Immigration, trade and productivity in services: evidence from U.K. firms

Immigration, Trade and Productivity in Services: Evidence from U.K. Firms

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February, 21, 2018

Abstract

This paper explores the impact of immigrants on the imports, exports and productivity of service-producing firms in the U.K. Immigrants may substitute for imported intermediate inputs (offshore production) and they may impact the productivity of the firm as well as its export costs. The first effect can be understood as the re-assignment of offshore tasks to immigrant workers. The second can be seen as a cost cutting effect due to immigration, and the third as a trade-cost reducing effect. To test the empirical significance and size of these effects, we exploit differences in immigrant inflows across U.K. labor markets and a new firm-level dataset on U.K. service firms. We find that immigrants increase overall productivity in service-producing firms, revealing a cost cutting impact on these firms. They also reduce the extent of country-specific offshoring, consistent with a reallocation of tasks, and they increase country-specific exports, consistent with a reduction in bilateral communication and trade costs.

Key Words: Immigration, Services Trade

JEL Codes: F16, F10, F22, F23

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1 Introduction

The connections between immigration, productivity, and trade have been the focus of active research in recent years. Several papers have analyzed the role of immigrants in increasing the diversity of skills within firms, as well as the positive productivity effects associated with this diversity (see, for instance, Kerr and Lincoln 2010; Ortega and Peri, 2014; Peri, Shih and Sparber, 2015; and Ghosh, Mayda and Ortega, 2014). Other papers have focused on the role of immigrants in promoting specialization and the division of labor (Peri and Sparber, 2009; D'Amuri and Peri, 2014; Foged and Peri, 2016). Within this literature researchers have also recognized that immigrants may be substitutes for the performance of tasks offshore (Ottaviano, Peri and Wright, 2013), thereby generating a cost-reduction effect that increases firm productivity in the same manner as offshoring does (Grossman and Rossi-Hansberg, 2008). To the extent that this substitution effect exists, it will produce a negative correlation between the employment of immigrants and imports of intermediate goods (i.e., "offshoring"). A separate branch of the literature has instead analyzed the effect of immigrants in promoting goods exports via a reduction in bilateral trade costs, for instance by enhancing information flows, trust and linkages between countries. This literature, pioneered by Gould (1994), has analyzed the country-level relationship between immigration and trade (Dunlevy and Hutchinson, 1999; Mundra, 2005; Head and Ries, 1998; Girma and Yu, 2002; just to name a few) and more recently has used cross-regional data within a country, exploiting the differential distribution of immigrants across regions (e.g. Bardhan and Guhathakurta, 2004; Co, Euzent and Martin, 2004; Dunlevy, 2006; Millimet and Osang, 2007; Bandyopadhyay et al., 2008; Tadesse and White, 2008; Herander and Saavedra, 2005)).[1]

Most of the literature described above has omitted an analysis of trade in services, while focusing narrowly on the manufacturing sector. To the best of our knowledge, no paper has analyzed the impact of immigration on the imports, exports and productivity of all firms that trade in services. In the U.K. both immigrants and services exports are relatively concentrated in the same sectors, suggesting there may be a relationship between the two. For example, high-skill immigrants to the U.K. are concentrated in scientific research and development occupations and, correspondingly, the largest category of services trade is professional, scientific and technical activities (see Figure 1).[2] This suggests that immigrants' origin-country networks may be particularly valuable for selling services in foreign markets. For instance, selling business services abroad requires a relatively nuanced understanding of the idiosyncrasies of country-specific business culture. Similarly, selling legal services abroad requires a deep understanding of the subtleties of a country's legal system. In this respect, delivering services effectively across country borders requires a sophisticated and detailed understanding of the specific

[1] See Felbermayr, Grossman and Kohler (2012) for a review of the literature and Genc, Gheasi, Nijkamp and Poot (2011) for a meta analysis of the findings. Much less developed is the analysis of the impact of immigrant workers using firm-level export data. In fact, the only paper we are aware of is Parrotta, Pozzoli and Sala (2016), who analyze the impact of ethnic diversity on exports using Danish firm-level data.

[2] The other major occupations for high skill immigrants to the U.K. are health occupations and computer programming (see ONS, 2013).

foreign markets. Immigrants from those countries may be particularly useful in enhancing and refining that understanding. Hence, this paper addresses a link that has been neglected in the literature and could be very important.

FIGURE 1 HERE

We analyze both the broad impact of an increase in immigration on firm productivity and, more narrowly, of bilateral migrations on firm bilateral imports and exports of services. In doing so, we are able to separately estimate three effects of immigration: a "productivity (or general export promotion) effect", due to the overall cost reduction in production; an "import substitution effect", due to the reduction in the relative cost of having some tasks (services) performed domestically by immigrants rather than being sourced offshore; and a "specific export promotion effect", due to a reduction in the bilateral costs of exporting.

We do this in the context of the U.K., the world's second most popular immigrant destination (in absolute numbers) and the second largest service trader (in value). In 2013, approximately half a million immigrants arrived in the U.K.[3] Figure 2 documents the average share of foreign-born workers for several U.K. local labor markets with above-average immigrant inflow over the period 2001-2007. The labor markets represented in the figure, and used as geographical units in the rest of the paper, are Travel to Work Areas (or TTWAs for short), defined to encompass areas within which people both work and live. There is a significant geographic heterogeneity in the presence of immigrants across TTWAs, which generates a corresponding heterogeneity in the supply of the specific skills that they bring to the labor market, variation that we leverage in our analysis.

FIGURE 2 HERE

Figure 3 shows the population share of foreign-born and of newly arrived foreign born between 1993 and 2015, and indicates rapid growth beginning in the late 1990s and especially over the decade 2000-2010. This is a period when newly arrived immigrants produced an increase in the share of foreign-born in the population of about 4 percent, and it covers the period that we focus on in our empirical analysis.

FIGURE 3 HERE

Figure 4 documents the trend in services imports and exports as a share of UK GDP, over the same period. Here we see that services imports and exports as a share of GDP were rising. In particular, beginning in the mid 1990's, and spanning the entire 2000-2010 decade, imports and exports of services in the UK increased significantly as a share of GDP.

FIGURE 4 HERE

In the empirical analysis we exploit services trade data at the firm level, where we link information on firm characteristics with information on the destination of the exports and origin of the imports for each firm. We further link this firm data with data from the U.K. Labour Force Survey (LFS), which describes worker

[3]Source: Office of National Statistics.

characteristics across local labor markets (TTWAs). In our analysis, inflows of new immigrants into a TTWA represent changes in the immigrant supply in the local labor market and we analyze their impact on productivity, imports and exports of U.K. firms.

To begin, in Section 4 we document two stylized facts that help us identify some key features of our model. In that section, we first show that there is a significant *negative* correlation between the change in the share of immigrants from specific countries and the change in imports of intermediate services from those countries. Second, we show that there is a significant *positive* correlation between the change in the share of immigrants from specific countries and exports of final services to those countries.

Motivated by these facts, we develop, in Section 5 a simple model in which the presence of immigrants may generate these correlations. First, in the model immigrants substitute for offshoring intermediate services (generating an "import substitution effect").[4] Second, by complementing and diversifying skills, immigrants may increase firm productivity, reduce firm labor costs and thus promote total firm exports (a "productivity" or "general export promotion effect"). Finally, they may reduce the specific cost of exporting to their country of origin, by improving communication and delivery of the service (a "specific export promotion effect"). Analogously also the import substitution effect are very likely to be country-specific, due to the specificity of traded services. On the other hand, the overall productivity effect is generated by immigrants' skills. Hence we can distinguish between these effects by exploring the impact of an exogenous increase in the share of immigrants on firm productivity and, separately, on the level of firm imports from, and exports to, the countries of origin of those immigrants. The literature has thus far not attempted to separate these effects from one another, and service-producing and service-exporting firms, which are deeply affected by country-specific knowledge and the skills of immigrants, are an ideal testing ground for these ideas.

Our main empirical findings, described in Section 7 confirm the implications of the model and can be summarized as follows. We find: (i) a bilateral import-substitution (offshore-reduction) effect of immigrants that is largest for language-intensive, culture-specific services; (ii) a bilateral export-promotion effect of immigrants, particularly for language-intensive, culture-specific services; (iii) a positive productivity effect of aggregate immigration. Consistent with the notion that the complementarity between immigrants and services exports may exceed that between immigrants and goods exports, our estimates indicate an elasticity that is near the upper end of the distribution of goods export elasticities found in the literature. Specifically, we find that a 10 percent increase in the bilateral share of immigrants increases exports by around 3 to 4 percent. We find the reverse effect with respect to imports: a 10 percent increase in the bilateral immigrant share reduces intermediate services imports by approximately 1 to 2 percent. We use the estimated effects to perform simple

[4]We note that, anecdotally, this is consistent with stories told in several sectors. For instance, many Silicon Valley firms argue that they face a trade-off between hiring software engineers from sub-contractors in Bangalore versus sponsoring H1B work visas for the same workers in the U.S.

calculations that provide quantitative guidance on what the consequences of a significant post-Brexit reduction in immigrants from the E.U. could be. We conclude that, absent further immigration flows comparable to the recent past, exports of services to the EU would grow at a significantly slower rate, possibly only half as fast as they would grow with continued immigration from Europe.

The rest of the paper is organized as follows. Section 2 reviews the related literature and Section 3 describes the data we use. Section 4 presents some basic facts regarding immigration and services trade in the U.K. Section 5 presents a model and discusses the predictions that the model generates. Section 6 describes the details of the empirical specification and of the identification strategy, whose results are then presented in Section 7. Section 8 provides some concluding remarks.

2 Related Literature

Beginning with Gould (1994) and Head and Ries (1998), a large literature has explored the effect of immigration on bilateral trade flows, typically finding an important role for immigrants in facilitating trade with their country of origin – i.e., immigration and trade (especially exports) are typically found to be complements. In particular, immigrants are found to reduce barriers to exports by facilitating communication between firms and reducing set up costs in the destination country (Rauch and Trindade, 2002). Recently Steingress (2015), Cohen, Gurun and Malloy (2015) and Parsons and Vezina (2016) have used sharper identification strategies, based on the dispersion of refugees, the scattering of Japanese in internment camps during World War II and the distribution of Vietnamese refugees in the 1970's to estimate the link between immigrants and trade. Their findings confirm the previous estimates of a significant elasticity of trade to immigrants, with a magnitude around 0.2.

Immigrants may, at the same time, demand goods and services from their home countries, leading to an increase in imports. Putting these ideas together, many researchers have looked for different effects of immigrants on imports and exports. In a previous paper (Ottaviano et al., 2013) we pointed out that when a good is part of a production chain, such that firms decide whether to produce some components locally or overseas (offshore), those two may be substitutes in production. Namely, increased immigration may *reduce* imports of intermediate goods as immigrants can be employed by firms to produce those intermediate goods in-house rather than offshore. On the whole then, it is not clear whether one should expect a positive or negative effect of immigration on trade and this effect could be different for imports of intermediates relative to exports.

In terms of the economic magnitudes involved, immigrants seem to generate a substantial amount of trade on average. For instance, Genc et al., (2011) perform a meta-analysis of this literature and conclude that a 10 percent increase in the number of immigrants to a country increases the volume of trade by 1.5 percent with most elasticity estimates being between 0.1 and 0.2 with a few as high as 0.3 or 0.4. At the same time, the literature has pointed out that the immigrant-trade relationship may be different depending on the type of good

being traded (Rauch and Trindade, 2002) and on the initial stock of immigrants (Gould, 1994), among other dimensions. For our purposes, it is important to note that the connection between immigrants and trade should apply very strongly to services trade, as these types of exchanges often require nuanced knowledge of language and culture. However, thus far, no paper has explored this nexus for services trade.[5] For instance, Aleksynska and Peri (2014) find that business networks are key to the immigration-trade relationship, evidenced by the fact that the impact is larger when immigrants are employed in managerial and business-oriented occupations.

A more recent branch of the literature focused on immigration (e.g. Ottaviano et al. (2013) has estimated the productivity impact of immigrants. In this framework productivity gains may arise simply from the cost-savings realized from hiring lower-cost immigrant workers (if a firm can discriminate in setting the wages of natives and immigrants). Beyond this, several studies find evidence suggesting that the change in skill mix in a local labor market due to immigration may induce firms to adopt new production techniques that use the immigrant labor intensively. These new techniques, in turn, may generate productivity gains (Beaudry and Green, 2003 and 2005; Beaudry, Doms and Lewis, 2010; Caselli and Coleman, 2006; Gray, Montresor and Wright, 2017). Another channel through which immigration may foster productivity gains is through increased competition or specialization of production activities between natives and immigrants. Peri (2012) estimates the long-run impact of immigration across U.S. states and finds a positive effect on state-level TFP, which can be explained in large part by increased specialization. Peri et al. (2015) find a positive long-run effect of foreign scientists and engineers on productivity in U.S. metropolitan areas. Similarly, estimates from Ottaviano et al. (2013) suggest a positive, short-run productivity effect at the industry level, while Trax, Brunow and Sudekum (2013) find little direct impact of immigrants in Germany on firm-level productivity, but they do find a positive effect that operates through immigrant diversity, especially at the local labor market level. Paserman (2013) exploits the mass migration of high skilled workers from the Soviet Union to Israel in the 1990s, finding no overall productivity effects related to the immigrant share, though he does find a positive effect in high-tech industries. Alesina, Harnoss and Rapoport (2016) find a positive productivity effect of place of birth diversity at the country level. Overall this line of research suggests that there may be positive productivity effects of immigrants. However, it does not incorporate services sector firms nor does it connect with the literature on firm imports and exports, both of which will be important contributions of this paper.

3 Data

Our dataset combines U.K. data from an employment survey with firm-level data on employment, revenues, total trade and capital stocks, as well as bilateral (firm-country) data on trade in services over the period

[5] An exception is Gheasi, Nijkamp and Rietveld (2011) who explore the impact of immigrants on tourism.

2001-2007.[6] We compile and homogenize the final dataset using the following three sources. The first source is represented by waves 1 and 5 of the U.K. Labour Force Survey (LFS) which provide data on employment and worker's characteristics. This is a one percent sample of individuals in the U.K. and it includes a variety of demographic, education and work-related information, including the geographic location in which an individual works and their country of birth. In our analysis, we exploit variation in LFS-reported immigrant stocks across geographic areas within the U.K., specifically across "travel-to-work" areas (TTWAs), which identify local labor markets. The variation in immigration occurs at the geographic (TTWA) level over time and we include 243 TTWAs over our period. When constructing our instrumental variable, we also exploit worker-level information from the 1991 U.K. Census, from the Office of National Statistics (ONS), in order to construct the pre-existing distribution of foreign-born across TTWAs.

Our second data source is the Annual Respondent's Database (ARD), which provides information on U.K. businesses (firms) and is the equivalent of the U.S. Longitudinal Respondents Database. It is administered by ONS and the data are drawn from the Annual Business Inquiry. The data consist of the full population of large firms (those with more than 250 employees) as well as a random sample of smaller firms.[7] In all, our ARD sample covers 37,019 firms over 7 years. Small firms are not sampled in each year and so do not appear in every year. Nearly half of firms appear in only a single year and so they do not contribute variation when firm fixed effects are included in the regression. Eight percent of firms in our sample report positive services trade over the period. The firm-level ARD variables that we use are: total value of imports and exports of services by the firm, firm employment, firm gross value added and firm capital expenditures. As some firms have more than one establishment and we only know the employment and the geographical location for each establishment (while the other variables are only known for the whole firm), we distribute the other variables proportionally to establishment employment. Then we place each establishment in its geographical location corresponding to a specific TTWA. The ARD database does not report the skill composition of workers nor their country of birth so we do not have that information at the firm (establishment) level.[8] The ARD does not include data on goods trade (only on services trade), and so we cannot make a direct comparison between goods and services trade using our sample. However, we will discuss how our results compare to other findings on the impact of immigration on trade in goods.[9]

Finally, the third data source is the ITIS dataset. It consists of firm-level information on the value of imports and exports of services *by country of origin/destination* and *by service type*. Those details are missing from

[6] The time series is constrained by the services trade data, obtained from the U.K. International Trade in Services (ITIS) dataset, which is only available through 2007.

[7] For a comprehensive description of this dataset, see Criscuolo, Haskel and Martin (2003). Given its focus on large firms this dataset covers 82% of UK services trade.

[8] In any case, we exploit LFS-reported geographic variation in immigration across TTWAs, rather than firm-level variation, as our exogenous change in the supply of immigrants.

[9] Data on U.K. goods trade is available at the firm level via secure data housed at Her Majesty's Revenue and Customs. However, these data currently cannot be linked to the ARD.

the aggregate trade values provided by the ARD. Again, the unit of analysis is the firm, and in the multi-establishment case we apportion the data on trade according to employment across establishments. The ITIS data include information on producer services and excludes travel and transport, higher education, banks and the public sector, each of which are covered in other surveys that are not available to researchers. Of particular note is the lack of information on banks, which are responsible for around half of U.K. services trade, though our data do include non-bank trade in financial services. We link the ARD with the ITIS via the common firm identifier in both datasets, and we are able to match 79 percent of ITIS trade flows to ARD firms.[10] We then link this combined dataset with the worker data from the LFS via the TTWA of the establishment.

For the bilateral analysis we group immigrants into 15 regions of origin. We do this in order to exploit data on the immigrant stock from the 1991 Census, which we use in constructing our instrumental variable and which only reports immigrant stocks for these groups. The groups are Ireland, Old Commonwealth,[11] East Africa, Other African countries, Caribbean, Bangladesh, India, Pakistan, South East Asia, Cyprus, Other New Commonwealth, Other countries in European Community,[12] Other countries in Europe,[13] China, and Rest of World. In order to explore the extent to which the allocation of foreign-born workers across TTWAs in the LFS survey is an accurate reflection of their true distribution, we compare the immigrant shares obtained from the LFS in 2001 with the immigrant shares obtained from the 2001 Census. For this single year we have the true immigrant shares in a TTWA cell derived from the universe of individuals.[14] The simple correlation coefficient across cells is 0.86, indicating that the LFS immigrant shares across TTWA are quite accurate.

For measures of services trade barriers, which we use as controls in several specifications, we rely on the OECD's Product Market Regulation (PMR) index which quantifies barriers to services trade in different service types for OECD and selected third countries.[15] In a first step we determine the service types that correspond to each UK SIC industry. To do this, we focus on the service types that are imported and exported by firms in a particular SIC industry. For imports, we compute the share of each service type imported by the firms in a given sector in the total service imports of these firms. We then use these shares as weights to aggregate the service-type specific trade barriers from the PMR to obtain UK SIC-specific import barriers.[16] For exports, we first compute service-type weights in a similar manner and calculate destination-industry specific export barriers by combining the weights and the service-specific barriers for each foreign country reported by the OECD PMR index. In a final step we aggregate across all foreign countries using the share of each country in total UK

[10] The ARD includes the universe of "large" firms, who are the most active service traders, which explains the good match rate.
[11] Australia, New Zealand, South Africa, and Canada.
[12] Note that we adopt the European Community as it stood in 1991: Belgium, Germany, France, Italy, Luxembourg, Netherlands, Denmark, Ireland, Greece, Spain, and Portugal. To be clear, the "Other" means excluding Ireland, which is recorded as an independent region.
[13] European countries that are not members of the European Community nor otherwise listed.
[14] ONS provided these data.
[15] These data are available at www.oecd.org/economy/growth/.
[16] We use the first year in our sample (1997) to construct these weights in order to reduce endogeneity problems. Note that constructing weights at the industry rather than the firm level also helps reduce endogeneity problems from using trade-based weights.

services exports between 1994-1996.

