NBER WORKING PAPER SERIES

IMMIGRATION, TRADE AND PRODUCTIVITY IN SERVICES: EVIDENCE FROM U.K. FIRMS

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Working Paper 21200
http://www.nber.org/papers/w21200

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
May 2015

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. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

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NBER Working Paper No. 21200
May 2015
JEL No. F16,F22,F23,F6

ABSTRACT

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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.

Key Words: Immigration, Services Trade

JEL Codes: F16, F10, F22, F23

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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 ones, in promoting skill diversity which can generate positive productivity effects for firms (see for instance Ottaviano and Peri 2012, Ortega and Peri 2014, Peri, Shih and Sparber, forthcoming 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 2015). 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 may increase 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") at the firm level. 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 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. 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 those countries may be particularly useful in enhancing and refining that understanding.

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 the firm's 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 moved 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.[1] Figure 1 shows the average share of foreign-born workers over the period examined, for several U.K. 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. Hence they represent self-contained labor markets. Those shown in Figure 1 are those whose immigrant population share was above the national average in the period that we consider (1999-2005). 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. We also note that during this period services exports and imports were important and growing, accounting for 9.4 percent and 7.4 percent of U.K. GDP, respectively. Figure 2 documents the volume of trade by type of aggregate service in which U.K. firms are active, where we see that various types of Business Services as well as Royalties and Licensing constitute the bulk of value of U.K. imports and exports.[2] In the empirical analysis we exploit these data at the firm level over the period 1999-2005, 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. Quarterly 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 in-house 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 from those countries may in fact be essential in order to produce them in-house. Figure 3 presents a correlation that is consistent with this notion. The figure plots the 1999-2005 change in the share of immigrant employment across TTWA-sector and country of origin cells against imports of services by local firms in the sector-TTWA from the same country. The negative and significant relationship between them is consistent with substitutability between the two. 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 migrate and work in the U.K. Figure 4 provides a stylized fact consistent with this idea. The figure shows a positive relationship between the 1999-2005 change in the share of immigrants in a labor market and country-of-origin cell and the change in bilateral exports (to the same country) of services from the same

[1] Source: Office of National Statistics.

[2] Table 1 shows the detailed list of services included in the analysis.

labor market. Next, Figures 5 and 6 consider the correlation between *aggregate* immigration in a labor market (TTWA-sector) and aggregate imports and exports. They clearly show that there is a positive relationship between the immigrant share in a local labor market and *aggregate* exports and imports of services. In sum, these stylized facts indicate a negative correlation between bilateral immigrants and offshoring, and a positive correlation between bilateral (aggregate) immigrants and bilateral (aggregate) exports.

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").[3] Second, they increase firm productivity and hence total exports by reducing the labor costs faced by the firm (a "productivity" or "general export promotion effect"). Finally, they 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. 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 the productivity of the firm and, separately, the effect of an increase in immigrants from a specific country on the level of imports and exports from those 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: (i) We find a bilateral import-substitution (offshore-reduction) effect of immigrants; (ii) We find a bilateral export-promotion effect of immigrants, particularly for language-intensive and institutional-knowledge intensive services; (iii) We find a positive productivity effect of aggregate immigration that, in some cases, is associated with country-of-origin diversity.

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.

[3]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.

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). 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. Recently, it has been pointed out (by Ottaviano et al 2013 among others) that, when a good is part of a production chain, such that firms must decide whether to produce the good locally or overseas (offshore), overseas workers and immigrants may be substitutes in production. Increased immigration may *reduce* imports of intermediate goods as immigrants can be employed by firms to produce those intermediate goods in house. 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 import and export.

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. At the same time, the literature has pointed out for a while 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 about the connection between immigrants and trade should apply very strongly to service trade, so far no paper has explored such nexus.[4]

A more recent branch of the literature focussed 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 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

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

Sparber (forthcoming) 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. Overall this line of research seems to find positive productivity effects of immigrants, however it does not focus 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 1999-2005. These data are collectively compiled from three sources: the Quarterly Labour Force Survey (QLFS), the Annual Respondent's Database (ARD) and the International Trade in Services (ITIS) dataset. The QLFS 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 and industry in which an individual works. 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.[5] 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 4-digit industry and geographic location of the firm. We can also control for various firm features such as capital expenditures and employment.

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, the financial sector and the public sector, each of which are covered in other surveys that are, unfortunately, not available to researchers. We link the ARD with the ITIS via the common establishment identifier in both datasets, and we link this combined dataset with the QLFS by the "travel-to-work" area (TTWA) and one-digit sector of the establishments and workers. Though we could link these datasets at a more disaggregate level (such as the 4-digit industry level), because the QLFS is a one percent sample of workers we need to be sure

[5] For a comprehensive description of this dataset, see Criscuolo, Haskel and Martin (2003).

there is an adequate number of workers in each cell. By matching at the one-digit sector level we ensure that each cell contains at least 1000 immigrant hours worked from each of the top 20 immigrant origin countries, thereby alleviating concerns about measurement error and the related attenuation bias[6]. We will then focus on the impact of immigrants from these specific countries when analyzing any bilateral effects. Ultimately, the final dataset encompasses workers from 142 countries (though the bilateral analysis focuses on the top 20) located across 243 TTWAs, working within 6 one-digit industries and trading with 180 countries (again, bilateral effects are constrained to the top 20 countries of immigrant origin) over 7 years. We will exploit firm-by-year level variation in our dependent variables and TTWA-sector by year level variation in the immigration regressors. There are 309,930 year-firm combinations and 640,054 year-firm-origin combinations. In addition, there are 11,649 export "bilateral matches" – i.e., instances in which a cell contains an immigrant from, and some firm's export services to, a particular country.

In our empirical analysis we will also distinguish between broad categories of services in order to account for the different ways in which service provision interacts with immigrant workers. Specifically, we categorize service output as belonging to one of three categories: Technical-Financial, Legal and Related, or Language-Human Resources. Table 1 lists how each detailed service type is categorized in one of these three broad categories. The idea is that immigrants may facilitate or, alternatively, substitute for trade 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 or complements – 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 so that immigrants are less relevant in cost-reduction for firms when trading these service types.

Finally, we also collect information on services trade barriers from the OECD.[7] 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 of import and export costs.

4 Stylized Facts on Services Trade and Immigration

To illustrate some important features of service production and trade, that will inform the development of our model, we augment the stylized facts presented in the introduction with some additional ones. In our sample

[6] Aydemir and Borjas (2011) show that measurement error can be a significant concern leading to attenuation bias when measuring the share of immigrants in employment with cells of small size.

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

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. Figures 7 and 8 document the primary destinations and source countries for service imports and exports and here we see the dominant role of the U.S. and, not surprisingly, a strong role for the large E.U. countries. This pattern is not unlike the one for goods.[8]

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 good trading firms, as evidenced by the literature. Hence firm heterogeneity, the presence of an important intensive and extensive margin of trade and the concentration in one foreign market are features that motivate the structure of our model below, partly inspired to good production and trade.

Immigration to the U.K. was significant over the period 1999 to 2005. 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. Importantly, looking over the period 1990 to 2005 twice as many immigrants worked in professional and managerial occupations relative to other 'less skilled' occupations. Immigrants, that is, worked in 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.[9] 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 9 we document the cross-sectional distribution of immigrants across education groups during our period, along with the native distribution. We can see that, as it has already been 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

[8]For additional facts with respect to services trade, see Breinlich and Criscuolo (2010).
[9]These facts come from the U.K. International Passenger Survey. Similar facts are also reported in Hatton (2005).

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. Moreover the most productive firms sell a wider variety of services in a greater number of markets. These facts, along with the empirical correlations depicted in Figures 3 to 6, motivate the model presented here.[10]

Consider a TTWA in which intermediate services are transformed 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.

5.1 Revenue 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 the 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

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

[10] 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.

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

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

and

$$p_{f,x} = \left[(p_{m,x})^{1-\theta} + (p_{o,x})^{1-\theta} \right]^{\frac{1}{1-\theta}} \tag{4}$$

where $\sigma > \delta$ 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

$$\Pi_x = P_x q_x - p_{f,x} f_x - p_{f,x} t_x \frac{q_x}{\varphi} - p \frac{q_x}{\varphi} \tag{5}$$

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

$$P_x(\varphi) = \frac{\delta}{\delta - 1} \frac{p + p_{f,x} t_x}{\varphi}, \tag{6}$$

with associated profit-maximizing export sales

$$R_x(\varphi) = P_x(\varphi) D_x(\varphi) = \left(\frac{\delta}{\delta - 1} \frac{p + p_{f,x} t_x}{\overline{P}_x} \right)^{1-\delta} E_x \varphi^{\delta - 1} \tag{7}$$

and maximized export profit

$$\Pi_x(\varphi) = \frac{R_x(\varphi)}{\delta} - p_{f,x} f_x. \tag{8}$$

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 under (8) yields

$$\varphi_x = \left(\frac{\delta}{\delta - 1} \frac{p + p_{f,x} t_x}{\overline{P}_x} \right) \left(\frac{p_{f,x} f_x \delta}{E_x} \right)^{\frac{1}{\delta - 1}}. \tag{9}$$

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.[11]

