



Immigrant employment and the contract enforcement costs of offshoring

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Abstract

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. In this paper, we investigate the role of immigrant employees within firms on firm offshoring, employing 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 by lowering contract enforcement costs. Hiring one additional immigrant employee is linked to a relatively larger increase in offshoring at the intensive than the extensive margin, on average. The association to offshoring is considerably stronger for skilled immigrant employees and for contract and R&D intensive offshoring. Instrumental variable estimations demonstrate qualitatively similar results, while a placebo test with randomized immigrant employment does not generate any link between immigrants and offshoring.

Keywords Offshoring · Contract enforcement · Immigrant employees · Networks · Information

JEL Classification F22 · F23 · F14 · D21 · D83

1 Introduction

The offshoring of intermediate input production by firms involves a trade-off between lower purchase prices against higher costs related to the search for foreign producers, international transport and contract enforcement abroad (e.g., Grossman & Rossi-Hansberg, 2008, 2012; Antràs and Helpman 2004; Head et al., 2009).

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Although one would expect that migrants could be instrumental for reducing firms' offshoring search and contract enforcement costs (e.g., Gould, 1994; Head & Ries, 1998; Rauch James & Vitor 2002; Parsons & Vézina 2018), there are few studies that explore this relationship (Olney & Pozzoli, 2021; Moriconi et al., 2020). In this paper, we provide such evidence, by investigating the disaggregate effects of immigrant employees on firm offshoring, focusing on their role in reducing the costs of contract enforcement.

Conceptually, immigrant employees can reduce the fixed search costs and variable contract enforcement costs of offshoring. 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 transmitted to the firm. Their closeness to the foreign supplier's country facilitates remote communication and monitoring. Immigrant employees may therefore reduce variable contract enforcement costs for the firm that employs them, increasing its capacity to coordinate, monitor and cajole the foreign upstream supplier to deliver, even in times of crisis. This will increase both the likelihood that the firm will offshore production to the country of the migrant worker and the intensity of existing relationships.

We test this prediction exploiting granular employer-employee data that include the nationality of immigrant workers and the country of offshoring by Swedish manufacturing firms. 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 that exploit the opportunities offered by the matched employer-employee data for Sweden that we use.

First, we recognize that employment by a firm of migrant workers from a given country does not occur randomly and therefore our benchmark estimations include both firm-year and country-year fixed effects. Adding these fixed effects allows us to remove the effect of firm-specific unobservable managerial or owner characteristics that make the firm more open to offshoring or to the employment of immigrant workers. It also controls for country-specific differences in institutional characteristics that affect the likelihood of workers appearing as migrants in Sweden and being used for offshoring. Moreover, including country-year fixed effects is important to control for multilateral trade resistance that is common to all firms in Sweden. After the inclusion of these fixed effects, we, in effect, estimate a fixed effects model where the only variability is from changes at the firm-country-year level. We thereby specifically zero in on the hiring of immigrants from particular countries and the offshoring to those countries, allowing us to focus tightly on our mechanism of interest.

In additional estimations, we replace the firm-year fixed effects by firm-country fixed effects. The idea is 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 initiate or supervise particular offshoring relationships and the intensity they use those destinations as a source of inputs. We find the results to be very similar to those where we instead include firm-year fixed effects.

Second, we present the results using an instrumental variable (IV) approach and a placebo test approach. Of particular 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 specificities we already control for. Starting with the instrumental variable approach, we consider a set of instruments that are based on factors governing immigration that are external to the firm. We build upon the idea that the flow of immigrants to Sweden is beyond the control of an individual company. 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 pre-period employment of immigrant workers by Swedish firms with Danish shocks to immigration from each country. Turning to the placebo test, we randomize the immigrant employment of firms and then re-estimate our benchmark specification, using Monte Carlo simulations. If there is a causal link from immigrant employment to offshoring, we should expect the placebo test to display trivial and statistically insignificant results.

As a third approach to possible endogeneity bias within the coefficients of interest we provide further support for the idea that immigrant employees carry assets that can reduce contract enforcement costs by exploiting the granularity of the data to consider treatment heterogeneity. Immigrant employees from a country are not homogenous and 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 be instrumental 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 little or no effect on offshoring intensity when the firm hires immigrants who are less qualified. 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 expect that other skills that immigrants possess, such as language skills for translation or the experience with the formal and informational institutions of a country, are unlikely to differ significantly 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 probability of offshoring and the value of offshoring for Swedish manufacturing firms. Hiring an additional foreign-born person from country c can increase the probability of offshoring and the offshoring value by 0.09 and 0.3%, respectively, on average and for country c . However, these effects are largely confined to skilled immigrants and to contract and R&D intensive products. At its largest, we find that hiring an additional skilled immigrant increases the offshoring of contract and R&D intensive products by between 4 and 8 times as much as for immigrants offshoring in general. 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 and coordination. In this way, hiring immigrants may promote the intensity and resilience of firms' offshoring activities.

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 a conceptual discussion and our hypotheses. Section 4 explains the empirical approach and estimation strategies. Section 5 describes the data, and Sect. 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 & Rossi-Hansberg, 2008, 2012; Bernard et al., 2020).¹ In these models, the procurement of intermediate inputs from 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, more importantly, coordination and monitoring that are necessary for contract enforcement. Offshoring is associated with other costs, such as those related to searching for matching suppliers (Antràs & Helpman, 2004). We conceptualize discuss and empirically analyze the role of foreign-born employees in promoting offshoring through the reduction in search and contract enforcement costs.

