ISSN 2042-2695

CENTRE *for* ECONOMIC PERFORMANCE

CEP Discussion Paper No 1353

Revised June 2016
(Replaced May 2015 version)

Immigration, Trade and Productivity in Services: Evidence from UK Firms

Gianmarco I.P. Ottaviano
Giovanni Peri
Greg C Wright

LSE THE LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE

E·S·R·C ECONOMIC & SOCIAL RESEARCH COUNCIL

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 behavior. The first effect can be understood as the re-assignment of offshore productive tasks to immigrant workers. The second can be seen as a productivity or cost cutting effect due to immigration, and the third as the effect of immigrants on specific bilateral trade costs. We test the predictions of our model using differences in immigrant inflows across U.K. labor markets, instrumented with an enclave-based instrument that distinguishes between aggregate and bilateral immigration, as well as immigrant diversity. We find that immigrants increase overall productivity in service-producing firms, revealing a cost cutting impact on these firms. Immigrants also reduce the extent of country-specific offshoring, consistent with a reallocation of tasks and, finally, they increase country-specific exports, implying an important role in reducing communication and trade costs for services.

Keywords: Immigration, services trade
JEL codes: F16; F10; F22; F23

This paper was produced as part of the Centre's Trade Programme. The Centre for Economic Performance is financed by the Economic and Social Research Council.

This paper was written as part of the project "Europe's Global Linkages and the Impact of the Financial Crisis: Policies for Sustainable Trade Capital Flows and Migration". We acknowledge the Volkswagen Foundation for generously funding the project. This work contains statistical data from the Office for National Statistics and Her Majesty's Revenue and Customs, which are Crown copyright and reproduced with the permission of the controller of HMSO and Queen's Printer for Scotland. The use of the ONS' statistical data in this work does not imply endorsement of the ONS in relation to the interpretation or analysis of the statistical data. This work uses research datasets which may not exactly reproduce National Statistics aggregates. We are grateful to participants of several workshops and seminars for helpful comments on earlier versions.

Gianmarco I.P. Ottaviano, Department of Economics, London School of Economics and Political Science, and Centre for Economic Performance, LSE. Giovanni Peri, Department of Economics, UC Davis. Greg C. Wright, Department of Economics, University of California.

Published by
Centre for Economic Performance
London School of Economics and Political Science
Houghton Street
London WC2A 2AE

1 Introduction

The connections between immigration and productivity, and between immigration and trade, have been the focus of active research in recent years. Several papers have analyzed the role of immigrants, especially highly educated immigrants, in promoting skill diversity that can generate positive productivity effects for firms (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 jobs along the manual-complex task spectrum (Peri and Sparber, 2009; Damuri 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, et al, 2013), thereby generating a cost-reduction effect that increases firm productivity in the same manner as offshoring (Grossman and Rossi-Hansberg, 2009). 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 the reduction in bilateral trade costs, by enhancing information flows, trust and linkages between countries (see Felbermayr, Grossman and Kohler, 2012, for a review of these studies).

Most of the literature described above has analyzed the relationship between immigrants and trade in goods while omitting any discussion or analysis of trade in services. As a result, the literature has focused narrowly on firms in the manufacturing sector. To the best of our knowledge, no paper has analyzed the impact of immigration on the imports, exports and productivity of firms who trade in services. However, 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 while the largest category of services trade is professional, scientific and technical activities (see Figure 4).[1] While immigrants' origin-country networks may lower the costs of both goods and services trade, selling services in foreign markets may require overcoming barriers that are more significant and more pervasive than in the trade of goods. 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 foreign markets. Immigrants from the corresponding countries may be particularly useful in enhancing and refining that understanding. Hence, the type of cultural, language and normative barriers that may be lowered by the presence of a network of migrants seems particularly relevant for trading services, and as such

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

this paper addresses a link that has been neglected in the literature but could be very important.

In this paper, we analyze the impact of an increase in total immigration, as well as of immigration from specific countries, on firm productivity (measured as gross value added per worker) in the service sector and on firm bilateral imports and exports of services with those countries. 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 service sector in the U.K., the world's second most popular immigrant destination (in absolute numbers) and the second largest service trader (in value). Just in 2013, approximately half a million immigrants arrived in the U.K.[2] Figure 1 shows the average share of foreign-born workers over a seven-year period, for several U.K. local labor markets. Formally, the labor markets considered in the figure, and in the rest of the paper, are Travel to Work Areas (or TTWAs for short), a U.K. geographic unit defined to encompass areas in which the bulk of people both work and live. In this respect, they represent "self-contained" local labor markets. The figure suggests a significant geographic heterogeneity in the presence of immigrants, which generates a corresponding heterogeneity in the supply of the specific skills that they possess, variation that we will leverage in our analysis. Looking over the long run, Figure 2 presents the pattern of growth in the U.K. immigrant stock, where we see very rapid growth beginning in the mid-1990s. Similarly, Figure 3 documents the long-run trend in services imports and exports, where we again see rapid growth beginning in the mid-1990s, in part as a result of the Uruguay Round of global trade negotiations. Over the more recent period we will study, 2001-2007, services exports and imports accounted for 9.4 percent and 7.4 percent of U.K. GDP on average, respectively. Figure 4 depicts the industries that trade most in services, where we see that professional and technical firms as well as information and communication technology firms sell the bulk of services overseas.[3] In the empirical analysis we exploit these data at the firm level over the period 2001-2007, 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, which describes worker characteristics across local labor markets (TTWAs). We consider inflows of new immigrants into a TTWA as reflecting changes in the immigrant supply in the local labor market.

Several stylized facts are consistent with the channels of firm response that we explore. First, services *imported* by U.K. firms (such as accounting, technical, or computer services) may subsequently be reassigned from the overseas (offshore) location to domestic provision if the individuals performing them immigrate to the U.K. These services may have a degree of country and cultural or institutional specificity such that immigrants

[2] Source: Office of National Statistics.

[3] Table 1 documents the detailed list of services included in the analysis.

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 against U.K. imports of services from the same country. The negative and significant relationship is consistent with overall substitutability between immigrants and services imports from a country. Given that this relationship may be driven by particular service types, in panels (b)-(d) we present the same plots for three broad service categories (described in greater detail in Section 3 below): Language and Human Resource (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 is the most important determinant of the aggregate effect. At the same time, some final services that are exported, especially those requiring knowledge of the language, institutional settings or norms of a country, could be exported more efficiently if some individuals from the country migrated and worked in the U.K. Figure 6 panel (a) provides a stylized fact consistent with this idea. The figure plots the 2001-2007 change in the share of immigrant employment across country-of-origin cells against U.K. exports of services to the same country. Here, the positive and significant relationship is consistent with overall complementarity between immigrants and services export to their country of origin. We decompose this correlation by service type in panels (b)-(d), and even in this case we see the strongest relationship between immigrants and LHR exports. 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 requiring the greatest country-specific knowledge.

Motivated by these facts, we develop a simple model in which the presence of immigrants may generate these correlations. First, in the model immigrants substitute for offshore workers and, therefore, for the imports of intermediate services (an "import substitution effect").[4] Second, they 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"). The offshore substitution effect and the export promotion effect are very likely to be country-specific, due to the specificity of traded services, and are also likely to be larger for LHR services given the relative intensity of country-specific content for these services. On the other hand, the overall productivity effect is generated by immigrants more broadly, and potentially by their overall diversity. Hence we can distinguish between these effects by exploring the impact of an exogenous increase in the number and diversity of immigrants on firm productivity and, separately, the effect of an increase in immigrants from a specific country on the level of firm imports and exports from those

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

countries. The literature has thus far not attempted to separate these effects from one another, and we believe that this approach is particularly relevant for the case of service-producing and service-exporting firms, which may reap relatively large benefits from the country-specific knowledge and skills of immigrants.

Our main empirical findings 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 LHR and LR services; (ii) a bilateral export-promotion effect of immigrants, particularly for LHR and LR services; (iii) a positive productivity effect of aggregate immigration that, in some cases, is associated with country-of-origin diversity. 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 services imports by approximately 1 to 2 percent.

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 et al. (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, Peri and Wright, 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) and 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 0.3/0.4. 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, while several of the above considerations regarding the connection between immigrants and trade should apply very strongly to services trade, thus far no paper has explored this nexus.[5]

A more recent branch of the literature focused on immigration (e.g. Ottaviano, Peri and Wright, 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 factor intensively. These new techniques, in turn, may generate productivity gains (Beaudry and Green, 2003 and 2005; Beaudry et al, 2010; Caselli and Coleman, 2006). 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 in U.S. states and finds a positive effect on state-level TFP that can be explained in large part by increased specialization. Peri, Shih and Sparber (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 Brunow, Trax 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 seems to find positive productivity effects of immigrants, however it does not focus

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

on the service sector and it does not 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 on workers, firms and trade in services over the period 2001-2007.[6] These data are collectively compiled from three sources: waves 1 and 5 of the U.K. Labour Force Survey (LFS), the Annual Respondent's Database (ARD) and the International Trade in Services (ITIS) dataset. The LFS 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. When constructing our instrumental variable we also exploit worker information from the 1991 U.K. Census, obtained from the Office of National Statistics. The ARD provides information on U.K. businesses and it is the equivalent of the U.S. Longitudinal Respondents Database. It is administered by the Office of National Statistics and the data are drawn from the Annual Business Inquiry. The data consist of the full population of large businesses (those with more than 100 or 250 employees depending on the year) as well as a random sample of smaller businesses.[7] The ARD includes many firm-level variables and, for our purposes, the most relevant will be the total value of imports and exports of services by the firm, as well as the geographic location of the firm. We also use the ARD to control for firm features such as capital expenditures and gross value added. Since the trade flows are reported at the firm level, but some firms have multiple establishments (located in different UK regions), we allocate the trade flows to establishments according to relative establishment employment. This will clearly add some classical measurement error to our specifications.

The ITIS dataset consists of firm-level information on the value of imports and exports of services by country of origin/destination and by service type, details that are missing from the aggregate trade values provided by the ARD. The ITIS includes 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 establishment identifier in both datasets, and are able to match 79 percent of ITIS trade flows to ARD firms.[8] We then link this combined dataset with the LFS by the "travel-to-work" area (TTWA) of the establishments which represents a local labor market for the workers. For the bilateral analysis we group immigrants by 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

[6] The time series is constrained by the ITIS coverage, which is only available through 2007.
[7] For a comprehensive description of this dataset, see Criscuolo, Haskel and Martin (2003).
[8] The ARD includes the universe of "large" firms, that are the most active service traders, which explains the good match rate.

these groups. The groups are Ireland, Old Commonwealth[9], East Africa, Other African countries, Caribbean, Bangladesh, India, Pakistan, South East Asia, Cyprus, Other New Commonwealth, Other countries in European Community[10], Other countries in Europe[11], China, and Rest of World. In order to explore the extent to which the allocation of workers across cells in the LFS survey is an accurate reflection of the 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.[12] The simple correlation coefficient across cells is 0.86, indicating that the LFS shares are quite accurate.[13]

The final dataset encompasses workers from 142 countries (though the bilateral analysis focuses on the 15 regions) located across 243 TTWAs and trading with 180 countries (again, bilateral effects are constrained to the 15 regions) over 7 years. We will exploit firm-by-year level variation in our dependent variables and TTWA-by-year level variation in the immigration regressors. 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 (see Figure 1A in the Appendix). Additionally, the mean number of the 15 regions 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 (see Figure 2A in the Appendix). This reveals a very large presence and diversity of immigrants in the vast majority of TTWAs. Table 1A in the Appendix provides basic summary statistics for the datasets described here.

In our empirical analysis we will also distinguish between broad categories of services differing in terms of the interactions that they entail between providers and customers. As anticipated above, we categorize services as belonging to one of three categories: Technical-Financial (TF), Legal and Related (LR), or Language-Human Resources (LHR). Table 1 lists how each detailed service type is categorized in one of these three broad categories. The idea is that immigrants may facilitate export and substitute for imports in services when language or culture is an important aspect of the service provision, because these have a high degree 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 importts 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. We also collect information

[9] Australia, New Zealand, South Africa, and Canada.

[10] 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.

[11] European countries that are not members of the European Community nor otherwise listed.

[12] ONS provided these data.

[13] Again, we note that the remaining measurement error will bias our estimates downward.

on services trade barriers from the OECD.[14] Since the bulk of U.K. exports are with OECD countries, these measures will serve as useful proxies for the overall barriers faced by U.K. firms in exporting services to foreign markets and will serve as an important proxy for import and export costs.