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

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

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 (9), 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 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 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 $\varphi > \varphi_x$ ($\varphi > \varphi_y$). Given (7), differentiation 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 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 the 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 $s^f_{o,x} = 1 - s^f_{m,x} = \left(p_{f,x}/p_{o,x}\right)^{\theta-1}$. 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 raises the total value of exports of firm i in that local labor market. Specifically, we estimate the following regression:

$$ln(y_{ikt}) = \phi_i + \theta_t + \xi_{st} + \xi_{at} + \beta_1 ImmSh_{kt} + \beta_2 ImmDiv_{kt} + \beta_x \ln X_{ijkt} + \epsilon_{ijkt} \tag{10}$$

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 market, as described in the model) are TTWA-Sector cells in each year. In (10) the outcome y_{ikt} is the value of exports of firm i belonging to TTWA-sector cell k in year t. The variable $ImmShr_{kt}$ is the share of immigrants in the TTWA-sector cell k; $ImmDiv_{kt}$ is a measure of country of birth immigrant diversity in cell k, constructed as (one minus) a Herfindahl Index across origin countries;[12] X_{ijkt} is a set of firm-level control variables; ϕ_i and θ_t are firm and year fixed effects, respectively; ξ_{st} are sector-by-year fixed effects capturing sector-specific changes in UK exports and ξ_{at} is a TTWA-by-year effect capturing the differential aggregate economic success of UK labor markets over time. The term ϵ_{ijkt} then captures zero-mean idiosyncratic errors. We cluster standard errors at the TTWA-sector 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 on exports of the share of immigrants and their diversity, respectively. 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, 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. To check that productivity is indeed increasing with immigration, and hence a plausible channel for this export-promotion effect, we run also specification (10) considering the labor productivity of firm i as the dependent variable (rather than the export value as before), y_{ikt}.

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 sector-TTWA k in period t due to a decrease in immigration

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

costs raises (reduces) the volume of final exports to (intermediate imports from) country n by local firm i in that sector-TTWA. Hence we run the following regression:

$$ln(y^n_{ikt}) = \phi_i + \theta_t + \xi_{st} + \xi_{at} + \gamma_{nt} + \beta_1 ImmSh_{kt} + \beta_2 ImmDiv_{kt} + \beta_3 ImmSh^n_{kt} + \tau_{jn} + \beta_x \ln X_{ijkt} + \epsilon_{ijkt} \quad (11)$$

In this case the units of observation for the dependent variable are firm-by-export destination cells. In (10) 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-sector 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 area-sector cell k. X_{ijkt} is a set of firm-level control variables; ϕ_i and θ_t are firm and year fixed effects, respectively; ξ_{st} are sector-by-year fixed effects and ξ_{at} is a TTWA-by-year effect. In this specification we also include γ_{nt}, a destination-country specific annual trend, to capture import trends from destination countries. Export barriers to services trade, denoted by τ_{jn}, are also included in the regression, and we use the OECD services trade barriers described above as indicator of service trade barriers. 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 (10) above, the coefficient β_3 captures alternatively the effects stated in Propositions 2 and 3. When the dependent variable is the value of export, we expect a positive estimate of β_3 as 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 intermediates. 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 identification, we note that while the simple model described in section 5 above is a useful way to organize the analysis, the three effects that we are testing are very general and intuitive and 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 substitutable 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 – in particular sector-year, TTWA-year and firm effects – aimed at capturing unobservable local shocks and firm heterogeneity, the presence of unobservable shocks still threatens proper identification. If the inflow of immigrants in a TTWA-sector in a year is driven by a demand shock (in that labor market) and such a shock is correlated with the outcome y^n_{ikt} then the estimated coefficients β_1, β_2 and β_3 are not consistent estimates of the effect of reducing immigration costs (and hence changing immigrants supply) 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) and then used in several papers exploiting the area-variation of immigrants in the U.S. (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 and we interact this with their initial differential presence in local labor markets in the U.K. Variation in the initial presence of immigrants from different countries in a TTWA-sector cell makes firms in that cell more or less subject to shifts in origin-specific push factors. Using these two facts we impute the population of immigrant groups across these cells over time.

More precisely, we first consider immigrant workers from country of origin n, working in each local labor market (TTWA-sector) k in 1997 as a share of the total employment of TTWA-sector k and denote this as $ImmSh^n_{k1997}$. We then augment this share by the aggregate growth rate between year 1997 and year $t = 1999, ..., 2005$, of the specific immigrant group n , $(1 + g^t_n)$ relative to total U.K. population growth $(1 + g^t_{UK})$. Hence we multiply $ImmSh^n_{k1997}$ 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 1997 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. Then summing $\widehat{ImmSh}^n_{kt}$ across countries of origin n, we obtain the imputed share of all foreign-born in employment in that cell that 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. 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-sector cell. On the other hand, because we rely on history-determined initial immigrant group this imputed variable is likely to vary with changing immigration costs, rather than with local demand shocks in

the 1999-2005 period. Certainly, however, unobservable persistent demand shocks, correlated with the presence of a specific group of immigrants in 1997, may threaten this identification strategy. However the large set of fixed effects attenuate this problem by capturing all location-specific and sector-specific shocks. We also check that the constructed instrument is not correlated with some of the outcomes in the pre-1999 period. To do so we regress the growth in imputed immigrant share over 1999-2005, which constitutes our instrument, on the growth of native employment and wages across TTWA cells in the period preceding our analysis 1992-1999. We find no significant correlation between these variables.

7 Empirical Results

In this section we present the results from estimating specifications (10) and (11) 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 of the firm and on variables that should be correlated with productivity at the firm level (capital and employment). We then analyze how, controlling for aggregate immigration, bilateral immigration affects bilateral offshoring and exports.

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. 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 labor markets (represented by TTWA-sector 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 three specifications of the estimating equation (10) that include different combinations of fixed effects. Throughout, we always include firm fixed effects and always cluster standard errors at the sector-TTWA level, which is the level of variation of the explanatory variables in each of the specifications based on (10). Column (1)-(3) show OLS estimates, while columns (4)-(6) show the 2SLS. The most demanding specifications are (3) and (6) which include sector-year and TTWA-year effects to capture local and sector-specific variation over time.

The results, presented in Table 2, indicate that immigration inflows were associated with an increase in gross value added per worker (our simple measure of productivity) within the firm, where a one percentage point increase in the share of immigrants in a local labor market produced a one to two percent increase in firm labor productivity. This result is significant and robust across specifications. In contrast, while the OLS results suggest an association between immigrant diversity and firm productivity, the 2SLS estimates are not significant.[13] The measure of immigrant diversity used is also instrumented when we use 2SLS estimation, by constructing an analogous Herfindahl Index IV, in which the immigrant shares used in its construction are the *imputed* bilateral immigrant shares.[14] Table 3 then shows the estimates of similar specifications as in equation (10) with the logarithm of firm investments in plant, machinery and equipment capital as the dependent variable. The estimates are positive and significant, though economically small, suggesting that the labor productivity gains only in small part accrue via an increase in the capital stock. Improvements in human capital and in productivity account for the remaining positive correlation detected in Table 2. Finally, Table 4 performs a relatively standard regression, usually estimated when analyzing the "crowding out" effects of immigrants in the labor market (e.g. Peri and Sparber 2011). The dependent variable is the (logarithm of) native employment and the explanatory variable is, as before, the immigrant share in employment. This regression detects a small, positive and significant effect, suggesting that the labor productivity gains may also manifest in part through increased employment within the firm and that this is consistent with no displacement effect on (hence weak complementarity rather than substitution with) native workers at the firm level.

7.2 Immigrants and Offshoring of Intermediate Services

Table 5 presents the results of specification (11) in which the dependent variable is firm imports of services from a specific country n. The explanatory variables include both the aggregate share of immigrants in the TTWA-sector and the country-specific immigrants in the same market. Moreover, we still include the index of immigrant diversity as it may potentially affect imports through increasing aggregate productivity of the firm. The structure and specifications of the table mirror those of Table 4 with the inclusion of the bilateral immigrant share as an explanatory variable. In addition, we also report the coefficients on the variable reflecting service barriers as it is a direct determinant of the cost of trading.

Several interesting results emerge from Table 5. First, all estimates, using 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.

[13] We also note that the power in the first stage is significant, as evidenced by the reported partial F-statistics.

[14] 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.

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 is positive and significant. This implies that an increase in the share of immigrants is associated with a large increase in imports of intermediate services, and this is consistent with the existence of a positive productivity effect of immigrants on the firm.

Beyond these effects there is also a positive effect of immigrant (country-of-origin) diversity on firm imports, also indicative of a positive productivity effect of that index. In terms of economic significance, the results suggest an important role for each channel. Over a period in which the overall share of immigrants in employment within a sector-TTWA cell increased by an average of 0.3 percentage points per year, the 2SLS estimates indicate that these inflows raised the volume of services imports by an average of around 6 percent per year, clearly a large effect. The bilateral and diversity effects were also important. Bilateral offshoring with the same country of origin of immigrants declined by about one percent per year for every three percentage point increase in the share of immigrants. The direct effect of immigrants in reducing offshoring to their specific country of origin is more than balanced by the effect of aggregate immigration in raising the amount of offshoring. Finally offshoring increased by about 0.3 percent per year due to increased immigrant diversity. We performed a further robustness check on the impact of immigrants on offshoring, not reported in the table. Namely 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 very similar to those reported in Table 5.

