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Do Immigrants Spur Offshoring? Firm-Level Evidence

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Do Immigrants Spur Offshoring? Firm-Level Evidence

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Offshoring is an important aspect of firms' internationalization. However, offshoring comes at a cost, especially where information or trust is lacking. Immigrant employees could reduce such offshoring costs through their knowledge of their former home countries and via access to foreign networks. We develop a framework of heterogeneous final-good firms to guide our empirical analysis and draw on new employer-employee data for approximately 12,000 Swedish firms during the time period 1998-2007. Our results support the hypothesis that immigrant employees spur offshoring activities by firms through lower offshoring costs. Hiring one additional foreign-born worker can increase offshoring up to three percent on average, with skilled migrants having the strongest effects.

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1 Introduction

Does immigration affect firms' offshoring? To answer this question, we exploit detailed employer-employee data from Sweden that allow us to place information about the countries from which intermediate inputs are imported alongside workers' country of birth. By directly connecting a migrant employee's birth country with the origin of offshored imports in our question and data, we are able to control for a wide range of confounding factors at the firm and country levels that may alternatively explain the correlation between immigration and offshoring.

To the best of our knowledge, this is the first study to examine the link between immigration and offshoring using micro-level data. While previous studies have analyzed the relationship between migration and international trade at the aggregate level and more recent firm-level studies have examined the relationship between migration and exports, the association of immigration with offshoring at the firm level has been left unstudied, largely due to data constraints.

Our focus on firms and the origin country of migrants together with offshored inputs is motivated by the hypothesis that an immigrant's effect on offshoring costs is country-specific and likely to be the strongest at the employer-employee level. Immigrants gain information, experience and access to networks in particular markets, usually their country of birth, potentially reducing offshoring costs to those same markets. The intensity of the interactions between migrant workers and their managers is governed by geographical proximity through employment. This proximity enhances the volume and quality of the knowledge that immigrants transmit to their managers about those markets (Gould, 1994; Rauch, 2001; Herander and Saavedra, 2005). We test whether the transmission of such information through employment raises the probability that the firm will offshore to the migrant's country of birth or affect the intensity of an existing offshoring relationship.

Questions about the effects of immigration on offshoring inevitably raise concerns about the presence of confounding factors that could provide alternative explanations for the presence of any correlation. The presence of unobservable managerial or owner characteristics is a particular concern in our setting because it can make the firm simultaneously more open to international markets, and therefore likely to offshore some of their required inputs, and more open to the employment of immigrant workers. A more extreme version of this issue could arise

should the same type of characteristics make it more likely that offshoring and immigrant employment occurs in the same country. In this paper, we make the assumption that these unobservable managerial or owner characteristics exist at the firm-country level but are time-invariant, which allows us to identify the effects of immigration by exploiting the panel dimension of the data. That is, we are able to ask whether the employment of *more* immigrant workers from a particular country makes it *more* likely that the firm will offshore, or offshore more heavily, to that same country, controlling for all the time-invariant characteristics of the firm that could affect its decision to offshore to that country. While this makes the list of potential confounding factors that might explain our main findings much shorter, we additionally control for a range of other time varying firm and country characteristics; we cannot completely rule out the possibility of their remaining presence. We therefore also present results using an instrumental variable approach (IV), using lags of immigrant employment in other firms and in other firms in the same industry as instruments.

The richness of the data allows us to further probe the relationship between firms and migrant employment. If firms' offshoring is affected by the employment of foreign-born employees, it is important to know whether this relationship rests upon the characteristics of immigrant workers, firms or products, and whether the relationship is ubiquitous in character. Typically, the broader literature on immigration and international trade has assumed that immigrants are a homogenous group. We are able to investigate this assumption with our data by adding information about the skill level of migrants. This issue is important in the current policy context with regard to the present refugee crisis. It also contributes to the general debates over the costs and benefits of immigration, such as the one that occurred during the recent UK-EU referendum. A large share of the recent refugees coming to Europe lack post-secondary education; in the case of Sweden, approximately 40 percent of the Syrian-born immigrants have primary education at most, and only approximately 28 percent have secondary education (Statistics Sweden, 2014). These recent events raise the following open questions. Does this type of influx alter the economic impact of immigration? If so, how?

We also test whether the results depend upon the characteristics of the inputs themselves. For example, we ask whether the effects are stronger or weaker if the input is contract or R&D intensive. We also explore whether the effects differ according to firm size, whether large firms are better at using the information available throughout

their workforce, and whether migrant employees are closer to the upper levels of management in small firms and therefore have a greater influence in such businesses.

Briefly highlighting the main results from our analysis, we find in the baseline estimates that employment of immigrants increases the value of offshored inputs purchased by Swedish firms. Hiring one additional foreign-born worker from country *x* can increase offshoring to that country by up to three percent on average. However, these effects are largely confined to high-skilled migrants, a result that continues to hold even for skilled migrants from lower-income countries. We find that employing an additional skilled migrant from a high-income country increases the value of related offshored contracts and R&D intensive products for large firms to that same high-income country by up to 24 percent. This pattern of results supports the proposition that firms can utilize the knowledge and contacts of foreign-born employees to reduce offshoring transaction costs and subsequently spur such offshoring. There is no evidence that migrant employees affect the decision of whether to offshore (the extensive margin) and therefore also affect the sunk costs of offshoring. Unlike the employment of skilled migrants, we find little consistent evidence of a positive effect of low-skilled workers on the value of offshoring; we even find occasional negative effects. For low-skilled migrants, any remaining positive effects are confined to those from high-income countries and those employed by small- and medium-sized firms.

This paper is organized as follows. Section 2 describes previous research. Section 3 presents the conceptual framework. Section 4 explains the empirical approach and estimation strategies. Section 5 describes the data, and section 6 provides the results. Section 7 concludes.

2 Related Research

This study is related to two strands of literature. First, it adds to the literature on trade costs and offshoring, which emphasizes that firms may split production across countries to achieve benefits from, *inter alia*, differences in labor costs (Grossman and Rossi-Hansberg, 2008; 2012).[5] Firms' procurement of intermediate inputs sourced from

[5] Intermediate goods and services account for 56 percent and 73 percent of total trade, respectively, in the OECD countries. Annual growth has been approximately six percent in recent years (Miroudot et al., 2009).

foreign producers is often characterized as a trade-off between the benefit of lower purchase prices compared to domestically produced equivalents *versus* higher costs associated with transportation and coordination.

Offshoring is associated with sunk costs, such as searching for matching suppliers (Antràs and Helpman 2004). Offshoring also involves variable costs because it requires long-distance transport, coordination and monitoring of the value-chain (Head et al., 2009; Cuberes, 2013; Cristea, 2012).[6] The information frictions increase with distance.[7] Differences in the business environment, as well as cultural factors, can complicate long-distance business relations. Firms may therefore need to invest substantially more in establishing, sustaining and developing such relations (Johanson and Vahlne, 2009; Hasche, 2013).[8] We conceptualize and empirically analyze the role of foreign-born workers in promoting offshoring through the reduction of such costs.

Second, our study is closely related to the literature on the relationship between migration and trade that was ignited by the seminal papers of Gould (1994) and Head and Ries (1998). Since then, a number of studies have emerged on the trade-facilitating role of migration.[9] While most studies address the ways in which migrants affect aggregate international trade flows, the newest ones are based on matched employer-employee data. For instance, Hiller (2013) investigates the role of immigrant employees and regional immigrant communities in export intensity in Danish exporting firms and confirms a statistically positive association between firm export sales and foreign-born workers. Hatzigeorgiou and Lodefalk (2016) adopt a heterogeneous firm trade model and panel data for

[6] Recent business surveys illustrate the importance of face-to-face meetings for business-to-business commerce and teamwork (e.g., Harvard Business Review, 2009; Oxford Economics, 2009; Forbes, 2009).

[7] Blum and Goldfarb (2006), as well as Hortacsu et al. (2009), find that geographic distance discourages consumption even in the case of e-commerce. Head et al. (2009) estimate the distance effects to be of similar magnitude for goods and services. Additionally, Mok and Wellman (2007) discuss the importance of distance for interpersonal contact and support, before and after the Internet.

[8] These are examples of 'informal barriers to trade' that have received increased attention in trade literature (e.g., Roberts and Tybout, 1997; Anderson and Marcouiller, 2002; Melitz and Constantini, 2003; Anderson and van Wincoop 2004; Nunn 2007; Melitz and Constantini, 2008; Felbermayr and Toubal, 2010; Kneller and Pisu, 2011; Petropoulou, 2011).