The dataset encompasses foreign-born workers from 142 countries (again, grouped in 15 regions) located across 243 TTWAs and trading with 180 countries (also grouped in the same 15 regions) over 7 years. Our dependent variables in most specifications will vary across establishment (but are imputed from firm level data), destination or source country and year. The main explanatory variable, immigrants as a share of TTWA employment, varies across TTWAs, year and country of origin. We note that most firms export to a single region: the mean number of regions exported to is 1.26 and the median is 1.07. Similarly, most firms import from a single source region, with a mean number of importing regions of 1.19 and median of 1.06. To provide a better sense of the match between firms and workers across TTWAs we note that the mean number of firms in a TTWA is 29, though there is substantial heterogeneity. Additionally, the mean number of the 15 regions of origin represented in a TTWA in a year is 10, and over 70 percent of TTWAs report immigrant flows for each of the 15 regions in every year. This reveals a very large presence and diversity of immigrants in the vast majority of TTWAs. Table 1 provides basic summary statistics for the main variables of the datasets described here.

INSERT TABLE 1 HERE

In our empirical analysis we will also distinguish between broad categories of services, which may differ in terms of the types of interactions that they produce between providers and customers. As anticipated above, we categorize services as belonging to one of three categories: Language and Human Resources (LHR) services,[17] Legal and Related (LR) services,[18] and Technical and Financial (TF) services.[19] The idea behind these groupings is that immigrants may facilitate exports and substitute for imports to differing degrees depending on the relative importance of language or culture in selling the service – i.e., different services may have different degrees of country-specificity. We refer to these services as Language-Human Resource (LHR) intensive services. Similarly, when service provision relies on country-specific norms and institutions, immigrant workers may be particularly strong substitutes of imports and complements of exports – these are what we call Legal and Related (LR) services. Finally, Technical-Financial (TF) services are likely to be relatively unaffected by country-specific knowledge, as they are based on international and quantitative standards rather than country-specific ones and, as a result, immigrants are less relevant in terms of reducing costs for firms when trading these service types.

4 Stylized Facts on Services Trade and Immigration

To illustrate some important features of service production and trade, which will inform the development of our model, we highlight and expand the two stylized facts already noted in the Introduction. First, services *imported*

[17]This group includes Recruitment and Training, Procurement, Management Consulting, Public Relation, Advertising, TV and Radio, Cultural and Recreational Services, Publishing Services, Health Services and Market Research.

[18]This group includes Legal, Accounting and Auditing, and Property Management

[19]This group includes Financial services, Insurance, Architectural, Engineering, Survey, Agricultural, Mining, Other Technical, Computer, Research-Development and Other Business Services.

by U.K. firms from overseas (offshore) may be reassigned to domestic provision if some of the individuals with the appropriate skills to perform them become available in the U.K. through immigration. These services may have a degree of country-, cultural-, or institutional-specificity such that immigrants from those countries may in fact be essential in order to produce them domestically. Figure 5 panel (a) presents a correlation that is consistent with this notion. The figure plots the 2001-2007 change in the share of immigrant employment across country-of-origin cells (x-axis) against the percent change in U.K. imports of services from the same country (y-axis). The negative and significant relationship is consistent with overall substitutability between immigrants and services imports from a country. In panels (b)-(d) we present the same plots for the three broad service categories described above: Language and Human Resources (LHR) services, Legal and Related (LR) services and Technical and Financial (TF) services. A comparison of the figures suggests that substitutability between immigrants and LHR services (for which language and cultural specificity is most relevant) is the strongest, reflected in the relatively steeper negative regression line.

FIGURE 5 HERE

The second stylized fact, depicted in Figure 6, is consistent with the idea that final services, especially those requiring knowledge of the language, institutions or norms of a country, could be exported more efficiently if some individuals from the country migrated and worked in the U.K. The figure plots the 2001-2007 change in the share of immigrant employment across country-of-origin cells (x-axis) against the percent change in U.K. exports of services to the same country (y-axis). The positive and significant relationship is consistent with the possible role of immigrants in reducing trade costs of services to their country of origin. We show separately the correlation by service type in panels (b)-(d), and even in this case we see the strongest (positive) relationship between immigrants and LHR exports. This also suggests that LHR services may benefit the most from the mediation of immigrants. In sum, these stylized facts indicate a negative correlation between bilateral immigrants and offshoring, and a positive correlation between bilateral immigrants and exports. These effects are strongest when considering LHR services trade, which is the type that is the most likely to require country-specific knowledge.

FIGURE 6 HERE

In our sample, around 8 percent of firms trade in services. This translates to nearly 3,000 importers and 3,100 exporters over our period. Again, 88 percent of exporters and 91 percent of importers are engaged with a single country only. For those that export, the mean export-to-sales ratio is 30 percent and the corresponding number for imports is 10 percent. Despite these relatively small shares, services traders are an important part of the economy, accounting for 22.5 percent of total employment and 30 percent of value added. Figure 7 documents the fact that even for services trade the two crucial gravity determinants of trade (GDP and distance) are very relevant. Panel (a) shows that services imports and exports would increase by 0.72 and 0.59 percent,

respectively, when the trading country's GDP increased by 1 percent. Similarly, Panel (b) shows that imports and exports both decline by 0.69 percent for each one percent increase in distance in the trading partner. This pattern and the coefficients estimated are not unlike the pattern for goods trade.[20]

FIGURE 7 HERE

In addition, the cross-section of services traders displays a similar pattern of heterogeneity compared with goods traders. In particular, few firms are responsible for the bulk of services trade, and within sector the volume of trade is positively associated with firm size and productivity. Along the extensive margin larger and more productive firms are much more likely to trade in services, and to trade with more countries. At the same time, on average, a service exporting firm sells 68 percent of their output to a single market, while importing 76 percent from a single market. Even more starkly, a single service type accounts for 95 percent of exports and 86 percent of imports for the average service trading firm (see Breinlich and Criscuolo, 2010). Each of these facts is broadly consistent with the characteristics of goods trading firms (see, e.g., Bernard, Jensen, Redding and Schott (2007) for the US, and Mayer and Ottaviano (2008) for Europe). Hence firm heterogeneity, the presence of an important intensive and extensive margin of trade and the concentration of trade in a single foreign market are features that motivate the structure of our model below, in part inspired by the patterns associated with goods production and trade.

FIGURE 8 HERE

Finally, we document the significance of U.K. immigration and the determinants of its growth between 2001 and 2007. Figure 8 shows the stock of immigrants by group of origin over the period. While Other countries (mainly China) and New Commonwealth experienced a significant increase in the late 1990's, the most substantial growth in the 2001-2007 period occurred for the new Eastern European countries, which joined the EU in 2004 (EU8 in the figure). The skill composition of U.K. immigrants in this period was bimodal. This is represented in Figure 9, which shows that U.K. foreign born are over-represented among college educated (the group at the far left of the bar chart) as well as among the less educated who only have primary education (the group at the right, indicated as Less Educated), while being under-represented at intermediate levels of schooling, especially those with secondary education, divided between a higher level certificate (A-level, which implies 12-13 years of schooling) and a lower level (the general Certificate of Secondary Education, GSCE which only requires 10-11 years of schooling).[21] Many immigrants worked in professional and managerial occupations relative to other "intermediately skilled" occupations. Immigrants to the UK, that is, worked in skilled occupations that are relatively abundant in the service sector, hence they may play a particularly relevant role in it.[22] While the EU expansion brought a higher flow of less-skilled Eastern Europeans, there was also an expansion of the

[20] For additional facts with respect to services trade, see Breinlich and Criscuolo (2010).

[21] The same U-shaped distribution of immigrants' skills is found in the United States as documented by Ottaviano and Peri (2012).

[22] These facts come from the U.K. International Passenger Survey. Similar facts are also reported in Hatton (2005).

points-based immigration system in 2002 by the U.K. government in order to target highly skilled immigrants, a policy that provided a route to U.K. citizenship for both high-skilled workers and their spouses and children. Part of the aggregate variation in immigration inflows and countries of origin that we exploit is due to this policy.

FIGURE 9 HERE

5 Conceptual Framework

As a conceptual framework for our empirical investigation, in this section we present a simple partial-equilibrium model of immigration and international trade in services in which firms are heterogeneous in their productivity, as in Melitz (2003). Although heterogeneous firm models have typically been motivated by stylized facts that are based on goods producers, in the previous section we noted the wide-ranging similarities between goods producers and services producers. Most importantly, services traders are – like goods traders – larger and more productive than non-traders with the most productive firms serving a larger number of markets. These facts, along with the empirical correlations depicted in Figures 3 to 6, motivate the model presented here.[23]

Consider a TTWA in which intermediate services are transformed by local firms into final services to foreign customers located in a number of export destinations indexed $x = 1, ..., X$. The TTWA is modeled as a "small open economy" in partial equilibrium so that all foreign variables and all prices are exogenously given except for the prices of final services.

Final services are horizontally differentiated, with constant elasticity of substitution $\delta > 1$, and are offered by an exogenously given number N of monopolistically competitive providers, each supplying one and only one service. Final service providers are heterogeneous in terms of their efficiency, which is denoted by $\varphi > 0$ and is distributed according to the continuous c.d.f. $F(\varphi)$. For a firm with efficiency φ the total cost of delivering its service to destination country x is

$$C_x = p_{f,x} f_x + p_{f,x} t_x \frac{q_x}{\varphi} + p \frac{q_x}{\varphi}, \tag{1}$$

where q_x is output exported to x, $p_{f,x} f_x$ is a fixed export cost incurred in terms of a bundle of x-specific intermediate services with price index $p_{f,x}$, $p_{f,x} t_x$ is a marginal export cost also incurred in terms of the same bundle of x-specific intermediate services, and p/φ is the marginal production cost incurred in terms of a different bundle of services not specific to x with price index p. The export cost parameters f_x and t_x depend on the cultural distance between the TTWA and destination x as well as on the importance of such distance for the

[23] While there is little in the model that makes it specific to services rather than goods, the effects it highlights are likely to be more important for services than for goods as discussed in the Introduction. Given that the model is otherwise fairly standard, we provide here only a streamlined presentation of its structure and comparative statics. Additional details can be found in the Appendix.

type of final service the provider supplies. In particular, all else equal, they are larger for final services with more relevant cultural content and for destinations with longer cultural distance from the TTWA. We think of cultural distance in terms of linguistic and institutional differences, and of cultural content in terms of linguistic and institutional intensity.

The non-specific bundle of intermediate services includes x-specific intermediate services for all destinations $x = 1, ..., X$ as well as intermediate services that are specific to the origin country (i.e. the UK) with price p_n. We call 'foreign' services those sourced from abroad ('offshore') or from immigrants, and 'native' services those sourced from natives. This suggests the price indexes' mnemonic labels. Intermediate services in the non-specific bundle are horizontally differentiated with constant elasticity of substitution $\sigma > \delta > 1$. Moreover, each x-specific bundle consists of intermediate services that can only be imported from x or sourced locally from workers who immigrated from x, with price $p_{m,x}$ or $p_{o,x}$ respectively. Also these x-specific intermediate services are horizontally differentiated, with constant elasticity of substitution $\theta > \sigma$. As already mentioned, due to the small open economy and partial equilibrium assumptions, all intermediates prices and price indexes are exogenously given.

Profit maximization by a final provider with efficiency φ implies that the profit-maximizing price $P_x(\varphi)$ is a constant markup over marginal delivered cost such that we have $P_x(\varphi) = [\delta/(\delta-1)]\left[\left(p + p_{f,x}t_x\right)/\varphi\right]$. Associated export sales and profit are $R_x(\varphi) = P_x(\varphi)^{1-\delta}A_x$ and $\Pi_x(\varphi) = R_x(\varphi)/\delta - p_{f,x}f_x$ respectively, where A_x is a destination specific demand shifter. Given $\delta > 1$, both $R_x(\varphi)$ and $\Pi_x(\varphi)$ are increasing functions of efficiency φ. This implies that, as final service providers with efficiency φ_x such that $\Pi_x(\varphi_x) = 0$ are indifferent between exporting and not to x, only the selected group of final service providers with efficiency $\varphi \geq \varphi_x$ actually serve destination x. As these exporters account for a share $\pi_x = 1 - F(\varphi_x)$ of all final service providers, the number of exporters to x is $N_x = \pi_x N$. From a different angle, π_x is also the probability that a randomly picked final service provider exports to x. Solving the indifference condition $\Pi_x(\varphi_x) = 0$ determines the export cutoff efficiency level

$$\varphi_x = \frac{\delta}{\delta - 1}\left(p + p_{f,x}t_x\right)\left(\frac{p_{f,x}f_x\delta}{A_x}\right)^{\frac{1}{\delta-1}}. \tag{2}$$

In our data we observe the number of immigrants in the TTWA. An increase in the number of immigrants (and thus in the immigrant share of the local labor force) reduces the price $p_{m,x}$ of immigrant services. As these are part of the bundle of foreign services, also the price index $p_{f,x}$ of this bundle falls, which in turn drives down the price index p of the larger bundle of services used for production to which foreign services belong. Three comparative statics results follow.[24] Differentiating the export cutoff φ_x with respect to $p_{m,x}$ gives:

Proposition 1 ***(Productivity or general export promotion effect)*** *Due to lower production costs, a larger share of immigrants in a TTWA from any given foreign country raises the probability that a final service provider*

[24]See the Online Appendix for detailed proofs of the following propositions.

located in the TTWA exports. Conditional on exporting, it also increases the provider's export sales.

This effect is similar to what in Ottaviano et al. (2013) was called the "cost-reduction" effect of immigration and makes it easier for the service provider to overcome the trade cost to any destination thanks to lower p.

While this effect increases exports to country x as well as to any other destination, the bilateral export probability and the bilateral export sales to x are also affected by an additional destination-specific effect associated with the reduction of bilateral export costs thanks to lower $p_{f,x}$. Hence, a larger share of immigrants from country x raises the probability π_x of exporting to that country through two channels: lower production costs (smaller p) and lower export costs (smaller $p_{f,x}$). The relative importance of the former channel depends on the tradability of the service and is thus a decreasing function of cultural distance (t_x) and of the cultural content of the exported service ($p_{f,x}/p$). Specifically, differentiating φ_x and $R_x(\varphi)$ (for $\varphi > \varphi_x$) with respect to $p_{m,x}$ yields:

Proposition 2 ***(Specific export promotion effect)*** *A larger share of immigrants in a TTWA from any given country disproportionately raises the probability that a final service provider located in the TTWA exports to that country and, conditional on exporting, it also increases disproportionately its export sales to the country. This effect is larger, the greater the cultural content of the service and the larger the cultural distance of the country from the TTWA.*

Finally, a larger share of immigrants also affects imports of intermediate services, and thus their shares in production and export cost. In particular, diffentiating the share of foreign services sourced offshore from country x with respect to $p_{m,x}$ shows that it is a decreasing function of the price of immigrant services. The same holds for the share of foreign intermediate services that are provided by country x to the detriment of the share of those provided by all other countries y (and by the TTWA). Hence, we have:

Proposition 3 ***(Import substitution effect)*** *A large share of immigrants in a TTWA from any given foreign country decreases the share of offshore intermediate services used by final service providers in that TTWA. This happens disproportionately for offshore intermediate services imported from that country.*

We will test these three qualitative predictions in the empirical analysis below, distinguishing between the productivity or general export promotion effect, the specific export promotion effect and the import substitution effect. As far as we know, this type of analysis has been absent from the literature, and we believe that service firms are an ideal group to analyze those effects, given the country-specificity of many services.

6 Empirical Strategy

Our first empirical specification is aimed at testing Proposition 1, which states that immigration into a local labor market k in period t raises the total value of exports of firm i, located in that local labor market. Specifically, we estimate the following regression:

$$ln(y_{ikt}) = \phi_i + \theta_t + \xi_k t + \beta_1 ImmSh_{kt} + \beta_x \ln X_{ikt} + \epsilon_{ikt} \tag{3}$$

The unit of observation for the dependent variable is the firm i, in TTWA k, and year t. The units for the immigrant share (which are negatively correlated with migration costs to that labor market, as described in the model) are TTWA cells in each year. In (3) the outcome y_{ikt} is the value of exports associated with firm i belonging to TTWA k in year t. The variable $ImmShr_{kt}$ is the share of immigrants in the TTWA cell k in year t and it is the main variable of interest; X_{ikt} is a set of firm-level and TTWA-level control variables, including a measure of country-of-birth diversity for immigrants in cell k, constructed as (one minus) the Herfindahl Index across origin countries;[25] ϕ_i and θ_t are firm and year fixed effects, respectively; and $\xi_k t$ are TTWA-specific trends capturing linear growth in U.K. exports over time. The term ϵ_{ikt} then captures zero-mean idiosyncratic errors. We cluster standard errors at the TTWA level which is the level of variation of our regressors of interest. The coefficient of interest in this specification is β_1 which captures the aggregate effect of the population share of immigrants on firm exports. To the extent that the changes in the share and diversity of immigrants is driven by the change in the cost of migrating from each origin country into that labor market, a finding of positive and significant values for these coefficients would be consistent with a positive general export promotion effect generated by the lower costs of production, as highlighted in Proposition 1. We also check whether firm productivity is affected by immigration, as this would be the plausible channel for the overall export-promotion effect. To do so, we run specification (3) with labor productivity of firm i as the dependent variable y_{ikt} (rather than the export value as before).

