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UK trade and productivity across space

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Abstract

We revisit the presence of international trade activity premia at the firm-level, as well as the presence of agglomeration economies, for the UK over the period 2008-2017. In doing so, we also look at the nexus between agglomeration economies and international trade premia and in particular at whether these two phenomena complement or substitute each other. In other words, are international trade premia higher (lower) in denser places and if so what is the direction of causality? Our analysis indicates that premia are (especially for export) lower and in particular in denser areas there is less need to be productive to select into internal trade activities. In terms of policy implications, our results suggest that regional disparities matter also for international trade in that not only being in a denser area fosters productivity because of agglomeration economies, but it also allows firms to reach more easily international clients and suppliers so boosting participation into exporting and importing activities conditional on productivity.

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Non-Technical Summary

Firms that trade internationally—whether by exporting goods or importing materials—are typically different from those that don't. On average, they tend to be more productive and larger. Economists refer to this difference as the 'international trade premium'.

At the same time, a separate but related body of research highlights the advantages that come from being based in densely populated areas — such as cities or industrial hubs — where firms can access deeper labour markets, a broader range of suppliers, and more opportunities for collaboration and knowledge-sharing. These advantages are known as 'agglomeration economies.'

This study asks an important question: how are international trade premia and agglomeration economies connected? Do they reinforce one another—or do they act as substitutes? In other words, does being in a dense area make it easier to trade internationally regardless of productivity, or do firms in such areas still need to outperform their peers?

To explore this, the research uses comprehensive firm-level data covering UK businesses with detailed trade information across all sectors and regions from 2008 to 2017. By examining multiple indicators of firm performance — such as labour productivity, total factor productivity, and price markups — the study takes a detailed look at how firms engage in trade at a fine spatial level based on Travel to Work Areas (TTWAs) defined in the 2011 Census.

The key finding is clear: in denser areas, the trade productivity premium is lower, especially exporting. That is, firms in these regions don't need to be as productive as others to take part in international trade, because their location already provides significant advantages, like easier access to consumers and suppliers. In contrast, firms in less densely populated areas might face greater obstacles and must be significantly more productive to succeed in international markets.

This finding has important policy implications. It suggests that regional disparities play a major role in shaping firms' access to international trade opportunities. Firms in already connected and prosperous regions benefit from a virtuous cycle: they have better access to global markets, which boosts their competitiveness, which in turn attracts more investment and talent. Meanwhile, firms in less connected regions face a tougher climb, reinforcing existing economic inequalities across the country.

The takeaway is that simply encouraging firms to trade internationally isn't enough to create a level playing field. Instead, targeted investments are needed — such as better transport links, faster digital infrastructure, and skills training in under-served areas. These policies could reduce the additional 'cost' of distance and help more firms across the UK participate in global trade, boosting their productivity, no matter where they are based. By addressing these regional disparities, trade and industrial policy can support more inclusive economic growth—ensuring that all parts of the UK can benefit from the opportunities of a globalised economy.

UK Trade and Productivity Across Space

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ABSTRACT: We revisit the presence of international trade activity premia at the firm-level, as well as the presence of agglomeration economies, for the UK over the period 2008-2017. In doing so, we also look at the nexus between agglomeration economies and international trade premia and in particular at whether these two phenomena complement or substitute each other. In other words, are international trade premia higher (lower) in denser places and if so what is the direction of causality? Our analysis indicates that premia are (especially for export) lower and in particular in denser areas there is less need to be productive to select into internal trade activities. In terms of policy implications, our results suggest that regional disparities matter also for international trade in that not only being in a denser area fosters productivity because of agglomeration economies, but it also allows firms to reach more easily international clients and suppliers so boosting participation into exporting and importing activities conditional on productivity.

Keywords: Firm-Level Dataset; Merging; BSD; FAME; VAT; Trade; Productivity; Markups; UK; Travel to Work Areas; Agglomeration Economies; International Trade Premia.

JEL classification: F14, R12, D24.

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1. Introduction

The recent decades have seen an expansion of micro data analyses across several fields looking at firm performance measures in various context. For example, the international trade literature has delivered a number of contributions looking at the firm-level involvement in international trade activities and relating it to issues like selection on productivity, multi-product firms and foreign direct investments (Bernard et al., 2012). At the same time, the regional literature has increasingly pointed to the presence of agglomeration economies using firm-level data while investigating a number of channels linked to the leading theoretical framework of matching, sharing, learning and sorting (Combes and Gobillon, 2015).

In this paper we revisit the presence of international trade activity premia at the firm-level as well as the presence of agglomeration economies for the UK building on an exhaustive dataset developed in Kauma and Mion (2025) and further expanded here to include information on export and import activities.[1] In doing so, we also look at the nexus between agglomeration economies and international trade premia and in particular at whether these two phenomena complement or substitute each other. In other words, are international trade premia higher (lower) in denser places and if so what is the direction of causality? Are perhaps premia lower in denser places because internationally active firms benefit less from agglomeration economies or rather that internationally active firms can more easily reach foreign consumers and suppliers by being located in denser areas and so do not need to be as competitive to select into international trade activities?

In order to achieve this, we first construct a large datasets spanning the entire population of UK firms with at least one employee over the period 2008-2017 allowing us to retrieve different measures of productivity – including labour productivity and total factor productivity (TFP) – as well as firm-level markups and investigate the links between firm performance, agglomeration economies and international trade activity at a fine spatial level: 228 Travel to Work Areas (TTWAs). Considering the last year of the data, i.e., 2017 the datasets we constructed span over 814,407 firms employing 17,441,714 workers. In both cases, the availability of the location of the different establishments belonging to each firm allows us to link firm performance measures to space and conduct our investigations.

[1] Our data contribution with respect to Kauma and Mion (2025) consists in adding information on firm-level exports and imports (coming from the HMRC trade panel dataset) to the data they constructed. Kauma and Mion (2025) provide a number of stats and figures about the comparison of their data with more standard sources like the ARD and ABS surveys. For example, in the ARDx database (a database combining the ARD and ABS surveys) the overall employment covered is in between 10 and 12 million while the data we use cover in between 14 and 17 million employees. Furthermore, the ARDx has a much lower coverage in terms of number of firms (15 times less firms) and a bias towards large firms, which is in line with the sample design of the ARD/ABS surveys covering all the big firms and a small fraction of the medium and small firms (Office for National Statistics, 2023). Finally, in our database there are more than 100 observations for each Travel to Work Area (TTWA) in each year, while in the ARDx less than half of TTWAs would meet this criterion.

We start by summarising a number of features of the data and delivering a number of maps visually highlighting the correlations across space of the density of economic activity, the involvement firms into exporting and importing and measures of firm performance (TFP, labour productivity and markups). We subsequently move to a regression framework where we relate firm performance measures of UK firms to the local economic density and the export/import participation while further exploring the role of specialisation. In doing so we find that: i) specialisation contributes much less than density in explaining the variation of firm performance across the UK space; ii) local economic density drives up both TFP and labour productivity while leading to lower markups (especially when conditioning markups to firm productivity) so suggesting that agglomeration economies are at work along with local competition driving markups down in denser/more competitive locations; iii) substantial exporter and importer productivity premia arise while being roughly of the same magnitude while markups for internationally trading firms are actually lower, which is likely related to the fact that these firms operate in an environment of costly international trade in which they absorb (through markups) part of the additional costs to reach international customers and suppliers.

We next move to analyse the interconnections between agglomeration economies and international trade and find overall that such interaction is of a negative type, i.e., productivity premia are lower in denser areas. The negative interactions indicate that either the international trade productivity premium is weakened by density or that the productivity premium in denser areas is weakened by the involvement in trade activities. In order ta make progress on this issue we use a logit framework to model participation in international trade as a function of firm productivity and density and find that, conditional on productivity, the odds of being and importer/exporter are significantly higher in denser areas so suggesting that in denser areas there is less need to be productive to select into exporting or importing activities.

Our paper is related to the literature on firm TFP measurement on which the Olley and Pakes (1996) proxy variable approach to tackle the issue of endogeneity has had a deep impact. This proxy variable approach has been further developed in Levinsohn and Petrin (2003), Wooldridge (2009), Ackerberg et al. (2015) and De Loecker et al. (2016). At the same time, our paper is linked to the international trade literature highlighting the connections between productivity and trade at the firm-level (Bernard and Jensen, 1999, Bernard et al., 2012). Furthermore, our paper speaks to the contributions in regional and urban economics related to agglomeration economies and their impact on productivity (Combes and Gobillon, 2015, Kauma and Mion, 2025). However, the most closely linked paper to ours is arguably Okubo and Tomiura (2019) in which they also look at the nexus between agglomeration economies and international trade premia. We expand upon their study in several ways: i) we look at both exporter and importer premia and find the former to be the key one; ii) we consider several measures of productivity as well as firm-level markups; iii) we concentrate on

local economic density rather than internal accessibility to core regions; iv) we study another country; the UK vs. Japan.

The rest of the paper is organised as follows. Sections 2 and 3 present the data sources we use and describe how we cleaned and combined the data for the UK. Section 4 provides details of productivity and markups estimation while Section 5 presents some data highlights: an overall picture of the evolution of aggregate UK productivity and markups as well as a number of useful maps connecting the various dimensions of the analysis (density, firm performance and trade participation) within the UK geography. Section 6 contains our main analysis. Section 7 concludes. Some complementary Tables are reported in the Appendix.

2. Data sources

2.1 BSD

The Business Structure Database (BSD) is an annual extract (the snapshot taking place at the end of a fiscal year) of the Inter-department Business Register (IDBR), a live database of business organisations in the UK. Organisations that are registered for VAT or pay at least one member of staff through the Pay As You Earn (PAYE) tax system, will appear on this register.

The BSD is administrated by the ONS and, while being one of the largest sources of data about business organisations in the UK, it contains only a limited number of variables. In our analysis, we borrow information about the number of employees, employment (number of employees plus owner(s)) and foreign ownership. A firm in the BSD is identified by a unique code to which we refer to as the 'BSD firm id'. The BSD also provides information on the employment and location (up to the postcode level) of the different establishments belonging to a given firm that we also use in our analysis. An establishment in the BSD is identified by a unique code to which we refer to as the 'BSD establishment id'.

2.2 VAT

The Value Added Tax (VAT) panel database is an annual extract from VAT Returns providing information on organisations that are registered for VAT.

The VAT panel database is administrated by HMRC and provide information on, among other, the value of purchases operated in a given (fiscal) year as well as the value of sales. A firm in the VAT panel database is identified by her unique VAT code, which is anonymised within the HMRC datalab environment, and to which we refer to as the 'VAT firm id'.

2.3 FAME

FAME contains information on companies registered at Companies House in the UK. It covers company financials, corporate structures, shareholders and subsidiaries. The data are collected

from various sources, most notably the national official bodies in charge of collecting company accounts data, and are then compiled and organised by Bureau van Dijk (BvD). FAME is available within the HMRC Datalab where original company identifiers are anonymised.

The coverage of variables like sales, intermediates purchases and employment in FAME is very patchy because only relatively large firms are required to report this information in their annual accounts. However, information on assets, and in particular on tangible fixed assets which we are going to use as our measure of the firm capital stock, is very well recorded. A firm in FAME is identified by her unique anonymised CHR number to which we refer to as the 'FAME firm id'.

2.4 Trade panel

The trade panel data provides information on exports and imports of UK firms. The data on trade with EU countries is provided in a different dataset from the data on trade with non-EU countries. The EU trade dataset is available from 2008 onwards while the non-EU trade data is available also for years prior to 2008. Both datasets provide information about the identity of the exporting/importing firm, the CN8 code of the product traded, the country of destination/origin of the goods, as well as the year and the value in pounds (and sometimes the quantity) of the transaction. A firm in the trade panel is identified by her unique anonymised trader number to which we refer to as the 'Trade firm id'.

3. Cleaning and combining the data

In what follows we explain how we cleaned and merged the data. The data are organised by fiscal year and, for example, when referring to the year 2017 we actually mean the fiscal year 2017-18.

3.1 Data cleaning

BSD. For the BSD we first worked on the industry classification to consistently have information on the SIC 2007 primary code of each firm. The SIC 2007 industry affiliation is not available in the 2004 and 2005 vintages of the data (only SIC 2003 is available) but we exploited the fact that both SIC 2003 and SIC 2007 are available from 2006 onwards to build a correspondence table that we applied to earlier years.

We have subsequently eliminated firms involved in financial and insurance activities (SIC 2007 codes 64, 65 and 66) and restricted the sample to firms with at least one employee. [2] A firm in the data is identified by the BSD firm id and the data spans from 2004 to 2017.

[2]We also restricted the sample to firms with a live vat status. This latter restriction allows to deal with an otherwise inexplicable drop of the number of firms around 2010.

