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Services trade and labour market outcomes in the United Kingdom

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SERVICES TRADE AND LABOUR MARKET OUTCOMES IN THE UNITED KINGDOM

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Services trade has become increasingly important, yet its impact on employment has been understudied at present. This paper uses fine-grained data on firm- and worker-level information to shed light on the impact of services trade on employment and wages in the United Kingdom. It finds that firms can benefit from services trade, through increased employment, production and productivity. On average, workers' wages are also positively impacted by increased services trade. The findings suggest that services imports enhance female wages more than those of males, thereby contributing to narrow the gender wage gap. They also suggest that reduction of services trade barriers in foreign markets with which the United Kingdom trades coincides with higher wages for employees of trading firms in the United Kingdom.

Keywords: Employment, worker and firm-level data, gender pay gap, skills, wages, trade liberalisation

JEL Codes: C26, F13, F16, F61, J31, J40

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Executive Summary

The effects of globalisation, in particular the link between trade and labour market outcomes, have been at the forefront of the policy agenda of many countries for several years. There has been growing concern about the distributional effects of increased import competition on the domestic labour market, in terms of job displacement and lower wages, which have put into question the benefits of open markets. Yet, the discussion overlooks the fact that international trade has positive overall effects for countries. Trade has led to vast improvements in living standards, and benefitted consumers and businesses by cutting prices and increasing product variety and quality. This could boost firms' productivity and generate broader employment opportunities.

This paper draws on linked employer-employee data matched with firm level trade in services information to assess: how UK firms respond to increases in services trade; which groups of workers stand to benefit the most; and how trade policy settings might impact on wage adjustments. The United Kingdom is highly specialized in services and workers and firms may be better able to reap the benefits of trade. The evidence reported here points to overall positive linkages between trade in services and firm level outcomes: increases in services trade are associated with new jobs, production expansion, and productivity gains.

Worker-level analysis suggests a positive causal relationship between trade in services and hourly wages: higher exports and imports of services lead to average wage improvements for a given employee matched to a given firm. However, the positive effect of services trade is distributed differently across firms and individuals, depending on their characteristics. Increases in services imports have a moderately beneficial effect on the wages of female workers and contribute to mitigating existing gender inequalities. In contrast, wages are negatively associated with higher services trade barriers in the markets in which UK firms trade. Finally, the evidence is ambiguous regarding the link between enhanced services trade activity and skills.

This evidence is broadly consistent with previous findings on the impact of manufacturing and services trade on labour-market outcomes in the United Kingdom and in other advanced countries. This has several policy implications. Trade reforms can complement policies aimed at reducing wage disparities between men and women. Measures targeting the removal of obstacles to sourcing foreign services inputs can lower firms' costs and raise the productivity of the employing firm, which, in turn, could contribute to narrow the gender pay gap.

UK trading companies, and their workers, would benefit from domestic policies that ensure greater competition, regulatory transparency, and ease conditions that enable the provision of services through electronic networks in the foreign markets with whom they trade. Policy actions on a bilateral, or preferably multilateral, level to encourage behind-the-border policy reforms that harmonise regulations across key markets and that favour the adoption of internationally-accepted standards would bring additional benefits to the UK economy.

Summary of findings

- *Services trade benefits firm employment and performance measures.* This finding may point to trade-induced improvements in firm productivity and should be reflected in domestic and trade policies that aim to boost productivity.
- *Increased services trade has a moderate positive impact on individual wages in the United Kingdom.* The average effect masks some heterogeneity across different groups of employees. This implies that higher services trade has distributional consequences, which can be addressed by redistribution policies that target specific workers.
- *Evidence suggests higher trade in services tends to attenuate the gender wage gap.* The impact of services trade varies slightly with age and according to skill levels. Active labour market policies, which support the inclusion of women, and a balance of different skill types can improve the resilience of labour markets and specific groups of workers.
- *Restrictions to services trade affect wages negatively.* British workers would benefit from domestic policies that remove barriers to competition, facilitates cross-border movement of professionals, and ease the provision of services through electronic networks in countries with which UK firms trade.

1. Introduction[1]

While it is well documented that international trade leads to aggregate welfare gains,[2] economic theory and evidence also show that trade has distributional effects, with gains and costs unequally shared across industries, regions, skills, etc. Thereby, some groups of workers gain, while others are typically left behind.[3] In OECD countries, these groups are often associated with manufacturing workers in industries that compete with countries that have relatively low wages, and which tend to have relatively lower skill levels (see Autor et al. (2014[1]) and Hummels et al. (2014[2]), among others).

To date, research on the distributional effects of trade on labour market outcomes has predominantly focused on merchandise trade rather than services trade. Typically, findings for goods trade are extended to services trade due to the fact that many stylised facts found for firms trading products also hold for firms trading services (Breinlich and Criscuolo, (2011[3]); Rouzet et al. (2017[4])).

However, focusing on the impact of trade on wages of workers in manufacturing sectors provides only a partial portrait of the overall effects of trade on the domestic labour market, notably in countries with large services sectors. Furthermore, services trade permeate all facets of a developed economy, particularly in light of the increasing *servitisation* of other sectors.

This study sheds light on the overall and distributional effects of services trade on labour market outcomes for the United Kingdom (UK). [4] Latest OECD estimates show that services are a major contributor to the UK economy, accounting, directly and indirectly (by being embedded in other products), for nearly 70% of UK gross exports in 2015, considerably higher than the OECD average of 45%.[5] Hence, the United Kingdom provides a particularly suitable setting for the examination of the link between services trade, employment and wages.

Micro data on trade, firms and workers from the UK Office for National Statistics (ONS) allow us to study this link at the firm and worker level between 2004 and 2017.[6] As a novel contribution, we provide evidence of the heterogeneous wage responses to services trade at the firm level and across worker characteristics. The analysis also sheds light on individual wage responses associated with changes in services trade policy.

The United Kingdom provides for an interesting environment to analyse in several respects. The service sector accounts for a large share of domestic economic activity (around 80% of GDP in 2017) and employs

[1] This work was produced using statistical data from ONS. The use of the ONS statistical data in this work does not imply the endorsement of the ONS in relation to the interpretation or analysis of the statistical data. This work uses research datasets which may not exactly reproduce National Statistics aggregates.

[2] See, for instance Samuelson (1939[28]), Broda and Weinstein (2006[11]), Arkolakis et al. (2008[26]), Feenstra and Weinstein (2017[29]), and Costinot and Rodríguez-Clare (2014[27]).

[3] See Harrison (2007[12]), Menezes-Filho and Muendler (2011[30]), Kovak (2013[13]), Dauth et al. (2014[31]), Ebenstein et al. (2014[14]), Hakobyan and McLaren (2016[32]), Dix-Carneiro and Kovak (2017[33]), OECD (2017[24]), and Utar (2018[15]).

[4] See Crinò, (2010[21]), Borghi and Crinò (2013[34]), Geishecker and Görg (2013[35]), Criscuolo and Garicano (2010[36]), Ornaghi et al. (2017[37]), Eppinger (2019[22]), Liu and Trefler (2019[38]), and more recently, OECD (2020[20]), which summarises results based on services trade in a number of countries.

[5] See latest Trade in Value Added release: https://www.oecd.org/industry/ind/TIVA-2018-United-Kingdom.pdf.

[6] The time coverage of this analysis corresponds to data available to the authors at the time of research. As the time period analysed only includes the first year following the EU referendum in the United Kingdom, no conclusions on the likely effects of Brexit on trade and wages can be firmly drawn from these results.

most workers (83% of the UK workforce jobs in 2018).[7] The United Kingdom is a stable net exporter of services, with net services trade with the world amounting to GBP 105 billion in 2018. Furthermore, labour markets are relatively flexible;[8] accordingly, it could be expected that services trade, and services trade policy, may have a potentially different effect on employment and wages in the United Kingdom compared to countries characterised by more regulated labour market institutions.

The availability of firm level services trade data linked to employee and firm data makes it possible to examine employment and wage decisions made at the firm level in response to trade in services, and thus give more informed policy advice.

Proper methods are used to ensure the representativeness of our findings (Annex A). Yet, questions related to the transmission of trade effects on labour markets across countries, for example in the form of competition on labour costs, are not part of this analysis. Also beyond the scope of this work is the assessment of the impact on wages of domestic firms that do not trade, as, by design, the analysis focuses only on firms engaged in services trade.

Finally, capturing the full re-distributional effects of trade across sectors, regions and countries, or the indirect effect of trade in terms of downward pressures on wages exercised from countries with cheaper labour are beyond this scope of this analysis. Nevertheless, these are interesting aspects that would deserve further attention in view of the disruptions to both production and labour markets following the Covid-19 pandemic.

In what follows, Section 2 presents the data and discusses the descriptive evidence. Section 3 outlines the estimation strategy while Section 4 reports new empirical results regarding the relationship between services trade and labour market outcomes. Section 5 offers policy considerations.

2. Data and main stylised facts

This section discusses the main datasets used in the analysis and provides descriptive evidence on trade and labour market outcomes.

2.1. Data sources

Micro-data on trade, firms and workers are drawn from several databases held by the Office for National Statistics (ONS) of the United Kingdom. More details can be found in Annex A. Weights have been applied to ensure representativeness of the survey data to the population of interest. Firm level services trade data are sourced from the International Trade in Services (ITIS) survey. ITIS collects information on the value of services traded by a UK-based private company by partner country and product type. It also reports the location and industry of main activity (classified according to UK Standard Industrial Classification, SIC) of the firm.

[7] Source: UK National Account, The Blue Book, Gross value added and Workforce jobs by Industry: https://www.ons.gov.uk/economy/grossdomesticproductgdp/compendium/unitedkingdomnationalaccountsthebluebook/2019/theindustrialanalyses.

[8] The United Kingdom is considered to have a highly flexible labour market, ranking 14th out of 141 countries in the World Economic Forum's labour market flexibility index, along with countries such as Canada, Switzerland, Germany and Denmark (WEF, (2019[16])). The United Kingdom also has comparatively low levels of employment protection among OECD countries, similar to those observed in Australia, Canada, New Zealand and the United States.

Structural business data are sourced from the Annual Business Survey (ABS) starting in 2008, and from the Annual Responded Database (ARDx) for previous years. The combined ARDx-ABS surveys ask respondent firms in UK non-financial sectors for information such as gross output, turnover, total number of employees, etc. These surveys include additional information on firms' industry affiliation, based on the UK Standard Industrial Classification 2007, largely similar to other international classifications (NACE Rev. 2 and ISIC Rev. 4), and the region where they are located.

Worker-level data are drawn from the Annual Survey of Hours and Earnings (ASHE), which provides comprehensive information on the structure and distribution of earnings in the United Kingdom. ASHE is based on a one% sample of employee jobs with national insurance numbers. Besides hours worked, hourly wage and earnings, ASHE collects a number of additional characteristics at the individual worker-level (e.g. gender, age, occupation), and at the firm level (e.g. region, industry of main activity, annual turnover). The analysis focuses on full-time employees aged 18-64.