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 augment the stylized facts presented in the Introduction with some additional ones. In our sample around 8 percent of firms trade in services. 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 primary destinations and source countries for service imports and exports in the year prior to our period (2000) and here we see the dominant role of the U.S. and, not surprisingly, a strong role for the large E.U. countries as service trade partners. This pattern is not unlike the pattern for goods trade.[15]

In fact, the cross-section of services traders displays much of the same pattern of heterogeneity as 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 et al, 2007, for the US; 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.

Immigration to the U.K. was significant over the period 2001 to 2007 (see Figure 2). This phase of large immigration inflows began in the early 1990s when there was a sharp increase in the number of immigrants to the U.K. Figure 8 orders the top immigrant groups by their stock in 2000 and reports this value along with the subsequent growth in each immigrant group through 2007. We see that the fastest growing group of immigrants over the period came from Commonwealth countries and China. Looking more closely at the variation we exploit in our analysis, Figure 9 plots the growth in the immigrant share, first for a representative immigrant-heavy TTWA (at the 90th percentile of immigrant share of population), second for the median immigrant populated

[14] See http://www.oecd.org/trade/services-trade/towardsaservicestraderestrictivenessindexstri.htm for more information

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

TTWA, and finally for a representative TTWA with few immigrants (at the 10th percentile). It is evident that most of our variation arises from TTWAs that already had relatively high shares of immigrants, though even the median TTWA saw growth of around one percentage point over the period. Importantly, over this period approximately twice as many immigrants worked in professional and managerial occupations relative to other "less 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. In terms of policy events, it is important to note that in 2004 several Eastern European countries joined the European Union and their workers gained access to U.K. labor markets. This partly altered the composition of new immigrants, tilting it toward the less skilled.[16] This event, however, took place very late in our sample. In addition, there was an expansion of the 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. In Figure 10 we document the cross-sectional distribution of immigrants across education groups during our period, along with the native distribution. We can see that, as documented for the United States (e.g. Ottaviano and Peri, 2012), U.K. immigrants are polarized (U-shaped) in their educational attainment relative to natives, and they are over-represented among highly and less educated groups, while under-represented in the intermediate education groups.

5 The Model

In this section we present a 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.[17]

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.

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

[17] 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.

5.1 Demand and Cost

Final services are horizontally differentiated. In a representative TTWA there is an exogenously given number N of monopolistically competitive final service providers, each supplying one and only one service. For exports to destination x each final service provider faces CES demand

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

where D_x is quantity demanded in destination x, E_x is its 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.

Final service providers are heterogeneous in terms of their efficiency. This is denoted by $\varphi > 0$ and is distributed according to the continuous c.d.f. $F(\varphi)$. For a firm with efficiency $\varphi > 0$ the total cost of delivering its service to country x is

$$C_x = p_{f,x} f_x + p_{f,x} t_x \frac{q_x}{\varphi} + p\frac{q_x}{\varphi} \tag{2}$$

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 type of final service the provider supplies. In particular, all the rest 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.

Whereas x-specific intermediate services can only be imported from x or sourced locally from workers who immigrated from x to the TTWA, production services can be sourced locally also from native workers. We call 'foreign' services those sourced from abroad ('offshore') or from immigrants, and 'native' services those sourced from natives. All these services are imperfectly substitutable. Specifically, using $p_{m,x}$ and $p_{o,x}$ to denote the prices of x-specific intermediate services sourced from immigrants and offshore respectively, the price indexes of

the two intermediate service bundles used for export and production are respectively

$$p = \left[(p_n)^{1-\sigma} + \sum_{x=1}^{X} (p_{f,x})^{1-\sigma} \right]^{\frac{1}{1-\sigma}} \text{ and } p_{f,x} = \left[(p_{m,x})^{1-\theta} + (p_{o,x})^{1-\theta} \right]^{\frac{1}{1-\theta}} \tag{3}$$

where $\sigma > \delta > 1$ is the elasticity of substitution between native and foreign services in production while $\theta > \sigma$ is the elasticity of substitution between foreign services sourced from immigrants and offshore workers. Due to the small open economy and partial equilibrium assumptions, all those prices and price indexes are exogenously given.

5.2 Profit Maximization and Selection

Given the cost to deliver services to country x expressed in (2), a final service provider with efficiency φ maximizes profit from sales in destination x defined as

$$\Pi_x = P_x q_x - p_{f,x} f_x - p_{f,x} t_x \frac{q_x}{\varphi} - p \frac{q_x}{\varphi} \tag{4}$$

subject to the market clearing constraint for its service $q_x = D_x$ and demand (1). Under monopolistic competition, the profit-maximizing price equals a constant markup over marginal cost

$$P_x(\varphi) = \frac{\delta}{\delta - 1} \frac{p + p_{f,x} t_x}{\varphi}, \tag{5}$$

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 $\Pi_x(\varphi) = R_x(\varphi)/\delta - p_{f,x} f_x$. Given $\delta > 1$, both $R_x(\varphi)$ and $\Pi_x(\varphi)$ are increasing functions of efficiency φ.

Final service providers with efficiency φ_x such that $\Pi_x(\varphi_x) = 0$ are indifferent between exporting and not exporting to x. Solving this indifference condition yields

$$\varphi_x = \left(\frac{\delta}{\delta - 1} \frac{p + p_{f,x} t_x}{\overline{P}_x} \right) \left(\frac{p_{f,x} f_x \delta}{E_x} \right)^{\frac{1}{\delta - 1}}. \tag{6}$$

As $\Pi_x(\varphi)$ is an increasing function of φ, efficiency $\varphi < \varphi_x$ is associated with $\Pi_x(\varphi) < 0$ while efficiency $\varphi > \varphi_x$ is associated with $\Pi_x(\varphi) > 0$. This defines a cutoff rule for exporting to x such that only the selected group of final service providers with efficiency $\varphi \geq \varphi_x$ serves destination x. As these exporters account for a share $\pi_x = 1 - F(\varphi_x)$ of all final service providers, the number of exporters 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.

5.3 Immigration and Trade

To study the impact of (exogenous) immigration on international trade by final service providers in the TTWA, we assume that the price of intermediate services sourced from immigrants is an increasing function of the x-specific immigration cost $\mu_x > 0$ that diminishes the (productivity of the) stock of immigrants in the TTWA: $p_{m,x} = p_{m,x}(\mu_x)$ with $p'_{m,x}(\mu_x) > 0$ and constant elasticity $\varepsilon_{p_{m,x},\mu_x} = \mu_x p'_{m,x}(\mu_x)/p_{m,x}(\mu_x) > 0$. A decrease in this cost will both increase the number of immigrants in the local labor market and decrease the cost of producing one unit of the cultural good they provide. We then characterize an x-specific immigration shock as an exogenous change in μ_x.[18]

We distinguish between country x and all other countries $y \neq x$ the TTWA trades with, and we assume that immigration becomes easier from country x, so that μ_x falls while μ_y remains constant for any $y \neq x$. 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). Given (6), differentiating φ_y with respect to μ_x gives

$$\frac{d\ln\varphi_y}{d\ln\mu_x} = \frac{p}{p + p_{f,y}t_y}\frac{d\ln p}{d\ln\mu_x} = \tau_y s_{m,x}\varepsilon_{p_{m,x},\mu_x} > 0$$

where $s_{m,x}$ and τ_y are defined as follows: $s_{m,x} \in (0,1)$ is the share of intermediate services supplied by immigrants from x in the production cost, that is, 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 $s^f_{m,x} \equiv (p_{f,x}/p_{m,x})^{\theta-1}$; $\tau_y \equiv p/(p + p_{f,y}t_y) \in (0,1)$ 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). This shows that 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.

Consider now export sales and focus on final services providers that export to x (y) both before and after the decline in immigration cost μ_x. These are providers with efficiency $\varphi > \varphi_x$ ($\varphi > \varphi_y$). Differentiating $R_y(\varphi)$ with respect to μ_x gives

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

given $\delta > 1$. This shows that easier immigration 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

[18] See the Appendix for detailed proofs of the propositions in this section.

content (smaller $p_{f,y}/p$). And it is at work for exports to country x too.

Hence, we can state:

Proposition 1 ***(Productivity or general export promotion effect)*** *Due to lower production costs, easier immigration to a TTWA from any given foreign country raises the probability that a service provider 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 immigrants and it is effectively the impact on exports of a positive productivity effect due to immigration. While this effect is also at work in increasing exports to country x, the bilateral export probability and the bilateral export sales to x are also affected by an additional term, associated with the reduction of bilateral export costs. Specifically, differentiating φ_x and $R_x(\varphi)$ (for $\varphi > \varphi_x$) with respect to μ_x yields

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

and

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

given $\delta > 1$. While the term $\tau_x s_{m,x}$ corresponds to the productivity effect we have already discussed, the term $(1-\tau_x)s^f_{m,x}$ corresponds to an additional effect due to the change in bilateral export costs. Accordingly, easier immigration from country x (smaller μ_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 (as measured by tradability τ_x) is a decreasing function of cultural distance (t_x) and of the cultural content of the exported service ($p_{f,x}/p$). Hence, we have:

Proposition 2 ***(Specific export promotion effect)*** *Easier immigration to a TTWA from any given country disproportionately raises the probability that a 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, easier immigration also affects imports of intermediate services, and thus their shares in production and export cost. The share of foreign services sourced offshore is $s^f_{o,x} = 1 - s^f_{m,x} = (p_{f,x}/p_{o,x})^{\theta-1}$. Given $\theta > 1$, differentiation with respect to μ_x yields

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

so that easier immigration from x (lower μ_x) reduces the share of foreign intermediate services that are offshored to x. Moreover, given $\sigma > 1$,we have

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

Thus, easier immigration from x (lower μ_x) 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). All this leads to:

Proposition 3 ***(Import substitution effect)*** *Easier immigration to 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 analysis has been absent from the literature, and we believe that service firms are an ideal group to analyze these 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 (and potentially its diversity) raises the total value of exports of firm i in that local labor market. Specifically, we estimate the following regression:

$$ln(y_{ikt}) = \phi_k + \theta_t + \xi_k t + \beta_1 ImmSh_{kt} + \beta_2 ImmDiv_{kt} + \beta_x \ln X_{ikt} + \epsilon_{ikt} \tag{7}$$

The unit of observation for the dependent variable is the firm, while 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 (7) the outcome y_{ikt} is the value of exports associated with firm i belonging to TTWA cell k in year t. The variable $ImmShr_{kt}$ is the share of immigrants in the TTWA cell k; $ImmDiv_{kt}$ is a measure of country of birth diversity for immigrants in cell k, constructed as (one minus) the Herfindahl Index across origin countries;[19] X_{ikt} is a set of firm-level control variables; ϕ_k and θ_t are TTWA and year fixed effects, respectively; and ξ_{kt} are TTWA trends capturing linear growth in U.K. exports over time. In an additional set of specifications we replace the TTWA fixed effects (ϕ_k) with firm fixed effects (ψ_i). The term ϵ_{ikt} then captures

[19] 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.

zero-mean idiosyncratic errors. We cluster standard errors at the TTWA level which is the level of variation of our regressors of interest. The coefficients of interest in this specification are β_1 and β_2 which capture the aggregate effect of the population share of immigrants and their diversity, respectively, 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 export-promotion effect, by running specification (7) 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:

$$ln(y^n_{ikt}) = \phi_k + \theta_t + \xi_k t + \beta_1 ImmSh_{kt} + \beta_2 ImmDiv_{kt} + \beta_3 ImmSh^n_{kt} + \tau^X_{nt} + \tau^M_{UK,t} + \beta_x \ln X_{ikt} + \epsilon^n_{ikt} \quad (8)$$

In this case the units of observation for the dependent variable are firm-by-export destination or firm-by-import-origin cells. In (8) 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 and $ImmDiv_{kt}$ is the measure described above of country of birth immigrant diversity in cell k. In this case these variables control 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 we remove this bilateral share from the calculation of the aggregate immigrant share measure $ImmSh_{kt}$ as well as the immigrant diversity measure $ImmDiv_{kt}$, so that there is no mechanical correlation between these variables. X_{ikt} is a set of firm-level control variables, ϕ_k and θ_t are TTWA 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, where we exploit the OECD services trade barriers described above. In this case, while the coefficients β_1 and β_2 reflect the overall productivity effect due to immigrants on the imports and exports of the firm (depending on the left-hand side variable) and should confirm the positive estimates from (7) above, the coefficient β_3 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_3 since the additional export promotion effect of immigrants that arises due to a reduction in exporting costs is positive. When the dependent variable is the value of intermediate inputs we expect a negative estimate of β_3, capturing the substitution effect of immigrants on imported intermediate

services. Taken together the size and significance of these coefficients allow us to test Propositions 1, 2 and 3 from the model.