We then move to a bilateral firm-country setting in order to test Propositions 2 and 3. Those Propositions state that increased immigration from country n into TTWA k in period t due to a decrease in immigration costs raises (reduces) the volume of final exports to (intermediate imports from) country n by local firm i in that TTWA. Hence we run the following regression:

$$ln(y^n_{ikt}) = \phi_k + \theta_t + \xi_k t + \beta_1 ImmSh_{kt} + \beta_2 ImmSh^n_{kt} + \tau^X_{nt} + \tau^M_{UK,t} + \beta_x \ln X_{ikt} + \epsilon^n_{ikt} \tag{4}$$

In this case the units of observation for the dependent variable are firm-by-export-destination or firm-by-

[25] Formally, the measure is defined as $ImmDiv_{kt} = 1 - \sum_{n=1}^{N} \left(ImmSh^n_{kt}\right)^2$, where $n = 1, ..., N$ indexes countries of immigrant origin. The measure is therefore constructed to be *increasing* in immigrant diversity.

import-origin cells. In (4) the outcome y^n_{ikt} can be either the value of exports from firm i to country n in year t (to test Proposition 2) or the value of intermediate imports of firm i from country n (to test Proposition 3). $ImmSh_{kt}$ is the share of immigrants in TTWA cell k. In this case this variable controls for the overall productivity and export-promotion effects. However, we now also include $ImmSh^n_{kt}$, which is the employment share of workers from country n in TTWA cell k. Note also that for each n we remove this bilateral share from the calculation of the aggregate immigrant share measure $ImmSh_{kt}$, so that there is no mechanical correlation between the last two variables. X_{ikt} is a set of firm-level and TTWA-level control variables which includes the TTWA immigrant diversity index. ϕ_i and θ_t are firm and year fixed effects, respectively, and $\xi_k t$ are TTWA trends. Country-specific export barriers and UK import barriers to services trade, denoted by τ^X_{nt} and $\tau^M_{UK,t}$, respectively, are also included in the regression. In this case, while the coefficient β_1 controls for the overall productivity effect due to immigrants on the imports or exports of the firm, the coefficient β_2 captures the effects reflected in Propositions 2 and 3. When the dependent variable is the value of exports, we expect a positive estimate of β_2 reflecting the additional export promotion effect of immigrants due to a reduction in exporting costs. When the dependent variable is the value of intermediate imports we expect a negative estimate of β_2, capturing the substitution between immigrants and imported intermediate services. Taken together the size and significance of these coefficients allow us to test Propositions 1, 2 and 3 from the model.

6.1 Identification and Instrumental Variable Strategy

While in the empirical specifications we control for an array of fixed effects aimed at capturing unobservable local shocks and firm heterogeneity, the presence of unobservable shocks still threatens proper identification. If the inflow of immigrants into a TTWA in a year is driven by a local demand shock and such a shock is correlated with the firm outcome y^n_{ikt} then the estimated coefficients β_1, β_2 and β_3 are not consistent estimates of the causal effect of reducing immigration costs (and hence changing the supply of immigrants) on the corresponding outcomes. In order to address this issue we construct instruments for the share of immigrants in a cell. The instrument should isolate exogenous, supply-driven variation in the share of immigrant labor in a cell. It extends the method proposed by Altonji and Card (1991) and Card (2001) which was then used in several papers exploiting the variation of immigrants across U.S. regions (e.g. Card and DiNardo, 2000; Ottaviano and Peri, 2006; Peri and Sparber, 2009) and in the U.K. (e.g. Dustmann, Frattini and Preston, 2013; Bell, Fasani and Machin, 2013). Specifically, we exploit the fact that foreigners from different countries have increased or decreased their migration flows to the U.K. due to changes in the barriers to migrating and other factors that were specific to their countries of origin or to their relation with the U.K. We interact these country-specific flows with their initial differential presence in local labor markets in the U.K. which proxies for the size of the existing network, known to reduce the cost of migrating to a location. Variation in the initial presence of immigrants

from different countries in a TTWA cell makes firms in that cell more or less subject to shifts in origin-specific push factors. The exclusion restriction for the validity of this instrument relies on the assumption that the initial presence of immigrants in a TTWA is not correlated with recent changes in local economic conditions, but it still affects the current inflow of immigrants.

Specifically, we first consider the number of immigrant workers from country of origin n, working in local labor market (TTWA) k as of 1991 as a share of the total employment of TTWA k, and we denote this value as $ImmSh^n_{k,1991}$.[26] We then augment this share by the aggregate growth rate between year 1991 and year $t = 2001, ..., 2007$, of the specific immigrant group n, $(1 + g^t_n)$, relative to total U.K. population growth, $(1 + g^t_{UK})$. Hence, we multiply $ImmSh^n_{k,1991}$ by this relative growth factor $(1 + g^t_n) / (1 + g^t_{UK})$. In so doing we obtain an imputed value for the country-specific share of immigrants in a labor market in year t. This value interacts the initial presence of immigrants in 1991 with the subsequent aggregate inflows. We denote this variable with $\widehat{ImmSh}^n_{kt}$. We will use this variable as an instrument for $ImmSh^n_{kt}$ in the regressions. Summing $\widehat{ImmSh}^n_{kt}$ across countries of origin n, we obtain the imputed share of all foreign-born in employment in that cell, which can be denoted as follows: $\widehat{ImmSh}_{kt} = \sum_{n=1}^{N} \widehat{ImmSh}^n_{kt}$. This variable, which we use as an instrument for $ImmSh_{kt}$, varies across labor-market cells and time.[27] In the first-stage regression associated with specification (4), the estimated coefficient on the bilateral immigrant share is 0.86 with a t-statistic of 5.8, and the estimate coefficient on the aggregate immigration share is 0.66 with a t-statistic of 4.3, indicating the strong predictive power of the historical immigrant distribution on future immigrant residence. The Wald F-statistics, also reported in Tables 3 and 4, are 19 and 14, respectively.[28]

FIGURE 3 HERE

Because of localized ethnic networks that decrease the costs of immigration (Bartel, 1989), we expect that the initial distribution of immigrants will be a predictor of future immigration flows into a TTWA cell. Moreover, this imputed variable varies with changing immigration costs at the country-of-origin level, rather than with local demand shocks over the 2001-2007 period, addressing potential omitted variable biases. At the same time, unobservable and persistent demand shocks that are both correlated with services trade and with the presence of a specific group of immigrants in 1991 may threaten this identification strategy. A number of features of our empirical approach attenuate these concerns. First, the set of firm fixed effects included in the regressions captures all location-specific and sector-specific shocks. Second, services trade was a much smaller share of the U.K. economy in 1991, with both exports and imports growing by approximately 500 percent between 1991 and the end of our period, 2007, as can be seen in Figure 3. Hence it is unlikely that economic shocks taking

[26] These data were obtained from the 1991 U.K. Census

[27] When we include the measure of immigrant diversity as control we also instrument it, by constructing a Herfindahl Index IV in which the immigrant shares used in its construction are the *imputed* bilateral immigrant shares. This IV is therefore defined as $\widehat{ImmDiv}_{kt} = 1 - \sum_{n=1}^{N} \left(\widehat{ImmSh}^n_{kt}\right)^2$, where n are countries of immigrant origin and $\widehat{ImmSh}^n_{kt}$ is as defined in section 6.1 above

[28] Note that in our bilateral analysis we remove for each n the bilateral share of immigrants from the calculation of the aggregate immigrant share instrument, as well as the immigrant diversity instrument described below.

place in the 90's, in specific TTWAs, affected services trade back then as well as in later years. The growth in services trade beginning in the mid-1990s (driven by the Uruguay Round of trade negotiations) was driven by international events and is therefore likely to be uncorrelated with the shocks driving immigrants to particular TTWAs in 1991.

7 Empirical Results

In this section we present the results from estimating specifications (3) and (4) and in particular we report the coefficients β_1 and β_2 in several tables. We first present the impact of immigrants on the productivity and export of firms. We then analyze how, controlling for aggregate immigration, bilateral immigration affects bilateral offshoring and exports.

7.1 Immigrants and Firm Productivity

We first estimate the impact of the immigrant share on firm productivity. Table 2 presents the results from four specifications of equation (3).[29] The first two columns use (log of) export value as the outcome, while columns 3 and 4 use labor productivity, measured as firm gross value added per worker.[30] The upper panel reports the OLS estimates, while the lower one presents the 2SLS estimates. The most demanding specifications are (2) and (4) which include TTWA-specific trends, while all regressions include firm and year fixed effects to control for firm-specific differences and common year-specific variation. Throughout, we cluster standard errors at the TTWA level which is the level of variation of the explanatory variables in each of the specifications based on (3).

INSERT TABLE 2 HERE

The results in columns (1) and (2) indicate that immigrant inflows were associated with an increase in (the log of) total firm exports. A one percentage point increase in the share of immigrant workers in the local labor force produced a 2.8 to 3.4 percent increase in firm exports (looking at the 2SLS estimates). This result is significant and robust across specifications. Since immigrants represented about 10 percent of the labor force in the average TTWA during the considered period, the estimated coefficient should be divided by about ten to obtain the elasticity of export to immigrants, which implies a value between 0.28 and 0.34, which is within the range of the magnitudes estimated for trade in goods, which is mostly between 0.1 and 0.4 (see Peri and Requena-Silvente, 2010).[31] Columns (3) and (4) present the estimates of similar specifications as in equation

[29] Online Appendix Table OA2 presents the complete results including the control variable coefficients.

[30] In this table we only include non-zero observations for exports (as the dependent variable is log(Export)), which results in a much smaller number of firms and observations in specifications (1) and (2) relative to (3) and (4). In Tables 3, 4 and 5 we will include also the zero-export observations in the non-linear estimation and as a robustness check.

[31] The power in the first stage, not reported in this table, is quite high, with partial F-statistics ranging between 24 and 68 depending on the specification.

(3), now with the log of firm gross value added per worker as the dependent variable. The estimates are positive, significant and close to three, suggesting a three percent rise in labor productivity due to an immigrant inflow equal to one percentage point of the local employment. This relationship confirms that increased presence of immigrants in the local labor market is associated with a significant increase in labor productivity and this could be the channel leading to larger overall exports by the local firms. The magnitude of the effect is significant and comparable with, if somewhat larger than, the estimates in Peri (2012) which finds a coefficient between 1.5 and 2 using variation of immigrants across US states.

7.2 Immigrants and Firm Offshoring and Exports

Table 3 presents the estimated coefficients from specification (4). In columns (1), (2), (5) and (6) the dependent variable is (the log of) firm imports of intermediate services from a specific country n. In columns (3), (4), (7) and (8) the dependent variable is (the log of) firm exports of services to specific country n. The key explanatory variables are the aggregate share of immigrants in the TTWA (as in Table 2) corresponding to the explanatory variable $ImmSh_{kt}$ indicated in the table as "Immigrant Share", and $ImmSh^n_{kt}$, which captures immigrants from country n as a share of employment in the local labor market, indicated as "Immigrant Share Bilateral". Each observation in this regression is at the firm-country-year level. In the Table we also report the coefficients on the trade barrier measures (for imports and exports) which are a direct determinant of the cost of trading services and could be correlated with immigration. The table presents estimates from four different methods of estimation. The upper left panel shows the OLS estimates with year and firm fixed effects (odd number columns) and adding the TTWA-specific trends (even number columns). The upper right panel shows Poisson Pseudo-Maximum likelihood (PPML) estimates using the levels (rather than logs) of the dependent variable. This method allows the inclusion of the zero observations for exports and imports, which contain important information, and therefore is based on a much larger number of firms and observations. Several authors, since the initial paper of Santos Silva and Tenreyro (2006), have used this non-linear method to estimate "gravity-type" regressions. The lower panel shows the Instrumental variable estimates with imputed immigrant shares (aggregate and bilateral) as instruments. The left lower panel uses 2SLS and the lower right panel shows the instrumental variable version of the PPML estimates. In the bottom panels of Table 3 we report the F-statistics of the IV, which are around 20 implying non-weak instruments. We also indicate which fixed effects are included as well as the number of firms and observations included in the regressions. Appendix Tables A1 and A2 present additional specifications as well as the coefficients on variables not reported in the main tables.[32]

INSERT TABLE 3 HERE

Several interesting results emerge from Table 3. First, all estimates, using all four methods, show a negative

[32]Specifically, columns (1), (2) of Table 3 are reported in more detail in Table A1 while columns (3), (4) are reported in more detail in Table A2. The Online Appendix reports more detail for Columns (5)-(8) in Table OA3.

and significant effect of the bilateral immigrant share on bilateral imports of services and a positive and mostly significant estimate of bilateral immigrant share on bilateral exports. This implies that, for instance, an increase in Pakistani workers in a firm producing business services in the U.K. is associated with a reduction in the imports of intermediate services from Pakistan for that same firm and with an increase in the firm's service export to Pakistan. This is consistent with Propositions 2 and 3 in the theory section above. It supports the idea that offshore workers and immigrants from the same country are substitutes in the provision of intermediate inputs for the firm, and that immigrant workers facilitate trade in services from their countries of origin, likely by reducing trade and information costs.

At the same time, the estimates on the aggregate immigrant share are positive and significant for both imports and exports. This implies that an increase in the share of immigrants is associated with an increase in both exports and imports of services, consistent with the existence of a positive productivity effect of immigrants on the firm, as stated in Proposition 1 and as already found in Table 2. As noted in the discussion in Section 5, this productivity effect may arise due to complementarity between immigrants and native-born workers, or may reflect a decline in unit costs associated with immigrants.

In terms of economic significance, the results suggest an important role for each channel. Over the considered period (2001-2007), the average share of immigrants in employment in the average TTWA cell increased by about one percentage point per year and the average share of immigrants in a TTWA at the beginning of the period was 3.2 percent. Using the 2SLS estimates (lower panel) of column (2) and (4) in Table 3 we calculate that the average immigrant inflows raised the volume of services imports by an average of around 3.6 percent per year and it also raised the volume of services exports by about 3.8 percent. On the other hand, bilateral offshoring with the same country of origin of immigrants is found to decrease by approximately 24 percent for every one percentage point increase in the share of immigrants. Since the average rise in bilateral immigration from the average country was about a tenth of a percentage point in the average TTWA, the offshoring reduction effect from immigrants of the same origin was, on average, about 2.4 percent per year, during the 2001-2007 interval. At the same time, the bilateral migration effect on exports to the country of origin produced an increase of about 4.5 percent per year. Hence, the bilateral effect of immigrants in *reducing* offshoring from their specific country of origin was more than offset by the effect of aggregate immigration in *raising* the amount of offshoring (which was about 1.5 percentage points larger than the bilateral reduction). On the other hand, the positive aggregate export effect of immigrants is half the specific bilateral impact of immigrants.

We interpret this "specific export promotion" effect as being the result of a reduction in the specific bilateral cost of trading services with the country of origin of immigrants. By hiring immigrants from a certain country the firm can deliver more effectively, in a more country-specific way, services to that country. Whereas a one percentage point rise in the share of *total* immigrant employment increased aggregate firm exports by around

3.8 percent, the bilateral effects added a further increase in exports of about 4.5 percent (based on the 2SLS estimates of Column 4, multiplied by a yearly growth at 0.1 percentage points per year). Noting that the average bilateral share of immigrants across cells (from the 15 regions we exploit) is 0.006 (just over half a percentage point), we can state the result in an alternative way: a 10 percent rise in the immigrant population from some country increases services exports to that country by about 2.5 percent. This is somewhat larger than the mean estimate from the Genc et al. (2011) meta-analysis of the immigrant impact on *goods* exports, which found an average 1.5 percent rise in exports for each 10 percent increase in immigration. At the same time, it is well within the range of goods export estimates across several studies as reported in Table 1 of Peri and Requena-Silvente (2010). Overall the estimates suggest that services exports may be somewhat more responsive to immigrant inflows than goods exports.

One reassuring feature of the results shown in Table 3 is that the point estimates of the relevant coefficients, comparing the PPML and OLS results, are not too different. Especially in the IV version, both the aggregate and the bilateral coefficient on immigrants are similar in the 2SLS and in the IV PPML estimates, except for the coefficient on aggregate imports which is estimated to be quite larger under 2SLS. Still, even this coefficient is positive and significant in both cases. Finally, as expected, we also find that in all specifications services import barriers significantly reduce the volume of imports, and services export barriers significantly reduce the volume of exports.

7.3 Robustness Checks

In Tables 4 and 5 we perform a series of robustness checks on the main specification.[33] We report the relevant coefficients on "Immigrant Share" and "Bilateral Immigrant Share", as well as on the measures of import and export barriers. Table 4 shows the estimates when (log of) imports of intermediate services is the dependent variable and Table 5 when the dependent variable is exports of services. The first column reports the main specification with several additional TTWA-level controls. While we already control in Table 3 for firm level differences and for TTWA trends, through fixed effects, there may be additional time-varying characteristics of the local labor markets that affect firm exports, imports and productivity that are also correlated with immigrant inflows. In column (1) we control for the share of college-educated workers in a TTWA to capture potential local positive spillovers from human capital (Moretti, 2004). We also control for the share of manufacturing employment in the TTWA to capture potential effects due to a local decline in manufacturing. In addition, we control for immigrant diversity (in terms of place of birth) and occupational diversity as measures of local diversification which could be conducive to idea circulation and growth. Lastly, we control for log population as a measure of density capturing the effect of agglomeration externalities at the local level. Local density and the

[33] Online Appendix Tables OA4 and OA5 report the complete results including coefficients on controls.

share of manufacturing turn out to have a positive correlation with imports and exports of services, while the other variables are less significant. In terms of the effects on immigrant shares, the inclusion of these controls, if anything, strengthens the positive effect on exports and imports. The controls also magnify the absolute value of the negative import effect as well as the positive export effect of bilateral migration. There is some loss of precision, but the point estimate of the bilateral migration effect on imports and exports more than doubles.

INSERT TABLE 4 HERE

Column (2) of Tables 4 and 5 reports the coefficients estimated via a linear 2SLS model with log imports or exports as the dependent variable, but now adding one to the zero observations and hence including all of them in the estimation. The point estimates and significance level are not too different from those in the corresponding 2SLS specification in Table 3, either for imports or for exports. Immigration increases imports and exports significantly and the bilateral flow offsets part of the immigration effect on the bilateral imports, and more than doubles the bilateral impact on exports. Since the city of London can be an important outlier, both in terms of the share of immigrants as well as the prevalence of exporting firms located there, in specification (3) we omit London from the regression. Interestingly, the effect on imports and exports (both aggregate and bilateral) becomes larger, perhaps because immigrants raise productivity and increase trade flows in areas in which the local labor force is less diversified and firms are less internationally connected. Similarly, in specification (4) we check whether the trade-creation and trade-substitution effects are driven by a few dominant immigrant groups. In that specification, for each TTWA we omit the largest group of immigrants and re-estimate the regressions. We still find significant effects that are somewhat larger in absolute value than in the reference case. This suggests that the largest trade creation and productivity effects of immigrants arise when the immigrant presence increases from very low levels, and these benefits decline with the size of the immigrant group.

INSERT TABLE 5 HERE

A final concern that we address is the fact that in multi-establishment firms we allocate several variables, including trade flows, proportionally to employment, introducing a significant source of potential error in the geographical allocation of exports and imports. With this in mind, we limit our analysis to single-establishment firms, though these are only a small subset of sample, especially among exporters and importers. We do report these coefficients in column (5). While the precision of the estimate decreases, the point estimates increases, implying that for smaller firms the local immigrant labor force is particularly important as a driver of productivity and exporting, and as a substitute for imports.

7.4 Different Types of Services

Having established, consistent with Propositions 2 and 3, that immigration substitutes to some extent for offshoring while encouraging exports to the country of origin of immigrants, we next test whether this effect is sensitive to the nature of the service being traded. Specifically, the hypothesis is that the import displacement effect, as well as the export-promotion effect, should be stronger the greater is the "cultural" content of the service. In particular, services with a significant degree of country-specific content – in terms of knowledge of institutions, language, or cultural details – should lend themselves to a greater degree of offshoring as a substitute for immigrant workers, as well as to a relatively larger export-promotion effect. Using our partition of service types into Technical (TF), Legal (LR) and Language (LHR), we hypothesize that the culture-specific content in the second and third group is larger than the first.