Second, our study is closely related to the empirical literature on the relationship between migrants and trade, ignited by the seminal papers of Gould (1994), Head and Ries (1998) and Rauch James and Vitor (2002). This literature assumes that migrants can reduce information frictions and increase trust in trading relations (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).

To date, a large number of studies have investigated the trade facilitating role of migration.² An important paper in establishing causal relationships is Parsons and Vézina (2018), who provide quasi-natural experimental evidence. The starting point

¹ Globally, trade in intermediates accounts for 57% of world trade (WTO, 2019). In the OECD countries, intermediate goods and services account for 56% and 73% of total trade, respectively (Miroudot et al., 2009).

² See, e.g., Herander and Saavedra (2005); Dunlevy (2006); Lewer (2006); White (2007); Hatzigeorgiou (2010a, b), Peri and Requena-Silvente (2010), Bastos and Silva (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 & Murat, 2011; Kugler & Rapoport, 2011).

of their paper was 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 recognize 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 Nedoncelle and Marchal (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. (2020), and Olney and Pozzoli (2021).³

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 & Wall, 2010). Ghani et al. (2013) find that outsourcing by company employees of likely Indian ethnicity via an 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.⁴ 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 in the manufacturing sector we study, as our offshoring contracts are larger in value and usually last for much longer periods of time.

Olney and Pozzoli (2021) and Moriconi et al. (2020) have contributed two related studies, utilizing Danish longitudinal micro-level data. Olney and Pozzoli (2021) apply a quasi-natural experiment with a shift-share instrument to estimate

³ Two related papers on services trade are Hatzigeorgiou and Lodefalk (2019) and Ottaviano et al. (2018).

⁴ 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.

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 a 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) use data for manufacturing firms with at least 10 employees (2000 firms) and a shift-share instrument with the fixed pre-period municipal immigrant share and the running country immigrant stock in the country to study the effect of the firm's share of immigrants and foreign institutions on a firm's bilateral probability of going 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 instrumented immigrant share are positively associated with the extensive firm-country margin of offshoring but have no statistically significant effect on the intensive margin.⁵ We instead focus on the role of immigrant workers in reducing the variable costs associated with the enforcement of contracts with offshore suppliers. Our paper also differs from, e.g., Olney and Pozzoli (2021) and Moriconi et al. (2020), in terms of estimation. For identification, we use the most demanding firm-level gravity method to date, which controls, among other things, for both time-varying firm heterogeneity and time-varying country heterogeneity. We also adopt a novel IV strategy and perform a placebo test. Furthermore, we study the number of immigrant employees rather than the share of immigrants. Conceptually, we consider an immigrant employee to be potentially instrumental for offshoring regardless of the size of the firm.⁶

To sum up, we contribute to these literatures by investigating the detailed effects of immigrant employees on firm offshoring, focusing on their role for contract enforcement. We exploit granular employer-employee data that include the nationality of workers and employ the most demanding specifications and tests so far. We also estimate how the skills of immigrant employees, the types of offshoring and the source countries affect the impact on offshoring.

⁵ 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.

⁶ We consider a small firm's hiring of an immigrant worker from a specific country, representing, for example, a 50% 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% increase in the share, which may represent hiring 100 immigrant workers from a single country.

3 Conceptual discussion and hypotheses

In this section, we discuss the costs firms face in offshoring and how immigrants may help, resulting in five hypotheses to guide the empirical analysis.

Sourcing intermediates goods from abroad is associated with fixed and variable costs. First, an offshoring firm has to search for a foreign supplier, carefully design the contract with the supplier and possibly make relation-specific investments, which give rise to fixed offshoring costs (e.g., Antràs & Helpman, 2004). This process of matching, contractual arrangement and investment is crucial. Firms aim to avoid potential “lemons”, defined as foreign suppliers producing with high uncertainty in terms of deliverance and/or product quality. The offshoring contract often also involves costs in the form of relationship-specific investments in capital or R&D assets by both parties.⁷ Therefore, it is possible that firms abstain to offshore. Second, the offshoring firms is expected to spend resources on cross-border coordination, communication and monitoring to counterbalance the partial loss of control of production that emerges when production and headquarter activities are geographically separated (Grossman & Rossi-Hansberg, 2008; Head et al., 2009; Leibl et al., 2011; Cuberes, 2013; Cristea, 2015; 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 spend resources not only to establish but also to sustain and develop long-distance relations (Johanson & Vahlne, 2009; Hasche, 2013).⁹ Hence, the firm also incurs variable offshoring costs to try to ensure contact enforcement.

Having immigrant employees may reduce the fixed offshoring costs of firms. Immigrant employees have tacit knowledge about the country of their birth that is important for firms that wish to discover and establish successful business relationships with foreign upstream suppliers. Immigrants know about foreign suppliers, 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

⁷ Naghavi and Ottaviano (2009) explicitly model how hold-ups reduces the supply of inputs, increases the price but decrease the upstream firms bargaining power.