VAT. Again we applied some cleaning to the industry classification (which is time varying in the VAT panel dataset) and eliminated firms involved in financial and insurance activities (SIC 2007 codes 64, 65 and 66). We checked for values meaning and consistency across years and kept only firms for which values of sales and acquisitions are both non missing and greater than zero. We also kept information about sales and acquisitions related to EU countries for future use. A firm in the data is identified by the VAT firm id and the data spans from 2004 to 2017.

FAME. We cleaned the data from some duplicates and keep only observations for which the variable fixed assets is not missing. As for the other datasets, we applied some cleaning to the industry classification (which is consistently SIC 2003 in the dataset) and eliminated firms involved in financial and insurance activities (SIC 2003 codes 65, 66 and 67). A firm in the data is identified by the FAME firm id and the data spans from 2004 to 2017.

Trade panel. We first get rid of classified trade transactions, as well as transactions not involving a transfer of ownership or corresponding to amendments and/or negative values, and subsequently aggregate the data at the firm-year-country-product level over the period 2008-2017. A firm in the data is identified by the Trade firm id and the data spans from 2008 to 2020.

Each of the 4 datasets has a different firm identifier and the correspondence between any pair of identifiers is in some cases many to many. The HMRC datalab provides a lookup Table across the 4 identifers but the many to many correspondence issue still needs to be addressed. A simple example highlighting the many to many issue, and how we deal with it, is reported in Table 1 below.

The example in Table 1 is related to the correspondence between the BSD firm id (for which we use letters) and the VAT firm id (for which we use numbers). Table 1 indicates that the BSD firm id A is linked to many VAT firm id and in particular to 1, 2, 3, 4 and 5. This would not be a problem (being simply a case of one to many) if VAT firm id 3 and 4 were not also linked to the BSD firm id B, which is also connected to VAT firm id 6 and 7. On the other hand, the case of BSD firm id C and D is simpler because they are both related to the VAT firm id 8, which in turn is not related to other BSD firm id (a simple case of many to one). For our analyses we have devised a looping code that would 'aggregate' BSD and VAT codes in such a way to get, in the case of Table 1, two 'combined firm id' (for which we use Greek letters). The first combined firm id α would correspond to BSD firm id A and B as well as to VAT firm id 1, 2, 3, 4, 5, 6, 7. The second combined firm id β would correspond to BSD firm id C and D as well as to the VAT firm id 8. Once solved the issue of the many to many cases for the BSD firm id and the VAT firm id, we apply the same procedure using the correspondence between the

Table 1: Example of correspondences

BSD firm id	VAT firm id
A	1
A	2
A	3
A	4
A	5
B	3
B	4
B	6
B	7
C	8
D	8

combined firm id and the FAME firm id, which will yet generate another more aggregate firm id, encompassing the three different firm identifiers, to which we refer to as the 'final firm id'. Concerning the Trade firm id, the correspondence with the VAT firm id is luckily of the many to one type only and so we can simply use the 'final firm id' to uniquely link it to each Trade firm id. At the end of the procedure, each original firm id (BSD, VAT, FAME and Trade) will be associated to a unique final firm id.

Armed with this notion we then aggregate the information coming from the four datasets at the final firm id level. For example, we sum the sales of the different VAT codes corresponding to a given final firm id and impute as SIC 2007 code of a final firm id the SIC 2007 code corresponding to the BSD firm id with the largest employment among the different BSD firm id linked to the final firm id considered.

We first match the BSD with the VAT data and keep only firms present in both datasets. This entails a drop of about 4 to 5 million employees per year that is concentrated in sectors where public employment is more prevalent. We then match FAME, which at this stage entails a minimal loss in terms of firms lost in the match, and apply some final cleaning and polishing to the capital stock variable to increase coverage. Subsequently, we define industries as two digit SIC 2007 codes and apply some grouping (detailed below) in preparation for TFP estimations. Finally, we attach the exports and imports data and assume that firms with no records of exports and/or imports do not actually export and/or import. Matching the trade data with the other data entails a loss (with respect to the original trade panel) in terms of exporting/importing firms and traded values that we document below.

3.2 Adding information on location

In order to retrieve the location(s) of a firm we use the information on local units from the establishments files of the BSD.[3] Each BSD establishment id is uniquely linked to a BSD firm id and so to a unique final firm id. For each final firm id in our data we can then identify the related establishments and for each such establishment the BSD provides information on location (up to the postcode level) and employment. In view of conducting a meaningful spatial analysis, we use an 'economic' partition of the UK geography and in particular the 2011 version of the Travel To Work Areas (TTWAs). The 2011 version of TTWAs breaks down the UK (including Northern Ireland) into 228 areas.

In order to go from postcodes to 2011 TTWAs for the whole of our sample period we use a postcode directory provided by the ONS. The match between the postcode directory and the postcodes in the data works very well and only requires minor adjustments. Starting from the year 2017 (fiscal year 2017-18), only the first part of the postcode is available in the BSD data but fortunately information on the corresponding TTWA 2011 version is also provided.

The above procedures allow us to associate each establishment to a unique TTWA as well as each establishment to a unique final firm id.

4. Productivity and markups estimation

In order to estimate productivity and markups we use a production function approach. We use sales from the VAT data as a measure of output/revenue, purchases from the VAT data as a measure of intermediates expenditure, tangible fixed assets from FAME as a measure of the capital stock, and employment (count of employees plus the owner(s)) from the BSD as a measure of the labour input.

First we deflate revenue, intermediates and capital using corresponding indexes provided by the ONS with the base year being 2017. Second, we apply some trimming to the data. More specifically, we discard observations where the value of intermediates is higher than the value of sales and further apply a bottom and top trimming of 0.5% (by industry) based on the ratios of: i) intermediates to sales; ii) capital to labour; iii) revenue to labour.[4] Third, we use a second-order polynomial in intermediates, capital and labour to smooth revenue and purge it from measurement error as suggested in De Loecker et al. (2016) and Forlani et al. (2023) among others.

A firm in our data is a final firm id. Denoting firms by i and time by t the production function we estimate is the following 3 inputs Cobb-Douglas:

[3] We only consider live establishments.

[4] Post-TFP estimations we also discard those (very few) observations with markups below 0.6 and above 20.

$$R_{it} = L_{it}^{\alpha_L} M_{it}^{\alpha_M} K_{it}^{\alpha_K} A_{it},$$

where A_{it} is Total Factor Productivity (TFP) of firm i at time t, R_{it} is revenue, L_{it} is labour, M_{it} is intermediates, K_{it} is capital and α_L, α_M and α_K are the related output elasticities. Considering the log production function we thus have:

$$q_{it} = \alpha_L l_{it} + \alpha_M m_{it} + \alpha_K k_{it} + a_{it}, \tag{1}$$

where small case letters indicate logs (for example $k_{it} = \log K_{it}$). In line with the productivity literature, we assume that the TFP process is driven by an autoregressive component:

$$a_{it} = \phi_a \, a_{it-1} + \nu_{ait}, \tag{2}$$

where ν_{ait} denotes productivity shocks that represent innovations with respect to the information set of the firm in $t-1$ and are iid across firms and time.

In line with the literature, we assume capital k_{it} to be predetermined in the short-run, i.e., the current capital level has been chosen in t-1 and cannot immediately adjust to current period shocks ν_{ait}.[5] We further assume, as standard in the literature, that intermediates m_{it} are a variable input free of adjustment costs. This means that intermediates can be optimally chosen in t based on, among others, the particular realization of ν_{ait}. In this respect, we will see later on that intermediates being fully adjustable in the short-run allows for a simple rule to pin-down the markup of firm i. Concerning labor, we assume it to be a semi-flexible input meaning that it can, to some extent, adjust to current shocks in t but not to the optimal cost-minimizing level determined only by wages and marginal productivity.[6]

At time t firms have already chosen capital and labor and so these inputs are considered as given in their decision process along with the cost of intermediates W_{Mit}. At the same time, productivity a_{it} becomes known at time t. We assume firms in t use the above information and constraints to choose intermediates in order to minimize production costs and choose quantity or price (depending upon the features of competition) in order to maximize profits. In this respect, as first highlighted in Hall (1986) and further implemented in De Loecker and Warzynski (2012), De Loecker et al. (2016) and Forlani et al. (2023) among others, cost-minimization of a variable input free of adjustment costs provides a simple rule to pin down

[5]Intuitively, the restriction behind this assumption is that it takes a full period for new capital to be ordered, delivered, and installed. Note this means that k_{it} is uncorrelated with current period shocks ν_{ait}. However, this does not mean that k_{it} is uncorrelated with the current productivity *level* a_{it}. For example, investment decisions in $t-1$ are likely to be determined by both the level of capital in $t-1$ and the level of productivity in $t-1$. In this light, k_{it} should be correlated with a_{it-1} and so with a_{it}. See Ackerberg et al. (2015) for more details.

[6]In sum, l_{it} should be correlated (like intermediates m_{it}) with shocks ν_{ait} but the amount of labour in t does not simply reflect wages and marginal productivity implying that it cannot be used to recover markups. As far as the timing is concerned, we assume l_{it} is chosen by firm i at time $t-b$ ($0 < b < 1$), after k_{it} being chosen in $t-1$ but prior to m_{it} being chosen in t.

markups. The marginal cost is:

$$\frac{\partial C_{it}}{\partial Q_{it}} = \frac{\partial C_{it}}{\partial M_{it}} \frac{\partial M_{it}}{\partial Q_{it}} = W_{Mit} \frac{\partial M_{it}}{\partial Q_{it}}.$$

Now define the markup as:

$$\mu_{it} \equiv \frac{P_{it}}{\frac{\partial C_{it}}{\partial Q_{it}}}.$$

We thus have:

$$\frac{P_{it}}{\mu_{it}} = W_{Mit} \frac{\partial M_{it}}{\partial Q_{it}}.$$

Multiplying by Q_{it} and dividing by M_{it} on both sides implies that:

$$\frac{P_{it}Q_{it}}{M_{it}\mu_{it}} = \frac{R_{it}}{M_{it}\mu_{it}} = W_{Mit} \frac{\partial M_{it}}{\partial Q_{it}} \frac{Q_{it}}{M_{it}} = W_{Mit} \frac{\partial m_{it}}{\partial q_{it}}.$$

Re-arranging we finally have:

$$\mu_{it} = \frac{\frac{\partial q_{it}}{\partial m_{it}}}{\frac{W_{Mit}M_{it}}{R_{it}}} = \frac{\frac{\partial q_{it}}{\partial m_{it}}}{s_{Mit}}.$$

This simple rule to pin-down markups is consistent with many hypotheses on product market structure (monopolistic competition, monopoly and standard forms of oligopoly) and consists in taking the ratio of the output elasticity of intermediates ($\frac{\partial q_{it}}{\partial m_{it}}$) to the share of intermediates in revenue ($s_{Mit} \equiv \frac{W_{Mit}M_{it}}{R_{it}}$). Considering our production function (1) we simply have:

$$\mu_{it} = \frac{\alpha_M}{s_{Mit}}. \tag{3}$$

Therefore, provided estimates of the parameters of the production function (1), and in particular of α_M, as well as data on intermediates expenditure and revenue, one can simply compute the firm-specific markup μ_{it} using (3).

In terms of estimating the parameters of the production function (1) we use the intuition developed in Wooldridge (2009), i.e, we: i) substitute for a_{it} in equation (1) using (2); ii) substitute for a_{it-1} using a polynomial in k_{it-1} and m_{it-1}; iii) in the final augmented production function equation we do not instrument capital k_{it} but instrument labour and intermediates l_{it} and m_{it} with time lags.[7] We estimate the parameters of the production function separately for each industry while adding as controls a battery of time dummies and information on foreign ownership. Standard errors are clustered at the firm-level. We label the TFP measure we obtain with the above procedure as WLD TFP.

Last but not least, we also perform simple OLS estimations of the production function (1) to provide robustness and label the related TFP measure as OLS TFP.

[7]We use l_{it-1}, l_{it-2}, m_{it-2} and k_{it-2}.

5. A view of the data

Our combined data spans the period 2008-2017 and comprises 7,217,296 final firm id-year combinations and 10,194,124 establishment-year combinations. Later on, we will provide some analyses at the level of establishments in which we will assume that all establishments belonging to a final firm id share the same productivity, markups and export/import involvement.

5.1 Summary stats

To get a sense of our dataset, Table 2 displays the key summary statistics across years. On average, a firm has a £4.3 million revenue, £3.2 million of intermediates, 2.5 million of capital and 22 working people. The values of the standard deviation are approximately two orders of magnitudes greater than mean values, indicating that our dataset covers firms ranging from notably small to significantly large. This is confirmed by the large difference between the 5th and 95th percentiles. For example, the firm situated in the 5th percentile reports a revenue of £33,550, while the firm at the 95th percentile records a substantial revenue of about £5.3 million. Moreover, for capital, the 95th percentile figure is much smaller the mean value. This observation is influenced by the inclusion of a few significantly large firms, thereby impacting the overall mean. Additionally, 7% of firms engage in exporting, while 9% of firms take part in importing.