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 model suggests that this displacement effect should be stronger, the greater is the cultural content of a service, which can be proxied by the degree of country-specific content of the service in terms of knowledge of institutions, language, or cultural details. 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, while the Legal and Language service types involve a higher cultural (country-specific) content relative to the Technical. Table 6 presents the estimates with respect to the same specification as columns (4)-(6) of Table 5, except that the dependent variable includes only the imports of services within one of the groups defined above. Columns (1)-(3) present the estimates when the log import of Technical and Financial services (TF) is the dependent variable, columns (4)-(6) show results for Legal and Related services as the dependent variable and columns (7)-(9) focus on the effects on imports of Language and Human Resources 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 unimportant for TF Services. This is consistent with immigrants being substitutes for foreign service provision when the services are intensive in language,

cultural and institutional content that may be specific to a country. 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 having immigrants from the same country perform the service domestically. In each case, as before, the aggregate immigrant share and the aggregate immigrant diversity variables have a positive and significant coefficient. 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 barrier index on offshoring is negative, implying that service 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 be 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, consistent with the positive correlation between immigrant and native employment shown in Table 4. In turn, this is consistent with a model in which immigrants displace specific offshore production tasks, but help overall productivity as well as native employment, an effect also found in Ottaviano et al (2013).

7.3 Immigrants and Exports of Services

Table 7 presents the results from estimating an equation similar to (11) in which the dependent variable is (the logarithm of) firm exports of services. The usual structure with OLS (Columns 1-3) and 2SLS (columns 4-6) estimates is presented and we focus on the estimated value 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 usual we always report the estimated coefficient for the Immigrant Diversity Index and for the Service Barrier Index as controls. The results confirm the positive effect of the aggregate immigration share, as even for exports we identify a positive impact of this variable. Firms in labor markets with more immigrants have a significant tendency to export more. An increase in immigrants equal to one percentage point of local employment increases exports of firms in that TTWA-sector by about two percent.

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 exports which is three to four times the magnitude of the aggregate effect. We interpret this "specific export promotion" effect as a result of the reduction of 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, the services to that specific country. While a one percentage point rise in the share of immigrant employment increases aggregate firm exports by around two percent, the bilateral effects are much larger indicating a 6 to 10 percent rise in bilateral export volumes for the same increase in the share of immigrants from the export destination country. Little evidence of an effect due to immigrant diversity exists while the service 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. In Table 8 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 0.10 percent via the productivity channel (consistent with our model in which productivity increases expand the set of exporting firms). However, there is no strong evidence of an effect of the bilateral share on the extensive margin of trade. This suggests that rather than opening new markets to exports of services, immigrants from a country may mainly help expand the existing market. Interestingly, most of the estimated coefficients are rather 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 1999-2005 that we examine here.[15]

Table 9 explores the role of the "cultural content" of services in relation to the immigrant export-complementarity. 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 6, Table 9 presents the effect of aggregate and bilateral immigration on the exports of the three type of services. Confirming our hypothesis, the strongest effect of both aggregate and bilateral migrants is for exports of LR services followed by LHR services. The effect on bilateral exports of FT services is only significant at the 10 percent confidence level. The bilateral effects are strongest for LR services, suggesting an important role for institutional knowledge transfer between immigrants and firms. When expanding service exports to a foreign market, employees 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, focussing on FT services, whose exports are those most positively affected by immi-

[15] We have also analyzed the effect of aggregate and bilateral immigrants on the extensive margin of bilateral offshoring, and even in that case we did not find significant effects of the bilateral share on bilateral offshoring. This implies that the substitution effect between immigrants and imports of intermediates reduced but does not eliminate firm imports from that country. The results of these regressions are available upon request.

grants (see Row 2 of Table 9), Table 10 explores what type of markets 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 insight through immigrant employees.

In Table 10 we decompose the effects of immigrants on the exports of LR services, dividing exports into trade with Anglo-Saxon versus Non-Anglo-Saxon countries. Here we define Anglo-Saxon countries as the five core English-speaking countries: Australia, Canada, New Zealand, the United Kingdom and the United States. In robustness checks we expand the set to also include South Africa, Ireland and India, but the results are virtually unchanged. The regression results 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 two to 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 able to help their company deliver better and more customized services. Even the overall effect on exports is larger when considering immigrants from non-Anglo Saxon countries, as they may bring new perspectives to the firm that complement the local employees 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 uses a novel micro-data set 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 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 the productivity of the firm, allowing it to produce and export more overall. Second, by bringing country-specific skills with them, they may substitute for the import of intermediate services that were previously offshored by the firm. 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 that operates 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. 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 highly skilled 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

$$\frac{d \ln p_{f,x}}{d \ln \mu_x} = \left(\frac{p_{f,x}}{p_{m,x}}\right)^{\theta-1} \varepsilon_{p_{m,x},\mu_x} > 0, \tag{12}$$

and

$$\frac{d \ln p}{d \ln \mu_x} = \left(\frac{p}{p_{f,x}}\right)^{\sigma-1} \left(\frac{p_{f,x}}{p_{m,x}}\right)^{\theta-1} \varepsilon_{p_{m,x},\mu_x} > 0. \tag{13}$$

Consider now two countries x and y. Given (9), (13) 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 export sales (7), (13) 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 (13) 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, one obtains

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

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 (13), (12) 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 (13), (12) 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 that we will use in Table 9**.**

Table 2
Immigrants and the Productivity of UK Firms

Dependent Variable: Log of Gross Value Added per Worker	(1)	(2)	(3)	(4)	(5)	(6)
		OLS			**2SLS**	
Immigrant Share Aggregate	1.4** (0.6)	1.2** (0.5)	1.1* (0.5)	1.1** (0.4)	0.7** (0.3)	1.1* (0.6)
Immigrant Diversity Index	1.3** (0.6)	1.4* (0.8)	1.7** (0.8)	1.1 (0.7)	1.1 (1.0)	1.2 (0.9)
Firm and Year FE	Yes	Yes	Yes	Yes	Yes	Yes
TTWA-Year FE	No	Yes	No	No	Yes	No
Sec-Year and TTWA-Year FE	No	No	Yes	No	No	Yes
Number of Observations	6930	6930	6930	6930	6930	6930
F-Statistic of first stage	33	21	12	33	21	12

Note: The dependent variable is the logarithm of gross value added per worker in the firm. Each regression contains firm fixed effects and the following controls: log capital investment, the log wage bill, and the log of computer software investments. Number of observations is based on the right hand side number of cells. Specifications (1), (2) and (3) 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 sector-TTWA (Travel to Work) cells constructed as described in the text. The period considered is 1999-2005. Standard errors are clustered at the sector-TTWA level. ***,**,* denote significance at the 1%, 5%, 10% confidence level.

Table 3
Immigrants and Capital investments of UK firms

Dependent Variable: Log of Capital Investments	(1)	(2)	(3)	(4)	(5)	(6)
		OLS			**2SLS**	
Immigrant Share Aggregate	0.2** (0.0)	0.1** (0.0)	0.2** (0.0)	0.1** (0.0)	0.1** (0.0)	0.1* (0.0)
Immigrant Diversity Index	-1.1 (1.4)	-1.0 (1.1)	-1.2 (0.9)	-1.3 (1.1)	-1.2 (1.3)	-1.1* (0.5)
Firm and Year FE	Yes	Yes	Yes	Yes	Yes	Yes
TTWA-Year FE	No	Yes	No	No	Yes	No
Sec-Year and TTWA-Year FE	No	No	Yes	No	No	Yes
Number of Observations	6930	6930	6930	6930	6930	6930
F-Statistic of first stage	59	43	12	59	43	12

Note: The dependent variable is the logarithm of capital investment (excluding buildings and land) by the firm. Each regression contains firm fixed effects and the following controls: the log wage bill and the log of computer software investments. Number of observations is based on the right hand side number of cells. Specifications (1), (2) and (3) 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 sector-TTWA cells, constructed as described in the text. The period considered is 1999-2005. Standard errors are clustered at the sector-TTWA level. ***,**,* denote significance at the 1%, 5%, 10% confidence level.

Table 4
Immigrants and Native Employment in UK Local Labor Markets

Dependent Variable: Log of Native Employment	(1)	(2)	(3)	(4)	(5)	(6)
		OLS			**2SLS**	
Immigrant Share Aggregate	0.3* (0.1)	0.4* (0.2)	0.3* (0.1)	0.2 (0.2)	0.4* (0.2)	0.1 (0.1)
Immigrant Diversity Index	3.9** (1.9)	1.7* (0.9)	3.3** (1.8)	3.9* (2.2)	1.8 (1.1)	2.6 (2.1)
TTWA-Sec FE	Yes	No	No	Yes	No	No
Sec-Year and TTWA-Year FE	No	Yes	No	No	Yes	No
TTWA-Sec, Year FE	No	No	Yes	No	No	Yes
Number of Observations	6930	6930	6930	6930	6930	6930
F-Stat of First Stage	38	31	12	38	31	12

Note: The dependent variable is the logarithm of native employment. The units of observation are TTWA-Sectors, for the period 1999-2005. Specifications (1), (2) and (3) differ from each other because of the inclusion of different sets of fixed effects included as described in the Table. Number of observations is based on the right hand side number of cells. The 2SLS regressions use as instrument the imputed number of foreign-born in the sector-TTWA cells, constructed as described in the text. The period considered is 1999-2005. Standard errors are clustered at the sector-TTWA level. ***,**,* denote significance at the 1%, 5%, 10% confidence level.