INSERT TABLE 6 HERE

Table 6 shows the relevant coefficient estimates, separating firms according to their type of service. Columns (1)-(3) present the estimates for the log imports of Technical and Financial (TF), Legal and Related (LR) services, and Language and Human Resource (LHR) services, respectively. Columns (4)-(6) do the same for log exports.[34]

Confirming our hypothesis, the bilateral effects of immigrants on imports are negative and significant (and similar in magnitude) for LR and LHR services, and they are smaller and not significant for TF Services [35]. Similarly, the bilateral effects of immigrants on exports are negative and significant for LR and LHR services, and they are smaller and not significant for TF Services. These estimates are consistent with a role for immigrants as substitutes for foreign service provision and as a complement for services exports when the services are intensive in language, cultural and institutional-specific content. The estimates suggest that TF services, on the other hand, are in a sense more "neutral" and as a result do not have strong country-of-origin specificity. In each case, as before, the aggregate immigrant share has positive and significant coefficients on total imports and exports. Finally, as expected, the effect of the service import barrier index is negative and significant on offshoring while the export barrier index is less significant and often has the incorrect sign when we focus on specific services groups. This may indicate that this index is not very accurate in picking up the specific barriers to trade in individual service sectors.

We further note that the negative (displacement) effect of immigrants on offshoring activities to the same country of origin, together with the positive effect of all immigrants on offshoring and exports, suggests that the variety of immigrants generates a complementarity between immigrants as a whole and trade as a whole, in

[34] Online Appendix Table OA6 reports the complete results including coefficients on controls.

[35] Using the estimates of columns (2) and (3) a formal test shows that the coefficients on the aggregate share of immigrants are significantly larger than the point estimate of column (1) at 1% confidence level. The coefficients on bilateral migration in column (2) and (3) are not significantly smaller than the coefficient in column (1). The large standard errors of columns (2) and (3) is the reason for the second finding.

spite of the fact that each group of immigrants can substitute for the specific services from their own country. This is consistent with a model in which immigrants displace specific offshore production tasks, but improve overall productivity as well as native employment, an effect also found in Ottaviano et al. (2013).

7.5 Simple Evaluation of the possible Brexit impact

Using the estimated effects of immigrants on imports, exports and productivity of service-producing firms in the U.K., we perform simple calculations that provide quantitative guidance on what the consequences of a significant reduction in immigrants from the E.U., following Brexit, could be. The Brexit process will require negotiations over the degree of labor mobility between the U.K. and E.U. as well as over the degree of access that the U.K. has to E.U. markets. Our findings contribute to this debate by estimating the importance of the link between changes in E.U.-U.K. migration and changes in imports and exports of services.

Net immigration from the E.U. in the 10 years prior to Brexit (2007-2016) led to an increase in the share of E.U. workers in the average TTWA of 0.5 percent of the labor force. The growth in total foreign workers in the average TTWA in that period was 1.3 percent of the labor force, so that more than a third of the growth of foreign-born workers came from the E.U. A plausible scenario if mobility with Europe is discouraged is that over the next 10 years the growth in E.U. immigration would come to a halt, rather than continuing at the existing rate over the period. This would imply 0.5 percent fewer E.U. immigrants in the UK labor force over the next 10 years.

Applying our estimates (we consider the 2SLS estimates of Table 2 and 3), the effect of a relative decline in E.U. immigration of 0.5 percent of the labor force implies a decline in the productivity of services firms equal to about 1.5 percent, and a decline in their total exports of around 1.5 percent. The trade effects vis-a-vis the E.U. will be *more* pronounced due to the important bilateral component of the effect. In fact, combining the average and the bilateral effect, services exports to the E.U. would drop by about 24 percent and services import from the E.U. would instead grow by 12 percent. The trade balance in services with the E.U., therefore, would significantly worsen for the U.K. as a consequence of these effects – i.e., these effects are economically significant. Given that the value of U.K. services exports nearly doubled over the 2007-2016 period,[36] while growth in services exports to the E.U. grew by around 57 percent, we conclude that immigration from the E.U. was responsible for a significant portion of the growth in U.K. services exports, especially to the E.U. Absent existing immigration flows exports of service to the EU will grow at a significantly slower rate, possibly only half as fast as they would grow with continued immigration from Europe.

Services that are most sensitive to the effect of immigrants will see the most dramatic declines. Using the estimates in Table 6, we find that Legal and Related Service exports to the E.U. would decline (or have slower

[36]See Office of National Statistics, International Trade in Services Survey

growth) by 28 percent while Language and Human Resource services would experience a whopping 51 percent decline. These are clearly simple calculations, and agreements with the E.U. may imply continued immigration at, or near, previous rates. Still, it is useful to explore a scenario in which net immigration from the E.U. halts, as we do here. In short, we find that it would have important consequences for the trade balance in the U.K. service sector, as well as for U.K. export penetration of the E.U. market.

7.6 Focus on Exports: Extensive Margin and Language Commonality

In light of the strong relationship between exports and firm productivity (Bernard, 2004), as well as firms' desires to expand the market for their products more generally, in this section we focus on the impact of immigrants on firms' export activities. Immigrants may increase the flow of exported services to their country of origin in two ways. First, they may help customize and target the service toward their home country customers, so that domestic firms are better able to successfully penetrate the new market. This reflects the extensive margin of trade: opening new markets for a firm. Alternatively, they may help expand an existing market for the firm by improving services already offered, hence increasing sales and revenues from that market. This is the intensive margin of trade. The results shown in Tables 3 and 6 show a combined effect of extensive and intensive impacts of immigration on exports. In Table 7 we explore the effect of immigration on the extensive margin of exports.

INSERT TABLE 7 HERE

The estimates reported are obtained using a Linear Probability Model (columns 1 and 2) or a Logit (column 3) or a Probit regression (columns 4 and 5).[37] For the Probit and Logit models we report the average marginal effect. Columns 2 and 6 report the IV estimates. Given the 0-1 nature of the dependent variable, reflecting a positive export status or not, we want to check that the marginal effect estimates using a non-linear model and the LPM are not too different. The estimates are quite similar across specifications and they indicate that a one percentage point increase in the aggregate immigrant share raised the probability of exporting by about 0.30 percent via the productivity channel, though the 2SLS results are mostly not significant. On the other hand, there is fairly good evidence of an effect of the bilateral share on the extensive margin of trade. This suggests that immigrants from a particular country may help firms break into their home-country market.

Most of the estimated coefficients are only weakly significant in the regressions capturing the effects on the extensive margin of trade. This is potentially due to the fact that many observations are 0, as there may not be a very large number of firms expanding in new markets during the relatively short period 2001-2007 that we examine here.[38]

INSERT TABLE 8 HERE

[37] Online Appendix Table OA7 reports the complete results including coefficients on controls.

[38] We have also analyzed the effect of aggregate and bilateral immigrants on the extensive margin of bilateral offshoring, and in that case we also did not find strong, significant effects. The results of those regressions are available upon request.

Finally, Table 8 explores the type of export markets that are more likely to benefit from bilateral migration [39]. Specifically, for a U.K. firm looking to export to a foreign country, the more distant this country is in terms of U.K. laws, culture and language, the larger should be the benefit of gaining insights and logistical support through immigrant employees. In Table 8 we separate the effects of immigrants on trade into non-Anglo-Saxon (columns 1 and 2) versus Anglo-Saxon countries (columns 3 and 4) for LHR service types, which were the types most affected by bilateral immigration. We define Anglo-Saxon countries as the five core English-speaking countries: Australia, Canada, New Zealand, the United Kingdom and the United States. The regression results (we present 2SLS only) are unambiguously in the expected direction. The model predicts that the trade-cost-reducing effect of immigration will have a stronger effect for services with a larger cultural content and for services with a larger bilateral cost. The estimates show an effect on exports of bilateral immigrants that is 2.5 to 3 times larger for non-Anglo-Saxon than for Anglo-Saxon countries. In other words, those countries whose laws and institutions differ the most from the U.K., and are therefore harder to penetrate by U.K. service firms, benefit substantially from immigrant employees in the U.K. who are seemingly able to help deliver better and more customized services. Even the aggregate immigrant effect on exports is larger when considering immigrants from non-Anglo-Saxon countries, suggesting that they may bring new perspectives and skills that complement the local ones to a relatively greater extent. Exports of services, especially services with a high degree of country-specificity, seem to benefit substantially from immigrants.

8 Conclusions

This paper has used a novel micro-dataset on U.K. service-producing firms to illustrate some basic empirical facts regarding the relationship between services trade and immigrant workers in the U.K. We have developed a simple model in which immigrants generate three potential effects on the production, imports and exports of services. First, immigrants can reduce costs and increase firm productivity, allowing firms to produce and export more overall. Second, by bringing country-specific skills with them, immigrants may substitute for the import of intermediate services that were previously offshored and subsequently imported by firms. Third, in bringing their country-specific knowledge, immigrants may increase exports of services to their country of origin.

Our empirical analysis provides evidence that is strongly consistent with each of these hypotheses. We find a productivity and general export promotion effect of immigrants. We then identify an import-substitution effect of immigrants. Finally, we find that immigrants promote bilateral exports to their countries of origin, with an economic magnitude near the upper range of estimates found with respect to goods trade. Each of these effects is greater for services that involve relatively large "cultural" and "country-specific" content. As trade and offshoring of services becomes more important and as the mobility of workers grows, the interplay of these

[39] Online Appendix Table OA8 reports the complete results including coefficients on controls.

two factors will become increasingly important to firms. This papers presents the first theoretical and empirical steps toward understanding these links.

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Table 1
Summary Statistics

	N	Mean	S.D.	Median
Exports > 0 (firm-years)	14655	2511088	231097	324881
Imports > 0 (firm-years)	14212	1611314	186366	263408
Employment (firm-years)	489342	885	270	178
Immigrant Diversity (TTWA-years)	1701	0.02	0.06	0.03
Immigrant Share (TTWA-years)	1701	0.09	0.02	0.04
Bilateral Immigrant Share (TTWA-country-years)	25515	0.01	0.01	0.01
Service Import Barriers (sector-years)	2394	0.07	0.02	0.05
Service Export Barriers (sector-years)	2394	0.10	0.03	0.08

Note: The source of the employment and the Immigrant data is the UK Labor force survey 2001-2007. The source of data on Export and Imports is the UK Annual Respondent's Database over the same 7 years. The universe considered includes only service-producing and service-exporting firms.

Table 2
Immigrant Impact on Log Aggregate Exports and Log Labor Productivity

	Exports		Labor Productivity	
	(1)	**(2)**	**(3)**	**(4)**
			OLS	
Immigrant Share	4.94*** (1.11)	4.05** (1.61)	3.54** (1.55)	3.49* (1.83)
			2SLS	
Immigrant Share	3.42** (1.27)	2.79* (1.84)	3.09* (1.77)	3.05* (2.09)
Year fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes
TTWA trends	No	Yes	No	Yes
Observations	8679	8679	80235	80235
Number of firms	2117	2117	19665	19665

Note: The dependent variable is the log of the value of services exports (columns 1 and 2) or log labor productivity (columns 3 and 4) for the firm. Labor productivity is measured as gross value added per worker. Each regression contains the fixed effects noted in the table plus it includes the log of employment, the log of capital investments and an immigrant diversity index at the firm level as controls. The key explanatory variable, "Immigrant Share" varies at the TTWA-year level. Number of observations is number of non-zero firm-year cells. The 2SLS regressions use as instrument the imputed number of foreign-born in the TTWA-year cells, constructed as described in the text. The period considered is 2001-2007. Standard errors are clustered at the TTWA level. ***,**,* denote significance at the 1%, 5%, 10% confidence level.

Table 3
Immigrant Impact on Log Imports of Services and Log Exports of Services

	Imports		Exports		Imports		Exports	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	OLS				PPML			
Immigrant Share	4.15***	3.74***	4.93***	4.17**	2.11**	2.80**	3.06**	2.49**
	(0.64)	(1.27)	(0.43)	(2.05)	(0.94)	(1.18)	(1.21)	(1.22)
Immigrant Share, Bilateral	-42.21***	-42.01***	66.69***	65.48***	-52.77***	-36.16***	59.13***	47.30***
	(11.91)	(11.76)	(7.71)	(7.69)	(20.52)	(10.42)	(23.55)	(18.43)
Service Import Barriers	-0.51***	-0.51***	0.17*	0.19	-0.38***	-0.30**	0.17	0.27
	(0.14)	(0.14)	(0.09)	(0.13)	(0.13)	(0.16)	(0.12)	(0.20)
Service Export Barriers	0.767	0.756	-0.16**	-0.15**	0.55	0.50	-0.19*	-0.17*
	(0.67)	(0.68)	(0.08)	(0.08)	(0.39)	(0.42)	(0.09)	(0.08)
	2SLS				IV PPML			
Immigrant Share	3.94**	3.63*	4.05***	3.77*	1.96**	1.73**	3.95**	3.77*
	(1.92)	(2.21)	(1.74)	(2.70)	(0.97)	(0.74)	(1.81)	(2.44)
Immigrant Share, Bilateral	-28.27**	-23.76**	50.01***	44.89***	-39.65**	-36.54**	48.87**	40.12
	(14.09)	(12.19)	(15.26)	(17.42)	(19.51)	(17.62)	(30.05)	(29.22)
Service Import Barriers	-0.31*	-0.42	0.18**	0.17*	-0.30*	-0.25*	0.25*	0.15
	(0.15)	(0.35)	(0.09)	(0.10)	(0.18)	(0.15)	(0.11)	(0.11)
Service Export Barriers	0.512	0.627	-0.28***	-0.23**	0.41	0.39	-0.20	-0.22
	(0.42)	(0.60)	(0.10)	(0.12)	(0.23)	(0.39)	(0.15)	(0.23)
Wald First Stage F-Statistics	19, 14	19, 14	19, 14	19, 14	19, 14	19, 14	19, 14	19, 14
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	No	No	Yes	Yes	No	No
TTWA trends	No	Yes	No	Yes	No	Yes	No	Yes
Observations	10415	10415	14212	14212	80235	80235	80235	80235
Number of firms	2117	2117	2961	2961	19665	19665	19665	19665

Note: The dependent variable is the logarithm of the value of services imports or exports by the firm. Each regression contains the fixed effects noted in the table plus the log of employment, the log of capital investments and an immigrant diversity index at the firm level as controls. The key explanatory variable "Immigrant Share" varies at the TTWA-year level, while "Immigrant Share, Bilateral" varies at the TTWA-country-year level. Number of observations is number of non-zero firm-year cells. Wald F-Stats are for the bilateral and aggregate immigration measures, respectively. The 2SLS regressions use as instrument the imputed number of foreign-born in the TTWA-year cells, constructed as described in the text. The period considered is 2001-2007. Additional specifications and coefficients not reported here are available in Appendix Tables A1 and A2. Standard errors are clustered at the TTWA level. ***,**,* denote significance at the 1%, 5%, 10% confidence level.

Table 4
2SLS: Immigrant Impact on Log Imports of Services, Robustness Checks

	Additional Controls	Imports Plus One	Drop London	Drop Dom. Imm Group	Single Establish. Firms
	(1)	(2)	(3)	(4)	(5)
Immigrant Share	4.20** (2.09)	1.31* (0.72)	4.10* (2.60)	4.37* (2.41)	6.14 (3.81)
Immigrant Share, Bilateral	-101.54** (43.11)	-30.14* (18.29)	-71.30** (33.69)	-75.79* (40.14)	-104.28 (67.41)
Service Import Barriers	-0.23 (0.19)	-0.25* (0.14)	-0.23* (0.13)	-0.21* (0.12)	-0.22* (0.12)
Service Export Barriers	0.41 (0.45)	0.62 (0.58)	0.33 (0.21)	0.34 (0.25)	0.30* (0.18)
Immigrant Diversity	55.43 (39.02)	60.52* (36.92)	59.05 (61.84)	57.24 (52.58)	55.01* (31.73)
Occupational Diversity	122.68 (84.38)				
Manufacturing Share of Emp	1.37** (0.64)				
College Share of Emp	7.14 (6.80)				
Log Population	0.61* (0.34)				
Wald First Stage F-Statistics	19, 14	19, 14	17, 14	14, 13	19, 14
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes
TTWA trends	Yes	Yes	Yes	Yes	Yes
Observations	10415	80235	9836	10415	1436
No of Firms	2117	19665	1985	2117	331

Note: The dependent variable is the log value of services imports (offshoring) by the firm. Each regression contains the fixed effects noted in the table. Each regression contains the fixed effects noted in the table plus it includes the log of employment, the log of capital investments and an immigrant diversity index as controls. Number of observations is number of non-zero firm-country-year cells. Wald F-Stats are for the bilateral and aggregate immigration measures, respectively. The 2SLS regressions use as instrument the imputed number of foreign-born in the TTWA-year cells, constructed as described in the text. The period considered is 2001-2007. Standard errors are clustered at the TTWA level. ***,**,* denote significance at the 1%, 5%, 10% confidence level.

Table 5
2SLS: Immigrant Impact on Log Exports of Services, Robustness Checks

	Additional Controls	Exports Plus One	Drop London	Drop Dom. Imm Group	Single Establish. Firms
	(1)	(2)	(3)	(4)	(5)
Immigrant Share	4.00* (2.21)	2.89** (1.24)	5.28* (3.01)	6.05* (3.85)	7.15** (3.09)
Immigrant Share, Bilateral	90.48** (38.91)	41.62* (26.14)	66.83* (38.60)	80.09* (44.87)	113.51* (64.48)
Service Import Barriers	0.12 (0.10)	0.18* (0.10)	0.11 (0.11)	0.12 (0.10)	0.18 (0.13)
Service Export Barriers	-0.23* (0.13)	-0.26 (0.25)	-0.27 (0.23)	-0.27 (0.20)	-0.36 (0.28)
Immigrant Diversity	40.95* (24.87)	42.86* (28.53)	55.61 (39.74)	63.74* (40.42)	69.63* (39.19)
Occupational Diversity	104.46 (77.63)				
Manufacturing Share of Emp	1.27** (0.60)				
College Share of Emp	6.90 (6.25)				
Log Population	0.55* (0.37)				
Wald First Stage F-Statistics	19, 14	19, 14	17, 14	14, 13	19, 14
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes
TTWA trends	Yes	Yes	Yes	Yes	Yes
Observations	11332	80235	9841	11332	1290
No of Firms	2192	19665	1768	2192	306

Note: The dependent variable is the log value of services exports by the firm. Regressions contain the fixed effects noted in the table. Each regression contains the fixed effects noted in the table plus it includes the log of employment, the log of capital investments and an immigrant diversity index as controls. Number of observations is number of non-zero firm-year cells. Wald F-Stats are for the bilateral and aggregate immigration measures, respectively. The 2SLS regressions use as instrument the imputed number of foreign-born in the TTWA-year cells, constructed as described in the text. The period considered is 2001-2007. Standard errors are clustered at the TTWA level. ***,**,* denote significance at the 1%, 5%, 10% confidence level.