Table 2: Key summary statistics across all years

	Mean	St.dev.	p5	p95	N.observ.
Revenue	4,335.90	222,776.51	33.55	5,316.14	7,217,296
Intermediates	3,210.12	171,799.80	8.06	3,701.21	7,217,296
Capital	2,528.88	263,888.77	1.14	668.67	7,217,296
Employment	22.33	619.27	1	39	7,217,296
Exporter	0.07	0.26	0	1	7,217,296
Importer	0.09	0.28	0	1	7,217,296

Notes: Revenue, intermediates and capital are measured in thousand pounds. Values have been deflated using indexes provided by the ONS with 2017 as the base year. Employment is the number of employees including the owner(s). The exporter and importer are dummy variables.

5.2 Coverage in terms of employment and sectors

Table 3 displays the number of firms and total employment in our dataset by year. The number of firms decreases from 701,827 in 2008 to 681,465 in 2010 and then rises to 814,407 in 2017. The total employment rises constantly from 15 million to 17 million during the period. [8] Table

[8] Firms involved in financial and insurance activities are excluded from our dataset and account for around 1.2 million workers are reported by ONS official figures.

4 presents instead an industry breakdown of the number of firms and related employment for 2017.

Table 3: Number of firms and total employment covered by year

Year	Number of firms	Total employment
2008	701,827	15,378,391
2009	684,485	15,307,760
2010	681,465	15,294,427
2011	700,898	15,544,064
2012	692,865	15,899,287
2013	716,939	16,263,075
2014	728,632	16,362,476
2015	740,365	16,609,343
2016	755,413	17,058,927
2017	814,407	17,441,714

Notes: Employment is the number of employees including the owner(s). Data are organised by fiscal year with, for example, the year 2017 means the fiscal year 2017-2018.

5.3 Coverage in terms of trade

Table 5 shows the summary of import transactions in our dataset by year. Overall our dataset spans over 11.7 million importer-product-country observations from 2008 to 2017. Over this period, the count of CN-8 products reduces from 9,366 to 9,052, while the number of trading countries remains relatively stable at around 224. In contrast, the count of importing firms experiences a decline from 66,990 in 2008 to 59,898 in 2011, subsequently rebounding to 63,855 in 2017. Concomitantly, the aggregate import value shows a general upward trajectory increasing from £244.27 billion to £315.14 billion over the period we consider.

Table 6 contains the summary of export transactions in our dataset by year and reports around 17.9 million exporter-product-country observations. The number of exporter-product-country observations rises from 1.5 million in 2008 to 2.1 million in 2017. The count of products declines from 9,234 to 9,018, while the number of trading countries remains relatively stable at about 233. Similarly to the case of imports, the count of exporting firms first experiences a decline from 50,612 in 2008 to 48,979 in 2010, while subsequently increasing to 52,402 in 2017. Finally, the aggregate export value rises from £169.23 billion to £235.6 billion during the period.

Table A-1 in the Appendix provides key summary statistics at the importer- and exporter-level covering the time frame 2008 to 2017. On average, an importer imports 13 products from 3 countries for an overall value of £4.4 million, while an exporter exports 11 products to 8

Table 4: Number of firms and total employment covered by SIC industry for the year 2017

SIC industry	SIC details	Number of firms	Total employment
1		21,430	172,647
0X	Covers SIC 02,03	1,813	12,016
0Y	Covers SIC 05, 06, 07, 08, 09	491	41,445
13		2,162	42,633
16		4,172	56,917
17		835	50,963
18		5,900	81,024
1X	Covers SIC 10, 11, 12	5,179	407,367
1Y	Covers SIC 14, 15	1,761	28,076
22		3,788	142,603
23		2,156	83,046
24		944	61,138
25		13,354	248,194
26		2,883	92,866
27		1,710	60,602
28		4,324	155,690
29		1,438	142,688
2X	Covers SIC 19, 20, 21	1,758	116,300
30		758	164,224
31		3,374	71,939
32		3,695	53,971
33		5,452	69,313
3X	Covers SIC 35, 36, 37, 38, 39	4,452	274,109
41		25,971	242,454
42		9,336	180,940
43		88,057	543,997
45		34,900	476,269
46		51,914	950,915
47		89,585	2,414,936
49		17,181	435,846
52		5,179	291,990
53		3,518	205,136
55		7,833	371,451
56		56,363	1,419,417
58		4,088	102,830
59		7,233	71,423
5X	Covers SIC 50, 51	682	49,312
62		46,770	391,303
63		2,225	46,138
68		18,093	298,456
69		22,901	495,478
6X	Covers SIC 60, 61	3,455	207,608
70		48,479	363,535
71		32,261	332,440
72		1,542	86,103
73		8,682	128,911
74		19,630	102,025
75		1,882	47,921
77		6,837	117,508
78		11,655	824,150
79		2,937	78,529
80		3,344	156,139
81		13,212	541,699
82		18,356	265,039
84		469	128,529
85		8,165	836,069
88		1,806	227,389
8X	Covers SIC 86, 87	4,040	555,582
94		3,287	94,823
95		2,674	26,899
9X	Covers SIC 90, 91	7,729	98,227
9Y	Covers SIC 92, 93	10,485	431,448
9Z	Covers SIC 96, 99	17,822	173,079

Notes: Employment is the number of employees including the owner(s). The year 2017 means the fiscal year 2017-2018. SIC industries in column 1 correspond either to a unique two-digit SIC 2007 code or are obtained from the aggregation of two-digit SIC 2007 codes as indicated in column 2. Financial and insurance activities (SIC 2007 codes 64, 65 and 66) are excluded in our analysis.

countries for an overall value of £3.8 million. Furthermore, both the relatively high standard deviation values and the large differences between the 5th and 95th percentiles indicate the presence of a wide spectrum of exporting and importing firms in our dataset.

Table 5: Summary of import transactions covered by year

Year	N.observations	N.products	N.countries	N.importers	Total value imports
2008	1,182,896	9,366	223	66,990	244.27
2009	1,150,315	9,205	223	62,770	216.32
2010	1,137,096	9,025	222	60,624	249.38
2011	1,117,106	8,881	223	59,898	279.91
2012	1,156,544	8,977	222	60,501	279.37
2013	1,193,276	8,959	227	61,920	286.29
2014	1,181,176	8,928	227	62,292	286.72
2015	1,182,884	8,919	229	62,919	278.90
2016	1,222,189	8,914	229	64,534	298.23
2017	1,229,384	9,052	224	63,855	315.14

Notes: Data are organised by fiscal year with, for example, the year 2017 means the fiscal year 2017-2018. Observations are defined at the firm-product-country level. Products are measured at the CN-8 level. The total value of imports is measured in billion pounds.

Table 6: Summary of export transactions covered by year

Year	N.observations	N.products	N.countries	N.exporters	Total value exports
2008	1,465,569	9,234	233	50,612	169.23
2009	1,502,019	9,123	230	49,229	155.02
2010	1,630,549	8,954	232	48,979	171.51
2011	1,662,013	8,780	232	49,052	189.18
2012	1,730,727	8,870	227	49,357	188.56
2013	1,834,244	8,852	233	50,910	192.43
2014	1,906,958	8,835	233	51,122	197.23
2015	1,956,951	8,836	236	51,133	193.24
2016	2,057,280	8,849	234	51,960	207.97
2017	2,144,517	9,018	237	52,402	235.60

Notes: Data are organised by fiscal year with, for example, the year 2017 means the fiscal year 2017-2018. Observations are defined at the firm-product-country level. Products are measured at the CN-8 level. The total value of exports is measured in billion pounds.

5.4 Productivity and markups

Table 7 presents average (employment weighted) apparent labour productivity, labour productivity, OLS TFP, WLD TFP and markups by year. Average apparent labour productivity and total factor productivity (both OLS TFP and WLD TFP) rise after a decline from 2008 to 2009. However, average labour productivity and markups go through a decline until 2011 and then start increasing.

Table 7: Average (employment weighted) apparent labour productivity, labour productivity, OLS TFP, WLD TFP and markups by year

Year	Apparent Lab. Prod.	Lab. Prod.	OLS TFP	WLD TFP	Markups	N.firms
2008	188,056	47,892	3.537	3.070	1.533	701,827
2009	179,307	47,832	3.528	3.062	1.534	684,485
2010	189,490	44,674	3.547	3.075	1.512	681,465
2011	191,634	43,756	3.548	3.074	1.513	700,898
2012	191,446	46,667	3.557	3.084	1.527	692,865
2013	190,029	47,480	3.594	3.123	1.532	716,939
2014	199,459	50,321	3.661	3.193	1.559	728,632
2015	197,796	54,829	3.706	3.237	1.570	740,365
2016	204,431	58,751	3.703	3.233	1.591	755,413
2017	206,930	59,777	3.736	3.268	1.620	814,407

Notes: Employment is the number of employees including the owner(s). Data are organised by fiscal year with, for example, the year 2017 means the fiscal year 2017-2018. Revenue, intermediates and capital have been deflated using indexes provided by the ONS with 2017 as the base year. Apparent labour productivity is computed as firm revenue (in 2017 pounds) over firm employment. Labour productivity is computed as firm value added (in 2017 pounds) over firm employment. OLS TFP is firm-level total factor productivity obtained from a 3-inputs (intermediates, labour and capital) Cobb-Douglas production function where revenue is the output measure and coefficients are estimated (separately by SIC industry) using the OLS estimator. WLD TFP is firm-level total factor productivity obtained from a 3-inputs (intermediates, labour and capital) Cobb-Douglas production function where revenue is the output measure and coefficients are estimated (separately by SIC industry) using a methodology consistent with Wooldridge (2009). Markups are estimates of the firm-level price to marginal cost ratio obtained from WLD TFP estimations and the share of intermediates in revenue as developed in De Loecker and Warzynski (2012). All firm-level variables have been aggregated using firm employment as weight.

5.5 *Some interesting maps*

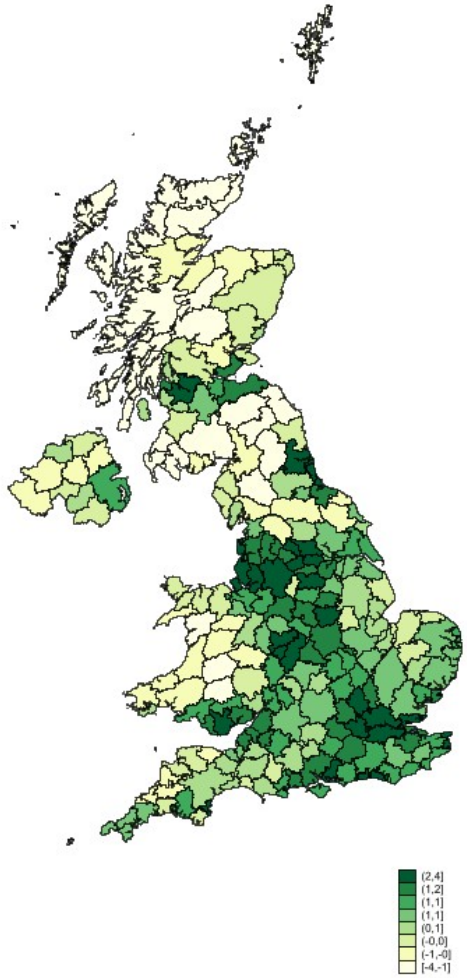
By incorporating into the analysis information on the location of establishments/firms, we provide here some maps of UK TTWAs giving a sense of the relationship between population density and local firms' performance, as well as international trade involvement.[9] Figure 1 presents TTWA-level density for the UK with darker colours indicating higher values. Density is computed as the log of the ratio between population in 2015 and surface area for each TTWA. Denser areas characterise large cities like London, Manchester, Glasgow, Newcastle, Birmingham, Cardiff and Brighton. The North of Scotland, Northern Ireland, the border regions between Scotland and England, as well as Wales instead feature a low density.

Figure 2 shows average (employment-weighted) labour productivity, WLD TFP and markups across space with data referring to the year 2017.[10] Maps show similar patterns for labour productivity and WLD TFP. In particular, areas featuring high labour productivity and/or WLD TFP are found around Aberdeen, Fort William, Manchester, Reading and London while areas in Northern Ireland and Wales, as well as border regions between Scotland and

[9]As already noted above, we impute firm-level variables like labour productivity, WLD TFP, markups and import/export status to all of the establishments of a firm. Each establishment has a unique location and so this allows us to switch from firms to space.

[10]The values of WLD TFP shown in the map have been demeaned by the respective industry average. Given that production function estimations have been carried separately for each industry, demeaning by the respective industry average is needed for WLD TFP values to be comparable across industries. By contrast, labour productivity and markups do not obviously need any demeaning.