Before moving on to a discussion of the identification strategy, we note that while the simple model described in Section 5 is a useful way to organize the analysis, the three effects that we are testing are quite general and intuitive such that a larger class of models could potentially generate them. The productivity or general export promotion effect described in Proposition 1 exists as long as lower immigration costs allow firms to cut costs of production thanks to intermediate services sourced from immigrants. The effects on exports described by Proposition 2 will exist as long as lower immigration costs, generating more immigrants from a country, reduce the costs to export specifically to that country. Finally, the effects described in Proposition 3 on imports of intermediates will exist as long as immigrants' productive services are partially substitutes for intermediate goods that can be imported from the same country.

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 demand shock (specific to that labor market) 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 that we use to isolate exogenous, supply-driven, variation in the share of immigrant hours worked in a cell 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 et al, 2013). Specifically, we exploit the fact that foreigners from different countries have increased or decreased their relative migration flows to the U.K. according to changes in the cost of migrating and other factors that are specific to their countries of origin. We interact this with their initial differential presence in local labor markets in the U.K which proxies for the size of current 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 instrumetn 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 each local

labor market (TTWA) k as of 1991 (obtained from the 1991 U.K. Census) as a share of the total employment of TTWA k, and we denote this as $ImmSh^n_{k,1991}$. 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. This value interacts the initial presence of immigrants in 1991 and the subsequent aggregate growth by country. We call this variable the imputed share of immigrants from country n in cell k at time t and we denote it 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.[20]

On the one hand, because of localized ethnic networks (Bartel, 1989), we expect that the initial distribution of immigrants will be a strong predictor of future immigration flows into a TTWA cell. On the other hand, because we rely on a historically-determined initial immigrant group, this imputed variable is likely to vary with changing immigration costs, rather than with local demand shocks over the 2001-2007 period. Certainly, however, 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, however, attenuate these concerns. First, the large set of 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 place in the 90's in specific TTWAs, were correlated with services trade back then. The growth in services trade beginning in the mid-1990s (driven by the Uruguay Round of trade negotiations) was driven by international events and likely to be uncorrelated with the shocks driving immigrants to particular TTWAs in 1991.

Finally, the measure of immigrant diversity used is also instrumented in our 2SLS specifications, 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.

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

7 Empirical Results

In this section we present the results from estimating specifications (7) and (8) and in particular we report the coefficients β_1, β_2 and β_3 in tables that share a similar structure. We first present the impact of immigrants and their country of birth diversity on the productivity and export of firms. We then analyze how, controlling for aggregate immigration, bilateral immigration affects bilateral offshoring and exports.[21]

7.1 Immigrants and Firm Productivity

Our model predicts that a lower cost of immigration reduces the price of the services provided by immigrants and thereby reduces production costs, increasing firm productivity and total exports. More generally, a larger class of models imply that when firms produce using differentiated services, a greater variety of locally available skills can increase their productivity (Ottaviano and Peri, 2012). Alternatively, if workers specialize in tasks according to their relative ability, a broader variety of abilities could increase specialization and productivity (see, for instance, Peri and Sparber, 2009, and Brunow et al, 2013). On the other hand, if differences in the country of origin of workers lead to costly coordination problems within the firm, then the increased presence of immigrants may cause a reduction in productivity (see Kahane et al, 2013). Using variation in immigrant shares across local labor markets (represented by TTWA cells), instrumented with the imputed value obtained from the pre-determined distribution of immigrants interacted with aggregate flows by country of origin (as describe in Section 6.1), we estimate the impact of the immigrant share on firm productivity. Table 2 presents the results from four specifications of the estimating equation (7) that include different combinations of fixed effects. 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 (7). Columns (1)-(4) show OLS estimates, while columns (5)-(8) present the 2SLS estimates. The most demanding specifications are (4) and (8) which include firm fixed effects and TTWA-specific time trends.

The results in Table 2 indicate that immigration inflows were associated with an increase in log total firm exports, where a one percentage point increase of immigrant workers in the local labor market produced a 3 to 5 percent increase in firm exports. This result is significant and robust across specifications. As immigrants represented about 10 percentage points 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 0.3 and 0.5, on the high range of the magnitude estimated for trade in goods. In contrast, there is little suggestion of an association between immigrant diversity and firm exports, as most estimates are not significantly different from 0.[22] Table 3 then presents the estimates of similar specifications

[21] Note that we perform our empirical analysis both including and excluding London. The results excluding London are quite similar to the aggregate estimates presented below, and are available on request.

[22] We also note that the power in the first stage is quite high, with partial F-statistics ranging between 24 and 68 depending on

as in equation (7) with the logarithm of firm gross value added per worker (our simple measure of productivity) as the dependent variable. The estimates are positive and mostly significant, suggesting a two to three percent rise in labor productivity due to an immigrant inflows 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 export by thee local firms. The magnitude of the effect is large and comparable to the estimates in Peri (2012). The evidence for a relationship between immigrant diversity and productivity is more mixed, with usually a positive correlation, both for productivity and export, but a significant finding appears only in two of the eight specifications.

7.2 Immigrants and Offshoring of Intermediate Services

Table 4 presents the estimated coefficients from specification (8) in which the dependent variable is firm imports of services from a specific country n. The key explanatory variables include both the aggregate share of immigrants in the TTWA (as in Tables 2 and 3) and the country-specific immigrants in the same market, also as a share of employment. Moreover, we continue to include the index of immigrant diversity since it may potentially affect imports by increasing the aggregate productivity of the firm. The structure and specifications of the table mirror those of Table 3 with the additional inclusion of the bilateral immigrant share as an explanatory variable. Furthermore, we now also report the coefficients on the service trade barrier measures as they are a direct determinant of the cost of trading. We thus control for those costs directly.

Several interesting results emerge from Table 4. First, all estimates, for both OLS and 2SLS methods, indicate a negative and significant effect of the bilateral immigrant share on bilateral services offshoring. This implies that, for instance, an increase in Pakistani workers in a company producing business services in the U.K. is associated with a reduction in the imports of intermediate services from Pakistan for that same firm. This is consistent with the idea that offshore workers and immigrants from the same country are substitutes in the provision of services that are used as inputs for the firm. At the same time, the estimates on the aggregate immigrant share are positive and significant. This implies that an increase in the share of immigrants is associated with an increase in imports of intermediate services, and this is consistent with the existence of a positive productivity effect of immigrants on the firm. As noted in the discussion in Section 5, this productivity effect may arise due to complementarities between immigrants and native-born workers, or may reflect a productivity-adjusted cost premium associated with immigrants.

Beyond these effects there is also a positive effect of immigrant (country-of-origin) diversity on firm imports in three of the six specifications where immigrant diversity is included, also indicative of a positive productivity effect associated with that index. In terms of economic significance, the results suggest an important role for

the specification.

each channel. Over the considered period, the average share of immigrants in employment in the average TTWA cell increased by just under 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 of column (8) in Table 4 we calculate that the average immigrant inflows raised the volume of service imports by an average of around 3.5 percent per year. The bilateral and diversity effects were also important. Bilateral offshoring with the same country of origin of immigrants is found to decrease by approximately 25 percent for every one percentage point increase in the share of immigrants (estimates of Column 8 in table 4). Since the average rise in bilateral immigration from the average country was about a tenth of a percentage point in the average TTWAs, the offshoring reduction effect from immigrants of the same origin was, on average, about 2.5 percent per year, during the 2001-2007 interval. Hence, the direct 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 twice as large as the bilateral reduction). Additionally, offshoring may have increased by around 0.3 percent per year due to increased immigrant diversity.[23]

Having established, consistent with Proposition 3, that immigration substitutes to some extent for offshoring to the country of origin of immigrants, we next test whether this effect is sensitive to the country-specific nature of services. Namely, the nature of service trade suggests that this displacement effect should be stronger, the greater is the cultural content of a 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 more directly to the substitution of immigrant workers for offshoring. Hence, using our partition of service types into Technical (TF), Legal (LR) and Language (LHR), we hypothesize that the cultural content increases from the first to the third, such that the Legal and Language service types involve a higher cultural (country-specific) content relative to the Technical. Table 5 presents a subset of the estimates from Table 4, namely the 2SLS regressions (OLS are available on request) with progressively stricter specifications, except that the dependent variable includes only the imports of services within one of the groups defined above. Columns (1)-(3) present the estimates for the log imports of Technical and Financial (TF) services, columns (4)-(6) show results for Legal and Related (LR) services, and columns (7)-(9) focus on the effects on imports of Language and Human Resource (LHR) services.

Confirming our hypothesis, the bilateral effects of immigrants are negative and significant and similar in magnitude for LR and LHR services. In contrast, they are relatively less important (and less significant) for TF Services. This is consistent with a role for immigrants as substitutes for foreign service provision when the services are intensive in language, cultural and institutional content, and therefore specific to a country.

[23] In a final set of specifications we performed a further robustness check on the impact of immigrants on offshoring. We checked whether the exclusion of London, the most diverse and largest local labor market, from our regression affected the results. The results, available upon request, are qualitatively similar to those reported in Table 4.

The estimates suggest that TF services, on the other hand, are in a sense more "neutral" and do not have strong country-of-origin specificity. This translates into less direct substitutability between the offshoring of a service and immigrant workers from the same country who could perform the service domestically. In each case, as before, the aggregate immigrant share and the aggregate immigrant diversity variables have positive and significant coefficients. In terms of magnitudes, however, the positive aggregate effect of immigrants seems to be driven primarily by firms that offshore LHR and LR services. Finally, as expected, the effect of the service trade barrier index on offshoring is negative, implying that service trade barriers reduce the offshoring of intermediate services.

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, suggests that the variety of immigrants generates a complementarity between immigrants as a whole and offshoring as a whole, in spite of the fact that each group of immigrants can substitute for the specific services from their own country. It is the complementarity across skills and countries that produces this effect. This is also consistent with the aggregate complementarity of immigrants and natives, in line with the positive correlation between immigrant and native employment shown in Table 3. In turn, 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).

7.3 Immigrants and Exports of Services

Table 6 presents the results from estimating an equation similar to (8) in which the dependent variable is (the logarithm of) firm exports of services. The usual table structure with OLS (Columns 1-4) and 2SLS (columns 5-8) estimates is presented and we focus on the estimated values of the coefficients in the top two rows, corresponding to the explanatory variable $ImmSh_{kt}$, which captures total immigrants as a share of employment in the local labor market, and $ImmSh^n_{kt}$, which captures immigrants from country n as a share of employment in the local labor market. As above, we report the results with and without the Immigrant Diversity Index and we always include the measures of services trade barriers as controls. The results confirm the positive effect of the aggregate immigration share: firms in labor markets with more immigrants have a tendency to export more. An increase in immigrants equal to one percentage point of local employment increases exports of firms in that TTWA by about 3 percent (based on the 2SLS results).

As for immigrants from a specific country n, the estimate of the coefficient on $ImmSh^n_{kt}$ suggests an additional positive and significant effect on services export, which is one-and-a-half to two times the magnitude of the aggregate effect over this period (recall that the average rise in the bilateral share across TTWAs over the period was about a tenth the magnitude of the rise in the aggregate share, which rose just under 1 percentage

point). 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, corresponding to the average yearly increase between 2001 and 2007, increased aggregate firm exports by around 3 percent, the bilateral effects were larger over this period, increasing exports by about 3 to 5 percent (based on the 2SLS estimates, 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 to 4 percent.[24] 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 the studies that those authors examine, suggesting that services exports may simply be a bit more responsive to immigrant inflows. Again there is mixed evidence with respect to immigrant diversity while the service trade barrier index is still negatively and significantly correlated with exports of services.

Immigrants may increase the flows 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, such 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 and hence increasing sales and revenues from that market. This is the intensive margin of trade and is reflected in the results just discussed from Table 6. In Table 7 we explore the effect of immigration on the extensive margin of exports. The estimates 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 (consistent with our model in which productivity increases expand the set of exporting firms), 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 expand into their home-country market. Interestingly, most of the estimated coefficients are somewhat weak 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 in the relatively short period 2001-2007 that we examine here.[25]

Table 8 explores the role of the "cultural content" of services in relation to immigrant-export complemen-

[24] To be clear: a one percentage point rise (reflected in the estimates presented in the table) is equivalent to an almost 200 percent rise in the number of bilateral immigrants. We then adjust the estimates to reflect a 10 percent rise.