[9] See, e.g., Herander and Saavedra (2005), Dunlevy (2006), Lewer (2006), White (2007); Hatzigeorgiou (2010a; 2010b); Requena-Silvente and Peri (2010); Bastos and Silva (2012); Egger et al. (2012). For reviews of the trade-migration literature, see Genc et al. (2011), Felbermayr et al. (2012), Hatzigeorgiou and Lodefalk (2016) and Lodefalk (2016). In another vein of the literature, a positive association is established between migration and foreign direct investment (e.g., Javorcik et al. 2011; Flisi and Murat 2011; Kugler and Rapoport 2011).

Sweden and find similar evidence of immigrants' positive effect on export trade, which is assumed to be derived from reduced information friction and increased trust.[10]

From this literature, our approach is most closely related to Ghani et al. (2013). Unlike previous studies that focus on labor market effects (e.g., Pouliakas et al., 2009; Beverelli et al., 2011; Ottaviano et al., 2012) or the general equilibrium effects of offshoring (e.g., Bandyopadhyay and Wall, 2010), Ghani et al. focus on outsourcing to India via an internet-based labor market. They demonstrate that company employees of likely Indian ethnicity are biased towards India when outsourcing via the internet-based job market and that this tendency is associated with a cost advantage, though its impact is likely derived from taste-based discrimination.[11] We develop a similar idea but employ detailed and comprehensive micro-level data for Sweden to provide more robust and general evidence of migrants' role in offshoring.

3 Conceptual Framework

3.1 The Set-up

To frame our empirical analysis, we develop a model of heterogeneous final-good firms that act as monopolistic competitors in line with Helpman et al. (2004) and Antras and Helpman (2004).[12] The world consists of countries located in two distinct regions (North and South). Final-good producers are allocated to North using intermediate inputs produced in either North or South. Headquarters services, such as knowledge of marketing, management, or product-specific research and development (R&D) assets, are produced in North (Helpman et al., 1984).[13] Final-

[10] Their model incorporates migrant employees and demand shocks related to migrants' home bias in demand. It predicts that additional migrant employees from a particular foreign country increase the propensity and intensity in trade with that source country through the channel of information and trust. On the other hand, a larger migrant stock lowers fixed and variable costs for all firms as well as causes a general shock in demand from their country of origin.

[11] More generally, Sangita (2013) explores the macro-level interaction between migration and trade. In an attempt to control for migrants' home bias in demand, trade in intermediate goods is separated from trade in final goods; the results are very similar.

[12] In Antras and Helpman (2004), the decision to source from abroad or domestically also includes the choice by the final good supplier to vertically integrate with the intermediate-good supplier. However, we abstract from the ownership structure and use the term offshoring, which does not explicitly differentiate between integration and outsourcing.

[13] Knowledge generated by headquarters can be transferred to a domestic or a foreign intermediate-good supplier without any costs. For example, blueprints from R&D labs in North could be transferred to an intermediate-good supplier in South to produce a new variety of the differentiated good. Likewise, knowledge about marketing the good and how to organize and coordinate its production may be used by domestic and foreign suppliers.

good producers may substitute some inputs produced by their firm at home with imports from a foreign (internal or external) supplier; that is, the firm may offshore.[14]

The inputs used in production are thus headquarters services (hq_i) from North and manufactured components, i.e., the cost of all materials (m_i) from either South or North. All firms are endowed with knowledge based on firm-specific assets, such as technology and management know-how. Firms are also endowed with foreign-born employees, but the share and their country of origin differs between firms.

The downstream firms' productivity is drawn from the distribution $G(\sigma)$, with $\sigma \in [1, \infty]$ for producing variety i. We assume an infinite number of potential input suppliers in either North or South.

Due to economies of scale or a Ricardian comparative advantage (lower wages, w^i), sourcing inputs from an upstream firm is potentially more efficient than in-house production. Sourcing inputs from abroad can thus increase the efficiency in the downstream firm when those inputs are produced more cheaply abroad and allow the firm to use existing resources more efficiently. We assume that the cost of producing a final good in North is $1/\sigma k_i$, where $k_i \geq 1$ is a multiplicative term that can increase productivity when inputs are sourced outside the firm.[15]

If firms produce their own inputs ($k_0 = 1$), there are no productivity gains. However, if firms source in North or South ($k_{N,S} > 1$),[16] there will be productivity gains due to lower average production costs.[17] Since firms differ in their productivity level σ, higher σ implies lower marginal costs c.[18]

However, sourcing intermediates abroad is also associated with direct and indirect offshoring costs. Therefore, even if, for example, $w^S < w^N$, it is possible that firms do not offshore.

[14] We will abstract from different implications that immigrants may have concerning the decision by firms to engage in foreign direct investments (FDI) or outsource the production to independent foreign suppliers.
[15] The model builds on Melitz (2003), Helpman et al. (2004) and Garcia-Vega and Huergo (2011).
[16] There is no a priori assumption of whether the productivity gains are the largest when sourcing from South or North. South is assumed to have lower wage costs, but an input supplier in North may have a technology advantage in developing and producing similar inputs.
[17] The multiplicative term also ensures that the increase in productivity is larger the higher the ex ante productivity (Garcia-Vega and Huergo, 2011).
[18] In addition to the fixed costs, offshoring incurs iceberg trade cost $\tau > 1$, which is assumed to be higher when sourcing from South. The decision to source intermediate inputs domestically or abroad (offshoring) is thus a tradeoff between low variable costs in South and low fixed costs in North.

Direct offshoring costs stem from several sources. First, a firm that wants to offshore has to search for a matching foreign supplier, incurring the fixed offshoring costs f_i. This matching process is crucial.[19] Firms want to avoid potential 'lemons,' which are defined as foreign suppliers whose terms of deliverance and/or product quality suffer from great uncertainty. The greater the knowledge the final good producer has regarding the input market, the smaller the problem of matching with lemons.

Second, the offshoring firm is expected to carefully draft the contract with the upstream supplier and spend additional resources on coordination and monitoring to counterbalance the partial loss of control of production that occurs when production and headquarters (HQ) activities are geographically separated (Grossman and Rossi-Hansberg, 2008). Therefore, the firm incurs additional fixed f_i and variable costs v_i.

Third, the offshoring contract often involves some sunk costs in the form of relationship-specific investments in capital or R&D assets by both parties.

A firm that offshores also runs the risk of incurring indirect offshoring costs. If the firm matches with a supplier that 'leaks' knowledge to rival firms, either by selling technology to a competitor or by entering into the industry as a new competitor, which assumes production of the final good, the demand will decrease for the offshoring firm (e.g., Lai et al., 2009). Consequently, the average production costs increase. Therefore, leakage may be viewed as adding to the variable costs of offshoring v_i. More formally, we define an inverse measure of leakage δ, where $\delta \in (0,1)$, which reduces demand for the final good x_i, where $x_i = \delta y \left[\frac{q}{p_i}\right]^{1/(1-\rho)}$ with y being a quantity index, q a corresponding price index, p_i the price of the good and ρ the love of variety parameter defined for $\rho \in (0,1)$.[20]

For lower values of δ (high leakage), the consumers' demand for the final good will be low and the corresponding cross price elasticity high.[21] However, if $\delta = 1$, there is no leakage effect on demand and thus no

[19] Naghavi and Ottaviano (2009) explicitly model how hold-ups reduce the supply of inputs, increasing the price but decreasing the upstream firms' bargaining power.

[20] Besides δ, the utility maximizing demand function facing a firm is derived from a standard Dixit-Stiglitz (1977) model, with derivations available upon request.

[21] If there is technology leakage, other input suppliers in the same industry or region may improve their efficiency in producing similar inputs and final-goods and thus lowering the demand and the price for the final-good (Lai et al., 2009; Garcia-Vega and Huergo, 2011).

indirect offshoring costs in terms of higher average production costs. Due to incomplete contracts, final good producers in North will anticipate δ to be too low, especially in regard to offshoring to South, where institutions are expected to be weak. They will therefore be reluctant to offshore intermediates in general and to the South in particular.

To summarize, due to higher costs associated with sourcing inputs from abroad, low productivity firms will source domestically, and high productivity firms will source from abroad.[22] Only the most productive firms can engage in offshoring to South since both direct and indirect offshoring costs are higher with respect to more foreign and distant Southern countries, which also have weaker institutions. Thus, the productivity cut-offs for offshoring are $\sigma_S > \sigma_N > \sigma$ because $f_S > f_N > f$; $v_S > v_N > v$; and $\delta_S > \delta_N > \delta$.