Figure 1: Local density across the UK



Notes: The map shows local density across the UK. Density is computed as the log of the ratio between population in 2015 and surface area for each TTWA.

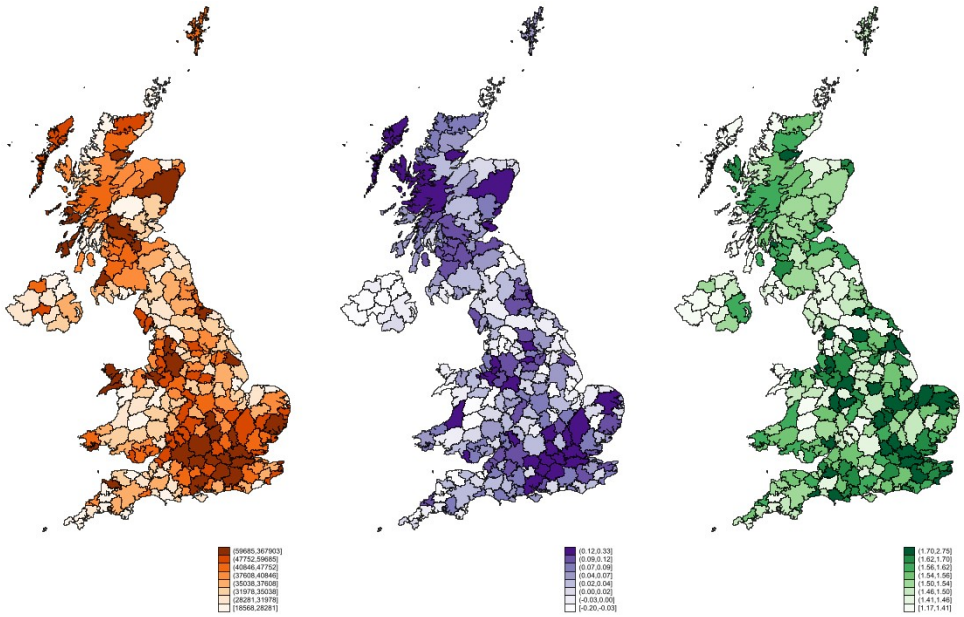
England, are characterised by the lowest values. Overall, these patterns are consistent with agglomeration economies contributing to higher productivity in the UK. As far as markups are concerned, the relationship with density is instead not so clear.

Figure 3 provides a measure of TTWA-level export and import intensities for the year 2017. Export/Import intensity is computed as the ratio between aggregate exports/imports of each TTWA and the corresponding aggregate TTWA employment.[11] Import intensity is particularly high in the areas surrounding Aberdeen, Chester, London and Reading while the North of Scotland, Wales and the South-West of England feature a low import intensity. As for export intensity, it is again high in the same areas seen for import intensity, as well as in the North-West of Scotland and Northern Ireland.

[11]In order to compute TTWA-level exports, imports and employment we aggregate the corresponding information coming from establishments. The employment information is directly available for establishments from the BSD. Import and export values are instead recorded at firm-level and we apportion them to the different establishments of a firm based on employment shares.

Figure 2: Labour productivity, TFP and markups across the UK, 2017

(a) Labour productivity (b) WLD TFP (c) Markups

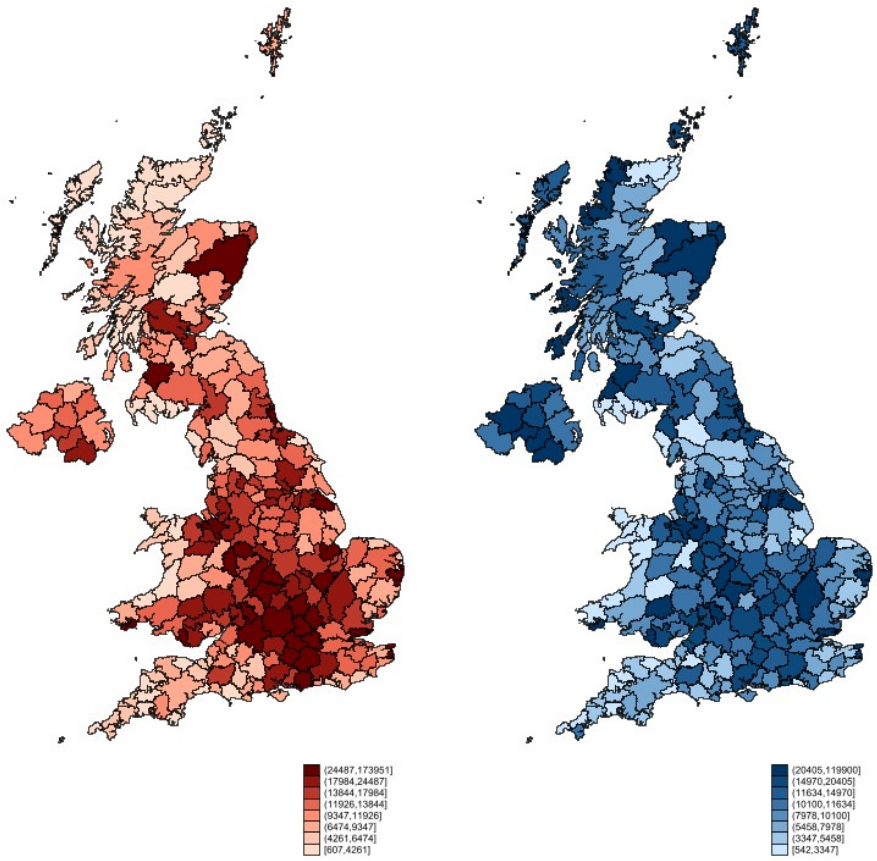


Notes: The left panel shows the distribution of labour productivity across UK TTWAs in 2017, while the middle panel shows (industry-demeaned) WLD TFP in 2017. WLD TFP has been obtained from the estimation of a 3-inputs (intermediates, labour and capital) Cobb-Douglas production function where revenue is the output measure and coefficients are estimated (separately by SIC industry) using a methodology consistent with Wooldridge (2009). The right panel shows markups across the UK space in 2017. Markups are estimates of the price to marginal cost ratio obtained from WLD TFP estimations and the share of intermediates in revenue, as developed in De Loecker and Warzynski (2012).

Figure 3: Export and import intensity across the UK, 2017

(a) Import intensity

(b) Export intensity



Notes: The left panel describes import intensity across UK TTWAs in 2017. Import intensity is computed as aggregate imports of each TTWA over TTWA aggregate employment. The right panel describes export intensity across UK TTWAs in 2017. Export intensity is computed as aggregate exports of each TTWA over TTWA aggregate employment.

6. The impact of trade and agglomeration economies on firm performance

The above maps suggest that both agglomeration forces and trade forces are at work in shaping firms' productivity and markups in the UK. However, how they interact with each other and contribute to firm performance is not clear. In this Section, we investigate this question, namely, how certain measures of local economic activity at the TTWA-level (density and specialisation) or trade activity at the firm-level (exporting and/or importing) are related to measures of firm performance (TFP, Labour productivity and markups). All regressions use establishments as the unit of analysis and contain year and broad region (12 regions) dummies covering the whole of the UK. In order to control for differences in industry composition, the measures of firm performance are subtracted by their respective industry average value and are then assigned to all of the establishments of a firm. Importer and exporter are dummies indicating, respectively, whether a firm imports or exports while trader is a dummy indicating whether a firm does either of the two. All of the establishments of a firm share the same indicators of international trade activity. We follow standard practice in regional economics (Combes and Gobillon, 2015) and measure density as the (log of) TTWA population in 2015 over surface area while specialisation is computed as the logarithm of industry employment (defined at the 4-digit SIC level) over total employment at the TTWA-level.[12]

6.1 Agglomeration economics and firm performance

We first explore the relationship between local economic activity and firm performance by regressing our measures of firm performance on density. Table 8 shows that local density is positively related to firm performance.[13] Columns 1, 4 and 7 report that a 1% increase in density is associated to a 0.02% increase in TFP and markup and a 0.03% increase in labour productivity. This is consistent with international evidence pointing to higher productivity in denser areas (Combes and Gobillon, 2015) and previous evidence for the UK in Kauma and Mion (2025). We then incorporate industry specialisation into the regressions shown in columns 2, 5 and 8. The coefficients of density remain rather stable while specialisation is related positively to TFP, but negatively to labour productivity and markups. This is suggestive that local specialisation does not necessarily correspond to increased firm performance in the UK space.

Additionally, column 9 shows that the relationship between density and markups changes to negative when we add firm TFP to the controls. Markups should be, and are in our regressions, positively related to firm productivity and so the negative coefficient on density suggests that,

[12] In practice, we use the equation $Specialisation = log(\frac{E_{jrt}+1}{E_{rt}})$, where E_{jrt} denotes the employment of industry j (a SIC 4-digit code) in TTWA r in year t, while E_{rt} denotes TTWA r total employment in the same year.

[13] The number of observations is smaller for regressions using value added per worker because certain firms have a negative value added and so the dependent variable is missing when taking logs.

once discounted for firm performance, markups are actually lower in denser places, which is suggestive of a stronger local competition among firms. Finally we report beta coefficients, rather than regression coefficients, in columns 3, 6 and 10 corresponding to the regressions in columns 2, 5 and 8. Beta coefficients indicate that specialisation is quantitatively less important than density in shaping firm performance in the UK while productivity is the strongest driver of markups.

Table 8: Agglomeration economies and firm performance

VARIABLES	WLD TFP			Lab.Prod.		
	(1)	(2)	(3)	(4)	(5)	(6)
	Coeff.	Coeff.	Beta coeff.	Coeff.	Coeff.	Beta coeff.
Log Density	0.0166***	0.0167***	0.0422	0.0321***	0.0313***	0.0303
	(0.0006)	(0.0006)		(0.0020)	(0.0020)	
Specialisation		0.0021***	0.0065		-0.0239***	-0.0276
		(0.0006)			(0.0013)	
Observations	10,194,124	10,194,124	10,194,124	9,326,394	9,326,394	9,326,394
R-squared	0.0074	0.0075	0.0075	0.0082	0.0089	0.0089
Region dummies	YES	YES	YES	YES	YES	YES
Year dummies	YES	YES	YES	YES	YES	YES
VARIABLES	Markup					
	(7)	(8)	(9)	(10)		
	Coeff.	Coeff.	Coeff.	Beta coeff.		
Log Density	0.0154***	0.0152***	-0.0201***	-0.0136		
	(0.0020)	(0.0020)	(0.0017)			
Specialisation		-0.0055***	-0.0100***	-0.0081		
		(0.0016)	(0.0015)			
WLD TFP			2.1153***	0.5654		
			(0.0141)			
Observations	10,194,124	10,194,124	10,194,124	10,194,124		
R-squared	0.0017	0.0017	0.3190	0.3190		
Region dummies	YES	YES	YES	YES		
Year dummies	YES	YES	YES	YES		

Notes: WLD TFP is firm-level total factor productivity obtained from a 3-inputs (intermediates, labour and capital) Cobb-Douglas production function where revenue is the output measure and coefficients are estimated (separately by SIC industry) using a methodology consistent with Wooldridge (2009). Labour productivity is computed as firm value added (in 2017 pounds) over firm employment. Markups are estimates of the firm-level price to marginal cost ratio obtained from WLD TFP estimations and the share of intermediates in revenue as developed in De Loecker and Warzynski (2012). Density is computed as the (log of) population over surface and specialisation is the logarithm of industry employment (4-digit SIC level) over total employment at the TTWA level. All regressions contain year and broad region (12 regions) dummies covering the whole of the UK. Beta coefficients, rather than regression coefficients, are reported in columns 3, 6 and 10 and correspond to the regressions in columns 2, 5 and 8. TTWA-year-level clustered standard errors in parenthesis. *** p<0.01, ** p<0.05, *p<0.1.

6.2 International trade activity and its interaction with density

We next explore how a firm's international trade involvement is related to firm performance and also consider how international trade activity and agglomeration economies interact with firm performance.[14] Table 9 displays the results of our analysis. Columns 1 and 4 show,

[14]In terms of measures of agglomeration economies, in what follows we focus on local density as it appears to be more important than local specialisation for the UK.

by means of the coefficients of the trader dummy, that being involved in international trade activities is related to a 7% higher TFP and a 33% higher labour productivity, which is in line with previous international evidence on productivity premia related to international activity (Bernard et al., 2012). Yet, being involved in trade activities is related to a 0.34 lower markup (column 7), with the negative relationship becoming stronger when we control for TFP in column 8. This is likely related to the fact that internationally active firms operate in an environment of costly trade in which they absorb (through markups) part of the additional costs to reach foreign customers and suppliers.[15].

