The Labour Market Effects of Services Importing: Evidence from the United Kingdom

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Abstract

This paper uses detailed data on international trade in services matched with employment information at both the worker and firm level to estimate the local labour market effects of services trade. In the cross-section, there is a wage premium at firms that trade services and in regions that trade a higher value of services. Looking at changes within a local labour market over time and using an instrumental variables strategy, I find that an increase in imports of services is associated with an increase in employment, suggesting evidence of an aggregate positive productivity effect from importing services. It is also associated with a redistribution of employment away from importing firms towards non-importers. Importing services has a negative effect on average wages in high skill occupations and on wages in the top half of the earnings distribution.

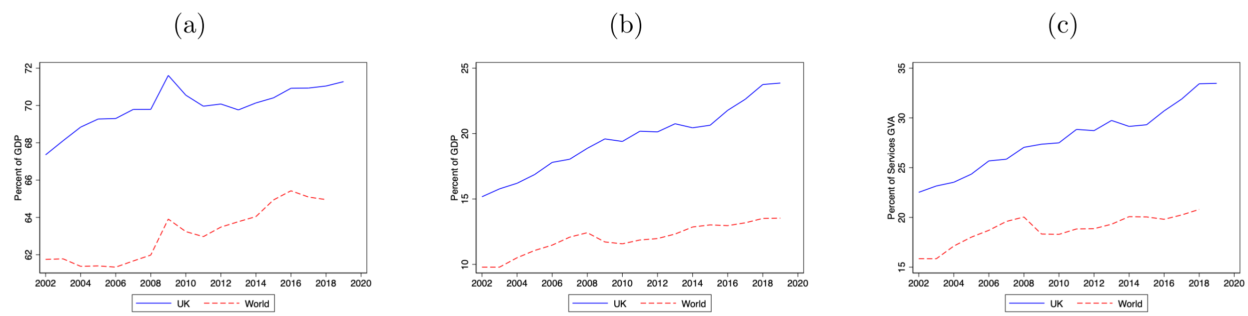
*Data from the Annual Survey of Hours and Earnings, Business Structure Database and International Trade in Services Survey are collected by the Office for National Statistics and supplied by the Secure Data Service at the UK Data Service. The work contains statistical data from ONS which is Crown Copyright. The use of data in this work does not imply the endorsement of ONS or the Secure Data Service in relation to the interpretation or analysis of the data. This work uses research datasets which may not exactly reproduce National Statistics Aggregates. Word count = 9,881

1 Introduction

Services make up a large and increasing share of world output. Trade in services has also risen, particularly since the late 1990s, as a share of total GDP and as a share of services value added. The trend is more pronounced in many developed countries. Figure 1 documents these trends for the world as a whole and for the UK.

The growth of global services trade has been driven by technological developments, most notably the fall in communication costs facilitated by the adoption of the internet, and efforts to liberalise trade policy both through deep preferential trade agreements, such as a deepening of the EU Single Market, and unilateral liberalisation, most significantly the General Agreement on Trade in Services (GATS).

Figure 1: (a) Services Value Added in World GDP; (b) Services Trade in World GDP (c) Services Trade in Services Value Added



Notes: Data is from the World Bank. Panel (a) shows services value added as a share of GDP. Panel (b) is the share of services trade in GDP and panel (c) is the share of services trade in services value added. Each plot shows the world aggregate and the UK.

Despite this growth, there is still relatively little evidence on the labour market impacts of services trade relative to the extensive literature on the effects of goods trade. This has partly been due to the lack of high quality data on trade in services and absence of obvious shocks to services trade that would enable the empirical investigation of its effects. Yet there are reasons to believe that the labour market impacts of services may be different to those in goods and warrant separate investigation.

"Tradable" services, such as legal, engineering, and advertising, comprise around 43% of UK employment, compared with just 11% in manufacturing. These tradable services industries tend to be high-skill intensive (Jensen, 2011; Gervais and Jensen, 2019) and business survey evidence suggests that the skills of foreign services providers are becoming increasingly important to importing businesses (PWC, 2010). It is well documented that workers of different skill types experience different outcomes in response to goods trade shocks (e.g. Autor et al., 2014; De Lyon and Pessoa, 2021), and Hummels et al. (2014) find that goods offshoring substitutes for low skill labour while augmenting high skill labour. Given that production of services is more skill intensive, as are traded services, it is not clear that the same responses would hold for services. In particular, it may be that some domestic high skill labour is substituted for foreign high skill labour.

In this paper, I investigate the effects of the growth of services imports on local labour market (LLM) outcomes in the UK. Using detailed micro data at the employer-employee level, I examine distributional and adjustment effects that are associated with a plausibly exogenous rise in services imports. Most notably, I find that an increase in services imports is associated with a relative fall in wages in the top half of the wage distribution within an LLM. The distributional wage effects of services importing are different to those of goods offshoring (e.g. Hummels et al., 2014), import competition (e.g. Autor et al., 2014; De Lyon and Pessoa, 2021), and technological change (e.g. Autor and Dorn, 2013; Acemoglu and Restrepo, 2020), but similar to the predicted wage effects of artificial intelligence (e.g. Webb, 2020).

In interpreting the empirical results, I begin with the influential offshoring framework of Grossman and Rossi-Hansberg (2008). Following the existing services trade literature and noting that the types of services included in this paper are defined to be those that are used as inputs to production, I consider imports of services to be analogous to offshoring. That is, importing a service is similar to employing a foreign worker to provide the service. The Grossman and Rossi-Hansberg (2008) insight was to show that there are (at least) two contrasting labour market implications of offshoring, when trade is considered from the perspective of tasks instead of final products. First, a substitution effect occurs whereby employing foreign labour to carry out a task has a negative effect on demand for domestic workers. Second, a productivity effect occurs, whereby the decision to offshore is taken by optimising firms and therefore increases productivity, which can increase labour demand.[1] Therefore, a fall in the cost of offshoring has a theoretically ambiguous effect on aggregate employment and wages.

To empirically investigate the labour market effects of services trade, I use a rich set of datasets collected by the Office for National Statistics (ONS) covering 2003 to 2016. Data on trade in services is provided by an annual survey of firms, covering all large firms and high value traders, reporting their value of imports (and exports) by the type of service and the partner country. The data is used by the ONS to construct the UK Balance of Payments statistics, and is amongst the most detailed services trade data in the world. This is supplemented with information on employment and industry for the universe of plants, as well as sales for the universe of firms. Additional balance sheet-type information at the firm level is provided by the Annual Business Survey. Finally, worker-level information on wages, detailed occupation, worker characteristics and a firm identifier is available for a nationally representative 1% sample of employees.

Looking at descriptive trends in the data, the share of employment in tradable services industries rose from 37% to 43% between 2004 and 2016. Employment in tradable services is relatively evenly spread across space, accounting for over 30% of employment in the majority of LLMs. The share of sales revenue accounted for by firms that import services increased from 18% to 22% over the same period, but the share of employment accounted for by these firms fell slightly from 15% to 14%.

[1] A third effect occurs through relative price adjustments for the final good on the world market. When offshoring leads to an increase in the world supply of the final good, the price of the good falls, which is mirrored in falling prices for the factors used relatively intensively in its production.

The services with the largest absolute growth in imports between 2004 and 2016 were communications, computer and information, and business and management. The largest source country in terms of both initial levels and growth was USA. As a block, the EU accounted for 44% of the UK's imports of services in 2004 and more than half of the growth of imports between 2004 and 2016. Imports from India and China had very high growth rates but in absolute terms they remain relatively small in terms of their share in total UK imports. Decomposing growth from the perspective of UK firms and averaging over three year periods, the vast majority of trade comes from within firms that already traded, and over half comes from increases in imports for existing service-country trade relationships.

The growth of services trade has coincided with a period of stagnant real wages in the UK. Wage inequality has been relatively stable in the UK since the early 2000s, except for right at the top of the wage distribution where inequalities continued to widen. This follows a trend of increasing wage inequality since the 1980s (Bell et al., 2021). The premium for being at a firm that either imports or exports grew over this period. Controlling for worker, firm, and LLM characteristics, workers at importing firms earn 5.9% higher wages than those at firms that do not import, although this number reduces to 2.7% when controlling for whether the firm also exports. Being located in a LLM that imports is also associated with a small but statistically significant wage premium in the cross section, with 10% higher imports being associated with 0.09% higher wages. The firm trade premium has risen over time, while the LLM trade premium has fallen.

The main aim of the paper is to identify the labour market effects of changes in exposure to imports of services over time. LLM exposure to services trade is highly likely to be endogenously determined with respect to labour market outcomes due to, for example, demand or productivity shocks that shift both importing and wages. To overcome this endogeneity, I construct an instrument that is correlated with changes in LLM imports but uncorrelated with changes in labour outcomes. The instrument relies on the empirical observation that much of the growth of services imports is growth within existing service-country trade. The instrument is a shift-share which uses a LLM's pre-period import shares for each service-country as exposure weights to changes in the world export supply (excluding the UK and deflating by service-specific prices) of a service-country over a period. The instrumental variables (IV) strategy is a LLM analogue of Hummels et al. (2014). I use this strategy to estimate the aggregate direct impacts of a plausibly exogenous rise in imports of services in a LLM, and utilize the detailed employer-employee micro data to estimate the distributional impacts as well as the reallocation of employment across firms and sectors.

The results suggest that a plausibly exogenous increase in LLM exposure to imports is associated with an increase in total employment. This is evidence of the productivity effect; LLMs that offshore benefit from efficiency gains of importing foreign services, generating increased total demand for labour overall. This is reinforced by the estimates for sales revenue, where increases in imports are associated with a positive but statistically insignificant change. The average wage in a LLM, however, falls with a rise in import exposure. This result can be explained by the distributional analysis. Employment at importing firms, who pay higher wages, falls, with the rise in employment driven by non-importing firms. The rise in employment is also driven by industries outside of tradable services and manufacturing.

Looking at the distributional effects on wages, I find that a rise in imports of services is associated with falls in wages at the 75th and 90th percentiles within a LLM, but not at other percentiles below and above this. The average wage of occupations involving non-routine cognitive tasks also falls with a rise in services imports. A rise in imports is also associated with a fall in the average wage of workers in managerial occupations, which appears to be driven by an increasing quantity of workers classed as managers.[2]

[2] I find a positive but statistically insignificant coefficient on employment of managers. Ariu et al. (2019) find that firm-level services offshoring in Finland is associated with an increase in employment of managers.