Hourly wages are measured as gross weekly pay (excluding overtime pay) divided by basic hours worked (excluding overtime hours). Workers are classified into 468 occupations following a UK-specific classification broadly comparable to the International Standard Classification of Occupations 2008 (ISCO-08), at 2-digit level. Workers are considered as high-skilled if their occupations are mapped with the two highest skill levels (3 and 4) in ISCO-08.[9] All other workers are classified as medium-to-low skilled.

Services trade data are combined with firm's characteristics at the plant level, and subsequently aggregated at the enterprise level to be matched with wage information from ASHE to create a linked employer-employee dataset.

2.2. Descriptive evidence

The combined sample covers approximately 32 600 unique enterprises and 154 000 unique employees over a thirteen-year period (2004-2017). The sample includes employees working for different types of firms: those that serve solely the UK domestic market and those that also operate internationally. Firms operating in primary sectors are excluded. Worker-firm observations with employment relationships not lasting more than one year are dropped.

Table 2.1 reports the main summary statistics from the data in the combined sample. The first panel shows average characteristics of firms, median values and the values corresponding to the 10th and 95th percentiles. The average firm has an annual turnover of around GBP 204 million, a gross output of about GBP 118 million and employs more than 900 employees. Nevertheless, our sample is skewed towards larger firms, as it is evident when comparing average, median and largest values.[10]

Not all firms in the combined sample that is used for the descriptive analysis, trade; only about a quarter of the companies in the sample has relationships with foreign markets. Average services import and export values of a UK-based firm are around GBP 39 million and GBP 80 million, respectively. However, these values might be influenced by a few large companies trading multiple services products with many partner countries. The median value gives a better indication of the typical annual import and export of services of UK firms, valued around GBP 3 million and GBP 6 million, respectively.

[9] Skill levels 3 and 4 are associated with the following ISCO-08 occupations: managers; professionals; technicians and associate professionals. For more information, please see: https://ilostat.ilo.org/resources/methods/classification-occupation/

[10] The tendency to have larger firms in the combined sample is also the result of merging various datasets based on different sampling schemes.

Table 2.1. Descriptive statistics on employer-employee sample, 2004-2017

		Observations	Mean	Median	10th percentile	95th percentile
Firm-level data	Turnover ('000 GBP)	101,159	203,972	45,200	8,623	576,502
	Employment	101,171	934	269	38	3,262
	Gross output ('000 GBP)	101,159	117,850	25,564	-	372,053
	Wage bill ('000 GBP)	101,159	44,976	32,020	15,695	76,891
Firm-level trade data	Total imports ('000 GBP)	18,897	39,218	3,081	92	145,400
	Total imports / Gross output	16,494	0.40	0.05	0.00	0.96
	Total exports ('000 GBP)	16,831	80,406	5,791	159	331,145
	Total exports / Gross output	14,272	3.76	0.11	0.00	2.53
Worker-level data	Hourly wage	591,025	16			
	Weekly wage	591,025	604			
	Annual wage	591,025	33,568			
	Hours worked	591,025	38	38	35	44
	Working experience	591,025	7	7	2	14
	Age	591,025	41	41	26	60
	High-skill	591,025	41%			
	Gender	591,025	34%			

Note: Firm level and employee level data are weighted by their respective sample weights. All value data are in GBP at constant 2015 prices (deflated with the UK consumer price index). Data refer to 2004-2017.
Source: Own calculations based on UK Office of National Statistics International Trade in Services Inquiry, Annual Responded Database, Annual Business Survey and Annual Survey of Hours and Earnings datasets.

A typical UK worker in the combined sample, spanning from 2004 to 2017, earns an hourly wage of GBP 16, an average gross weekly pay of GBP 604 and an average annual gross pay of GBP 33 500.[11] The average worker in our sample has a seven-year working experience, is around 40-year old and works about 38 hours a week. Slightly over 40% of the observations in the combined sample are associated with high-skilled workers and 34% with female employees.

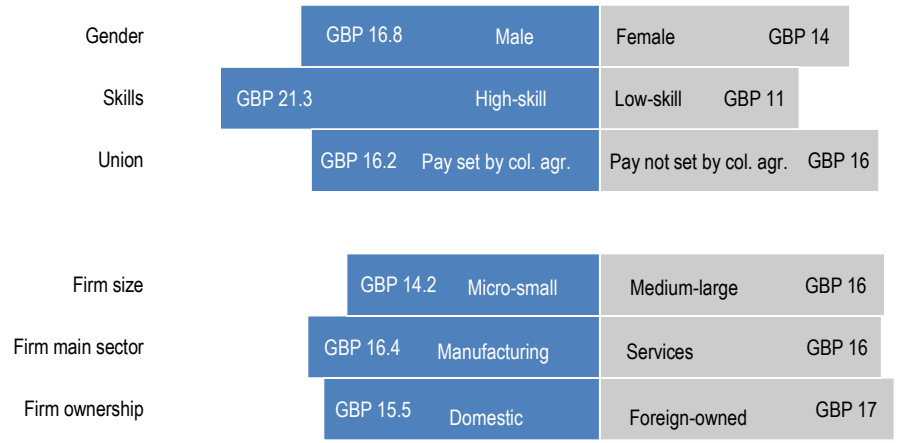
The top panel of Figure 2.1 breaks down average hourly pay in the combined sample by worker and firm characteristics. There is evidence of a skill premium, with workers in high-skilled occupations earning more, and a firm-size wage premium. Both are intuitive and well in line with previous work (Bernard et al. (2007[5])). Foreign-owned firms pay higher wages than domestic ones and there is a gender pay gap, slightly larger for high-skilled workers (Figure 2.1, bottom panel).[12]

[11] These figures are fairly comparable to ONS official statistics, although not exactly identical because of differences in the underlying assumptions (e.g. on the industry selection, age brackets considered, etc.) and a considerable loss of information when merging ASHE to the other two surveys (i.e. ITIS and ABS-ARDx).

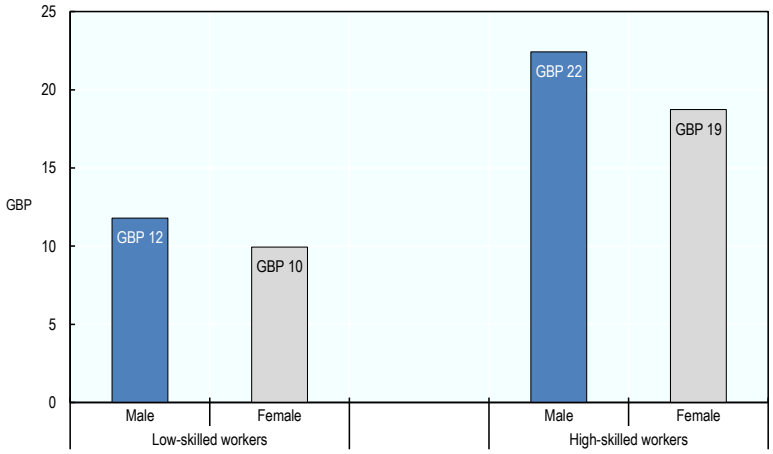
[12] On average, women earn 16.5% less than men in skilled professions, while for unskilled jobs the gender pay gap is 15.7%. These values, although in line with official estimates of gender pay gaps for full-time workers, might mask large variations within broadly defined occupational categories.

Figure 2.1. Wage heterogeneity

A. Average hourly pay, in levels, 2004-2017



B. Average hourly pay by gender and skill-level, 2004-17



Note: Data are weighted and expressed in GBP at constant 2015 prices. Services industries in our sample do not cover the financial sector and include many companies in distribution, education, transport and logistics.
Source: Own calculations based on UK Office of National Statistics International Trade in Services Inquiry, Annual Responded Database, Annual Business Survey and Annual Survey of Hours and Earnings datasets.

Finally, Table 2.2 presents evidence of a wage premium of trading firms, and in particular for those firms engaged in both import and export activities. These tend to be larger firms and account for about 12% of the combined sample.[13]

[13] See Amiti and Davis (2008[39]), Helpman et al. (2010[40]), Haller (2012[17]) and Bamieh et al. (2020[41]), *inter alia*, for trading firms wage premium, and Verhoogen (2008[18]), Martins and Opromolla (2011[42]) and Tanaka (2015[19]) as examples of studies providing similar evidence using linked employer-employee data.

Table 2.2. Wages by trade status

	Average hourly wage (GBP)	Average gross weekly pay (GBP)	Firm average headcount (number of employees)	Firm median headcount (number of employees)	Firm average annual turnover (GBP '000)	Firm median annual turnover (GBP '000)	Share in total number of firms (%)
Non-traders	15	575	892	375	141,119	37,407	78%
Exporters only	17	642	1,141	426	219,289	57,006	4%
Importers only	14	545	1,539	439	331,559	85,235	6%
Importer-Exporters	19	701	1,761	513	520,415	104,359	12%

Note: All value data are weighted and expressed in British pounds at constant 2015 prices. The averages are computed over the period 2004-2017. Note that non-traders are defined as respondents in the business registry that do not trade services in a given year, thus not present in the services trade survey.
Source: Own calculations based on UK Office of National Statistics International Trade in Services Inquiry, Annual Responded Database, Annual Business Survey and Annual Survey of Hours and Earnings datasets.

While these figures provide some interesting employment and wage patterns for firms engaging in services trade, they do not reveal any causal relationship. The next section lays out the methodological framework for a more systematic analysis.

3. Empirical methodology

The methodology applied in this paper follows a twofold strategy in line with Hummels et al. (2014[2]), adapted to services trade as described in Lassmann (2020[6]). First, we examine trade effects for different outcomes at the firm level, and then, we analyse the impact of trade on individual workers' hourly wages.

We employ fine-grained data described in Section 2 for two main reasons. First, linked employer-employee data allow for the identification of a clear-cut impact of services trade on both individual firms and workers within individual job spells, conditional on a host of factors that otherwise cannot be accounted for. Second, these data allow for insights into the distribution of these effects across firms, with varying degrees of engagement in international trade, and workers of different characteristics.

To examine the effects of increased services trade at the firm level, we estimate the following panel regression as a first step:

$$lnY_{jt} = \alpha_0 + \alpha_M lnM_{jt}^s + \alpha_X lnX_{jt}^s + \mu_j + \varphi_{IND,t} + \rho_r + \varepsilon_{jt}, \quad (1)$$

where lnY_{jt} refers to the log of a firm level (*j*) outcome in a given year (*t*);[14] lnM_{jt}^s are firm level log imports of service *s* in *t*; lnX_{jt}^s are the log value of services exports; μ_j, $\varphi_{IND,t}$ and ρ_r are firm, industry-time and region fixed effects; and ε_{jt} is an idiosyncratic error term, which is clustered at the firm level. We estimate different specifications, in which we include only imports, exports and both simultaneously. This way, we account for differences across firms with different trade status, which Table 2.2 has revealed. As the sample compositions may differ across those firms, the employment and wage responses may do so as well.