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 and Wellman (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 & Tybout, 1997; Anderson and Marcoullierr 2002; Melitz, 2003; Anderson & van Wincoop, 2004; Nunn, 2007; Melitz, 2008; Felbermayr & Toubal, 2010; Kneller & Pisu, 2011; Petropoulou, 2011). Allen (2014) studies information frictions in trade and finds them to be as costly as cross-border transport.

networks there, including those developed during higher education. By hiring immigrants as employees, downstream firms may reduce the fixed search and contractual arrangement costs of offshoring. Therefore, firms with more immigrant employees from a country are more likely to engage in offshoring to that same country, increasing offshoring at the extensive firm-country margin.

Hypothesis 1 (H1): *Increasing immigrant employment from a country increases the likelihood of offshoring to that country.*

Hiring immigrants as employees can also promote offshoring at the intensive firm-country margin by reducing the variable contract enforcement costs. During the *ex post* contracting phase, that is, in the continued relationship with the upstream foreign supplier, immigrant employees may promote the fulfilment of the contract, its renewal and potential expansion, as well as to continuous improvements in off-shore production. By being employed and coming from another country, immigrant workers have intimate knowledge of their employing company and country of birth, as well as relevant networks there, which can be used both to build trust and to make credible reputational threats. Therefore, immigrant employees may increase the capacity of their firm to coordinate and monitor upstream suppliers of intermediate inputs, to communicate and cajole to minimize contractual frictions, including hold-up problems.¹⁰

Hypothesis 2 (H2): *Increasing immigrant employment from a country increases the value of offshoring to that country.*

However, the role of immigrant employees for offshoring may differ according to the skills of the immigrants. 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). 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 & Peri, 2012; Mundra, 2012).

Hypothesis 3 (H3): *Skilled immigrant employees have a larger positive impact on firm offshoring than do unskilled immigrant employees.*

Offshoring of some intermediate inputs is expected to be more costly than others. The fixed offshoring costs, such as costs related to search and contractual arrangements, as well as the variable offshoring costs, such as costs related to contract

¹⁰ 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.

enforcement, are likely to be higher for inputs that are particularly sensitive to information, coordination and control frictions and dependent on relation-specific investment (Rauch, 1999; Herander & Saavedra, 2005; Nunn, 2007; Levchenko, 2007). The impact from immigrant employees on offshoring costs is presumably the largest with respect to the offshoring of inputs that are differentiated and require more relation-specific investment in capital or R&D assets by both the upstream foreign supplier and the downstream buyer. 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.

Hypothesis 4 (H4): *Immigrant employees have a larger positive impact on firm offshoring of contract and R&D intensive intermediate inputs than on offshoring of other intermediate inputs.*

Finally, countries differ in terms of the strength of their property rights and contract enforcement regime. Therefore, a firm may face differential fixed and variable costs when offshoring to different countries, affecting offshoring decisions (e.g., Levchenko, 2007).¹¹ Assuming that property rights and contract enforcement are generally weaker in low-income countries, immigrant workers may be particularly important in such environments.

Hypothesis 5 (H5): *Immigrant employees have a larger positive impact on firm offshoring to low-income countries than to high-income countries.*

4 Empirical Approach

Based on the hypotheses 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 specification (e.g., Chaney, 2008; Hatzigeorgiou & 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 as follows:

$$\begin{aligned} E(o_{gct} > 0 | me_{gct}, Z_{gt}, V_{ct}, U_{gc}, H_{it}, T_t) \\ = \Phi(\beta_{me} me_{gct} + Z_{gt} \beta_Z + V_{ct} \beta_V + U_{gc} \beta_U + H_{it} \beta_H + T_t \beta_T), \end{aligned} \quad (1)$$

and

¹¹ 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. Since offshoring means that knowledge is transferred across borders the argument also applies to sourcing of material inputs from abroad.

$$E(\ln(o_{gct})|me_{gct}, \mathbf{Z}_{gt}, \mathbf{V}_{ct}, \mathbf{U}_{gc}, \mathbf{H}_{it}, \mathbf{T}_t) = \beta_{me}me_{gct} + \mathbf{Z}_{gt}\beta_Z + \mathbf{V}_{ct}\beta_G + \mathbf{U}_{gc}\beta_U + \mathbf{H}_{it}\beta_H + \mathbf{T}_t\beta_T, \quad (2)$$

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 \mathbf{Z}_{gt} , including firm size, productivity, ownership status, previous offshoring experience, and human and physical capital intensities; country characteristics of row vector \mathbf{V}_{ct} , including GDP, population and immigrant stocks (m_{ct}); firm-country fixed effects of row vector \mathbf{U}_{gc} , which controls for time-invariant characteristics at the levels of the firm, country and firm-country pairs, including variables that are commonly used to proxy for factors such as transport costs; 3-digit industry and time fixed effects of row vectors \mathbf{H}_{it} , for industry i , and \mathbf{T}_t for time, respectively; and where Φ is a normally distributed cumulative density function.

The crucial feature of our empirical strategy, 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 and offshoring from that country. Therefore, the immigrant employees me_{gct} of Swedish firms in Eqs. (1) and (2) are the focus of the empirical results. Additionally, we pay attention to the role in offshoring of immigrant communities m_{ct} from country c , which is included in vector \mathbf{V}_{ct} .¹²

The inclusion of firm-country fixed effects reduces threats to identification that relate to unobservable firm and country characteristics that may be correlated with the decision to offshore, how much to offshore and the decision to hire foreign-born persons. For example, 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. We then assume that these omitted variables exist at the firm and country level and are time-invariant, so that they can be captured by including firm-country 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 migrant employment is zero or is positive but does not change, any effect of migration on offshoring is captured by the firm-country effects. In addition, the firm-country fixed effects account for unobserved country-pair heterogeneity and therefore controls for time-invariant bilateral particularities related to offshoring and immigration, irrespective of their positive or negative influence.