Table 6
2SLS: Immigrant Impact on Log Imports and Log Exports
by Service Type

	Imports			Exports		
	Fin & Tech	**Legal & Related**	**Language & HR**	**Fin & Tech**	**Legal & Related**	**Language & HR**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Immigrant Share, Aggregate	0.32** (0.18)	9.55*** (3.28)	10.83*** (2.24)	4.26** (3.09)	6.22*** (1.05)	5.08*** (2.63)
Immigrant Share, Bilateral	-1.91 (1.88)	-14.21* (9.52)	-16.77** (8.39)	5.90 (8.63)	61.32* (43.58)	107.51** (55.36)
Service Import Barriers	-0.31** (0.17)	-0.34** (0.18)	-0.30*** (0.08)	-0.25* (0.16)	-0.33*** (0.12)	-0.29*** (0.05)
Service Export Barriers	0.21* (0.12)	0.22 (0.15)	0.17* (0.11)	0.17** (0.11)	0.14 (0.10)	0.16** (0.07)
Wald First Stage F-Statistics	19, 14	19, 14	19, 14	19, 14	19, 14	19, 14
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
TTWA trends	Yes	Yes	Yes	Yes	Yes	Yes
Observations	8588	1579	4329	8609	2208	4255
No of Firms	1142	329	902	1266	503	948

Note: The dependent variable is the log of the value of services imports (offshoring) or exports by the firm. Each regression contains the fixed effects noted in the table plus it includes the log of employment, the log of capital investments and an immigrant diversity index as controls. Number of observations is number of non-zero firm-year cells. Wald F-Stats are for the bilateral and aggregate immigration measures, respectively. The 2SLS regressions use as instrument the imputed number of foreign-born in the TTWA-year cells, constructed as described in the text. The period considered is 2001-2007. Standard errors are clustered at the TTWA level. ***,**,* denote significance at the 1%, 5%, 10% confidence level.

Table 7
Immigrants and the Extensive Margin of Services Exports
OLS, Logit and Probit

	LPM		Logit	Probit	
	OLS	**2SLS**	**MLE**	**MLE**	**MLE IV**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
Immigrant Share	0.36* (0.24)	0.32 (0.29)	0.31* (0.18)	0.34* (0.16)	0.31 (0.24)
Immigrant Share, Bilateral	0.47* (0.29)	0.40* (0.26)	0.47** (0.23)	0.42* (0.23)	0.40 (0.28)
Service Import Barriers	0.16 (0.16)	0.15 (0.20)	0.21 (0.15)	0.24* (0.15)	0.22 (0.21)
Service Export Barriers	-0.20 (0.15)	-0.18 (0.19)	-0.17* (0.09)	-0.16* (0.09)	-0.20 (0.20)
Wald First Stage F-Statistics	NA	19, 14	NA	NA	19, 14
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes
TTWA trends	Yes	Yes	Yes	Yes	Yes
Observations	8578	8578	8578	8578	8578
No of Firms	2016	2016	2117	2016	2016

Note: The dependent variable is an indicator of the export status of the firm (0,1). Each regression contains the fixed effects noted in the table plus it includes the log of employment, the log of capital investments and an immigrant diversity index at the firm level as controls. Number of observations is number of non-zero firm-year cells. Wald F-Stats are for the bilateral and aggregate immigration measures, respectively. The 2SLS regressions use as instrument the imputed number of foreign-born in the TTWA-year cells, constructed as described in the text. The period considered is 2001-2007. Standard errors are clustered at the TTWA level. ***,**,* denote significance at the 1%, 5%, 10% confidence level.

Table 8

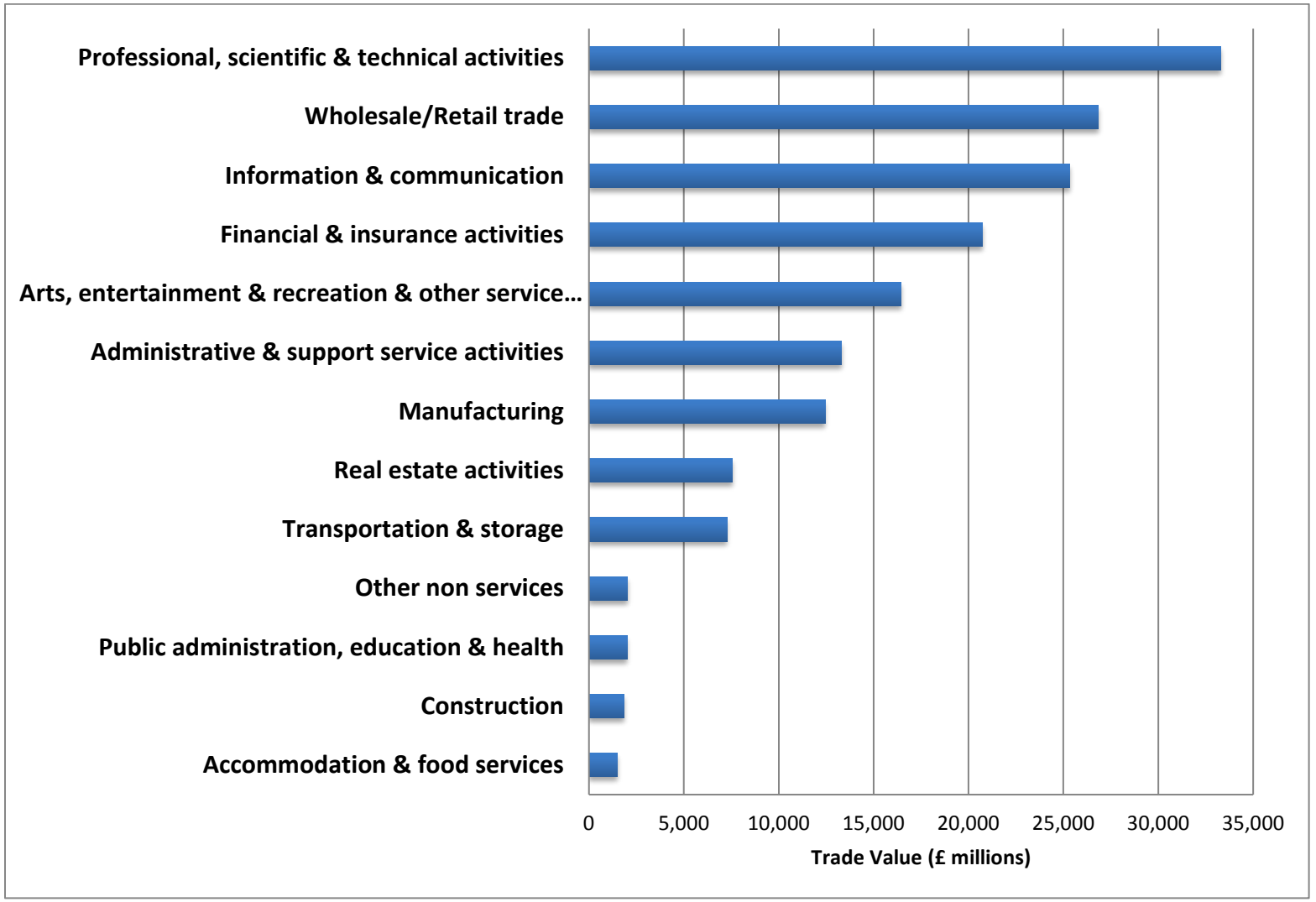
2SLS: Immigrant Impact on Log Language and Human Resources (LHR) Exports

by Export Destination Type

	Non-Anglo-Saxon Destinations		Anglo-Saxon Destinations	
	(1)	**(2)**	**(3)**	**(4)**
Immigrant Share	3.67*	6.09**	3.57*	1.78
	(2.17)	(2.71)	(2.12)	(1.50)
Immigrant Share, Bilateral	101.34***	132.48***	30.15	49.25
	(22.93)	(36.83)	(54.09)	(66.30)
Service Import Barriers	0.30	0.19	0.26	0.17
	(0.33)	(0.15)	(0.29)	(0.13)
Service Export Barriers	-0.31**	-0.24*	-0.27**	-0.21*
	(0.13)	(0.14)	(0.11)	(0.12)
Wald First Stage F-Statistics	19, 14	19, 14	19, 14	19, 14
Year fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes
TTWA trends	No	Yes	No	Yes
Observations	1309	1309	3675	3675
No of Firms	373	373	841	841

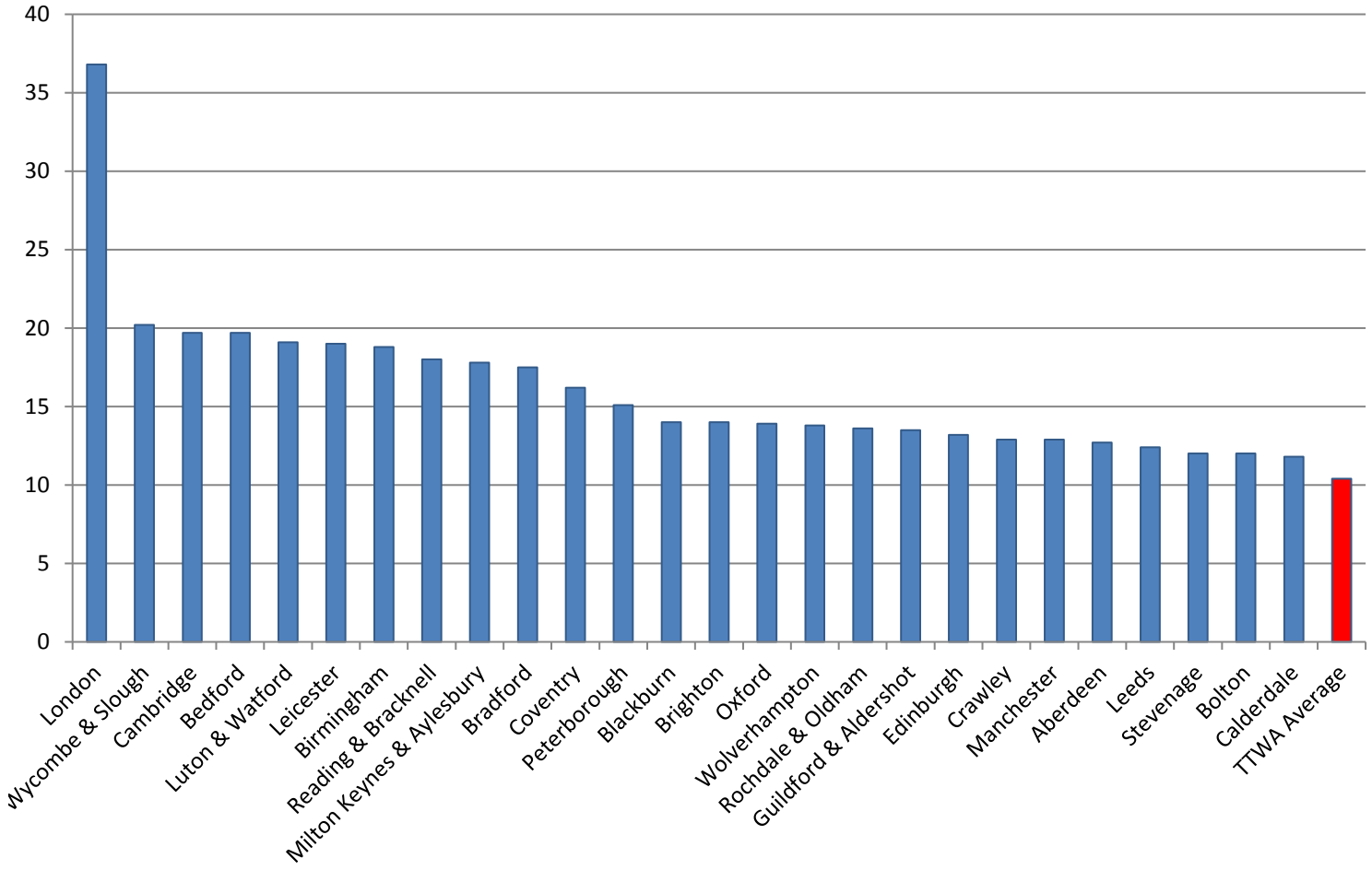
Note: The dependent variable is the log of the value of Language and Human Resources services exports by the firm. Anglo–Saxon countries are defined as Australia, Canada, New Zealand, the UK and the US. Non-Anglo-Saxon are all others. Each regression contains the fixed effects noted in the table plus it includes the log of employment, the log of capital investments and an immigrant diversity index at the firm level as controls. Number of observations is number of non-zero firm-year cells. Wald F-Stats are for the bilateral and aggregate immigration measures, respectively. The 2SLS regressions use as instrument the imputed number of foreign-born in the TTWA-year cells, constructed as described in the text. The period considered is 2001-2007. Standard errors are clustered at the TTWA level. ***,**,* denote significance at the 1%, 5%, 10% confidence level.

Figure 1
U.K. Services Trade Value (Exports + Imports) by Industry, 1999-2005
Millions of UK Pounds



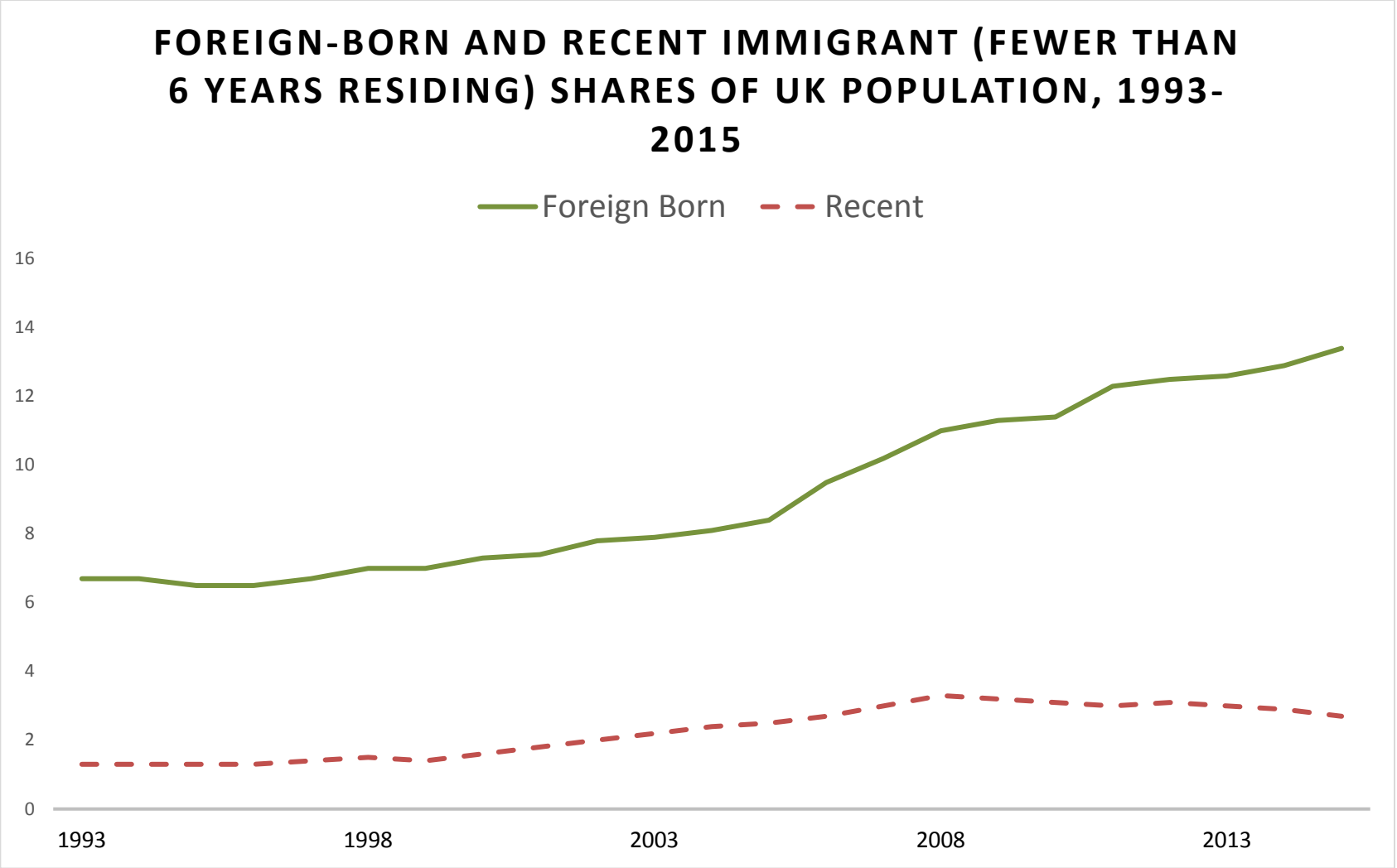
Note: The source of the data is the UK International Trade in Services, ONS.