The firm level outcomes used as dependent variables are log annual turnover, log total employment, log labour productivity (gross value added at basic prices divided by number of employees), log wage bill per worker (total employment costs divided by number of employees), log gross output, log profits (gross operating surplus) and log material inputs (goods and all raw materials used in the running of the business).

[14] The indexation of firm-level outcomes could also include its sector of main activity *s* and region where it is located *r*, but since these are mostly specific to a given firm in a given year, the notation can be simplified.

Industry-year fixed effects are intended to capture for example demand or supply shocks specific to industries in a given year, or general industry prices (including inflation), and productivity, while region fixed effects take account of general characteristics, including economic ones, of the regions where the firms are located. Firm fixed effects take account of any factors specific to the firm that do not vary over time. Such factors could include, for example, a generic type of specialisation and firm-specific comparative advantage.

In a second step, we employ worker-level regressions of the following form:

$$ln\omega_{ijt} = \beta_0 + \beta_M lnM_{jt}^S + \beta_X lnX_{jt}^S + \gamma\Omega_{it} + \delta Z_{jt} + \lambda_{ij} + \theta_{ind,t} + \zeta_r + \epsilon_{ijt} \quad (2)$$

where $ln\omega_{ijt}$ refers to log of hourly wage of individual *i* working in firm *j* in year *t*;[15] Ω_{it} includes worker-level characteristics (described below), some of which vary over time; Z_{jt} includes log total employment and log turnover as firm level control variables; λ_{ij} is a job-spell fixed effect; $\theta_{ind,t}$ and ζ_r are industry-year and region fixed effects; and ϵ_{ijt} is an idiosyncratic error term clustered at the firm-year level.[16]

The worker-level characteristics are: gender (1=female, 0=male), age, a squared term of age, a dummy indicating whether a worker is high-skilled (1) or not (0), and a dummy indicating whether a worker's wage is set by collective agreements (1) or not (0).

Equation (2) is run separately for different subsets of the combined sample: firms importing services, firms exporting services and firms importing and exporting services. While equation (2) represents the baseline, alternative specifications include interaction terms between certain worker's characteristics and the trade variable of interest, to assess the differential impact of trade on wages depending on gender, skill-levels and age. In addition, some specifications also include measures of services trade policy in addition to trade variables.

The inclusion of job-spell fixed effects λ_{ij}[17] is a crucial ingredient as they control for factors specific to a worker in a given job, which could entail for instance specific tasks, ability, experience, etc. Such factors are not easily observed, yet if one ignores them in the estimation, the effect of services trade on wages would be biased. Their inclusion implies that workers need to stay in the same job for at least two years in order to be included in the estimation.[18] This methodology is already solid in itself, but to identify a causal impact for services trade on labour markets, we go beyond this strategy by applying an instrumental variables approach.

Our methodology addresses the possible presence of a simultaneous relationship between trade and wages (or employment) for individual firms. For example, services trade may be boosted by technological advancement, which at the same time affects the firm's labour demand. This is an important concern,

[15] This equation was also estimated for alternative measures of wages, such as log of gross weekly pays, log of annual gross pays as well as log of hours worked by an individual *i*. We find no statistically significant services trade effects on log hours worked and thus omit results for weekly and annual wages, which therefore provide no additional information compared to hourly wages. All results are available from the authors upon request.

[16] Specifications in Tables C.4-C.6 include job-spell and year fixed effects.

[17] While this specification is also rich compared to an OLS regression without fixed effects, it disregards the aspect that firms engaged in services trade may be able to hire workers with experience in services trade industries (i.e. worker mobility is not independent of factors related to the worker-firm combination, e.g. because high-productivity firms typically dominate trade and so may be able to improve the matching quality). See also Krishna, Poole and Senses (2014[10]).

[18] We run an alternative specification using firm and worker fixed effects separately instead of the job-spell fixed effect. Firm fixed effects control, among other things, for an average wage level in a firm, while worker fixed effects account for general characteristics related to the employee, which remain unchanged over time. This alternative approach estimates the effect on workers that switch between firms, while the former approach, using job-spell fixed effects, identifies the effect of interest for a specific pair of worker-firm. We find no statistically significant services trade effects in these alternative specifications. Results are available upon request.

because unobserved productivity improvements or higher demand for a firm's services may increase both labour demand and imported services used for production at the same time (see Autor et al. (2014[1]), Hummels et al. (2014[2]), Lassmann (2020[6])).

This analysis makes use of instrumental variables (IV), further discussed in Annex B, based on world market supply and demand for individual firms. These are expected to be unrelated to firm level factors determining wages or employment, while at the same time they are strongly linked to the supply and demand of specific services that individual firms use as inputs.

While the advantage of understanding a causal effect for services trade is clear, the approach used in this paper is not suitable to identify general equilibrium effects; we recognise that trade may induce knock-on effects, adjustments and reallocations both within and across industries and countries, which are outside the scope of this paper. For example, competition on labour costs, which is a source of comparative advantage for some countries, especially ones exhibiting lower unit labour costs, may affect wages in other countries as well (Lassmann (2020[6])).

4. Main findings

In the following section we present first estimated results at the firm level, assessing the effect of services trade on different firm outcomes. Then, we report regression results at the individual worker-level, looking at the heterogeneous impact of services imports and exports on the wages of different groups of workers.

4.1. Services trade is largely beneficial for firms

Table 4.1 reports the results from estimating equation (1). This equation is estimated on a subset of the linked employer-employee dataset used for the descriptive analysis, that is, it includes only firms trading services. We distinguish between imports in the first panel, exports in the second, and both imports and exports in the third panel of Table 4.1.[19] The latter generally represents on average larger firms than the ones that only import or export.

Overall, increases in services imports and exports are positively correlated with a large variety of firm characteristics, both when considered on their own (Panels A and B) and jointly (Panel C). For example, a rise in services imports by one% is associated with an average increase in annual turnover of 0.04%. Given an average rise in overall services imports of 76%, in real terms, between 2012 and 2017, this would imply an additional 3% increase in the annual turnover of an average services importing firm over the same period.

Similarly, services trade and firm level employment are positively correlated.[20] A one% increase in services exports is associated with an increase in employment of 0.02%. To contextualise these figures, given an average increase in total services exports (in real terms) of 56% over the same five years (2012-2017), this would translate into an increase in employment by 1.4%. For a typical firm employing 269 workers, this effect would correspond, on average, to an additional four employees. The gains are smaller for the other variables related to labour outcomes, but still qualitatively important.

[19] Equation (1) was also estimated using weighted trade and firm-specific data yielding very similar results, hence, for simplicity we report unweighted results.

[20] Firm level employment elasticities estimated for the United Kingdom are qualitatively similar to those found in the literature. See Eppinger (2019[22]) for Germany, and Hijzen et al. (2011[23]) for the United Kingdom.

Table 4.1. Effect of services trade on firms

Dependent var. (in logs)	Turnover	Employment	Productivity	Wage bill	Output	Profits	Material
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
				Panel A. Log imports			
Log imports	0.0402***	0.0250***	0.0096**	0.0065**	0.0455***	0.0358***	0.0523***
	[9.16]	[8.92]	[2.31]	[2.52]	[11.38]	[4.79]	[5.23]
Obs.	29,062	29,196	27,723	29,089	24,891	22,413	27,150
R-squared	0.93	0.96	0.68	0.79	0.95	0.81	0.86
No. clusters	6,755	6,789	6,509	6,754	6,002	5,480	6,399
				Panel B. Log exports			
Log exports	0.0360***	0.0237***	0.0133***	0.0134***	0.0372***	0.0412***	0.0267***
	[8.17]	[7.42]	[3.03]	[4.69]	[7.50]	[5.01]	[2.84]
Obs.	27,034	27,183	26,064	27,036	22,389	21,147	24,800
R-squared	0.93	0.96	0.69	0.78	0.95	0.82	0.84
No. clusters	6,525	6,559	6,330	6,508	5,658	5,337	6,098
				Panel C. Log imports and exports			
Log imports	0.0395***	0.0218***	0.0062	0.0011	0.0409***	0.0301***	0.0556***
	[6.69]	[5.64]	[1.19]	[0.33]	[7.47]	[3.06]	[3.90]
Log exports	0.0225***	0.0158***	0.0047	0.0112***	0.0188***	0.0230**	0.0027
	[3.90]	[3.86]	[0.84]	[3.16]	[3.08]	[2.15]	[0.23]
Obs.	19,408	19,509	18,678	19,434	16,381	15,092	17,787
R-squared	0.93	0.96	0.68	0.78	0.95	0.81	0.84
No. clusters	4,632	4,656	4,493	4,632	4,095	3,766	4,325

Note: *** p<0.01, ** p<0.05, * p<0.1, t-statistics reported in brackets. All monetary values are measured in real GBP. All dependent variables are at the level of establishments. Pooled panel regressions from 2004 to 2017, including firm-, industry-year and region-fixed effects. The standard errors are clustered at the firm level.
Source: Own calculations based on UK Office of National Statistics International Trade in Services Inquiry, Annual Responded Database and Annual Business Survey datasets.

4.2. Services trade has a small, but heterogeneous, on-the-job effect on wages

This section examines the causal effects of services trade on wages. The estimation results for equation (2) relating changes in individual worker's hourly wage to changes in trading activity by the employing firm, while controlling for firm and worker specificities, are reported in Tables A C.1 - A C.6 along with estimates of the correlation effects between trade and wages.[21] The results are organised by different subsets of the combined sample: firms that import services, firms that export services and firms that import and export services.

This sub-section focuses on the results obtained in the baseline specification (first two columns of the tables in the annex), while the rest of this section describes the estimates obtained from interacting certain worker's characteristics with services trade. The overall effects in terms of wage elasticities to trade for different groups of workers, derived from the coefficients reported in Tables A C.4 – A C.6, are shown in Table 4.2.

Results shown in the last three columns of Table 4.2 (and in odd columns in the tables reported in Annex C) provide estimates of the direct effect of services trade on wages when holding certain firm characteristics constant. However, increases in foreign trade are correlated with increases in productivity levels, which in turn might lead firms to employ more workers and/or pay higher wages. Hummels et al. (2014[2]) show that by removing from equation (2) firm variables, one can control for this productivity effect; these results are reported in the first three columns of Table 4.2 (or in even columns of the tables in Annex C).

[21] The estimation is done at the individual worker-firm-year level and includes job-spell, industry-year and regional fixed effects. The estimated results in the annex are very similar to those obtained using weighted labour, trade and firm data.

Overall, the estimated results from the baseline specification show qualitatively important wage effects from services trade within an average job spell. Increases in services imports of one percent lead to a rise in hourly wages by 0.14-0.15% (Table A C.4). Hourly wages do not respond in a statistically significant way to growth in services exports (Table A C.5), however when looking at firms that both export and import services, this effect becomes significant, amounting to 0.05-0.06% (Table A C.6). For these firms, the impact of higher services imports drops to 0.03-0.05%.

These figures are economically significant when put into context. With total services import increasing by 76% between 2012 and 2017, our estimates imply a 12% increase in average hourly wages solely due to higher services trade (e.g. from GBP 16 to nearly GBP 18).