Related literature. This paper contributes to a small but growing literature on the labour market effects of services trade, which has broadly found mixed results. Most closely related, Magli (2020) uses the same data on trade in services for the UK to estimate the impacts of an increase in imports within a service-LLM on aggregate and firm outcomes. She finds that there are spillovers from offshoring firms to non-offshoring firms and that large firms benefit most from services offshoring. Ariu et al. (2019) use firm-level data for Finland to estimate that offshoring firms reduce employment of low skill workers, increase employment of managers, and improve overall performance as measured by, for example, productivity. Similarly, Eppinger (2019) uses German firm-level data to show that services offshoring of the firm is associated with an increase in employment, with greater effects for firms with a higher initial share of services offshoring. Liu and Trefler (2019) estimate a worker-level regression with an occupational shock for the US to examine the impact of services offshoring to India and China on employment outcomes, particularly occupational mobility and wages. They find a small negative impact on earnings, and an increase in occupational switching both up and down in terms of occupational quality.[3] Finally, Eckert (2019) quantitatively estimates a model of within-country trade for the US and shows that regions that are net importers of services experience a reduction in the skill premium. That is, importing services puts downward pressure on the high skill wage relative to the low skill wage. My main contribution to this literature is to estimate in detail the distributional impacts of services trade across the earnings distribution. I am also the first to make use of a worker-level panel with matched employer trade information.

There is a broader literature on services trade to which this paper contributes. Notably,

[3] Using data from the British Household Panel Survey with an industry-level services import shock, Geishecker and Görg (2013) find that services offshoring is associated with a decrease in low and medium skill wages and an increase in high skill wages. Crinò (2010) estimates occupational level regressions to show that services offshoring increases the demand for high skill occupations more than low skill ones and, conditional on skill level of the occupation, services offshoring penalises tradable occupations relative to non-tradable ones. In work that motivated the subsequent literature, Amiti and Wei (2009) show that in manufacturing industries, offshoring services has a positive impact on labour and total factor productivity (more so than for goods offshoring).

Breinlich and Criscuolo (2011) use the same trade in services data for the UK to document the characteristics of firms that are engaged in services trade. Jensen (2011) writes comprehensively about the rise of global services trade and how it has materialised across the US economy. Eaton and Kortum (2018) show that gravity holds for services trade, while Head et al. (2009) estimate that the costs of distance in trading services are large but declining. Gervais and Jensen (2019) use a novel method of comparing production and use of services in US regions to impute values of trade in services. They show that services value added is unevenly distributed across regions and that labour productivity and wages are higher on average for tradable industries. I contribute to this literature by presenting new facts on services trade, including the firm and LLM services trade premiums at the worker level, and a decomposition of the margins of growth of services trade, as well as by examining margins of labour adjustment to services imports.

There is a vast literature on the labour market effects of international trade and offshoring of goods. Looking at the effect of import competition from China, Autor et al. (2013) estimate the US commuting zones (LLMs) that are relatively more exposed to Chinese growth experience declining employment in manufacturing and a fall in wages. [4] Other research has looked at worker-level adjustments to the China shock, showing that workers initially in industries or LLMs exposed to the shock suffer in terms of their long term employment and wage outcomes (see Autor et al. (2014) for US, De Lyon and Pessoa (2021) for UK, and Utar (2018) for Denmark). Turning to offshoring, Hummels et al. (2014) use data for Denmark to estimate the firm-level effects of offshoring and exports of goods. They show that within job spells (i.e. a worker-firm match), offshoring increases high skill wages and reduces low skill wages, while exporting increases the wage of all skill types.[5] Fort (2017) finds evidence that when manufacturing firms adopt new communications technologies, they are more likely to fragment their production process, but only with high income countries

[4] Fort et al. (2018) summarise evidence on the causes of the decline in US manufacturing.
[5] Hummels et al. (2018) review the literature on the labour market effects of offshoring.

(as well as domestically) and not low income income countries. Finally, Costa et al. (2019) use the currency depreciation that followed the UK's decision to leave the EU as a shock to the cost of intermediate imports (as well as an export depreciation), which allows them to examine both goods and services industries. They find that workers in the sectors more exposed to the increase in the costs of intermediate imports experienced lower wages and reduced training.

The remainder of the paper is structured as follows. Section 2 outlines the data used in the paper and presents descriptive evidence on the prevalence of services trade and its growth as well as the labour market characteristics of exposure to services trade. Section 3 discusses the estimating relationship of interest and the identification strategy. Section 4 presents the results and Section 5 concludes.

2 Data

I use a rich set of administrative and survey data on workers and firms in the United Kingdom between 2003 and 2016 provided by the Office for National Statistics (ONS). In this section, I first outline the key characteristics of each dataset used in the analysis and how they are aggregated to the LLM level. I then document descriptive statistics in the data.

2.1 Datasets

Information on services trade is from The International Trade in Services Survey (ITIS), which is an annual survey of firms conducted by the ONS and used to inform the UK's Balance of Payments account and GDP statistics (Office for National Statistics, 2019b).[6] Surveyed firms record the value of their services imports and exports by the partner country and by service "product". ITIS includes around 16,000 businesses each year, including a

[6] The data is collected at the ONS "reporting unit" level which, for the vast majority of units, corresponds directly to the firm level. I aggregate remaining cases up to the firm level.

panel of core contributors and larger firms. Firms that report a total value of services trade above a certain threshold will be surveyed in subsequent years. The sample excludes firms in the financial sector - that is, firms whose main industry is financial - although firms in sectors that are surveyed do report their trade in financial services.[7] Firms in the transport, travel, and higher education industries are also omitted, as well as many in the legal industry.

In 2017, ITIS covered around 59% of the total value of UK services exports and 48% of imports in the UK's Balance of Payments Trade in Services Account (Office for National Statistics, 2021b), with the remaining amounts accounted for by the omitted sectors discussed above as well as other services such as tourism which are not included in ITIS. Breinlich and Criscuolo (2011) report that ITIS covered 70% of exports and 85% of imports of the balance of payments categories that predominantly contained producer services for their sample period (2000 to 2005).

The focus of the survey is on producer services - i.e. those which are typically used in production. and which are most relevant for the questions addressed in this paper. As with all services trade data, the product classifications are coarse. In this paper, I aggregate all 16 service classifications that are consistent over the sample period and can be matched to the UN eBoPs classifications.[8]

Basic information including employment, industry, and location is available for the universe of plants from the Business Structure Database (BSD). The same variables are also available at the level of the firm, as well as additional information on sales revenue and foreign ownership, and plants can be matched with the firm. The BSD is mainly derived from the Inter-Departmental Business Register (IDBR), an administrative register of businesses collected by HM Revenue and Customs via VAT and Pay As You Earn (PAYE) records (Of-

[7]For example, if a manufacturing firm imports financial services from USA, this would show up in ITIS but all services trade activity by banks is omitted as it is collected by the Bank of England.

[8]I exclude royalties and license fees, government services not included elsewhere, and trade with foreign affiliates that does not fall under the other product categories.

fice for National Statistics, 2019a).[9] If a business is liable for VAT and/or has at least one member of staff registered for the PAYE tax collection system, then the business will appear in BSD. Businesses listed in the IDBR account for almost 99 percent of economic activity in the UK, with only very small businesses (such as those of self-employed individuals) not included in the register.

I supplement information from the BSD with more detailed firm-level information from the Annual Respondent Database (ARD) and the Annual Business Survey (ABS). These are surveys of approximately 62,000 businesses each year. The sample includes the universe of businesses with more than 250 employees and is stratified by local area, firm size, and industry, with weights provided to provide representative aggregations by strata. Businesses report a wide range of information, including gross value added, wage bill, inputs of services as well as other inputs to production, whether they are a goods importer or exporter (since 2015), and their total value of purchases and sales of services at home and abroad (Office for National Statistics, 2021a).[10]

Worker-level data is available from the Annual Survey on Hours and Earnings (ASHE). It is an administrative dataset covering a one percent sample of employees, selected based on the last two digits of an individual's national insurance number.[11] ASHE is a panel dataset with workers repeatedly sampled each year, conditional on being employed. The resulting dataset contains around 150,000 employees per year. It provides information on workers' wages, detailed occupation, industry, and workplace location. It contains basic worker information such as age, sex, and whether they are a member of a union. It also contains a firm identifier, meaning that workers can be matched with firms in each year.

[9]PAYE is the system that HM Revenue and Customs uses to collect Income Tax and National Insurance contributions from employees.

[10]The latter question is used as a filter for the ITIS sample, with firms responding above a certain threshold being selected for the ITIS sample in that year.

[11]Much of the data is collected automatically through the PAYE system and the sample is broadly representative of employment in the UK, except for workers on very low pay. Sample weights are provided to account for under-represented cells and non-response and are used throughout the paper. Self-employed workers are excluded.

Finally, I use data on world trade in services from the OECD to construct the instrument. It provides the value of trade at the origin-destination-service-year level. OECD countries report their imports and exports with all countries in the world.

All values are deflated to 2016 pounds using industry specific measures for firm sales and trade values by service, and using a consumer price index for wages.

Throughout this paper, I use local labour markets (equivalent to US commuting zones) as the unit of analysis. I therefore aggregate the datasets described above to the level of ONS Travel to Work Areas which are based on where populations will typically commute and I refer to them as LLMs. Using the BSD plant level information, I have the population of employment by industry in each LLM. Given that ASHE is a random sample, it is also representative at the LLM level.[12] Data on international trade in services and sales of the firm are only observed at the firm level, not at the plant level. Yet, it is likely that labour market exposure to services trade is not only transmitted through the location of the headquarter of the firm. Therefore, I distribute firm level values across LLMs according to the (non-retail) employment shares of plants within a firm. I drop a very small number of LLMs that do not trade any services in the initial period as the instrument is not defined for these. The final LLM dataset covers around 166 LLMs each period in England and Wales.

2.2 Descriptive statistics

This section summarises descriptive trends in the data relating to the evolution of the UK labour market, the growth of services trade and the links between services trade and labour markets.

Table 1 presents summary statistics for the first and last years of the sample at the LLM

[12]One issue that arises with ASHE at the LLM level is that the sample count is small for some small areas. In the baseline analysis, I weight by pre-period employment of each LLM to represent employment across the economy. This also helps to address the issue of heteroskedasiticity introduced by small samples in the smallest LLMs (given that the form of heteroskedasticity is known to be a monotonic function of employment.)

level, weighted by employment of the area. Therefore, for all statistics denominated by employment, the statistics are nationally representative. Unweighted statistics, i.e. averages across LLMs, are presented in Table A.1 of Appendix A.2 and the trends discussed below all qualitatively hold when unweighted.