Adding density to the above specifications, columns 2, 5 and 9 display a positive relationship between firm performance and density, which is consistent with the results of Table 8. At the same time, there seems to be no dramatic change of the coefficients of the trader dummy. Columns 3, 6, 11 and 12 further incorporate an interaction between the trader dummy and log density. We find that the positive signs of density and the trader dummy remain unchanged across firm productivity measures (columns 3 and 6 compared with columns 2 and 5). However, the negative coefficients for the interaction indicate that either the international trade productivity premium is lower in denser areas or that the productivity gains associated to denser areas are weaker for internationally active firms. Meanwhile, the relationship of markups with density (both with and without firm productivity as a control) remains unchanged (columns 11 and 12 compared to columns 9 and 10) and so does the message of a lower markup for internationally active firms. However, the negative interaction coefficient suggests that internationally trading firms have disproportionately lower markups in denser areas.

In order to investigate whether the above relationships are different depending upon the type of international trade activity, we split the trader indicator into two separate importer and exporter dummies and repeat all of the regressions. Results are shown in Table 10. Columns 1 and 4 provide the importer and exporter productivity premia. Being an importer is related to a 5% higher TFP and a 25% higher labour productivity, while being an exporter is related to a 4% higher TFP and a 21% higher labour productivity. Column 7 indicates a negative relationship between being an importer/exporter and the markup, with the importer dummy featuring a higher value of the coefficient (0.22 vs 0.15). Column 8 further adds TFP as controls, which strengthens the relationships in a way similar to column 8 of Table 9. Incorporating local density, columns 2, 5 and 9 show that all of the relationships between firm performance and the covariates (importer, exporter and density) are very similar with respect to previous results. Columns 3, 6 and 11 (as well as columns 10 and 12 in which we introduce firm

[15]For example, the relationship between the average (across destination countries) firm markup and export activity is indeed ambiguous. On the one hand, internationally active firms are more productive, which should correspond to a higher average markup as also indicated by the findings of Table 9. On the other hand, more international activity means the firm is tapping into more costly destinations on which she optimally charges lower markups. See Figure 4 and related material in Behrens et al. (2014) for an analysis of this issue.

Table 9: The nexus between density and international trade activity for firm performance

VARIABLES		WLD TFP			Lab.Prod.	
	(1)	(2)	(3)	(4)	(5)	(6)
Trader	0.0703***	0.0689***	0.0781***	0.3267***	0.3246***	0.3439**
	(0.0019)	(0.0019)	(0.0022)	(0.0047)	(0.0047)	(0.0055)
Log Density		0.0150***	0.0161***		0.0248***	0.0272***
		(0.0006)	(0.0006)		(0.0020)	(0.0021)
Trader X Log Density			-0.0050***			-0.0106***
			(0.0013)			(0.0038)
Observations	10,194,124	10,194,124	10,194,124	9,326,394	9,326,394	9,326,394
R-squared	0.0106	0.0113	0.0113	0.0204	0.0207	0.0207
Region dummies	YES	YES	YES	YES	YES	YES
Year dummies	YES	YES	YES	YES	YES	YES
VARIABLES				Markup		
	(7)	(8)	(9)	(10)	(11)	(12)
Trader	-0.3425***	-0.4931***	-0.3447***	-0.4924***	-0.2966***	-0.4641***
	(0.0091)	(0.0082)	(0.0090)	(0.0082)	(0.0112)	(0.0101)
Log Density			0.0236***	-0.0084***	0.0298***	-0.0048*
			(0.0020)	(0.0016)	(0.0032)	(0.0025)
Trader X Log Density					-0.0263***	-0.0155**
					(0.0089)	(0.0079)
WLD TFP		2.1424***		2.1428***		2.1427***
		(0.0141)		(0.0141)		(0.0140)
Observations	10,194,124	10,194,124	10,194,124	10,194,124	10,194,124	10,194,124
R-squared	0.0084	0.3329	0.0086	0.3329	0.0086	0.3329
Region dummies	YES	YES	YES	YES	YES	YES
Year dummies	YES	YES	YES	YES	YES	YES

Notes: WLD TFP is firm-level total factor productivity obtained from a 3-inputs (intermediates, labour and capital) Cobb-Douglas production function where revenue is the output measure and coefficients are estimated (separately by SIC industry) using a methodology consistent with Wooldridge (2009). Labour productivity is computed as firm value added (in 2017 pounds) over firm employment. Markups are estimates of the firm-level price to marginal cost ratio obtained from WLD TFP estimations and the share of intermediates in revenue as developed in De Loecker and Warzynski (2012). Trader is a dummy indicating whether a firm is involved in imports and/or exports. Density is computed as the (log of) population over surface. All regressions contain year and broad region (12 regions) dummies covering the whole of the UK. TTWA-year-level clustered standard errors in parenthesis. *** p<0.01, ** p<0.05, * p<0.1.

TFP as an additional control when looking at markups) further add two terms denoting the interactions between the importer/exporter dummy and density. Overall, the key message from these regressions is that the negative interaction between density and trading activity for firm performance seen in Table 9 above is essentially driven by exporting firms, with importing firms being less characterised by negative and significant interaction coefficients.

Having established that the interaction between exporting and density on firm performance is both significant and of a negative type we then attempt to address the following question: are the exporter/impoter premia lower in denser areas because exporters/importers benefit less from agglomeration economies or because in denser areas there is less need to be productive to select into exporting/importing? In order to shed some light into this issue, we estimate a logit model where the dependent variable is the trader dummy (as well as the importer and exporter dummies) and the regressors are either density or density and TFP. Results are shown in Table 11. Columns 1, 3 and 5 convey the message that a firm in a denser area is more likely to be involved in international trade activities. More specifically, the odds of being an internationally active firm are expected to increase by about 13% with a one-unit

Table 10: The nexus between density and export/import activities for firm performance

VARIABLES		WLD TFP			Lab.Prod.	
	(1)	(2)	(3)	(4)	(5)	(6)
Importer	0.0521***	0.0508***	0.0473***	0.2243***	0.2222***	0.2259***
	(0.0035)	(0.0035)	(0.0041)	(0.0081)	(0.0081)	(0.0104)
Exporter	0.0365***	0.0364***	0.0528***	0.1872**	0.1871***	0.2106***
	(0.0038)	(0.0038)	(0.0042)	(0.0098)	(0.0098)	(0.0123)
Log Density		0.0148***	0.0160***		0.0241***	0.0269***
		(0.0006)	(0.0006)		(0.0020)	(0.0021)
Importer X Log Density			0.0018			-0.0021
			(0.0021)			(0.0052)
Exporter X Log Density			-0.0089***			-0.0129*
			(0.0024)			(0.0069)
Observations	10,194,124	10,194,124	10,194,124	9,326,394	9,326,394	9,326,394
R-squared	0.0116	0.0123	0.0123	0.0235	0.0238	0.0238
Region dummies	YES	YES	YES	YES	YES	YES
Year dummies	YES	YES	YES	YES	YES	YES
VARIABLES				Markup		
	(7)	(8)	(9)	(10)	(11)	(12)
Importer	-0.2181***	-0.3299***	-0.2202***	-0.3292***	-0.1985***	-0.3000***
	(0.0102)	(0.0074)	(0.0102)	(0.0074)	(0.0110)	(0.0098)
Exporter	-0.1453***	-0.2236***	-0.1454***	-0.2236***	-0.1125***	-0.2257***
	(0.0100)	(0.0065)	(0.0100)	(0.0065)	(0.0087)	(0.0098)
Log Density			0.0231***	-0.0087***	0.0289***	-0.0056**
			(0.0020)	(0.0016)	(0.0031)	(0.0025)
Importer X Log Density					-0.0118	-0.0156**
					(0.0084)	(0.0064)
Exporter X Log Density					-0.0183***	0.0007
					(0.0060)	(0.0056)
WLD TFP		2.1457***		2.1461***		2.1460***
		(0.0142)		(0.0142)		(0.0141)
Observations	10,194,124	10,194,124	10,194,124	10,194,124	10,194,124	10,194,124
R-squared	0.0077	0.3328	0.0078	0.3329	0.0079	0.3329
Region dummies	YES	YES	YES	YES	YES	YES
Year dummies	YES	YES	YES	YES	YES	YES

Notes: WLD TFP is firm-level total factor productivity obtained from a 3-inputs (intermediates, labour and capital) Cobb-Douglas production function where revenue is the output measure and coefficients are estimated (separately by SIC industry) using a methodology consistent with Wooldridge (2009). Labour productivity is computed as firm value added (in 2017 pounds) over firm employment. Markups are estimates of the firm-level price to marginal cost ratio obtained from WLD TFP estimations and the share of intermediates in revenue as developed in De Loecker and Warzynski (2012). Importer and exporter are dummies indicating whether a firm imports or exports, respectively. Density is computed as the (log of) population over surface. All regressions contain year and broad region (12 regions) dummies covering the whole of the UK. TTWA-year-level clustered standard errors in parenthesis. *** p<0.01, ** p<0.05, *p<0.1.

increase in the log density. The related value for importers is 14% while for exporters is 11%. Columns 2, 4 and 6 add TFP as control and display very similar coefficients, while confirming a positive relationship between involvement in international trade activities and TFP. In sum, the above results indicate that, conditional of productivity, it is more likely for a firm to engage in international trade activities in denser areas so suggesting that in denser areas there is less need to be productive to select into exporting or importing activities.[16]

[16]Denser areas provide enhanced access to international markets because of, for example, better transport networks and greater availability of information regarding foreign markets. In the light of the framework developed in Melitz (2003), the productivity threshold required for exporting will thus be lower in denser areas.

Table 11: A simple logit model of international trade involvement

VARIABLES	Trader dummy		Importer dummy		Exporter dummy	
	(1)	(2)	(3)	(4)	(5)	(6)
Log Density	0.1263***	0.1217***	0.1321***	0.1270***	0.1080***	0.1028***
	(0.0032)	(0.0031)	(0.0032)	(0.0032)	(0.0034)	(0.0033)
WLD TFP		0.2927***		0.3259***		0.3266***
		(0.0096)		(0.0093)		(0.0104)
Observations	10,194,124	10,194,124	10,194,124	10,194,124	10,194,124	10,194,124
Region dummies	YES	YES	YES	YES	YES	YES
Year dummies	YES	YES	YES	YES	YES	YES

Notes: This Table presents estimations of a logit model where the dependent variable is the trader dummy (as well as the importer and exporter dummies) and the regressors are either density or density and TFP. WLD TFP is firm-level total factor productivity obtained from a 3-inputs (intermediates, labour and capital) Cobb-Douglas production function where revenue is the output measure and coefficients are estimated (separately by SIC industry) using a methodology consistent with Wooldridge (2009). Density is computed as the (log of) population over surface. Importer and exporter are dummies indicating, respectively, whether a firm imports or exports while trader is a dummy indicating whether a firm does either of the two. All regressions contain year and broad region (12 regions) dummies covering the whole of the UK. TTWA-year-level clustered standard errors in parenthesis. *** p<0.01, ** p<0.05, *p<0.1.

6.3 Further results and robustness

In order to further qualify our findings, and in particular to uncover sectoral heterogeneity, we also run regressions related to Tables 9, 10 and 11 for the sub-sample of firms belonging to a specific macro industry. More specifically, we consider 6 macro industries: Land, Manufacturing, Utility, Tradable, Public and Other.[17] Results are reported in Tables A-2 to A-19 in the Appendix and portray the following picture. With some exceptions in the Public industry, firms in the remaining macro industries display patterns very consistent with the evidence provided in Tables 9 to 11. In particular, the interaction between density and international activity delivers negative coefficients while the logit selection model points to a higher likelihood of being involved in international activities in denser areas conditional on firm productivity.

Focusing on the logit selection model results, we provide in Table A-20 in the Appendix some additional specifications in which we split importers and exporters into those trading with EU vs. non-EU countries. This delivers us with 4 categories of international trade involvement: EU exporters, non-EU exporters, EU importers and non-EU importers. Table A-20 in the Appendix indicates that, for each of these categories of firms, involvement in international trade activity is more likely in denser areas conditional on firm TFP, so further corroborating the idea that in denser areas there is less need to be productive to select into international trade activities.

Last but not least, we also consider whether the presence of a major trade port in the TTWA provides further insights into the lower premium needed for international trade activities in

[17]Land consists of SIC industries 01, 0X and 0Y; Manufacturing covers SIC industries 13, 16-18, 1X, 1Y, 22-33, and 2X; Utility includes SIC industries 3X and 41-43; Tradable consists of the SIC industries 45-47, 49, 52, 53, 55, 56, 58, 59, 5X, 62, 63, 68, 69, 6X, 70-75 and 77-82; Public covers SIC industries 84, 85, 88 and 8X; Other includes SIC industries 94, 95, 9X, 9Y and 9Z.

denser areas. Results provided in Table A-21 in the Appendix indicate that the presence of a local major port does not alter previous findings. This suggests that proximity to port infrastructures, which is indeed better (on average) in denser areas, is not the key to the lower international trade premia.