Figure 2
Top Travel-to-Work Areas by Foreign-Born Share of Population



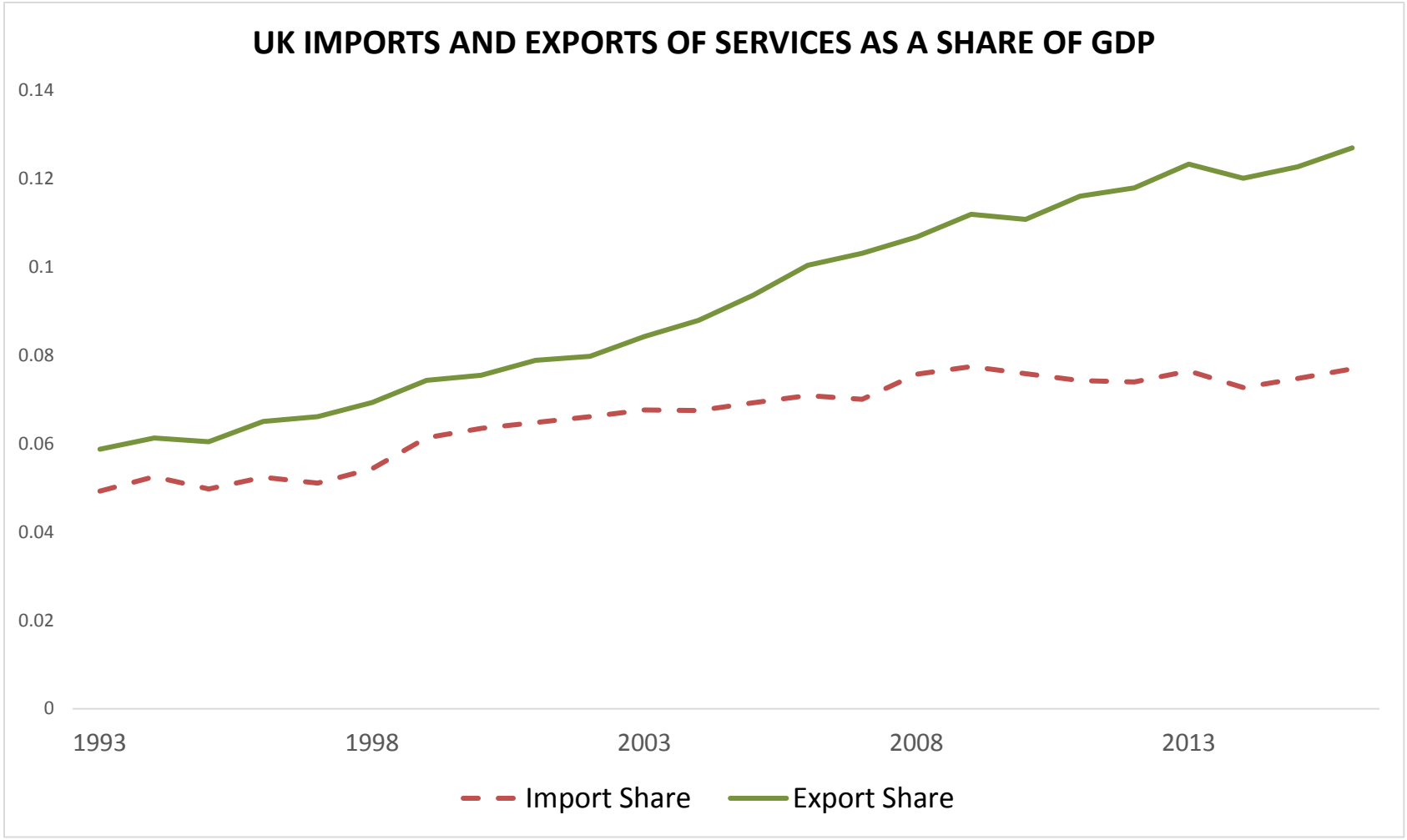
Note: The source of the data is the UK Office of National Statistics

Figure 3



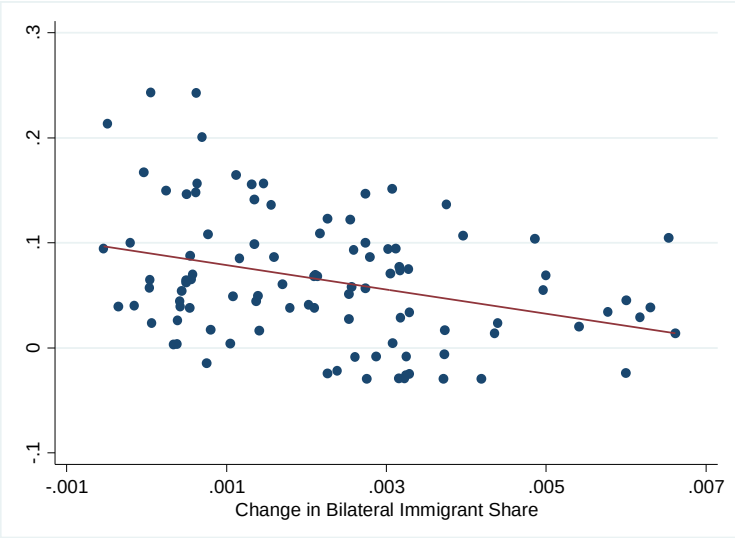
Note: The source of the data is the UK Office of National Statistics

Figure 4

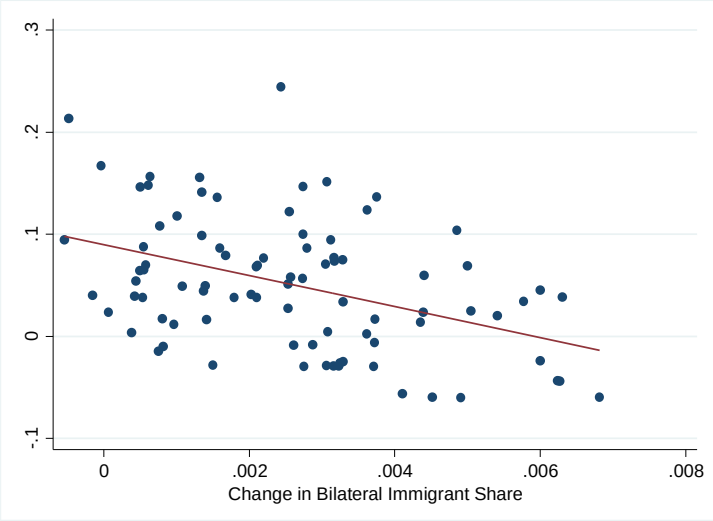


Note: The source of the data is the World Bank

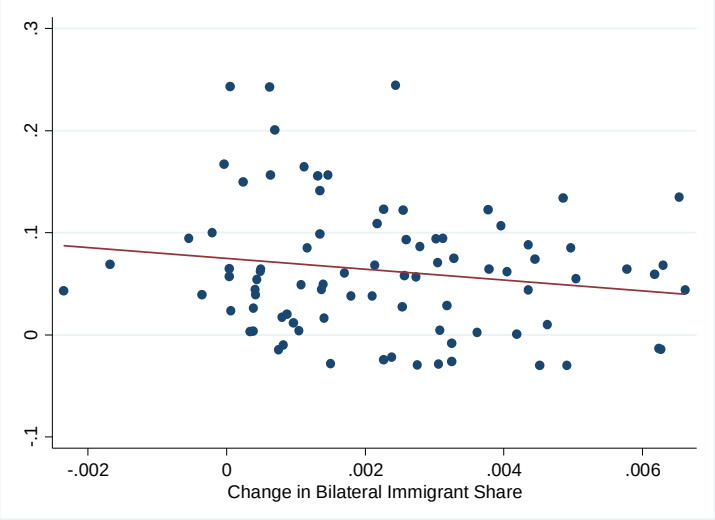
Figure 5. Change in Bilateral Services Imports vs Change in Bilateral Immigrant Share, 2001-2007



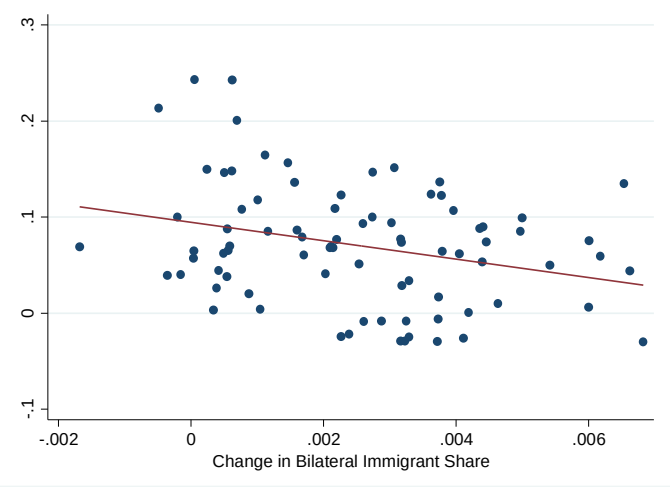
(a) All Services



(b) Language and Human Resources

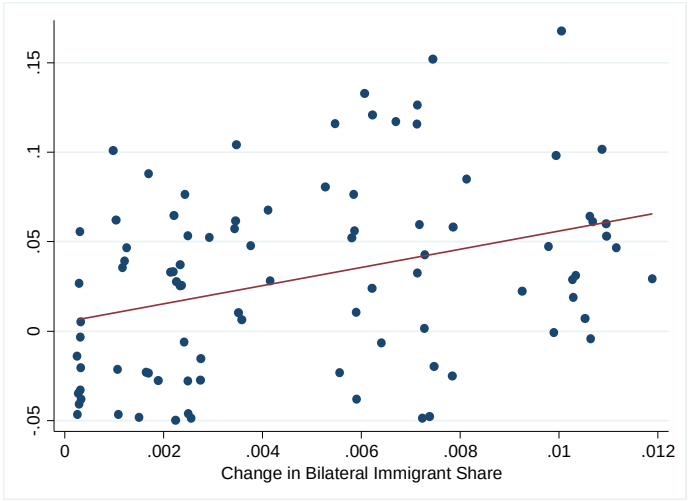


(c) Legal and Related

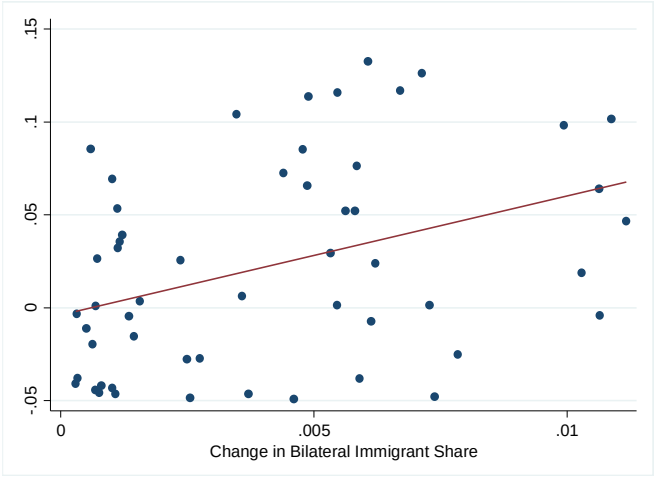


(d) Technical and Financial

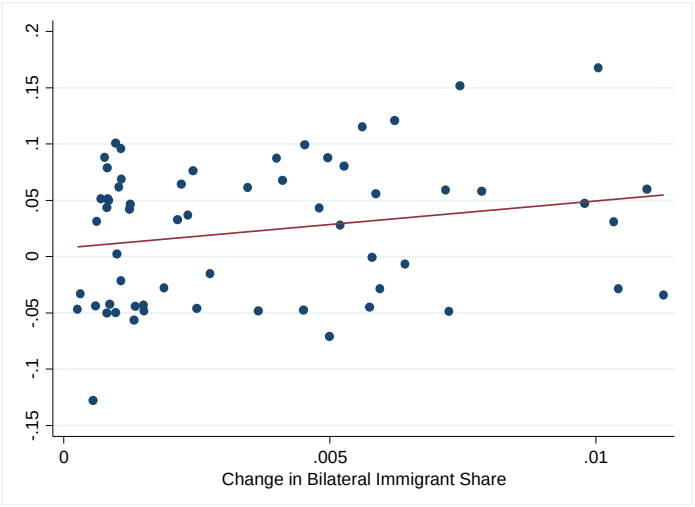
Figure 6. Change in Bilateral Services Exports vs Change in Bilateral Immigrant Share, 2001-2007