However, there are still valid concerns regarding identification that relate to unobservable *time-variant* firm and country characteristics that may be correlated with offshoring and the hiring of immigrants. We therefore gradually introduce other fixed effects. First, we include firm-year fixed effects to further narrow the scope for confounding factors, such as investment in research and development or changes in the international orientation of the management of the firm, and measurement issues with firm variables such as productivity. The firm-year fixed effects also control for

¹² The immigrant stock variable, as in all continuous covariates in Eqs. (1) and (2), is expressed in logs. The exception is me_{gct} , which we do not log because of the many zeros within the data.

the multilateral trade resistance facing the firm that is common to all potential offshoring countries. Second, we include country-year fixed effects to control for multilateral trade resistance that is common to all firms in Sweden. These fixed effects allow us to control for the presence of time-varying features between Sweden and other countries that affects the offshoring or employment of immigrants by Swedish firms, such as macro-economic shocks that stimulate or reduce offshoring from Sweden or immigration to Sweden. By including these fixed effects, we estimate a fixed effects model where the only variation comes from changes at the firm and country level, focusing in particular on the employment of immigrants from certain countries and offshoring to these countries. This benchmark specification will be compared with less demanding specifications that include firm-country, industry and year fixed effects.

We recognize that the employment of immigrants may still be endogenous even when controlling for a set of specific effects, for example, due to time-varying changes at the firm and country level. We therefore adopt two additional identification strategies constituted by an instrumental variable approach and a placebo exercise.

Starting with the instrumental variable estimator, we apply a Bartik-style IV approach. The approach 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 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.¹³ In the next step, we link these shocks to Swedish companies. The links to firms have two components, resulting in two instruments. The first component is the pre-period average number of immigrant employees from that same country c in the same detailed industry h as the firm (for instrument one). The second component is the pre-period average number of immigrant employees from that same country c 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:

$$me_{gct}^{IV_h} = m_{ct}^{DK} \left(\sum_{g \in h} me_{gc98}^* / \sum_{g \in h} I_g^* \right), \quad (3)$$

and

¹³ 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.

$$me_{gct}^{IV_s} = m_{ct}^{DK} \left(\sum_{g \in s} me_{gc98}^* / \sum_{g \in s} I_g^* \right), \quad (4)$$

with I_g being a firm-specific indicator variable.¹⁴ We regard the pre-period average migrant employment variables as effectively exogenous to individual firm behavior. We then estimate this alternative estimator for the years 1999–2007, excluding the initial year.

The intuition behind this IV strategy is that there is a variation over time in the supply of immigrants from specific countries to Denmark. This variation is exogenous to the specific Swedish firm's hiring of immigrants from country c , while correlated with the supply of immigrants from specific countries to Sweden. Meanwhile, Swedish firms' employment of immigrants from country c varies across detailed industries and firm size, with some industries employing more immigrants from country c than others and with larger firms employing considerably more immigrants from country c than do smaller firms. Combining this source of exogenous variation with the pre-period immigrant employment particularities of a firm's industry and its firm size leads to a set of instruments that arguably is both valid and relevant. We have examined the appropriateness of the instruments and consider the results of the instrument relevance and exogeneity tests to reassuring, and the statistics are presented and discussed in the [results](#) section.

Turning to the placebo exercise, the idea is to randomize the number of immigrant employees across firms of the same size as the individual firm itself and then re-estimate our benchmark specification to see if there still is any economically non-trivial and statistically significant impact.¹⁵ If it is the case that the randomized treatment still suggests a link between a firm's (now random) hiring of foreign-born persons from a country and the firm's offshoring, it would indicate that we are capturing something else than a causal mechanism. For example, such a result could signal that there are firm-country-year confounders that are affecting the estimations. To carry out the test, we first observe, for each finely grained firm size and year,¹⁶ the maximum employment share of immigrants from a specific country in that year among firms of that firm size category. We then randomly generate a new and fictitious immigrant employment share for each firm size and year, a share which is between zero and the maximum of that firm size category in that specific year. Finally, for each firm, we multiply the randomized immigrant employment share of its firm size in a year with the firm's actual workforce size in the same year. In this way, we have randomly generated a new and fictitious immigrant employment variable me_{gct}^{me} for each firm-country-year. In essence, this mimics a random reshuffling of the immigrant employees from (say) Chile in Sweden in a specific year across firms in the same detailed firm size category. Thus, a given firm can now register a significantly different number of (say) Chileans in its workforce than is actually the

¹⁴ The “*” in Eqs. (3)-(4) denote the firm's exclusion from the respective variables. However, inclusion does not change the results (results available upon request).

¹⁵ We are indebted to one of the reviewers for this idea.

¹⁶ The firm size classification consists of the integer values of the range of the workforce size variable, i.e., it consists of the categories of the minimum number of employees, the minimum + 1 employees, the minimum + 2 employees, ..., the maximum number of employees.

case. For robustness, we reiterate the randomization and estimation, using Monte Carlo simulations. Reassuringly, we find only trivial and non-statistically significant estimates, with the results presented and discussed in the [results](#) section.