[25] 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 these regressions are available upon request.

tarity. The prediction of the model is that the trade-creation effect of immigrants, by reducing the cost of exporting services to their country of origin, should be greater for those services that have stronger cultural and country-specific content. Mirroring Table 5, Table 8 presents the effect of aggregate and bilateral immigration on the exports of the three types of services. Confirming the hypothesis, the strongest effect of both aggregate and bilateral migrants is for exports of LHR and LR services. The effect on bilateral exports of TF services is never significant while the bilateral effects are strongest for LHR services, suggesting an important role for language as a determinant of the impact of immigrants on services trade. When expanding service exports to a foreign market, immigrants from that same country are a great boon. They likely understand and connect better with those customers and, eventually, they facilitate the expansion of the market for those services. Finally, Table 9 explores the type of markets that are more likely to benefit from bilateral migration. 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 9 we decompose the effects of immigrants on trade with Anglo-Saxon versus Non-Anglo-Saxon countries for LHR service types, those most affected by bilateral immigration. Here 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. Our 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 approximately three times larger for Non-Anglo-Saxon than for Anglo-Saxon countries. 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 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 have 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 by firms. Third, in bringing their country-specific knowledge, immigrants may increase exports of services to their country of origin.

Our empirical analysis confirms each of these hypotheses. We find a productivity and general export promotion effect of immigrants. We then identify an import-substitution effect of immigrants operating primarily through imports of services that rely on country-specific language, cultural and institutional knowledge. 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 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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A Proofs of Propositions 1, 2 and 3

Characterizing an x-specific immigration shock as an exogenous change in μ_x, we have

$$\frac{\partial \ln p}{\partial \ln p_{f,x}} = \frac{(p_{f,x})^{1-\sigma}}{(p_n)^{1-\sigma} + \sum_x (p_{f,x})^{1-\sigma}} = \left(\frac{p}{p_{f,x}}\right)^{\sigma-1} > 0,$$

and

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

Accordingly, we also have

$$\frac{d \ln p_{f,x}}{d \ln \mu_x} = \left(\frac{p_{f,x}}{p_{m,x}}\right)^{\theta-1} \varepsilon_{p_{m,x},\mu_x} > 0, \tag{9}$$

and

$$\frac{d \ln p}{d \ln \mu_x} = \left(\frac{p}{p_{f,x}}\right)^{\sigma-1} \left(\frac{p_{f,x}}{p_{m,x}}\right)^{\theta-1} \varepsilon_{p_{m,x},\mu_x} > 0. \tag{10}$$

Consider now two countries x and y. Given (6), (10) implies

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

Given the expression of export sales $R_x(\varphi) = \left(P_x(\varphi)/\overline{P}_x\right)^{1-\delta} E_x$ and profit maximizing price (5), (10) implies

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

where the sign is dictated by (10) and $\delta > 1$. Given the definitions $\tau_y \equiv p/(p + p_{f,y} t_y)$, $s_{f,x} \equiv (p/p_{f,x})^{\sigma-1}$, $s^f_{m,x} \equiv (p_{f,x}/p_{m,x})^{\theta-1}$ and $s_{m,x} \equiv s_{f,x} s^f_{m,x}$, these results prove Proposition 1.

Analogously, we obtain

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

and

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

where the signs are dictated by (10), (9) and $\delta>1$. Given the above definitions of τ_y, $s_{f,x}$, $s^f_{m,x}$ and $s_{m,x}$, these results prove Proposition 2.

Finally, differentiating $(p_{f,x}/p_{o,x})^{\theta-1}$ with respect to μ_x yields

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

where the sign is granted by $\theta>1$, while differentiating $(p/p_{f,x})^{\sigma-1}$ with respect to μ_x yields

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

where the sign is dictated by (10), (9) and $\sigma>1$. Given the definitions of τ_y, $s_{f,x}$, $s^f_{m,x}$ and $s_{m,x}$, these results prove Proposition 3.

Table 1
Tradable Service Sectors Divided by Category

Technical-Financial	Legal & Related	Language-Human Resources
Financial Services	Legal Services	Recruitment & Training
Insurance	Accounting & Auditing	Procurement
Architectural	Property Management	Management Consulting
Engineering		Public Relations
Surveying		Advertising
Agricultural		TV and Radio Services
Mining		Cultural & Recreational Services
Other Technical		Publishing Services
Computer & Information Services		Health Services
Research & Development		Market Research & Polling
Other Business Services		

Note: This is the sector partition between service types that we will adopt in Tables 5 and 8**.**

Table 2
Immigrants and Log Aggregate Exports

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	OLS				**2SLS**			
Immigrant Share	3.71*** (1.29)	3.65** (1.36)	4.94*** (1.11)	4.05** (1.61)	3.09** (1.63)	3.04** (1.71)	3.42** (1.27)	2.79* (1.84)
Immigrant Diversity	95.49* (58.14)	70.02 (85.47)	128.21 (180.55)	99.63 (97.05)	79.62 (73.11)	58.36 (107.47)	41.05 (50.24)	58.92 (55.13)
TTWA fixed effects	Yes	Yes	No	No	Yes	Yes	No	No
Firm fixed effects	No	No	Yes	Yes	No	No	Yes	Yes
TTWA trends	No	Yes	No	Yes	No	Yes	No	Yes
Observations	147087	147087	147087	147087	147087	147087	147087	147087

Note: The dependent variable is the logarithm of the value of services exports by the firm. The unit of analysis is the firm-year. Each regression contains the fixed effects noted in the table plus it includes the log of value added and the log of capital investments as controls. The key explanatory variable, "immigrant Share" varies at the TTWA-year level. Number of observations is number of firm-year cells. Specifications (1), (2), (3) and (4) differ from each other because of the inclusion of different sets of fixed effects included as described in the Table. 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
Immigrants and Log Labor Productivity

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
			OLS				2SLS	
Immigrant Share	4.95*** (2.22)	3.72* (2.56)	3.54** (1.55)	3.49* (1.83)	2.46 (2.21)	2.26 (2.07)	3.09* (1.77)	3.05* (2.09)
Immigrant Diversity	65.00* (41.96)	66.54 (71.61)	91.20* (69.58)	66.86 (82.29)	46.69 (52.77)	47.80 (90.05)	83.39 (79.46)	61.13 (116.82)
TTWA fixed effects	Yes	Yes	No	No	Yes	Yes	No	No
Firm fixed effects	No	No	Yes	Yes	No	No	Yes	Yes
TTWA trends	No	Yes	No	Yes	No	Yes	No	Yes
Observations	147087	147087	147087	147087	147087	147087	147087	147087

Note: The dependent variable is the logarithm of gross value added per worker for the firm. The unit of analysis is the firm-year. Each regression contains the fixed effects noted in the table plus it includes the log of value added and the log of capital investments as controls. The key explanatory variable, "immigrant Share" varies at the TTWA-year level. Number of observations is equal to the number of firm-year cells. Specifications (1), (2), (3) and (4) differ from each other because of the inclusion of different sets of fixed effects included as described in the Table. 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 4
Immigrants and Log Imports of Intermediate Services (Offshoring)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
			OLS				2SLS	
Immigrant Share	5.695* (2.885)	6.483** (3.199)	4.151*** (0.642)	3.739*** (1.269)	3.550** (1.842)	3.712** (1.871)	3.939** (1.922)	3.625* (2.211)
Immigrant Share, Bilateral	-83.137*** (28.272)	-70.310* (42.294)	-42.214*** (11.91)	-42.012*** (11.76)	-24.48* (13.04)	-23.38** (10.94)	-28.27** (14.09)	-23.76** (12.19)
Service Import Barriers	-0.246** (0.123)	-0.205** (0.093)	-0.511*** (0.14)	-0.506*** (0.14)	-0.231* (0.133)	-0.209* (0.127)	-0.311* (0.14)	-0.422 (0.35)
Service Export Barriers	0.613 (0.666)	0.745 (0.935)	0.767 (0.67)	0.756 (0.67)	0.601 (0.541)	0.487 (0.537)	0.512 (0.42)	0.627 (0.60)
Immigrant Diversity		69.674 (74.983)		51.371 (53.35)		60.72* (45.20)		43.44 (58.88)
TTWA fixed effects	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
Firm fixed effects	No	No	Yes	Yes	No	No	Yes	Yes
TTWA trends	No	Yes	No	Yes	No	No	No	Yes
Observations	489342	489342	489342	489342	489342	489342	489342	489342

Note: The dependent variable is the logarithm of the value of services imports (offshoring) by the firm. The unit of analysis is the firm-country-year. Each regression contains the fixed effects noted in the table plus it includes the log of value added and the log of capital investments at the firm level as controls. Number of observations is number of firm-country-year cells. Specifications (1), (2), (3) and (4) differ from each other because of the inclusion of different sets of fixed effects included as described in the Table. 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

Immigrants and Log Imports of Intermediate Services (Offshoring), by Service Type

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	2SLS: Fin & Tech Services			**2SLS: Legal & Related Services**			**2SLS: Language & HR Services**		
Immigrant Share, Aggregate	0.32*** (0.11)	0.35** (0.16)	0.32** (0.18)	7.31*** (2.71)	8.22* (3.24)	9.55*** (3.28)	11.20*** (3.72)	9.50*** (2.19)	10.83*** (2.24)
Immigrant Share, Bilateral	-1.01 (1.04)	-0.82 (1.61)	-1.91 (1.88)	-20.85** (10.57)	-16.3** (9.23)	-14.21* (9.52)	-30.06** (15.13)	-26.02* (14.08)	-16.77** (8.39)
Service Import Barriers	-0.29*** (0.12)	-0.33*** (0.15)	-0.31** (0.17)	-0.44*** (0.17)	-0.41*** (0.18)	-0.34** (0.18)	-0.35*** (0.10)	-0.31*** (0.06)	-0.30*** (0.08)
Service Export Barriers	0.17* (0.09)	0.22** (0.11)	0.21* (0.12)	0.19*** (0.07)	0.24* (0.16)	0.22 (0.15)	0.16** (0.08)	0.19* (0.12)	0.17* (0.11)
Immigrant Diversity	52.63*** (22.95)	57.48** (36.17)	62.16** (36.92)	31.09** (16.44)	41.02* (20.68)	31.61* (20.80)	35.36* (19.72)	41.78** (20.74)	32.13* (21.08)
TTWA fixed effects	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No
Firm fixed effects	No	No	Yes	No	No	Yes	No	No	Yes
TTWA trends	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Observations	276157	276157	276157	49515	49515	49515	167824	167824	167824

Note: The dependent variable is the logarithm of the value of services imports (offshoring) by the firm. The unit of analysis is the firm-country-year. Each regression contains the fixed effects noted in the table plus it includes the log of value added and the log of capital investments as controls. Number of observations is number of firm-country-year cells. Specifications (1), (2), (3) and (4) differ from each other because of the inclusion of different sets of fixed effects included as described in the Table. 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
Immigrants and Log Exports of Services

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
			OLS				2SLS	
Immigrant Share	6.233*** (1.498)	4.761** (2.121)	4.931*** (0.433)	4.172** (2.048)	4.026** (2.083)	4.014* (2.513)	4.045*** (1.744)	3.774* (2.703)
Immigrant Share, Bilateral	116.77*** (26.424)	103.65*** (28.82)	66.69*** (7.71)	65.48*** (7.69)	89.01*** (31.41)	81.210** (39.82)	50.01*** (15.26)	44.89*** (17.42)
Service Import Barriers	0.271 (0.224)	0.503 (0.597)	0.168* (0.09)	0.187 (0.13)	0.471** (0.263)	0.414* (0.272)	0.175** (0.09)	0.168* (0.10)
Service Export Barriers	-0.410** (0.218)	-0.456** (0.274)	-0.155** (0.08)	-0.152** (0.08)	-0.424** (0.200)	-0.387** (0.193)	-0.278*** (0.104)	-0.230** (0.12)
Immigrant Diversity		52.466 (61.178)		106.887** (52.72)		49.73 (57.25)		91.35* (60.02)
TTWA fixed effects	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
Firm fixed effects	No	No	Yes	Yes	No	No	Yes	Yes
TTWA trends	No	Yes	No	Yes	No	No	No	Yes
Observations	489342	489342	489342	489342	489342	489342	489342	489342