Table 5
Immigrants and Imports of Intermediate services (Offshoring) by UK firms

Dep. Variable: Log of Import Value	(1)	(2)	(3)	(4)	(5)	(6)
		OLS			**2SLS**	
Immigrant Share Aggregate	12.2*** (3.4)	11.3*** (3.8)	9.8*** (2.5)	9.7** (5.9)	7.4** (3.7)	7.3** (3.4)
Immigrant Share Bilateral	-5.1* (3.3)	-4.0** (2.7)	-4.8** (2.6)	-8.2** (4.4)	-4.9* (3.4)	-7.9** (4.4)
Immigrant Diversity	3.0** (1.6)	2.1* (1.3)	2.8** (1.4)	1.0* (0.5)	0.7* (0.4)	1.0* (0.5)
Service Barrier Index	-0.5*** (0.2)	-0.6** (0.3)	-0.6*** (0.2)	-0.5* (0.3)	-0.6* (0.4)	-0.6* (0.4)
Firm and Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Sec-Year and TTWA-Year FE	No	Yes	No	No	Yes	No
Sec-, TTWA-, Dest-Year FE	No	No	Yes	No	No	Yes
Number of Observations	138,600	138,600	138,600	138,600	138,600	138,600
TTWA-Sec F-Stat (Agg, Bilat)	59, 40	43, 38	12, 23	59, 40	43, 38	12, 23

Note: The dependent variable is the logarithm of the value of the imports of intermediate services by the firm from the country. The unit of analysis is the firm-import country couple. Each regression contains firm fixed effects and the following controls: log capital investment, the log wage bill, and the log of computer software investments. Number of observations is number of TTWA-Sector-Year-Destination cells. Specifications (1), (2) and (3) differ from each other because of the inclusion of different sets of fixed effects included as described in the Table above. The 2SLS regressions use as instrument the imputed number of foreign-born in the sector-TTWA cells, constructed as described in the text. The period considered is 1999-2005. Standard errors are clustered at the sector-TTWA level. ***,**,* denote significance at the 1%, 5%, 10% confidence level.

Table 6

Immigrants and Imports of intermediate services (Offshoring), by Service Type

Dep. Variable: Log of Import Value	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	2SLS: Financial & Technical Services			**2SLS: Legal & Related Services**			**2SLS: Language & HR Services**		
Immigrant Share Aggregate	0.3***	0.3**	0.3**	7.3***	8.2*	9.5***	11.2***	9.5***	10.8***
	(0.1)	(0.1)	(0.1)	(2.7)	(3.2)	(3.2)	(3.7)	(2.1)	(2.2)
Immigrant Share Bilateral	-1.0	-0.8	-1.9	-10.8*	-6.3**	-14.2**	-10.0**	-6.0*	-6.7**
	(1.0)	(0.6)	(1.2)	(6.5)	(3.2)	(6.5)	(5.1)	(4.0)	(3.3)
Immigrant Diversity	5.6**	5.8**	6.1*	1.0**	1.0*	1.6*	3.3*	1.7**	2.1*
	(2.9)	(3.1)	(3.9)	(0.4)	(0.6)	(0.8)	(1.7)	(0.7)	(1.0)
Service Barrier Index	-0.6**	-0.6**	-0.6**	-1.0*	-1.4*	-1.1*	-2.2***	-1.9***	-1.1**
	(0.3)	(0.3)	(0.3)	(0.6)	(0.8)	(0.5)	(0.1)	(0.3)	(0.4)
Firm and Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sec-Year and TTWA-Year FE	No	Yes	No	No	Yes	No	No	Yes	No
Sec-, TTWA-, Dest-Year FE	No	No	Yes	No	No	Yes	No	No	Yes
Number of Observations	138,600	138,600	138,600	138,600	138,600	138,600	138,600	138,600	138,600
TTWA-Sec F-Stat (Agg, Bilat)	33, 49	21, 40	12, 23	33, 49	21, 40	12, 23	33, 49	21, 40	12, 23

Note: The dependent variable is the logarithm of the value of the imports of traded services by the firm from the country. The unit of analysis is the firm-import country couple. Each regression contains firm fixed effects and the following controls: log capital investment, the log wage bill, and the log of computer software investments. Number of observations is number of TTWA-Sector-Year-Destination cells. Specifications (1), (2) and (3) differ from each other because of the inclusion of different sets of fixed effects included as described in the Table above. The 2SLS regressions use as instrument the imputed number of foreign-born in the sector-TTWA cells, constructed as described in the text. The period considered is 1999-2005. Standard errors are clustered at the sector-TTWA level. ***,**,* denote significance at the 1%, 5%, 10% confidence level.

Table 7
Immigrants and the Export of Services (Total and Bilateral) of UK firms

Dep. Variable: Log of Export Value	(1)	(2)	(3)	(4)	(5)	(6)
		OLS			**2SLS**	
Immigrant Share Aggregate	2.2*** (0.4)	2.1** (0.8)	2.5*** (0.8)	1.7*** (0.2)	2.0** (0.8)	1.5*** (0.2)
Immigrant Share Bilateral	8.1* (5.5)	10.1** (5.2)	10.4** (5.0)	6.2 (8.0)	8.9* (5.9)	9.3* (6.2)
Immigrant Diversity	-0.0 (0.1)	-0.0 (0.1)	0.0 (0.0)	-1.0* (0.5)	-0.7* (0.4)	-1.1* (0.6)
Service Barrier Index	-0.3* (0.2)	-0.6* (0.3)	-0.4* (0.2)	-0.5* (0.3)	-0.3 (0.3)	-0.5* (0.3)
Firm and Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Sec-Year and TTWA-Year FE	No	Yes	No	No	Yes	No
Sec-, TTWA-, Dest-Year FE	No	No	Yes	No	No	Yes
Number of Observations	138,600	138,600	138,600	138,600	138,600	138,600
TTWA-Sec F-Stat (Agg, Bilat)	33, 49	21, 40	12, 23	33, 49	21, 40	12, 23

Note: The dependent variable is the logarithm of the value of exports from the firm to a country. The unit of analysis is the firm-export country couple. Each regression contains firm fixed effects and the following controls: log capital investment, the log wage bill, and the log of computer software investments. Number of observations is number of TTWA-Sector-Year-Destination cells. Specifications (1), (2) and (3) differ from each other because of the inclusion of different sets of fixed effects included as described in the Table above. The 2SLS regressions use as instrument the imputed number of foreign-born in the sector-TTWA cells, constructed as described in the text. The period considered is 1999-2005. Standard errors are clustered at the sector-TTWA level. ***,**,* denote significance at the 1%, 5%, 10% confidence level.

Table 8
Immigrants and the Extensive Margin of Service Exports

Dependent Variable: Export Status Indicator (0,1)	(1)	(2)	(3)	(4)	(5)	(6)
		OLS			**2SLS**	
Immigrant Share Aggregate	0.12*** (0.03)	0.14* (0.07)	0.11** (0.04)	0.10** (0.03)	0.10* (0.05)	0.11* (0.05)
Immigrant Share Bilateral	0.32 (0.41)	0.04 (0.04)	0.22* (0.12)	0.27 (0.47)	0.03 (0.11)	0.11 (0.29)
Immigrant Diversity	0.02 (0.15)	0.14** (0.05)	0.03 (0.03)	0.14 (0.17)	0.12* (0.06)	0.11 (0.10)
Service Barrier Index	-0.22** (0.10)	-0.18* (0.10)	-0.33** (0.15)	-0.21* (0.11)	-0.14 (0.13)	-0.27* (0.14)
Firm and Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Sec-Year and TTWA-Year FE	No	Yes	No	No	Yes	No
Sec-, TTWA-, Dest-Year FE	No	No	Yes	No	No	Yes
Number of Observations	138,600	138,600	138,600	138,600	138,600	138,600
TTWA-Sec F-Stat (Agg, Bilat)	33, 49	21, 40	12, 23	33, 49	21, 40	12, 23

Note: The dependent variable is an indicator (0,1) for the firm exporting to a country. The unit of analysis is the firm-export country couple. Each regression contains firm fixed effects and the following controls: log capital investment, the log wage bill, and the log of computer software investments. Number of observations is number of TTWA-Sector-Year-Destination cells. Specifications (1), (2) and (3) differ from each other because of the inclusion of different sets of fixed effects included as described in the Table above. The 2SLS regressions use as instrument the imputed number of foreign-born in the sector-TTWA cells, constructed as described in the text. The period considered is 1999-2005. Standard errors are clustered at the sector-TTWA level. ***,**,* denote significance at the 1%, 5%, 10% confidence level.

