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The Impact of Offshoring and Migration Policies on Migration Flows

Cosimo Beverelli, Gianluca Orefice & Nadia Rocha

Highlights

- We develop and empirically test a trade-in-tasks model on the effects of migration and offshoring policies on employment of migrant workers. Namely, we test whether there is substitutability between migrant and offshore workers and whether there is migration diversion across developing countries.
- We find empirical evidence of the substitutability between migration and offshoring and of the absence of migration diversion effects.
- When migration and offshoring policies are implemented at the same time, the overall effect on bilateral migration flows is null.

Abstract

In a theoretical framework that extends Ottaviano *et al.* (2013) to three countries, we investigate two research questions. First, whether offshore workers directly compete with migrants from the same origin country to perform tasks of low/medium complexity (migration-offshoring substitutability). Second, whether migrants from different origin countries compete among each other (migration diversion). These questions are addressed empirically using a dataset covering 28 OECD high-income countries (as destinations of migrants flows) and 144 non high-income countries (as origins of migrant flows) for the period 1996-2010. The empirical results suggest strong direct substitutability between migrant and offshore workers from the same origin country and the absence of policy driven migration diversion across different origin countries.

Keywords

Migrant Employment, Migration-Offshoring Substitutability, Migration Diversion.

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RESEARCH AND EXPERTISE
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The impact of offshoring and migration policies on migration flows[1]

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1. Introduction

The reduction in the costs of relocating production activities abroad and the increasing availability of low-wage foreign-born workers[2] allows firms from industrial countries to engage in offshoring or to hire immigrant workers when it is profitable to do so. The effects of immigration and offshoring have often been studied in isolation, with a particular emphasis on their impact on employment of natives.[3] Only the recent contribution by Ottaviano et al. (2013) combines offshore, migrant and native workers as alternative production options in a unified framework, in which firms from a developed country can either hire offshore workers in a developing country, or employ at home immigrants coming from such country. They

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[2]Ample empirical evidence shows that immigrants earn lower wages than native workers, after controlling for workers' characteristics. See Antecol et al. (2003); Butcher and Nardo (2002); Chiswick et al. (2008).

[3]Offshoring is often perceived as a relocation of jobs abroad, reducing native employment. Görg and Hanley (2005), Amiti and Wei (2009) and Crinò (2010) find a mild negative effect of offshoring on their impact on domestic employment. But if the relocation of jobs results in a business increasing productivity (or innovation) – a result shown by Amiti and Wei (2009), Görg et al. (2008) and Görg and Hanley (2011) – sales can expand, increasing employment. Similarly, migration has been considered for a long time as detrimental for native employment because of substitutability between native workers ad migrants (Borjas, 2003; Aydemir and Borjas, 2006; Borjas et al. 2008). But new empirical evidence reverses this conclusion arguing that migrant and native workers might be imperfect substitute (D'Amuri et al. 2010; Ottaviano and Peri, 2012) and productivity gains in using migrants in production could offset the direct negative effect on native employment (Peri, 2012).

argue that immigrants do not compete with native workers because they perform tasks at the opposite ends of the task complexity spectrum. Conversely, offshore workers directly compete with immigrants and native workers since they perform tasks in the middle of the complexity distribution.

This paper extends the framework of Ottaviano et al. (2013) to a third country to explore two policy-relevant research questions. First, we investigate substitutability between offshore workers and migrant workers from a given origin country. Migrant workers from origin country i would substitute for offshore workers (labor hired in the same country i) if a reduction in the costs of migrating from i to destination d reduced the amount of offshore employment by country-d firms in country i.

Second, we test whether bilateral migration policies have a crowding-out (diversion) effect on third origin countries. A specific definition of migration diversion is used is this paper, referring to the flow of migrants from origin country i to destination d being negatively affected by a reduction in the cost of migrating from another origin country j to d.[4] Since there is almost no literature formally testing this specific type of migration diversion across origin countries, this test is the main contribution of the paper.

If offshoring and migration are substitutable strategies, policy makers in developed countries could indirectly affect immigration flows by changing incentives for firms to source labor abroad via offshoring. This is policy-relevant in the light of the stylized fact that individuals tend to be more pro-trade than pro-immigration (Mayda, 2008). The existing literature offers relatively little guidance on the question of substitutability between migration and offshoring. In a seminal theoretical paper, Ramaswami (1968) argued that using immigrant workers, rather than offshoring the production abroad, is the optimal strategy for firms located in capital abundant countries. In Jones (2005), the offshoring-migration trade-off depends on the scale of production. Since offshoring is assumed to entail fixed costs, it is the optimal strategy when the production scale is large. Conversely, using immigrants is optimal for small

[4] Throughout the paper, i and j are the countries of origin that send migrants to, and receive offshoring from, a destination country d.

scale firms. In a model with one good, two factors and two countries, Bandyopadhyay and Wall (2010) show that an exogenous migration inflow implies a decrease in outward capital flows (substitutability).