Note: The dependent variable is the logarithm of the value of services exports by the firm. The unit of analysis is the firm-country-year. Each regression contains the fixed effects noted in the table plus it includes the log of value added and the log of capital investments as controls. Number of observations is number of firm-country-year cells. Specifications (1), (2), (3) and (4) differ from each other because of the inclusion of different sets of fixed effects included as described in the Table. 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

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
			OLS				2SLS	
Immigrant Share	0.39** (0.19)	0.25* (0.15)	0.32* (0.21)	0.36* (0.24)	0.28* (0.20)	0.22 (0.84)	0.30 (0.26)	0.32 (0.29)
Immigrant Share, Bilateral	0.50** (0.16)	0.43* (0.28)	0.49** (0.23)	0.47* (0.29)	0.31* (0.18)	0.31* (0.19)	0.40* (0.25)	0.40* (0.26)
Service Import Barriers	0.28** (0.12)	0.18 (0.29)	0.24 (0.37)	0.16 (0.16)	0.26* (0.15)	0.16 (0.35)	0.23 (0.45)	0.15 (0.20)
Service Export Barriers	-0.24*** (0.07)	-0.26*** (0.07)	-0.25* (0.14)	-0.20 (0.15)	-0.23** (0.09)	-0.24** (0.09)	-0.23 (0.17)	-0.18 (0.19)
Immigrant Diversity		2.99 (5.74)		1.51 (2.21)		3.86 (2.98)		2.15 (3.74)
TTWA fixed effects	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
Firm fixed effects	No	No	Yes	Yes	No	No	Yes	Yes
TTWA trends	No	Yes	No	Yes	No	No	No	Yes
Observations	489342	489342	489342	489342	489342	489342	489342	489342

Note: The dependent variable is an indicator of the export status of the firm (0,1). The unit of analysis is the firm-country-year. Each regression contains the fixed effects noted in the table plus it includes the log of value added and the log of capital investments as controls. Number of observations is number of firm-country-year cells. Specifications (1), (2), (3) and (4) differ from each other because of the inclusion of different sets of fixed effects included as described in the Table. 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
Immigrants and Log Exports of Services, by Service Type

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	2SLS: Fin & Tech Services			2SLS: Legal & Related Services			2SLS: Language & HR Services		
Immigrant Share, Aggregate	6.01*** (2.76)	4.95** (3.04)	4.26** (3.09)	7.04*** (3.19)	6.59** (3.26)	6.22*** (1.05)	3.47** (1.90)	3.40* (2.24)	5.08*** (2.63)
Immigrant Share, Bilateral	8.34 (11.74)	5.19 (9.12)	5.90 (8.63)	53.06** (27.17)	71.77** (41.88)	61.32* (43.58)	97.59** (57.03)	84.83** (48.63)	107.51** (55.36)
Service Import Barriers	-0.23** (0.11)	-0.26** (0.14)	-0.25* (0.16)	-0.35** (0.16)	-0.32** (0.17)	-0.33*** (0.12)	-0.34*** (0.07)	-0.30*** (0.04)	-0.29*** (0.05)
Service Export Barriers	0.13** (0.08)	0.17** (0.10)	0.17** (0.11)	0.15*** (0.06)	0.19 (0.15)	0.14 (0.10)	0.15*** (0.05)	0.18** (0.08)	0.16** (0.07)
Immigrant Diversity	41.66** (21.21)	45.50** (23.44)	49.20* (34.14)	24.61* (15.20)	32.47* (19.12)	30.39** (13.56)	34.00** (12.85)	40.17*** (13.52)	30.89** (13.74)
TTWA fixed effects	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No
Firm fixed effects	No	No	Yes	No	No	Yes	No	No	Yes
TTWA trends	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Observations	276157	276157	276157	49515	49515	49515	167824	167824	167824

Note: The dependent variable is the logarithm of the value of services exports by the firm. The unit of analysis is the firm-country-year. Each regression contains the fixed effects noted in the table plus it includes the log of value added and the log of capital investments as controls. Number of observations is number of firm-country-year cells. Specifications (1), (2), (3) and (4) differ from each other because of the inclusion of different sets of fixed effects included as described in the Table. 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 9

Immigrants and Log Language and Human Resources (LHR) Exports, by Country Type

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Non-Anglo-Saxon Destinations				Anglo-Saxon Destinations			
Immigrant Share	6.32*** (0.47)	5.54*** (0.83)	3.67* (2.17)	6.09** (2.71)	5.90*** (1.70)	2.92** (1.49)	3.57* (2.12)	1.78 (1.50)
Immigrant Share, Bilateral	118.65*** (10.21)	109.89*** (15.29)	101.34*** (22.93)	132.48*** (36.83)	29.16 (24.31)	35.13 (50.41)	30.15 (54.09)	49.25 (66.30)
Service Import Barriers	0.34** (0.11)	0.22 (0.26)	0.30 (0.33)	0.19 (0.15)	0.30** (0.10)	0.19 (0.23)	0.26 (0.29)	0.17 (0.13)
Service Export Barriers	-0.30*** (0.07)	-0.32*** (0.07)	-0.31** (0.13)	-0.24* (0.14)	-0.26*** (0.06)	-0.28*** (0.06)	-0.27** (0.11)	-0.21* (0.12)
Immigrant Diversity		51.67** (22.79)		37.87* (20.54)		47.23** (22.44)		24.33 (27.17)
TTWA fixed effects	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
Firm fixed effects	No	No	Yes	Yes	No	No	Yes	Yes
TTWA trends	No	Yes	No	Yes	No	No	No	Yes
Observations	489342	489342	489342	489342	489342	489342	489342	489342

Note: The dependent variable is the logarithm 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. The unit of analysis is the firm-country-year. Each regression contains the fixed effects noted in the table plus it includes the log of value added and the log of capital investments as controls. Number of observations is number of firm-country-year cells. Specifications (1), (2), (3) and (4) differ from each other because of the inclusion of different sets of fixed effects included as described in the Table. 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

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

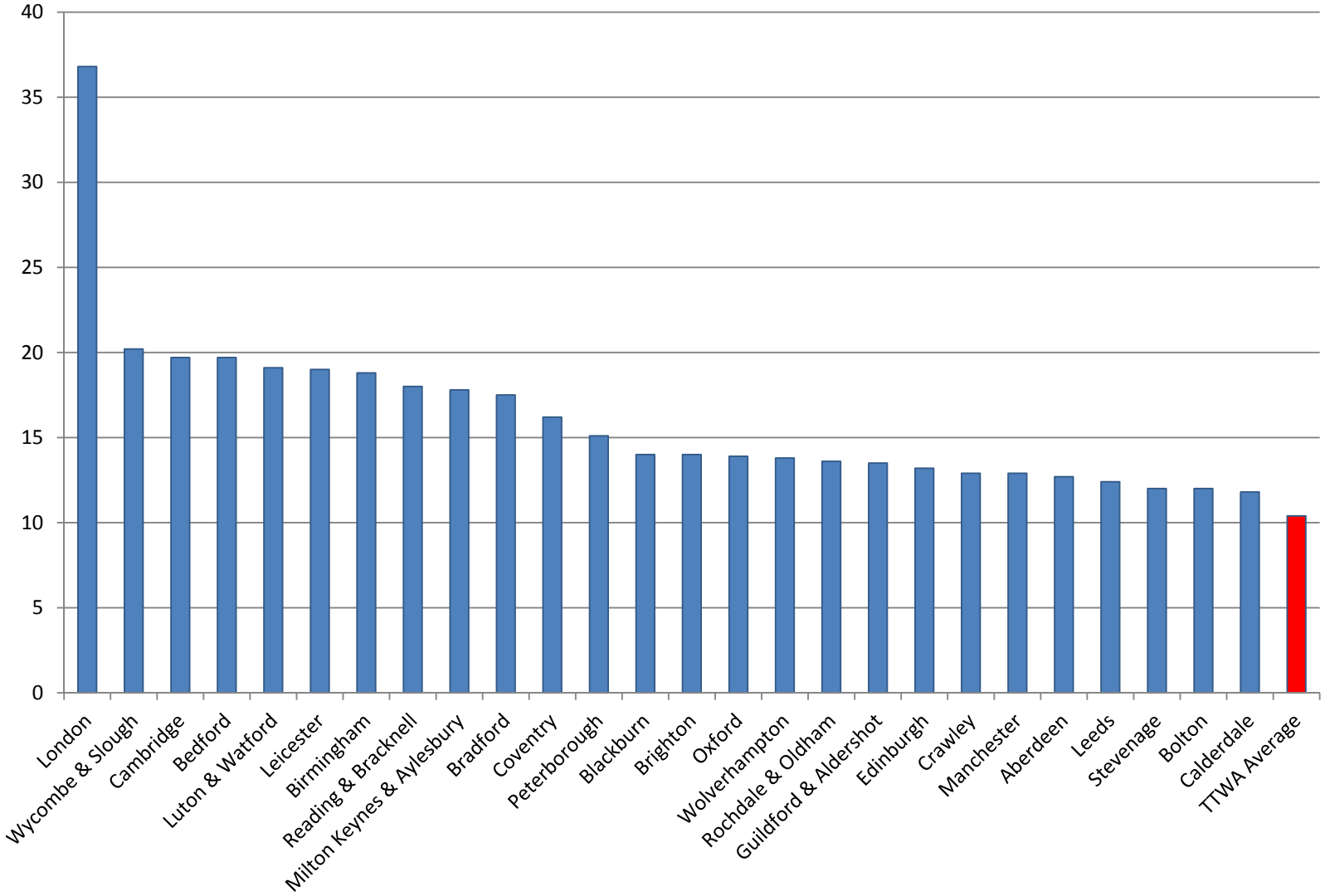


Figure 2

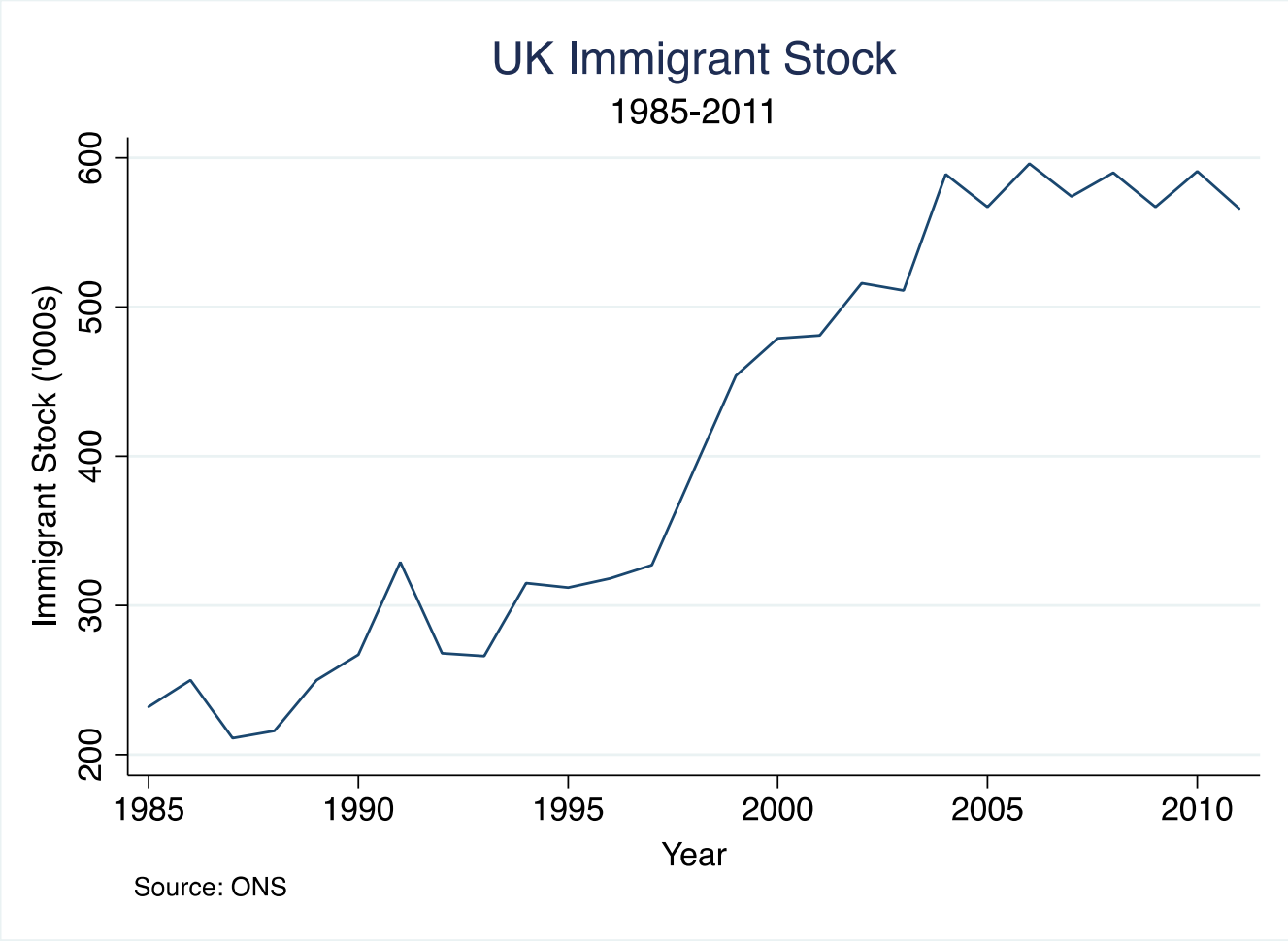

UK Immigrant Stock
1985-2011
Immigrant Stock ('000s)
200
300
400
500
600
1985
1990
1995
2000
2005
2010
Year
Source: ONS