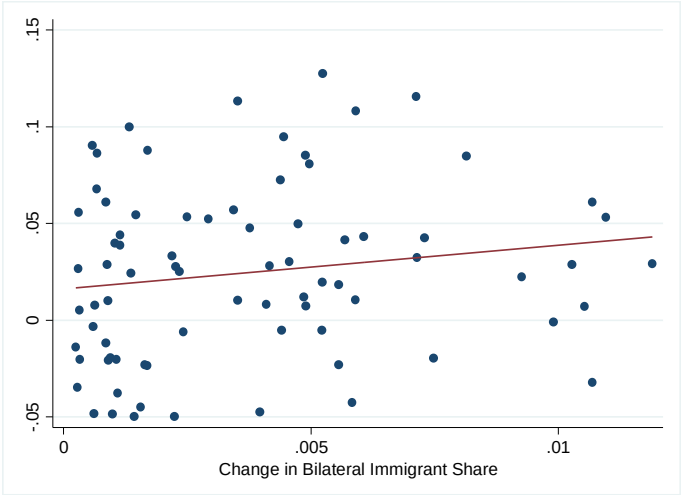
(a) All Services



(b) Language and Human Resources



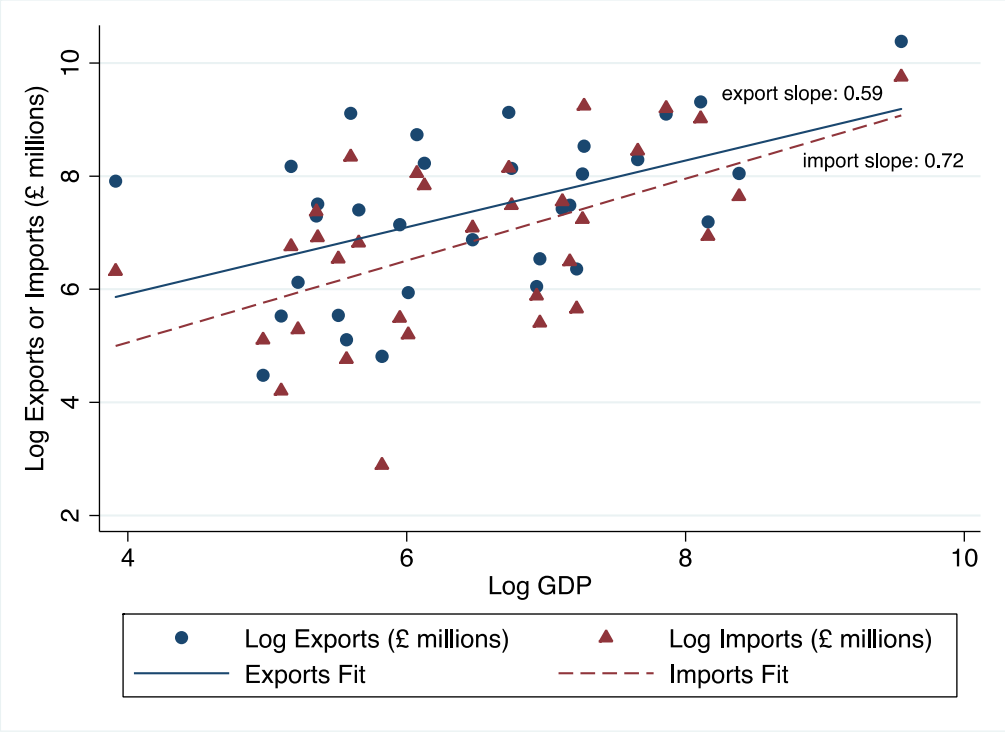
(c) Legal and Related



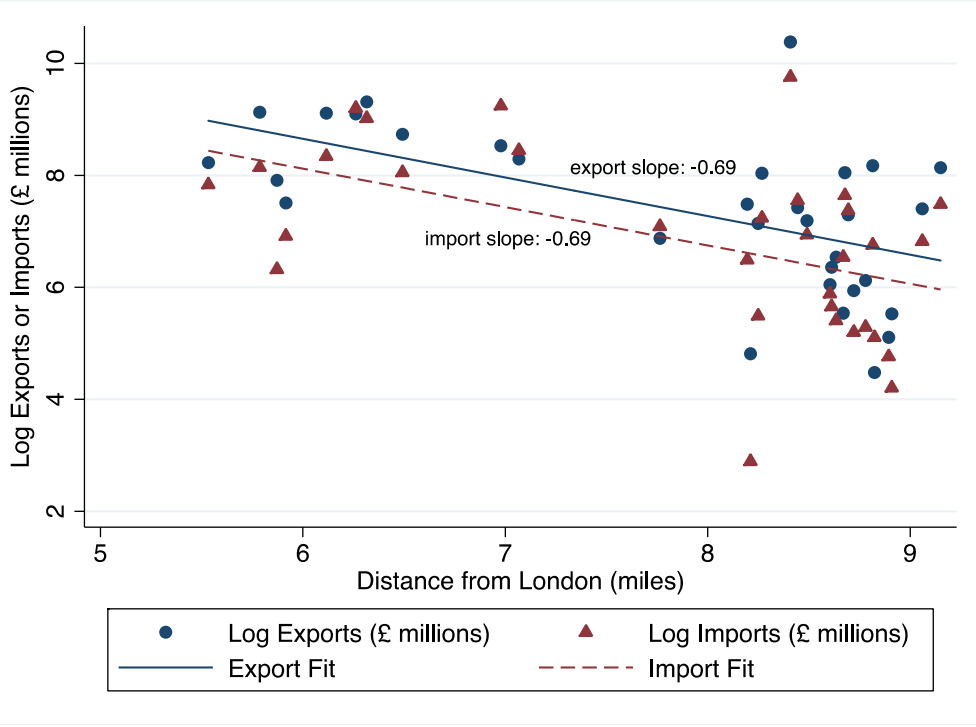
(d) Technical and Financial

Figure 7

(a) UK Trade with Top Partners vs GDP, 2007

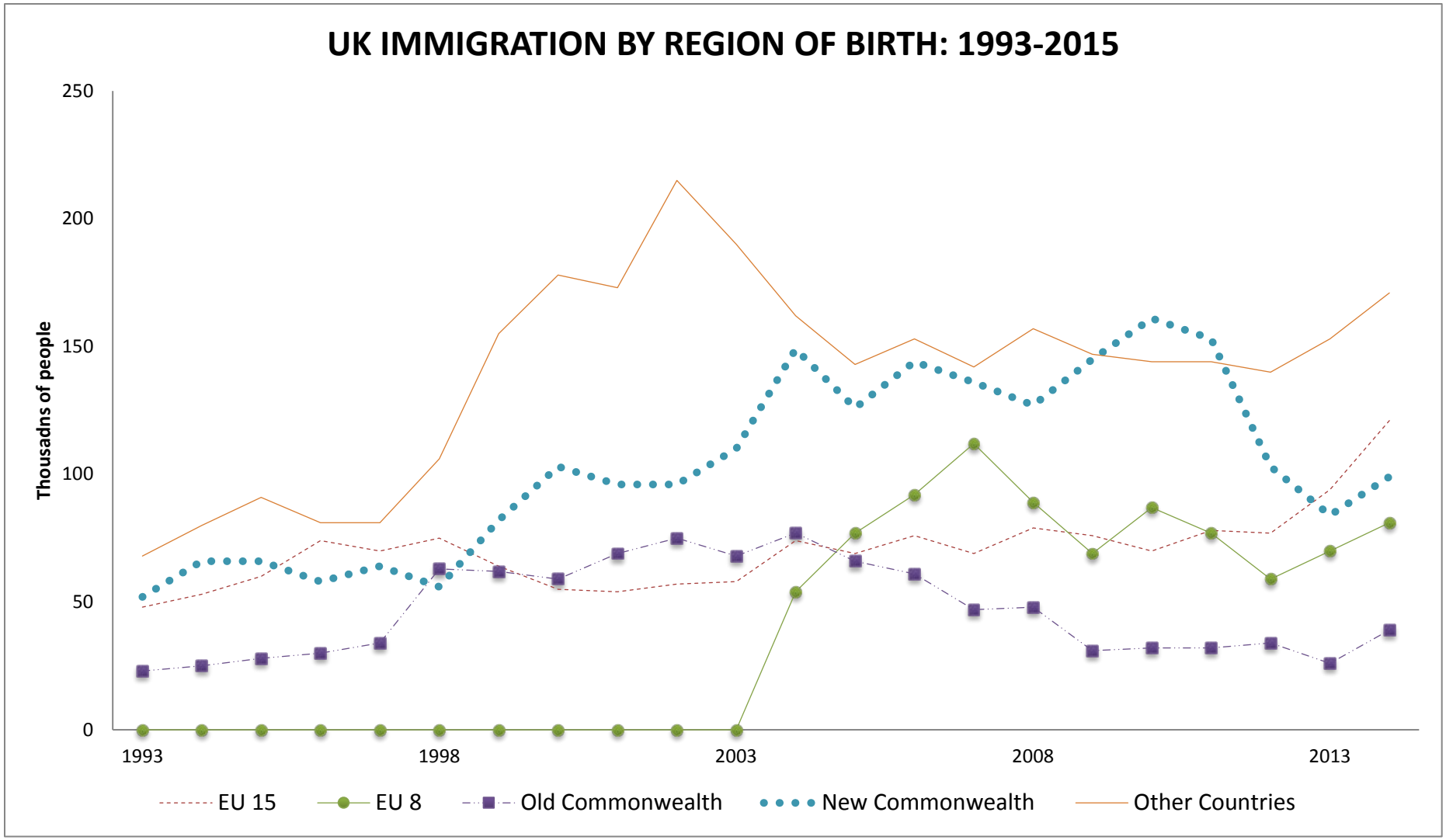


(b) UK Trade with Top Partners vs Distance, 2007



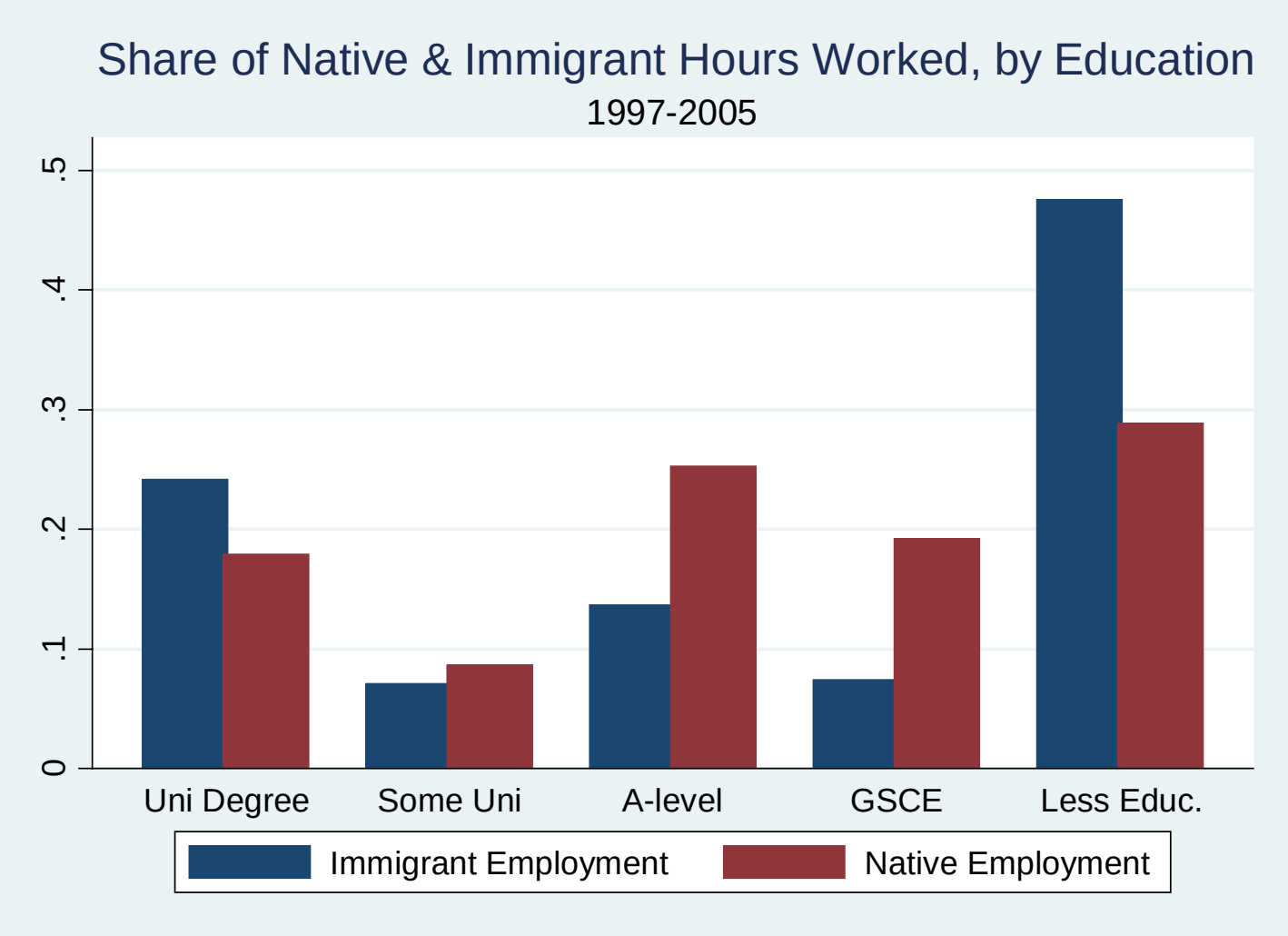
Note: The source of the data is World Bank

Figure 8



Notes: EU 15: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, The Netherlands, Portugal, Spain, Sweden, United Kingdom. **EU 8:** Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, Slovenia. **Old Commonwealth:** Canada, Australia, New Zealand. **New Commonwealth:** Antigua and Barbuda, Bangladesh, Barbados, Belize, Botswana, Kenya, Malawi, Malaysia, Maldives, Malta, Samoa, Singapore, Solomon Islands, South Africa, Sri Lanka. Source: Office of National Statistics.

Figure 9



Note: The source of the data is the UK Office of National Statistics. The Group "Uni. Degree" has a Bachelor degree, The group "Some Uni" has some college education but no degree; the group "A-level" has the higher level of secondary education, corresponding to 12-13 years of schooling in UK and the "GSCE" has a lower General Certificate of Secondary education attained with 10-11 years of schooling. The 'Less educ." Group has only primary education

APPENDIX TABLE

Table A1

Immigrants and Log Imports of Intermediate Services (Offshoring)

Additional Specifications Plus Coefficients on Firm-Level Controls for Employment, Capital and Immigrant Diversity

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
			OLS				2SLS	
Immigrant Share	5.68* (2.90)	6.46** (3.20)	4.15*** (0.64)	3.74*** (1.27)	3.55** (1.84)	3.71** (1.87)	3.94** (1.92)	3.63* (2.21)
Immigrant Share, Bilateral	-83.13*** (28.27)	-70.31* (42.29)	-42.21*** (11.91)	-42.01*** (11.76)	-24.48* (13.04)	-23.38** (10.94)	-28.27** (14.09)	-23.76** (12.19)
Service Import Barriers	-0.25** (0.12)	-0.21** (0.09)	-0.51*** (0.14)	-0.51*** (0.14)	-0.23* (0.13)	-0.21* (0.13)	-0.31* (0.15)	-0.42 (0.35)
Service Export Barriers	0.613 (0.67)	0.745 (0.94)	0.767 (0.67)	0.756 (0.68)	0.601 (0.54)	0.487 (0.54)	0.512 (0.42)	0.627 (0.60)
Immigrant Diversity		69.67 (74.98)		51.37 (53.35)		60.72* (45.20)		43.44 (58.88)
Log Employment	0.13*** (0.02)	0.09** (0.04)	0.12*** (0.03)	0.12*** (0.04)	0.19*** (0.04)	0.18*** (0.04)	0.16*** (0.05)	0.16** (0.07)
Log Capital	0.56*** (0.27)	0.51*** (0.27)	0.46*** (0.23)	0.45** (0.25)	0.64*** (0.21)	0.64*** (0.23)	0.52** (0.26)	0.51** (0.27)
Wald First Stage F-Statistics	NA	NA	NA	NA	19, 14	19, 14	19, 14	19, 14
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	No	No	Yes	Yes	No	No	Yes	Yes
TTWA trends	No	Yes	No	Yes	No	Yes	No	Yes
Observations	14212	14212	10415	10415	14212	14212	10415	10415
No of Firms	2961	2961	2117	2117	2961	2961	2117	2117

Note: The dependent variable is the log of the value of services imports (offshoring) by the firm. Each regression contains the fixed effects noted in the table. Number of observations is number of non-zero firm-year cells. Wald F-Stats are for the bilateral and aggregate immigration measures, respectively. The 2SLS regressions use as instrument the imputed number of foreign-born in the TTWA-year cells, constructed as described in the text. The period considered is 2001-2007. Standard errors are clustered at the TTWA level. ***,**,* denote significance at the 1%, 5%, 10% confidence level.

Table A2

Immigrants and Log Exports of Services

Additional Specifications Plus Coefficients on Firm-Level Controls for Employment, Capital and Immigrant Diversity

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
			OLS				2SLS	
Immigrant Share	6.23*** (1.50)	4.76** (2.12)	4.93*** (0.43)	4.17** (2.05)	4.03** (2.08)	4.01* (2.51)	4.05*** (1.74)	3.77* (2.70)
Immigrant Share, Bilateral	116.77*** (26.42)	103.65*** (28.82)	66.69*** (7.71)	65.48*** (7.69)	89.01*** (31.41)	81.21** (39.82)	50.01*** (15.26)	44.89*** (17.42)
Service Import Barriers	0.27 (0.22)	0.50 (0.60)	0.17* (0.09)	0.19 (0.13)	0.47** (0.26)	0.41* (0.27)	0.18** (0.09)	0.17* (0.10)
Service Export Barriers	-0.41** (0.22)	-0.46** (0.28)	-0.16** (0.08)	-0.15** (0.08)	-0.42** (0.20)	-0.39** (0.19)	-0.28*** (0.10)	-0.23** (0.12)
Immigrant Diversity		52.47 (61.18)		106.89** (52.72)		49.73 (57.25)		91.35* (60.02)
Log Employment	0.22*** (0.06)	0.19*** (0.05)	0.25*** (0.07)	0.21*** (0.06)	0.28*** (0.07)	0.24*** (0.08)	0.26** (0.12)	0.25* (0.14)
Log Capital	0.61** (0.30)	0.61** (0.29)	0.47*** (0.21)	0.46** (0.20)	0.43** (0.22)	0.43** (0.22)	0.41** (0.21)	0.40** (0.22)
Wald First Stage F-Statistics	NA	NA	NA	NA	19, 14	19, 14	19, 14	19, 14
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	No	No	Yes	Yes	No	No	Yes	Yes
TTWA trends	No	Yes	No	Yes	No	Yes	No	Yes
Observations	14655	14655	11332	11332	14655	14655	11332	11332
No of Firms	3089	3089	2192	2192	3089	3089	2192	2192

Note: The dependent variable is the log of the value of services exports by the firm. Each regression contains the fixed effects noted in the table. Number of observations is number of non-zero firm-year cells. Wald F-Stats are for the bilateral and aggregate immigration measures, respectively. The 2SLS regressions use as instrument the imputed number of foreign-born in the TTWA-year cells, constructed as described in the text. The period considered is 2001-2007. Standard errors are clustered at the TTWA level. ***,**,* denote significance at the 1%, 5%, 10% confidence level.

A Online Appendix: The Model in Detail

In this Appendix we first present the details of our conceptual framework and then provide proofs for Propositions 1,2 and 3. As discussed in the main text, we consider a TTWA in which intermediate services are transformed by local firms into final services to foreign customers located in a number of export destinations indexed $x = 1, ..., X$. As the TTWA is assumed to be a "small open economy" in partial equilibrium, all foreign variables and all prices are exogenously given with the exception of the prices of final services.

A.1 Demand and Cost

For exports to destination x each final service provider faces the following CES demand:

$$D_x = \left(\frac{P_x}{\overline{P}_x}\right)^{1-\delta} \frac{E_x}{P_x}, \tag{5}$$

where D_x is quantity demanded in destination x, E_x is the destination's total expenditure on final services, P_x is the delivered price quoted by the provider, $\delta > 1$ is the elasticity of substitution between final services offered by different providers, and $\overline{P}_x$ is the destination's price index of these services. Due to the small open economy assumption, both E_x and $\overline{P}_x$ are exogenously given and in the main text they are subsumed in a single demand shifter $A_x \equiv E_x \left(\overline{P}_x\right)^{\delta-1}$.

Final service providers have heterogeneous efficiency distributed according to the c.d.f. $F(\varphi)$. The total cost a final service provider with efficiency φ incurs in delivering q_x units of its service to country x is given by (1) where the price indexes of the two intermediate service bundles used for export and production are respectively:

$$p = \left[(p_n)^{1-\sigma} + \sum_{x=1}^{X} (p_{f,x})^{1-\sigma}\right]^{\frac{1}{1-\sigma}} \text{ and } p_{f,x} = \left[(p_{m,x})^{1-\theta} + (p_{o,x})^{1-\theta}\right]^{\frac{1}{1-\theta}}. \tag{6}$$

A.2 Profit Maximization and Market Clearing

Given total cost (1), a final service provider with efficiency φ maximizes profit from sales in destination x defined as

$$\Pi_x = P_x q_x - p_{f,x} f_x - p_{f,x} t_x \frac{q_x}{\varphi} - p\frac{q_x}{\varphi}, \tag{7}$$

subject to the market clearing constraint for its service $q_x = D_x$ and demand (5). Under monopolistic competition, the profit-maximizing price equals a constant markup over marginal cost:

$$P_x(\varphi) = \frac{\delta}{\delta - 1} \frac{p + p_{f,x} t_x}{\varphi}, \tag{8}$$

with associated profit-maximizing export sales $R_x(\varphi) = P_x(\varphi)D_x(\varphi) = \left(P_x(\varphi)/\overline{P}_x\right)^{1-\delta} E_x$ and maximized export profit $\Pi_x(\varphi) = R_x(\varphi)/\delta - p_{f,x}f_x$. Solving $\Pi_x(\varphi_x) = 0$ for φ_x gives the productivity cutoff for exports to destination x. Exporters to x are a share $\pi_x = 1 - F(\varphi_x)$ of all final service providers, and the number of exporters is $N_x = \pi_x N$.

A.3 Immigration and Trade

To study the impact of immigration on international trade in final services, we differentiate key outcome variables with respect to $p_{m,x}$ for given $p_{o,x}$, p_n and $p_{m,y\neq x}$, noting that the implied change in the price of x-specific immigrant services is the dual of an opposite change in the number and thus in the share of immigrants from x.

A.3.1 Proof of Proposition 1

The probability that a randomly selected final service provider exports to x (y) is $\pi_x = 1 - F(\varphi_x)$ ($\pi_y = 1 - F(\varphi_y)$), which is a decreasing function of the export cutoff φ_x (φ_y). The change in φ_y associated with a given change in $p_{m,x}$ can be characterized as follows.

Differentiating p with respect to $p_{f,x}$ and $p_{f,x}$ with respect to $p_{m,x}$ gives:

$$\begin{aligned} \frac{\partial \ln p}{\partial \ln p_{f,x}} &= \frac{(p_{f,x})^{1-\sigma}}{(p_n)^{1-\sigma} + \sum_x (p_{f,x})^{1-\sigma}} = \left(\frac{p}{p_{f,x}}\right)^{\sigma-1} > 0, \\ \frac{\partial \ln p_{f,x}}{\partial \ln p_{m,x}} &= \frac{(p_{m,x})^{1-\theta}}{(p_{m,x})^{1-\theta} + (p_{o,x})^{1-\theta}} = \left(\frac{p_{f,x}}{p_{m,x}}\right)^{\theta-1} > 0. \end{aligned} \tag{9}$$

For two countries x and y, (2) and (9) imply:

$$\frac{d \ln \varphi_y}{d \ln p_{m,x}} = \frac{p}{p + p_{f,y}t_y} \left(\frac{p}{p_{f,x}}\right)^{\sigma-1} \left(\frac{p_{f,x}}{p_{m,x}}\right)^{\theta-1} > 0.$$

Turn now to export sales and focus on final services providers that export to x (y) both before and after the decline in immigrant services price $p_{m,x}$. These are providers with efficiency $\varphi > \varphi_x$ ($\varphi > \varphi_y$). Given export sales $R_x(\varphi) = \left(P_x(\varphi)/\overline{P}_x\right)^{1-\delta} E_x$ and profit maximizing price (8), (9) implies

$$\frac{d \ln R_y(\varphi)}{d \ln p_{m,x}} = -(\delta - 1) \frac{p}{p + p_{f,y}t_y} \left(\frac{p}{p_{f,x}}\right)^{\sigma-1} \left(\frac{p_{f,x}}{p_{m,x}}\right)^{\theta-1} < 0$$

where the sign is dictated by $\delta > 1$.

Defining $\tau_y \equiv p/(p + p_{f,y}t_y)$, $s_{f,x} \equiv (p/p_{f,x})^{\sigma-1}$, $s^f_{m,x} \equiv (p_{f,x}/p_{m,x})^{\theta-1}$ and $s_{m,x} \equiv s_{f,x}s^f_{m,x}$ allow us to rewrite:

$$\frac{d \ln \varphi_y}{d \ln p_{m,x}} = \tau_y s_{m,x} > 0,$$

where $s_{m,x} \in (0,1)$ is the share of intermediate services supplied by immigrants from x in the production cost, i.e. the share of foreign services $s_{f,x} \equiv (p/p_{f,x})^{\sigma-1}$ in the production cost times the share of immigrant services from x in the cost of foreign services $s^f_{m,x}$; $\tau_y \in (0,1)$ measures the 'tradability' of final services with respect to shipments to country y. This is a decreasing function of both the cultural content of final services (as captured by the importance of foreign services for the production cost $p_{f,y}/p$) and of the cultural distance between y and the TTWA (as captured by t_y). Accordingly, easier immigration from country x raises the probability π_y of exporting to all other countries y due to lower production cost (smaller p). This 'extensive margin' effect is stronger for countries at closer cultural distance to the TTWA (smaller t_y) and for services with smaller cultural content (smaller $p_{f,y}/p$). Clearly, this effect is also at work for the probability π_x of exporting to country x.

Applying the above definitions, we can also rewrite:

$$\frac{d\ln R_y(\varphi)}{d\ln p_{m,x}} = -(\delta-1)\,\tau_y s_{m,x} < 0$$

where the sign is dictated by $\delta > 1$. This shows that a larger share of immigrants from country x raises the export sales of each provider to all other countries y due to lower marginal production cost (smaller p). This 'intensive margin' effect is also stronger for countries at closer cultural distance to the TTWA (smaller t_y) and for services with smaller cultural content (smaller $p_{f,y}/p$). And it is at work for exports to country x too. We have thus proved Proposition 1.