The share of employment in tradable services industries has risen from 37% in 2004 to 43% in 2016. In contrast, manufacturing employment has fallen from 17% in 2004 to 11% in 2016. The share of workers in routine occupations has declined slightly while the share in tradable services occupations is almost unchanged.[13]

Average gross value added per worker has risen markedly over the period, from £58,000 to £94,000, yet there has been no increase in average wages. Measures of wage inequality based on wage ratios between p10, p50, and p90 within a LLM have declined slightly over the period. This is in line with aggregate trends in the UK over the period (Bell et al., 2021). The wage premium for being at an importer in a LLM has increased from 12% to 17% over the period.

The use of services as a share of inputs has declined slightly over the period, while the share of services imports in services inputs has increased from 1% to 4%. The data contains information on the total value of services purchased for resale (domestic or international); this, scaled by services inputs, has remained relatively constant over the period. Firms that import services tend to be large, accounting for 15% of employment in 2004 and 14% of employment in 2016. The share of sales accounted for by importing firms has risen from 18% in 2004 to 22% in 2016. Finally, in 2016, 19% of employment was at foreign multinationals.[14]

[13]Tradable services industries and occupations are defined using a manually created concordance from industries and occupations to traded services categories. Routine occupations are defined based on Autor et al. (2003).

[14]23% of firms that import services are foreign owned.

Table 1: Summary statistics by year

	2004		2016	
Female Share	0.33	(0.04)	0.34	(0.04)
Manufacturing Share	0.17	(0.07)	0.11	(0.05)
Tradable Service Industry Share	0.37	(0.05)	0.43	(0.05)
Collective Agreement Share	0.43	(0.07)	0.27	(0.07)
Routine Occupation Share	0.51	(0.10)	0.45	(0.09)
Tradable Service Occupation Share	0.43	(0.06)	0.44	(0.07)
GVA per Worker (ths)	57.9	(12.6)	94.3	(32.7)
Annual Wage (ths)	33.6	(6.1)	32.6	(5.3)
p90/p50 Wage Ratio	2.14	(0.21)	2.13	(0.20)
p90/p10 Wage Ratio	4.00	(0.65)	3.74	(0.57)
p50/p10 Wage Ratio	1.86	(0.14)	1.75	(0.13)
Importer Firm Wage / Mean Wage	1.12	(0.09)	1.17	(0.11)
Service Inputs / Non-Energy Inputs	0.15	(0.04)	0.09	(0.04)
Services Imports / Services Inputs	0.01	(0.01)	0.04	(0.03)
Services for Resale / Services Inputs	0.05	(0.03)	0.06	(0.04)
Importing Firm Employment Share	0.15	(0.03)	0.14	(0.03)
Importing Firm Sales Share	0.18	(0.07)	0.22	(0.07)
Foreign Owned Share	0.17	(0.04)	0.19	(0.05)
Observations	173		173	

Notes: The table shows the mean and standard errors (in parentheses) for 2004 and 2016. Statistics are weighted by employment.

I now turn to documenting the growth of UK services trade. Table 2 shows the initial value of imports and the value change in imports between 2004 and 2016 for the 16 services product categories. Overall, the value of UK imports more than doubled over the period, from £18.6 billion to £43.9 billion. In the initial period, the services with the highest import values were communication and information, business and management, architectural, engineering and technical, and research and development. Communications had the largest growth in imports, followed by computer and information, business and management, and research and development. Architectural, engineering and technical had very small growth, despite high initial imports.

Table 3 shows imports by country (group). The individual country that exports most to the UK is the US. The EU accounted for 44% of UK imports of services in 2004 and just over half of the subsequent growth. Unlike for goods trade, imports from China did not grow substantially over the period in absolute terms. Similarly, while the growth rate of imports from India was high, in absolute terms it still accounts for less than 4% of UK imports of producer services. It is also possible to split imports by the main language of the country (using data from the CEPII gravity dataset). Imports from English speaking countries accounted for 35% of all UK imports, almost directly proportional to their share of world GDP (37%). By 2016, imports from English speaking countries accounted for 41% of imports (while their share of world GDP remained relatively constant).

Table 2: Imports by service

	Imports (2004)	Δ Imports
Communications	1.5	4.5
Construction	0.2	1.2
Insurance	0.2	0.2
Financial	1.3	2.2
Computer and Information	2.5	3.9
Merchanting	1.6	0.9
Operating Leasing	0.4	0.1
Legal	0.5	0.6
Accounting	0.4	0.7
Business and Management	2.3	3.2
Advertising	1.2	2.2
Research and Development	2.2	3
Architectural, Engineering, Technical	2.3	0.2
Agriculture and Mining	0.1	0.4
Other Business Services	1.6	1.9
Personal, Cultural, Recreation	0.3	0.1
Total	18.6	25.3

Notes: Units are 2016 billions of pounds.

Table 3: Imports by country group

	Imports (2004)	Δ Imports
Canada	0.2	0.3
China	0.1	0.5
EU	8.3	12.8
India	0.3	1.3
Japan	0.5	0.4
Other	5	3.5
Switzerland	0.6	0.9
USA	3.7	5.4
Total	18.7	25.1

Notes: Units are 2016 billions of pounds.

To understand the margins of import growth within and between firms, I conduct a decomposition of growth values following Bernard et al. (2009). The value of growth in any three year period is decomposed into three margins: entry and exit of firms (across firm extensive margin); within firm growth but adopting or dropping a service-country source (within firm extensive margin); and within firm-service-country growth (intensive margin). Table 4 shows that, aggregating over all three year periods, more than half of growth in imports comes from within firm-service-country changes. The remainder of the growth is approximately evenly split between the within and across firm extensive margins. This empirical observation provides part of the motivation for the identification strategy used in this paper, discussed in detail in Section 3.2.

Table 4: Growth Decomposition

	2004-2007	2007-2010	2010-2013	2013-2016	All
Importer Births	5.3	6.5	6.2	6.9	24.9
Importer Deaths	-4.9	-5.3	-5.0	-4.4	-19.6
Net Firm Entry	0.4	1.2	1.2	2.5	5.3
New Service-Country	9.1	7.3	8.7	9.5	34.6
Retired Service-Country	-5.4	-6.0	-9.5	-7.7	-28.6
Net Service-Country	3.7	1.2	-0.8	1.9	6.0
Service-Country Growth	8.4	9.8	9.5	11.4	39.1
Service-Country Decline	-3.6	-8.0	-7.2	-7.1	-25.9
Net Intensive Margin	4.8	1.9	2.3	4.3	13.3
Total Change in Imports	9.0	4.3	2.7	8.6	24.6

Notes: Units are 2016 billions of pounds.

To document the cross-sectional wage premiums associated with exposure to services trade at both the firm and LLM level, I estimate regressions of the following form:

$$\log Wage_{it} = \beta^j Importer_{j(i)t} + \beta^r \log Imports_{r(i)t} + \gamma_1 \mathbf{X_{it}} + \gamma_2 \mathbf{X_{j(i)t}} + \gamma_3 X_{r(i)t} + \tau_\mathbf{t} + \varepsilon_\mathbf{it} \quad (1)$$

for worker i at firm $j(i)$ in region $r(i)$ at time t. The outcome of interest is the the log of the worker's weekly wage, $\log Wage_{it}$. The regression includes two measures of exposure to trade: $Importer_{j(i)t}$ is a dummy which equals 1 if the worker is at a firm that imports services and 0 otherwise; $\log Imports_{r(i)t}$ is the log value of imports in the worker's LLM. The regression includes two sets of controls. First, $\mathbf{X_{it}}$ is a vector of worker controls including age, age-squared and age-cubed, a dummy for union membership, a dummy for whether the job is full time, a dummy for whether the worker is female, and an occupation-year fixed effect.[15] Second, $\mathbf{X_{j(i)t}}$ includes information about the worker's firm, including log employment, log sales, a dummy for foreign ownership and an industry-year fixed effect. Finally, $X_{r(i)t}$ controls for the log of employment in the LLM, capturing employment density or city size. I estimate the regression using pooled OLS for two separate periods: 2003-2005 and 2013-2015.

The results are shown in Table 5. Column 1 does not include the controls and shows that workers at firms that import services earned 11% more than those at non-importing firms in the early period and 19% more in the later period, conditional on their LLM's log imports.[16] In terms of LLM imports, 10% more imports in a LLM is associated with around 0.4% higher wages, conditional on whether the worker is at a firm that trades. Column 2 adds the controls and shows that the positive premiums hold, but are smaller in magnitude. Columns 3 and 4 repeat the exercise for exports instead of imports (with equation 1 modified accordingly). Unsurprisingly, the export premiums are larger than the corresponding import

[15] Unfortunately ASHE does not contain information on education of the worker. However, it is likely that the included worker and firm controls are highly predictive of education.

[16] The firm level trade premiums also hold within LLMs, i.e. when including a LLM-year fixed effect.

premiums. Columns 5 and 6 include both import and export exposure measures together. Comparing columns 2 and 6, controlling for export exposure significantly reduces the import premiums. In the early sample, the importing firm premiums actually becomes marginally negative.

These results suggest that, in the cross-section, trade in services is associated with differential wages across LLMs and firms. To estimate the causal impact of services trade on wage and employment outcomes, I adopt an empirical specification that exploits changes within a LLM over time and instruments for variation in exposure to services trade. I use the worker and firm level micro data to explore the dimensions of adjustments. I outline this strategy in the following section.

Table 5: Services trade wage premiums

	$\log Wage_{it}$	$\log Wage_{it}$	$\log Wage_{it}$	$\log Wage_{it}$	$\log Wage_{it}$	$\log Wage_{it}$
			2003-2005			
$Importer_{jt}$	0.107***	0.017***			-0.071***	-0.006*
	(0.003)	(0.002)			(0.005)	(0.003)
$\log Imports_{rt}$	0.042***	0.023***			0.019***	0.011***
	(0.000)	(0.000)			(0.001)	(0.001)
$Exporter_{jt}$			0.227***	0.037***	0.279***	0.040***
			(0.004)	(0.002)	(0.005)	(0.003)
$\log Exports_{rt}$			0.038***	0.022***	0.023***	0.013***
			(0.000)	(0.000)	(0.001)	(0.001)
			2013-2015			
$Importer_{jt}$	0.190***	0.059***			-0.022***	0.027***
	(0.003)	(0.002)			(0.005)	(0.003)
$\log Imports_{rt}$	0.044***	0.021***			0.015***	0.009***
	(0.000)	(0.000)			(0.001)	(0.001)
$Exporter_{jt}$			0.284***	0.068***	0.301***	0.050***
			(0.004)	(0.002)	(0.006)	(0.003)
$\log Exports_{rt}$			0.042***	0.020***	0.030***	0.013***
			(0.000)	(0.000)	(0.001)	(0.001)
Controls	No	Yes	No	Yes	No	Yes
N (2003-2005)	440446	401494	440446	401494	440446	401494
N (2013-2015)	445662	440640	444281	439271	442202	437218

Notes: The table presents results for pooled cross-sectional OLS regressions at the worker level. The dependent variable is log wage. The explanatory variables of interest are dummy variables for whether the firm is an importer or exporter, and the log value of imports and log exports of the local labour market. The controls are: age, age2, age3, union, full-time, sex, log employment, log sales, foreign owned, industry-year fixed effect, occupation-year fixed effect.