Another potential concern is that the intensive margin of offshoring is observed only for those firms with positive imports of intermediate inputs. To test the robustness of our benchmark specification at the intensive margin, we adopt a two-pronged approach, and the results are qualitatively similar, as is discussed in the [results](#) section. First, we jointly estimate the extensive and intensive margins of firms' bilateral offshoring. Here we compare results using the practical approach of adding a small constant to offshoring values before taking the natural log (e.g., Artal-Tur et al., 2012; Peri & Requena-Silvente, 2010), and then using our within-estimator, and employing a Poisson-Pseudo Maximum Likelihood (PPML) estimator (Santos Silva 2006), where the outcome variable is offshoring value (not in log) and the immigrant employment variable is the share of immigrants in firm employment. Second, we adopt a theoretically sound estimator that models the underlying behavior at both the extensive and intensive margins of firms' bilateral offshoring. Specifically, 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 outcomes. 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.¹⁷ 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.¹⁸

5 Data and stylized facts

The microlevel datasets are from Statistics Sweden and include all manufacturing firms in Sweden 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

¹⁷ The strategy performs well, with the regulatory measure affecting the propensity but not the intensity of offshoring.

¹⁸ 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.

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.¹⁹

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.

To measure offshoring, we employ a definition of offshoring that is based on the Broad Economic Categories (BEC) classification of the UN (2002). 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. We consider imported products as offshored products if they are included in the category of intermediate goods, with intermediary goods being contained in BEC codes 111, 121, 21, 22, 31, 322, 42 and 53.²⁰

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, aggregated to the firm level. 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.

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 increased familiarity with foreign countries, including their languages, within Sweden. In 1940, the foreign-born population accounted for 1% of the total population. By 1970, that figure rose to approximately 7%. The most recent figure is close to 19%. Between 1998 and 2007, immigration to Sweden increased by 22% and immigration accounted for 77% of the increase in the population in Sweden.²¹

¹⁹ Information on the specific variables and their sources is available in Table A1 of the Online Appendix. Additionally, we use information on the GDP and population size of partner countries from the World Bank.

²⁰ 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.

²¹ 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.

The largest immigrant groups by source country are from Finland, Iraq, Poland, Serbia/former Yugoslavia and Iran.²²

During the 1998–2007 period, offshoring increased by 57%. Although most of the top offshoring destination countries still are in Europe (Table A3), the largest increase in offshoring has been to low-income countries, as displayed in Panel A of Table 2. The share of offshoring to low-income countries has increased by approximately twice the rate of offshoring to high-income countries over the sample period. The disproportional rise in offshoring to low-income countries has also occurred in tandem with a substantial rise (almost quadrupling) in immigration from low-income countries. The shift in offshoring to low-income countries, particularly for R&D-intensive offshoring, as displayed in Panel B of Table 2, has occurred simultaneously with China acceding to the WTO, while other countries, such as India, continue to liberalize trade.²³

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.

6 Results

6.1 Benchmark estimation results

Table 3 presents our estimation results on the role of immigrant employees for firms' bilateral offshoring at the extensive margin (columns 1–4) and the intensive margin (columns 5–8), testing our first hypotheses (H1 and H2).

Starting with our baseline estimations, in columns 1 and 5, the results suggest some similarities but also differences between the determinants of the firm-country-extensive and firm-country-intensive margins of offshoring. The associations between the employment of immigrants by firm g from country c and offshoring to the same country are similar in magnitude at the two margins of offshoring, while only statistically significant at the extensive firm-country margin.²⁴ However, the sign and magnitudes differ substantially regarding the link between the total Swedish stock of immigrants from country c and offshoring at the two margins. The country immigrant stock hardly matters for the extensive margin, with the coefficient being economically trivial. At the intensive margin, the stock is, in comparison, associated

²² Table A5 in the Online Appendix presents a complete list of Sweden's largest immigrant groups, their respective sizes and population shares.

²³ 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.

²⁴ The number of observations is substantially smaller at the intensive margin, as expected. Most firms offshore, but they do so to a few countries only.

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

The table provides a snapshot of the characteristics of Swedish manufacturing firms in 2007. The number of firms is 6855. The number of firm-country observations in the 1998–2007 period is 15,020,024, which here have been aggregated to the firm-level. Monetary values are in 1000 SEK (approximately 148 USD). Only merchandise trade is considered. Two maximum values are not disclosed for confidentiality reasons

with an economically important and statistically significant impact, where a 1% increase in the immigrant stock is associated with an 0.3% increase in the firm offshoring value. Other determinants at both margins of offshoring include firm size, productivity and offshoring experience.

In the consecutive columns, we address concerns about time-variant firm and country characteristics confounding the estimation results. In columns 2 and 6, as well as 3 and 7, we add country-year and firm-year fixed effects, respectively. In columns 4 and 8, we include both country-year and firm-year fixed effects – these are our benchmark specifications. We find that adding these fixed effects matters for identification. The coefficients for the role of immigrant employees for the extensive margin of offshoring are reduced by a third across the table. Even more marked are the changes that occur for our estimates on the intensive margin, where the coefficient estimates almost double and turn statistically significant. The results suggest that the hiring of an additional immigrant from country c is associated with an increase in firm g 's probability to offshore and its value of offshoring to country c by 0.09 and 0.3%, respectively and on average. It is worth noting that these results hold after estimating a fixed effects model where the only variability is from changes at the firm-country-year level, that is, where we, for example, control for country-year variation, including country immigrant stocks.