3.2 The Role of Immigrant Employees

Immigrant employees have tacit knowledge that is important for firms that want to find, establish and maintain successful business relationships with foreign upstream suppliers. These employees know about foreign suppliers and about the institutions and cultural context in which the upstream firms operate.[23] They also speak the language of their former home country and have access to social networks there, including those developed in higher education. By utilizing immigrants, downstream firms can, for example, mitigate contractual friction, reduce hold-up problems, increase the capacity to coordinate, and monitor upstream suppliers of intermediate inputs and (to some extent) prevent technology leakage.[24] In sum, foreign-born employees spur offshoring via improved 'offshoring technology' (Grossman and Rossi-Hansberg, 2008; 2012) (**H1**).[25] These gains may also differ according

[22] This argument is put forward in Antràs and Helpman (2004) and builds on Grossman and Helpman (2002; 2005).

[23] In Levchenko's (2007) theoretical model, the quality of institutions and contract enforcement in the source country may act as a source of comparative advantage. Northern firms in industries that depend intensively on relationship-specific investment from their suppliers will be attracted to countries with better institutions. The risk of technology leakage is a crucial factor in the context of outsourcing of innovations as in Lai et al. (2009). Since offshoring means that knowledge is transferred across borders, the argument also applies to sourcing of material inputs from abroad.

[24] Brandts et al (2016) provide experimental evidence that communication helps to align perceptions in flexible contracts, thereby improving their effectiveness and resulting in higher earnings. We conjecture that immigrants could be instrumental in this regard.

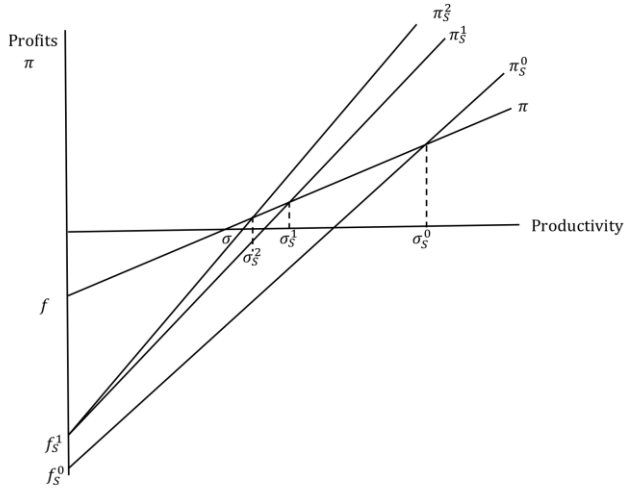
[25] This potential role of migrants in enhancing offshoring is consistent with the predictions of network trade theory (Rauch, 1996, 1999). More generally, we expect immigrants to reduce uncertainty in offshoring through their knowledge and networks. Establishing open flows of information and lowering the risk of being surprised by future 'bad news' can be important for firms seeking to enter into global value-chains by lowering the sunk costs involved (Bernanke, 1983; Dixit, 1989).

to whether offshoring technology is held by countries that are more or less developed than, in this case, Sweden (**H2**). Due to the weaker property rights and contract enforcement in Southern countries, immigrant knowledge is more valuable in those markets (Grossman and Rossi-Hansberg, 2008). Alternatively, as these legal limitations are likely to affect the types of products that are available from those Southern countries, it might be that knowledge of the developed North is of greater value.

Figure 1 illustrates the relation between productivity and profits for offshoring and non-offshoring firms as well as the impact of hiring foreign-born employees.[26] In this figure, the fixed costs associated with offshoring are indicated by *f* on the vertical axis, and the variable costs are indicated by the slope of the profit function. The profit function is positively sloped since profits positively depend on productivity. For productivity levels below σ, production is not profitable. For a non-offshoring firm, the profit function π is flatter, indicating high marginal costs, although fixed costs are relatively low. The offshoring firm incurs higher fixed costs f_S^0 but lower variable costs. The threshold where offshoring becomes profitable is indicated by the point σ_S^0. Importantly, the figure also demonstrates that foreign-born employees cause a shift in the costs of offshoring to South, spurring offshoring entry and intensity. Due to lower fixed costs in finding a relevant supplier in combination with lower variable costs due to easier monitoring of and coordination with the foreign input supplier, the productivity threshold for offshoring will be lower, i.e., $\sigma_S^1 < \sigma_S^0$. Thus, the fixed costs of offshoring to South decrease from f_S^0 to f_S^1, shifting the profit function, and the variable costs decrease from v_S^0 to v_S^1, increasing the slope of the profit function from π_S^0 to π_S^1. Taken together, these shifts produce a lower productivity threshold, σ_S^1, meaning that more immigrant employees enable firms to make positive profits from offshoring to South even though their productivity is relatively low. Moreover, if foreign-born employees indirectly help firms to reduce variable costs from leakage δ, the reduction will sustain the slope of the profit function even further from π_S^1 to π_S^2, lowering the productivity threshold further to σ_S^2. Finally, to maximize profits, firms that already offshore will respond to the fall in v_i with increased producing and offshoring since their marginal cost curve shifts downward.

[26] Our figure concerns offshoring, drawing on Melitz (2003) and Helpman et al. (2004), who model different productivity thresholds for exporting and FDI.

Figure 1. Effects from Lower Offshoring Costs to South



We expect a stronger impact on offshoring from foreign-born employees with more skills, such as post-secondary education or substantial experience in areas such as management (**H3**). Skilled immigrant employees are in a better position to disseminate relevant knowledge to firms and to put information into practice within firms (Gould, 1994). They carry general and specific expertise, such as communication skills, and tend to have more qualified occupational positions that therefore give them more say over business decisions (Aleksynska and Peri, 2012; Mundra, 2012).

Finally, we conjecture that the impact on firms of the knowledge of immigrant employees is likely to differ between low productivity firms with limited international networks—such as smaller firms and non-multinational firms—and larger firms (**H4**). Small firms that are likely to have fewer layers of management provide managers closer access to immigrants' knowledge, but such firms are less likely to be able to manage complex international supply chains. Additionally, immigrants ought to have the largest effect with respect to heterogeneous inputs since they are expected to be particularly sensitive to information and coordination frictions, relation-specific investment and the risk of leakage (Rauch, 1999; Herander and Saavedra, 2005; Nunn, 2007) (**H5**). These factors are especially important in contracts in which tacit information is more prevalent, such as in contract and R&D intensive offshoring.

4 Empirical Approach

Following the hypothesis that hiring more immigrant employees in a firm increases the probability that the firm will source inputs from the immigrant's country of birth and do so with greater intensity, we draw upon recent models of international trade and specify a reduced form log-linearized firm-level gravity model of offshoring. Thus, our empirical model integrates firm and market characteristics as determinants of trade behavior into a single estimating equation (e.g., Chaney, 2008).

We estimate the benchmark specification through two equations. The first (selection) equation models firm entry into offshoring,

$$P(O_{fjt} = 1) = P[\beta_0 + \beta_1 me_{fjt} + \beta_2 \ln(m_{jt}) + \sum_c \beta_c z_{cft} + \sum_d \beta_d g_{djt} + \varphi_f F_f + \pi_s P_s + \mu_n N_{fj} + \eta_i H_i + \tau_t T_t + \varepsilon_{fjt}], \quad (1)$$

and the second (outcome) equation models the quantity that the firm offshores,

$$\ln(o_{fjt}) = \beta_0 + \beta_1 me_{fjt} + \beta_2 \ln(m_{jt}) + \sum_c \beta_c z_{cft} + \sum_d \beta_d g_{djt} + \varphi_f F_f + \pi_s P_s + \mu_n N_{fj} + \eta_i H_i + \tau_t T_t + \varepsilon_{fjt}, \quad (2)$$

where O_{fjt} is a zero-one indicator set to one if firm *f* offshores to source country *j* at time *t*, and $\ln(o_{fjt})$ represents logarithmic value of intermediate imports of firm *f* from country *j* at time *t*.

The defining feature of our empirical strategy, made possible by our comprehensive micro dataset, is the direct connection between a firm's employment of immigrants from country *j* and that firm's offshoring from the same country. This represents an important component of the contribution of this paper to the broader empirical literature on migration and trade because migrant employees are expected to be closely connected to networks in their countries of origin. Members of migrant-based networks are characterized as having important knowledge that may affect the commercial exchange between countries (Rauch, 2001). The number of immigrant employees in firm *f* at time *t* who are born in country *j* is represented by the variable me_{fjt} in the two equations, which is the focus of our empirical results.