3 Empirical Strategy

In this section I outline the baseline estimating equation and identification strategy. The paper aims to identify the impacts of an exogenous increase in exposure to services imports on a range of labour market outcomes. I focus on LLMs as the unit of analysis for three main reasons. First, LLM boundaries are defined based on local opportunities for work (equivalent to US commuting zones) and economic migration within the UK is relatively uncommon

(Langella and Manning, 2019). Therefore, LLMs provide a natural unit of markets for factors of production. Second, it allows for analysis of distributional and adjustment effects within a labour market. Third, they capture a broad set of effects including the direct impact on exposed occupations and industries as well as the local impact on linked industries and local demand effects (Acemoglu et al., 2016).

3.1 Estimating Equation

With this in mind, I estimate the following regression for LLM r at time t:

$$\%\Delta_3 Y_{rt} = \beta \frac{\Delta_3 Imports_{rt}}{Employment_{r,t-3}} + \boldsymbol{\gamma} \boldsymbol{X}_{r,t-3} + \tau_t + \varepsilon_{rt} \tag{2}$$

The regression is specified in three year stacked differences, denoted by Δ_3, to allow for medium-term labour market adjustments to materialise.[17] I weight by the pre-period (t-4) employment share of the LLM in national employment to be representative of employment outcomes across the UK.[18]

I define the measure of exposure to changes in services imports as the change in the value of imports in LLM over the three year period based on the location of plants within firms trading services as defined in Section 2.1, scaled by the initial employment of the LLM. Figure 2a shows the treatment variable across UK LLMs for the first period (2004-2007), measured in thousands of pounds per worker (in 2016 real terms).[19] There is a significant degree of cross-sectional variation in exposure to growth of imports across the country. In particular, the treatment is not only concentrated in London and the South East.[20]

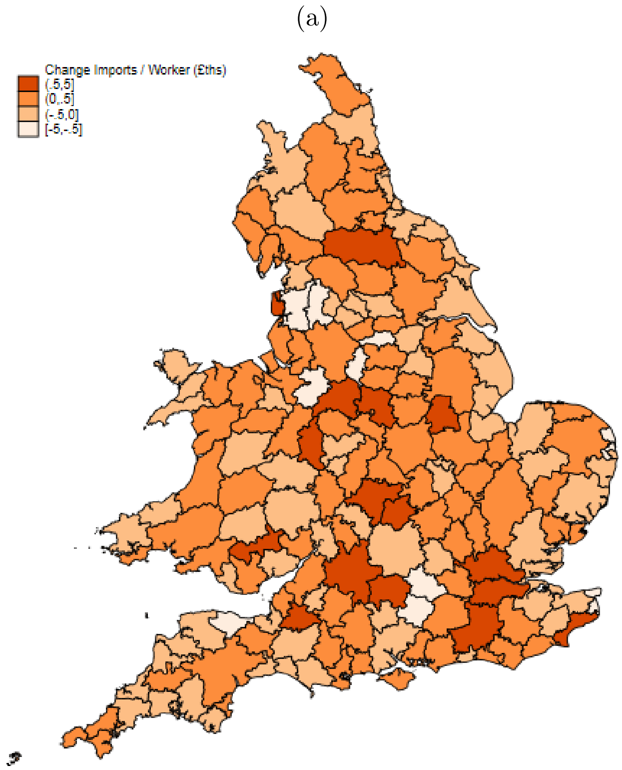
[17] For example, wages - a key outcome side variable - are sticky and may take more than one year to adjust to the shock.

[18] As discussed above, this also helps to deal with the heteroskedasticity issue induced by the small sample size of ASHE in smaller LLMs.

[19] Figure B.1 in Appendix B.1 shows the long change in the treatment variable over the full sample period.

[20] There is also serial correlation in the treatment variable within areas, and I account for this in the clustering of standard errors in the preferred specification, as discussed below.

Figure 2: (a) Change in Imports per Worker (2004-07); (b) Instrumental Variable (2004-07)



The baseline outcome variables of interest are the percentage changes in aggregate employment and wage.[21] I then exploit the worker-level micro data to estimate the impact of services import growth on wages across percentiles of the wage distribution within a LLM. I conduct further cuts of wages according to the type of tasks (non-routine cognitive, routine cognitive, manual) involved in a worker's four digit occupation based on Autor et al. (2003) and the broad occupational group of the worker (managerial, professional, supplementary, other). I also look at within-worker wage outcomes whereby the left hand side variable is defined at the worker-level and the changes are for a particular worker over time. This captures the wage effects controlling for composition, and allows analysis of the impacts on workers conditional on their initial status - for example, whether they were initially at a firm that imports services. Finally, I look at cuts of employment according to whether the firm

[21]The estimated coefficients are very similar in magnitude if log changes are used, and qualitatively similar if level changes are used.

imports services, and by industry group.

The vector $\boldsymbol{X}_{r,t-3}$ represents a set of initial period controls. First, this includes measures of exposure of the LLM to trade in the initial period, which are captured by the share of employment in tradable services industries and the share of employment in tradable services occupations, as well as the share of employment at foreign owned firms and the share of routine occupation employment. Second, I control for initial employment characteristics of the LLM, including the share of employment initially in tradable service occupations (defined based on a manually created concordance of services products to occupation codes) and the share of employment in key industries - specifically financial services, telecommunications, and manufacturing. I control for pre-period (t-4) log employment to capture the differential effects across city sizes and for pre-period log wage. I present results with and without these controls.[22] Finally, τ_t is a year fixed effect which controls for changes in macroeconomic conditions in each period.

The parameter of interest is β, which measures the marginal percentage change in the outcome of interest $\%\Delta Y_{rt}$ for an increase in imports of one thousand pounds per each worker initially in the LLM over the three year period, conditional on the controls.

The specification is similar in nature to the influential research of Autor et al. (2013). They relate changes in the value of imports of goods from China per worker in a LLM to the change in manufacturing employment share in the US. One key difference is that they observe national-level trade by industry and use pre-period LLM employment shares by industry to distribute the shocks to LLMs. In contrast, I have firm-level trade in services data and I therefore make use of information on the location of where the trade is taking place. I argue that, at least for services trade, using the location of the firm to measure exposure to changes in services trade is more appropriate. Services are not typically resold, meaning that when firms in an area exogenously increase their imports of services, the effects are likely

[22] The results are also robust to the inclusion of a LLM fixed effect, which flexibly controls for all observed and unobserved labour market characteristics with a linear time trend.

to materialise locally. Put differently, knowing the location of the firm provides additional information on the extent of the treatment in a LLM beyond the pre-period employment shares in nationally traded products.[23]

Table 6 presents summary statistics for the LLM level treatment and controls variables in the estimation sample. The mean level of imports per worker in the initial period is £1,000 per worker compared with an average change of £180. The standard deviation of the treatment variable is large relative to the mean, suggesting that there is variation across labour markets, as seen in Figure 2a.

Table 6: Estimation sample summary statistics

	mean	sd
Treatment		
Imports / Employment (t-3), £ths	1.00	0.99
(Change Imports) / Employment(t-3), £ths	0.18	0.51
Controls		
Services Occupation Employment Share (t-3)	0.44	0.06
Services Industry Employment Share (t-3)	0.39	0.05
Finance Services Employment Share (t-3)	0.02	0.02
Telecoms Employment Share (t-3)	0.01	0.01
Manufacturing Employment Share (t-3)	0.14	0.07
Foreign Owned Employment Share (t-3)	0.19	0.05
Routine Occupation Share (t-3)	0.48	0.09
Sum Import Shares (t-4)	0.80	0.13
Observations	662	

Notes: The unit of analysis is local labour market by year and statistics are weighted by t-3 local labour market employment share.

[23] Ideally I would also like to be able to distribute national service level trade to LLMs based on employment shares as a robustness check. However, the definition of services products, which would need to be mapped to industries, is too coarse so there would not be enough variation in the treatment and, in particular, for identification of the shift-share instrument discussed below.

3.2 Identification

Changes in imports per worker in a LLM are likely to be endogenously determined with respect to labour market outcomes. There is a wide range of unobservable factors that may affect aggregate and the composition of employment as well as firms' decision to offshore services. For example, the OLS estimator of β could be downward biased if firms in a LLM respond to negative shocks, such as increased output market competition or rising costs, by offshoring to reduce input costs (Antràs et al., 2017; Bernard et al., 2020; Monarch et al., 2017). On the other hand, firms that import services tend to be more productive and pay higher wages, both in the cross section (Breinlich and Criscuolo, 2011) and within firms over time (Ariu et al., 2019), which would lead β to be upward biased. The problem is further complicated by differential effects for markets for factors within a LLM. For example, imported services tend to be high skill and therefore may displace workers from high wage occupations. Yet optimising firms benefit from a boost to productivity from offshoring which could boost demand for workers in other occupations, meaning that the bias of OLS may differ according to the outcome variable of interest.[24] Finally, given that the treatment variable is constructed by distributing firm-level trade to LLMs based on within-firm plant employment shares, it is almost certain that the treatment variable is measured with some error, which will cause β in an OLS regression to be biased towards 0.

I therefore require variation in the treatment variable that is uncorrelated with changes in labour market outcomes. I construct a shift-share instrument which uses a LLM's pre-period service-country import shares as exposure weights to changes in the world export supply of each service by each country. The instrument is broadly analogous to a LLM version of that used in Hummels et al. (2014).