The rest of the coefficients on worker and firm characteristics in the baseline specification have the expected sign and are mostly positively (and significantly) correlated with increases in hourly wages (Tables A C.4-C.6). We find evidence of a general skill-premium, particularly for firms importing services. For instance, high-skilled workers in importing firms earn nearly 5% more than low-skilled workers, within the same job spell and when holding all other factors constant (Table A C.4). The latter means that this premium is solely due to the general skill difference, and not to other factors such as experience on the job, job-specific skill requirements (accounted for by the job spell fixed effect), or age, which affect wage in a positive way. This skill premium is also highly robust in magnitude across different specifications.[22]

Results show that hourly wages increase with the worker's age, slightly more for those workers employed by services exporters and firms that both import and export (Tables A C.5 and A C.6). This age premium is diminishing as the worker gets older. The coefficient on the gender dummy is negative in the baseline specification for these three types of firms, suggesting a gender pay gap independent of trade of about 3% to 7% for female workers of firms exporting and importing services, respectively (Tables A C4 and A C.5).

Finally, collective wage bargaining brings tangible benefits to workers employed in trading firms, with wage differentials ranging from 0.45% to 0.94% for workers whose pay is not set by collective agreements (Tables A C.4 – A C.6).[23] These differentials are not always statistically significant. We also find evidence that larger firms tend to pay higher wages.

4.2.1. Services imports lead to small reductions of the gender pay gap

The results reported in columns 3 and 4 of Tables A C.4 - A C.6 show how hourly wages of female and male workers react to changes in trading behaviours.[24] Table 4.2 below shows the overall effect of trade for different groups of workers, including female and male employees. Note that results on the left-hand side refer to our preferred estimates, because they exclude possible productivity effects. In these regressions, we find no robust evidence of a statistically significant underlying gender pay gap for a subset of firms in our sample. However, these figures are difficult to interpret as such, because they hold for firms

[22] We also run a series of alternative specifications with different sets of fixed effects and control variables, all yielding similar results.

[23] See also Carluccio et al. (2015[43]) for an assessment of how wage elasticities to trade are different depending on the wage bargaining regimes adopted by French firms. Note that in our ASHE sample, more than half of the individuals are covered by collective agreements (about 55%). However, at the population level, about 17% of employees had trade union membership in 2019, according to statistics based on all non-financial services industries (by SIC classification). Source: ONS, Trade union statistics 2019.

[24] Results are very similar for specifications controlling for worker's occupation via fixed effects. The estimated results reported in Annex C and in Table 4.2 are based on a sample of full-time employees only; no statistically significant evidence was found for a similar specification run only on part-time workers, which, however, accounted for a very small fraction of our linked employer-employee dataset.

that have zero trade (as they refer to the intercept in our estimation model). The differential impact of increased trade on wages of women versus men yields more interesting results.

When looking at importing firms, there is a positive impact on hourly wages of rising trade for women. The coefficient for men is negative but not statistically significant (Table 4.2 based on Table A C.4). There is no statistically significant effect linked to higher exports (Table 4.2 based on Table A C.5). In firms that trade in both directions, we find a positive overall growth in both female and male workers' wages due to increases in the trading activity of the employing firm (Table 4.2 based on Table A C.6). These effects are small and, overall, about the same for women and men.

To contextualise our findings, for an average increase in total services import of 76% between 2012 and 2017, and an average hourly wage of GBP 16, our estimates would imply a 38% increase in the hourly wages of women (e.g. around GBP 22) solely due to higher services imports by the employing firm. However, a similar increase in services imports in firms that also export, would lead to a milder increase of 5% in female average hourly wages (e.g. around GBP 17).

The overall effects of services trade for men versus women (and similarly, for low-skilled versus high-skilled, discussed below) differ according to the sample of firms that we study. For example, we show that increased services imports reduce the gender wage gap and have considerable positive effects on female wages (Table 4.2 based on Table A C.4). The magnitude is much smaller when looking at increased imports of firms that both import and export (Table 4.2 based on Table A C.6). Since we control for individual and job characteristics, and report results with and without firm level controls, we rule out explanations due to differences in productivity, skills, etc. Instead, it is possible that this difference is due to the different samples studied (one including all services imports and one including imports of firms that both import and export).

Table 4.2. Heterogeneous effect of services trade on hourly wages (percentage change)

	Net of trade-related productivity effects			Including productivity effects		
	Firms importing services	Firms exporting services	Firm importing and exporting services	Firms importing services	Firms exporting services	Firm importing and exporting services
Import effect on male workers	-0.14		**0.05**	-0.13		**0.03**
Import effect on female workers	0.51		0.06	0.50		0.04
Export effect on male workers		0.03	**0.06**		0.01	**0.05**
Export effect on female workers		-0.02	0.05		-0.03	0.06
Import effect on low-skilled workers	**0.16**		**0.04**	**0.14**		**0.03**
Import effect on high-skilled workers	0.15		0.04	0.15		0.03
Export effect on low-skilled workers		-0.02	**0.07**		**-0.05**	**0.06**
Export effect on high-skilled workers		0.00	**0.04**		**-0.02**	**0.04**

Note: This table reports the overall effects calculated on the basis of the estimated coefficients in Tables A C.4-C.6 in Annex C, including IVs, and represent the estimated percentage change in hourly wages of each specific group of workers listed in the table. Effects in grey are based on less precise estimates, while those in bold are estimated with higher precision.
Source: Own calculations based on UK Office of National Statistics International Trade in Services Inquiry, Annual Responded Database and Annual Business Survey and Annual Survey of Hours and Earnings datasets.

4.2.2. Higher services trade improves the wages of both high and low-skilled workers

The literature on trade and skills shows that offshoring hurts disproportionately lower skill occupations, and those that are more tradable.[25] The results from the correlation analysis, reported in Tables A C.1 - A C.3 in Annex C, show a mild negative effect for low-skilled workers.[26] However, these are likely to be biased estimates as they do not account for the possible unobservable linkages between external changes of parts of the economy or the economy as a whole (e.g. a technology improvement), that might affect both trade and wage setting at the same time.

When we account for this simultaneity problem through the use of instrumental variables, we do not find evidence of a skill-premium (Tables A C.4 – A C.6). On the contrary, increased services imports have about the same positive overall effect on wages of high-skilled compared to low-skilled workers, conditional on the specific skills required for the job or the unobserved.[27] This pattern is the same for increases in services imports and exports among firms that do both types of trading activities, while there is no significant effect when only accounting for exports.

4.2.3. No evidence of a strong age-premium from trade in services

The last two columns of Tables A C.4 – A C.6 report the results obtained from specifications including interactions of trade variables with age. While the corresponding findings are ambiguous, they are economically unimportant. We observe a small positive wage effect associated with stronger import performance, which increases with age (Table A C.4). This age premium kicks in just after the age of 25, in a qualitatively important way, but is small in magnitude (Figure 4.1). When it comes to exports (Table A C.5), we find a small positive effect on the wages of young employees, which is decreasing in age and becomes negative from around age 45 onwards (in principle, the diminishing return to age due to higher services exports holds already for workers aged 40, however it is not statistically significant as shown in Figure 4.1).

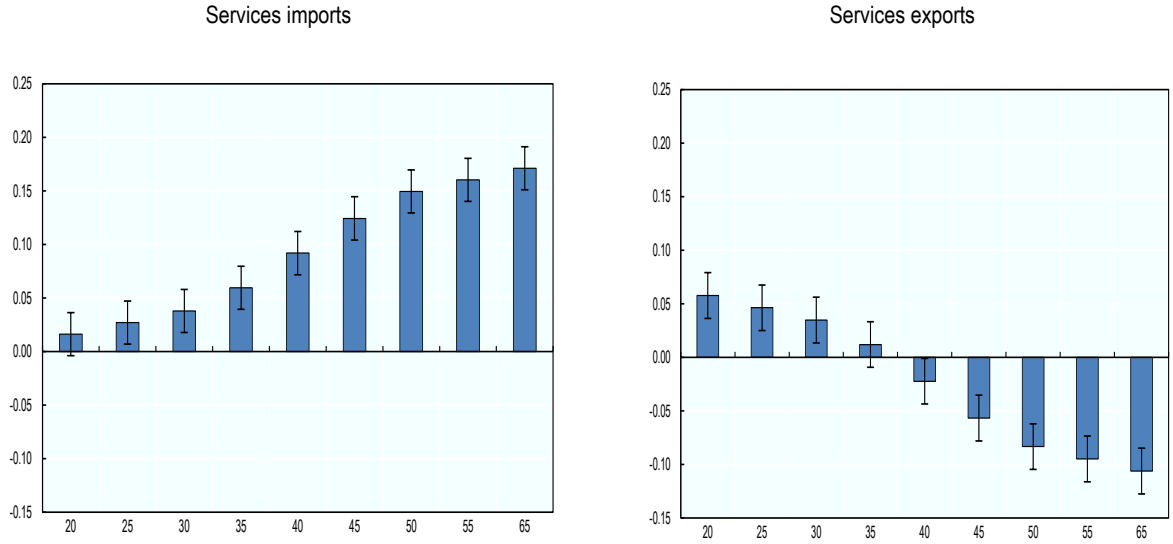
When looking at firms that both import and export, there is no more such significant difference in age, due to higher services trade (Table A C.6). Generally, we observe that firm productivity does not play a role for potential trade-related effects of age. This is because our findings do not change whether or not we account for firms' characteristics. In addition, we have accounted for simultaneous productivity changes by way of an appropriate estimation strategy (e.g. instrumental variables). This is consistent with Haltiwanger et al. (1999[7]). Finally, it is also worthwhile to note that we have accounted for a general positive relationship between age and wages, which holds independently of trade.

[25] Crinò, (2010), Borghi and Crinò (2013), Geishecker and Görg (2013), Liu and Trefler (2019).

[26] In the correlation analysis, we also analysed how changes in trade are associated with changes in hourly wages of skilled workers by gender (see Tables A C1-C3 in Annex C, columns 7 and 8). In those specifications, we found a negative effect mostly for low skilled male workers. Nevertheless, as hinted above, these results might be biased because the estimation strategy did not account for possible endogeneity problems.

[27] Note that the wage effects are negative for both low- and high-skilled workers when looking at firms that only export. However, this negative wage influence becomes qualitatively unimportant when firm productivity it is taken into account. We can therefore not confirm a negative wage effect stemming from trade in a causal manner.

Figure 4.1. Marginal change in wage from trade by age (%)



Note: These estimates are the marginal changes in hourly wages from a one percentage increase in services imports and exports, while holding the age of workers in our estimation sample constant at values ranging from 20 to 65. The vertical bars represent the standard errors. These margins are derived from the specifications reported in column 7 of Tables A C.4 and A C.5.
Source: Own calculations based on UK Office of National Statistics International Trade in Services Inquiry, Annual Responded Database and Annual Business Survey and Annual Survey of Hours and Earnings datasets.