7. Conclusions

In this paper we revisit the presence of international trade activity premia at the firm-level as well as the presence of agglomeration economies for the UK building on an exhaustive dataset developed in Kauma and Mion (2025) and further expanded here to include information on export and import activities. In doing so, we also look at the nexus between agglomeration economies and international trade premia and in particular at whether these two phenomena complement or substitute each other. In other words, are international trade premia higher (lower) in denser places and if so what is the direction of causality?

In order to achieve this, we first construct a large dataset spanning the entire population of UK firms with at least one employee over the period 2008-2017. We relate firm performance measures of UK firms to the local economic density and the export/import participation while further exploring the role of specialisation. In doing so we find that: i) specialisation contributes much less that density in explaining the variation of firm performance across the UK space; ii) local economic density drives up both TFP and labour productivity while leading to lower markups (especially when conditioning markups to firm productivity) so suggesting that agglomeration economies are at work along with local competition driving markups down in denser/more competitive locations; iii) substantial exporter and importer productivity premia arise while being roughly of the same magnitude while markups for internationally trading firms are actually lower.

We next move to analyse the interconnections between agglomeration economies and international trade and find overall that such interaction is of a negative type, i.e., productivity premia are lower in denser areas. In this respect, our logit analysis suggests that in denser areas there is less need to be productive to select into exporting or importing activities.

In terms of policy implications our results suggest that regional disparities matter also for international trade in that not only being in a denser area fosters productivity but it also allows firms to reach more easily international clients and suppliers so boosting participation into exporting and importing activities.

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Appendix: Additional Tables

Table A-1: Key summary statistics for importers and exporters across all years

	Mean	St.dev.	p5	p95	N.observ.
Importer					
Value imports	4,366.14	84,675.31	1.29	8,507.02	626,303
N.products	12.68	40.02	1	48	626,303
N.countries	3.34	4.61	1	12	626,303
Exporter					
Value exports	3,764.16	90,696.90	1.20	7,012.12	504,756
N.products	11.21	37.92	1	40	504,756
N.countries	7.69	12.43	1	34	504,756

Notes: Values are measured in thousand pounds. Products are measured at the CN-8 level.

Table A-2: Table 9 for the Land industry

VARIABLES	WLD TFP		Lab.Prod.		Markup			
Trader	0.2671***	0.3783***	0.5888***	0.6071***	-0.3928***	-0.4151***	-0.8440***	-1.0681***
	(0.0109)	(0.0143)	(0.0178)	(0.0228)	(0.0116)	(0.0139)	(0.0221)	(0.0312)
Log Density	0.0008	0.0147***	-0.0066	-0.0037	0.0439***	0.0411***	0.0425***	0.0157***
	(0.0019)	(0.0013)	(0.0042)	(0.0043)	(0.0037)	(0.0039)	(0.0043)	(0.0036)
Trader X Log Density		-0.1619***		-0.0272		0.0325***		0.3120***
		(0.0117)		(0.0186)		(0.0106)		(0.0274)
WLD TFP							1.6898***	1.7262***
							(0.0235)	(0.0219)
Observations	248,559	248,559	186,175	186,175	248,559	248,559	248,559	248,559
R-squared	0.0403	0.0585	0.0337	0.0337	0.0118	0.0119	0.3837	0.3927
Region dummies	YES	YES	YES	YES	YES	YES	YES	YES
Year dummies	YES	YES	YES	YES	YES	YES	YES	YES

Notes: Labour productivity is computed as firm value added (in 2017 pounds) over firm employment. WLD TFP is firm-level total factor productivity obtained from a 3-inputs (intermediates, labour and capital) Cobb-Douglas production function where revenue is the output measure and coefficients are estimated (separately by SIC industry) using a methodology consistent with Wooldridge (2009). Markups are estimates of the firm-level price to marginal cost ratio obtained from WLD TFP estimations and the share of intermediates in revenue as developed in De Loecker and Warzynski (2012). Trader is a dummy indicating whether an establishment is involved in imports and/or exports. Density is computed as the (log of) population over surface. All regressions contain year and broad region (12 regions) dummies covering the whole of the UK. TTWA-year-level clustered standard errors in parenthesis. *** p<0.01, ** p<0.05, *p<0.1.

Table A-3: Table 10 for the Land industry

VARIABLES	WLD TFP		Lab.Prod.		Markup			
Importer	0.1144***	0.1585***	0.2947***	0.3143***	-0.2059***	-0.1993***	-0.4003***	-0.4747***
	(0.0078)	(0.0107)	(0.0208)	(0.0263)	(0.0107)	(0.0121)	(0.0153)	(0.0225)
Exporter	0.2355***	0.3098***	0.4698***	0.4510***	-0.3370***	-0.3592***	-0.7370***	-0.8973***
	(0.0131)	(0.0154)	(0.0256)	(0.0271)	(0.0137)	(0.0145)	(0.0249)	(0.0311)
Log Density	0.0008	0.0142***	-0.0066	-0.0064	0.0441***	0.0424***	0.0428***	0.0177***
	(0.0018)	(0.0013)	(0.0042)	(0.0043)	(0.0037)	(0.0039)	(0.0041)	(0.0035)
Importer X Log Density		-0.0559***		-0.0237		-0.0077		0.0894***
		(0.0071)		(0.0214)		(0.0097)		(0.0161)
Exporter X Log Density		-0.1394***		0.0246		0.0347***		0.2768***
		(0.0123)		(0.0259)		(0.0098)		(0.0260)
WLD TFP							1.6988***	1.7370***
							(0.0229)	(0.0217)
Observations	248,559	248,559	186,175	186,175	248,559	248,559	248,559	248,559
R-squared	0.0424	0.0619	0.0346	0.0346	0.0133	0.0133	0.3883	0.3975
Region Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Labour productivity is computed as firm value added (in 2017 pounds) over firm employment. WLD TFP is firm-level total factor productivity obtained from a 3-inputs (intermediates, labour and capital) Cobb-Douglas production function where revenue is the output measure and coefficients are estimated (separately by SIC industry) using a methodology consistent with Wooldridge (2009). Markups are estimates of the firm-level price to marginal cost ratio obtained from WLD TFP estimations and the share of intermediates in revenue as developed in De Loecker and Warzynski (2012). Importer and exporter are dummies indicating whether the establishment imports or exports, respectively. Density is computed as the (log of) population over surface. All regressions contain year and broad region (12 regions) dummies covering the whole of the UK. TTWA-year-level clustered standard errors in parenthesis. *** p<0.01, ** p<0.05, *p<0.1.

Table A-4: Table 11 for the Land industry

VARIABLES	Trader		Importer		Exporter	
Log Density	0.1116***	0.1376***	0.1038***	0.1456***	0.1236***	0.1494***
	(0.0235)	(0.0190)	(0.0290)	(0.0224)	(0.0258)	(0.0208)
WLD TFP		1.2162***		1.3371***		1.1586***
		(0.0312)		(0.0370)		(0.0339)
Observations	248,559	248,559	248,559	248,559	248,559	248,559
Region dummies	YES	YES	YES	YES	YES	YES
Year dummies	YES	YES	YES	YES	YES	YES

Notes: WLD TFP is firm-level total factor productivity obtained from a 3-inputs (intermediates, labour and capital) Cobb-Douglas production function where revenue is the output measure and coefficients are estimated (separately by SIC industry) using a methodology consistent with Wooldridge (2009). Density is computed as the (log of) population over surface at the TTWA level. Importer and exporter are dummies indicating, respectively, whether a firm imports or exports while trader is a dummy indicating whether a firm does either of the two. All regressions contain year and broad region (12 regions) dummies covering the whole of the UK. TTWA-year-level clustered standard errors in parenthesis. *** p<0.01, ** p<0.05, *p<0.1.

Table A-5: Table 9 for the Manufacturing industry

VARIABLES	WLD TFP		Lab.Prod.		Markup			
Trader	0.0358***	0.0580***	0.4570***	0.5067***	-0.3450***	-0.2860***	-0.4243***	-0.4145***
	(0.0013)	(0.0019)	(0.0035)	(0.0065)	(0.0044)	(0.0070)	(0.0033)	(0.0053)
Log Density	0.0108***	0.0163***	0.0167***	0.0290***	0.0151***	0.0296***	-0.0089***	-0.0064***
	(0.0007)	(0.0008)	(0.0023)	(0.0024)	(0.0019)	(0.0028)	(0.0014)	(0.0019)
Trader X Log Density		-0.0133***		-0.0299***		-0.0354***		-0.0059*
		(0.0011)		(0.0034)		(0.0044)		(0.0031)
WLD TFP							2.2152***	2.2150***
							(0.0154)	(0.0154)
Observations	809,513	809,513	756,078	756,078	809,513	809,513	809,513	809,513
R-squared	0.0081	0.0085	0.0536	0.0539	0.0233	0.0236	0.4871	0.4871
Region Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Labour productivity is computed as firm value added (in 2017 pounds) over firm employment. WLD TFP is firm-level total factor productivity obtained from a 3-inputs (intermediates, labour and capital) Cobb-Douglas production function where revenue is the output measure and coefficients are estimated (separately by SIC industry) using a methodology consistent with Wooldridge (2009). Markups are estimates of the firm-level price to marginal cost ratio obtained from WLD TFP estimations and the share of intermediates in revenue as developed in De Loecker and Warzynski (2012). Trader is a dummy indicating whether an establishment is involved in imports and/or exports. Density is computed as the (log of) population over surface. All regressions contain year and broad region (12 regions) dummies covering the whole of the UK. TTWA-year-level clustered standard errors in parenthesis. *** p<0.01, ** p<0.05, *p<0.1.

Table A-6: Table 10 for the Manufacturing industry

VARIABLES	WLD TFP		Lab.Prod.		Markup			
Importer	0.0174***	0.0288***	0.3168***	0.3394***	-0.2542***	-0.2193***	-0.2927***	-0.2832***
	(0.0012)	(0.0022)	(0.0044)	(0.0085)	(0.0036)	(0.0060)	(0.0030)	(0.0045)
Exporter	0.0287***	0.0414***	0.2373***	0.2705***	-0.1399***	-0.1057***	-0.2037***	-0.1975***
	(0.0013)	(0.0021)	(0.0044)	(0.0078)	(0.0031)	(0.0056)	(0.0028)	(0.0046)
Log Density	0.0109***	0.0158***	0.0167***	0.0284***	0.0153***	0.0296***	-0.0088***	-0.0056***
	(0.0007)	(0.0008)	(0.0022)	(0.0024)	(0.0019)	(0.0026)	(0.0014)	(0.0018)
Importer X Log Density		-0.0068***		-0.0136***		-0.0209***		-0.0057**
		(0.0011)		(0.0048)		(0.0036)		(0.0029)
Exporter X Log Density		-0.0077***		-0.0202***		-0.0209***		-0.0038
		(0.0011)		(0.0041)		(0.0029)		(0.0026)
WLD TFP							2.2206***	2.2203***
							(0.0155)	(0.0154)
Observations	809,513	809,513	756,078	756,078	809,513	809,513	809,513	809,513
R-squared	0.0089	0.0093	0.0618	0.0621	0.0244	0.0247	0.4901	0.4901
Region Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Labour productivity is computed as firm value added (in 2017 pounds) over firm employment. WLD TFP is firm-level total factor productivity obtained from a 3-inputs (intermediates, labour and capital) Cobb-Douglas production function where revenue is the output measure and coefficients are estimated (separately by SIC industry) using a methodology consistent with Wooldridge (2009). Markups are estimates of the firm-level price to marginal cost ratio obtained from WLD TFP estimations and the share of intermediates in revenue as developed in De Loecker and Warzynski (2012). Importer and exporter are dummies indicating whether the establishment imports or exports, respectively. Density is computed as the (log of) population over surface. All regressions contain year and broad region (12 regions) dummies covering the whole of the UK. TTWA-year-level clustered standard errors in parenthesis. *** p<0.01, ** p<0.05, *p<0.1.

Table A-7: Table 11 for the Manufacturing industry

VARIABLES	Trader		Importer		Exporter	
Log Density	0.0047	0.0017	-0.0080	-0.0114**	0.0144***	0.0113**
	(0.0050)	(0.0050)	(0.0055)	(0.0054)	(0.0051)	(0.0051)
WLD TFP		0.2814***		0.3209***		0.2950***
		(0.0126)		(0.0121)		(0.0118)
Observations	809,513	809,513	809,513	809,513	809,513	809,513
Region dummies	YES	YES	YES	YES	YES	YES
Year dummies	YES	YES	YES	YES	YES	YES

Notes: WLD TFP is firm-level total factor productivity obtained from a 3-inputs (intermediates, labour and capital) Cobb-Douglas production function where revenue is the output measure and coefficients are estimated (separately by SIC industry) using a methodology consistent with Wooldridge (2009). Density is computed as the (log of) population over surface at the TTWA level. Importer and exporter are dummies indicating, respectively, whether a firm imports or exports while trader is a dummy indicating whether a firm does either of the two. All regressions contain year and broad region (12 regions) dummies covering the whole of the UK. TTWA-year-level clustered standard errors in parenthesis. *** p<0.01, ** p<0.05, *p<0.1.