An advantage of our empirical approach is that it minimizes the risk of confounding factors. However, concern exists around the possibility of omitted variable bias, explained by unobservable firm characteristics that

are correlated with the decision to offshore and the decision to hire non-Swedish born workers. For example, the management of a firm could be more internationally focused and therefore choose to offshore some aspects of production and hire immigrant workers. They may also display a predisposition towards particular countries. We assume that these omitted variables exist at the firm-country level and are time invariant such that they can be captured by including relevant fixed effects. The identification of the effects of immigration employment on offshoring in the two equations can be seen in the changes in employment in immigrants from that same country. For firms where employment is zero or is positive but does not change, any effect on migration is captured by the country-firm effects. In addition, the model accounts for unobserved country-pair heterogeneity and therefore controls for bilateral particularities related to offshoring and immigration irrespective of their positive or negative influence.[27]

Specifically, F_f represents indicators that capture firm-specific effects, and P_p consists of indicators that capture both observed and unobserved country-specific heterogeneity, including variables that are commonly used to proxy for factors such as transport costs.[28] Indicators that capture specific effects of firm-country pairs are represented by N_{fj} , while H_i represents industry indicator variables that control for industry-specific heterogeneity at the 3-digit industry level. Finally, T_t is a vector of indicators that controls for unobserved time-variant variables.

Alongside these fixed effects, we control for a range of time-varying firm and country determinants of offshoring in the regression. We include the Swedish stock of immigrants from country j, m_{jt}, to control for transplanted home bias in the spirit of White (2007) and a country-wide reduction in offshoring costs. A set of explanatory firm-specific supply side factors are included in z_{cft}. These are firm size, productivity, ownership status, and previous trade experience, as well as human and physical capital intensities. Characteristics that affect bilateral trade resistance are included in g_{djt}, such as economic 'mass,' which is measured in terms of GDP. The idiosyncratic

[27] We also sought to include specific fixed firm-year effects. However, despite working on powerful servers, it has not been possible to perform estimations with the required number of dummies.

[28] Inclusion of country-year fixed effects substantially increases the complexity of estimations and is therefore only included in the robustness analysis. Practically, in the estimation of Eq. 2, firm, country and firm-country specific heterogeneity is considered by including firm-country fixed effects, following Andrews et al. (2006). In the estimation of Eq. 1, we model the same heterogeneity as a linear function of the mean of firm and gravity predictors across time, that is, as $\sum_c \bar{z}_{cf} + \sum_d \bar{g}_{dj}$ (Mundlak 1978).

error term is ε_{fjt}. The immigrant stock variable, like all continuous covariates, is expressed in logs. The exception is me_{fjt}, which we do not log because of the number of zeros within the data.

The intensive margin of offshoring is observed only for those firms with positive imports of intermediate inputs. We address selection by utilizing a two-step selection model for panel data while correcting for bias caused by unobserved heterogeneity (Heckman, 1979; Mundlak, 1978; Chamberlain, 1980; Wooldridge, 2002; Helpman et al., 2008). The panel selection model allows factors that are expected to influence both the offshoring propensity and intensity, such as immigrant employees, to have different impacts on the two outcomes. The omitted variable bias correction of the model is advantageous, *inter alia*, because it takes the form of fixed effects and thus allows a correlation between unobserved factors causing heterogeneity and the predictor variables.[29]

As an exclusion restriction, we apply a measure of the fixed costs associated with offshoring to a particular destination. We construct this variable using data from the World Bank (2011) that examines the regulatory burden imposed on business abroad. These data, available for 173 countries, contain information on policies related to the start-up and closedown costs of businesses, costs based on contractual obligations, and concern for investment protection. Our measure subsequently accounts for sunk costs associated with entry into a foreign market and the uncertainty surrounding these entry costs.[30] In the spirit of Helpman et al. (2008), who also use a measure of the fixed regulatory cost as a means for identification in presence of selection, we interact the fixed cost measure with firm size to account for differential effects across firms of different sizes.[31]

For the IV analysis, we apply a generalized method of moments (GMM) estimator with an instrument consisting of two components. The first is the average number of immigrants employed in Swedish firms other than *f*, lagged by two periods. The second is the average number of immigrants employed in other firms within the same three-digit industry as the firm, lagged by three periods. The logic behind these instruments assumes that the greater

[29] A Hausman test confirms the appropriateness of the fixed effects specification over random effects.
[30] In estimation, the strategy performs well. The regulatory measure affects the propensity to offshore but not the intensity of offshoring. Since standard errors from the Heckman estimation are known to be downward biased and with the aim of dealing with serial correlation as well as heteroscedasticity, we cluster standard errors by firm-country address and adopt the Huber/White/sandwich variance-covariance estimator.
[31] There are alternative exclusion restrictions commonly used in the empirical literature, including common religion, trade experience and the share of white-collar workers, but they are not as well founded theoretically.

the increase in the number of immigrant workers outside the firm or in the same industry as the firm, the more likely it is that the firm will hire immigrants from that country. We also require that the presence of these migrants is unlikely to affect the offshoring decisions of the firm vis-à-vis country *j* other than through their role as employees, which would seem reasonable. Changes in the number of immigrants (from anywhere) employed by firms and in a firm's specific industry are likely correlated with trends in hiring policies. In Sweden, firms are increasingly working to promote diversity in the workforce (Proffice Group, 2015). The use of lagged values is predicated on an assumption that differences in the timing of employment versus offshoring decisions are important. We find that both components of our instrument are correlated with the number of immigrant workers from *j* employed by firm *f*. These instruments also fulfil the conventional criteria for an appropriate instrument as indicated by standard statistical tests.

5 Data and Stylized Facts

The micro-level datasets are from Statistics Sweden and include all Swedish manufacturing firms with at least ten employees for the years 1998-2007. We match and supplement the core micro-level data with detailed information on each worker's country of birth as well as the skill level of foreign-born employees. All datasets are register-based and include unique identifiers for firms and individuals. The combined data enable us to analyze the relationships between specific characteristics of firms, their employees and the offshoring of those firms.[32]

Firm-specific and source-country-specific trade data are included at the Combined Nomenclature 8-digit (CN8) level. We consider the numerous substantial changes to the nomenclature over time in line with the recommendations of Pierce and Schott (2012). For instance, we construct a detailed concordance of the CN8 between 1998 and 2007 matched with trade data for the 10-digit US nomenclature to the EU context. Imported

[32] Information on the specific variables and their sources is available in Table A1, while a detailed account of the construction of the dataset is available upon request. Additionally, we use information on the GDP and population size of partner countries from the World Bank, geographical indicators and other conventional gravity variables from the Centre d'Etudes Prospective et d'Informations Internationales, and data on trade barriers from the Heritage Foundation.

products are considered offshored if they are included in the category of intermediate goods in the Broad Economic Categories (BEC) classification of the UN (United Nations, 2002).[33]

For 2007, the full sample contains economic and migration data from 6,855 Swedish firms employing 599,333 full-time workers. Approximately 12,000 firms are represented over the whole period. The dataset includes information on macroeconomic, geographic, historic and cultural factors for 176 partner countries (Table A2). In total, our dataset includes approximately 12 million observations over ten years.

Table 1 provides a snapshot of our data for the year 2007. The average firm is a medium-sized company in terms of its workforce. It offshores but is not yet part of a multinational enterprise. Less than a fifth of employees of the average firm have a post-secondary education. Approximately ten percent of the employees were born outside of Sweden.

Table 1. Snapshot of Swedish Manufacturing Firms

	Mean	Median	Std. dev.	Min.	Max.
Offshoring value	36,007	28.275	405,208	0	20,814,582
Number of immigrants	12.20	3.00	97.68	0	n/a
Share of immigrants	0.12	0.09	0.13	0	1
No. of employees	87.43	24	507.26	10	n/a
Labor productivity	643.03	559.08	416.38	0	12,427
Human capital intensity	0.17	0.13	0.16	0	1
Physical capital intensity	293.55	161.80	490.16	0	11,681
Multinational status	0.32	0	0.47	0	1
Offshorer	0.57	1	0.50	0	1
Exporter	0.70	1	0.46	0	1
Importer	0.64	1	0.48	0	1

Note: Data refer to the year 2007. Number of firms is 6,855. Number of observations in the 1998-2007 period is 15,020,024. Monetary values are in 1,000 SEK (approximately 148 USD). Only merchandise trade is considered. Two maximum values are not disclosed for confidentiality reasons.