Table 9
Effect of Immigrants on Exports by Type of Service

Dep. Variable: Log of Export Value	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	2SLS: Financial & Technical Services			**2SLS: Legal & Related Services**			**2SLS: Language & HR Services**		
Immigrant Share Aggregate	0.3*** (0.0)	0.2* (0.1)	0.3*** (0.0)	2.9*** (0.4)	2.0* (1.1)	2.0** (0.9)	1.9*** (0.7)	3.0* (2.1)	2.8*** (0.6)
Immigrant Share Bilateral	4.1* (2.9)	2.6 (2.8)	3.1* (1.8)	13.3* (7.6)	8.1*** (2.2)	12.1** (3.9)	4.2** (2.1)	5.0 (4.2)	2.9* (1.4)
Immigrant Diversity	-0.9 (0.7)	-1.0 (0.9)	-0.5 (0.6)	-1.1* (0.7)	1.1 (0.8)	2.0 (1.1)	-2.0 (1.8)	1.0 (0.9)	1.1 (1.0)
Service Barrier Index	-0.4 (0.3)	-0.7** (0.3)	-0.5* (0.3)	-1.5* (0.8)	-1.1** (0.5)	-1.5** (0.7)	-0.8*** (0.3)	-0.5* (0.3)	-0.7** (0.3)
Firm and Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sec-Year and TTWA-Year FE	No	Yes	No	No	Yes	No	No	Yes	No
Sec-, TTWA-, Dest-Year FE	No	No	Yes	No	No	Yes	No	No	Yes
Number of Observations	138,600	138,600	138,600	138,600	138,600	138,600	138,600	138,600	138,600
TTWA-Sec F-Stat (Agg, Bilat)	33, 49	21, 40	12, 23	33, 49	21, 40	12, 23	33, 49	21, 40	12, 23

Note: The dependent variable is the logarithm of the value of exports from the firm to a country. The unit of analysis is the firm-export country couple. Each regression contains firm fixed effects and the following controls: log capital investment, the log wage bill, and the log of computer software investments. Number of observations is number of TTWA-Sector-Year-Destination cells. Specifications (1), (2) and (3) differ from each other because of the inclusion of different sets of fixed effects included as described in the Table above. The 2SLS regressions use as instrument the imputed number of foreign-born in the sector-TTWA cells, constructed as described in the text. The period considered is 1999-2005. Standard errors are clustered at the sector-TTWA level. ***,**,* denote significance at the 1%, 5%, 10% confidence level.

Table 10
Immigrants and Exports of Legal & Related (LR) Services: Effect by Country Type

Dep. Variable: Log of Export Value of Legal Services	(1)	(2)	(3)	(4)	(5)	(6)
	2SLS: Trade and Immigration with Anglo-Saxon Countries			**2SLS: Trade and Immigration with Non-Anglo-Saxon Countries**		
Immigrant Share Aggregate	2.2* (1.4)	0.7* (0.5)	1.1* (0.6)	4.6** (2.4)	2.7** (1.4)	4.4*** (2.0)
Immigrant Share Bilateral	5.2* (3.2)	5.5 (5.7)	3.9* (1.9)	9.8*** (3.1)	8.3*** (2.0)	11.1** (5.8)
Immigrant Diversity	0.2 (0.2)	0.0 (0.1)	0.1 (0.1)	1.2 (0.9)	1.3 (0.9)	2.2 (1.7)
Service Barrier Index	-0.4** (0.2)	-0.5* (0.3)	-0.3* (0.2)	-1.2** (0.6)	-1.0* (0.6)	-1.1** (0.5)
Firm and Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Sec-Year and TTWA-Year FE	No	Yes	No	No	Yes	No
Sec-, TTWA-, Dest-Year FE	No	No	Yes	No	No	Yes
Number of Observations	138,600	138,600	138,600	138,600	138,600	138,600
TTWA-Sec F-Stat (Agg, Bilat)	33, 49	21, 40	12, 23	33, 49	21, 40	12, 23

Note: The dependent variable is the logarithm of the value of exports from the firm to a country. The unit of analysis is the firm-export country couple. Each regression contains firm fixed effects and the following controls: log capital investment, the log wage bill, and the log of computer software investments. Number of observations is number of TTWA-Sector-Year-Destination cells. Specifications (1), (2) and (3) differ from each other because of the inclusion of different sets of fixed effects included as described in the Table above. The 2SLS regressions use as instrument the imputed number of foreign-born in the sector-TTWA cells, constructed as described in the text. The period considered is 1999-2005. Standard errors are clustered at the sector-TTWA level. ***,**,* denote significance at the 1%, 5%, 10% confidence level.

Figure 1

Share of foreign-born workers; top (travel-to-work) Areas

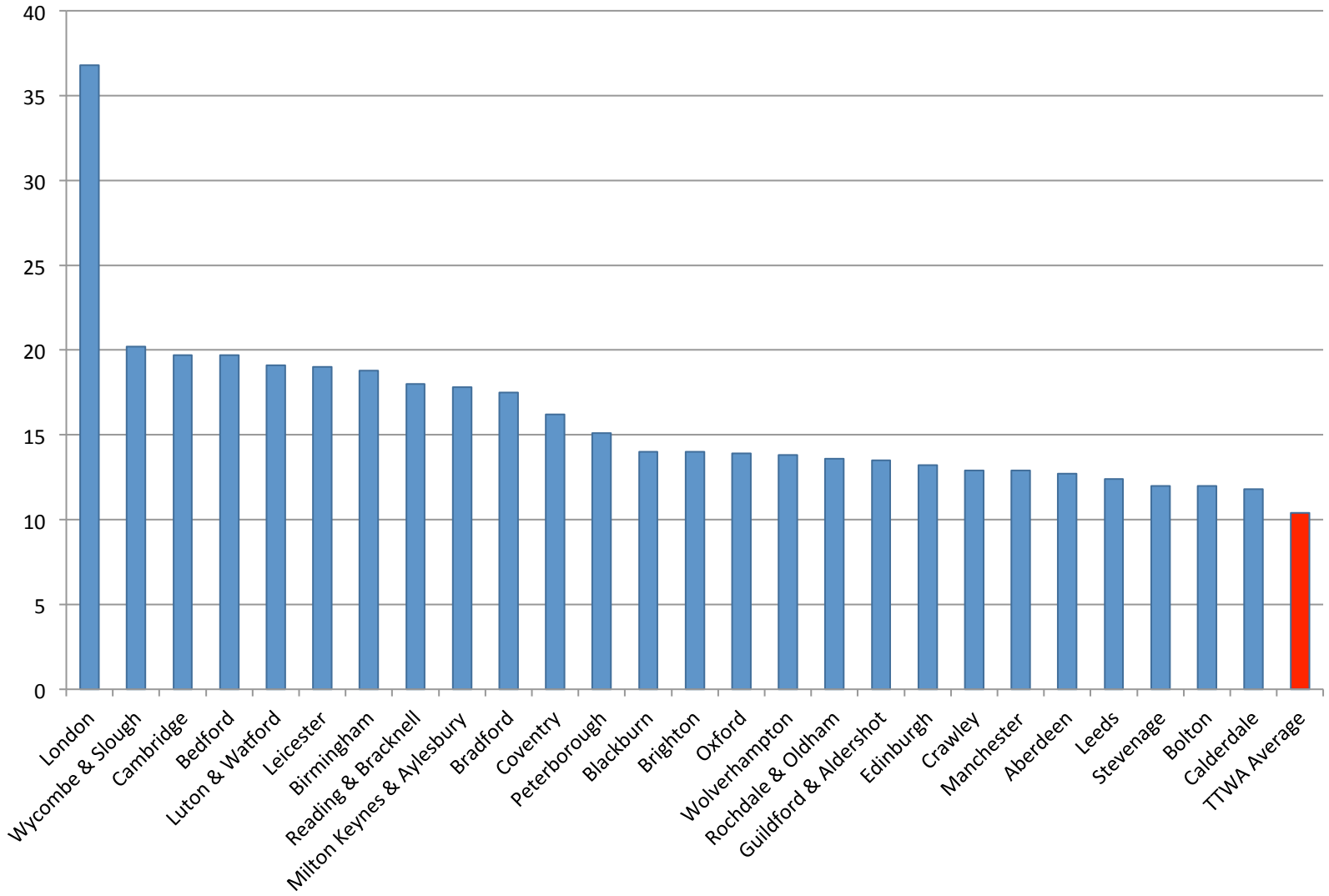


Figure 2
U.K. Services Exports and Imports by Service Type, 1999-2005
Thousands of UK Pounds