The finding of a robust link between immigrant employees and offshoring at both margins of offshoring is consistent with hypotheses H1 and H2. Notably, the main benefits provided by immigrant employees with respect to offshoring are in the *ex post* contracting phase, where they, e.g., facilitate communication and coordination with suppliers, the monitoring of those suppliers, and infuse trust in relationships, all which promote contract enforcement.

Table 2 Offshoring and immigration – the case of Sweden

<i>Panel A</i>	Offshoring value 2007	Δ 1998–2007 (%)	Immigrant stock 2007	Δ 1998–2007 (%)
High-income countries	234,542,676	55	824,116	13
Low-income countries	12,286,768	106	395,510	46
<i>Panel B</i>	R&D-intensive offshoring (share) 2007	Δ 1998–2007 (%)	Contract-intensive offshoring (share) 2007	Δ 1998–2007 (%)
High-income countries	0.06	–32	0.48	–18
Low-income countries	0.14	47	0.31	–28

Panel A of the table presents Swedish offshoring values (in 1,000 SEK) and immigrant stocks in year 2007 as well as the percent changes compared to the initial year of 1998. Panel B displays the shares of R&D- and contract-intensive offshoring in total offshoring, respectively, in 2007 and percent changes compared to the initial year of 1998.

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.

A causal interpretation of our results would be threatened if the variable of immigrant employment was endogenous. We therefore adopt the IV estimator that we introduced and discussed in Sect. 4 as an alternative way of identifying the impact of immigrant employees on offshoring. The results are presented in columns 1 and 2 of Table 4 for the extensive and intensive margins of offshoring respectively. The previously discussed Bartik-style instrumental variable approach exploits the fact that Swedish and Danish immigration stocks are strongly correlated, while arguably exogenous to Swedish firms' bilateral trade. As specified in Eqs. (3) and (4), we use variation in the Danish immigrant stock from a particular country as the shock, and we use the fixed pre-period 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 weights. Basically, any variation across time in the Bartik-style instruments for Swedish firms' offshoring with a particular country is entirely driven by exogenous shocks to Denmark's stock of immigrants from that particular country. The likely exogeneity of the shocks as well as of the pre-period 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 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 the first-stage estimations and perform a number of tests. In columns 1 and 2, we find that the two instruments are both economically

and statistically significantly associated with firms' hiring of immigrants from a particular country. Next, we test instrument validity. As displayed in columns 1 and 2, the Kleibergen–Paap rk Lagrange multiplier statistics strongly reject the null hypothesis of underidentification. Furthermore, the Kleibergen–Paap and Sanderson–Windmeijer 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 exogenous 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. Based on our the first-stage results, 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.

The second stage of the IV estimations are consistent with our benchmark results. Immigrant employment is again positively and statistically significantly associated with the firm's offshoring at both the extensive and intensive margin. The IV estimates from columns 1 and 2 of Table 4 are somewhat larger than our benchmark estimates in Table 3; we find that hiring one additional immigrant from country c is associated with a 0.5 and 1.1% rise in firm g 's probability and value of offshoring to country c , respectively, on average.

Our alternative approach to establish causality is the placebo test that we introduced in Sect. 4. As previously discussed, the idea is to randomize the number of immigrant employees from a particular country c in firm g and re-estimate the benchmark specifications, which include firm-year and country-year fixed effects. For robustness, we repeatedly carry out this exercise, using Monte Carlo simulations, and present the average estimates. If immigrant employees have a causal impact on firms' offshoring, we should not expect any economically and statistically significant results from these regressions. It is therefore reassuring to note that for both the extensive and intensive margins, the average coefficient estimates for the "pseudo-treatment" immigrant employment are very small (10 and 15% the size of the benchmark estimates, respectively). Importantly, the estimates are not statistically significant at any conventional level.²⁵ We interpret the results of this exercise as further contributing to demonstrate the causal effect of immigrant employment on firm offshoring.

Next, we expose our benchmark results to several other robustness checks. As noted above, our results imply that the employment of an additional immigrant worker increases the offshoring from the same country by 0.09% at the extensive and 0.3% at the intensive margin, 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 respect are presented in columns 3 and 4 of

²⁵ Moreover, the minimum and maximum coefficient estimates at the extensive (intensive) margin are -0.0000744 (-0.00154) and 0.000235 (0.00250) – the benchmark estimates are thus beyond the maximum values at both margins.