4.3. Services trade barriers have a small but negative impact on hourly wages

Table A C.7 in reports the estimated results including different measures of trade barriers, as captured by the OECD Services Trade Restrictiveness Index (STRI), the intra-EEA STRI and the Digital STRI. In these specifications, these measures of trade barriers vary across firms by construction.[28]

Overall, the findings point to a negative link of services trade barriers with hourly wages. Higher services trade barriers translate into lower hourly wages within job spells, particularly so for firms exporting to countries characterised by tighter measures regulating movement of certain services providers, increased barriers to competition and red-tape, which favour domestic companies over UK firms. Nevertheless, the effects on wages are relatively low: a marginal increase in measures related to movement of professional providers, associated for instance with a decrease in the number of months a UK engineer can temporarily work in the foreign country (e.g. from 36 to twelve months), corresponding to an increment of 0.01 index points, on an index that varies between zero and one, would translate into a small reduction in wages of about 0.3-0.4%.

The overall relationship between wages and barriers affecting services traded digitally is positive, but masks considerable variation among the different policy areas that compose the Digital STRI. In particular, we find significant evidence of increases in average wages in UK firms with higher services exports to countries where enforcement mechanisms to redress copyrights and trademarks infringements worsen. One possible explanation for this is the absence of downward pressures on the wages of UK employees due to the fact that UK companies might be reluctant to move sensitive R&D activities to countries with weaker protection of Intellectual Property Rights (IPRs). Moreover, fear of misappropriating sensitive new

[28] For each firm, we construct a trade policy measure by combining the respective STRI score for every type of service and partner country the firm trades with. Therefore, STRI, Intra EEA STRI and Digital STRI scores are firm-specific. We also instrument services trade variables included in the regressions according to the strategy described in Annex B.

technology is a great concern for many companies, thus keeping design activities close to home might be perceived as more secure.

We also find evidence that hourly wages coincide negatively with trade barriers, for firms trading more intensively with partner countries whose regulatory frameworks related to electronic transmissions and on-line payments deviates further from internationally accepted standards. In other words, UK companies might trade more with countries that have a more receptive regulatory environment for the digital delivery of their services; thus, they could internalise a possible productivity effect, due to serving more markets, by paying higher wages. Similarly, UK firms importing services from countries with more inefficient communication infrastructures and limitations to cross-border data flows might experience a decrease in productivity, which could translate into lower wages at home.

5. Conclusions

The services sector makes an important contribution to the UK economy, providing jobs to over 80% of the UK labour force. And while the United Kingdom is a net exporter of services, services embodied in other traded products further contribute the country's trade surplus, indirectly sustaining jobs in other sectors. The evidence presented in this paper is based on detailed linked employer-employee data and show that the impact of services trade on employment and wages is overall positive, but moderate.

Increases in trade in services are associated with higher employment and better firm performance, perhaps reflecting trade-related boosts in productivity. This finding has implications for services trade policies and domestic policies aiming at enhancing productivity growth.

However, we find evidence that the benefits of services trade, in terms of higher wages, are not spread equally among different groups of workers within the same employing firms. For instance, the distributional effect of services trade on labour market outcomes varies across female and male workers. Women are found to benefit more from services imports. Our findings show no strong evidence of skill nor age premia.

Moreover, we find that policies addressing the reduction of regulatory obstacles to services trade are associated with an increase in productivity, which in turn, could contribute to a lower gender pay gap. Future work on trade and gender pay gaps will shed further light on these results.

UK firms and UK workers stand to benefit from more open markets. Even small reductions in regulatory hurdles to services trade among foreign partners lead to greater participation of UK firms, particularly by smaller and medium-size enterprises, which tend to employ a large share of British workers in some sectors (Rouzet et al. (2017[4])). Firms that are more active outside their home country are also more productive and more likely to pay higher wages (e.g. Bernard and Jensen (1999[8]), Melitz (2003[9])).

Our findings show that domestic policies aimed at ensuring greater competition in foreign markets and favouring temporary cross-border movement of British professionals could lead to improvements of wages at home. Similarly, limiting the extent of obstacles to electronic transmissions, online payments and exchange of data would have positive effects on wages, possibly through a productivity effect. Hence, it stands to reason that concerted policy actions on a bilateral, and preferably multilateral, level encouraging behind-the-border policy reforms in key foreign markets and the adoption of internationally-accepted standards could bring additional benefits to UK firms and British workers.

The approach followed in this paper does not aim to capture the full picture of the re-distributional effects of trade across sectors, regions and countries, nor the indirect effects of trade on labour markets, for example, through increased competition on wages or changes in job quality. These aspects, while interesting, are beyond the scope of this paper, but would deserve further attention in view of the disruptions to both production and labour markets in a post-COVID-19 situation.

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Annex A. Data

This annex describes the three main sources of micro-level data and how these are combined for the purpose of this analysis.

Employee-level data

Individual-level data is extracted from the Annual Survey on Hours and Earnings (ASHE). ASHE is composed of a 1% random sample of employee jobs taken from HM Revenue and Customs' Pay As You Earn (PAYE) register, approximately 180 000 employee jobs.[29] ASHE collects data on earnings and hours worked broken down by gender, age, occupation, industry, region, union[30], and a number of other characteristics. In addition, ASHE includes weighting factors that provide a way of aggregating results to the UK working population. Unlike the Labour Force Survey (LFS), which is self-reported by employees[31], ASHE gathers the information through annual questionnaires addressed directly to employers, ensuring greater accuracy and consistency on earnings, hours worked and occupational records. ASHE, however, does not sample, by design, the self-employed and has a relatively more limited range of personal characteristics compared to LFS, the latter including also information on educational levels, nationality, etc. The initial sample of individual worker-level data is subject to quality checks (e.g. removal of duplications among workers, implausible and extreme values for hours worked and weekly earnings, observations for which there are no firm identifiers, etc.) and trimmed to only include employees aged 18-64 in their main job, with positive working hours and weekly earnings over the period 2004-2017. Gross weekly pay and hours worked exclude overtime, and so do hourly earnings (being the ratio of the former two concepts). Following Hummels et al. (2014[2]), without educational data, workers are classified as high-skilled or low-skilled on the bases of their occupational category; high-skilled workers correspond to ISCO-08 highest skill levels (3 and 4).[32] Only full-time workers are considered in the analysis, with the exception of specifications examining the differential impact of trade on gender.

Firm-level services trade data

The main source for services trade data at the firm and plant level is the International Trade in Services Inquiry (ITIS). ITIS collects quarterly and annual unaffiliated, or arm's length, services trade data from

[29] See the latest Quality and Methodology Information for ASHE: https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/earningsandworkinghours/methodologies/annualsurveyofhoursandearningslowpayandannualsurveyofhoursandearningspensionresultsqmi.

[30] ASHE also provides information on whether the individual worker's pay is set according to collective agreements. These collective agreements can be at the national or industry level, sub-national, organisational and workplace agreements.

[31] The accuracy of the information collected through LFS varies considerably due to proxy responses (in particular when the information is provided by a household respondent – often not the breadwinner – without any reference to detailed documentation on pay slips nor number of hours worked in a week) or to different interpretation that respondents might have for certain concepts, such as part-time, occupation, industry. Ormerod and Ritchie (2007[25]) have documented a tendency for LFS to under-report earnings below the 10th%ile and above the 90th%ile.

[32] High-skilled occupations correspond to the following two digits categories of the Standard Occupational Classification 2010 (in line with the International Standard Classification of Occupations 2008): Managers, directors and senior officials; Professional occupations; and, Associate professional and technical occupations. All other occupations are classified as low-skilled.

approximately 16 000 trading UK businesses in the private sector with ten or more employees.[33] The target population is the universe of UK businesses in the IDBR. Firms are indirectly selected using filter questions on other business surveys, directly sampled in "high propensity industries", or in a group of "known traders" (based on previous transactions). The survey contains information on the value of services imports and exports by country of origin and destination, respectively, as well as on the product group.[34] ITIS does not cover the entirety of the United Kingdom's international transactions in the sense that it excludes consumer services such as travel, transport, and higher education. Banking, film and television, and the majority of legal services are also excluded from ITIS and collected through a series of additional surveys conducted by the ONS or the Bank of England. Nevertheless, in 2017, ITIS still accounted for nearly 60% and 50% of total UK services exports and imports estimates, respectively.[35] ITIS also reports the region and the activity of the business according to the Standard Industrial Classification (SIC). ITIS data are already treated for outliers, hence the only treatment applied to this dataset is the dropping of duplicates and observations without information on firm identifier and year.

Business registry data

From 2009 onwards, structural business data are sourced from the Annual Business Survey (ABS), which covered about 73 000 reporting businesses in 2017, active in production industries, construction, distribution and other services industries.[36] The ABS collects financial information from the UK non-financial economy, which accounts for about two-thirds of the overall economy. Prior to 2009, data are obtained from the Annual Respondents Database (ARDx). The ABS includes, among others, financial information such as output, gross value added at basic prices, gross operating surplus, material inputs, etc. Data are classified by industry of main activity, following the SIC 2007, and by region. Employment information, such as total number of employees and employment costs, is also covered in the combined ARD-ABS dataset. We clean both the yearly ARD and ABS respondent files by dropping duplicate observations, observations without information on firm identifier, observations with imputed values. We finally append the yearly files. All variables but the ones referring to quantities are deflated using the consumer price index (CPI) for the United Kingdom from the OECD Harmonised Index on Consumer Prices database (2015=100).

The results used in the descriptive analysis are weighted to make the combined sample as representative of the underlying population as possible. In particular, employee data are calibrated to population totals taken from the Labour Force Survey, based on classes defined by occupation, region, age and gender. Business information is weighted up to the register population using the inverse sampling probabilities, so that they relate to all active UK businesses for the sectors covered. Weights for trade figures are based on the conditional probability of being included in the combined ITIS|ABS-ARD sample.[37]

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[33] The quarterly survey focuses on approximately 2 200 large companies with international transactions exceeding GBP 10 million, while the annual survey, which covers nearly 15 500 UK-based businesses, also covers smaller enterprises. Quarterly and annual results are aggregated in the annual ITIS estimates.

[34] The classification of service types used in ITIS is based on the Extended Balance of Payments Services classification and covers 52 different types of services products, mostly producer services used as intermediate inputs into the production of other goods and services.

[35] See the latest Quality and Methodology Information for international trade in services: https://www.ons.gov.uk/businessindustryandtrade/internationaltrade/methodologies/internationaltradeinservicesqmi.

[36] See the Quality and Methodology Information for the Annual Business Survey for 2017 data: https://www.ons.gov.uk/businessindustryandtrade/business/businessservices/methodologies/annualbusinesssurveyqmi.

[37] Breinlich and Criscuolo (2011[3]) provide an extensive discussion of weighting procedures for a matched ITIS-ARD sample.