Table A-8: Table 9 for the Utility industry

VARIABLES	WLD TFP		Lab.Prod.		Markup			
Trader	0.2312***	0.2703***	0.6103***	0.8112***	-0.5386***	-0.3449***	-1.1454***	-1.0544***
	(0.0034)	(0.0037)	(0.0119)	(0.0123)	(0.0123)	(0.0087)	(0.0122)	(0.0115)
Log Density	0.0335***	0.0349***	0.0682***	0.0758***	0.0596***	0.0666***	-0.0284***	-0.0250***
	(0.0009)	(0.0009)	(0.0022)	(0.0023)	(0.0029)	(0.0030)	(0.0022)	(0.0022)
Trader X Log Density		-0.0218***		-0.1131***		-0.1081***		-0.0508***
		(0.0023)		(0.0072)		(0.0057)		(0.0071)
WLD TFP							2.6252***	2.6247***
							(0.0190)	(0.0189)
Observations	1,235,578	1,235,578	1,143,343	1,143,343	1,235,578	1,235,578	1,235,578	1,235,578
R-squared	0.0286	0.0288	0.0393	0.0402	0.0088	0.0091	0.4957	0.4958
Region Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Labour productivity is computed as firm value added (in 2017 pounds) over firm employment. WLD TFP is firm-level total factor productivity obtained from a 3-inputs (intermediates, labour and capital) Cobb-Douglas production function where revenue is the output measure and coefficients are estimated (separately by SIC industry) using a methodology consistent with Wooldridge (2009). Markups are estimates of the firm-level price to marginal cost ratio obtained from WLD TFP estimations and the share of intermediates in revenue as developed in De Loecker and Warzynski (2012). Trader is a dummy indicating whether an establishment is involved in imports and/or exports. Density is computed as the (log of) population over surface. All regressions contain year and broad region (12 regions) dummies covering the whole of the UK. TTWA-year-level clustered standard errors in parenthesis. *** p<0.01, ** p<0.05, *p<0.1.

Table A-9: Table 10 for the Utility industry

VARIABLES	WLD TFP		Lab.Prod.		Markup			
Importer	0.1861***	0.2181***	0.5627***	0.7296***	-0.4437***	-0.2515***	-0.9326***	-0.8244***
	(0.0047)	(0.0055)	(0.0121)	(0.0168)	(0.0152)	(0.0105)	(0.0186)	(0.0156)
Exporter	0.0861***	0.0952***	0.1069***	0.1792***	-0.1394***	-0.1258***	-0.3656***	-0.3759***
	(0.0043)	(0.0061)	(0.0111)	(0.0180)	(0.0091)	(0.0100)	(0.0163)	(0.0182)
Log Density	0.0335***	0.0348***	0.0683***	0.0759***	0.0593***	0.0659***	-0.0287***	-0.0254***
	(0.0009)	(0.0009)	(0.0022)	(0.0023)	(0.0029)	(0.0030)	(0.0022)	(0.0022)
Importer X Log Density		-0.0174***		-0.0919***		-0.1047***		-0.0590***
		(0.0038)		(0.0073)		(0.0075)		(0.0131)
Exporter X Log Density		-0.0057		-0.0431***		-0.0107		0.0041
		(0.0040)		(0.0090)		(0.0072)		(0.0137)
WLD TFP							2.6272***	2.6267***
							(0.0190)	(0.0190)
Observations	1,235,578	1,235,578	1,143,343	1,143,343	1,235,578	1,235,578	1,235,578	1,235,578
R-squared	0.0294	0.0296	0.0395	0.0404	0.0084	0.0087	0.4956	0.4956
Region Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Labour productivity is computed as firm value added (in 2017 pounds) over firm employment. WLD TFP is firm-level total factor productivity obtained from a 3-inputs (intermediates, labour and capital) Cobb-Douglas production function where revenue is the output measure and coefficients are estimated (separately by SIC industry) using a methodology consistent with Wooldridge (2009). Markups are estimates of the firm-level price to marginal cost ratio obtained from WLD TFP estimations and the share of intermediates in revenue as developed in De Loecker and Warzynski (2012). Importer and exporter are dummies indicating whether the establishment imports or exports, respectively. Density is computed as the (log of) population over surface. All regressions contain year and broad region (12 regions) dummies covering the whole of the UK. TTWA-year-level clustered standard errors in parenthesis. *** p<0.01, ** p<0.05, *p<0.1.

Table A-10: Table 11 for the Utility industry

VARIABLES	Trader		Importer		Exporter	
Log Density	0.1418***	0.1076***	0.1402***	0.1037***	0.1426***	0.1064***
	(0.0118)	(0.0117)	(0.0089)	(0.0089)	(0.0124)	(0.0123)
WLD TFP		0.8819***		0.9128***		0.9209***
		(0.0183)		(0.0160)		(0.0184)
Observations	1,235,578	1,235,578	1,235,578	1,235,578	1,235,578	1,235,578
Region dummies	YES	YES	YES	YES	YES	YES
Year dummies	YES	YES	YES	YES	YES	YES

Notes: WLD TFP is firm-level total factor productivity obtained from a 3-inputs (intermediates, labour and capital) Cobb-Douglas production function where revenue is the output measure and coefficients are estimated (separately by SIC industry) using a methodology consistent with Wooldridge (2009). Density is computed as the (log of) population over surface at the TTWA level. Importer and exporter are dummies indicating, respectively, whether a firm imports or exports while trader is a dummy indicating whether a firm does either of the two. All regressions contain year and broad region (12 regions) dummies covering the whole of the UK. TTWA-year-level clustered standard errors in parenthesis. *** p<0.01, ** p<0.05, *p<0.1.

Table A-11: Table 9 for the Tradable industry

VARIABLES	WLD TFP		Lab.Prod.		Markup			
Trader	0.0477***	0.0631***	0.2718***	0.2819***	-0.3460***	-0.2927***	-0.4482***	-0.4279***
	(0.0016)	(0.0018)	(0.0048)	(0.0063)	(0.0105)	(0.0144)	(0.0100)	(0.0132)
Log Density	0.0110***	0.0132***	0.0186***	0.0200***	0.0116***	0.0191***	-0.0120***	-0.0092**
	(0.0007)	(0.0008)	(0.0023)	(0.0025)	(0.0027)	(0.0045)	(0.0021)	(0.0036)
Trader X Log Density		-0.0082***		-0.0054		-0.0285***		-0.0109
		(0.0011)		(0.0046)		(0.0108)		(0.0101)
WLD TFP							2.1434***	2.1433***
							(0.0162)	(0.0161)
Observations	6,854,200	6,854,200	6,310,504	6,310,504	6,854,200	6,854,200	6,854,200	6,854,200
R-squared	0.0104	0.0105	0.0182	0.0182	0.0091	0.0091	0.2987	0.2987
Region Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Labour productivity is computed as firm value added (in 2017 pounds) over firm employment. WLD TFP is firm-level total factor productivity obtained from a 3-inputs (intermediates, labour and capital) Cobb-Douglas production function where revenue is the output measure and coefficients are estimated (separately by SIC industry) using a methodology consistent with Wooldridge (2009). Markups are estimates of the firm-level price to marginal cost ratio obtained from WLD TFP estimations and the share of intermediates in revenue as developed in De Loecker and Warzynski (2012). Trader is a dummy indicating whether an establishment is involved in imports and/or exports. Density is computed as the (log of) population over surface. All regressions contain year and broad region (12 regions) dummies covering the whole of the UK. TTWA-year-level clustered standard errors in parenthesis. *** p<0.01, ** p<0.05, *p<0.1.

Table A-12: Table 10 for the Tradable industry

VARIABLES	WLD TFP		Lab.Prod.		Markup			
Importer	0.0378***	0.0445***	0.2095***	0.2198***	-0.1684***	-0.1337***	-0.2495***	-0.2292***
	(0.0019)	(0.0028)	(0.0080)	(0.0125)	(0.0087)	(0.0121)	(0.0082)	(0.0101)
Exporter	0.0257***	0.0404***	0.1423***	0.1500***	-0.2011***	-0.1729***	-0.2563***	-0.2595***
	(0.0023)	(0.0029)	(0.0090)	(0.0139)	(0.0048)	(0.0070)	(0.0056)	(0.0085)
Log Density	0.0109***	0.0134***	0.0178***	0.0200***	0.0109***	0.0185***	-0.0124***	-0.0102***
	(0.0007)	(0.0008)	(0.0023)	(0.0025)	(0.0027)	(0.0043)	(0.0021)	(0.0036)
Importer X Log Density		-0.0036*		-0.0055		-0.0184**		-0.0106
		(0.0019)		(0.0067)		(0.0093)		(0.0079)
Exporter X Log Density		-0.0079***		-0.0043		-0.0156***		0.0014
		(0.0020)		(0.0080)		(0.0043)		(0.0056)
WLD TFP							2.1471***	2.1470***
							(0.0163)	(0.0162)
Observations	6,854,200	6,854,200	6,310,504	6,310,504	6,854,200	6,854,200	6,854,200	6,854,200
R-squared	0.0113	0.0114	0.0214	0.0214	0.0084	0.0085	0.2988	0.2988
Region Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Labour productivity is computed as firm value added (in 2017 pounds) over firm employment. WLD TFP is firm-level total factor productivity obtained from a 3-inputs (intermediates, labour and capital) Cobb-Douglas production function where revenue is the output measure and coefficients are estimated (separately by SIC industry) using a methodology consistent with Wooldridge (2009). Markups are estimates of the firm-level price to marginal cost ratio obtained from WLD TFP estimations and the share of intermediates in revenue as developed in De Loecker and Warzynski (2012). Importer and exporter are dummies indicating whether the establishment imports or exports, respectively. Density is computed as the (log of) population over surface. All regressions contain year and broad region (12 regions) dummies covering the whole of the UK. TTWA-year-level clustered standard errors in parenthesis. *** p<0.01, ** p<0.05, *p<0.1.

Table A-13: Table 11 for the Tradable industry

VARIABLES	Trader		Importer		Exporter	
Log Density	0.1052***	0.1028***	0.0872***	0.0844***	0.1103***	0.1075***
	(0.0030)	(0.0030)	(0.0033)	(0.0033)	(0.0031)	(0.0031)
WLD TFP		0.2086***		0.2456***		0.2467***
		(0.0093)		(0.0109)		(0.0098)
Observations	6,854,200	6,854,200	6,854,200	6,854,200	6,854,200	6,854,200
Region dummies	YES	YES	YES	YES	YES	YES
Year dummies	YES	YES	YES	YES	YES	YES

Notes: WLD TFP is firm-level total factor productivity obtained from a 3-inputs (intermediates, labour and capital) Cobb-Douglas production function where revenue is the output measure and coefficients are estimated (separately by SIC industry) using a methodology consistent with Wooldridge (2009). Density is computed as the (log of) population over surface at the TTWA level. Importer and exporter are dummies indicating, respectively, whether a firm imports or exports while trader is a dummy indicating whether a firm does either of the two. All regressions contain year and broad region (12 regions) dummies covering the whole of the UK. TTWA-year-level clustered standard errors in parenthesis. *** p<0.01, ** p<0.05, *p<0.1.

Table A-14: Table 9 for the Public industry

VARIABLES	WLD TFP		Lab.Prod.		Markup			
Trader	0.0212	-0.1009***	0.2112***	-0.1089	-0.6272***	-0.7374***	-0.6617***	-0.5731***
	(0.0263)	(0.0236)	(0.0714)	(0.0667)	(0.0687)	(0.0376)	(0.0401)	(0.0340)
Log Density	0.0126**	-0.0047	0.0131	-0.0237	0.0318***	0.0161*	0.0113	0.0239***
	(0.0055)	(0.0051)	(0.0151)	(0.0148)	(0.0114)	(0.0094)	(0.0079)	(0.0080)
Trader X Log Density		0.0713***		0.1820***		0.0644**		-0.0518***
		(0.0151)		(0.0401)		(0.0298)		(0.0182)
WLD TFP							1.6255***	1.6277***
							(0.0407)	(0.0405)
Observations	456,570	456,570	383,657	383,657	456,570	456,570	456,570	456,570
R-squared	0.0387	0.0416	0.0224	0.0247	0.0266	0.0269	0.3362	0.3364
Region Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Labour productivity is computed as firm value added (in 2017 pounds) over firm employment. WLD TFP is firm-level total factor productivity obtained from a 3-inputs (intermediates, labour and capital) Cobb-Douglas production function where revenue is the output measure and coefficients are estimated (separately by SIC industry) using a methodology consistent with Wooldridge (2009). Markups are estimates of the firm-level price to marginal cost ratio obtained from WLD TFP estimations and the share of intermediates in revenue as developed in De Loecker and Warzynski (2012). Trader is a dummy indicating whether an establishment is involved in imports and/or exports. Density is computed as the (log of) population over surface. All regressions contain year and broad region (12 regions) dummies covering the whole of the UK. TTWA-year-level clustered standard errors in parenthesis. *** p<0.01, ** p<0.05, *p<0.1.