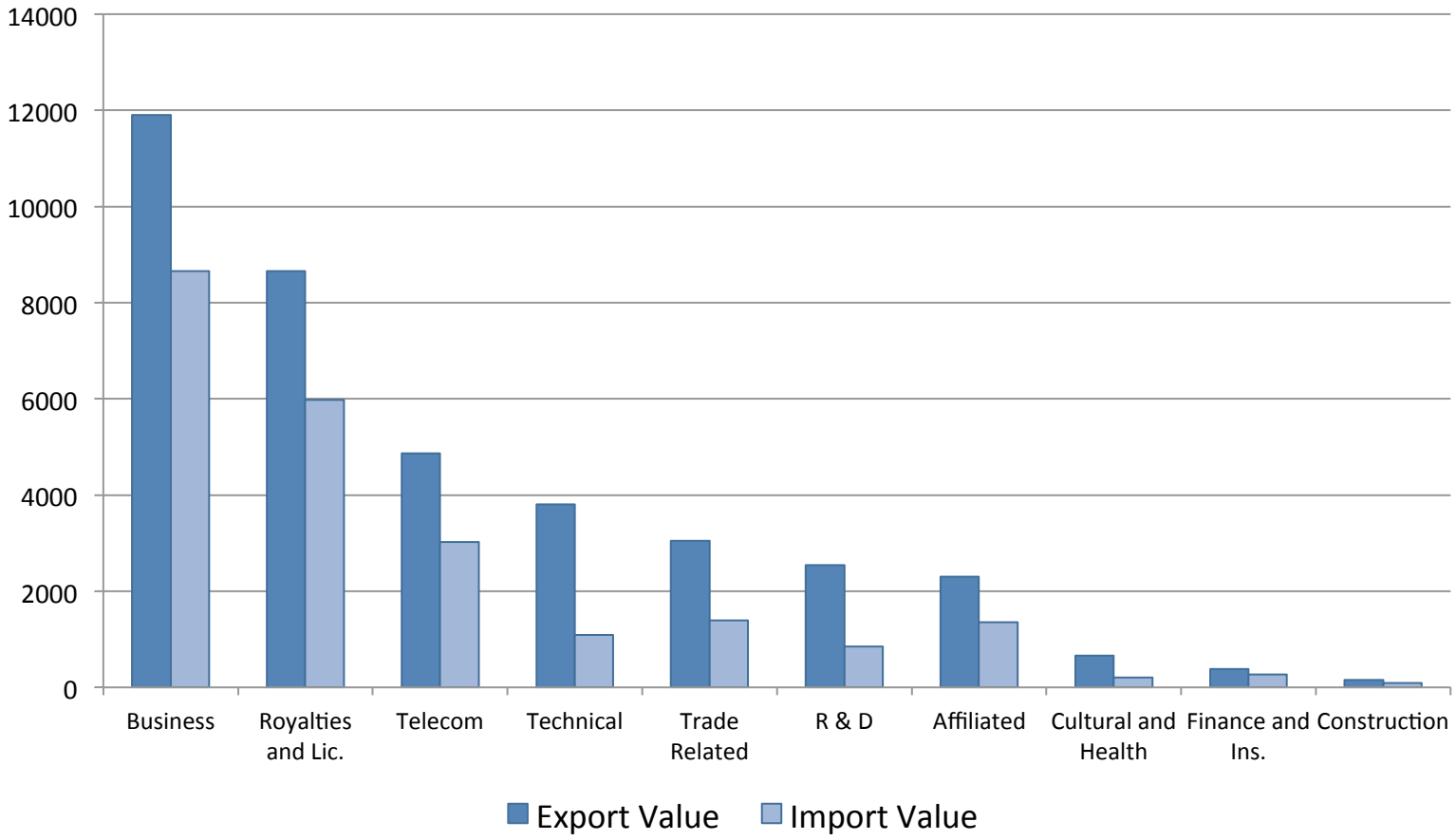


Figure 3
Change in Bilateral Services Imports vs. Change in Immigrant Share
TTWA-Sector Cells, 1999-2005

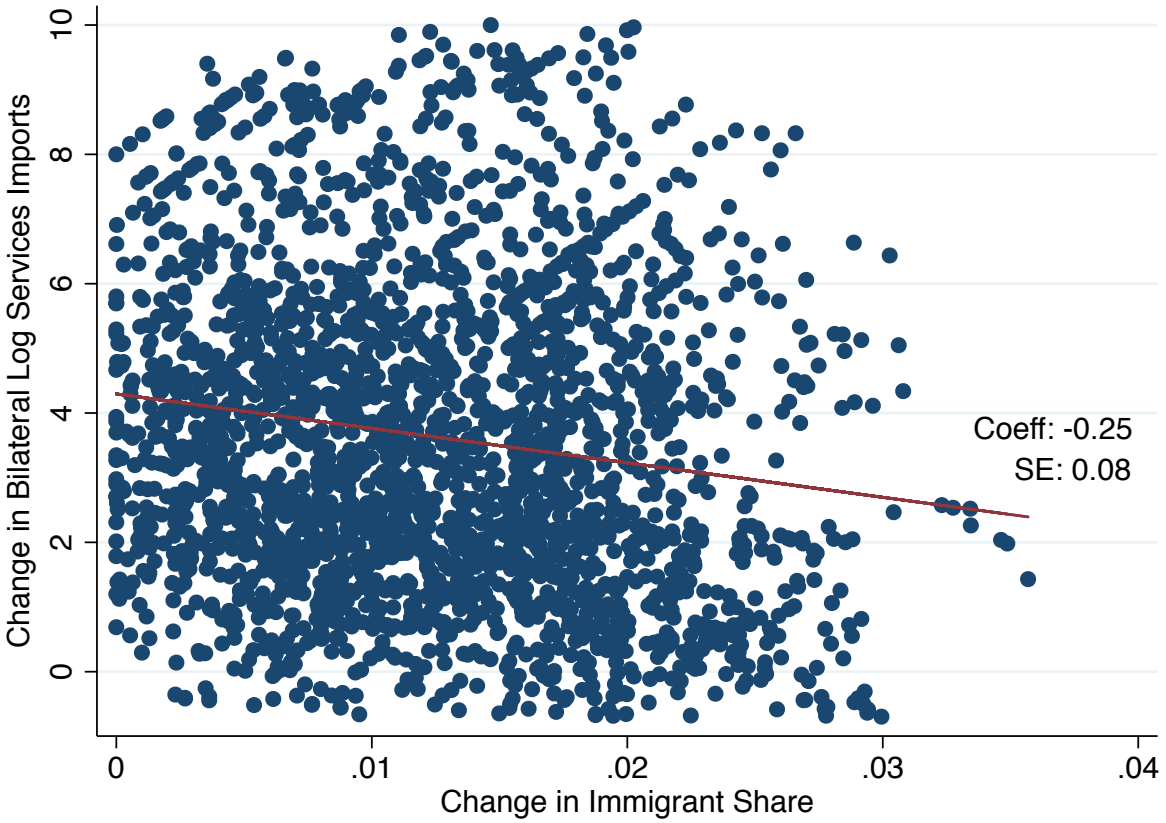


Figure 4
Change in Bilateral Services Exports vs. Change in Immigrant Share
TTWA-Sector Cells, 1999-2005

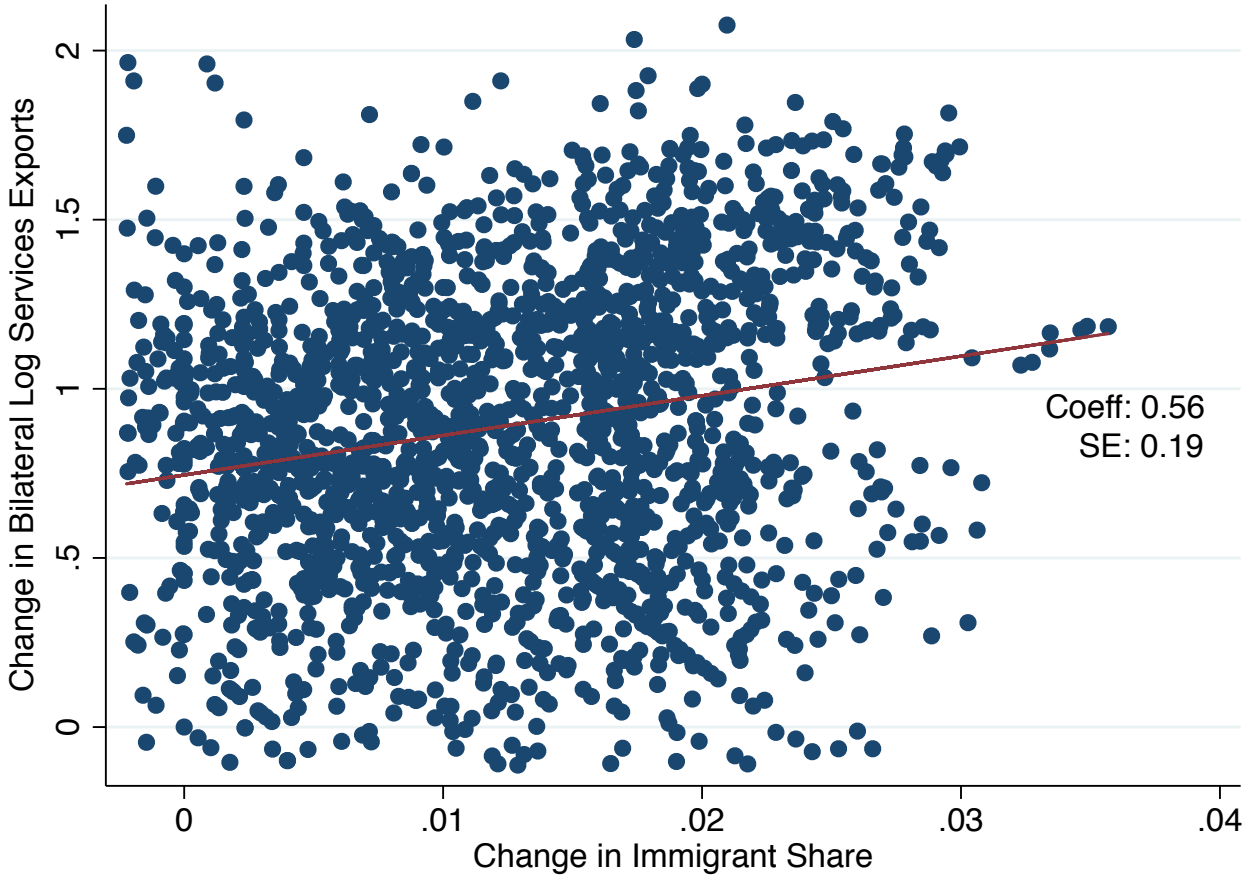


Figure 5
Change in Aggregate Services Imports vs. Change in Immigrant Share
TTWA-Sector Cells, 1999-2005