A.3.2 Proof of Proposition 2

Analogously, differentiating φ_x and $R_x(\varphi)$ (for $\varphi > \varphi_x$) with respect to $p_{m,x}$ gives:

$$\frac{d\ln \varphi_x}{d\ln p_{m,x}} = \left[\frac{p}{p+p_{f,x}t_x}\left(\frac{p}{p_{f,x}}\right)^{\sigma-1} + \frac{p_{f,x}t_x}{p+p_{f,x}t_x}\frac{\delta}{\delta-1}\right]\left(\frac{p_{f,x}}{p_{m,x}}\right)^{\theta-1} > 0$$

and

$$\frac{d\ln R_x(\varphi)}{d\ln \mu_x} = -(\delta-1)\left[\frac{p}{p+p_{f,x}t_x}\left(\frac{p}{p_{f,x}}\right)^{\sigma-1} + \frac{p_{f,x}t_x}{p+p_{f,x}t_x}\right]\left(\frac{p_{f,x}}{p_{m,x}}\right)^{\theta-1} < 0$$

where the signs are dictated by $\delta > 1$. The above definitions of τ_y, $s_{f,x}$, $s^f_{m,x}$ and $s_{m,x}$ allows us to rewrite:

$$\frac{d\ln \varphi_x}{d\ln p_{m,x}} = \tau_x s_{m,x} + (1-\tau_x)\frac{\delta}{\delta-1}s^f_{m,x} > 0$$

and

$$\frac{d\ln R_x(\varphi)}{d\ln p_{m,x}} = -(\delta-1)\,\tau_x s_{m,x} + (1-\tau_x)\,s^f_{m,x} < 0$$

This proves Proposition 2.

A.3.3 Proof of Proposition 3

Finally, the share of foreign services sourced offshore is $s^f_{o,x} = 1 - s^f_{m,x} = (p_{f,x}/p_{o,x})^{\theta-1}$. Differentiating this share with respect to $p_{m,x}$ yields:

$$\frac{\partial \ln (p_{f,x}/p_{o,x})^{\theta-1}}{\partial \ln p_{m,x}} = (\theta - 1) \left(\frac{p_{f,x}}{p_{m,x}} \right)^{\theta-1} > 0,$$

where the sign is granted by $\theta > 1$. Differentiating $(p/p_{f,x})^{\sigma-1}$ with respect to $p_{m,x}$ gives instead:

$$\frac{d \ln (p/p_{f,x})^{\sigma-1}}{d \ln p_{m,x}} = -(\sigma - 1) \left[1 - \left(\frac{p}{p_{f,x}} \right)^{\sigma-1} \right] \left(\frac{p_{f,x}}{p_{m,x}} \right)^{\theta-1} < 0,$$

where the sign is dictated by $\sigma > 1$. Based again on the definitions of τ_y, $s_{f,x}$, $s^f_{m,x}$ and $s_{m,x}$, we can rewrite:

$$\frac{d \ln s^f_{o,x}}{d \ln p_{m,x}} = (\theta - 1)\, s^f_{m,x} > 0,$$

so that a larger share of immigrants from x (lower $p_{m,x}$) reduces the share of foreign intermediate services that are offshored to x. Moreover, we have

$$\frac{d \ln s_{f,x}}{d \ln p_{m,x}} = -(\sigma - 1)(1 - s_{f,x})\, s^f_{m,x} < 0,$$

so that rising immigrant share increases the share of foreign intermediate services that are provided by country x to the detriment of the share of those provided by all other countries y (and by the TTWA itself). This proves Proposition 3.

Online Appendix Tables:
Table OA2
Immigrant Impact on Log Aggregate Exports and Log Labor Productivity

	Exports		Labor Productivity	
	(1)	(2)	(3)	(4)
			OLS	
Immigrant Share	4.94***	4.05**	3.54**	3.49*
	(1.11)	(1.61)	(1.55)	(1.83)
Immigrant Diversity		33.12		41.30
		(29.01)		(45.84)
Log Employment	0.11**	0.08**	0.14***	0.16***
	(0.06)	(0.05)	(0.06)	(0.05)
Log Capital	0.48***	0.52**	0.41**	0.36**
	(0.18)	(0.29)	(0.26)	(0.21)
			2SLS	
Immigrant Share	3.42**	2.79*	3.09*	3.05*
	(1.27)	(1.84)	(1.77)	(2.09)
Immigrant Diversity		60.53		46.33
		(66.15)		(50.86)
Log Employment	0.09***	0.10***	0.11***	0.12***
	(0.01)	(0.02)	(0.03)	(0.03)
Log Capital	0.49***	0.42***	0.40**	0.42**
	(0.23)	(0.24)	(0.27)	(0.27)
Year fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes
TTWA trends	No	Yes	No	Yes
Observations	8679	8679	80235	80235
Number of firms	2117	2117	19665	19665

Note: The dependent variable is the log of the value of services exports (columns 1 and 2) or log labor productivity (columns 3 and 4) for the firm. Labor productivity is measured as gross value added per worker. The 2SLS regressions use as instrument the imputed number of foreign-born in the TTWA-year cells, constructed as described in the text. The period considered is 2001-2007. Standard errors are clustered at the TTWA level. ***,**,* denote significance at the 1%, 5%, 10% confidence level.

Table OA3
Immigrant Impact on Log Imports of Services and Log Exports of Services

	Imports		Exports		Imports		Exports	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	PPML				IV PPML			
Immigrant Share	2.11**	1.96**	1.96**	1.96**	1.96**	2.80**	3.06**	2.49**
	(0.94)	(0.97)	(0.97)	(0.97)	(0.97)	(1.18)	(1.21)	(1.22)
Immigrant Share, Bilateral	-52.77***	-39.65**	-39.65**	-39.65**	-39.65**	-36.16***	59.13***	47.30***
	(20.52)	(19.51)	(19.51)	(19.51)	(19.51)	(10.42)	(23.55)	(18.43)
Service Import Barriers	-0.38***	-0.30*	-0.30*	-0.30*	-0.30*	-0.30**	0.17	0.27
	(0.13)	(0.18)	(0.18)	(0.18)	(0.18)	(0.16)	(0.12)	(0.20)
Service Export Barriers	0.55	0.41	0.41	0.41	0.41	0.50	-0.19*	-0.17*
	(0.39)	(0.23)	(0.23)	(0.23)	(0.23)	(0.42)	(0.09)	(0.08)
Immigrant Diversity		48.33		50.98		62.01		66.73*
		(55.22)		(52.09)		(54.21)		(42.81)
Log Employment	0.11***	0.08**	0.16***	0.16***	0.11***	0.11***	0.15***	0.14**
	(0.03)	(0.04)	(0.05)	(0.06)	(0.05)	(0.06)	(0.05)	(0.05)
Log Capital	0.52***	0.42***	0.42***	0.42**	0.65***	0.61***	0.53**	0.52***
	(0.27)	(0.24)	(0.25)	(0.21)	(0.20)	(0.21)	(0.22)	(0.22)
Wald First Stage F-Statistics	19, 14	19, 14	19, 14	19, 14	19, 14	19, 14	19, 14	19, 14
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	No	No	Yes	Yes	No	No
TTWA trends	No	Yes	No	Yes	No	Yes	No	Yes
Observations	10415	10415	14212	14212	80235	80235	80235	80235
Number of firms	2117	2117	2961	2961	19665	19665	19665	19665

Note: The dependent variable is the logarithm of the value of services imports or exports by the firm. Each regression contains the fixed effects noted in the table. The key explanatory variable "Immigrant Share" varies at the TTWA-year level, while "Immigrant Share, Bilateral" varies at the TTWA-country-year level. Number of observations is number of non-zero firm-year cells. Wald F-Stats are for the bilateral and aggregate immigration measures, respectively. The 2SLS regressions use as instrument the imputed number of foreign-born in the TTWA-year cells, constructed as described in the text. The period considered is 2001-2007. Standard errors are clustered at the TTWA level. ***,**,* denote significance at the 1%, 5%, 10% confidence level.

Table OA4

2SLS: Immigrant Impact on Log Imports of Services, Robustness Checks

	Additional Controls	Imports Plus One	Drop London	Drop Dom. Imm Group	Single Establish. Firms
	(1)	(2)	(3)	(4)	(5)
Immigrant Share	4.20**	1.31*	4.10*	4.37*	6.14
	(2.09)	(0.72)	(2.60)	(2.41)	(3.81)
Immigrant Share, Bilateral	-101.54**	-30.14*	-71.30**	-75.79*	-104.28
	(43.11)	(18.29)	(33.69)	(40.14)	(67.41)
Service Import Barriers	-0.23	-0.25*	-0.23*	-0.21*	-0.22*
	(0.19)	(0.14)	(0.13)	(0.12)	(0.12)
Service Export Barriers	0.41	0.62	0.33	0.34	0.30*
	(0.45)	(0.58)	(0.21)	(0.25)	(0.18)
Immigrant Diversity	55.43	60.52*	59.05	57.24	55.01*
	(39.02)	(36.92)	(61.84)	(52.58)	(31.73)
Occupational Diversity	122.68				
	(84.38)				
Manufacturing Share of Emp	1.37**				
	(0.64)				
College Share of Emp	7.14				
	(6.80)				
Log Population	0.61*				
	(0.34)				
Immigrant Diversity	69.01	65.23	78.02	73.33	51.28*
	(71.75)	(47.87)	(75.86)	(60.01)	(35.22)
Log Employment	0.20*	0.15	0.21*	0.18**	0.22**
	(0.13)	(0.10)	(0.12)	(0.08)	(0.09)
Log Capital	0.68**	0.51*	0.70*	0.81*	0.55**
	(0.31)	(0.38)	(0.40)	(0.55)	(0.30)
Wald First Stage F-Statistics	19, 14	19, 14	17, 14	14, 13	19, 14
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes
TTWA trends	Yes	Yes	Yes	Yes	Yes
Observations	10415	80235	9836	10415	1436
No of Firms	2117	19665	1985	2117	331

Note: The dependent variable is the log value of services imports (offshoring) by the firm. Each regression contains the fixed effects noted in the table. Each regression contains the fixed effects noted in the table plus it includes the log of employment, the log of capital investments and an immigrant diversity index as controls. Number of observations is number of non-zero firm-country-year cells. Wald F-Stats are for the bilateral and aggregate immigration measures, respectively. The 2SLS regressions use as instrument the imputed number of foreign-born in the TTWA-year cells, constructed as described in the text. The period considered is 2001-2007. Standard errors are clustered at the TTWA level. ***,**,* denote significance at the 1%, 5%, 10% confidence level.

Table OA5

2SLS: Immigrant Impact on Log Exports of Services, Robustness Checks

	Additional Controls	Exports Plus One	Drop London	Drop Dom. Imm Group	Single Establish. Firms
	(1)	(2)	(3)	(4)	(5)
Immigrant Share	4.00*	2.89**	5.28*	6.05*	7.15**
	(2.21)	(1.24)	(3.01)	(3.85)	(3.09)
Immigrant Share, Bilateral	90.48**	41.62*	66.83*	80.09*	113.51*
	(38.91)	(26.14)	(38.60)	(44.87)	(64.48)
Service Import Barriers	0.12	0.18*	0.11	0.12	0.18
	(0.10)	(0.10)	(0.11)	(0.10)	(0.13)
Service Export Barriers	-0.23*	-0.26	-0.27	-0.27	-0.36
	(0.13)	(0.25)	(0.23)	(0.20)	(0.28)
Immigrant Diversity	40.95*	42.86*	55.61	63.74*	69.63*
	(24.87)	(28.53)	(39.74)	(40.42)	(39.19)
Occupational Diversity	104.46				
	(77.63)				
Manufacturing Share of Emp	1.27**				
	(0.60)				
College Share of Emp	6.90				
	(6.25)				
Log Population	0.55*				
	(0.37)				
Log Employment	0.16**	0.16	0.15*	0.19*	0.20**
	(0.07)	(0.12)	(0.08)	(0.11)	(0.10)
Log Capital	0.71*	0.58*	0.61*	0.73*	0.64**
	(0.41)	(0.41)	(0.37)	(0.57)	(0.32)
Immigrant Diversity	39.42	55.18	69.59	65.70	58.09
	(37.82)	(40.05)	(72.18)	(72.31)	(41.36)
Wald First Stage F-Statistics	19, 14	19, 14	17, 14	14, 13	19, 14
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes
TTWA trends	Yes	Yes	Yes	Yes	Yes
Observations	11332	80235	9841	11332	1290
No of Firms	2192	19665	1768	2192	306

Note: The dependent variable is the log value of services exports by the firm. Regressions contain the fixed effects noted in the table. Each regression contains the fixed effects noted in the table plus it includes the log of employment, the log of capital investments and an immigrant diversity index as controls. Number of observations is number of non-zero firm-year cells. Wald F-Stats are for the bilateral and aggregate immigration measures, respectively. The 2SLS regressions use as instrument the imputed number of foreign-born in the TTWA-year cells, constructed as described in the text. The period considered is 2001-2007. Standard errors are clustered at the TTWA level. ***,**,* denote significance at the 1%, 5%, 10% confidence level.

Table OA6
2SLS: Immigrant Impact on Log Imports and Log Exports
by Service Type

	Imports			Exports		
	Fin & Tech	**Legal & Related**	**Language & HR**	**Fin & Tech**	**Legal & Related**	**Language & HR**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Immigrant Share, Aggregate	0.32**	9.55***	10.83***	4.26**	6.22***	5.08***
	(0.18)	(3.28)	(2.24)	(3.09)	(1.05)	(2.63)
Immigrant Share, Bilateral	-1.91	-14.21*	-16.77**	5.90	61.32*	107.51**
	(1.88)	(9.52)	(8.39)	(8.63)	(43.58)	(55.36)
Service Import Barriers	-0.31**	-0.34**	-0.30***	-0.25*	-0.33***	-0.29***
	(0.17)	(0.18)	(0.08)	(0.16)	(0.12)	(0.05)
Service Export Barriers	0.21*	0.22	0.17*	0.17**	0.14	0.16**
	(0.12)	(0.15)	(0.11)	(0.11)	(0.10)	(0.07)
Immigrant Diversity	39.85*	44.72	43.90	52.92*	51.52	46.23
	(21.88)	(29.12)	(28.59)	(31.88)	(39.17)	(38.55)
Log Employment	0.21**	0.14**	0.15**	0.18**	0.17**	0.14***
	(0.07)	(0.08)	(0.08)	(0.07)	(0.08)	(0.08)
Log Capital	0.67**	0.64**	0.68*	0.80**	0.72***	0.77***
	(0.32)	(0.35)	(0.41)	(0.52)	(0.35)	(0.31)
Wald First Stage F-Statistics	19, 14	19, 14	19, 14	19, 14	19, 14	19, 14
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
TTWA trends	Yes	Yes	Yes	Yes	Yes	Yes
Observations	8588	1579	4329	8609	2208	4255
No of Firms	1142	329	902	1266	503	948

Note: The dependent variable is the log of the value of services imports (offshoring) or exports by the firm. Number of observations is number of non-zero firm-year cells. Wald F-Stats are for the bilateral and aggregate immigration measures, respectively. The 2SLS regressions use as instrument the imputed number of foreign-born in the TTWA-year cells, constructed as described in the text. The period considered is 2001-2007. Standard errors are clustered at the TTWA level. ***,**,* denote significance at the 1%, 5%, 10% confidence level.

Table OA7
Immigrants and the Extensive Margin of Services Exports
OLS, Logit and Probit

	LPM		Logit	Probit	
	OLS	2SLS	MLE	MLE	MLE IV
	(1)	(2)	(3)	(4)	(5)
Immigrant Share	0.36*	0.32	0.31*	0.34*	0.31
	(0.24)	(0.29)	(0.18)	(0.16)	(0.24)
Immigrant Share, Bilateral	0.47*	0.40*	0.47**	0.42*	0.40
	(0.29)	(0.26)	(0.23)	(0.23)	(0.28)
Service Import Barriers	0.16	0.15	0.21	0.24*	0.22
	(0.16)	(0.20)	(0.15)	(0.15)	(0.21)
Service Export Barriers	-0.20	-0.18	-0.17*	-0.16*	-0.20
	(0.15)	(0.19)	(0.09)	(0.09)	(0.20)
Immigrant Diversity	0.62	0.65	0.58*	0.54	0.58
	(0.51)	(0.45)	(0.38)	(0.45)	(0.51)
Log Capital	0.57**	0.44**	0.41*	0.59**	0.48*
	(0.27)	(0.20)	(0.28)	(0.32)	(0.28)
Log Employment	0.18	0.19	0.18*	0.14	0.22
	(0.13)	(0.12)	(0.10)	(0.13)	(0.21)
Wald First Stage F-Statistics	NA	19, 14	NA	NA	19, 14
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes
TTWA trends	Yes	Yes	Yes	Yes	Yes
Observations	8578	8578	8578	8578	8578
No of Firms	2016	2016	2117	2016	2016

Note: The dependent variable is an indicator of the export status of the firm (0,1). Number of observations is number of non-zero firm-year cells. Wald F-Stats are for the bilateral and aggregate immigration measures, respectively. The 2SLS regressions use as instrument the imputed number of foreign-born in the TTWA-year cells, constructed as described in the text. The period considered is 2001-2007. Standard errors are clustered at the TTWA level. ***,**,* denote significance at the 1%, 5%, 10% confidence level.

Table OA8

2SLS: Immigrant Impact on Log Language and Human Resources (LHR) Exports

by Export Destination Type

	Non-Anglo-Saxon Destinations		Anglo-Saxon Destinations	
	(1)	**(2)**	**(3)**	**(4)**
Immigrant Share	3.67*	6.09**	3.57*	1.78
	(2.17)	(2.71)	(2.12)	(1.50)
Immigrant Share, Bilateral	101.34***	132.48***	30.15	49.25
	(22.93)	(36.83)	(54.09)	(66.30)
Service Import Barriers	0.30	0.19	0.26	0.17
	(0.33)	(0.15)	(0.29)	(0.13)
Service Export Barriers	-0.31**	-0.24*	-0.27**	-0.21*
	(0.13)	(0.14)	(0.11)	(0.12)
Immigrant Diversity	38.09	49.55	53.34	45.68
	(41.15)	(49.68)	(42.18)	(45.81)
Log Capital	0.49**	0.43*	0.42**	0.44**
	(0.26)	(0.28)	(0.26)	(0.25)
Log Employment	0.27*	0.21*	0.22**	0.23*
	(0.17)	(0.14)	(0.11)	(0.13)
Wald First Stage F-Statistics	19, 14	19, 14	19, 14	19, 14
Year fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes
TTWA trends	No	Yes	No	Yes
Observations	1309	1309	3675	3675
No of Firms	373	373	841	841

Note: The dependent variable is the log of the value of Language and Human Resources services exports by the firm. Anglo–Saxon countries are defined as Australia, Canada, New Zealand, the UK and the US. Non-Anglo-Saxon are all others. Number of observations is number of non-zero firm-year cells. Wald F-Stats are for the bilateral and aggregate immigration measures, respectively. The 2SLS regressions use as instrument the imputed number of foreign-born in the TTWA-year cells, constructed as described in the text. The period considered is 2001-2007. Standard errors are clustered at the TTWA level. ***,**,* denote significance at the 1%, 5%, 10% confidence level.