Most of the empirical literature in this field uses macro-level data and finds complementarity between migration and offshoring (Kugler and Rapoport, 2005; Javorcik et al., 2011), with the underlying idea that immigrants convey information about their origin countries and reduce the risk of making outward FDIs. Only two studies, to our knowledge, test the relation between migration and offshoring using micro-level data. In a sample of 4289 Italian manufacturing firms, Barba Navaretti et al. (2008) find a negative relation between offshoring and the share of foreign-born workers in the firm, leading them to conclude that migration substitutes for offshoring. Using data on 192 US Metropolitan Statistical Areas from 1998 to 2004, Olney (2013) finds that a 1% increase in the share of low-skilled immigrants leads to a 0.11% increase in the net birth of firms in the metropolitan area (offshoring is deterred), while a 1% increase in the high-skilled share of immigrants leads to a 0.26% decrease in net birth rate of firms (offshoring is stimulated).

When two countries bilaterally agree on easier procedures for labor migration, employers in these countries might find it relatively easier to hire immigrant workers from the partner country. This could divert migration flows away from a third country if its migrants were competing for similar tasks (Sykes, 2013). The policy relevance of migration diversion is twofold. First, as argued by Sykes (2013), bilateral migration agreements resulting in such externality are inefficient – in the same way as bilateral trade agreements that fail to freeze existing trade vectors with non-members (Panagariya, 2000). Second, the extent of migration diversion is important in the light of another stylized fact concerning attitudes towards migration, namely that the public in host countries is more favorable to migration from certain sending countries than others.[5]

[5]Perceived cultural differences between immigrant and native born population are among the main drivers of public resistance to immigration. For instance, Ivarsflaten (2005) and Sides and Citrin (2007) provide evidence that a preference for cultural unity is the strongest predictor of hostility to immigration in a wide range of European societies. The PEW Global Attitudes Report (PEW, 2007) argues that opinions about immigration are closely linked to perceptions about threats to a country's culture. In 46 of 47 surveyed countries, those who favor stricter immigration controls are also more likely to believe their way of life needs to

To the best of our knowledge, Marques (2010) is the only study attempting to quantify migration diversion between origin countries. She provides some empirical evidence that the opening of EU-15 borders to the Eastern and Central European countries diverted migration to the EU-15 away from the rest of the word in favor of such countries. The literature has overwhelmingly focused on spillover effects across European destination countries.[6] Boeri and Brücker (2005) compare actual and counterfactual flows of migrants from new (Eastern) EU member states to existing members in 2004. They provide limited evidence of diversion of such flows from countries tightly closing borders during the transitional period (such as Germany, Italy, Austria, Denmark and Finland) to countries with more liberal migration policies *vis-à-vis* new members (such as the UK, Ireland and Sweden).[7] Bertoli et al. (2013) consider migration from EEA (European Economic Area) countries to Germany between January 2006 and June 2012. Rather than focusing on migration policies, they consider economic conditions in traditional destination countries other than Germany (such as Italy, Spain and the UK) as potential triggers of migration diversion. They find that changes in economic conditions in these alternative destinations – approximated by the multilateral resistance term in a migration gravity specification – account for 78% of the increase in gross migration flows into Germany observed over the sample period.

To allow both for the possibility of migration-offshoring substitutability and of migration diversion across origin countries, we build a trade in tasks model *à la* Grossman and Rossi-Hansberg (2008). In the model, differences in offshoring and migration costs determine which tasks will be assigned to native workers and which tasks will be assigned to migrant or offshore workers from each of two partner countries i and j. Such framework delivers two

be protected against foreign influence. Importantly, such preferences need not be related to economic factors. In a pioneering experimental study, Sniderman et al. (2004) demonstrated that Dutch hostility to immigrants is greatly magnified simply by describing the migrant group in cultural rather than economic terms. Moreover, ethnicity matters when it comes to attitudes, as shown by a large body of sociological research. The public (and representative governments) often prefer migration from culturally close or ethnically similar countries, at the expense of migration from culturally distant or ethnically dissimilar ones (see, for instance, Ford, 2011).

[6] An exception is Bertoli and Fernández-Huertas Moraga (2015). They use variations in migrant stocks from 182 origins to 31 destination countries to assess the sensitivity of bilateral migration flows to a variation in the attractiveness of other destinations within given 'nests'.

[7] See also Baas and Brücker (2012). Kahanec and Zimmermann (2010) argue that if diversion occurred as a result of the 2004 EU enlargement, it took the form of diversion of high skilled migrants away from countries with closed-door policy towards more open countries, like the UK and Ireland.

realistic alternative scenarios. In the first scenario, there is substitutability between offshoring and migration (as migrants from country *i* compete with offshore workers from the same country in the performance of the same set of tasks), while there is no migration diversion (as migrants from country *j* do not compete with migrants from country *i* for the same set of tasks). In the second scenario, conversely, there is no substitutability between migration and offshoring (as migrants from country *i* do not compete with offshore workers from the same country for the same set of tasks), but there is migration diversion (as migrants from country *j* compete with migrants from country *i* for the same set of tasks).