The instrument relies on the empirical observation that the structure of imports by service-

[24]These factors all concern demand for labour, which is more likely to shift over a three year period. Labour supply factors could also bias OLS. An increase in the supply of high skill labour may increase average wages and reduce offshoring of high skill services.

country is relatively constant over time. Put differently, it is clear from the growth decomposition of Table 4 in Section 2.2 that the majority of growth of services over any three year period is within firm-service-country, a trend which also holds at the LLM level. Therefore, the pre-period shares are a good measure of exposure of a LLM to world trade shocks. The exposure shares are defined as the value of imports in a particular service with a particular partner country divided by the total value of imports in the LLM, written:

$$impshare_{rsc,t-4} = \frac{Imports_{rsc,t-4}}{\sum_{sc \in \mathcal{S} \times \mathcal{C}^*} Imports_{rsc,t-4}}$$

for region r, service $s \in \mathcal{S}$ and country $c \in \mathcal{C}^*$ in the pre-period (t-4). The set $\mathcal{S}$ denotes the set of services discussed in Section 2 while $\mathcal{C}^*$ represents a restricted set of countries including all OECD countries, all EU countries, and some rapidly growing economies such as China and India. The country set is restricted to minimise issues with sporadic reporting in the OECD world services trade data. There are also a small number of country and service codes that cannot be matched to the world data, which are also excluded from the sets. To account for the fact that the amount of trade with the restricted country set may differ across LLMs (i.e. restricting the country set induces an incomplete shares issue), I control for the sum of included shares in a labour market following Borusyak et al. (2021), written as:

$$sumshares_{r,t-4} = \sum_{sc \in \mathcal{S} \times \mathcal{C}^*} \frac{Imports_{rsc,t-4}}{\sum_{sc \in \mathcal{S} \times \mathcal{C}} Imports_{rsc,t-4}}$$

Table 6 shows that the mean value of this control variable is 0.80, meaning that on average trade with the included countries covers 80% of total trade.

The shocks, or shifters, are the change in the value of exports of service s by country c

to other developed countries in the world excluding the UK.[25] The aim is to capture shifts in the supply of each service from each country which would therefore encourage UK firms to increase their imports of growing service-countries. One issue is that services trade is observed in values which capture the product of price and quantity. Clearly, rises in price and quantity are likely to shift UK imports in different directions. To the best of my knowledge, information on world prices by service-country is unavailable. Therefore, I aim to hold prices fixed by deflating values by a service-specific price index available for the UK published by the ONS. The shocks therefore primarily capture changes in the quantity supplied to the rest of the world of each service by each country, aiming to capture a shift in the supply curve.

At the LLM level, the instrument aggregates these shocks using the exposure weights described above:

$$IV_{rt}^{Imports} = \sum_{sc \in \mathcal{S} \times \mathcal{C}^*} \underbrace{impshare_{rsc,t-4}}_{\text{Exposure share}} \times \underbrace{\Delta_3 WorldExportSupply_{sct}}_{\text{Shock}}$$

The instrument is plotted for the first time period in Figure 2b.

A recent literature outlines properties of shift-share instrumental variables specifications (Borusyak et al., 2021; Goldsmith-Pinkham et al., 2020; Adão et al., 2019; Jaeger et al., 2018). They provide frameworks for interpreting the identifying assumptions, as well as how to construct the appropriate standard errors. The issue with the standard errors on the two stage least squares (2SLS) estimated on the LLM level data is that it ignores that the instrument is correlated across LLMs with a determinable structure - specifically through

[25] I winsorize the shocks at the 1st and 99th percentile. The set of countries included in the other developed countries is restricted to improve the strength of the first stages, mainly based on countries with more consistent reporting in the world trade data. The countries are: Australia, Denmark, Finland, Ireland, Japan, Portugal, and Singapore.

the exposure shares.[26]

In this paper, I follow Borusyak et al. (2021) in estimating the regression at the level of the *shocks* (denoted with the subscript sct) instead of at the LLM level (denoted with the subscript rt). The approach relies on the Frisch-Waugh-Lovell theorem to show that using the exposure weights to aggregate the outcome variables (residualised on LLM level controls) to the level of the shocks and then estimating the regression at the shock level yields the same estimate of β that is obtained from 2SLS on the LLM level regression. This equivalence result is described in more detail in the context of my estimator in Appendix B.2. The shock level estimating equation is estimated by 2SLS and enables the direct inclusion of shock-level controls and an alternative representation of the identifying assumption. It also yields standard errors that are consistent and account for correlation in exposure to the shocks as described above. The shock level estimating equation for service s and country c at time t is:

$$\Delta_3 Y_{sct}^{\perp} = \beta \left(\frac{\Delta_3 Imports_{sct}}{Employment_{sc,t-3}} \right)^{\perp} + \varepsilon_{sct} \tag{3}$$

and can be directly instrumented using the shocks ($\Delta_3 WorldExportSupply_{sct}$). The superscript $\perp$ denotes that the shock level variables have been residualised with respect to the LLM controls. The shock-level first stage plots are included in Figure B.2 in Appendix B.2.

The exclusion restriction necessary for identification requires that the shocks are quasi-randomly assigned to LLMs with respect to labour outcomes, conditional on LLM and shock level controls. At the shock level, the exclusion restriction requires:

[26] A highly stylized example is as follows. Suppose Bristol, in the west of England, and Sunderland, in the north-east of England, both import a high share of accountancy services from USA in the pre-period. Their values of the instrument will be correlated, but typical approaches to clustering, such as by broad geographic region, would not account for this correlation.

$$\mathbb{E}[\Delta_3 WorldExportSupply_{sct}|\boldsymbol{\varepsilon}, \boldsymbol{impshare}] = constant \, \forall \, sct$$

where $\boldsymbol{\varepsilon}$ is the vector of error terms and $\boldsymbol{impshare}$ the vector of import exposure shares for each service-country-year unit. Put differently, the values of the shocks must be uncorrelated with unobservable characteristics that affect labour market outcomes for LLMs exposed to those shocks through their import shares.

Liu and Trefler (2019) develop a model of trade in services tasks which considers three potential factors that shift services offshoring: changes in domestic demand; changes in the cost of offshoring; and changes in foreign costs. The model suggests that only changes in foreign costs provides a shock that is exogenous to domestic labour outcomes. The service-country specific shocks are shifted by relative productivities of each country at supplying a particular service, as well as world demand changes for each service from each country. To the extent that these are exogenously determined with respect to UK labour market outcomes, the exclusion restriction is satisfied.

One potential threat to identification is that there are service-specific technology shocks that are common across countries. For example, a new accounting software developed in USA could be adopted by firms in the UK using accountancy inputs as well as in other countries across the world. If this adoption affects labour outcomes in the UK, such as by substituting domestic accountants or increasing their productivity, and labour markets that import more accountancy in the pre-period are subject to higher world shocks as a result of this technology then the exclusion restriction would be violated. To address this concern, I present results that include a service-country fixed effect α_{st} as a control in the shock-level regression, such that the identifying variation comes within a service across countries.[27] This soaks up any service-specific shocks common across countries, including service-specific demand shocks. This causes a reduction in the estimation precision such that the standard errors are often

[27] The identification condition is then $\mathbb{E}[\Delta_3 WorldExportSupply_{sct}|\boldsymbol{\varepsilon}, \alpha_{st}, \boldsymbol{impshare}] = constant \, \forall \, sct$.

larger, but the key takeaway is that the estimated coefficients are typically relatively similar (formal Hausman tests could also be conducted on the estimates).

Another concern could be that the shocks are serially correlated. To address this, I also present results where the lag of the shocks are included as an additional (exogenous) explanatory variable. Finally, a remaining concern could be the activities of multinational corporations who offshore services from plants in both the UK and other countries in the world, thus driving both the world export supply and labour market outcomes in the UK. To the extent that they offshore the same service from each country, this would be soaked up by the service-year fixed effect. But if they offshore different services to the same country, the issue may persist. I control for the initial presence of multinationals in a LLM to try to mitigate this effect. I provide further discussion of the identifying assumptions and conditions required for consistency in Appendix B.3.

4 Results

This section presents the regression results from the empirical strategy outlined above. The right-hand-side of all of the regressions included has the same structure. Column 1 presents OLS results without LLM controls while column 2 shows the OLS with LLM controls. They are estimated at the LLM level and there are 662 LLM-year observations. The remaining columns present results for the IV regressions estimated at the level of the shocks - there are 2013 service-country-year observations. Column 3 shows the IV without any controls and column 4 does not include the LLM controls but does include the shock level service-year fixed effect. Column 5 includes LLM controls but no shock controls while column 6 additionally adds the service-year fixed effect. Finally, column 7 is the most stringent specification and includes the LLM controls, service-year fixed effect and the lag value of the shocks as a control.

Column 5 is the preferred specification. The Kleibergen-Paap F statistic is 28.8, above the

Montiel Olea Plueger maximal 10% bias critical value of 23.1. The estimated first stage coefficients δ are positive, suggesting that an increase in the quantity of world supply is associated with an increase in UK imports. In the specifications that include the service-year fixed effect, the power of the first stage is reduced, as it relies only on variation across countries within a service. The F statistics are therefore smaller and the standard errors tend to be larger. I include these results to show that the estimated second stage coefficients are relatively similar (in a Hausman test sense) when control for potentially correlated shocks specific to a service across countries.

The remainder of the section discusses the estimated second stage coefficients for a range of dependent variables. I first document aggregate LLM outcomes: employment, sales and wages. I then show the distributional wage effects, and results to suggest where these wage effects are materialising. Finally, I document changes in the distribution of employment.

Table 7 presents the regression results for four dependent variables. Panel (a) column 5 shows that an increase in imports per worker of £1,000 causes an increase in employment of 4%, recalling that the mean change in imports per worker is £180 in a three year period. This is consistent with the productivity effect of importing services outweighing the domestic labour substitution effect (Grossman and Rossi-Hansberg, 2008). There are numerous channels through which this productivity effect may materialise at the LLM level. For example, upstream and downstream industries may benefit from increases in efficiency of offshoring industries, or there may be an increase in demand for workers conducting complementary tasks to imported services. Evidence of this productivity effect is reinforced in Panel (b) which shows that the coefficient on total sales revenue of firms in the LLM is positive but statistically insignificant.