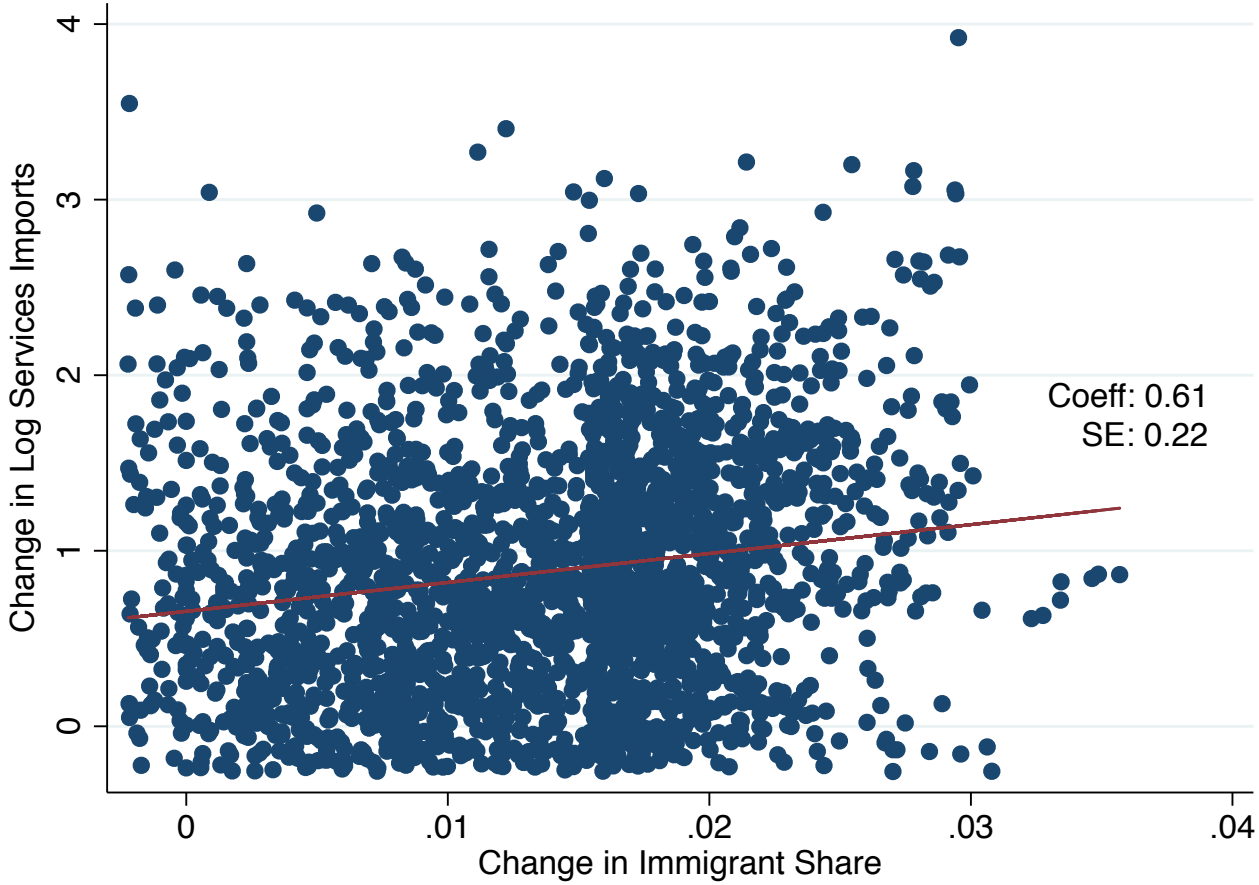


Figure 6
Change in Aggregate Services Exports vs. Change in Immigrant Share
TTWA-Sector Cells, 1999-2005

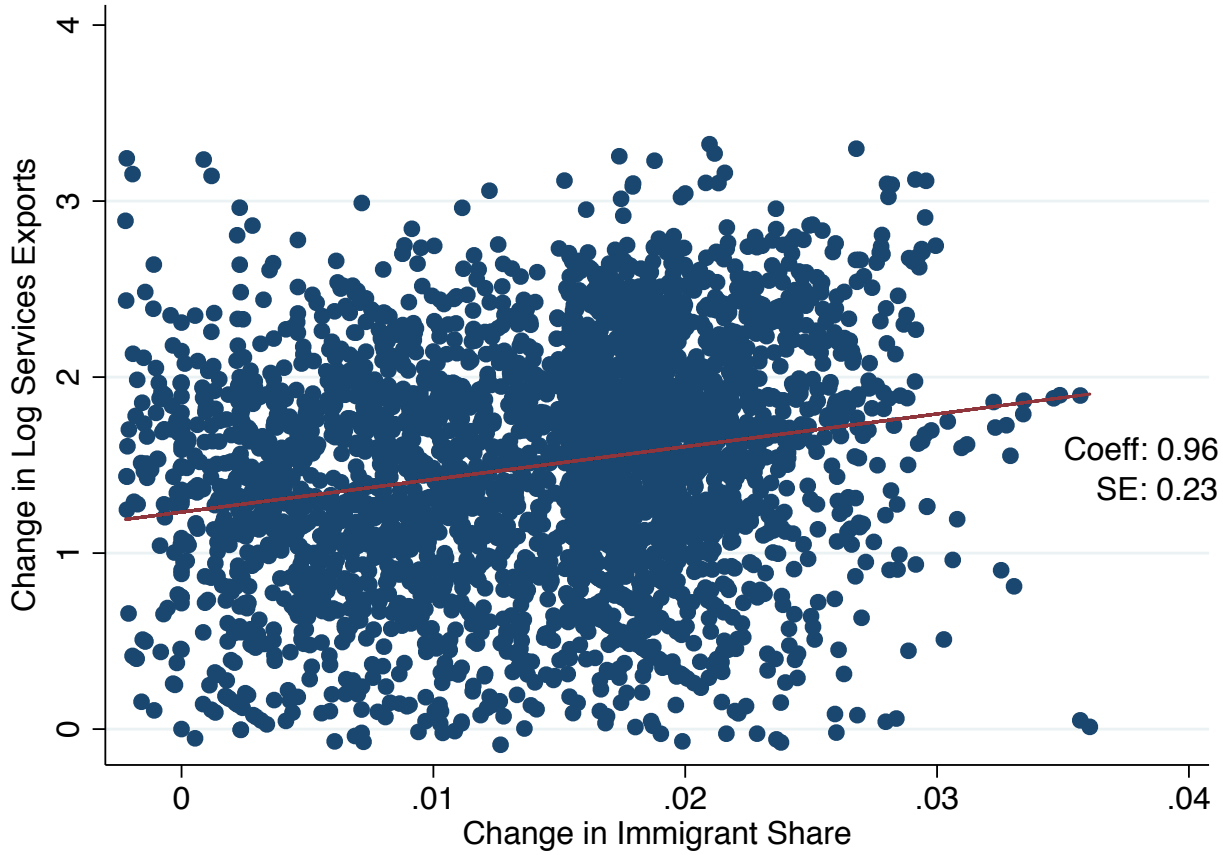


Figure 7

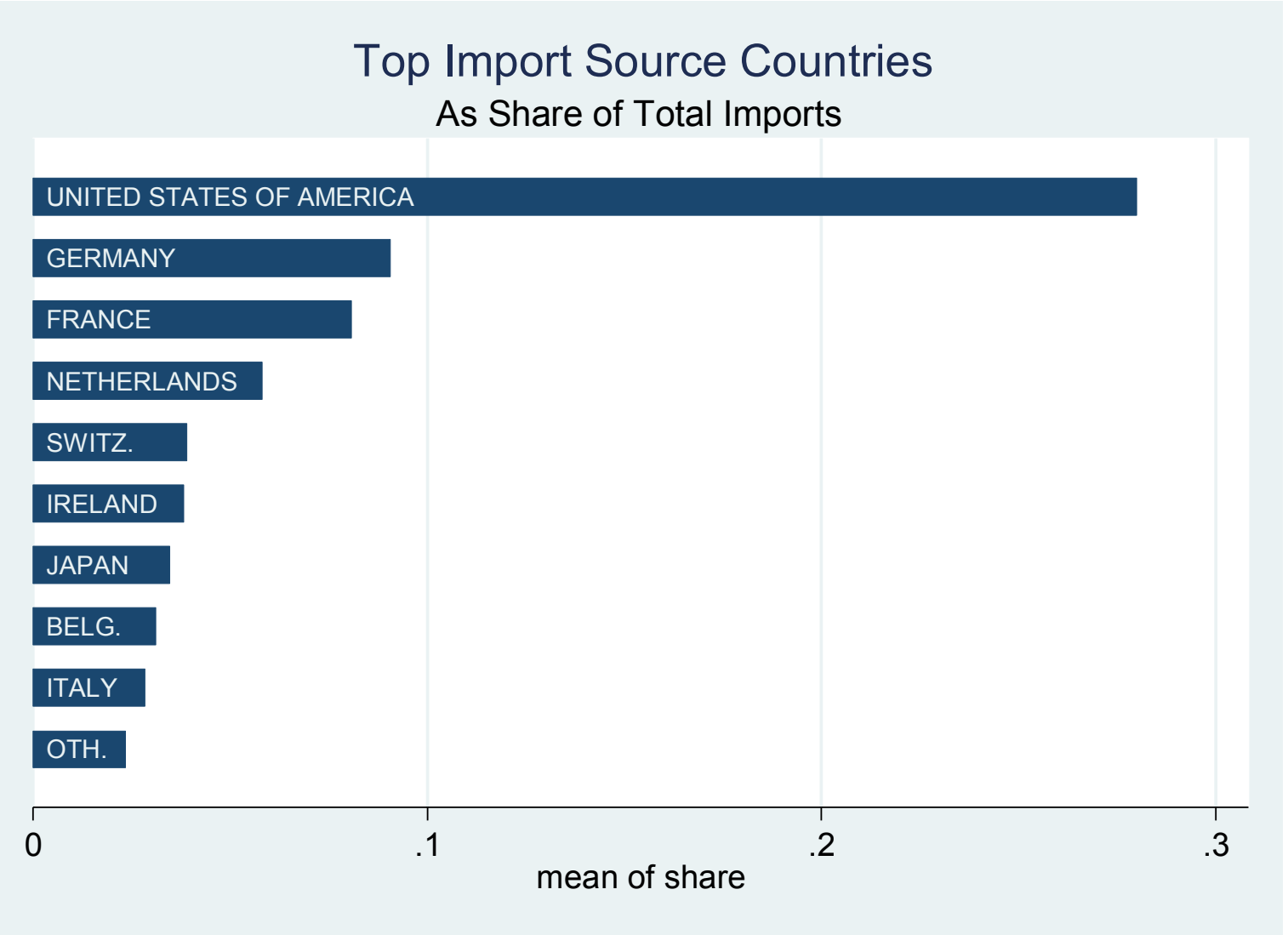

Top Import Source Countries
As Share of Total Imports
UNITED STATES OF AMERICA
GERMANY
FRANCE
NETHERLANDS
SWITZ.
IRELAND
JAPAN
BELG.
ITALY
OTH.
0
.1
.2
.3
mean of share

