0.0119)	(0.0041)	(0.0112)
Same group LLM# Broad Offshoring	0.0034	-0.3169		
	(0.1518)	(1.2404)		
Same group UK			-0.5569***	-0.5553***
			(0.1208)	(0.1209)
Control LLM	√	√	√	√
Control Firm	√	√	√	√
TTWA # Year	√	√	√	√
Sector # Year	√	√	√	√
N	437,310	437,310	437,310	437,310

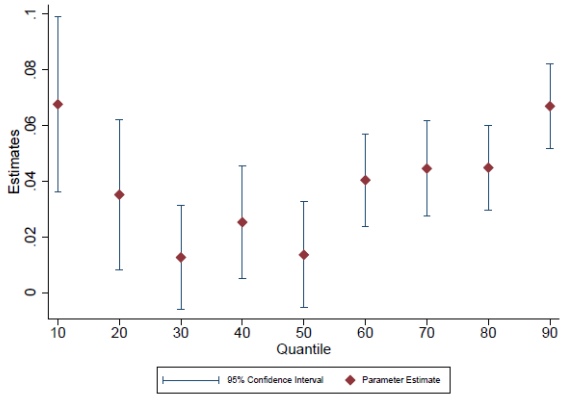
Source: Own computation. Data obtained combining ARD/ABS, ITIS datasets (ONS). Standard errors in parentheses are clustered at the sector-local area level if not specified differently. Dependent variable: Logarithm of Employment (panel A), Logarithm of Average Wage (Panel B). IV is the offshoring of services in Australia, Canada, Japan and South Korea from the US, Germany, France and Ireland. "IV Use" is the instrument constructed with usage share computed in different periods (2000, 2005, 2010). Control variables LLM: log of share of British owned firms, log population of firms and the log of expenditure in computer service, lagged 1 year. Control variables firms: productivity measured as gross value added at market price, dummy variable on ownership status, dummy variable on exporting status. * ($p < 0.10$), ** ($p < 0.05$), *** ($p < 0.01$)

Table A.8: **Firms' competition**

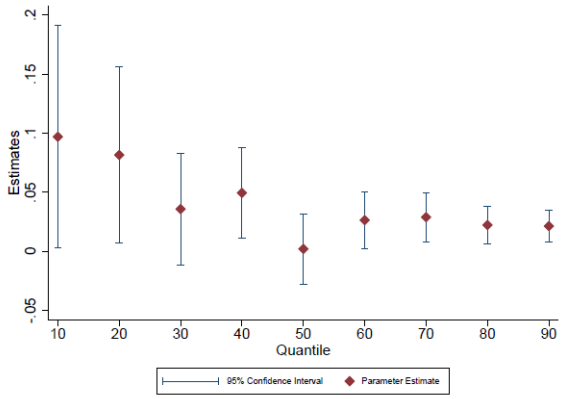
	Employment Share		Gross Value Added Share	
	(1)	(2)	(3)	(4)
	OLS	IV Use	OLS	IV Use
Broad Offshoring	0.0244***	0.0843***	0.0204***	0.0821***
	(0.0026)	(0.0074)	(0.0025)	(0.0074)
Importer	0.5243***	0.1744*	0.5658***	0.0757
	(0.0456)	(0.1029)	(0.059)	(0.1592)
Broad Offshoring #	-0.0574***	-0.0334***	-0.0635***	-0.0256
Importer	(0.005)	(0.0107)	(0.007)	(0.0165)
Control LLM	√	√	√	√
Control Firm	√	√	√	√
TTWA # Year	√	√	√	√
Sector # Year	√	√	√	√
N	452,800	452,800	452,800	425,353