Turning to wages, there is tentative evidence to suggest that an exogenous increase in imports of services reduced overall wages. Panel (c) shows that the estimated effect on the mean wage in a LLM is negative in all IV specifications but is statistically insignificant in the preferred specification (column 5). The dependent variable presented in Panel (d) aims to capture the average wage in a LLM controlling for individual-specific characteristics. It is constructed by running a worker-level regression for the full national sample of workers of log wage on worker controls and the full set of LLM dummy variables. The estimated coefficients on the LLM dummy variables capture the conditional mean log wage in a LLM and are used as the dependent variable. The approach follows Kovak (2013). The estimated coefficient in Panel (d) column 5 is statistically significant at the 10% level. Noting that the units in Panel (d) are log wage and in Panel (c) is the percentage change in wages, the economic magnitudes of the coefficients in column 5 are very similar, suggesting that an increase of £1,000 in imports per worker reduces aggregate wages by approximately 1.5%.

In Appendix C.1 I present results for within-worker wage changes which make use of the panel nature of the employee data, and additionally control for worker characteristics. The estimated coefficients on within-worker wages, which essentially hold fixed the workforce composition, are similar to those for overal wages in a LLM. In column 5, the estimated coefficient is -1.77 and is statistically significant at the 10% level.

In the framework of LLM-level aggregate labour demand and supply, such a fall in wages is only consistent with a rise in employment if an increase in imports per worker causes a shift out of the labour supply curve, which seems implausible. In the remainder of the section, I present evidence to suggest that imports of services, which tend to be higher skill, have a negative impact on the wages of high wage workers, and a redistribution of employment across firms (and industries). This redistribution could explain the fall in wage and rise in total employment. That is, it is necessary to consider disaggregated markets within the LLM to explain the aggregate LLM effects.

Table 7: Employment, sales and wages

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel (a)				**%Δ Employment**			
$\Delta Imports/worker$	1.055***	0.654	8.722***	6.259*	4.703**	4.279	4.976*
	(0.393)	(0.451)	(2.046)	(3.432)	(2.168)	(3.144)	(2.999)
Panel (b)				**%Δ Sales**			
$\Delta Imports/worker$	-1.318	2.927***	7.819	3.124	13.956	3.331	4.755
	(2.361)	(0.970)	(5.769)	(7.494)	(10.007)	(8.408)	(9.301)
Panel (c)				**%Δ Wage**			
$\Delta Imports/worker$	-0.255	0.273	-2.794*	-3.257	-1.463	-2.705	-2.916
	(0.371)	(0.536)	(1.503)	(2.206)	(1.742)	(2.159)	(2.246)
Panel (d)				**Δ LLM Log Wage Estimate**			
$\Delta Imports/worker$	0.000	0.000	-0.012***	-0.011	-0.015*	-0.011	-0.011
	(0.002)	(0.003)	(0.004)	(0.013)	(0.008)	(0.013)	(0.013)
1^{st} *Stage Statistics*							
δ			.135	.09	.085	.08	.082
F			214.7	11.2	28.8	9.4	8.6
Estimation	OLS	OLS	IV	IV	IV	IV	IV
LLM Controls		Yes			Yes	Yes	Yes
Shock Controls				α_{st}		α_{st}	α_{st}, lag shock
Dimension	LLM	LLM	Shock	Shock	Shock	Shock	Shock
N	662	662	2013	2013	2013	2013	2013

Notes: Columns 1 and 2 present OLS results at the local labour market level while columns 3-7 present IV results at the level of the shocks (service-country-year). Standard errors are clustered by area in (1) and (2), by country in (3) and (5), and by country-year in (4), (6), and (7).

Table 8 shows the estimated effects on wage percentiles within a LLM. The negative wage effects are driven by the 75th and 90th percentiles. The estimated effects on the 50th wage percentile and below are close to 0 and statistically insignificant, as are those right at the top of the distribution (95th percentile). These results suggest that services imports affected workers at the top of the distribution, unlike goods offshoring and import competition which have typically harmed low wage workers and in some cases benefited higher wage or high skill workers. The rise in services imports over the past 20 years may therefore explain part of the reversal of the trend of rising wage inequality at the top of the distribution (such as the p90/p50 ratio), which had been rising up until the early 2000s and has been relatively constant since then.

Table 9 examines wage effects by the tasks involved in an occupation, based on Autor et al. (2003). It shows that the rise in imports of services is associated with a fall in the average wages of workers in non-routine cognitive occupations, which tend to be higher skill. The estimated coefficient for routine cognitive wages is also negative but is insignificant in the preferred specification. Unsurprisingly given the nature of traded services, the coefficients on wages in manual occupations are small and statistically insignificant.

Looking at wages by broad occupational group, Table 10 shows that the average wage of workers in managerial occupations declines with a rise in services imports, while there is no evidence of an impact on wage changes on other broad occupational groups. One possible explanation for the fall in managerial wages is that the quantity of workers employed in managerial occupations increased. I find tentative but statistically insignificant evidence of this in my data, but Ariu et al. (2019) find evidence that within firms, an increase in services offshoring is associated with an increase in employment of managers. Such an increase in employment of managers may mean that the average ability or the quality of the occupational match may be lower on average, explaining the lower managerial wage. Put differently, the effects are similar to a LLM-level analogue of the Caliendo and Rossi-Hansberg (2012); Caliendo et al. (2015) model whereby when a firm adds a layer of workers as it expands - for example foreign services workers - the average wage of existing layers can fall.[28]

[28] Consistent with this explanation, there is no negative affect on wages when looking at within-worker wage changes for workers initially in managerial occupations at importing firms. Meanwhile, workers initially in “supporting” and “other” occupations at importing firms do decline.

Table 8: Wage changes across the distribution

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel (a)				%Δ **Wage (p10)**			
$\Delta Imports/worker$	0.062	0.640	0.443	0.713	3.409	2.028	0.991
	(0.331)	(0.403)	(2.573)	(2.060)	(2.637)	(1.941)	(1.644)
Panel (b)				%Δ **Wage (p25)**			
$\Delta Imports/worker$	-0.339	0.217	-1.569	-2.507	0.813	-1.593	-2.711
	(0.384)	(0.533)	(2.297)	(1.966)	(2.591)	(1.743)	(1.913)
Panel (c)				%Δ **Wage (p50)**			
$\Delta Imports/worker$	-0.530	-0.041	-0.118	0.145	2.704	1.196	0.392
	(0.408)	(0.612)	(2.312)	(1.647)	(2.570)	(1.481)	(1.676)
Panel (d)				%Δ **Wage (p75)**			
$\Delta Imports/worker$	-0.406	0.079	-4.354**	-5.562*	-3.779	-5.037*	-5.288*
	(0.404)	(0.616)	(1.860)	(2.991)	(2.405)	(2.950)	(3.105)
				%Δ **Wage (p90)**			
$\Delta Imports/worker$	-0.365	0.338	-6.171***	-6.833	-5.666**	-6.497	-6.259
	(0.465)	(0.662)	(1.987)	(4.481)	(2.751)	(4.282)	(4.152)
				%Δ **Wage (p95)**			
$\Delta Imports/worker$	-0.039	0.173	-1.494	2.326	-0.464	3.052	3.749
	(0.350)	(0.536)	(1.648)	(3.517)	(2.920)	(3.883)	(3.846)
1^{st} *Stage Statistics*							
δ			.135	.09	.085	.08	.082
F			214.7	11.2	28.8	9.4	8.6
Estimation	OLS	OLS	IV	IV	IV	IV	IV
LLM Controls		Yes			Yes	Yes	Yes
Shock Controls				α_{st}		α_{st}	α_{st}, lag shock
Dimension	LLM	LLM	Shock	Shock	Shock	Shock	Shock
N	662	662	2013	2013	2013	2013	2013

Notes: Columns 1 and 2 present OLS results at the local labour market level while columns 3-7 present IV results at the level of the shocks (service-country-year). Standard errors are clustered by area in (1) and (2), by country in (3) and (5), and by country-year in (4), (6), and (7).

Table 9: Wage by occupational task

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel (a)			**%Δ Wage (Non-routine Cognitive)**				
$\Delta Imports/worker$	0.017	0.463	-3.678***	-3.920	-3.724**	-4.094	-3.654
	(0.352)	(0.524)	(1.165)	(3.135)	(1.677)	(3.195)	(3.170)
Panel (b)			**%Δ Wage (Routine Cognitive)**				
$\Delta Imports/worker$	0.045	0.637	-2.188*	-2.977	-1.870	-2.790	-2.838
	(0.380)	(0.476)	(1.294)	(3.057)	(1.837)	(3.583)	(3.710)
Panel (c)			**%Δ Wage (Manual)**				
$\Delta Imports/worker$	-0.259	0.320	-0.241	0.025	2.233	0.733	0.548
	(0.415)	(0.517)	(1.090)	(2.001)	(1.420)	(2.151)	(2.305)
1^{st} *Stage Statistics*							
δ			.135	.09	.085	.08	.082
F			214.7	11.2	28.8	9.4	8.6
Estimation	OLS	OLS	IV	IV	IV	IV	IV
LLM Controls		Yes			Yes	Yes	Yes
Shock Controls				α_{st}		α_{st}	α_{st}, lag shock
Dimension	LLM	LLM	Shock	Shock	Shock	Shock	Shock
N	662	662	2013	2013	2013	2013	2013

Notes: Columns 1 and 2 present OLS results at the local labour market level while columns 3-7 present IV results at the level of the shocks (service-country-year). Standard errors are clustered by area in (1) and (2), by country in (3) and (5), and by country-year in (4), (6), and (7).

Table 10: Wage by occupational group

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel (a)				**%Δ Wage (Managers)**			
$\Delta Imports/worker$	-0.010	0.321	-5.315***	-11.682**	-9.353***	-14.380**	-13.708**
	(0.587)	(0.858)	(0.944)	(5.239)	(1.749)	(6.032)	(6.089)
Panel (b)				**%Δ Wage (Professional)**			
$\Delta Imports/worker$	0.037	0.828	-4.088	1.273	-1.718	3.651	2.964
	(0.622)	(0.763)	(3.067)	(5.281)	(5.052)	(5.988)	(5.868)
Panel (c)				**%Δ Wage (Supporting)**			
$\Delta Imports/worker$	-0.698	0.043	-3.578***	-1.935	-1.944	-0.843	-0.690
	(0.573)	(0.800)	(0.834)	(3.576)	(1.390)	(3.874)	(3.683)
Panel (d)				**%Δ Wage (Other)**			
$\Delta Imports/worker$	0.195	0.405	-0.627	-1.436	1.223	-0.914	-1.235
	(0.319)	(0.453)	(0.973)	(2.013)	(1.173)	(2.221)	(2.387)
1^{st} *Stage Statistics*							
δ			.135	.09	.085	.08	.082
F			214.7	11.2	28.8	9.4	8.6
Estimation	OLS	OLS	IV	IV	IV	IV	IV
LLM Controls		Yes			Yes	Yes	Yes
Shock Controls				α_{st}		α_{st}	α_{st}, lag shock
Dimension	LLM	LLM	Shock	Shock	Shock	Shock	Shock
N	662	662	2013	2013	2013	2013	2013

Notes: Columns 1 and 2 present OLS results at the local labour market level while columns 3-7 present IV results at the level of the shocks (service-country-year). Standard errors are clustered by area in (1) and (2), by country in (3) and (5), and by country-year in (4), (6), and (7).