Figure 8

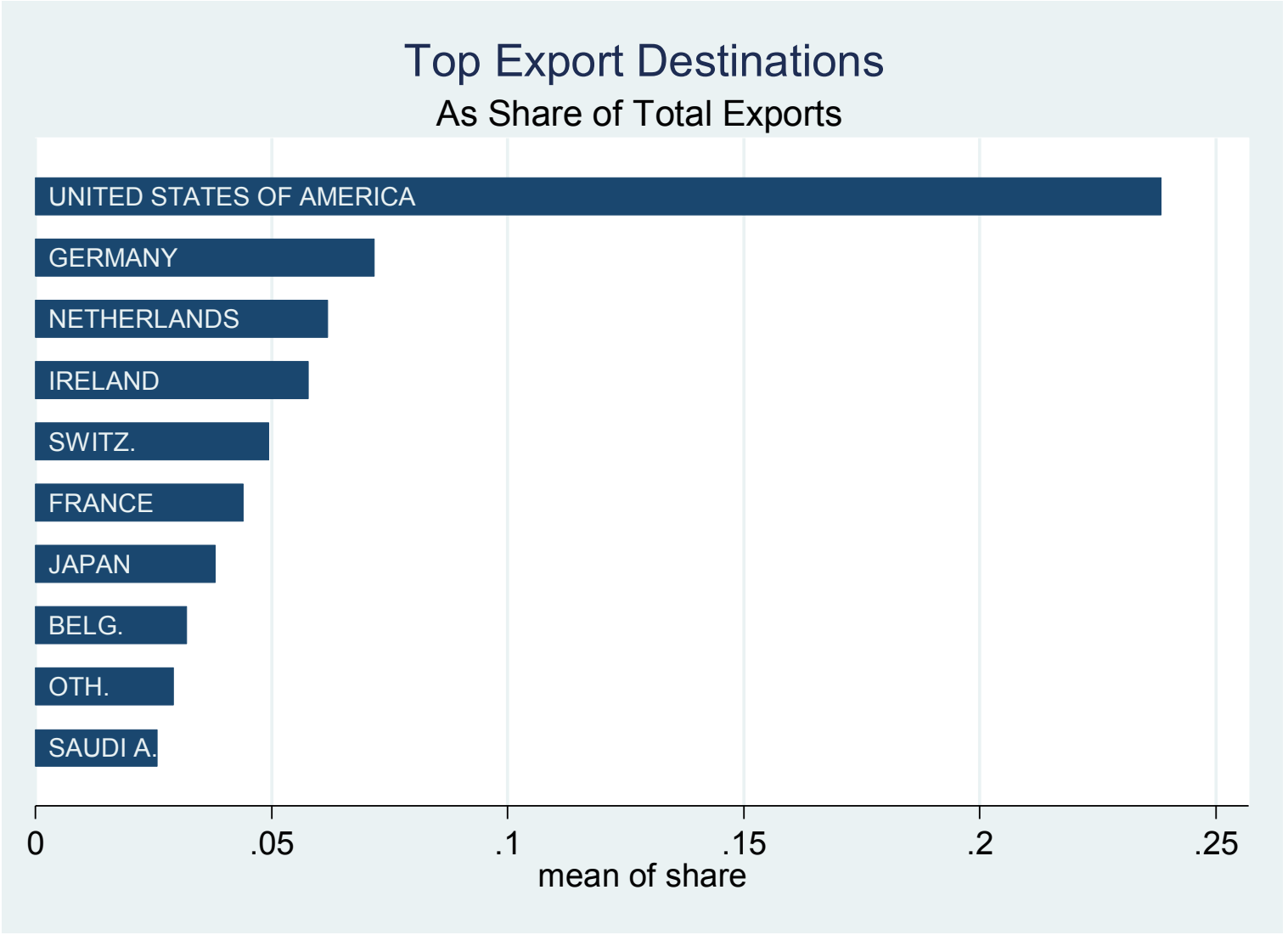
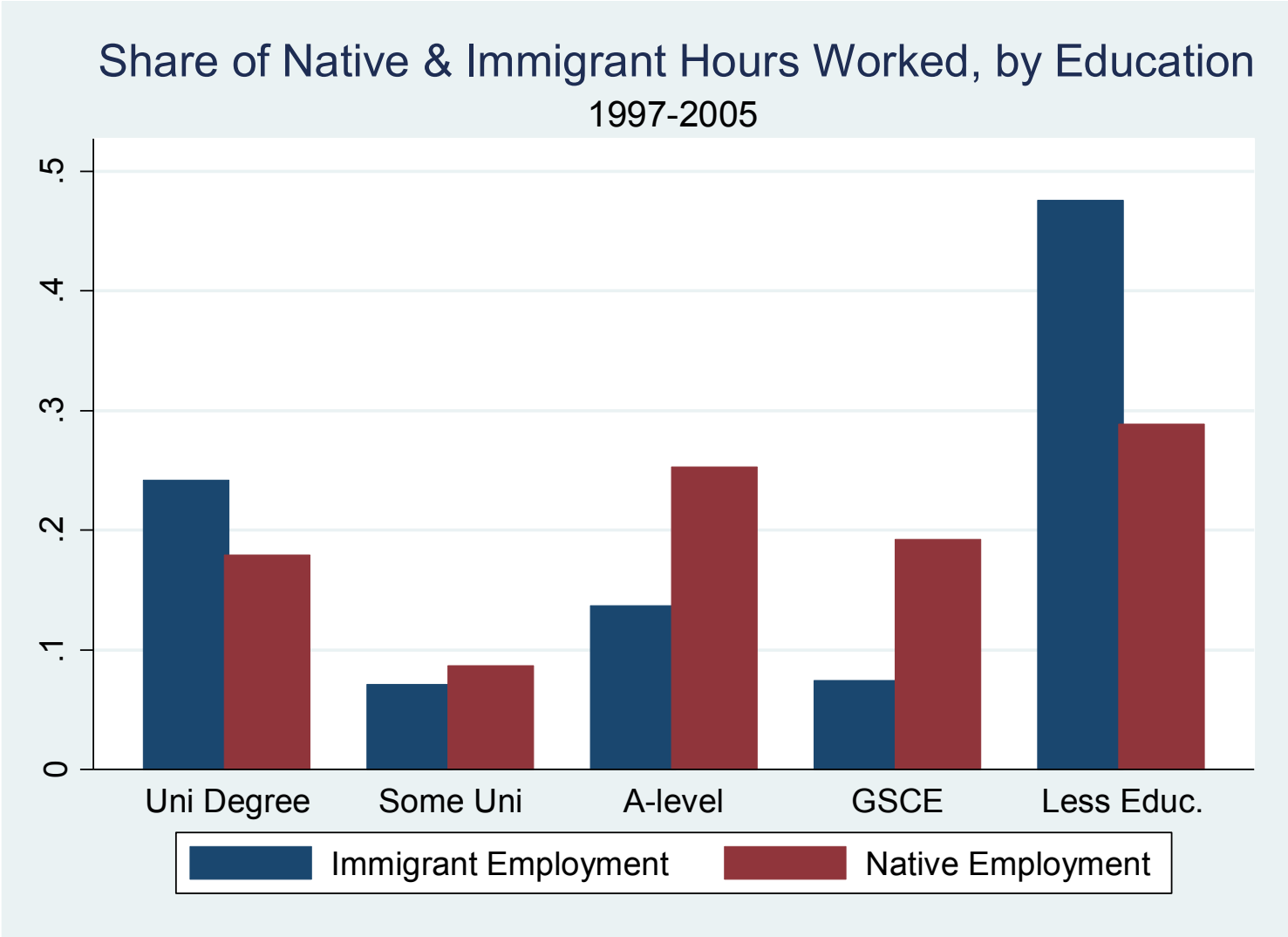

Top Export Destinations
As Share of Total Exports
UNITED STATES OF AMERICA
GERMANY
NETHERLANDS
IRELAND
SWITZ.
FRANCE
JAPAN
BELG.
OTH.
SAUDI A.
0
.05
.1
.15
.2
.25
mean of share

Figure 9


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