Immigration to Sweden has increased substantially over the past seven decades. In 1940, the foreign-born population accounted for one percent of the total population, and in 1970, that figure rose to approximately seven percent. The most recent figure is approximately 16 percent. Between 1998 and 2007, immigration accounted for

[33] BEC is a reclassification of the Standard International Trade Classification (SITC) according to main end-use of commodities: capital goods, intermediate goods, and consumption goods. Intermediary goods are contained in the BEC codes 111, 121, 21, 22, 31, 322, 42 and 53.

77 percent of Sweden's total population increase. The largest immigrant groups by source country are Finland, Iraq, Poland, Serbia/former Yugoslavia and Iran.[34]

According to pairwise correlations (Table A3), firm offshoring is negatively related to the distance of source countries but positively related to the size of the firm and the market size of the source country. Offshoring is positively related to both a larger country immigrant stock and more foreign-born employees from the source country.

During the period 1998-2007, immigration to Sweden increased by 22 percent, and offshoring increased by 57 percent. Most offshoring is to high-income countries, particularly for contract intensive products. Within the data, the top offshoring destination countries are all in Europe except for the US, Russia and Japan (Table A4). Similarly, the major immigrant source countries are mainly European except for Iraq and Iran (Table A5). The rise in offshoring to low-income countries has occurred in tandem with a substantial rise in immigration from those countries. R&D intensive offshoring is mostly directed towards low-income countries. The share of offshoring to low-income countries has increased by twice the rate of offshoring to high-income countries over the sample period.

Table 2. Offshoring and Immigration – The Case of Sweden

	Offshoring value 2007	Δ1998-2007 (%)	Contract intensive offshoring (share) 2007	Δ1998-2007 (%)
High-income countries	234,542,676	55	0.48	-18
Low-income countries	12,286,768	106	0.31	-28
	R&D intensive offshoring (share) 2007	Δ1998-2007 (%)	Country immigrant stock 2007	Δ1998-2007 (%)
High-income countries	0.06	-32	824,116	0.13
Low-income countries	0.14	47	395,510	0.46

[34] Table A5 in the appendix presents a complete list of Sweden's largest immigrant groups, their respective size and share of population.

6 Results

6.1 Benchmark Estimation

Table 3 presents our estimation results based on the benchmark specification for both total imports and offshoring. We include total imports to check whether our results are dependent upon the classification of intermediate inputs. In practice, firms import few goods that are not intermediate inputs, and the results are insensitive to this change. The table also presents the regressions for the probability of importing/offshoring (regressions 1 and 3) alongside those for the value of imports (regressions 2 and 4). In both cases, identification comes from the within firm-source-country variation over time.

The evidence from the table suggests a difference between the determinants of the firm-country-extensive and firm-country-intensive margins of offshoring. Interestingly, we find no significant effect from the employment of migrants on the probability of offshoring to the same country (the firm-country-extensive margin) irrespective of whether we use total imports or only intermediate goods. However, the total Swedish stock of immigrants from country *j* does appear to matter somewhat for this margin. We think this result indicates a preference bias in the demand for offshored goods and/or an indirect impact of immigrants on firm offshoring to source countries. Other significant determinants of the probability of offshoring include firm characteristics such as size, productivity and human capital intensity, as well as country characteristics such as GDP and population size.

In contrast to the effect on the firm-country-extensive margin of offshoring, the employment of migrant workers born in country *j* does appear to matter for the intensive margin of offshoring to country *j* (regression 2 and 4). As the number of migrants that a firm employs from a particular origin country rises, the firm becomes more likely to start purchasing a greater value of intermediate inputs from that country. This is consistent with our explanation that migrant employees affect the level of trust between the firm and their offshore supplier, making it less costly to trade. The effect of migrant employment would also appear to be economically significant: hiring one additional immigrant from country *j* is associated with an average three percent rise in firm *f*'s offshoring to country *j*.

Additionally, in contrast to the extensive margin, we now find only a barely measurable (and now negative) effect from the total Swedish stock of migrants from country *j* on the value of offshored imports from that country. There are also a number of changes to the results for other firm and country characteristics. Offshoring is increasing in the size and productivity of the firm, but is decreasing in human capital intensity. It is increasing in the economic mass of a country (GDP), but decreasing in the size of its population.

Table 3. Benchmark Estimation Results

	(1)	(2)	(3)	(4)
	P(Import)	Import	P(Offshoring)	Offshoring value
				Total
Immigrant employees	0.000888	0.0366***	0.00137	0.0339***
	(0.003)	(0.010)	(0.002)	(0.009)
Immigrant stock (log)	0.0287**	-0.00167***	0.0463**	-0.000439***
	(0.013)	(0.000)	(0.020)	(0.000)
Workforce (log)	0.289***	0.251***	0.284***	0.217***
	(0.007)	(0.006)	(0.007)	(0.005)
Multinational (0,1)	0.0650***	0.0199***	0.0731***	0.0195***
	(0.007)	(0.005)	(0.008)	(0.005)
Offshorer (0,1)		2.787***		2.689***
		(0.042)		(0.045)
Labor productivity (log)	0.0156***	0.0302***	0.0151***	0.0282***
	(0.005)	(0.003)	(0.005)	(0.003)
Human cap intensity (log)	0.00309***	-0.00108***	0.00222**	-0.000645***
	(0.001)	(0.000)	(0.001)	(0.000)
Physical cap intensity (log)	0.00552***	0.00228***	0.00491***	0.00180***
	(0.001)	(0.000)	(0.001)	(0.000)
GDP (log)	0.545***	0.0765***	0.593***	0.111***
	(0.028)	(0.010)	(0.032)	(0.009)
Population (log)	0.417***	-0.518***	0.352***	-0.272***
	(0.078)	(0.031)	(0.088)	(0.028)
Obs.	9,218,137	8,608,859	9,109,283	8,608,859
Adjusted / Pseudo R^2	0,497	0.7456	0.500	0.7361

Notes: All regressions include firm-country, industry and time fixed effects. In columns 2 and 4-6, dependent variables are in logs (1e-7 is added to avoid truncation). Robust and firm-country clustered standard errors are in parentheses.
* p <0.10, ** p < 0.05, *** p < 0.01

Unexpectedly, the impact of immigrant employees on the intensity of offshoring to source countries is no different than the impact on total imports (columns 4 versus 2). However, additional analysis in which we exclude

offshoring from overall imports reveals a heterogeneous pattern across firm size. For small- and medium-sized firms (SMEs), immigrant employees have no statistically significant impact on non-intermediate imports, nor is their impact substantially weaker on such imports than on offshoring. For large firms, the impact is marginally stronger for such imports than for offshoring (see Tables 5 and A7).[35] The results are in line with our fourth hypothesis that the usefulness of the knowledge of migrant workers when offshoring varies across firms of different sizes. Our interpretation of the results is that less able firms with limited foreign networks will gain the most from the knowledge of immigrant employees.

6.2 Robustness Checks and Further Analysis

Table 4 includes several checks of the robustness of our main results as well as further analysis to determine the direction of causation. For this exercise, we focus on the results for the intensive margin of trade in column 4 of Table 3. We begin by testing whether our estimates depend on a linear specification. Although a slightly quadratic relationship seems to be present (column 1), the relevant coefficient is too small to alter our main results.[36] Columns 2 and 3 demonstrate that our results are not driven by main immigrant source countries or by main offshoring markets. Rather than weakening the link to offshoring, excluding the top five immigrant and offshoring countries increases the estimated influence of immigrant employment. This is interesting because it appears to suggest that immigrants have stronger effects when the firm is less familiar with the country as an offshoring destination.

Column 4 includes results from a lagged approach in which immigrant employees and the country immigrant stock are lagged by three periods. These results suggest that the estimated offshoring-migration link at the firm level runs from immigrant employment to offshoring. As explained above, preparation for offshoring may have started at the firm several years before the actual shipment of goods and services, which the use of lagged values plausibly overcomes. We develop this point in the IV analysis below.

[35] With respect to covariates, we find that larger and more efficient firms are more strongly associated with offshoring to high-income countries relative to low-income countries. We interpret this difference across firms of different sizes and efficiencies as a result of the fact that contract intensive goods account for a much larger share of offshoring to high-income countries than low-income countries. Most of the other conventional firm-gravity covariates have the expected sign.

[36] Hiring the first immigrants is slightly more important than hiring later immigrants when we interact the squared variable with firm size. Interestingly, the 'diminishing returns' is larger in smaller firms than in larger ones with the interaction being positive and the squared variable turning negative. The results are available upon request.