Annex B. Instrumental variables

The empirical methodology laid out in Section 3 is based on panel regressions that involve different sets of fixed effects, which are supposed to remove bias in the estimated coefficients due to factors that cannot be observed. Most importantly, job spell fixed effects are included. These capture various factors that influence the wage in a given job, such as specific task or skill requirements (Krishna, Poole and Senses, 2014[10]). According to Hummels et al. (2014[2]), however, not all endogeneity can be removed through this approach. Using firm-level manufacturing trade and employees' wages for Danish firms, the authors state that change in firm productivity or output demand influence both the demand for (unskilled) labour and trade (intermediate input imports). This generates correlation between the two, and thus bias in the estimated coefficients. Similar concerns hold for the setting under study here, i.e. trade in services in the United Kingdom. With the aim of obtaining a causal estimate for the effect of services trade on wages, this paper therefore augments the empirical specification by employing an instrumental variables (IV) strategy.

Precisely, the instrumental variable for exports is constructed as $\tilde{X}_{jt}^{s} = \sum_{c,k} s_{jkc}^{s} X_{ckt}^{s}$, where s_{jck}^{s} is the share of a service (*s*) type *k* in firm *j*'s exports to country *c,* over all services exports to all countries in a time period before the start of our analysis. In our case, this period refers to a period before each firm starts to trade, i.e., this base period differs across firms. A common base period would be preferred, but this choice is necessary due to survey data limitations. In addition, this keeps fluctuations constant and is computed from the data described in Section 2.1. X_{ckt}^{s} refers to the services exports of a given product by country *c* in year *t* to all other countries except the one in which the firm is located. Trade data are sourced from the WIOD database (2005-2014).[38]

Thus, the instrumental variable essentially reflects two things: first, the share measure lets each firm export a specific mix of services, and second, changes in world demand for these products affect firm's exports depending on this mix. For example, firms that specialise in the exports of business services benefit from a worldwide increase in demand for these types of services as compared to firms specialising in transport services. The calculation is analogous for imports. The validity of this approach hinges on the assumption that the IV and the trade variables are correlated, but that the IV does not affect wages directly, and is not correlated with other factors that determine productivity and wages.

[38] Note that the variable X_{ckt}^{s} uses ISIC industries *p* instead of services types *k*, i.e. it would be X_{ckt}^{s}. However, we pre-match industries to services types so that notation can use the index *k*. Note also that *p* is specific to the firm *j*.

Annex C. Additional tables

Table A C.1. Correlation effect of services imports and workers hourly wage

Dependent variable: Log of hourly wages	Baseline		Gender		Skill		Skill-Gender		Age		Age-Skill	
	With firm-controls	Without firm-controls	With firm-controls	Without firm-controls	With firm-controls	Without firm-controls	With firm-controls	Without firm-controls	With firm-controls	Without firm-controls	With firm-controls	Without firm-controls
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Log(imp)	-0.0001	0.0002	-0.0009	-0.0006	-0.0011	-0.0008	-0.0020**	-0.0017*	0.0196***	0.0204***	0.0134***	0.0140***
	[-0.14]	[0.32]	[-1.17]	[-0.74]	[-1.22]	[-0.86]	[-2.14]	[-1.83]	[7.20]	[7.47]	[4.70]	[4.91]
Female	-0.0217	-0.0218	-0.0494**	-0.0503**	-0.0214	-0.0215	-0.0594**	-0.0607***	-0.0252	-0.0253	-0.0238	-0.0239
	[-1.34]	[-1.34]	[-2.20]	[-2.24]	[-1.32]	[-1.32]	[-2.52]	[-2.58]	[-1.51]	[-1.51]	[-1.43]	[-1.44]
Female * log(imp)			0.0026*	0.0027*			0.0028*	0.0029*				
			[1.89]	[1.96]			[1.85]	[1.92]				
High-skill	0.0429***	0.0429***	0.0429***	0.0429***	0.0211**	0.0204**	0.0112	0.0103	0.0520***	0.0520***	-0.0496	-0.0522
	[12.27]	[12.25]	[12.27]	[12.25]	[2.50]	[2.42]	[1.20]	[1.10]	[14.24]	[14.22]	[-1.49]	[-1.57]
High-skill * log(imp)					0.0021**	0.0022**	0.0024***	0.0025***			0.0148***	0.0151***
					[2.45]	[2.52]	[2.64]	[2.73]			[4.55]	[4.63]
High-skill * Female							0.0259	0.0267*				
							[1.62]	[1.67]				
Highskill*Female*log(imp)							-0.0003	-0.0003				
							[-0.19]	[-0.23]				
Age	0.0377***	0.0378***	0.0377***	0.0378***	0.0377***	0.0378***	0.0377***	0.0377***	0.0004	0.0005	-0.0001	0
	[16.01]	[16.05]	[16.02]	[16.06]	[16.01]	[16.05]	[15.96]	[16.00]	[0.20]	[0.25]	[-0.06]	[-0.02]
Age^2	-0.0005***	-0.0005***	-0.0005***	-0.0005***	-0.0005***	-0.0005***	-0.0005***	-0.0005***				
	[-40.70]	[-40.77]	[-40.93]	[-41.00]	[-40.62]	[-40.68]	[-40.81]	[-40.88]				
Age * log(imp)									-0.0005***	-0.0005***	-0.0004***	-0.0004***
									[-7.64]	[-7.76]	[-5.34]	[-5.43]
High-skill * Age											0.0017**	0.0017**
											[2.30]	[2.36]
High-skill*Age*log(imp)											-0.0003***	-0.0003***
											[-3.96]	[-4.02]
Union	0.0084***	0.0084***	0.0084***	0.0084***	0.0084***	0.0084***	0.0084***	0.0085***	0.0089***	0.0090***	0.0090***	0.0090***
	[2.93]	[2.95]	[2.93]	[2.95]	[2.96]	[2.97]	[2.97]	[2.99]	[2.95]	[2.97]	[2.99]	[3.01]
Log(turnover)	0.0068***		0.0068***		0.0068***		0.0068***		0.0078***		0.0076***	
	[3.26]		[3.25]		[3.25]		[3.25]		[3.63]		[3.57]	
Log(employment)	0.0177***		0.0176***		0.0176***		0.0174***		0.0168***		0.0167***	
	[4.85]		[4.84]		[4.82]		[4.78]		[4.53]		[4.49]	
Observations	158,279	158,317	158,279	158,317	158,279	158,317	158,279	158,317	158,279	158,317	158,279	158,317
R-squared (adj.)	0.935	0.935	0.935	0.935	0.935	0.935	0.935	0.935	0.932	0.932	0.932	0.932
Clusters	16,356	16,371	16,356	16,371	16,356	16,371	16,356	16,371	16,356	16,371	16,356	16,371

Note: *** p<0.01, ** p<0.05, * p<0.1, t-statistics reported in brackets. Dependent variable: log of hourly wages. All regressions are estimated as pooled panel regressions from 2004 to 2017 and include job-spell, industry-year and region fixed effects. All regressions include worker controls: age, age squared, gender, skill and union (i.e. pay set by collective agreements or not). Firm controls (log employment, log turnover) are omitted in even columns. The standard errors are clustered at the firm-year level.
Source: Own calculations based on UK Office of National Statistics International Trade in Services Inquiry, Annual Responded Database and Annual Business Survey and Annual Survey of Hours and Earnings datasets.

Table A C.2. Correlation effect of services exports and workers' hourly wage

Dependent variable: Log of hourly wages	Baseline		Gender		Skill		Skill-Gender		Age		Age-Skill	
	With firm-controls	Without firm-controls	With firm-controls	Without firm-controls	With firm-controls	Without firm-controls	With firm-controls	Without firm-controls	With firm-controls	Without firm-controls	With firm-controls	Without firm-controls
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Log(exp)	-0.0003	0.0001	0.0001	0.0004	-0.0017**	-0.0014*	-0.0011	-0.0008	0.0131***	0.0136***	0.0059*	0.0062*
	[-0.36]	[0.15]	[0.09]	[0.56]	[-2.11]	[-1.70]	[-1.25]	[-0.87]	[4.27]	[4.45]	[1.83]	[1.93]
Female	-0.0346	-0.0346	-0.0222	-0.0218	-0.034	-0.034	-0.0192	-0.0189	-0.0395	-0.0395	-0.0372	-0.0372
	[-1.33]	[-1.33]	[-0.76]	[-0.75]	[-1.30]	[-1.30]	[-0.65]	[-0.64]	[-1.49]	[-1.50]	[-1.42]	[-1.42]
Female * log(exp)			-0.0011	-0.0012			-0.0021	-0.0021*				
			[-1.08]	[-1.12]			[-1.63]	[-1.65]				
High-skill	0.0408***	0.0408***	0.0408***	0.0408***	0.0074	0.007	0.0091	0.0085	0.0514***	0.0515***	-0.0595	-0.0636*
	[10.59]	[10.59]	[10.58]	[10.58]	[0.83]	[0.77]	[0.92]	[0.86]	[12.57]	[12.57]	[-1.54]	[-1.65]
High-skill * log(exp)					0.0031***	0.0031***	0.0025***	0.0025***			0.0159***	0.0164***
					[3.37]	[3.41]	[2.66]	[2.71]			[4.33]	[4.45]
High-skill * Female							-0.008	-0.0076				
							[-0.43]	[-0.41]				
Highskill*Female*log(exp)							0.0023	0.0022				
							[1.27]	[1.26]				
Age	0.0407***	0.0409***	0.0407***	0.0409***	0.0406***	0.0408***	0.0406***	0.0407***	-0.0015	-0.0013	-0.002	-0.002
	[14.41]	[14.49]	[14.41]	[14.49]	[14.38]	[14.46]	[14.35]	[14.43]	[-0.64]	[-0.59]	[-0.89]	[-0.86]
Age^2	-0.0006***	-0.0006***	-0.0006***	-0.0006***	-0.0006***	-0.0006***	-0.0006***	-0.0006***				
	[-38.06]	[-38.08]	[-38.01]	[-38.03]	[-37.92]	[-37.94]	[-37.85]	[-37.87]				
Age * log(exp)									-0.0003***	-0.0003***	-0.0002**	-0.0002**
									[-4.51]	[-4.54]	[-2.52]	[-2.51]
High-skill * Age											0.0016*	0.0017**
											[1.91]	[2.01]
High-skill*Age*log(exp)											-0.0003***	-0.0003***
											[-3.64]	[-3.75]
Union	0.0107***	0.0106***	0.0107***	0.0106***	0.0106***	0.0105***	0.0106***	0.0105***	0.0115***	0.0114***	0.0113***	0.0113***
	[3.19]	[3.17]	[3.19]	[3.17]	[3.20]	[3.18]	[3.22]	[3.20]	[3.12]	[3.09]	[3.13]	[3.10]
Log(Turnover)	0.0070***		0.0070***		0.0069***		0.0069***		0.0090***		0.0087***	
	[3.06]		[3.07]		[3.02]		[3.04]		[3.79]		[3.69]	
Log(Employment)	0.0149***		0.0149***		0.0149***		0.0147***		0.0155***		0.0152***	
	[3.81]		[3.80]		[3.79]		[3.76]		[3.89]		[3.81]	
Observations	133,776	133,830	133,776	133,830	133,776	133,830	133,776	133,830	133,776	133,830	133,776	133,830
R-squared (adj.)	0.931	0.931	0.931	0.931	0.931	0.931	0.931	0.931	0.928	0.928	0.928	0.928
Clusters	14,313	14,334	14,313	14,334	14,313	14,334	14,313	14,334	14,313	14,334	14,313	14,334

Note: *** p<0.01, ** p<0.05, * p<0.1, t-statistics reported in brackets. Dependent variable: log of hourly wages. All regressions are estimated as pooled panel regressions from 2004 to 2017 and include job-spell, industry-year and region fixed effects. All regressions include worker controls: age, age squared, gender, skill and union (i.e. pay set by collective agreements or not). Firm controls (log employment, log turnover) are omitted in even columns. The standard errors are clustered at the firm-year level.
Source: Own calculations based on UK Office of National Statistics International Trade in Services Inquiry, Annual Responded Database and Annual Business Survey and Annual Survey of Hours and Earnings datasets.