Turning now to the allocation of employment across firms, Table 11 shows that the rise in imports per worker caused a redistribution of employment away from importing firms towards firms that do not import services. A rise of £1,000 of imports per worker is associated with a fall in employment at importing firms of 13% and a rise at non-importers of 7%.[29] This is consistent with the aggregate trend in the economy that, while the share of sales accounted for by importing firms rose over the period, the share of employment at these firms declined

[29] Note that employment at importing firms accounts for around 15% of total employment across England and Wales, explaining why the rise in imports is associated with an increase in total employment while the negative coefficient on importing firms is larger than the positive coefficient on the non-importers.

slightly. When looking at the effect of the rise in imports on employment by industry, the increase in total employment is mainly driven by industries outside of tradable services and manufacturing.[30]

Table 11: Employment by trade status

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel (a)				**%Δ Employment (Importer)**			
$\Delta Imports/worker$	3.095**	3.807***	-9.416***	-13.203	-13.214***	-9.035	-7.568
	(1.321)	(1.350)	(3.497)	(9.424)	(4.465)	(8.619)	(8.055)
Panel (b)				**%Δ Employment (Not Importer)**			
$\Delta Imports/worker$	0.655**	0.160	10.410***	8.137**	7.009**	5.763	6.224*
	(0.322)	(0.410)	(1.938)	(3.894)	(2.745)	(3.572)	(3.435)
1^{st} Stage Statistics							
δ			.135	.09	.085	.08	.082
F			214.7	11.2	28.8	9.4	8.6
Estimation	OLS	OLS	IV	IV	IV	IV	IV
LLM Controls		Yes			Yes	Yes	Yes
Shock Controls				α_{st}		α_{st}	α_{st}, lag shock
Dimension	LLM	LLM	Shock	Shock	Shock	Shock	Shock
N	662	662	2013	2013	2013	2013	2013

Notes: Columns 1 and 2 present OLS results at the local labour market level while columns 3-7 present IV results at the level of the shocks (service-country-year). Standard errors are clustered by area in (1) and (2), by country in (3) and (5), and by country-year in (4), (6), and (7).

The key results of the paper are qualitatively robust to excluding the period of the financial crisis (2007-2010) and to dropping London from the sample. They are also qualitatively robust to including the lag change in wage and employment in a LLM as controls (and excluding the first time period). The distributional wage effects across percentiles are qualitatively robust to using a measure of wages that partials out observable individual characteristics such as a polynomial of age and a dummy for female. The distributional wage effects are robust to including controls for the pre-period percentiles of wages. One concern with specifying the outcomes in percentage changes is that they can generate extreme values which

[30]These results are not yet available to be included in the paper.

drive the results, but the results are very similar when specifying the dependent variable in log differences (with coefficients approximately 100 times smaller as expected). The baseline results are also qualitatively robust to including a LLM fixed effect (instead of the lag LLM controls), which flexibly control for any linear observed or unobserved LLM-specific effects and are reassuring that non-random allocation of the shocks across LLMs is not driving the results.

5 Conclusion

This paper documents the effects of a rise in exposure to imports of services in a LLM. Total employment increases with imports of services while wages decrease, driven by redistribution of employment across firms and industries. A rise in imports of services causes a fall in average wages of high skilled non-routine cognitive occupations, and a decline in wages in the top half of the wage distribution.

The results suggest that the labour market impacts of services trade are different to those of import competition of goods, offshoring of goods, and skill or routine biased technological change, but more similar to the predicted impacts of artificial intelligence on the wage distribution.

The results presented in this paper represent the partial effects and miss aggregate general equilibrium effects. For example, there is likely to be an overall fall in the price index as a result of cheaper services imports, which would benefit firms through improved productivity and lower consumer prices, assuming some pass-through.

The findings have important implications for policy, as global services trade continues to rise. For example, a further round of the General Agreement on Trade in Services (GATS) would have differential impacts across the earnings distribution, and would cause redistribution of factors across firms and industries. On the flip side, Brexit is predicted to cause a fall in services trade (Dhingra et al., 2017) which would also translate to labour market effects.

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Appendix A Data

A.1 ASHE

This section outlines the data cleaning process for the ASHE worker panel data. Firstly, I drop all individuals if their earnings were affected by absence based on an indicator included in the data. I exclude any workers that report negative or zero earnings. I exclude workers with total working hours in a week above 168 or equal to 0. I drop a small share of workers with a missing personal identifier.

There are a small number of cases where a worker appears in multiple jobs within a year. To construct a worker-year panel, I deal with these cases by making the following sequential restrictions. First, I keep the observation marked as the main job of the worker. Second, I keep the job with the highest hours worked. Third, I keep the job with the highest earnings. Finally, I remove the jobs marked as part time, where the other is marked as full time.

I winsorize earnings at the top and bottom one percentile. There are some cases in particular years where the LLM codes do not exist, in which case I replace the code with the matched location of the worker's firm.

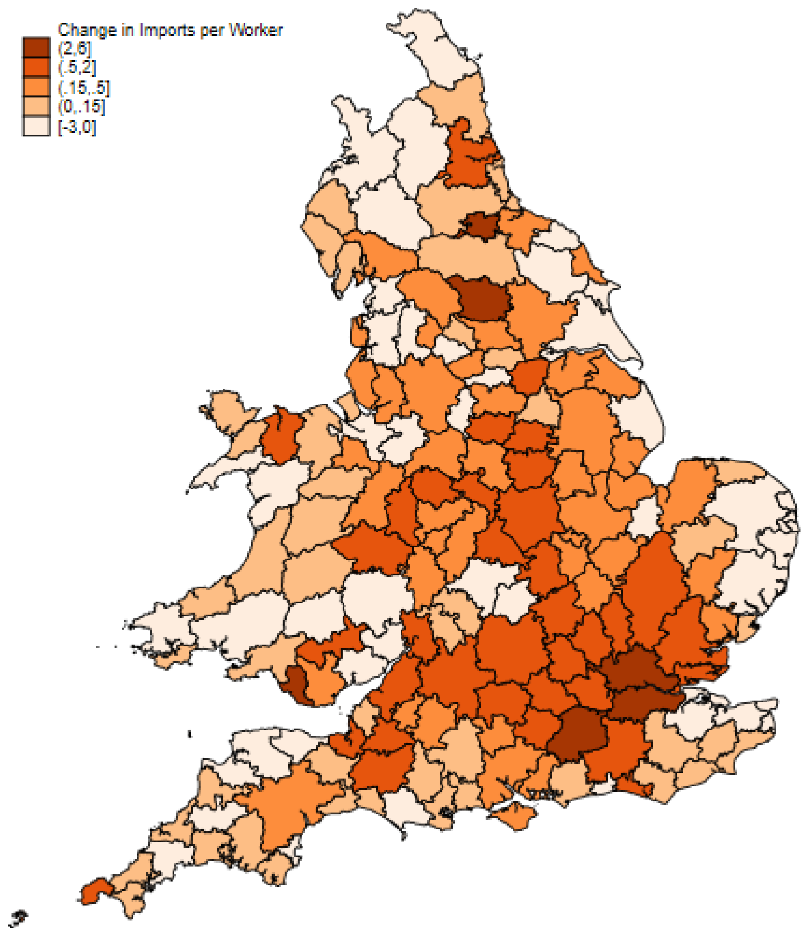
A.2 Descriptive statistics

Table A.1: Summary statistics by year

	2004		2016	
Employment (ths)	104	(246)	122	(323)
Female Share	0.32	(0.06)	0.33	(0.05)
Manufacturing Share	0.19	(0.07)	0.13	(0.06)
Tradable Service Industry Share	0.35	(0.05)	0.40	(0.05)
Collective Agreement Share	0.42	(0.10)	0.28	(0.08)
Routine Occupation Share	0.58	(0.09)	0.52	(0.09)
Tradable Service Occupation Share	0.39	(0.07)	0.39	(0.08)
GVA per Worker (ths)	53.1	(12.6)	81.9	(44.8)
Annual Wage (ths)	28.9	(4.5)	28.3	(3.8)
p90/p50 Wage Ratio	2.04	(0.20)	2.00	(0.23)
p90/p10 Wage Ratio	3.56	(0.50)	3.27	(0.48)
p50/p10 Wage Ratio	1.74	(0.16)	1.63	(0.13)
Importer Firm Wage / Mean Wage	1.10	(0.18)	1.16	(0.21)
Service Inputs / Non-Energy Inputs	0.14	(0.05)	0.09	(0.05)
Services Imports / Services Inputs	0.01	(0.02)	0.02	(0.03)
Services for Resale / Services Inputs	0.04	(0.03)	0.05	(0.05)
Importing Firm Employment Share	0.13	(0.05)	0.11	(0.04)
Importing Firm Sales Share	0.16	(0.09)	0.19	(0.09)
Foreign Owned Share	0.14	(0.06)	0.15	(0.07)
Observations	173		173	

Notes: The table shows the mean and standard errors (in parentheses) for 2004 and 2016.