In column 5, we test whether the results are sensitive to time-variant source country variation, such as price shocks, by including country-year fixed effects while replacing the country immigrant stock with the regional stock. This test confirms that the results are robust to such source-time trends. Further, in column 6, we address potential selection bias via a Heckman panel estimation with fixed effects. Although the level of significance of the main coefficient is lower, the main results seem largely robust to controlling for selection.

Column 7 presents the results from the IV analysis. In our view, these estimation results provide reliable evidence supporting the prediction that causality runs from immigrant employment to offshoring rather than vice versa. In regard to instrument validity, the Kleibergen-Paap rk Lagrange multiplier and Wald F statistics reject the null hypotheses of under-identification and weak partial correlation between the instrument and the immigrant employment variable. The exogeneity of the instrument with respect to the error term is examined by Hansen's J test. On this basis, we do not reject the null hypothesis of exogeneity at conventional significance levels.

The results from column 7 in Table 4 are similar to those of the baseline estimates in Table 3. We continue to find that the employment of migrant workers positively and significantly affects the value of inputs that are offshored to their country of origin. In fact, now the effect hiring one additional immigrant from country *j* is associated with an average 6 percent rise in firm *f*'s offshoring to country *j*.

Column 8 presents results from a partial adjustment model implemented to further control for omitted variable bias and to focus on the known persistence in firms' internationalization behavior. Previous offshoring to a specific country is clearly a strong predictor of contemporary offshoring. However, this does not undermine the main result that immigrant employees are positively linked to firm offshoring to their countries of origin.

A final concern might be whether our results were biased due to omitted variables that relate to the engagement of the firm in the specific country or globally in terms of exports, offshoring or imports of final goods. Reassuringly, including indicator variables for such engagement does not alter our main finding in terms of its magnitude or its level of statistical significance.[37]

[37] These results are available upon request.

Table 4. Further Analysis and Tests of Robustness

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Quadratic	Excluding top five immigrant countries	Excluding top five offshoring countries	Lagged model (*t-3*)	Extended FE specification	Heckman panel estimation	IV analysis	Partial adjustment model
Immigrant employees	0.0579***	0.126***	0.0468***	0.0105*	0.0303***	0.007508*	0.0665***	0.0318***
	(0.008)	(0.016)	(0.010)	(0.006)	(0.007)	(0.004)	(0.018)	(0.009)
Immigrant employees^2	-0.0000339***							
	(0.000)							
Offshoring$_{t-1}$							1.989***	0.972***
							(0.050)	(0.012)
Obs.	8,608,859	8,363,410	8,363,423	4,593,656	8,608,859	144,202	6,175,790	8,608,859
Adjusted R^2	0.7361	0.7246	0.6877	0.7619	0.7429	0.391	-0.185	0.7429
Kleibergen–Paap rk (p)							0.0000	
Kleibergen–Paap Wald (F)							9.847	
Hansen J (p)							0.400	

Notes: Dependent variable is firm offshoring in logs (1e-7 added to avoid truncation). All results are within-firm estimations with firm-country, industry and time fixed effects. In column 5, country-year fixed effects are added while replacing the country immigrant stock with the regional immigrant stock. Robust and firm-country clustered standard errors are in parentheses. For brevity, other firm and gravity estimates are not reported.

* p <0.10, ** p < 0.05, *** p < 0.01

6.3 The Role of Inputs, Skills and Source Country Characteristics

Having established the robustness of the main results, we next exploit the country, immigrant, input and firm information in the Swedish data. In Table 5, we analyze the immigration-offshoring relation according to the skill level of immigrant employees, the type of goods that are offshored and the source country characteristics (their income levels). As a reminder, we measure immigrant skill level according to whether their education level is above or below secondary schooling. As immigration employment from country *x* affects the value of offshoring to that same country in Table 3, we report regressions for the estimation of equation 2 only.

We separate product characteristics according to their contract intensity and their R&D intensity. As explained previously, we expect that some goods are particularly vulnerable to offshoring barriers, such as those whose production requires larger relation-specific investments and/or the involvement of novel technology that may leak to rival firms. This might occur because some products lack a fixed reference price, i.e., the price of the products cannot be determined without reference to more detailed information about the brand, origin, producer or other characteristics. The price of such inputs may require greater negotiation, and the quality may be more difficult to determine ex ante than for inputs for which knowledge about price and quality is more readily available. Therefore, the drafting, negotiation and monitoring of the contract for such offshoring issues tend to be particularly cumbersome. We define such differentiated input as contract intensive goods, following the 'strict' definition of Rauch (1999).[38]

It might also be anticipated that R&D intensive inputs are especially sensitive to information and coordination related barriers. To consider this, we apply the list of high-technology products produced by the OECD while taking the major revision conducted in 2007 into account. High-tech products are defined as goods whose production is R&D intensive (Hatzichronoglou, 1997). Finally, we combine these measures of contract and R&D intensity to identify a set of contract-R&D products.

[38] Our approach is related to the study by Nunn (2007), who establishes the contract intensity of industries based on the degree of 'relationship-specific investment' in intermediate inputs by those industries where the degree of such investment is determined by the share of inputs that are differentiated goods.

Table 5. Results across Inputs, Skills, and Source Countries

		Immigrant employees		
		All	Skilled	Unskilled
All offshoring	Low-income	0.0557***	0.122**	0.0215
	High-income	0.0292***	0.136***	0.0178*
Contract intensive	Total	0.0351***	0.100***	0.0227**
	Low-income	0.0487***	0.0828*	0.0252
	High-income	0.0314***	0.105***	0.0196*
Non-contract intensive	Total	0.0361***	0.0765***	0.0284***
	Low-income	0.0221***	0.0727***	-0.0129*
	High-income	0.0362***	0.0809***	0.0291***
R&D intensive	Total	0.0326***	0.152***	0.00986
	Low-income	0.0290***	0.105***	-0.0237***
	High-income	0.0319***	0.176***	0.00884
Non-R&D intensive	Total	0.0336***	0.107***	0.0197**
	Low-income	0.0554***	0.0958**	0.0276
	High-income	0.0290***	0.108***	0.0164*
Contract and R&D	Total	0.0319***	0.196***	0.000713
	Low-income	0.0316***	0.111***	-0.0231**
	High-income	0.0312***	0.240***	-0.00213

Notes: Presented are the results from 34 within estimations with firm-country, industry and time fixed effects. Dependent variables are in logs (1e-7 is added to avoid truncation). Robust and firm-country clustered standard errors are in parentheses. For brevity, other firm and gravity estimates are not reported.
* p <0.10, ** p < 0.05, *** p < 0.01

The semi-elasticities in Table 5 reveal some interesting patterns, particularly with respect to the skill intensity of the immigrant workers employed by the firm. The various coefficient estimates for the employment of skilled workers are universally positive and consistent with an interpretation that the skill-level of immigrant employees influences the extent to which foreign-born workers facilitate offshoring. In the column that calculates the immigration variable as the number of unskilled workers, the different coefficient estimates display a less clear pattern; they vary between positive-significant, insignificant and negative-significant.

Using the characteristics of the products and countries in which offshoring occurs, we are able to dig further into the importance of these different skill levels. For skilled migrant workers, employment appears to have relatively little difference regardless of whether the offshoring is to high-income countries or low-income countries. The estimated coefficients are always larger for offshoring to high-income countries, but the differences are not substantial.

The exception is found in the final row of the table when we focus on offshored products that are contract and R&D intensive. We find here that the employment of migrant workers has strong effects on the value of offshored inputs; the coefficient estimate is the largest of those reported in Table 5. Separating the contract and R&D components that compose this category indicates that this result appears to be driven by the R&D intensity of the product, although there is clearly an additional effect from contract intensity on this result as well. For this group of products, we also find a large difference in the effect of migrant employment on the value of offshored inputs from high- as compared to low-income countries. This contrast is evident when we study contract intensive products separately where the effects of migrant employment are positive and significant but similar in magnitude when offshoring is to either high- or low-income countries. This also happens for non-R&D intensive and non-contract intensive products.

This same pattern on offshoring does not hold for the employment of low-skilled immigrant workers, particularly when offshoring and employment involve a low-income country. For high-income countries, there is a positive effect on the offshoring of contract, non-contract intensive and non-R&D intensive products. However, the significance level is generally low and the estimated effect of unskilled immigrant workers is about a fifth of for the estimated effect of skilled workers. Evidence supports that employing unskilled workers reduces firms' offshoring to the country of origin for non-contract intensive products and R&D intensive products. Notably, this occurs even for the contract and R&D products on which the employment of skilled migrants had such a strong effect. Overall, the greatest impact on offshoring appears to be the employment of skilled rather than unskilled migrants, which is consistent with the idea that this employment provides access to market-specific knowledge and networks in the migrants' home country.