Table A C.3. Correlation effect of services trade and workers' hourly wage

Dependent variable: Log of hourly wages	Baseline		Gender		Skill		Skill-Gender		Age		Age-Skill	
	With firm-controls	Without firm-controls	With firm-controls	Without firm-controls	With firm-controls	Without firm-controls	With firm-controls	Without firm-controls	With firm-controls	Without firm-controls	With firm-controls	Without firm-controls
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Log(imp)	0.0006	0.0008	-0.0003	-0.0002	-0.0001	0.0001	-0.0014	-0.0013	0.0239***	0.0245***	0.0182***	0.0186***
	[0.71]	[0.94]	[-0.33]	[-0.18]	[-0.07]	[0.09]	[-1.05]	[-0.96]	[6.51]	[6.64]	[4.79]	[4.89]
Log(exp)	-0.001	-0.0006	-0.0002	0.0001	-0.0021**	-0.0018*	-0.001	-0.0006	0.0022	0.0026	-0.002	-0.0017
	[-1.14]	[-0.76]	[-0.21]	[0.14]	[-2.09]	[-1.78]	[-0.86]	[-0.58]	[0.60]	[0.72]	[-0.51]	[-0.44]
Female	-0.0306	-0.0313	-0.0357	-0.0378	-0.0298	-0.0305	-0.0412	-0.0438	-0.0375	-0.0384	-0.0347	-0.0355
	[-1.34]	[-1.37]	[-1.11]	[-1.18]	[-1.30]	[-1.33]	[-1.23]	[-1.31]	[-1.60]	[-1.64]	[-1.49]	[-1.52]
Female * log(imp)			0.0031	0.0033*			0.0038*	0.0040*				
			[1.58]	[1.69]			[1.66]	[1.76]				
Female * log(exp)			-0.0025**	-0.0026**			-0.0036**	-0.0036**				
			[-2.13]	[-2.17]			[-2.26]	[-2.28]				
High-skill	0.0401***	0.0401***	0.0401***	0.0400***	0.0001	-0.0009	-0.0054	-0.0066	0.0498***	0.0498***	-0.1040**	-0.1092**
	[9.23]	[9.21]	[9.23]	[9.21]	[0.01]	[-0.08]	[-0.41]	[-0.50]	[10.94]	[10.92]	[-2.10]	[-2.21]
High-skill * log(imp)					0.0013	0.0013	0.002	0.0021			0.0112**	0.0114***
					[1.01]	[1.04]	[1.49]	[1.54]			[2.56]	[2.60]
High-skill * log(exp)					0.0024**	0.0025**	0.0016	0.0016			0.0089**	0.0093**
					[2.09]	[2.12]	[1.33]	[1.37]			[2.00]	[2.08]
High-skill*Female							0.0128	0.0136				
							[0.54]	[0.58]				
High-skill*Fem*log(imp)							-0.0017	-0.0017				
							[-0.76]	[-0.77]				
High-skill*Fem*log(exp)							0.0025	0.0025				
							[1.12]	[1.10]				
Age	0.0406***	0.0408***	0.0406***	0.0408***	0.0405***	0.0408***	0.0405***	0.0407***	0.0017	0.002	0.0009	0.0011
	[13.44]	[13.52]	[13.45]	[13.53]	[13.41]	[13.48]	[13.40]	[13.47]	[0.69]	[0.79]	[0.34]	[0.42]
Age^2	-0.0006***	-0.0006***	-0.0006***	-0.0006***	-0.0006***	-0.0006***	-0.0006***	-0.0006***				
	[-33.42]	[-33.46]	[-33.70]	[-33.76]	[-33.30]	[-33.34]	[-33.67]	[-33.72]				
Age * log(imp)									-0.0006***	-0.0006***	-0.0004***	-0.0005***
									[-6.63]	[-6.70]	[-5.10]	[-5.16]
Age * log(exp)									-0.0001	-0.0001	0	0
									[-0.87]	[-0.89]	[-0.05]	[-0.04]
High-skill * Age											0.0023**	0.0024**
											[2.18]	[2.27]
High-skill*Age*log(imp)											-0.0002**	-0.0002**
											[-2.22]	[-2.24]
High-skill*Age*log(exp)											-0.0001	-0.0002
											[-1.56]	[-1.63]
Union	0.0133***	0.0132***	0.0133***	0.0133***	0.0132***	0.0132***	0.0133***	0.0132***	0.0136***	0.0135***	0.0135***	0.0134***
	[3.45]	[3.43]	[3.45]	[3.43]	[3.48]	[3.46]	[3.50]	[3.49]	[3.27]	[3.25]	[3.31]	[3.29]
Log(Turnover)	0.0074***		0.0073***		0.0072***		0.0071***		0.0097***		0.0093***	
	[2.89]		[2.87]		[2.84]		[2.81]		[3.67]		[3.53]	
Log(Employment)	0.0158***		0.0156***		0.0157***		0.0155***		0.0153***		0.0150***	
	[3.54]		[3.51]		[3.51]		[3.48]		[3.37]		[3.29]	
Observations	113,080	113,114	113,080	113,114	113,080	113,114	113,080	113,114	113,080	113,114	113,080	113,114
R-squared (adj.)	0.930	0.930	0.930	0.930	0.930	0.930	0.930	0.930	0.927	0.927	0.927	0.927
Clusters	10,980	10,992	10,980	10,992	10,980	10,992	10,980	10,992	10,980	10,992	10,980	10,992

Note: *** p<0.01, ** p<0.05, * p<0.1, t-statistics reported in brackets. Dependent variable: log of hourly wages. All regressions are estimated as pooled panel regressions from 2004 to 2017 and include job-spell, industry-year and region fixed effects. All regressions include worker controls: age, age squared, gender, skill and union (i.e. pay set by collective agreements or not). Firm controls (log employment, log turnover) are omitted in even columns. The standard errors are clustered at the firm-year level.
Source: Own calculations based on UK Office of National Statistics International Trade in Services Inquiry, Annual Responded Database and Annual Business Survey and Annual Survey of Hours and Earnings datasets.

Table A C.4. Causal effects of services imports on workers' hourly wage

Dependent variable: Log of hourly wages	Baseline		Gender		Skill		Age	
	With firm-controls	Without firm-controls	With firm-controls	Without firm-controls	With firm-controls	Without firm-controls	With firm-controls	Without firm-controls
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log(imp)	0.1538***	0.1395***	-0.1362	-0.1317	0.1561***	0.1415***	-0.0559	-0.0635
	[4.89]	[5.32]	[-0.45]	[-0.24]	[4.88]	[5.27]	[-1.22]	[-1.43]
Female	-0.0722*	-0.0709**	-6.7835**	-6.7176	-0.0727*	-0.0713**	-0.0373	-0.0369
	[-1.91]	[-1.98]	[-2.35]	[-1.48]	[-1.92]	[-1.99]	[-1.31]	[-1.32]
Female * log(imp)			0.6419**	0.6357				
			[2.35]	[1.47]				
High-skill	0.0471***	0.0477***	0.0309***	0.0311**	0.1562*	0.1296	0.0631***	0.0634***
	[13.18]	[13.84]	[3.75]	[2.29]	[1.76]	[1.56]	[17.08]	[17.30]
High-skill * log(imp)					-0.0104	-0.0078		
					[-1.23]	[-0.99]		
Age	0.0341***	0.0334***	0.0451***	0.0450***	0.0342***	0.0335***	-0.0391***	-0.0398***
	[10.19]	[10.19]	[6.79]	[4.16]	[10.33]	[10.30]	[-3.65]	[-3.73]
Age^2	-0.0005***	-0.0005***	-0.0006***	-0.0006***	-0.0005***	-0.0005***		
	[-26.94]	[-26.02]	[-19.06]	[-13.24]	[-27.58]	[-26.55]		
Age * log(imp)							0.0036***	0.0037***
							[3.36]	[3.45]
Union	0.0035	0.0045**	0.0182	0.0184	0.0034	0.0044**	0.0003	0.0005
	[1.62]	[2.09]	[1.59]	[1.36]	[1.59]	[2.07]	[0.14]	[0.24]
Log(Turnover)	-0.0274***		0.0019		-0.0265***		-0.0064	
	[-3.79]		[0.04]		[-3.81]		[-1.40]	
Log(Employment)	-0.0891***		-0.0122		-0.0877***		-0.0338***	
	[-4.30]		[-0.08]		[-4.34]		[-2.81]	
Observations	125,600	125,620	125,563	125,583	125,600	125,620	125,600	125,620
F-test	34.86	43.42	1.022	0.432	17.77	21.98	30.42	44.50

Note: *** p<0.01, ** p<0.05, * p<0.1, t-statistics reported in brackets. Dependent variable: log of hourly wages. All regressions are estimated as pooled panel regressions from 2004 to 2014 and include job-spell and year fixed effects. Results in columns 3-4 include job-spell, industry-year and region fixed effects. All regressions include worker controls: age, age squared, gender, skill and union (i.e. pay set by collective agreements or not). Firm controls (log employment, log turnover) are omitted in even columns. Robust standard errors. F-test refers to the Kleibergen-Paap rk Wald F statistic for weak identification.
Source: Own calculations based on UK Office of National Statistics International Trade in Services Inquiry, Annual Responded Database and Annual Business Survey and Annual Survey of Hours and Earnings datasets.