Table 3 Benchmark Estimation Results for Offshoring

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Extensive margin				Intensive margin			
Immigrant emp _{gt}	0.00128*** (0.000)	0.00116*** (0.000)	0.000938*** (0.000)	0.000871*** (0.000)	0.00160 (0.001)	0.00265* (0.001)	0.00305* (0.002)	0.00291** (0.001)
Immigrant stock _{ct} (ln)	-0.0000134** (0.000)		-0.0000137* (0.000)		0.263*** (0.0739)		0.261*** (0.075)	
Workforce _{gt} (ln)	0.00976*** (0.000)	0.00793*** (0.000)			0.760*** (0.028)	0.740*** (0.026)		
Multinational _{gt} (0,1)	0.000945*** (0.000)	0.000826*** (0.000)			0.0503** (0.023)	0.0406*** (0.022)		
Offshore _{gt-1} (0,1)	0.109*** (0.002)	0.130*** (0.002)	0.107*** (0.002)	0.128*** (0.002)	0.596*** (0.015)	0.590*** (0.014)	0.657*** (0.017)	0.660*** (0.016)
Labor prod _{gt} (ln)	0.00127*** (0.000)	0.00102*** (0.000)			0.0991*** (0.0148)	0.104*** (0.014)		
Human cap int _{gt} (ln)	-0.0000221** (0.000)	-0.000033*** (0.000)			-0.000196 (0.004)	-0.000158 (0.004)		
Physical cap int _{gt} (ln)	0.0000766*** (0.000)	0.0000526*** (0.001)			0.00885*** (0.003)	0.00729** (0.003)		
GDP _{ct} (ln)	0.00552*** (0.000)	0.00553*** (0.000)	0.00553*** (0.000)		1.829*** (0.155)		2.135*** (0.167)	
Population _{ct} (ln)	-0.00833*** (0.001)		-0.00840*** (0.001)		-0.089*** (0.519)		-5.869*** (0.568)	
Firm-year FE	N	N	Y	Y	N	N	Y	Y
Country-year FE	N	Y	N	Y	N	Y	N	Y
Obs.	8,368,261	11,844,107	8,368,261	11,844,107	181,104	204,865	173,831	196,608

Table 3 (continued)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Adjusted R^2	0.6946	0.6878	0.6960	0.6892	0.7516	0.7423	0.7513	0.7439

The table displays estimates of the effect of employment migration at the extensive and intensive firm-country margins of offshoring. Regressions include firm-country and year fixed effects. In columns 1 and 6 we add country-year and industry FE, in columns 3 and 7 we instead add firm-year fixed effects, and, finally, in columns 4 and 8, we add country-year and firm-year fixed effects. In columns 1–4, the dependent variable is an indicator for offshoring and estimates are from a linear probability model. In columns 5–8, the dependent variable is $\ln(\text{offshoring} > 0)$ and estimates are from linear regressions. Robust and firm-country clustered standard errors are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4. Controlling for firm-year and country-year fixed effects, we find the quadratic terms to be very small and the relative importance of immigrant employees for offshoring at the extensive and intensive margin to be approximately preserved, while the coefficients are somewhat larger in size. We therefore infer that across our data set, each additional immigrant employee influences imports of offshored inputs approximately to a similar extent.

Another concern could be that selection into offshoring confounds and potentially drives the positive links between immigrant employment and the probability and intensity of offshoring. Our two approaches to investigate this are first to jointly estimate the extensive and intensive margins of firms' bilateral offshoring, and then to specifically model the two margins. The first approach is carried out by adding a small constant to offshoring values before taking the natural log and estimating the benchmark specification, or by using a PPML estimator where the outcome variable is offshoring value (not in log) and the immigrant employment variable is the share of immigrants in firm employment. These results are displayed in columns 7 and 8 of Table 4. They suggest that there is a robust and positive association between immigrant employment and firm offshoring, that is, they qualitatively confirm the benchmark results, although the estimates are larger in size. The second approach is to adopt a theoretically sound estimator that models the underlying behavior at both the extensive and intensive margins of firms' bilateral offshoring, as specified in Sect. 4 and with the results displayed in column 9 of Table 4. Once more, we find a positive and statistically significant association between immigrant and firm offshoring.

Finally, we have tested whether the results are driven by the most common countries of origin of immigrants into Sweden or the most common destinations of offshoring, and whether the results are qualitatively robust to log transformation of the immigrant employment variable. These results are presented in Online Appendix Table A6. They suggest that 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, while log-transforming the immigrant employment variable (after adding a small constant to avoid truncation) substantially reduces the size of the coefficient, as expected, it neither alters the sign, nor the statistical significance of the association between immigrant employment and firm offshoring.²⁶

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 analyze the relation between immigration and offshoring according to the skill levels of immigrant employees (H3) and the types of goods

²⁶ The coefficient captures the effect of a 1% increase in immigrant employment. Since most firms have no immigrant employee from a random foreign country, such a 1% increase, in effect, means hiring a small "fraction of a person", which is expected to be associated with a small increase in offshoring.

Table 4 Further Analysis and Tests of Robustness

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	2SLS IV estimator		Placebo treatment		Quadratic	Int margin	In(offsh + 1e-7)	PPML	Heckman
IV one ($me_{gct}^{IV_1}$)	Ext margin 3.310** (1.430)	Int margin 9.598** (4.270)	Ext margin 2.915*** (0.677)	Ext margin 0.0000868 (0.00006)	Ext margin 0.00212*** (0.000)	Int margin 0.00448* (0.002)	Int margin 0.0241*** (0.006)	2.650* (1.477)	0.00473*** (0.002)
IV two ($me_{gct}^{IV_2}$)	(0.362)	(0.677)	(0.0000868)	(0.00006)	(0.000)	(0.002)	(0.006)		
Immigrant employees	0.00491** (0.002)	0.0111* (0.007)	0.0000868 (0.00006)	0.000432 (0.0006)	0.00212*** (0.000)	0.00448* (0.002)	0.0241*** (0.006)	2.650* (1.477)	0.00473*** (0.002)
Immigrant employees ²					-0.00000135*** (0.000000358)	-0.00000196 (0.00000121)			
Firm-year FE	Y	Y	Y	Y	N	N	Y	Y	Y
Country-year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Obs.	8,543,103	159,289	11,844,107	196,608	11,844,107	204,865	11,844,107	417,866	122,560
F-stat/Adj. R ² /Pseudo R ²	6.11	2.81	0.6892	0.7439	0.6878	0.7423	0.7338	0.9650	0.7730
Kleibergen-Paap rk (p)	0.0000	0.0000							
Kleibergen-Paap Wald (F)	14.76	11.54							
Sanderson-Windmeijer (F)	14.76	11.54							
Hansen J (p)	0.5650	0.2133							