6.4 The Role of Inputs, Skills and Firm Size

Table 6 extends some of the patterns found in the previous table by separating out firms of different sizes. Again, we note that this plays an important role in understanding the effects of migrant employment. The results for skilled migrants in Table 5 appear to be driven by an effect of outsourcing by large firms to high-income countries and medium- and large-sized firms to low-income countries. For large firms, this effect is again found to be strongest

when outsourcing contract and R&D intensive products; this effect is again the largest in the table. Consistent with Table 5, it would appear that this is again driven by R&D intensity, although there is clearly a role for both characteristics of the input. There is also a large effect on the probability of offshoring of the same type of inputs to low-income countries. For outsourcing to low-income countries, there is also evidence of strong effects of migrant employment for non-R&D intensive products by medium-sized firms. We find no evidence of an effect of skilled migrants on outsourcing by small firms irrespective of the type of input that is purchased. It is instead large firms that appear to gain most from the employment of skilled migrants.

Table 6. Results across Inputs, Skills, Firm Size

		Immigrant employees						
		All	Skilled	High-income	Low-income	Unskilled	High-income	Low-income
All offshoring	Small	0.057***	0.070	0.083	0.029	0.055***	0.650**	-0.004
	Medium	0.075***	0.071	0.031	0.146**	0.075***	0.085***	0.000
	Large	0.020***	0.091***	0.074***	0.093*	0.006	0.002	0.174
Contract intensive	Small	0.055***	0.059	0.0727	0.021	0.055***	0.060**	0.185
	Medium	0.041***	0.107*	0.108	0.916	0.029	0.029	-0.012
	Large	0.018**	0.078***	0.065**	0.075	0.006	0.002	0.020
Non-contract intensive	Small	0.009	0.050	0.065	0.013	0.000	0.003	-0.018**
	Medium	0.031**	-0.010	-0.036	0.047	0.039**	0.044**	0.003
	Large	0.035***	0.075***	0.070***	0.079***	0.027***	0.027***	-0.017
R&D intensive	Small	0.002	0.030	0.037	0.010	-0.004	-0.007	0.006
	Medium	0.002	0.025	0.012	0.049	-0.003	-0.001	-0.006
	Large	0.034***	0.152***	0.158***	0.121	0.011	0.009	-0.040***
Non-R&D intensive	Small	0.058***	0.054	0.053	0.045	0.058***	0.071***	-0.007
	Medium	0.077***	0.069	0.030	0.143**	0.079***	0.087***	0.003
	Large	0.019**	0.085***	0.072***	0.083	0.006	0.002	0.026
Contract and R&D intensive	Small	0.008	0.019	0.021	0.121	0.005	0.005	0.005
	Medium	-0.036	0.020	0.020	0.012	-0.008	-0.009	-0.001
	Large	0.034***	0.021***	0.236***	0.130***	0.001	-0.003	-0.038***

Notes: Presented are the results from 72 within estimations with firm-country, industry and time fixed effects. Dependent variables are in logs (1e-7 is added to avoid truncation). Robust and firm-country clustered standard errors are in parentheses. For brevity, other firm and gravity estimates are not reported.
* p <0.10, ** p < 0.05, *** p < 0.01

For the employment of low-skilled migrants, we again find fewer consistent patterns in the results. The results for all offshoring at the top of table indicate that the effect is strongest for small- and medium-sized firms, which the next column indicates occurs when offshoring is to high-income countries. Further down in the table, the results suggest that this occurs primarily because of offshoring of contract intensive (small firms only) and non-R&D intensive products. However, non-contract intensive products have significant effects from the employment of unskilled migrants in offshoring by medium- and large-sized firms.

The negative effects of low-skilled migrant employment on offshoring found in Table 5 were found to be confined to offshoring to low-income countries. Here, in Table 6, negative and significant effects are found for the offshoring of non-contract intensive products by small firms and R&D intensive products by large firms. Aside from this, there are no other significant effects. Indeed, across the table, the employment of low-skilled migrants still has the weakest effect on offshoring to low-income countries.

7 Conclusion and Final Remarks

Exchange in intermediate goods accounts for a considerable share of international trade. Complex and increasingly global value chains make firms dependent on producers across many different countries. Firms themselves only account for a thin slice of the value chains of their specific industry. Intermediate trade distinguishes itself from trade in general by being especially sensitive to distance in time and space, hold-up problems, incomplete contracts and weak institutions. Therefore, individuals with a unique knowledge of foreign markets and access to trust-enhancing networks—such as immigrants—could reduce the transaction costs associated with offshoring. To our knowledge, no previous study has focused on the potential influence of immigration on offshoring at the firm level. The aim of this study has been to bridge this gap.

The analysis provides evidence in support of a statistically and economically significant positive impact of immigrant employees on offshoring: hiring one additional foreign-born worker increases the value of offshored inputs by three percent in the baseline model. These effects were strongest when of the employee was a skilled migrant from a high-income country and the products were contract and R&D intensive. Under such circumstances,

these strong effects were also only present for large firms. Skilled migrants from low-income countries had a similar type of effect, although the magnitude of this relationship was approximately half that found for migrants from high-income countries. Overall, the employment of high-skilled migrants from low-income countries had a positive effect on the value of offshoring.

In contrast to this observation, we find fewer systematic and occasionally negative effects of the employment of low-skilled migrants from low-income countries on offshoring. To the extent that there were positive effects from low-skilled migrants on offshoring, they appear largely confined to migrants from high-income countries employed by small and medium-sized firms.

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APPENDIX

Table A1. Variable Descriptions and Sources

Variable	Definition	Source
Offshoring	Intermediate imports in 1,000 SEK (approx. 148 USD)	Statistics Sweden, FTS
Immigrant employees	Number of foreign-born employees in firm	Statistics Sweden, RAMS and PS
Employees	Number of employees (full-time equivalents)	Statistics Sweden, SBS
Multinational	Multinational status dummy; unity if a firm is part of an enterprise with firms abroad, zero otherwise	Statistics Sweden, EGR
Offshorer	Unity if the firm imports intermediates, zero otherwise	Statistics Sweden, FTS
Labor productivity	Value-added per full-time employee	Statistics Sweden, SBS
Human capital intensity	Share of employees with post-secondary education	Statistics Sweden, RAMS
Physical capital intensity	Capital stock per full-time employee	Statistics Sweden, SBS
GDP	Partner's GDP calculated in constant prices	World Bank
Population	Partner's size of population	World Bank
Distance	Distance in kilometers between Stockholm and partner's capitol (weighted by the two cities' populations)	CEPII
Adjacency	Unity if partner shares a national border with Sweden, zero otherwise	CEPII
Landlocked	Unity if partner is landlocked, zero otherwise	CEPII
English	Unity if English is official language in partner country, zero otherwise	CEPII
Trade openness	Index based on partner's trade-weighted average tariff plus the incidence of non-tariff barriers to trade (0-100, where higher values correspond to freer trade)	Heritage Foundation
Business burden	Index of cumbersome business environment (0-1, where a higher value corresponds to a more cumbersome business environment)	World Bank; authors' calculations
Common religion	Unity if partner is mainly Christian, zero otherwise	CIA World Factbook

Note: Sources from Statistics Sweden are Structural Business Statistics (SBS); Register Based Labor Market Statistics (RAMS), Foreign Trade Statistics (FTS); Population Statistics (PS); and Enterprise Group Register (EGR).

