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Immigrant Employment and the Contract Enforcement Costs of Offshoring

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Offshoring continues to be an important dimension of firms' internationalization choices. However, offshoring also increases contract enforcement costs by inhibiting the coordination and monitoring of performance. Immigrant employees may reduce such costs through their specific knowledge of the employer, their country of birth and access to foreign networks. We develop a heterogeneous firm framework with immigrants and offshoring costs, including technology leakage. In the model, immigrant employees augment the supervisory services of headquarters and limit technology leakage, thereby reducing contract enforcement costs. Then, we bring our conjectures to rich administrative Swedish microlevel data that include specific information about the characteristics of employees, manufacturing firms and their bilateral offshoring. Our results support the hypothesis that immigrant employees increase offshoring intensity by lowering contract enforcement costs. Hiring one additional immigrant employee can increase offshoring by up to three percent on average, with the strongest effects found for skilled immigrant employees.

JEL Classification: F22, F23, F14, D21, D83

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1 Introduction

Among its many economic effects, the COVID-19 pandemic has highlighted the vulnerability of international value chains to disruptions, such as those from health-related threats and diverging policy instruments. To build greater resilience into international supply chains, firms may therefore need to increase investment in monitoring and long-term relationships with foreign upstream suppliers (Miroudot 2020).[5] As is well known from the offshoring literature, such remote monitoring, communication and coordination of offshore production is difficult, increasing contract enforcement costs (Grossman and Rossi-Hansberg 2018).

In this paper, we contribute, for the first time, theoretical and empirical evidence that immigrant employees can reduce such frictions and thereby facilitate firms' offshoring (Antràs and Helpman 2004; Rauch 2001). Immigrant employees possess knowledge about and networks within both their offshoring firm and their own country of birth. Their geographic proximity to senior managers of the firm promotes the volume and quality of the tacit information that is transmitted to the firm. Their own closeness to the foreign supplier's country facilitates remote communication and monitoring. Immigrant employees may therefore reduce contract enforcement costs for the firm that employs them by increasing the firm's capacity to coordinate, monitor and cajole the foreign upstream supplier to deliver, even in times of crisis. In this way, immigrant employment can increase the intensity and resilience of firms' offshoring relationships.

We conceptualize this idea by developing an offshoring model with heterogeneous firms and immigrants.[6] In our model, offshoring inhibits coordination and monitoring, in addition to increasing fixed costs for finding a supplier. Offshoring also imposes the risk of technology leakage, in a broad sense, including leakage of intellectual property rights and details about production, as well as supplier, distributor and customer networks. Technology leakage would allow the entry of new rivals of the offshoring firm. Immigrant employees with different skill levels can to a varying extent augment a firm's headquarters services related to the coordination and monitoring of

[5] An alternative suggestion is to reshore production. Firms do not appear to be following this route, with trade in intermediate goods already reaching prepandemic levels.

[6] We draw on the heterogeneous firm trade models of Melitz (2003), Helpman et al. (2004) and Antras and Helpman (2004), as well as the R&D-offshoring exporters' model with technology leakage of Garcia-Vega and Huergo (2011), to provide a parsimonious framework for studying the effects of immigrant employment on variable contract enforcement costs.

offshoring as well as limit technology leakage, thereby reducing variable contract enforcement costs. In addition, immigrant communities contribute to the pool of knowledge about their home countries, thereby reducing the fixed offshoring costs of firms.

In the empirical part of the paper, we investigate whether the employment of more immigrants from a given country by a firm affects the intensity of offshoring to that same country. As with all empirical work on the connection between immigration and international trade, we must confront challenges to causal identification. We consider three approaches to this issue.

First, we recognize that employment by a firm of migrant workers from a given country does not occur randomly. The matched employer-employee data for Sweden that we use, which includes information on the country of birth of immigrant employees and the countries to which inputs are offshored by the firm, offers opportunities to address these issues. To focus tightly on our mechanism of interest, our baseline estimations include firm-country fixed effects. Adding these controls allows us to remove the effect of (time-invariant) firm-specific unobservable managerial or owner characteristics that make the firm simultaneously more open to a specific foreign market and to the employment of workers from that market. It also controls for (time-invariant) country-specific differences in institutional characteristics that affect the likelihood of workers appearing as migrants in Sweden and being used for offshoring. In addition, it extends these ideas to recognize that the specificities of the firm and the particular country may interact, i.e., the knowledge and understanding managers or owners have of the institutional, cultural and tacit characteristics of a country and its migrants, including any prejudices they have, are likely to be both firm and country specific. This knowledge could affect their willingness to use migrant employees from specific countries to supervise particular offshoring relationships and the intensity they use those destinations as a source of inputs.

Second, we present the results using an instrumental variable (IV) approach. Of concern here is the presence of time-varying changes at the firm-country level that might confound our findings for migrant employment and that exist in addition to the time-invariant firm-country effects we already control for. We consider two sets of instruments, both of which are based on factors governing immigration that are external to the firm. The first instrument set exploits the presence of demonstration effects from other firms and the idea that Swedish firms are

increasingly working to promote diversity in the workforce (Proffice Group 2015). We construct measures of the average number of immigrants employed in other Swedish firms over time and, as a refinement of this, the average number of immigrants employed in other firms within the same three-digit industry. We utilize the time variation in the instrument to capture trends in hiring policies. The dual approach enables us to test for instrument exogeneity. As an alternative IV strategy, we build upon the idea that the flow of immigrants to Sweden is outside of the control of an individual firm. Here, to ensure that the immigrant shocks are exogenous to Swedish firms, we exploit the strong correlation between Swedish and Danish immigration stocks using shocks to Danish immigration. Our Bartik-style instrument connects the fixed preperiod employment of immigrant workers by Swedish firms with Danish shocks to immigration from each country.

Third, we provide further support for the idea that immigrant employees carry assets that can reduce variable contract enforcement costs by exploiting the granularity of the data to consider treatment heterogeneity. Under our hypothesis, an immigrant employee, with knowledge and networks of her employing firm as well as her host and home countries, has an advantage in supervising the offshoring relationship between her firm and a foreign supplier from the country of her birth. However, immigrant employees from a country are not homogenous in the assets they carry; those with the highest skill levels are likely to have the most relevant knowledge, abilities, and networks, as well as the greatest opportunity to communicate with managers in both the offshoring and the supplying firm. Skilled immigrant employees can therefore effectively augment the supervisory services of the headquarters and deter technology leakage during the *ex post* contracting phase by improving coordination, monitoring and persuasion, as well as by promoting trustful relations. As a result, we would anticipate weaker or an absence of effects on offshoring intensity when the firm employs immigrants who are less skilled. The less skilled immigrants are likely to carry less relevant knowledge, abilities and networks. They are also further away from positions of responsibility within the firm. We would also anticipate that other skills possessed by immigrants, such as language skills for translation or the experience with the formal and informational institutions within a country, are unlikely to substantially differ across workers and industries, ruling out alternative mechanisms. Additionally, we expect contract enforcement costs to be the highest for inputs that are contract- and R&D intensive. We therefore extend

the analysis to test whether the effects of immigrant employment are strongest for skilled workers and contract and R&D-intensive inputs.