Table A C.5. Causal effect of services exports on workers' hourly wage

Dependent variable: Log of hourly wages	Baseline		Gender		Skill		Age	
	With firm-controls	Without firm-controls	With firm-controls	Without firm-controls	With firm-controls	Without firm-controls	With firm-controls	Without firm-controls
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log(exp)	-0.0051	-0.0257	0.0275	0.0116	-0.0170	0.1415***	0.1339**	0.2112*
	[-0.39]	[-1.18]	[0.74]	[0.26]	[-0.97]	[5.27]	[2.24]	[1.86]
Female	-0.0385	-0.0344	0.5594	0.3999	-0.0369	-0.0312	-0.0379	-0.0280
	[-1.33]	[-1.15]	[0.86]	[0.58]	[-1.26]	[-1.00]	[-1.25]	[-0.85]
Female * log(exp)			-0.0524	-0.0383				
			[-0.92]	[-0.63]				
High-skill	0.0421***	0.0432***	0.0394***	0.0397***	-0.1260	-0.2301*	0.0508***	0.0512***
	[14.08]	[13.56]	[13.14]	[13.20]	[-1.27]	[-1.67]	[15.14]	[13.20]
High-skill * log(exp)					0. 0150*	0.0244**		
					[1.70]	[1.98]		
Age	0.0407***	0.0424***	0.0409***	0.0416***	0.0406***	0.0425***	0.0359*	0.0689*
	[14.32]	[13.93]	[13.09]	[12.80]	[14.32]	[13.69]	[1.91]	[1.69]
Age^2	-0.0006***	-0.0006***	-0.0006***	-0.0006***	-0.0006***	-0.0006***		
	[-41.94]	[-33.27]	[-46.62]	[-45.78]	[-42.22]	[-32.51]		
Age * log(exp)							-0.0038**	-0.0068*
							[-2.25]	[-1.84]
Union	0.0004	-0.0043	0.0138***	0.0142***	-0. 0007	-0.0069	0.0005	-0.0080
	[0.16]	[-0.95]	[5.82]	[5.88]	[-0.23]	[-1.22]	[0.15]	[-1.12]
Log(Turnover)	0.0116**		0.0073		0.0131***		0.0222***	
	[2.08]		[1.00]		[2.17]		[2.86]	
Log(Employment)	0.0171***		0.0110***		0.0179***		0.0225***	
	[3.23]		[2.75]		[3.25]		[3.90]	
Observations	103,362	103,403	103,333	103,374	103, 362	103,362	103,362	103,403
F-test	50.87	19.19	4.035	2.707	16.91	5.989	5.114	2.097

Note: *** p<0.01, ** p<0.05, * p<0.1, t-statistics reported in brackets. Dependent variable: log of hourly wages. All regressions are estimated as pooled panel regressions from 2004 to 2014 and include job-spell and year fixed effects. All regressions include worker controls: age, age squared, gender, skill and union (i.e. pay set by collective agreements or not). Firm controls (log employment, log turnover) are omitted in even columns. Robust standard errors. F-test refers to the Kleibergen-Paap rk Wald F statistic for weak identification.
Source: Own calculations based on UK Office of National Statistics International Trade in Services Inquiry, Annual Responded Database and Annual Business Survey and Annual Survey of Hours and Earnings datasets.

Table A C.6. Causal effect of services imports and exports on workers' hourly wage

Dependent variable: Log of hourly wages	Baseline		Gender		Skill		Age	
	With firm-controls	Without firm-controls	With firm-controls	Without firm-controls	With firm-controls	Without firm-controls	With firm-controls	Without firm-controls
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log(imp)	0.0533***	0.0306***	0.0524***	0.0268***	0.0436***	0.0257***	0.1688	0.1530
	[4.**23**]	[3.81]	[3.48]	[2.71]	[3.83]	[3.26]	[0.98]	[0.96]
Log(exp)	0.0564***	0.0540***	0.0611***	0.0527***	0.0661***	0.0619***	0.2696	0.2758
	[5.90]	[6.45]	[4.48]	[4.79]	[5.67]	[5.99]	[1.07]	[1.11]
Female	-0.0573	-0.0500	-0.0007	-6.7176	-0.0573*	-0.0509	-0.0670	-0.0598
	[-1.61]	[-1.58]	[-0.00]	[-1.48]	[-1.67]	[-1.62]	[-1.36]	[-1.37]
Female * log(imp)			0.0086	0.0135				
			[0.39]	[0.65]				
Female * log(exp)			-0.0131	0.0049				
			[-0.51]	[0.21]				
High-skill	0.0427***	0.0428***	0.0424***	0.0426***	0.3666**	0.2950**	0.0442***	0.0436***
	[11.52]	[11.95]	[11.26]	[11.84]	[2.53]	[2.17]	[3.36]	[3.32]
High-skill * log(imp)					-0.0017	-0.0007		
					[-0.30]	[-0.13]		
High-skill * log(exp)					-0.0264**	-0.0212**		
					[-2.39]	[-2.06]		
Age	0.0355***	0.0353***	0.0353***	0.0355***	0.0367***	0.0363***	0.0804	0.0850
	[10.89]	[11.14]	[10.51]	[11.01]	[11.73]	[11.78]	[0.79]	[0.84]
Age^2	-0.0005***	-0.0005***	-0.0005***	-0.0005***	-0.0005***	-0.0005***		
	[-29.48]	[-30.57]	[-29.02]	[-30.43]	[-31.63]	[-31.94]		
Age * log(imp)							-0.0025	-0.0027
							[-0.75]	[-0.80]
Age * log(exp)							-0.0053	-0.0055
							[-0.90]	[-0.94]
Union	0.0094***	0.0114***	0.0098***	0.0111***	0.0095***	0.0112***	0.0116**	0.0140**
	[3.36]	[4.04]	[3.20]	[3.77]	[3.50]	[4.06]	[2.24]	[2.29]
Log(Turnover)	-0.0389***		-0.0401***		-0.0327***		-0.0416*	
	[-4.68]		[-4.58]		[-4.60]		[-1.87]	
Log(Employment)	-0.0542***		-0.0562***		0.0179***		-0.0689	
	[-4.33]		[-4.30]		[3.25]		[-1.47]	
Observations	84,710	84,719	84,710	84,719	103,362	103,403	84,710	84,719
F-test	48.52	90.96	13.43	18.34	16.91	5.989	0.604	0.610

Note: *** p<0.01, ** p<0.05, * p<0.1, t-statistics reported in brackets. Dependent variable: log of hourly wages. All regressions are estimated as pooled panel regressions from 2004 to 2014 and include job-spell and year fixed effects. All regressions include worker controls: age, age squared, gender, skill and union (i.e. pay set by collective agreements or not). Firm controls (log employment, log turnover) are omitted in even columns. Robust standard errors. F-test refers to the Kleibergen-Paap rk Wald F statistic for weak identification.
Source: Own calculations based on UK Office of National Statistics International Trade in Services Inquiry, Annual Responded Database and Annual Business Survey and Annual Survey of Hours and Earnings datasets.

Table A C.7. Effect of services trade policy on hourly wages

	Log of hourly wage					
	Importers only		Exporters only		Importers and exporters	
Panel A. Overall STRI scores						
Log imports	-0.139**	-0.168**			-0.039**	-0.042***
	(-3.76)	(-3.32)			(-2.89)	(-2.93)
Log exports			0.018***	0.017***	0.024***	0.026***
			(3.06)	(3.03)	(4.79)	(5.20)
STRI score	-0.139**	-0.166**	0.001	-0.004	-0.101*	-0.123**
	(-2.64)	(-2.57)	(0.02)	(-0.07)	(-1.69)	(-1.99)
Intra-EEA score	-0.265*	-0.373**	0.020	0.045	0.291*	0.360**
	(-1.69)	(-1.96)	(0.16)	(0.36)	(1.76)	(2.07)
Digital STRI	0.887***	0.949***	0.317***	0.317***	0.614***	0.603***
	(4.06)	(3.54)	(3.21)	(3.19)	(4.60)	(4.57)
Obs.	26,723	26,723	20,275	20,275	18,081	18,081
F-test	18.95	13.60	208.60	205.40	48.47	45.86
Panel B. STRI measures						
Log imports	-0.314**	-0.328*			-0.141**	-0.152*
	(-1.97)	(2.33)			(-2.02)	(-1.95)
Log exports			0.020***	0.019***	0.029***	0.030***
			(2.82)	(2.75)	(3.12)	(3.16)
Area 1	-0.499	-0.557	0.225***	0.223***	-0.004	-0.053
	(-1.28)	(-1.29)	(2.78)	(2.75)	(-0.03)	(-0.31)
Area 2	0.034	0.084	-0.302**	-0.303**	-0.409**	-0.412***
	(0.12)	(0.28)	(-3.23)	(-3.25)	(-3.18)	(-3.08)
Area 3	-2.653	-2.698	0.370	0.358	-1.117	-1.277
	(-1.62)	(-1.57)	(1.28)	(1.23)	(-1.20)	(-1.24)
Area 4	2.148	1.999	-0.560**	-0.567**	0.659	0.631
	(1.54)	(1.45)	(-4.00)	(-4.00)	(1.05)	(0.99)
Area 5	4.878*	4.473*	-0.433**	-0.423**	2.862	3.072
	(1.89)	(1.80)	(-2.36)	(-2.33)	(1.62)	(1.59)
Obs.	31,495	31,495	24,363	24,363	21,864	21,864
F-test	4.04	3.73	146.40	140.90	3.05	2.72
Panel C. Digital STRI measures						
Log imports	0.197**	0.160**			-0.080**	-0.086*
	(1.97)	(2.33)			(-1.97)	(-1.95)
Log exports			0.013	0.014*	0.034***	0.041***
			(1.61)	(1.76)	(2.95)	(2.99)
Area 1	-1.289**	-1.002**	-0.047	-0.046	0.613	0.727
	(-2.14)	(-2.56)	(-0.27)	(-0.26)	(1.49)	(1.58)

Area 2	-1.357*	-0.989	-0.590	-0.683	-1.483**	-2.191**
	(-1.74)	(-1.43)	(-1.03)	(-1.16)	(-2.07)	(-2.49)
Area 3	-8.836**	-6.766**	-2.037**	-2.102**	1.125	0.953
	(-2.05)	(-2.46)	(-2.76)	(-2.90)	(0.55)	(0.48)
Area 4	15.175**	12.919**	4.386***	4.323***	-0.660	-1.757
	(2.67)	(3.32)	(3.78)	(3.72)	(-0.18)	(-0.42)
Area 5	-0.608	-0.624	0.597	0.623	2.586**	3.259***
	(-0.82)	(-0.94)	(1.15)	(1.22)	(2.52)	(2.59)
Obs.	36,572	36,579	29,208	29,212	24,551	24,551
F-test	5.19	7.99	122.70	127	5.50	4.89

Note: *** p<0.01, ** p<0.05, * p<0.1, robust t-statistics reported in parentheses. Dependent real (CPI-deflated) variable: log of hourly wages. All regressions are estimated by way of instrumental variables (IV) pooled panel regressions and include job-spell and year fixed effects. Trade in services is instrumented as described in Annex B. All regressions include worker controls (age, age squared, gender, skill, union affiliation). Firm controls (log employment, log turnover) are omitted in even columns. STRI for the years 2014-2017 from the OECD. STRI policy areas in Panel B: Restrictions on foreign entry (area 1), restrictions on the movement of people (area 2), other discriminatory measures (area 3), barriers to competition (area 4), regulatory transparency (area 5). Policy areas in Panel C: Infrastructure and connectivity (area 1), electronic transactions (area 2), payment systems (area 3), intellectual property rights (area 4), other barriers affecting trade in digitally enabled services (area 5).
Source: Own calculations based on UK Office of National Statistics International Trade in Services Inquiry, Annual Responded Database and Annual Business Survey and Annual Survey of Hours and Earnings datasets.