The table displays regression estimates of the effect of employment migration on firm-country offshoring. Regressions include firm-year and country-year fixed effects, as indicated, and additionally firm-country and year fixed effects. In columns 1, 3 and 5, the dependent variable is an indicator for offshoring, and in columns 2, 4 and 6, the dependent variable is $\ln(\text{offshoring} > 0)$. In columns 1 and 2, we present estimates from a 2SLS IV estimation based on the instruments of Eqs. 3 and 4. In columns 3 and 4, the linear regression estimates are averages from Monte Carlo simulations of a randomized "pseudo-treatment" in terms of firm immigrant employment instead of actual firm immigrant employment, with 250 (500) simulations at the extensive (intensive) margin of offshoring. In columns 5 and 6, we present results from adding the square of immigrant employment. In column 7, the dependent variable is $\ln(\text{offshoring} + 1e-7)$. In column 8, we employ a PPML estimator, where immigrant employees are captured as the share of in total firm employment. Finally, in column 9, estimates are from a two-step panel Heckman selection estimator, with the first-year lag of migration and with firm-country and year fixed effects in step one and firm-year and country-year fixed effects in step two. Robust and firm-country clustered standard errors are in parentheses. For brevity, other firm estimates are not reported. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

that are offshored (H4), and this jointly at the extensive and intensive margin. Concerning skills, 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, sustaining and developing 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).²⁷

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 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.

The semielasticities in Panel A of 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. Focusing on contract and R&D intensive inputs, we note that the employment of immigrants has the strongest effects on offshoring in Table 5, consistent with H4. Separating the contract and R&D components that make up 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 also. For unskilled employees, the coefficient estimates are much smaller in size than those of their skilled counterparts and the statistical significance appears to be driven by

²⁷ 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.

Table 5 Results across Inputs, Skills, Source Countries

<i>Panel A</i>		Immigrant employees	
		Skilled	Unskilled
All offshoring	Total	0.0638 ^{***}	0.0163 ^{**}
Contract and R&D	Total	0.152 ^{***}	-0.00942
R&D intensive	Total	0.118 ^{***}	-0.00150
Contract intensive	Total	0.0748 ^{***}	0.0147 ^{**}
<i>Panel B</i>		Immigrant employees	
		Skilled	Unskilled
Contract and R&D	Low-income	0.101 ^{***}	-0.0236 ^{***}
	High-income	0.195 ^{***}	-0.00986
R&D intensive	Low-income	0.0784 ^{***}	-0.0179 ^{**}
	High-income	0.154 ^{***}	-0.00155
Contract intensive	Low-income	0.0649 ^{**}	0.0146
	High-income	0.101 ^{***}	0.0136 [*]

The table displays estimates from 10 estimations of the effect of immigrant employment on firm-country offshoring. Regressions include firm-year, firm-country, country-year, and year fixed effects. Dependent variables are $\ln(\text{offshoring} + 1e-7)$. Robust and firm-country clustered standard errors are in parentheses. For brevity, other firm estimates are not reported. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

the impact of unskilled immigrant employees on the offshoring of contract-intensive inputs.

In Panel B of Table 5, we separate the destination of offshored inputs according to whether they relate to high- or low-income countries to test our hypothesis H5, while, again, separating the immigrant employees according to their skills. Somewhat unexpectedly, the effects are the strongest when offshoring and immigrants are from high-income foreign countries. These estimates for high-income countries are between 56 and 96% higher than for low-income countries. Thus, the evidence cannot confirm hypothesis H5. Once more turning to H3, we find that the importance of the skill level of immigrant employees is clear also in these regressions. Other than a relatively small positive effect from unskilled immigrant employment on contract-intensive 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 offshoring.

7 Conclusion and final remarks

Intermediate goods accounts for a considerable share of total international trade. Complex global value chains make firms dependent on producers across many different countries, and indications are that neither the global financial crisis nor the recent pandemic have changed this. Foreign trade in intermediates distinguishes itself by being especially sensitive to incomplete contracts, hold-up

problems and imperfect contract enforcement. 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 contract enforcement costs of offshoring. We examine how immigrants affect manufacturing firms' offshoring while carefully controlling for confounding factors by using firm-year and country-year fixed effects, by using an instrumental variable approach, by conducting a placebo test, and by examining 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 entry into offshoring and an even larger impact on the value of offshoring. Hiring one additional immigrant employee increases offshoring by 0.09 and 0.3% at the extensive and intensive margins, respectively, on average. Hiring skilled immigrants substantially enhances the positive impact on offshoring, 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' use of 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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Declarations

Conflict of interest We do not have any conflicting interest.

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