The baseline results from the empirical analysis suggest that employment of immigrants increases the value of offshored inputs purchased by Swedish firms. Hiring one additional foreign-born person from country *c* can increase offshoring by up to three percent on average to country *c*. These effects are, however, largely confined to skilled immigrants and to R&D and contract-intensive products. At its largest, we find that employing an additional skilled immigrant increases the value of offshored contracts and R&D-intensive products by 11 to 24 percent on average. This pattern of results supports the proposition that offshoring firms can utilize the knowledge, abilities and contacts of foreign-born employees to reduce contract enforcement costs related to, e.g., monitoring, coordination and technology leakage. In this way, hiring immigrants may promote the intensity and resilience of firms' offshoring activities. Additionally, we find that immigrant communities increase the probability to offshore to their country of origin, suggesting a lowering of the fixed costs of offshoring. Outside of the employment of skilled immigrants, the analysis generates less consistent evidence of an effect on the value of offshoring from immigrant employment.

This paper is organized as follows. Section 2 describes previous research and identifies more clearly the contributions this paper makes to the literature. 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, along with various extensions and robustness tests. Section 7 concludes. (Additional results and details are provided in the Online Appendix.)

2 Related Research

This study is related to two strands of literature. First, it adds to the literature on trade costs and their effect on offshoring decisions. This literature emphasizes that firms may split production across different countries to achieve benefits from, *inter alia*, differences in labor costs (Grossman and Rossi-Hansberg 2008, 2012; Bernard et al.

2020).[7] In these models, the procurement of intermediate inputs from foreign producers by firms is then 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, more importantly, coordination and monitoring.

The trade costs associated with offshoring commonly take two different forms. Offshoring is associated with sunk costs, such as those related to searching for matching suppliers (Antràs and Helpman 2004). Offshoring also involves variable costs beyond transportation because it requires cross-border coordination and monitoring of the value chain to ensure contract enforcement (Head et al. 2009; Cuberes 2013; Cristea 2012; Growe 2019). These supervisory costs increase with distance, as long-distance coordination and monitoring are inherently difficult.[8] Differences in the business environment, alongside cultural factors, can further complicate long-distance business relations and increase uncertainty. Firms may therefore need to invest in establishing, sustaining and developing long-distance relations (Johanson and Vahlne 2009; Hasche 2013).[9] We conceptualize and empirically analyze the role of foreign-born employees in promoting offshoring through the reduction in variable contract enforcement costs.

Second, our study is closely related to the empirical literature on the relationship between migration and trade, ignited by the seminal papers of Gould (1994) and Head and Ries (1998). This literature assumes migrants can reduce information frictions and increase trust in trading relationships (the foreign market and contacts mechanism), facilitating international trade, alongside a direct effect from raising bilateral imports from their countries of origin (the preference mechanism).

[7] Globally, trade in intermediates accounts for 57 percent of world trade (WTO 2019). In the OECD countries, intermediate goods and services account for 56 percent and 73 percent of total trade, respectively (Miroudot et al. 2009).

[8] The current pandemic illustrates the potential of the internet to facilitate remote work, yet it appears to be second-best when comparing survey and job ads data (Holgersen et al. 2020). 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). Studies by Blum and Goldfarb (2006), as well as Hortacsu et al. (2009), find that geographic distance discourages consumption even for e-commerce. Head et al. (2009) estimate the distance effects to be of similar magnitudes for goods and services. Mok et al. (2007) discuss the importance of distance for interpersonal contact and support, before and after the internet, while Agrawal et al. (2015) find social networks to continue to be rather local despite contemporary social media. For an overview of geography and the internet, see Greenstein et al. (2018).

[9] These are examples of 'informal barriers to trade' that have received increased attention in the trade literature (e.g., Roberts and Tybout 1997; Anderson and Marcouiller 2002; Melitz 2003; Anderson and van Wincoop 2004; Nunn 2007; Melitz 2008; Felbermayr and Toubal 2010; Kneller and Pisu 2011; Petropoulou 2011). Allen (2014) studies information frictions in trade and finds them to be as costly as cross-border transport.

To date, a large number of studies have investigated the trade facilitating role of migration.[10] An important paper in establishing causal relationships is Parsons and Vezina (2018), who provide quasi-natural experimental evidence. Their starting point is the end of the Vietnam war and the large number of Vietnamese that were assisted by the US military to become refugees and settle in the United States, the locations for which were largely predetermined. During this time, there was an embargo on US trade with Vietnam. The study finds a significant positive relationship between the settlement of refugees in the mid-1970s and US-Vietnam trade when the embargo was finally lifted 20 years later. In a similar vein, we emphasize the foreign market and contact mechanism as a route through which migrants may affect international trade, although we are able to exploit richer employer-employee data to focus more narrowly on the role immigrant employees play in reducing contract enforcement costs for offshored inputs.

We also build on a small number of recent studies that use matched employer-employee data, although the majority of these explore the link between migrants and exports. Hiller (2013) investigates the role immigrant employees and regional immigrant communities play in the export intensity of Danish firms and finds a statistically positive association between firm export sales and foreign-born workers. Hatzigeorgiou and Lodefalk (2016) develop a heterogeneous firm model for exports and use panel data for Sweden to find a robust positive effect of immigrant employees on exports. Andrews et al. (2017) and Marchal and Nedoncelle (2019) exploit panel data for Germany and France to study the immigrant-export link, again confirming a pro-export effect at the firm level.

Within this new literature, our approach is most closely related to Ghani et al. (2013), previous work on Sweden by Hatzigeorgiou and Lodefalk (2016), two studies on Denmark by Moriconi et al. (2018), and Olney and Pozzoli (2021).[11]

[10] 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 goods trade and migration literature, see Genc et al. (2011) and Felbermayr et al. (2012) and for reviews of internationalization more generally and its relation to migration literature, see Hatzigeorgiou and Lodefalk (2021). 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).

[11] Two related papers on services trade are Hatzigeorgiou and Lodefalk (2019) and Ottaviano et al (2018).

Ghani et al. (2013) focus on outsourcing (to India) via an internet-based labor market. The study differs from 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. (2013) find that outsourcing by company employees of likely Indian ethnicity via the internet-based job market is biased toward India and is associated with a cost advantage, where the impact is likely derived from taste-based discrimination.[12] This finding suggests that the intensity with which the online platform is used to contract with Indian workers is primarily associated with the experience of the firm with the platform; therefore, ethnicity affects the extensive rather than intensive margin of imports. The focus on the outsourcing of mostly minor service tasks on an online platform is quite different from the offshoring of input production within the manufacturing sector that we study, given that our offshoring contracts are greater in value and typically last for much longer lengths of time.

Olney and Pozzoli (2021) and Moriconi et al. (2020) have contributed two related studies exploiting Danish longitudinal microlevel data. Olney and Pozzoli (2021) apply a quasi-natural experiment with a shift-share instrument to estimate the impact on goods offshoring from the local workforce share of foreign-born individuals from non-EU countries. A measure of the migrant stock at the multilateral level produces a negative result, which suggests a consequence of the substitution of immigrant labor for offshoring. In contrast, a positive result on the probability to offshore is found with a measure of the stock of migrants at the bilateral level, which is explained by market-specific information. This same measure has an nonsignificant effect on the volume of offshoring. The bilateral impact is stronger for more senior foreign-born immigrants, measured in terms of education or occupation.