Figure 3

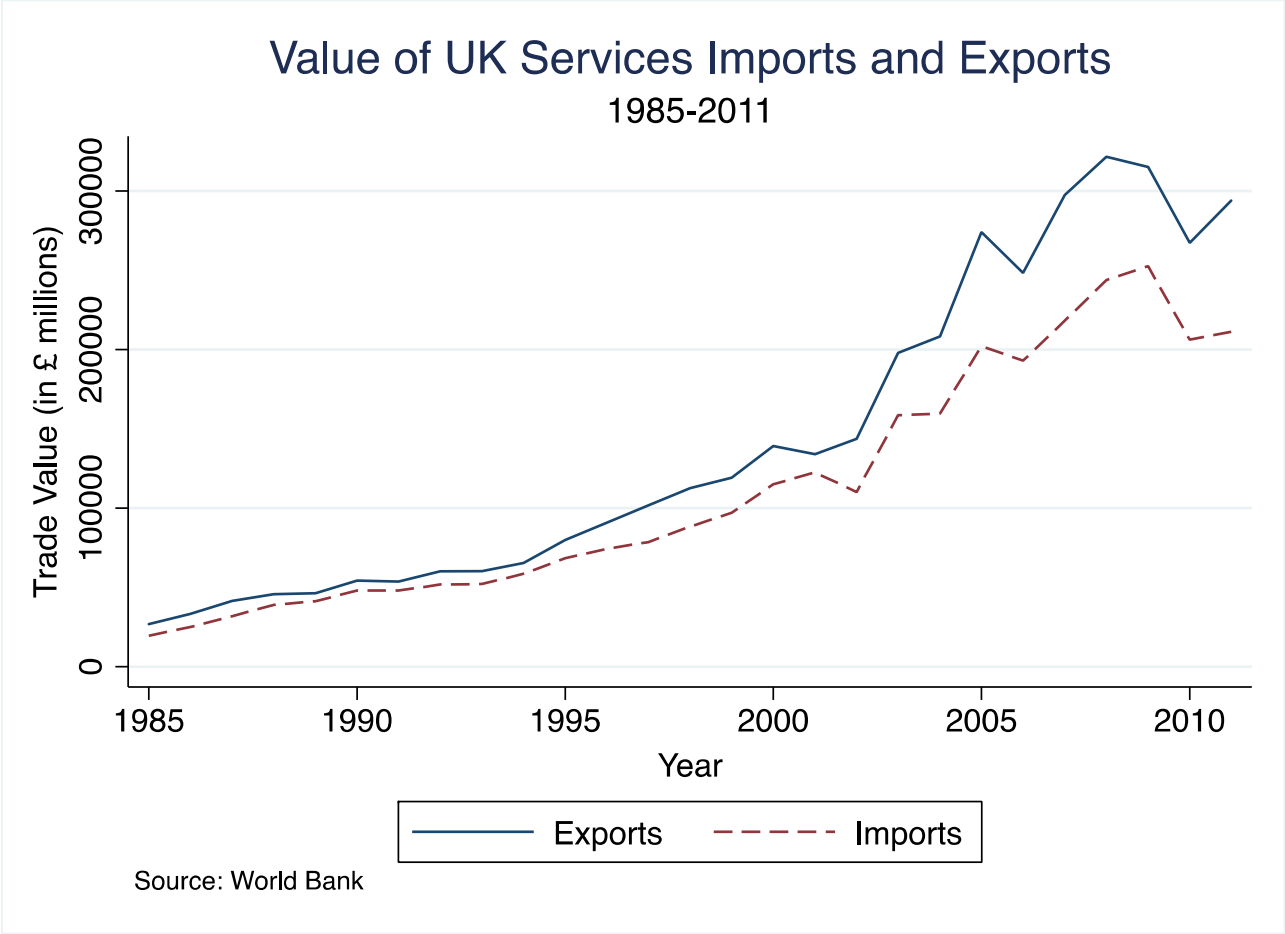

Value of UK Services Imports and Exports
1985-2011
Trade Value (in £ millions)
0
100000
200000
300000
1985
1990
1995
2000
2005
2010
Year
Exports
Imports
Source: World Bank

Figure 4
U.K. Services Trade Value (Exports + Imports) by Industry, 1999-2005
Millions of UK Pounds

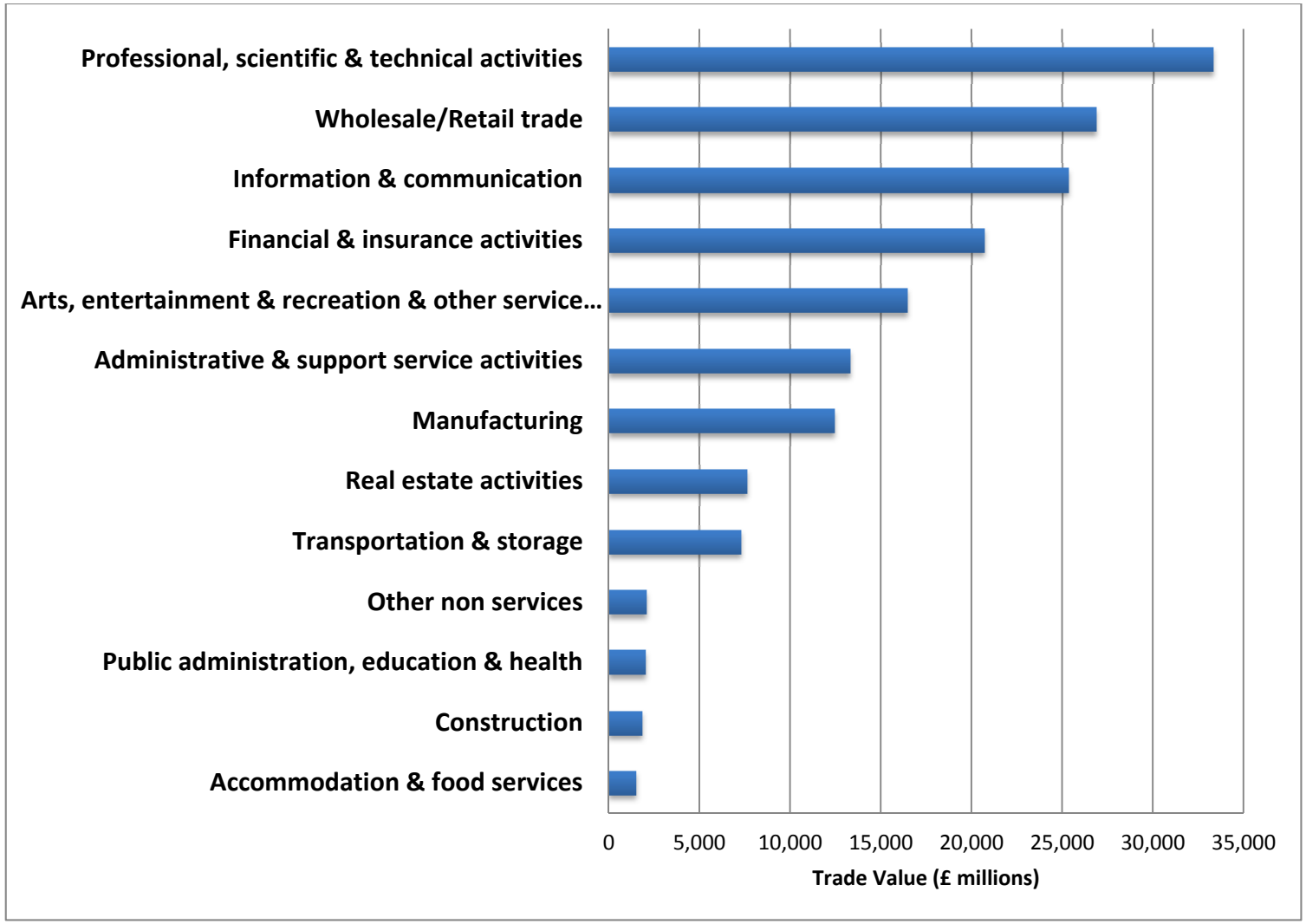
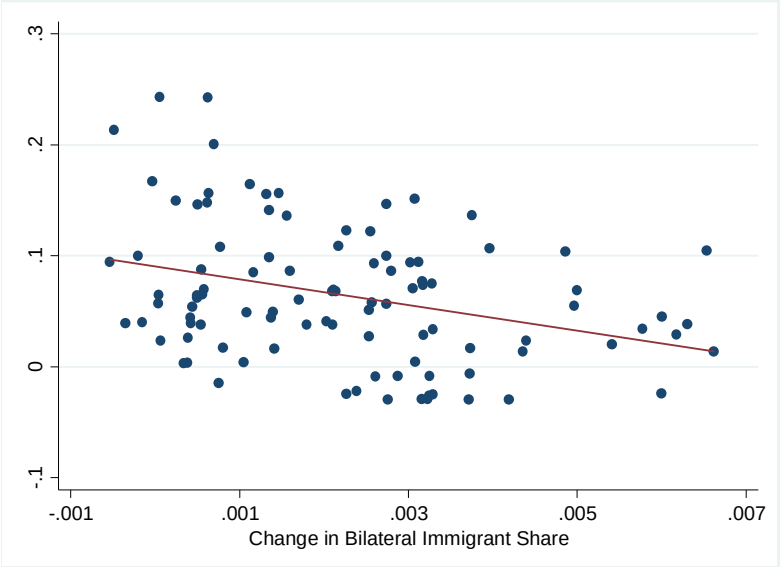
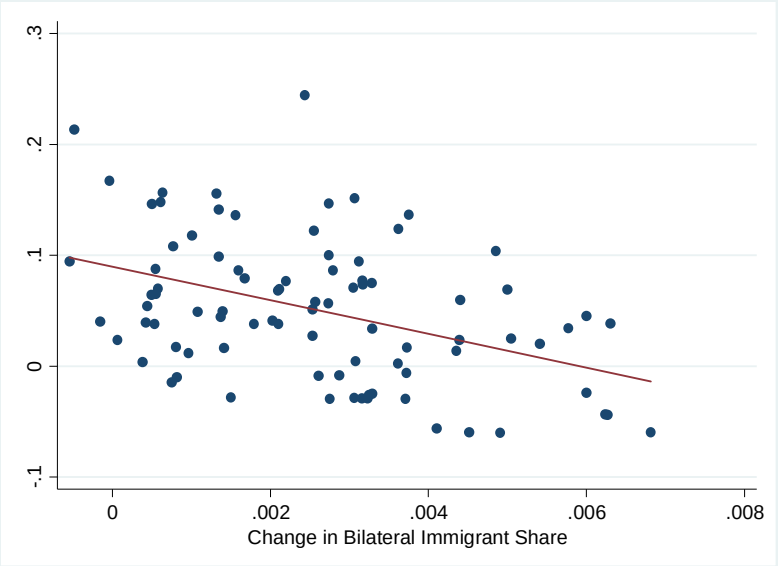