Source: Own computation. Data obtained combining ARD/ABS, ITIS datasets (ONS). Standard errors in parentheses are clustered at the sector-local area level. Dependent variables: Logarithm of employment share (columns 1-2), logarithm of gross value-added share (columns 3-4). IV is the offshoring of services in Australia, Canada, Japan and South Korea from the US, Germany, France and Ireland. "IV Use" is the instrument constructed with usage share computed in different periods (2000, 2005, 2010). Control variables LLM: log of share of British owned firms, log population of firms and the log of expenditure in computer service, lagged 1 year. Control variables firms: productivity measured as gross value added at market price, dummy variable on ownership status, dummy variable on exporting status. * $(p < 0.10)$, ** $(p < 0.05)$, *** $(p < 0.01)$

Figure A.5: **Elasticity of employment and wages to services offshoring by quantile with fixed productivity quantile**



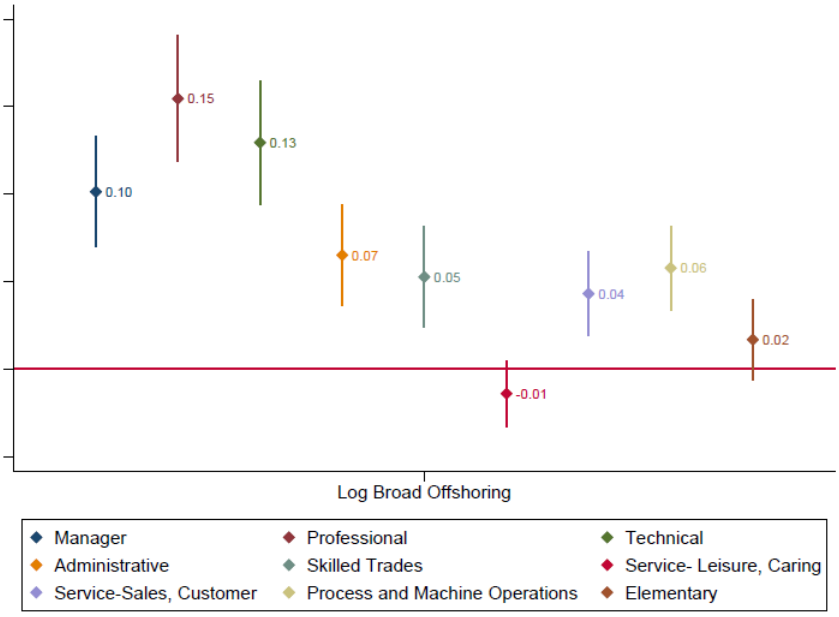
(a) Employment Elasticity



(b) Average Wage Elasticity

Source: Own computation. Data obtained combining ARD/ABS, ITIS datasets (ONS). The two graphs show the regression coefficients of employment and average wage elasticity to services offshoring by fixed productivity quantile.IV is the offshoring of services in Australia, Canada, Japan and South Korea from the US, Germany, France and Ireland. The instrument is constructed with usage share computed in different periods (2000, 2005, 2010). Control variables LLM: log of share of British owned firms, number of firms in each, number of firms used to construct the distribution and the log of expenditure in computer service, lagged 1 year.

Figure A.6: **Elasticity of Employment and of Hourly Pay to services offshoring by workers' occupation**