Moriconi et al. (2020) employ data for manufacturing firms with at least 10 employees (2,000 firms) and a shift-share instrument with the fixed preperiod municipal immigrant share and the running country immigrant stock to study the effect of the firm share of immigrants and foreign country institutions on a firm's bilateral probability to offshore. The proposition is that the fixed costs of entering offshoring are affected by host country institutions and information, as well as linguistic frictions, which are presumed to be lower for firms with foreign networks (measured as the instrumented firm immigrant share). The main results indicate that institutions and the

[12] More generally, Sangita (2013) explores the macrolevel 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.

instrumented immigrant share are positively associated with the extensive firm-country margin of offshoring but have no statistically significant effect on the intensive margin.[13] We instead focus on the role of immigrant employees in reducing the variable costs that are associated with the enforcement of contracts with offshore suppliers. Our paper also differs in estimation from, e.g., Olney and Pozzoli (2021) and Moriconi et al. (2018). For identification, we adopt a firm-level gravity approach that, among other things, controls for time-variant country heterogeneity and for multilateral trade resistance, as well as time-invariant unobserved firm-country heterogeneity. Furthermore, we study the number of immigrant employees rather than the share of immigrants. In our conceptual framework, an immigrant employee can be instrumental, regardless of the size of the firm.[14]

Finally, unlike the study by Hatzigeorgiou and Lodefalk (2016), which focuses mostly on exports, we analyze offshoring in depth, both conceptually and empirically.[15] As mentioned, we contribute to filling the gap in the previous research by developing a new offshoring framework for heterogeneous firms and immigrant employees and then using that framework to guide a detailed analysis of the effects of immigrant employees on offshoring.

3 Conceptual Framework

In this section, we develop the conceptual framework and its demand and supply sides before arriving at the propositions on the role of immigrants. Our two-sector model builds on Melitz (2003), Helpman et al. (2004), Antras and Helpman (2004) and Garcia-Vega and Huergo (2011). One sector is producing a homogenous good x_0 under perfect competition, and the other sector is producing differentiated goods q under increasing returns. Output is produced with inputs from headquarters (h) and manufacturing (m). In the differentiated goods sector, there are n firms, each producing a variety g of good q in the North and South. The regions are symmetrical in terms of factor

[13] Interacting the institutional measures with the immigrant share suggests that immigrants attenuate the credit risk in foreign markets but increase the negative effect of corruption on offshoring probability.
[14] We consider a small firm's hiring of an immigrant worker from a specific country, representing, for example, a 50 percent increase in the share of immigrant workers from that country in that firm, as more comparable to a similar single hire in a large-sized firm than a 50 percent increase in the share, which may represent hiring 100 immigrant workers from a single country.
[15] Swedish imports consist of more than a quarter final goods and the remainder are intermediate goods. However, there is also a substantial heterogeneity in the character of firms' imports, with a nonnegligible share of firms either only importing final or only intermediate goods.

supply and taste but may differ in their use of technology. 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 firms differ in terms of the presence of foreign-born employees in the workforce and their country of origin .

3.1 Demand

We use a two-tier utility function with the upper level (Cobb–Douglas) denoting the consumers' choice between homogenous and the differentiated goods and the lower level denoting the choice between different variants of the differentiated goods (represented by a CES)

$$U = {x_0}^{1-a} Q^a, \tag{1}$$

where x_0 is the consumption of the homogenous numeraire good, Q is the consumption of the differentiated goods $q_1 \dots q_n$, and a is the share of the income that is spent on differentiated goods.[16] The consumption of the differentiated good is given by the following equation:

$$Q = \left(\int_{g=0}^{n} q_g^{\frac{\sigma-1}{\sigma}} dg \right)^{\frac{\sigma}{\sigma-1}}, \tag{2}$$

where n is the number of differentiated goods, q_g is the consumption of the varieties and $\sigma > 1$ is the elasticity of substitution between the differentiated goods, with $0 < a < 1 < \sigma$. The homogenous good is treated as a numeraire such that the price is equal to unity, $p_0 = 1$, with wages being normalized to one across countries. The direct demand for a variety g is given by the following equation:

$$q_g = \frac{\delta a p^{-\sigma}}{P^{1-\sigma}}, \tag{3}$$

where p is the consumer price of a single variety, δ is an inverse measure of technology leakage, where $\delta \in [0, 1]$, and P is the aggregated price index of the differentiated goods defined as follows:

[16] Preferences are assumed homothetic between the homogeneous good x_0 and the differentiated goods Q.

$$P = \left(\int_{g=0}^{n} p(g)^{1-\sigma} \, dg \right)^{\frac{1}{1-\sigma}}. \quad (4)$$

The inverse measure of technology leakage captures that the consumer demand for a specific product variety may decrease when a supplier offers a very similar product, using another firm's technology, but charges a lower price. Here, we consider technology in a broad sense, including both registered and unregistered intellectual property rights, as well as, e.g., knowledge about marketing the good and how to organize and coordinate its production. If, for example, an offshoring firm matches with a supplier that 'leaks' technology to rival firms, e.g., by selling the technology to a competitor in the same region or by entering into the industry as a new competitor, the final demand for the good will decrease for the offshoring firm (e.g., Lai et al. 2009, Garcia-Vega and Huergo 2011).[17] For lower values of δ (i.e., high leakage), consumer demand for the final good will be low, and the corresponding cross-price elasticity will be high. If $\delta = 1$, there are no leakage effects.[18] Due to incomplete contracts, final-good producers in the North will anticipate δ to be too low, especially in regard to offshoring to the South, where institutions are expected to be weak. They will, therefore, be reluctant to offshore intermediates in general and to the South in particular and offshore less than without leakage. However, the employment of immigrants by final goods producers in the North reduces leakage, making firms more willing to offshore.

3.2 Supply

We consider a world economy with a continuum of downstream firms g in multiple countries $c \in C$, each with a productivity φ drawn from a known distribution $G(\varphi)$ to produce variety g. Final-good producers use their headquarters services (h) and manufactured components (m) in production.[19] They may substitute some manufactured inputs produced by their firm at home with imports from a foreign (internal or external) upstream

[17] We assume that the technology 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 the North could be transferred to an intermediate-good supplier in the South to produce a new variety of the differentiated good.

[18] The corresponding inverse demand is $p(g) = \frac{P^{1-\sigma}}{\delta a} q^{-\frac{1}{\sigma}}$.

[19] In the model, headquarters services, such as knowledge in marketing, management, or product-specific research and development (R&D) assets, are produced in North (Helpman 1984).

supplier, that is, the firm may offshore m.[20] Assuming a Cobb–Douglas output, then the supply is given by the following equation:

$$q_g = \varphi_g \left(\tau_{gc} h_g\right)^{1/2} (m)^{1/2}, \tag{5}$$

where φ_g is the firm-specific productivity and $\tau_{gc} > 1$ indicates that the number of immigrant employees in firm g from country c, close to or at the headquarters, increases offshoring to that country.[21] If $\tau_{gc} = 1$, there is no advantage. Moreover, τ_{gc} is destination specific and is higher when trade is bilateral between the firm and the home country of the migrant. Additionally, it increases with the skill level of the migrants such that $\tau^{HS} > \tau^{LS}$, where HS denotes high-skilled and LS denotes low-skilled migrants.

Let us now introduce some additional costs and benefits faced by firms. f is the fixed costs to start production and f_O is the additional fixed costs associated with offshoring, while b is the benefit from having immigrant communities and potentially also immigrant employees from country c.

We assume that the world economy consists of an infinite number of potential suppliers of m. Sourcing inputs from an upstream firm is potentially more efficient than in-house production. Hence, sourcing inputs from abroad can (1) increase the efficiency of the downstream firm when inputs are produced more inexpensively abroad and (2) allow the firm to use existing resources more efficiently. Since firms differ in their productivity level φ, a higher φ implies lower marginal costs.