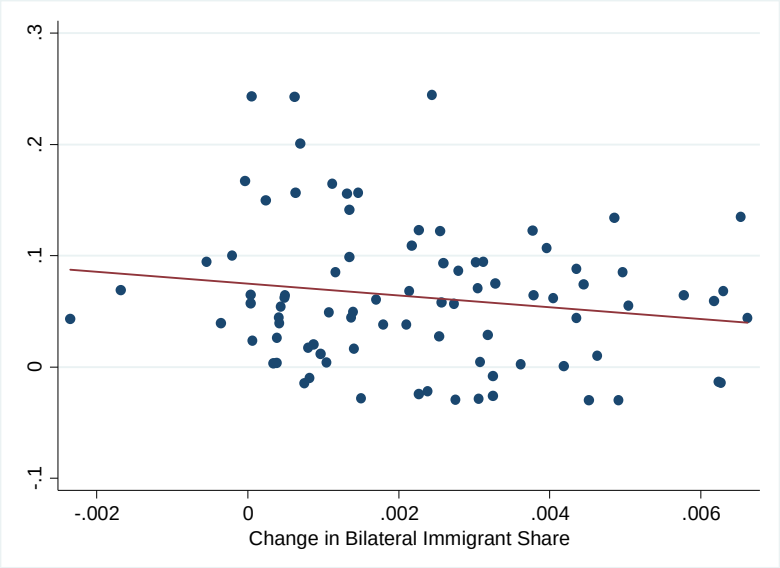
Figure 5. Bilateral Services Imports vs Bilateral Immigrant Share, 2001-2007



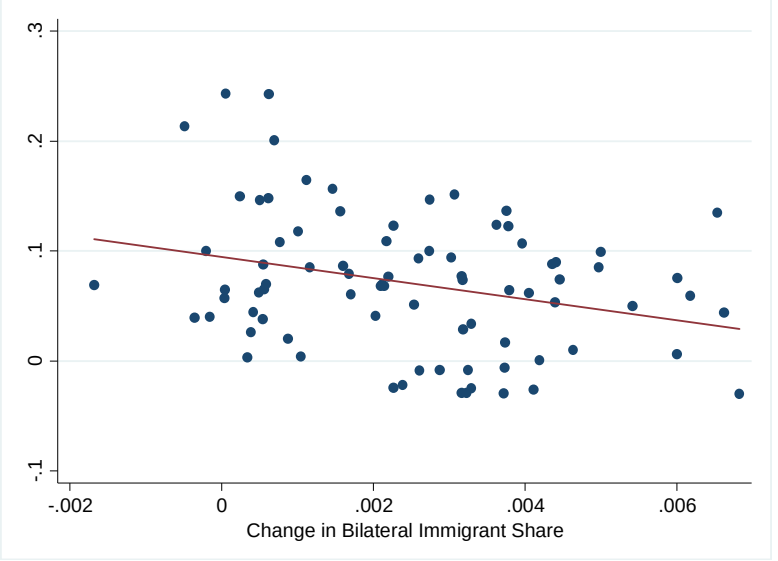
(a) Aggregate Relationship



(b) Language and Human Resources

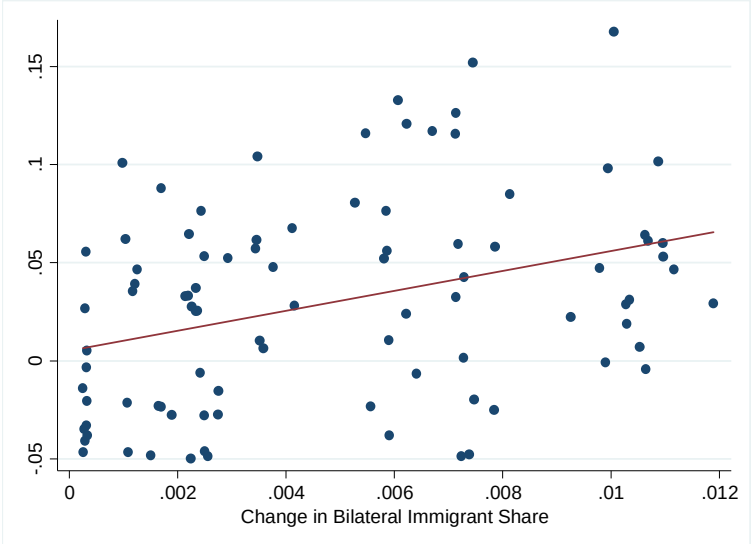


(c) Legal and Related

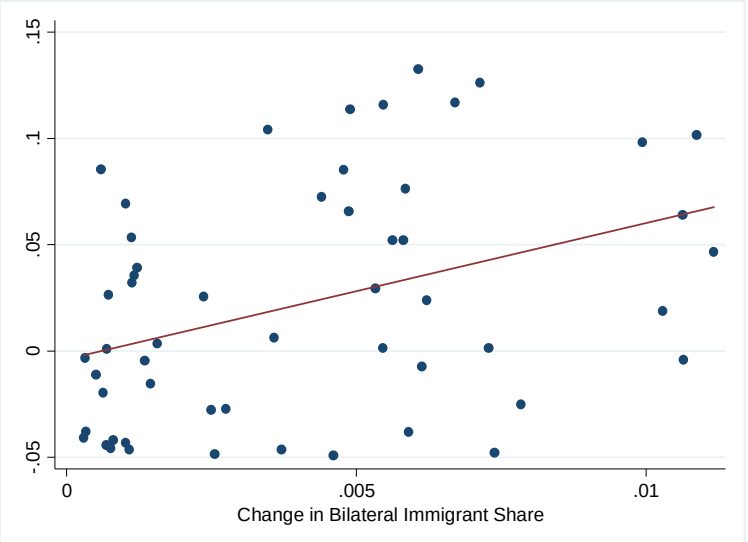


(d) Technical and Financial

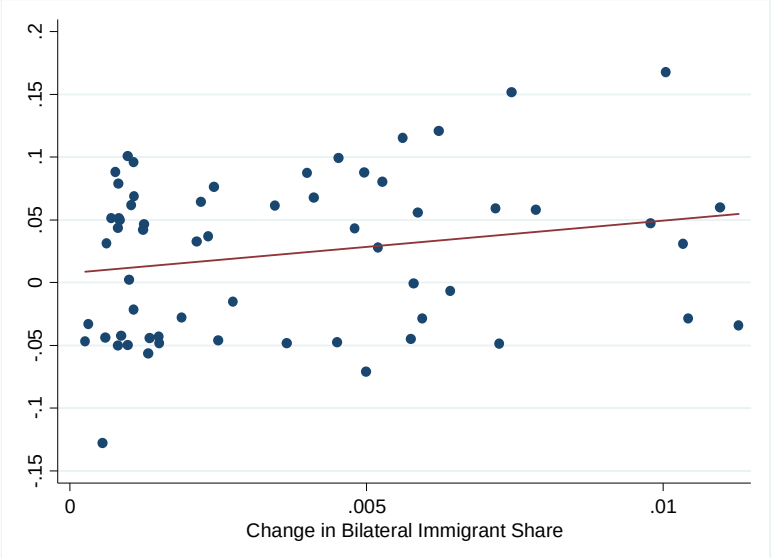
Figure 6. Bilateral Services Exports vs Bilateral Immigrant Share, 2001-2007



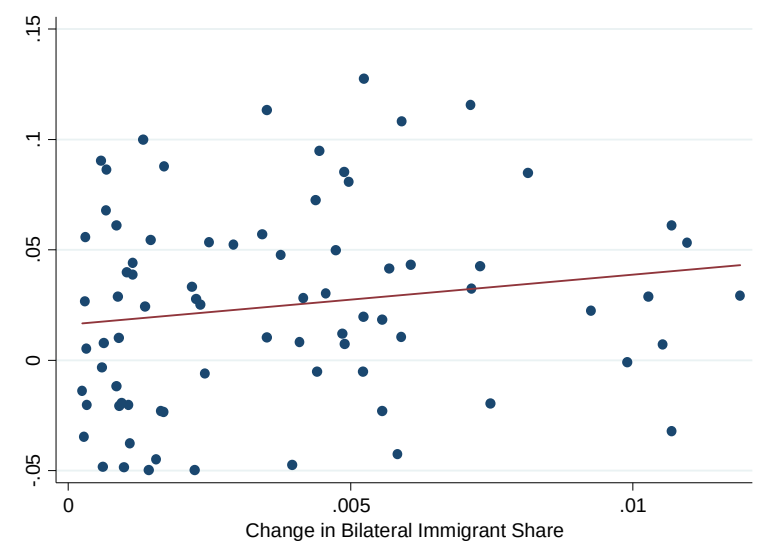
(a) Aggregate Relationship



(b) Language and Human Resources



(c) Legal and Related



(d) Technical and Financial

Figure 7

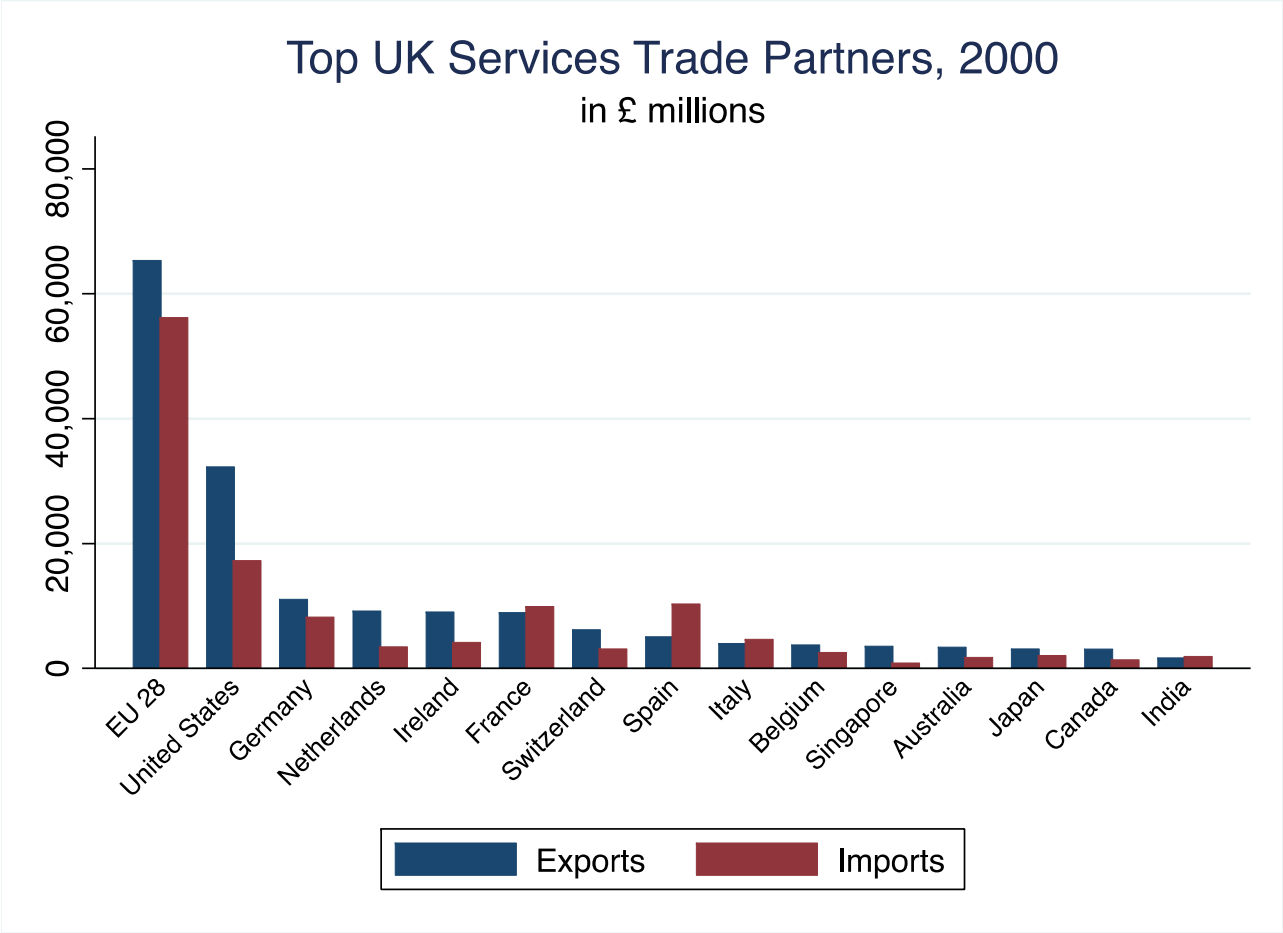

Top UK Services Trade Partners, 2000
in £ millions
0
20,000
40,000
60,000
80,000
EU 28
United States
Germany
Netherlands
Ireland
France
Switzerland
Spain
Italy
Belgium
Singapore
Australia
Japan
Canada
India
Exports
Imports