Table A2. Countries Included in the Sample

THE AMERICAS	Kyrgyzstan	Oman	SOUTHEASTERN AFRICA
Antigua and Barbuda	Latvia	Qatar	Angola
Argentina	Lithuania	Saudi Arabia	Botswana
Bahamas	Moldova	Syrian Arab Republic	Burundi
Belize	Poland	United Arab Emirates	Comoros
Bermuda	Romania	Yemen	Ethiopia
Bolivia	Russian Federation		Eritrea
Brazil	Serbia and Montenegro	NORTHERN AFRICA	Kenya
Canada	Tajikistan	Algeria	Lesotho
Chile	Turkmenistan	Djibouti	Madagascar
Colombia	Ukraine	Egypt	Malawi
Costa Rica	Uzbekistan	Libya	Mauritius
Cuba		Morocco	Mozambique
Dominica	WESTERN PACIFIC	Tunisia	Namibia
Dominican Republic	Australia		Rwanda
Ecuador	Brunei Darussalam	REST OF EUROPE	Seychelles
El Salvador	Cambodia	Andorra	South Africa
Grenada	China	Austria	Sudan
Guatemala	East Timor	Belgium	Swaziland
Guyana	Fiji	Luxembourg	Tanzania, United Rep. of
Haiti	Hong Kong	Cyprus	Uganda
Honduras	Indonesia	Denmark	Zambia
Jamaica	Japan	Finland	
Mexico	Kiribati	France	WESTERN AFRICA
Nicaragua	Korea	Germany	Benin
Panama	Lao People's Dem.	Greece	Burkina Faso
Paraguay	Malaysia	Greenland	Cameroon
Peru	Marshall Islands	Iceland	Cape Verde
Saint Kitts and Nevis	Micronesia	Ireland	Central African Republic
Saint Lucia	Mongolia	Italy	Chad
Saint Vincent and the Grenadines	New Zealand	Malta	Congo
Suriname	Palau	Netherlands	Congo (Democr. R.)
Trinidad and Tobago	Papua New Guinea	Norway	Côte d'Ivoire
United States of America	Philippines	Portugal	Equatorial Guinea
Uruguay	Samoa	San Marino	Gabon
Venezuela	Singapore	Spain	Gambia
	Solomon Islands	Switzerland	Ghana
EASTERN EUROPE & CENTRAL ASIA	Thailand	Turkey	Guinea
Albania	Tonga	United Kingdom	Guinea-Bissau
Armenia	Vanuatu		Liberia
Azerbaijan	Vietnam	SOUTHERN ASIA	Mali
Belarus		Bangladesh	Mauritania
Bulgaria	MIDDLE EAST	Bhutan	Niger
Czech Republic	Bahrain	India	Nigeria
Estonia	Iran	Maldives	Senegal
Georgia	Iraq	Nepal	Sierra Leone
Hungary	Israel	Pakistan	Togo
Kazakhstan	Jordan	Sri Lanka	
	Kuwait		
	Lebanon		

Table A3. Correlation

	Offshoring value	Immigrant employees	Country immigrant stock	Workforce	Multinational	Offshorer	Labor productivity	Human capital int.	Physical capital int.	GDP	Population	Distance	Contiguity	Landlocked	English	Low income
Offshoring value	1															
Immigrant employees	0.0850	1														
Country immigrant stock	0.1164	0.0302	1													
Workforce	0.1475	0.0685	-0.0006	1												
Multinational	0.1030	0.0234	-0.0001	0.5214	1											
Offshorer	0.9911	0.0758	0.1166	0.1427	0.1016	1										
Labor productivity	0.0363	0.0037	0.0071	0.1271	0.1514	0.0351	1									
Human capital int.	0.0501	0.0106	0.0029	0.2999	0.2459	0.0503	0.1079	1								
Physical capital int.	0.0217	0.0047	-0.0015	0.1124	0.0642	0.0205	0.1288	0.0164	1							
GDP	0.2177	0.0221	0.6252	-0.0009	0.0012	0.2182	0.0105	0.0044	-0.0012	1						
Population	0.1013	0.0166	0.6491	-0.0001	0.0003	0.1014	0.0017	0.0007	-0.0001	0.7508	1					
Distance	-0.2197	-0.0424	-0.3934	-0.0000	0.0000	-0.2175	-0.0000	-0.0000	-0.0000	-0.3348	-0.1712	1				
Contiguity	0.1985	0.0770	0.1348	0.0000	-0.0000	0.2026	-0.0000	0.0000	-0.0000	0.1156	0.0039	-0.2950	1			
Landlocked	-0.0265	-0.0094	0.0075	-0.0000	0.0000	-0.0257	-0.0000	-0.0000	-0.0000	-0.1624	0.1085	-0.0253	-0.0459	1		
English	-0.0270	-0.0136	-0.2699	-0.0000	-0.0000	-0.0261	-0.0000	-0.0000	0.0000	-0.2153	-0.3082	0.3187	-0.0630	-0.0959	1	
Low income	-0.1075	-0.0120	0.0092	0.0004	-0.0007	-0.1077	-0.0047	-0.0019	0.0004	-0.3753	0.2579	0.2161	-0.1085	0.2562	-0.1015	1

Note: All variables in logs, except dummy variables and the immigrant employee variable.

Table A4. Stylized Data for Main Partner Countries

Partner country	Value	Share of offshoring	Contract intensive share	R&D intensive share	Country immigrant stock
Germany	51,951,721	0,21	0,59	0,05	45,034
United Kingdom	25,840,320	0,10	0,59	0,09	18,486
France	22,234,729	0,09	0,42	0,12	6,946
Finland	20,604,045	0,08	0,33	0,00	178,179
Norway	19,575,599	0,08	0,21	0,06	44,59
Belgium and Luxembourg	12,979,255	0,05	0,51	0,01	1,837
Netherlands	11,747,551	0,05	0,31	0,12	7,204
Denmark	10,350,783	0,04	0,50	0,02	45,941
Italy	7,481,761	0,03	0,61	0,03	6,845
Poland	7,383,813	0,03	0,67	0,04	58,18
United States of America	6,602,223	0,03	0,51	0,14	15,309
Russian Federation	5,735,494	0,02	0,01	0,19	19,27
Japan	4,308,144	0,02	0,40	0,05	2,667
Czech Republic	3,733,535	0,02	0,69	0,02	7,961

Note: Top Swedish offshoring destinations in 2007 in 1,000 SEK (148 USD).

Table A5. Sweden's Largest Immigrant Groups

	Immigrant country	Total stock	Share of population		Immigrant country	Total stock	Share of population
1	Finland	163,867	1.71%	11	Norway	42,884	0.45%
2	Iraq	127,860	1.34%	12	Thailand	35,554	0.37%
3	Poland	75,323	0.79%	13	Chile	28,425	0.30%
4	Serbia/Yugoslavia	69,269	0.72%	14	Syria	27,510	0.29%
5	Iran	65,649	0.69%	15	China	26,824	0.28%
6	Bosnia-Herzegovina	56,595	0.59%	16	Lebanon	24,743	0.26%
7	Germany	48,731	0.51%	17	United Kingdom	22,670	0.24%
8	Turkey	45,085	0.47%	18	Romania	22,079	0.23%
9	Denmark	44,209	0.46%	19	Afghanistan	21,484	0.22%
10	Somalia	43,966	0.46%	20	India	19,415	0.20%

Source: Statistics Sweden (2013); authors' calculations.

Table A6. Results on the Propensity to Offshore across Firm Size

	(1)	(2)	(3)
	P(Offshorer)		
	Small	*Medium*	*Large*
Immigrant employees	0.0562***	0.00974**	0.00334
	(0.010)	(0.004)	(0.002)
Country immigrant stock (log)	0.112***	0.0731**	0.00437
	(0.031)	(0.030)	(0.015)
Workforce (log)	0.283***	0.199***	0.420***
	(0.012)	(0.016)	(0.022)
Multinational (0,1)	0.0755***	0.0656***	0.0416*
	(0.011)	(0.013)	(0.024)
Labor productivity (log)	0.0269***	0.0105	-0.0119
	(0.010)	(0.006)	(0.011)
Human capital intensity (log)	0.00177*	0.0206**	0.251***
	(0.001)	(0.009)	(0.044)
Physical capital intensity (log)	0.000264	0.0108***	0.0150***
	(0.001)	(0.002)	(0.003)
GDP (log)	0.583***	0.585***	0.478***
	(0.047)	(0.053)	(0.069)
Population (log)	0.911***	0.0212	0.211
	(0.156)	(0.141)	(0.169)
Obs.	5,312,753	1,763,600	501.898
Pseudo R^2	0.388	0.482	0.533

Notes: Presented are results for within-firm estimations with firm-country, industry and time as fixed effects. Robust and firm-country clustered standard errors are in parentheses.
* p <0.10, ** p < 0.05, *** p < 0.01

Table A7. Results for Imports of Non-Intermediate Goods across Firm Size

	(1)	(2)	(3)
	Small	Medium	Large
Immigrant employees	0.0269	0.0355**	0.0260***
	(0.018)	(0.014)	(0.008)
Obs.	6,147,949	1,951,856	506,274
Adjusted R^2	0.67	0.72	0.79

Notes: The dependent variable is imports of capital and consumption but not intermediate goods (1e-7 is added to avoid truncation). All results are within-firm estimations with firm-country, industry and time as fixed effects. Robust and firm-country clustered standard errors are in parentheses.
* p <0.10, ** p < 0.05, *** p < 0.01