However, sourcing intermediates from abroad is associated with offshoring costs, in addition to the risk of technology leakage. Therefore, it is possible that firms will abstain from offshoring. Offshoring costs stem from several sources. First, a firm that wants to offshore has to search for a foreign market and supplier, as well as establish a contract with the foreign supplier, incurring fixed offshoring costs f_O. This process is crucial.[22] Firms aim to avoid potential 'lemons,' defined as foreign suppliers that are producing with high uncertainty in terms of delivery and/or product quality. The risk of choosing a lemon is presumably smaller if the final-good producer has

[20] We will abstract from different implications that immigrants may have on the decision in firms to engage in foreign direct investments (FDI) or offshore the production to independent foreign suppliers.
[21] To simplify the model, we assume that headquarter (h) and manufacturing (m) inputs are equally important, i.e., $\eta_j = 1/2$.
[22] Naghavi and Ottaviano (2009) explicitly model how hold-ups reduce the supply of inputs, increasing the price but decreasing the upstream firm's bargaining power.

more knowledge about the foreign input market. The risk is also likely to be smaller if the final-good producer pays careful attention to the drafting of the contract with the upstream supplier to reduce its incompleteness and thereby minimize surprises for both parties. The offshoring contract also often involves sunk costs in the form of relationship-specific investments in capital or R&D assets by both parties. The fixed offshoring costs f_O can be partly offset by the benefits b from having immigrant communities from country c in the country of the offshoring firm.

Second, during the *ex post* contracting phase, the offshoring firm has to spend additional resources to ensure that the foreign supplier delivers according to the contract, implicitly incurring variable offshoring costs beyond technology leakage. More specifically, the firm must engage in long-distance communication, coordination and monitoring to counterbalance the partial loss of control of production that emerges when production and headquarters activities are geographically separated (Grossman and Rossi-Hansberg 2008). If the firm suspects that the foreign supplier has started to deviate from what the offshorer had expected, e.g., in terms of delivery or quality, the firm must persuade the supplier to adjust accordingly. These variable offshoring costs related to ensuring contract fulfilment are reduced by having immigrant employees in the offshoring firm, captured by $\tau_{gc} \geq 1$.

In summary, due to the higher costs associated with sourcing inputs from abroad, low productivity firms will source domestically, high productivity firms will source from abroad, and the intensity of the high productivity firms' offshoring will be depressed because of the additional costs of offshoring.[23] The presence of immigrants may lower offshoring costs and thereby promote offshoring.

3.3 Equilibrium

To evaluate how migrants affect offshoring, we start by evaluating how they enter the profit function. Each firm's profit function is given as follows:

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

$$\pi \equiv p(g)q(g) - (h+m) - (f + f_o - b)$$

$$= \Omega\left[\varphi_g\left(\tau_{gc}h_g\right)^{\frac{1}{2}}(m)^{\frac{1}{2}}\right]^{\frac{\sigma-1}{\sigma}} - (h+m) - (f + f_O - b) \quad (6)$$

where Ω is the market size of the differentiated sector and $\Omega = \left(\frac{P^{1-\sigma}}{\delta a}\right)^{-\frac{1}{\sigma}}$. First, we solve for the profit maximizing problem to obtain the optimal h^* and m^*; then, by inserting the optimal values in the profit function, we obtain the equilibrium firm profit as follows:

$$\pi^* = 2^{1-\sigma}\Omega^{\sigma-1}{\tau_{gc}}^{\frac{\sigma-1}{2}}\left(\frac{\sigma-1}{\sigma}\right)^{\sigma}\left(\frac{1}{\sigma-1}\right) - (f + f_O - b). \quad (7)$$

3.4 Propositions Regarding the Role of Immigrants

From the optimal profit function, we first note that profits decrease with fixed offshoring costs, $\frac{d\pi^*}{df_O} < 0$, and increase with fixed benefits from immigrants, $\frac{d\pi^*}{db} > 0$. Second, we note that profits increase with the number of immigrant employees from the foreign supplier country, $\frac{d\pi^*}{d\tau_{gc}} > 0$, and the effect is higher for high-skilled workers, $\frac{d\pi^*}{d\tau_{gc}^{HS}} > \frac{d\pi^*}{d\tau_{gc}^{LS}} > 0$. Third, profits are positively related to the (inverse) technology leakage measure, $\frac{d\pi^*}{d\delta} > 0$, where a higher value of δ means lower leakage, which is why profits are indirectly and positively related to immigrant employees through their reduction in leakage. Emanating from these observations, we arrive at a number of propositions, which we discuss below.

Immigrants spur offshoring via improved 'offshoring technology' (Grossman and Rossi-Hansberg 2008; 2012) (**H1**).[24] Immigrants have tacit knowledge about the country of their birth that is important for firms that wish to discover, establish and maintain successful business relationships with foreign upstream suppliers. Migrants

[24] This potential offshoring-enhancing role of migrants is consistent with the predictions of network trade theory (Rauch 1996; 1999; 2001). 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 surprising 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).

know about the institutions and the cultural context that the upstream firms wish to operate in. They speak the language of their former home country and have access to social networks there, including those developed while pursuing their education. Therefore, by dissipating knowledge and reducing network distance, the presence of immigrant communities facilitates firms wanting to offshore their production, leading to a country-wide reduction in offshoring costs. In the model, this is captured by an increase in b that partly offsets f_O. Hiring immigrants in the offshoring firm may further sustain this effect on the extensive margin of offshoring. Importantly, hiring immigrants as employees also promotes offshoring at the intensive margin. During the *ex post* contracting phase, that is, in the continued relationship with the upstream foreign supplier, immigrant employees augment headquarters supervisory services h related to the fulfilment of the contract, its renewal and potential expansion, as well as to continuous improvements in offshore production. They also reduce technology leakage δ in the *ex post* contracting phase.[25] By being employed and from the foreign country, immigrant employees have intimate knowledge of their employing firm and their country of birth, as well as relevant networks there, which can be levied both for infusing trust and making credible reputational threats. Therefore, immigrant employees increase the capacity of their firms to coordinate and monitor upstream suppliers of intermediate inputs, to communicate and cajole to minimize contractual frictions, including hold-up problems and to reduce technology leakage.[26]

The gains from the presence of immigrant employees may differ according to whether offshoring is with countries that are similar and developed than, in our case, Sweden (**H2**). Due to the weaker property rights and contract enforcement in the South, immigrant knowledge and networks are more valuable in those markets (Grossman and Helpman 2012).[27]

[25] The scope for leakage arguably increases with the intensity of offshoring to a supplier and with how "core" the offshored inputs are to the firm's final products.

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

[27] In Levchenko's (2007) theoretical model, the quality of institutions and contract enforcements 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.

We expect a stronger impact on offshoring from skilled foreign-born employees, measured by their completion of postsecondary education or because they have substantial experience, for example, in management (**H3**). Skilled immigrant employees have superior abilities to disseminate relevant knowledge and contacts to their firm and to use this information in practice within the firm and its offshoring relations (Gould 1994). They have general and specific abilities, such as communication and persuasion skills and are also in or close to others in occupational positions requiring higher education levels and, therefore, have more input regarding business decisions (Aleksynska and Peri 2012; Mundra 2012).

Finally, the impact from immigrant employees is presumably largest with respect to the offshoring of more heterogeneous inputs since these inputs are expected to be particularly sensitive to information, coordination and monitoring frictions, relation-specific investment and the risk of technology leakage (Rauch 1999; Herander and Saavedra 2005; Nunn 2007) (**H4**). This impact is expected to be especially important in contracts where tacit information is more prevalent, such as in contract and R&D-intensive offshoring.

4 Empirical Approach

Using the prediction developed above that immigrants can promote offshoring by firms, we draw upon recent international trade models 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; Hatzigeorgiou and Lodefalk 2016).