Figure B.1: Treatment: change in imports per worker, 2004-2016



Appendix B Empirical Strategy

B.1 Additional figures and tables

	mean	sd
Treatment		
Imports / Employment (t-3), £ths	0.49	0.76
(Change Imports) / Employment(t-3), £ths	0.07	0.50
Controls		
Services Occupation Employment Share (t-3)	0.40	0.07
Services Industry Employment Share (t-3)	0.38	0.05
Finance Services Employment Share (t-3)	0.01	0.01
Telecoms Employment Share (t-3)	0.01	0.01
Manufacturing Employment Share (t-3)	0.16	0.07
Foreign Owned Employment Share (t-3)	0.15	0.06
Routine Occupation Share (t-3)	0.55	0.09
Sum Import Shares (t-4)	0.81	0.17
Observations	662	

B.2 Shock level estimation

The estimating equation at the local labour market (LLM) level is:

$$\%\Delta_3 Y_{rt} = \beta \frac{\Delta_3 Imports_{rt}}{Employment_{r,t-3}} + \boldsymbol{\gamma} \boldsymbol{X}_{r,t-3} + \tau_t + \varepsilon_{rt}$$

which is weighted by the LLM's share of employment in the country total employment, denoted $EmpShare_{r,t-3}$. The instrumental variable can be written as the exposure-share weighted average of the world export supply shocks:

$$IV_{rt}^{Imports} = \sum_{sc \in \mathcal{S} \times \mathcal{C}^*} \underbrace{impshare_{rsc,t-4}}_{\text{Exposure share}} \times \underbrace{\Delta_3 WorldExportSupply_{sct}}_{\text{Shock}}$$

To translate the regression model to the level of the shocks, first residualise the LLM level outcome and treatment variables by the LLM controls. I denote residualised variables with the superscript $\perp$. For example, for outcome variable$\%\Delta_3 Y_{rt}$ I regress:

$$\%\Delta_3 Y_{rt} = \boldsymbol{\gamma} \boldsymbol{X}_{r,t-3} + \tau_t + \%\Delta_3 Y_{rt}^{\perp}$$

and do the equivalent for the treatment variable. The key result of Borusyak et al. (2021) is to show that the residualised outcome and treatment variables can be weighted by to the exposure shares $impshare_{rsc,t-4}$ and the LLM weights $EmpShare_{r,t-3}$ to be represented at the same dimension as the shocks. Again focusing on the outcome variable, the shock level measure is:

$$\Delta_3 Y_{sct}^{\perp} = \frac{\sum_r EmpShare_{r,t-3} \times impshare_{rsc,t-4} \times \Delta_3 Y_{rt}^{\perp}}{\sum_r EmpShare_{r,t-3} \times impshare_{rsc,t-4}}$$

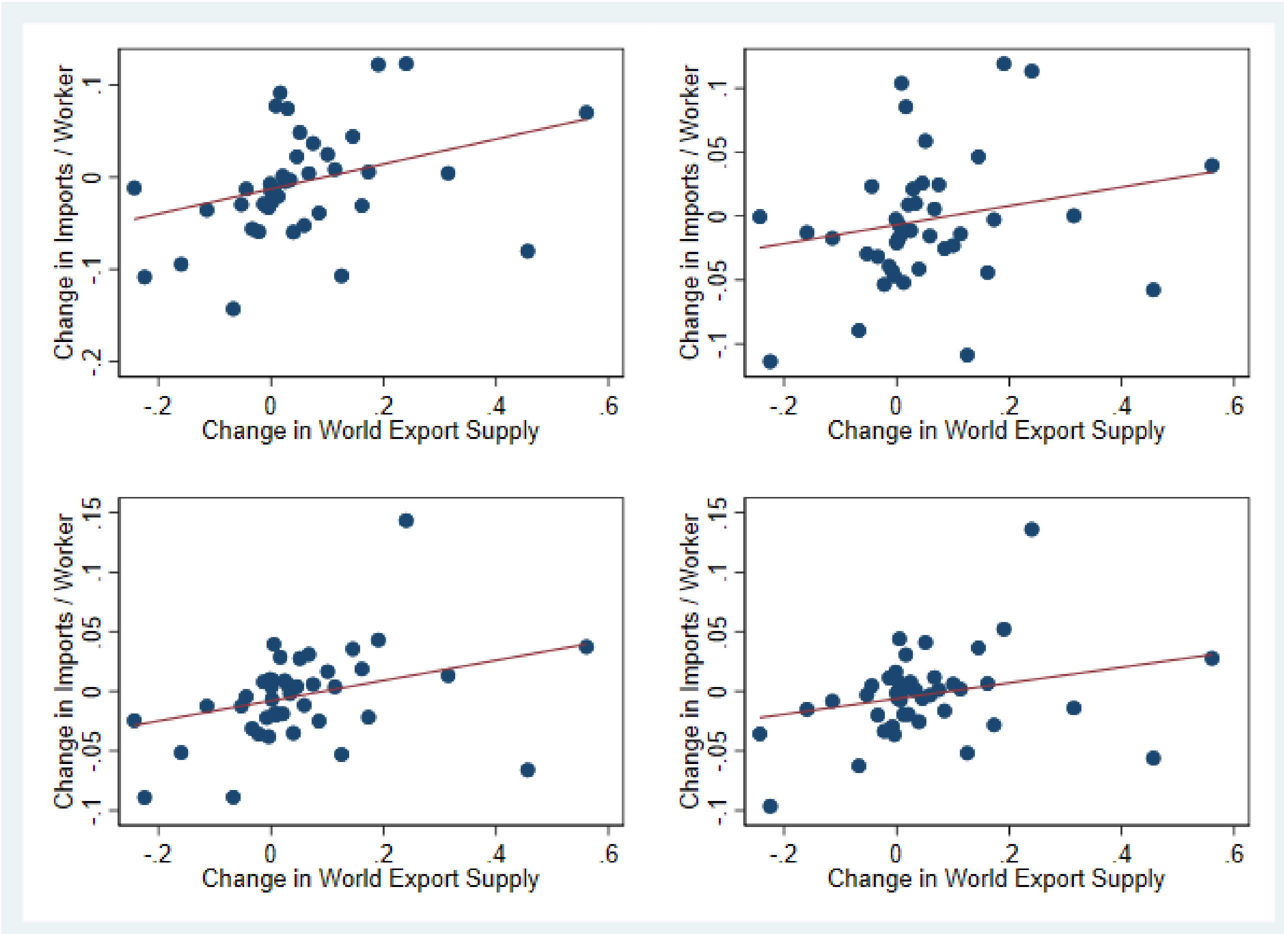
Given this weighting and having residualised the variables with respect to the controls $\boldsymbol{X}_{r,t-3}$, by the Frisch-Waugh-Lovell theorem, the following shock level relationship

$$\Delta_3 Y_{sct}^{\perp} = \beta \left(\frac{\Delta_3 Imports_{sct}}{Employment_{sc,t-3}} \right)^{\perp} + \varepsilon_{sct}$$

can be estimated by 2SLS to obtain the same estimator of β as the LLM. The shock level regression is weighted by $impshare_{sc,t-4} = \sum_r EmpShare_{r,t-3} \times impshare_{rsc,t-4}$ and the instrument is now just the shocks $\Delta_3 WorldExportSupply_{sct}$. Additional controls at the level of the shocks can also be directly included. In this paper, I present results that include a service-year fixed effect and a lag of the shock as controls.

The shock level first stage plots are shown in Figure B.2. The top left panel corresponds to the specification in column 3 (no LLM controls, no shock controls) of the results tables, as outlined at the beginning of Section 4. The top right panel corresponds to specification 4 (no LLM controls, service-year fixed effect). The bottom left panel shows the first stage

Figure B.2: Shock-level first stages



of specification 5 (LLM controls and no shock controls) and the final plot presents the specification in column 6. (LLM controls and a service-year fixed effect).

B.3 Identifying assumptions

It is of course impossible to formally test the exclusion restriction. However, it is possible to regress the shocks on LLM characteristics in the initial period. Some of the LLM level controls included in the model are correlated with the shocks. Notably, the initial share of employment in financial services is correlated with the shocks (in the regression without the service-year fixed effect), because financial services tend to grow quickly and labour markets with employment in financial services tend to have systematically different outcomes. In this case, the LLM controls account for this direct effect. Other factors, such as the share of females in a LLM, or the share of employment in routine occupations, are uncorrelated with the shocks.

The concern is that these correlations represent other unobservable factors which may affect identification. In a robustness check, I have included a LLM fixed effect which controls for any observable and unobservable linear trends in a LLM, leaving only non-linear unobservable trends.

Consistency of the shift-share estimator requires that the average exposure to each shock is small and there are many uncorrelated shock clusters, where clustering occurs at the shock level. The mean of the share at the shock level is small - just 0.0037 - meaning that the importance weight of each service-country shock is small. There is a trade-off on clustering. It is likely that shocks are correlated within a country, such as through a country-level policy shock. At the country-year level, the number of shock clusters is well above the suggested threshold of 20 (Borusyak et al., 2021) in each year. However, it is also possible that shocks are correlated within a country over time, which would suggest a need to cluster at the country level. Then, the effective cluster sample size is below 20. It is also not possible to cluster at the country level in the specifications with the service-year fixed effect as it nests the identifying variation. Where possible, I opt to cluster standard errors by country.

Appendix C Additional Results

C.1 Within-worker estimation

To estimate the within-worker effects, the estimating equation can be redefined at the level of worker i in LLM r at time t:

$$\Delta_3 Y_{irt} = \beta \frac{\Delta_3 Imports_{rt}}{Employment_{r,t-3}} + \gamma_1 X_{r,t-3} + \gamma_2 W_{i,t-3} + \tau_t + \varepsilon_{irt}$$

where $W_{i,t-3}$ includes age, age-squared, age-cubed, sex, and union membership. The regression can be estimated at the worker level, as are the results presented for the OLS in columns 1 and 2 of Table C.1. Alternatively, the same estimator of β can be obtained from a LLM-level equation, adhering to the Frisch-Waugh-Lovell theorem and first orthogonalising worker wages with respect to the worker level controls and aggregating to the LLM level. For the within-worker regressions, I use the count of workers sampled in ASHE in a LLM as the employment weights instead of using the universe of plants in a LLM. These two measures of employment are highly correlated. For the IV regressions, I aggregate workers to the shock level, as in the main regressions. Columns 3-7 of Table C.1 are therefore presented at the shock level.

Table C.1: Within-worker wage effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
				%Δ **Wage**$_{it}$			
$\Delta Imports/worker$	1.331**	0.355	1.760**	-1.802	-1.771*	-3.604	-3.525
	(0.576)	(0.220)	(0.715)	(1.686)	(1.015)	(2.411)	(2.437)
1^{st} *Stage Statistics*							
δ			.153	.098	.084	.079	.083
F			62.5	13.9	27.1	12.3	12.3
Estimation	OLS	OLS	IV	IV	IV	IV	IV
LLM Controls		Yes			Yes	Yes	Yes
Shock Controls				α_{st}		α_{st}	α_{st}, lag shock
Dimension	LLM	LLM	Shock	Shock	Shock	Shock	Shock
N	79106	79106	2013	2013	2013	2013	2013

Notes: Columns 1 and 2 present OLS results at the local labour market level while columns 3-7 present IV results at the level of the shocks (service-country-year). Standard errors are clustered by area in (1) and (2), by country in (3) and (5), and by country-year in (4), (6), and (7).