Table A-15: Table 10 for the Public industry

VARIABLES	WLD TFP		Lab.Prod.		Markup			
Importer	-0.0112	-0.1081***	0.0666	-0.1750*	-0.5838***	-0.6203***	-0.5657***	-0.4449***
	(0.0372)	(0.0357)	(0.0973)	(0.0994)	(0.0944)	(0.0460)	(0.0535)	(0.0536)
Exporter	0.0161	-0.0358	0.1220	-0.0635	-0.1717	-0.2713***	-0.1978**	-0.2133***
	(0.0563)	(0.0512)	(0.1629)	(0.1521)	(0.1576)	(0.0700)	(0.0874)	(0.0638)
Log Density	0.0130**	-0.0041	0.0143	-0.0219	0.0304***	0.0179*	0.0094	0.0246***
	(0.0056)	(0.0055)	(0.0151)	(0.0154)	(0.0118)	(0.0109)	(0.0081)	(0.0086)
Importer X Log Density		0.0565***		0.1387**		0.0218		-0.0698**
		(0.0206)		(0.0574)		(0.0432)		(0.0291)
Exporter X Log Density		0.0321		0.1017		0.0592		0.0072
		(0.0326)		(0.0872)		(0.0706)		(0.0420)
WLD TFP							1.6192***	1.6219***
							(0.0396)	(0.0394)
Observations	456,570	456,570	383,657	383,657	456,570	456,570	456,570	456,570
R-squared	0.0385	0.0416	0.0211	0.0236	0.0282	0.0285	0.3355	0.3358
Region Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Labour productivity is computed as firm value added (in 2017 pounds) over firm employment. WLD TFP is firm-level total factor productivity obtained from a 3-inputs (intermediates, labour and capital) Cobb-Douglas production function where revenue is the output measure and coefficients are estimated (separately by SIC industry) using a methodology consistent with Wooldridge (2009). Markups are estimates of the firm-level price to marginal cost ratio obtained from WLD TFP estimations and the share of intermediates in revenue as developed in De Loecker and Warzynski (2012). Importer and exporter are dummies indicating whether the establishment imports or exports, respectively. Density is computed as the (log of) population over surface. All regressions contain year and broad region (12 regions) dummies covering the whole of the UK. TTWA-year-level clustered standard errors in parenthesis. *** p<0.01, ** p<0.05, *p<0.1.

Table A-16: Table 11 for the Public industry

VARIABLES	Trader		Importer		Exporter	
Log Density	0.0613**	0.0606**	-0.0079	-0.0082	0.0568**	0.0570**
	(0.0261)	(0.0259)	(0.0281)	(0.0274)	(0.0273)	(0.0272)
WLD TFP		0.0466		0.0176		-0.0114
		(0.0594)		(0.0936)		(0.0591)
Observations	456,570	456,570	456,570	456,570	456,570	456,570
Region dummies	YES	YES	YES	YES	YES	YES
Year dummies	YES	YES	YES	YES	YES	YES

Notes: WLD TFP is firm-level total factor productivity obtained from a 3-inputs (intermediates, labour and capital) Cobb-Douglas production function where revenue is the output measure and coefficients are estimated (separately by SIC industry) using a methodology consistent with Wooldridge (2009). Density is computed as the (log of) population over surface at the TTWA level. Importer and exporter are dummies indicating, respectively, whether a firm imports or exports while trader is a dummy indicating whether a firm does either of the two. All regressions contain year and broad region (12 regions) dummies covering the whole of the UK. TTWA-year-level clustered standard errors in parenthesis. *** p<0.01, ** p<0.05, *p<0.1.

Table A-17: Table 9 for the Other industry

VARIABLES	WLD TFP		Lab.Prod.		Markup			
Trader	0.4639***	0.4419***	0.8160***	0.8836***	-0.1254***	-0.1986***	-1.2418***	-1.2622***
	(0.0077)	(0.0099)	(0.0178)	(0.0216)	(0.0202)	(0.0248)	(0.0086)	(0.0139)
Log Density	0.0315***	0.0296***	0.0756***	0.0818***	0.0590***	0.0524***	-0.0169***	-0.0187***
	(0.0012)	(0.0020)	(0.0031)	(0.0046)	(0.0033)	(0.0055)	(0.0024)	(0.0029)
Trader X Log Density		0.0109		-0.0336**		0.0364*		0.0102
		(0.0077)		(0.0159)		(0.0207)		(0.0066)
WLD TFP							2.4069***	2.4067***
							(0.0127)	(0.0126)
Observations	589,704	589,704	546,637	546,637	589,704	589,704	589,704	589,704
R-squared	0.1330	0.1331	0.0952	0.0953	0.0039	0.0040	0.5055	0.5055
Region Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Labour productivity is computed as firm value added (in 2017 pounds) over firm employment. WLD TFP is firm-level total factor productivity obtained from a 3-inputs (intermediates, labour and capital) Cobb-Douglas production function where revenue is the output measure and coefficients are estimated (separately by SIC industry) using a methodology consistent with Wooldridge (2009). Markups are estimates of the firm-level price to marginal cost ratio obtained from WLD TFP estimations and the share of intermediates in revenue as developed in De Loecker and Warzynski (2012). Trader is a dummy indicating whether an establishment is involved in imports and/or exports. Density is computed as the (log of) population over surface. All regressions contain year and broad region (12 regions) dummies covering the whole of the UK. TTWA-year-level clustered standard errors in parenthesis. *** p<0.01, ** p<0.05, *p<0.1.

Table A-18: Table 10 for the Other industry

VARIABLES	WLD TFP		Lab.Prod.		Markup			
Importer	0.3030***	0.3002***	0.4980***	0.6107***	-0.1063***	-0.2068***	-0.8471***	-0.9409***
	(0.0107)	(0.0126)	(0.0221)	(0.0270)	(0.0337)	(0.0384)	(0.0151)	(0.0208)
Exporter	0.2631***	0.2392***	0.4589***	0.4282***	0.0492	0.0743*	-0.5942***	-0.5106***
	(0.0097)	(0.0117)	(0.0140)	(0.0221)	(0.0335)	(0.0383)	(0.0177)	(0.0181)
Log Density	0.0288***	0.0270***	0.0721***	0.0795***	0.0570***	0.0505***	-0.0134***	-0.0156***
	(0.0012)	(0.0020)	(0.0031)	(0.0045)	(0.0033)	(0.0055)	(0.0025)	(0.0028)
Importer X Log Density		0.0014		-0.0557***		0.0500		0.0465***
		(0.0104)		(0.0198)		(0.0333)		(0.0128)
Exporter X Log Density		0.0118		0.0151		-0.0126		-0.0414***
		(0.0090)		(0.0129)		(0.0325)		(0.0132)
WLD TFP							2.4454***	2.4454***
							(0.0128)	(0.0127)
Observations	589,704	589,704	546,637	546,637	589,704	589,704	589,704	589,704
R-squared	0.1532	0.1533	0.1018	0.1021	0.0034	0.0035	0.5092	0.5092
Region Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Labour productivity is computed as firm value added (in 2017 pounds) over firm employment. WLD TFP is firm-level total factor productivity obtained from a 3-inputs (intermediates, labour and capital) Cobb-Douglas production function where revenue is the output measure and coefficients are estimated (separately by SIC industry) using a methodology consistent with Wooldridge (2009). Markups are estimates of the firm-level price to marginal cost ratio obtained from WLD TFP estimations and the share of intermediates in revenue as developed in De Loecker and Warzynski (2012). Importer and exporter are dummies indicating whether the establishment imports or exports, respectively. Density is computed as the (log of) population over surface. All regressions contain year and broad region (12 regions) dummies covering the whole of the UK. TTWA-year-level clustered standard errors in parenthesis. *** p<0.01, ** p<0.05, *p<0.1.

Table A-19: Table 11 for the Other industry

VARIABLES	Trader		Importer		Exporter	
Log Density	0.2024***	0.1402***	0.2236***	0.1548***	0.2186***	0.1543***
	(0.0075)	(0.0080)	(0.0087)	(0.0096)	(0.0079)	(0.0085)
WLD TFP		1.7219***		1.9255***		1.8476***
		(0.0410)		(0.0448)		(0.0440)
Observations	589,704	589,704	589,704	589,704	589,704	589,704
Region dummies	YES	YES	YES	YES	YES	YES
Year dummies	YES	YES	YES	YES	YES	YES

Notes: WLD TFP is firm-level total factor productivity obtained from a 3-inputs (intermediates, labour and capital) Cobb-Douglas production function where revenue is the output measure and coefficients are estimated (separately by SIC industry) using a methodology consistent with Wooldridge (2009). Density is computed as the (log of) population over surface at the TTWA level. Importer and exporter are dummies indicating, respectively, whether a firm imports or exports while trader is a dummy indicating whether a firm does either of the two. All regressions contain year and broad region (12 regions) dummies covering the whole of the UK. TTWA-year-level clustered standard errors in parenthesis. *** p<0.01, ** p<0.05, *p<0.1.

Table A-20: Additional logit model results of international trade involvement

VARIABLES	Exporter EU		Exporter non-EU		Importer EU		Importer non-EU	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log Density	0.0682***	0.0653***	0.1120***	0.1064***	0.0940***	0.0914***	0.1325***	0.1273***
	(0.0036)	(0.0036)	(0.0035)	(0.0034)	(0.0034)	(0.0034)	(0.0033)	(0.0032)
WLD TFP		0.1679***		0.3485***		0.1600***		0.3344***
		(0.0096)		(0.0108)		(0.0127)		(0.0092)
Observations	10,194,124	10,194,124	10,194,124	10,194,124	10,194,124	10,194,124	10,194,124	10,194,124
Region dummies	YES	YES	YES	YES	YES	YES	YES	YES
Year dummies	YES	YES	YES	YES	YES	YES	YES	YES

Notes: This Table presents estimations of a logit model where the dependent variable is a dummy indicating the type of international trade involvement of the firm (exporter EU, exporter non-EU, importer EU, importer non-EU) and the regressors are either density or density and TFP. WLD TFP is firm-level total factor productivity obtained from a 3-inputs (intermediates, labour and capital) Cobb-Douglas production function where revenue is the output measure and coefficients are estimated (separately by SIC industry) using a methodology consistent with Wooldridge (2009). Density is computed as the (log of) population over surface. All regressions contain year and broad region (12 regions) dummies covering the whole of the UK. TTWA-year-level clustered standard errors in parenthesis. *** p<0.01, ** p<0.05, *p<0.1.

Table A-21: A simple logit model of international trade involvement. Adding the presence of a major trade port in the same TTWA.

VARIABLES	Trader dummy	Importer dummy	Exporter dummy
	(1)	(2)	(3)
Log Density	0.1233***	0.1287***	0.1037***
	(0.0030)	(0.0030)	(0.0033)
Major Trade Port	-0.0218*	-0.0249*	-0.0131
	(0.0122)	(0.0133)	(0.0126)
WLD TFP	0.2927***	0.3259***	0.3266***
	(0.0096)	(0.0093)	(0.0104)
Observations	10,194,124	10,194,124	10,194,124
Region dummies	YES	YES	YES
Year dummies	YES	YES	YES

Notes: This Table presents estimations of a logit model where the dependent variable is the trader dummy (as well as the importer and exporter dummies) and the regressors are density, TFP, as well as a dummy indicating whether a major international trade port is located in the TTWA (Major Trade Port). WLD TFP is firm-level total factor productivity obtained from a 3-inputs (intermediates, labour and capital) Cobb-Douglas production function where revenue is the output measure and coefficients are estimated (separately by SIC industry) using a methodology consistent with Wooldridge (2009). Density is computed as the (log of) population over surface. Major trade ports are defined as the top 30 ports of entry or exit of goods in/from the UK as measured by the value of exports and imports over our sample period. Indeed, our trade data provide information on the port of entry/exit of goods for non-EU trade. Importer and exporter are dummies indicating, respectively, whether a firm imports or exports while trader is a dummy indicating whether a firm does either of the two. All regressions contain year and broad region (12 regions) dummies covering the whole of the UK. TTWA-year-level clustered standard errors in parenthesis. *** p<0.01, ** p<0.05, *p<0.1.