We estimate the benchmark specification through two equations. The first (selection) equation models firm entry into offshoring, and the second (outcome) equation models how much the firm offshores, more specifically, as follows:

$$\begin{aligned} &\mathrm{E}(o_{gct} > 0 | me_{gct}, \boldsymbol{Z_{gt}}, \boldsymbol{V_{ct}}, \boldsymbol{U_{gc}}, \boldsymbol{H_{it}}, \boldsymbol{T_t}) \\ &\qquad = \Phi(\beta_{me} me_{gct} + \boldsymbol{Z_{gt}\beta_Z} + \boldsymbol{V_{ct}\beta_V} + \boldsymbol{U_{gc}\beta_U} + \boldsymbol{H_{it}\beta_H} + \boldsymbol{T_t\beta_T}), \end{aligned} \tag{8}$$

and

$$\mathrm{E}\left(ln(o_{gct})|me_{gct}, \boldsymbol{Z_{gt}}, \boldsymbol{V_{ct}}, \boldsymbol{U_{gc}}, \boldsymbol{H_{it}}, \boldsymbol{T_t}\right) = \beta_{me} me_{gct} + \boldsymbol{Z_{gt}}\boldsymbol{\beta_Z} + \boldsymbol{V_{ct}}\boldsymbol{\beta_G} + \boldsymbol{U_{gc}}\boldsymbol{\beta_U} + \boldsymbol{H_{it}}\boldsymbol{\beta_H} + \boldsymbol{T_t}\boldsymbol{\beta_T}, \quad (9)$$

where the expected conditional offshoring probability o_{gct} of firm *g* to partner country *c* at time *t* is a function of the number of immigrant employees me_{gct}; firm characteristics of row vector $\boldsymbol{Z_{gt}}$; gravity variables of row vector $\boldsymbol{V_{ct}}$, including immigrant communities from country *c*; observed and unobserved time-invariant heterogeneity at the levels of the firm, country and firm-country pairs of row vector $\boldsymbol{U_{gc}}$, including variables that are commonly used to proxy for factors such as transport costs;[28] 3-digit industry specific and time specific heterogeneity of row vectors $\boldsymbol{H_{it}}$, for industry *i*, and $\boldsymbol{T_t}$, respectively; and where Φ is a normally distributed cumulative density function.

The defining feature of our empirical strategy, which is made possible by our comprehensive and longitudinal employer-employee dataset, is the direct connection between the employment of immigrants from country *c* by firm *g* with offshoring from that country. Therefore, the immigrant employees me_{gct} of Swedish firms in equations (8) and (9) are the focus of the empirical results. Additionally, we pay attention to the role in offshoring of immigrant communities m_{gt} from country *c*. The Swedish stock of immigrants is included in vector $\boldsymbol{V_{ct}}$.[29]

An advantage of our empirical approach is that it minimizes the risk of confounding factors. The primary concern surrounds the possibility of omitted variable bias caused by unobservable firm characteristics that are correlated with the decision to offshore and the decision to hire foreign-born persons. The management of a firm could be more internationally focused and therefore choose to both offshore some aspects of production and to hire immigrants. These same managers/owners may also display a predisposition toward particular countries and biases against others. Following this, 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. It is worth noting that identification of the effects of immigration employment on offshoring in the two equations is therefore identified from changes in the employment of immigrants from that same country. For firms where employment is zero or is positive but does not change, any effect of migration is captured by the firm-country effects. In addition, the model accounts for

[28] Inclusion of country-year fixed effects adds substantially to the estimation complexity and is therefore only included in the robustness analysis. Practically, in the estimation of Eq. 8, we model firm, country and firm-country heterogeneity as a linear function of the mean of firm and gravity predictors *k* and *r* across time, that is, as $\sum_k \bar{z}_{kg} + \sum_r \bar{v}_{rc}$ (Mundlak 1978).

[29] The immigrant stock variable, as in all continuous covariates in equations (8) and (9), is expressed in logs. The exception is me_{gct}, which we do not log because of the many zeros within the data.

unobserved country-pair heterogeneity and therefore controls for multilateral trade resistance and bilateral particularities related to offshoring and immigration, irrespective of their positive or negative influence.

Alongside the extensive set of fixed effects, we control for a range of time-varying firm and country determinants of offshoring in the regressions. In vector $\boldsymbol{V_{ct}}$, we include, in addition to the immigrant stock, characteristics that affect bilateral trade resistance, including economic 'mass'—measured in terms of GDP. A set of explanatory firm-specific supply side factors are included in vector $\boldsymbol{Z_{gt}}$. These are firm size, productivity, ownership status, previous trade experience, and human and physical capital intensities.

Since the hiring of immigrants could potentially be endogenous even when controlling for a set of specific effects, e.g., due to time-variant changes at the firm-country level, we employ two IV strategies. For the first IV analysis, we apply a generalized-method-of moments (GMM) estimator with two instruments (Hatzigeorgiou and Lodefalk 2016). Having multiple instruments for me_{gct} enables us to test for instrument exogeneity, which is key for reducing asymptotic bias. The first instrument is the lagged average number of immigrants employed in Swedish firms other than *g*. The second is the lagged average number of immigrants employed in other firms within the same three-digit industry.[30] Both capture changes in the supply of migrant labor, as changes in the number of immigrants (from anywhere) employed by other firms in general and in the same industry of a firm are likely correlated with common trends in hiring policies. In Sweden, firms are increasingly working to promote diversity in the workforce (Proffice Group 2015). Additionally, we require that the presence of these immigrants in other firms or industries is unlikely to directly affect the offshoring decisions of the firm to country *c*, which would seem reasonable. We show that both our instruments are correlated with the number of immigrant employees from *c* employed by firm *g*. These instruments also fulfil the conventional criteria for an appropriate instrument, as indicated by standard statistical tests.

Finally, we employ an alternative Bartik-style IV strategy. The strategy forces the link from immigrant employment to offshoring by Swedish firms to be solely driven by changes across time in the Danish stock of immigrants from a particular country *c*, m_{ct}^{DK}, a stock that is unlikely to be driven by individual Swedish firm

[30] The first and second instruments use the second and third lags, respectively.

characteristics. To the best of our knowledge, our study is the first to implement such a strategy in a microlevel study on migration and internationalization. We exploit the fact that Swedish and Danish immigration stocks are similar and strongly correlated, while exogenous to Swedish firms' trade with foreign countries.[31] In the next step, we tie these shocks to Swedish firms. The link to firms consists of the preperiod average number of immigrant employees from that same country *c* in the same detailed industry *h* as the firm (for instrument one) and in the same firm workforce size category *s* as the firm, with small defined as having <50 employees, medium as having 50-249 employees, and large as having >249 employees (for instrument two). Thus, these Bartik-style instruments are given as follows:

$$me_{gct}^{IV_h} = m_{ct}^{DK}\left(\sum\nolimits_{g\in h} me_{gc98}^{*} \Big/ \sum\nolimits_{g\in h} I_g^{*}\right), \tag{10}$$

and

$$me_{gct}^{IV_s} = m_{ct}^{DK}\left(\sum\nolimits_{g\in s} me_{gc98}^{*} \Big/ \sum\nolimits_{g\in s} I_g^{*}\right), \tag{11}$$

with I_g being a firm-specific indicator variable.[32] We regard the preperiod average migrant employment variables as effectively exogenous to individual firm behavior. We then estimate this alternative GMM estimator for the years 1999-2007, excluding the initial year. Again, we have investigated the appropriateness of the instruments, and we find that the results from testing for instrument relevance and exogeneity are reassuring.

Another potential concern is that the intensive margin of offshoring is observed only for those firms with positive imports of intermediate inputs. In the robustness analysis, we utilize a two-step panel data selection model 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 offshoring propensity and intensity, such as immigrant employees, to have different impacts on the two

[31] A potential concern with the Bartik-style strategy could be if immigration stocks stemmed from time-varying specificities of the source, rather than the host, countries. Fortunately, Hatzigeorgiou and Lodefalk (2015), who use a similar approach but in a macrolevel study, heed this issue and test for it. Their results suggest that factors in the source countries do not drive the results, suggesting the appropriateness of our strategy.