Figure 8

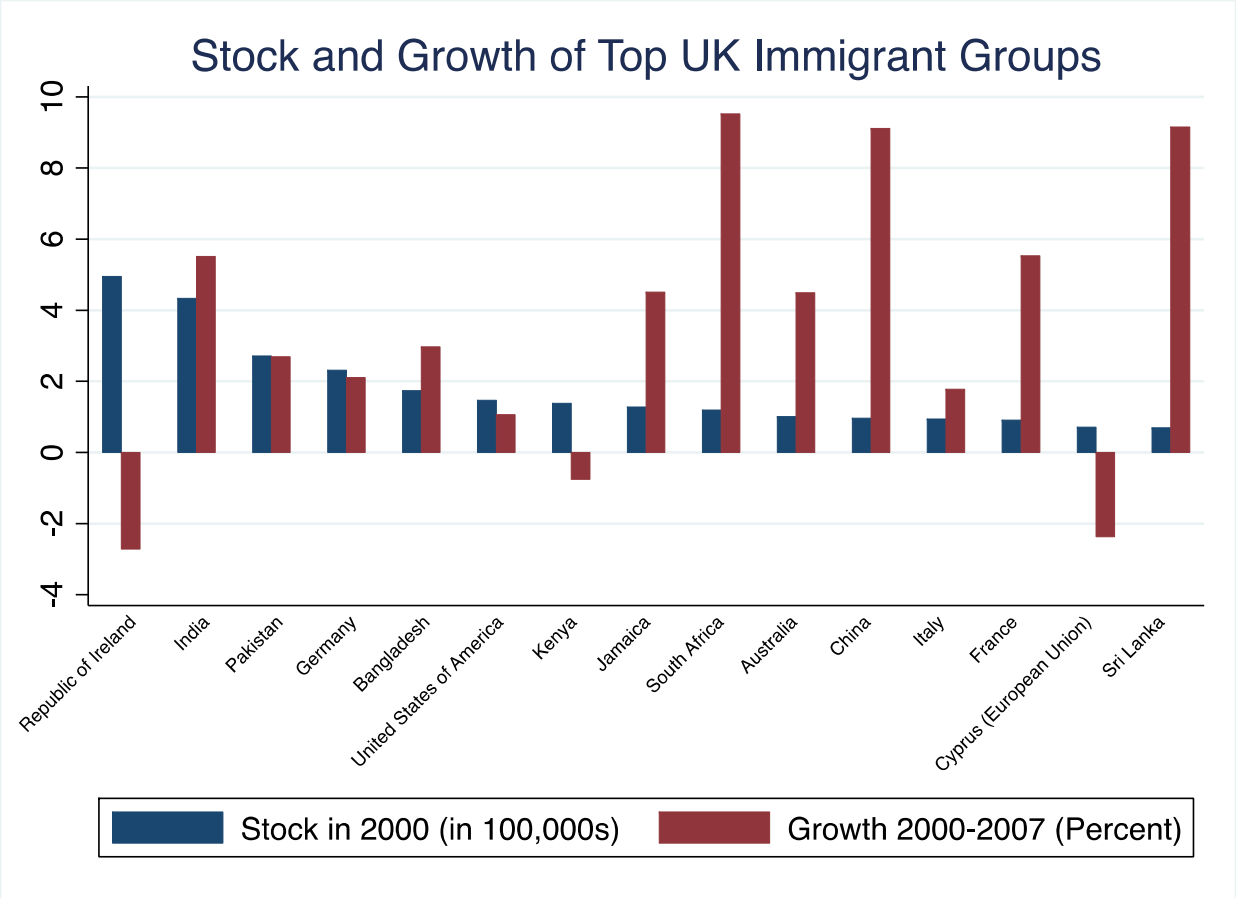

Stock and Growth of Top UK Immigrant Groups
10
8
6
4
2
0
-2
-4
Republic of Ireland
India
Pakistan
Germany
Bangladesh
United States of America
Kenya
Jamaica
South Africa
Australia
China
Italy
France
Cyprus (European Union)
Sri Lanka
Stock in 2000 (in 100,000s)
Growth 2000-2007 (Percent)

Figure 9

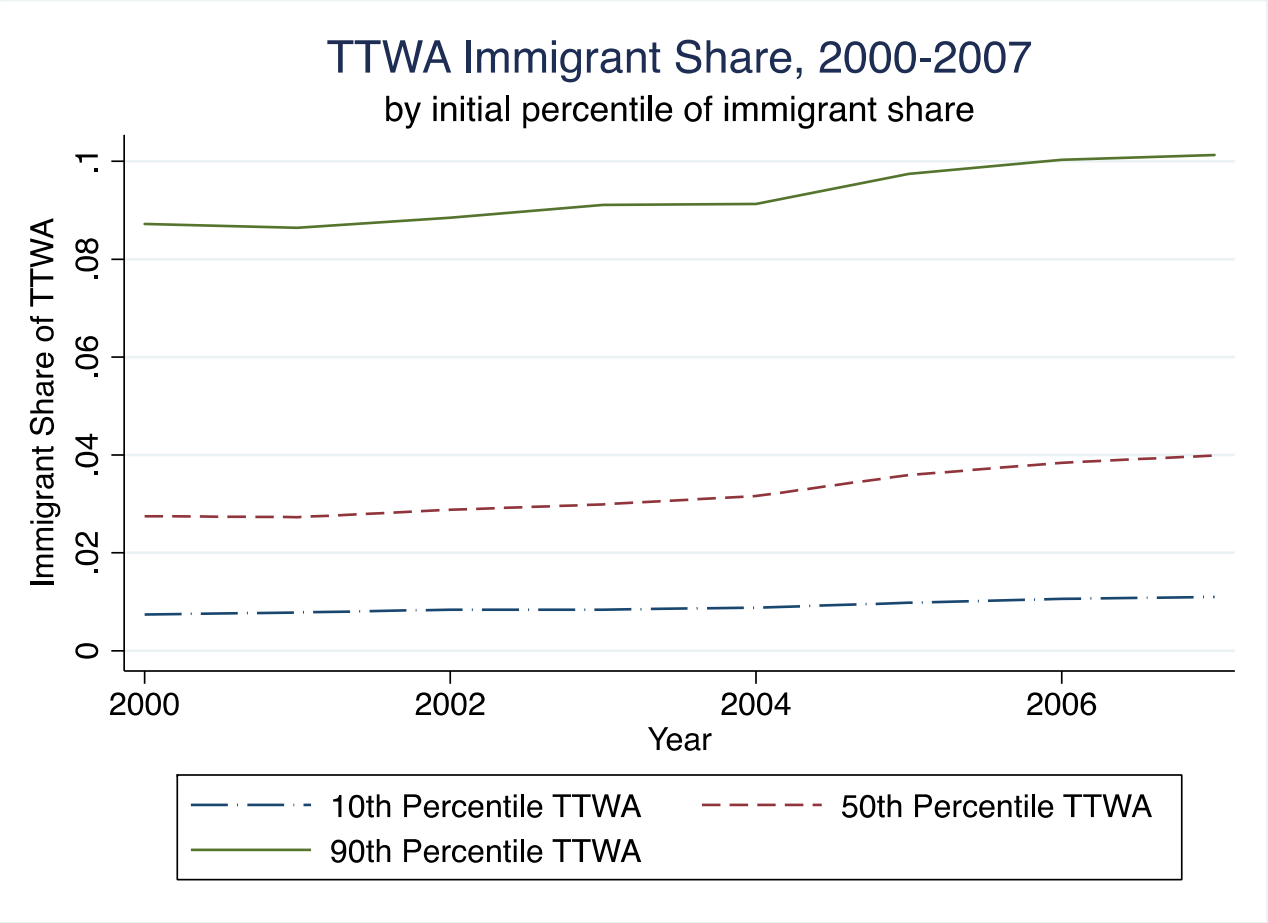
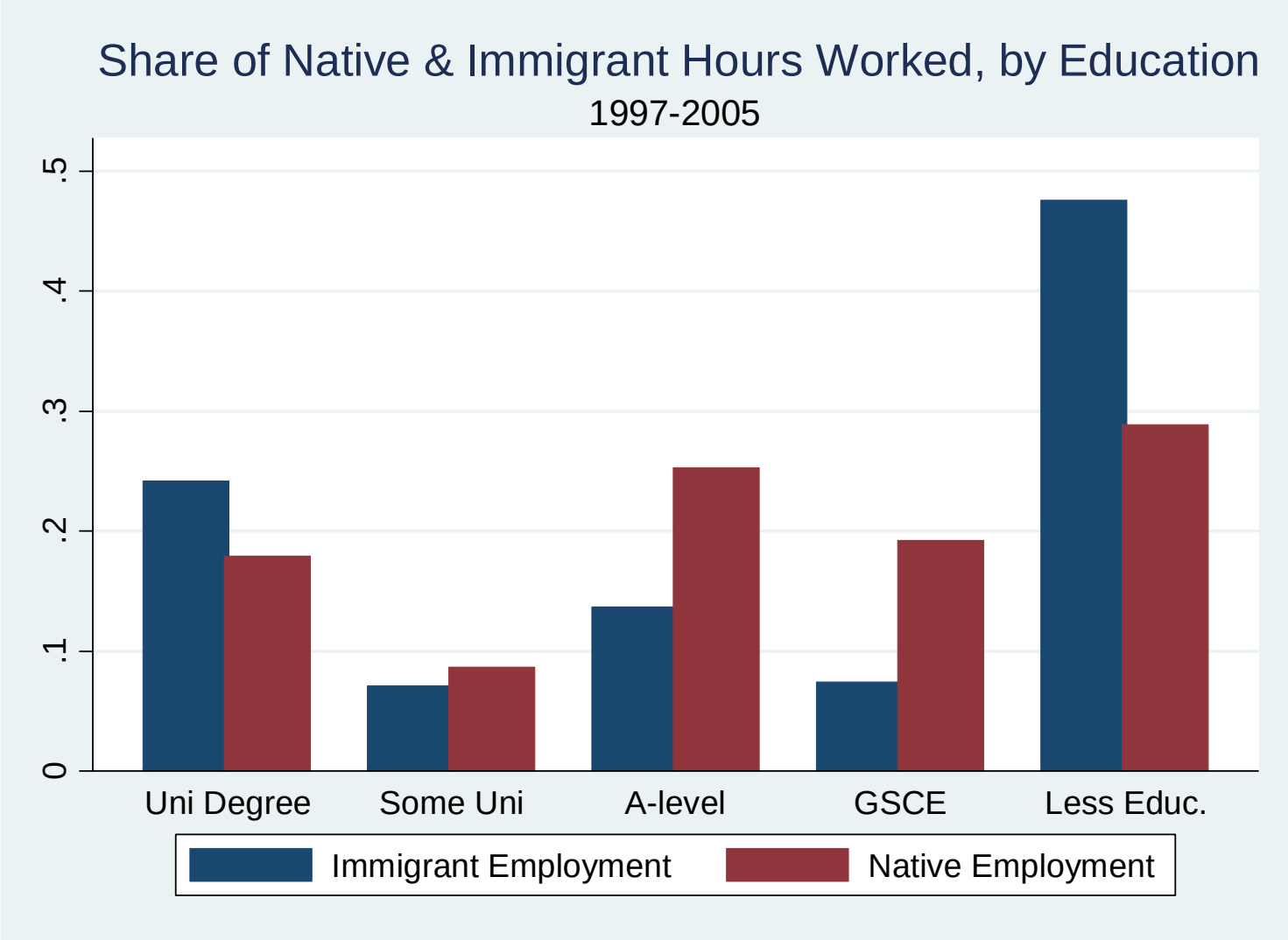

TTWA Immigrant Share, 2000-2007
by initial percentile of immigrant share
Immigrant Share of TTWA
0
.02
.04
.06
.08
.1
2000
2002
2004
2006
Year
10th Percentile TTWA
50th Percentile TTWA
90th Percentile TTWA

Figure 10


Share of Native & Immigrant Hours Worked, by Education
1997-2005
0
.1
.2
.3
.4
.5
Uni Degree
Some Uni
A-level
GSCE
Less Educ.
Immigrant Employment
Native Employment

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