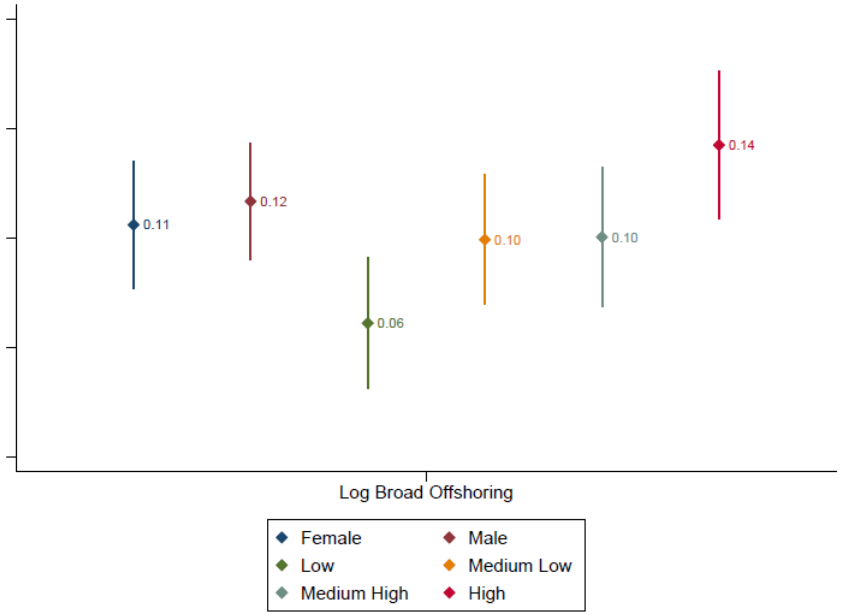


(a) Elasticity of Employment to Broad Offshoring

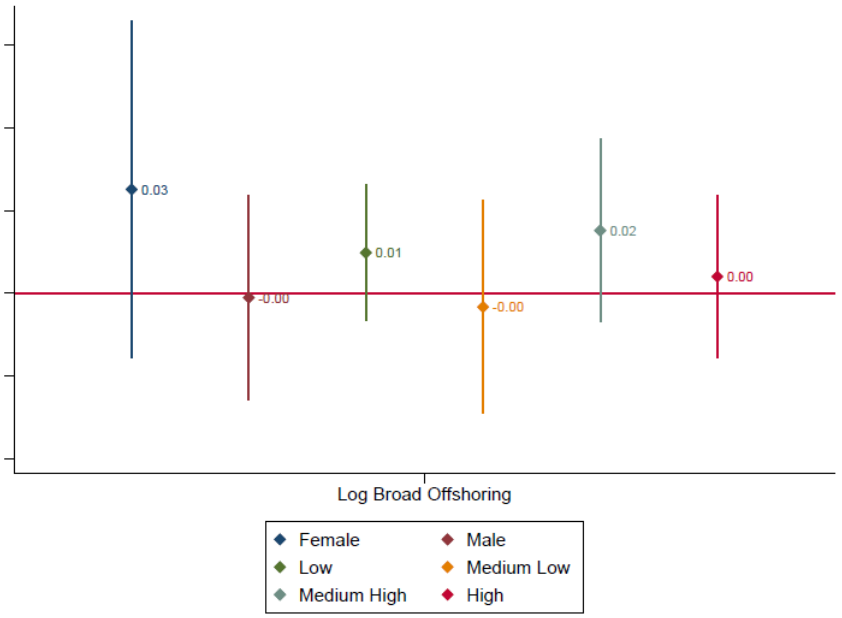
(b) Elasticity of Hourly Pay to Broad Offshoring

Source: Own computation. Data obtained combining QLFS, ARD/ABS, ITIS datasets (ONS). Dependent variables: Logarithm of Employment (panel A), Logarithm of Hourly Pay (Panel B). Figures report second stage regressions coefficients by workers' occupation. IV is the offshoring of services in Australia, Canada, Japan and South Korea from the US, Germany, France and Ireland. The instrument constructed with usage share computed in different periods (2000, 2005, 2010). Each regression contains sector-year and local area-year fixed effects. Standard errors are robust. The analysis is limited to the years 2000-2012.

Figure A.7: **Elasticity of Employment and of Hourly Pay to services offshoring by workers' characteristics**



(a) Elasticity of Employment to Broad Offshoring



(b) Elasticity of Hourly Pay to Broad Offshoring

Source: Own computation. Data obtained combining QLFS, ARD/ABS, ITIS datasets (ONS). Dependent variables: Logarithm of Employment (panel A), Logarithm of Hourly Pay (Panel B). Figures report second stage regressions coefficients by workers' gender and level of education. IV is the offshoring of services in Australia, Canada, Japan and South Korea from the US, Germany, France and Ireland. The instrument constructed with usage share computed in different periods (2000, 2005, 2010). Each regression contains sector-year and local area-year fixed effects. Standard errors are robust. The analysis is limited to the years 2000-2012.