[32] The "*" in eqs. (10)-(11) denote the firm's exclusion from the respective variables. However, inclusion does not change the results (results available upon request).

outcomes. The omitted variable bias correction of the model is advantageous, *inter alia*, because it takes the form of fixed effects and, thus, allows correlation between unobserved factors causing heterogeneity and the predictor variables.[33]

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 on the regulatory burden imposed on businesses abroad from the World Bank (2011). These data, which are available for 173 countries, contain information on policies related to the start-up and closedown costs of businesses, as well as 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.[34] In the spirit of Helpman et al. (2008), who also use a measure of the fixed regulatory cost as a means for identification in the presence of selection, we interact the fixed cost measure with firm size to account for differential effects across firms of different sizes.[35]

5 Data and Stylized Facts

The microlevel datasets are from Statistics Sweden and include all Swedish manufacturing firms with at least ten employees for the years 1998-2007. We supplement this core microlevel data with detailed information also available from Statistics Sweden on an employee's country of birth and the skill levels of foreign-born employees. All datasets are based on administrative registers and include unique identifiers for firms and individuals. The combined data enable us to analyze the relationship between specific characteristics of the firm and its employees with offshoring.[36]

[33] A Hausman test confirms the appropriateness of a fixed effects specification over random effects.
[34] 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.
[35] There are alternative, but less well theoretically founded, exclusion restrictions commonly used in the empirical literature, including common religion, trade experience and the share of white-collar workers.
[36] Information on the specific variables and their sources is available in Table A1 of the Online Appendix, 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.

Firm-specific trade data are then added, which include products measured by the Combined Nomenclature 8-digit (CN8) along with the source country. We account for the numerous and substantial changes to the product nomenclature over time using 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 products are considered offshored products if they are included in the category of intermediate goods in the Broad Economic Categories (BEC) classification of the UN (United Nations 2002).[37] We therefore do not include all imports made by the firm as intermediate inputs.

The full sample contains economic and migration data from 6,855 Swedish firms, employing 599,333 full-time employees in 2007. Approximately 12,000 firms are represented in at least one year 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 2007. The average firm is a medium-sized company in terms of workforce, which offshores yet is not part of a multinational enterprise. Less than a fifth of the employees of the average firm have a postsecondary education. Approximately a tenth of the employees were born outside of Sweden. There is considerable variation in the employment of immigrant workers, with some firms employing no such workers and others only employing workers born outside Sweden.

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

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 2007. The number of firms is 6,855. The 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 the small and open economy of Sweden has increased substantially over the past seven decades. Based on the conceptual framework, we expect this to have increasingly made familiarity with foreign countries, including their languages, into common knowledge. In 1940, the foreign-born population accounted for one percent of the total population. By 1970, that figure rose to approximately seven percent. The most recent figure is close to 19 percent. Between 1998 and 2007, immigration accounted for 77 percent of the increase in the population in Sweden.[38] The largest immigrant groups by source country are from Finland, Iraq, Poland, Serbia/former Yugoslavia and Iran.[39]

During the 1998-2007 period, immigration to Sweden increased by 22 percent, and offshoring increased by 57 percent. Within the data, the top offshoring destination countries are all in Europe, except for the US, Russia and Japan (Table A3). Similarly, the major immigrant source countries are mainly European, except for Iraq and Iran (Table A5). The considerable rise in offshoring to low-income countries has occurred in tandem with a substantial rise in immigration from those countries (see Table 2). R&D-intensive offshoring is mostly directed toward low-income countries. The share of offshoring to low-income countries has increased by twice the rate of offshoring to

[38] An advantage of studying this period is that it excludes the subsequent and substantial liberalization of Swedish laws for labor immigration, from December 2008. Using the pre-2008 period reduces the prospect of having a firm targeting an individual to recruit her for offshoring and restricting her to only work for the recruiting firm. Consequently, studying this period mitigates some endogeneity concerns.

[39] Table A5 in the Online Appendix presents a complete list of Sweden's largest immigrant groups, their respective sizes and population shares.

high-income countries over the sample period. The shift in offshoring, and particularly of R&D-intensive offshoring, to low-income rather than high-income countries has occurred simultaneously with China acceding to the WTO, while other countries, such as India, continue to liberalize trade.[40]

According to pairwise correlations (Table A4), the value of inputs offshored is negatively related to the distance to the source country but positively related to market size and the size of the firm. Consistent with the main predictions of the model, the value of offshored inputs is also positively correlated with the size of the immigrant stock of a country and with the number of foreign-born employees from the source country.

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	13
Low-income countries	0.14	47	395,510	46

6 Results

6.1 Benchmark Estimation

Table 3 presents our estimation results based on the two equations of the benchmark specification. The table displays the regression for the probability of offshoring (regression 1) alongside that for the value of offshoring (regression 2). 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. We find no significant effect from the employment of immigrants by firm *g* from country *c* for the probability of offshoring to the same country (the firm-country-extensive margin).

[40] Swedish newspapers have frequently reported anecdotal evidence of the offshoring of R&D intensive production, while keeping production of the absolute premium segment (together with the main R&D department) in Sweden.

However, the total Swedish stock of immigrants from country *c* within Sweden matters for the extensive margin, consistent with evidence from Olney and Pozolli (2021). Together, this suggests that the presence of a large immigrant stock from country *c* within Sweden contributes to the pool of common knowledge about a country, thereby reducing fixed offshoring costs. The employment of migrants from that country by firm *g* then adds no additional knowledge beyond that already available in the common knowledge stock. 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.

Table 3. Benchmark Estimation Results

	(1)	(2)
	P(Offshoring)	Offshoring value
Immigrant employees$_{gct-1}$	0.00137	0.0339***
	(0.002)	(0.009)
(log) Immigrant stock$_{ct-1}$	0.0463**	-0.000439***
	(0.020)	(0.000)
(log) Workforce$_{gt-1}$	0.284***	0.217***
	(0.007)	(0.005)
Multinational$_{gt}$ (0,1)	0.0731***	0.0195***
	(0.008)	(0.005)
Offshorer$_{gt}$ (0,1)		2.689***
		(0.045)
Labor productivity$_{gt}$ (log)	0.0151***	0.0282***
	(0.005)	(0.003)
Human cap intensity$_{gt}$ (log)	0.00222**	-0.000645***
	(0.001)	(0.000)
Physical cap intensity$_{gt}$ (log)	0.00491***	0.00180***
	(0.001)	(0.000)
GDP$_{ct}$ (log)	0.593***	0.111***
	(0.032)	(0.009)
Population$_{ct}$ (log)	0.352***	-0.272***
	(0.088)	(0.028)
Obs.	9,109,283	8,608,859
Adjusted/Pseudo R^2	0.500	0.7361

Notes: Both within-regressions include firm-country, industry and time fixed effects. In column 2, the dependent variable is 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

In contrast to the effect on the firm-country-extensive margin of offshoring, the employment of immigrants born in country *c* by the firm matters for the intensive margin of offshoring to country *c* (regression 2). As the number of immigrant employees from a particular origin country rises, so does the value of intermediate inputs from that country. This finding is consistent with an interpretation that immigrant employees reduce contract enforcement costs (hypothesis **H1**). The main benefits provided by immigrant employees with respect to offshoring are in the *ex post* contracting phase, where they facilitate communication and coordination with suppliers, the monitoring of those suppliers, and infuse trust in relationships, all which promote contract enforcement, including the deterrence of technology leakage. The effect of immigrant employment is economically significant, as hiring one additional immigrant from country *c* is associated with an increase in firm *g*'s offshoring to country *c* by 3 percent on average.

The evidence from this regression indicates a small yet statistically significant (and negative) effect from the total Swedish stock of immigrants from country *c* on the value of offshored intermediates from that country. This finding contrasts with the results for the same variable on the extensive margin in the previous column. This result is consistent with the notion that the immigrant stock primarily reduces fixed offshoring costs and immigrant employees primarily reduce variable offshoring costs related to contract enforcement. Whereas general familiarity with a given foreign country reduces information frictions that deter the entry into offshoring to a given foreign market, it is more difficult to conceive how a larger immigrant stock, per se, would substantially reduce variable offshoring costs related to coordination and monitoring costs or technology leakage.

For the other firm and country characteristics, we note a number of changes compared with the results for the extensive margin. Offshoring along the intensive margin is increasing with the size and productivity of the firm and is decreasing with human capital intensity. Of the country-level variables, we find that it is increasing with the economic mass of a country (GDP) but decreasing with the size of its population.[41]

[41] 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 efficiency levels as a result of the fact that contract intensive goods account for a much higher share of offshoring to high-income countries than to low-income countries. Most of the other conventional firm-gravity covariates have the expected signs.

6.2 Causality and Robustness Checks

Table 4 includes a careful analysis to determine the direction of causation and to check the robustness of our main results. For these exercises, we focus on the intensive margin of offshoring results.

A causal interpretation of our results would be threatened if the variable of immigrant employment was endogenous. We therefore adopt the IV estimators that we introduced and discussed in section 4 as alternative ways of identifying the impact of immigrant employees on offshoring.[42] The results are presented in the first two columns of Table 4. Column 1 presents the results from the main IV analysis, where immigrant employment by the firm is instrumented by both the lagged average number of immigrants employed by Swedish firms other than *g* and the lagged average number of immigrants employed by other firms within the same detailed industry *i*. The idea is to capture common changes in hiring that are arguably exogenous to the firm's offshoring but are correlated with the firm's hiring. Column 2 presents our alternative IV results. Here, we employ the previously discussed Bartik-style instrumental variable approach to further reduce endogeneity concerns, exploiting the fact that Swedish and Danish immigration stocks are strongly correlated, while arguably exogenous to Swedish firms' bilateral trade. As specified in equations (10) and (11), we use variation in the Danish immigrant stock from a particular country as the shock, and we use the fixed preperiod average number of immigrant employees from that same country who work in Swedish firms of the same detailed industry and the same firm size category as the weight. Basically, any variation across time in the Bartik-style instruments for Swedish firms' offshoring with a particular country is entirely driven by exogeneous shocks to Denmark's stock of immigrants from that particular country. The likely exogeneity of the shocks as well as of the preperiod exposure variables to individual time-variant firm behavior is supportive of identification, since exogeneity of either the shocks or the exposure variables is sufficient for the instruments to be valid (Borusyak et al. 2021; Goldsmith-Pinkham et al. 2020).

To further establish whether the instruments are sufficiently associated with the potentially endogenous variable of immigrant employment and whether the instruments indeed are exogenous, we carry out a number of tests. First, we test instrument validity. As displayed in columns 1 and 2 of Table 4, the Kleibergen–Paap rk

[42] We also include previous offshoring to further control for omitted variable bias and persistence in firm internationalization.

Lagrange multiplier statistics strongly reject the null hypotheses of underidentification. Furthermore, the Wald F statistics reject the null of a weak partial correlation between the instruments and the immigrant employment variable. These tests indicate that the two sets of instruments are valid. Next, we examine whether the instruments are exogeneous to the error term. Performing Hansen's J test for both sets of instruments, we find that we cannot reject the null hypothesis of exogeneity at any conventional significance levels.[43] Based on our discussion and the tests performed, we therefore consider the two sets of instruments as appropriate for the identification of the impacts of immigrant employment on firms' bilateral offshoring.

Now, we are ready to present the coefficients from the IV estimations. Fortunately, we find that our benchmark result is confirmed. Immigrant employment is again positively and statistically significantly associated with the firm's offshoring. The IV estimates from columns 1 and 2 of Table 4 are larger than our benchmark estimates in Table 3; we find that hiring one additional immigrant from country *c* is associated with a 7 and 14 percent rise in firm *g*'s offshoring to country *c*, respectively, on average. We interpret the finding that both sets of IV analyses generate estimates that are qualitatively similar to our benchmark results, while both sets of instruments behave well, strengthens the interpretation of the positive link from immigrant employees to firm offshoring as causal (**H1**).

Next, we expose our benchmark results to a number of robustness checks, starting with the main specification issues. As noted above, our results imply that the employment of an additional immigrant worker increases the imports of offshored inputs from the same country by an economically meaningful 3 percent on average. An open question is whether the relationship is linear in character. That is, does hiring one additional migrant have a similarly sized impact, or does the impact vary with the number of existing migrant employees? The results relevant in this regard are presented in column 3 of Table 4, suggesting a quadratic relationship. However, since the relevant coefficient is too small to alter our main results, we infer that across our dataset, each additional immigrant employee influences imports of offshored inputs to a similar extent.[44]

[43] First-stage results also support instrument validity, see, e.g., Table A6 of the Appendix for the Bartik-style instruments.
[44] Hiring the first immigrants is slightly more important than hiring the (for example) 50th immigrant when we interact the squared variable with firm size. Interestingly, the 'diminishing returns' effect is larger in smaller than in larger firms, with the interaction being positive and the squared variable turning negative. The results are available upon request.

Next, we turn to the question of whether the results are driven by the most common country of origin of immigrants into Sweden (column 4) or the most common destinations of offshoring (column 5). These countries are European or Middle Eastern countries. Rather than weakening the link to offshoring, excluding in turn the top five immigrant and offshoring countries increases the estimated influence of immigrant employment. In addition to showing the robustness of the result, we find it interesting that this is in line with our second hypothesis about immigrant employees playing an even more important role when the firm is less familiar with the country as an offshoring destination, contributing tacit and firm-relevant information and networks that can be leveraged to reduce contract enforcement costs (**H2**).

Another concern regarding our results could be that we somehow capture the effect of unobserved productivity shocks that raise the likelihood that the firm offshores—and hires immigrant workers—from a given country. We tackle this issue in column 6 by using a lagged approach, where immigrant employees and the country immigrant stock are lagged by three periods. If unobserved productivity shocks are important but have a low time persistence, we would expect to find that these lagged values do not help to explain current offshoring decisions. The results of this exercise indicate, however, 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, a scenario that is addressed by the use of lagged values.[45]

In column 7, we test whether the results are sensitive to time-variant source country variation, such as price shocks, by including country-year fixed effects. As these are collinear with the variable measuring the broader migrant stock from country *c* within Sweden, we replace this variable with the immigrant stock of the country within the region in which the firm is located. The results confirm that the main findings for immigrant employment are robust to such country-time trends. Furthermore, in column 8, we address the potential selection bias via

[45] Another concern would be if 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 neither alters our main finding in terms of its magnitude, nor in terms of its level of statistical significance. These results are available upon request.

Heckman panel estimation with fixed effects. Although this reduces the level of significance of the main coefficient, the main result is robust to controlling for selection.[46]

[46] Similar results are obtained using a Poisson estimator with firm-year specific effects (results available upon request).

Table 4. Further Analysis and Tests of Robustness

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	IV analysis	Alternative IV analysis	Quadratic	Excluding top five immigrant countries	Excluding top five offshoring countries	Lagged model (*t-3*)	Extended FE specification	Heckman panel estimation
Immigrant employees	0.0665***	0.136***	0.0579***	0.126***	0.0468***	0.0105*	0.0303***	0.0075*
	(0.018)	(0.047)	(0.008)	(0.016)	(0.010)	(0.006)	(0.007)	(0.004)
Obs.	6,175,790	8,195,802	8,608,859	8,363,410	8,363,423	4,593,656	8,608,859	144,202
F-statistic/Adjusted R^2	32.24	48.89	0.7361	0.7246	0.6877	0.7619	0.7429	0.391
Kleibergen–Paap rk (p)	0.0000	0.0000						
Kleibergen–Paap Wald (*F*)	9.847	16.661						
Hansen *J* (p)	0.400	0.202						

Notes: The dependent variable is firm offshoring in logs (1e-7 added to avoid truncation). All results are from within estimation, with firm-country, industry and time fixed effects. In column 7, country-year fixed effects are added while the country immigrant stock is replaced 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 Treatment Heterogeneity: The Role of Inputs and Skills

Having established the robustness of the main results, we next exploit the country, immigrant, input and firm information in the Swedish data to explore treatment heterogeneity. In Table 5, we begin analyzing the immigration-offshoring relation according to the skill levels of immigrant employees (**H3**) and the types of goods that are offshored (**H4**). Concerning skill, we anticipate that the quality of the information provided and leveraged by employees regarding their country of their birth, including contacts there, is greater the higher their level of education. Skilled immigrant workers are also more likely to be closer and better at communicating with decision makers both within their employing firm and at the foreign supplier, building and sustaining long-term relationships. As a reminder, we measure the level of immigrant skill level according to whether they have above or at the most secondary schooling.

We separate product characteristics according to their contract intensity and their R&D intensity. As explained, we expect that the production of some goods is particularly exposed to offshoring barriers, for example, due to their production requiring larger relation-specific investments, maintenance and supervision. This result 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 and other characteristics. The quality of such products may be more difficult to assess than that for inputs for which knowledge about price and quality is more readily available. Therefore, the remote coordination and monitoring of the contract for such products tend to be particularly cumbersome. We define such differentiated inputs as contract-intensive goods, following the 'strict' definition of Rauch (1999).[1]

R&D-intensive inputs are especially sensitive to monitoring- and coordination-related barriers. Their production may also involve novel technology that could leak to rival firms. Thus, we apply the list of high-technology products produced by the OECD, while considering the major revision conducted in 2007. High-tech products are defined as goods whose production is R&D intensive (Hatzichronoglou 1997). We initially consider

[1] 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 the intermediate inputs of those industries, where the degree of such investment is determined by the share of inputs that are differentiated goods.

the combination of R&D and contract intensity while also presenting results for these groups separately to judge whether the results are being driven by one aspect of this measure.[2] As immigration employment from country *c* affects the value of offshoring to that same country in Table 3, we report only the regressions for the estimation of equation 9.

Table 5. Results across Inputs, Skills, Source Countries

		Immigrant employees	
		Skilled	Unskilled
Contract and R&D	Total	0.196***	0.000713
R&D intensive	Total	0.152***	0.00986
Contract intensive	Total	0.100***	0.0227**
Contract and R&D	Low-income	0.111***	-0.0231**
	High-income	0.240***	-0.00213
R&D intensive	Low-income	0.105***	-0.0237***
	High-income	0.176***	0.00884
Contract intensive	Low-income	0.0828*	0.0252
	High-income	0.105***	0.0196*

Notes: The results from 18 within estimations are presented, 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 semielasticities in Table 5 reveal some interesting patterns, particularly with respect to the skill intensity of the immigrants employed by the firm. The various coefficient estimates for the employment of skilled immigrants are universally positive, consistent with an interpretation that the skill level of immigrant employees influences the extent to which they facilitate offshoring and in line with **H3**.[3] Focusing on R&D and contract-intensive inputs, we note that the employment of immigrants has the strongest effects on the value of offshored inputs in Table 5, consistent with **H4**. Separating the contract and R&D components that make up this category

[2] Results for non-R&D intensive and noncontract intensive offshoring are available upon request.
[3] Both skilled immigrant employees who arrived in Sweden a long time ago, possibly before adulthood, and those who came more recently are positively and statistically significantly associated with offshoring to high-income countries; however, only the former category displays a similar association with offshoring to low-income countries (results available upon request).

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 also. For unskilled employees, the coefficient estimates are much smaller in size than those of their skilled counterparts and are statistically significant only for contract-intensive inputs.

In the remaining regressions within Table 5, we separate the destination of offshored inputs according to whether they relate to high- or low-income countries and again separate the immigrant employees according to their skills to further test **H2** and **H3**. Somewhat unexpectedly, the effects are broadly similar when offshoring and immigrants are from either high- or low-income foreign countries, although the strongest effects are found for high-income countries. This result is contrary to our finding in the previous robustness analysis that the impact of immigrant employees is stronger for offshoring to less familiar and less developed countries, including all the less developed countries and countries in which we would expect more lax enforcement of property rights and contracts. Thus, the evidence for **H2** remains inconclusive. Once more turning to **H3**, we find that the importance of the skill level of immigrant employees is also clear in these regressions. Other than a weakly positive effect from unskilled immigrant employment on offshoring to high-income countries, the effects are either statistically nonsignificant and/or negative. For skilled immigrants, however, we continue to find that their employment increases the intensity of offshoring.

7 Conclusion and Final Remarks

The exchange of intermediate goods accounts for a considerable share of international trade. Complex global value chains make firms dependent on producers across many different countries, and indications are that neither the financial crisis nor the recent pandemic have changed this. Intermediate foreign trade distinguishes itself by being especially sensitive to incomplete contracts, hold-up problems and weak institutions. Therefore, individuals with knowledge of specific foreign markets and access to trust-enhancing networks—such as immigrants—could potentially reduce the contract enforcement costs associated with offshoring, facilitating foreign supply chains and making them more resilient.

The aim of this study has been to explore how the employment of immigrants allows firms to reduce the costs of sustaining the intensity with which they use this form of international input supply. Conceptually, we model immigrant employees as augmenting headquarters supervisory services related to offshoring and reducing the risk of technology leakage. Migrant employees lower the variable contract enforcement costs, while immigrant communities in general make the foreign country less foreign to their new country of residence, in effect lowering the fixed offshoring costs. Empirically, we investigate the impact of immigrants on offshoring while carefully controlling for confounding factors through the use of combinations of firm-country and time fixed effects by using an instrumental variable approach and by exploring heterogeneity across workers, inputs and countries. The analysis provides evidence in support of a statistically and economically significant positive impact of immigrant employees on the intensity of offshoring, while they have no effect beyond migrant communities in general on the entry into offshoring. Hiring one additional immigrant employee increases the value of offshored inputs by three percent on average in the baseline model. Hiring skilled immigrants substantially enhances this effect, and even more so when the traded products are contract and R&D intensive. There are lessons for policymakers. For policymakers in high-income and open economies, such as Sweden, an objective to facilitate firms' intensity and resilience in offshoring could justify policies that promote high-skilled immigration and facilitate the ability of high-skilled immigrants to remain in the country and integrate into the labor market. For policymakers who have an interest in advancing their country's offshoring attractiveness, it would be relevant to consider encouraging the emigration of high-skilled persons seeking employment abroad, especially in sectors with high contract and R&D intensity. However, whether this would be associated with a net gain or a net loss for the economy as a whole requires a comprehensive welfare analysis, which is beyond the scope of this paper.

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