The empirical questions of whether there is migration-offshoring substitutability and/or migration diversion are tackled using a dataset covering 28 OECD high-income countries (as destinations) and 144 non high-income countries (as origins) for the period 1996-2010.The specific provisions included in bilateral Preferential Trade Agreements (PTAs) are used to proxy for (the inverse of) policy-driven migration and offshoring costs. The data strongly support the predictions of the first scenario. Therefore, a country can affect the inflow of migrants by facilitating offshoring strategies affecting the same set of activities that would be assigned to migrants. Moreover, using theory-driven diversion dummies, we show that, contrary to trade flows, bilateral migration flows are not diverted by migration policies between the destination country and third origin countries.

The contribution of this paper to the exiting literature is threefold. First, migration-offshoring substitutability and migration diversion are analyzed in a unified framework. Second, the use of a large set of origin and destination countries allows abstracting from specific migration policies, such as EU enlargements. Third, migration and offshoring provisions contained in PTAs are used to identify bilateral specific migration and offshoring policies.

The remainder of the paper is organized as follows. The next section introduces the theoretical model and derives the two alternative scenarios. Section 3 discusses the link between the theoretical framework and the empirical strategy, which is then presented in Section 4, together with the data and the results. We conclude with the relevant policy implications in Section 5.

2. Theory

As in Ottaviano et al. (2013), we consider a small open economy denoted as country d, producing a good Y using labor. The labor input is a constant elasticity of substitution (CES) aggregate of tasks, indexed by $k \in [0,1]$, with elasticity of substitution between tasks $\sigma > 1$.[8] Along the $[0,1]$ continuum, tasks are ordered by increasing degree of complexity. The production function of the economy is:

$$Y = AL = \left[\int_0^1 \left[L(k) \right]^{\frac{\sigma-1}{\sigma}} dk \right]^{\frac{\sigma}{\sigma-1}} \tag{1}$$

where A is a technology parameter (marginal productivity of the labor aggregate).[9] We assume a linear cost function $c\left[\omega(k)\right] = \omega(k)$, where $\omega(k)$ is the marginal cost of task k.[10] Profit maximization yields the following conditional demand for labor input of task k:

$$L(k) = \left[\omega(k)\right]^{-\sigma} \frac{W}{\Omega^{1-\sigma}} \tag{2}$$

where $W \equiv \int_0^1 \omega(k) L(k)\, dk$ is the wage bill in the economy and $\Omega \equiv \left[\int_0^1 \left[\omega(k)\right]^{1-\sigma} dk \right]^{\frac{1}{1-\sigma}}$ is a CES aggregate of marginal costs.

2.1. Participation constraints

The tasks along the $[0,1]$ continuum can be performed by three types of workers: natives from country d; immigrants and offshore workers from foreign countries i and j. A task is offshored to country c, $c = i, j$ rather than performed by natives, if it is cheaper for firms to do it, namely if $\left[\omega(k)\right]^{NAT} \geq \left[\omega(k)\right]_c^{OS}$, where NAT stands for natives and OS stands for

[8]To have substitutability between tasks, it suffices to have $\sigma > 0$. However, for the sake of the tractability, we assume $\sigma > 1$. Such assumption is in line with the empirical literature surveyed in Appendix A.

[9]Without loss of generality, we set $A = 1$. Moreover, using Walras law, the price of Y is normalized to one.

[10]The assumption of linearity of the cost function is justified by noting that, by perfect competition in the labor market, each task is remunerated its marginal productivity $\omega(k)$.

offshore workers. This condition can be expressed as:

$$w \geq w_c \beta_c \chi_c (k) \tag{3}$$

The left-hand side of this expression is the marginal cost of performing a task domestically, equal to the wage times the unit input requirement (one). The right-hand side is the marginal cost of offshoring the task, equal to the wage in country c times the unit input requirement of offshored tasks, $\beta_c \chi_c (k)$. This is an inverse measure of 'ease of offshoring'. The unit input requirement comprises $\beta_c \geq 1$, a policy parameter common to all tasks, and $\chi_c (k) \geq 1$, a task-specific offshoring cost. We assume $\chi' (k) \geq 0$, i.e. the more complex a task, the higher the marginal cost of performing it via offshoring. To make sure that at least some tasks are offshored, we further assume that $w > w_c \beta_c \chi_c (0)$.

Similarly, a task is assigned to immigrants, rather than performed by natives, if $[\omega (k)]^{NAT} \geq [\omega (k)]_c^{MIG}$, where MIG stands for migrants. This condition can be expressed as:

$$w \geq w_c^{\oplus} \tau_c (k) \tag{4}$$

In equation (4), $w^{\oplus}$ represents the wage that firms from the host country are willing to pay to immigrants.[11] $\tau_c (k) \geq 1$ is a task-specific cost of assigning a task to migrant workers, with $\tau_c' (k) \geq 0$. Immigrants are assumed to incur a frictional cost of foregone productivity, $\delta_c \geq 1$, which is independent of the task performed in the host country.[12] In other words, an immigrant endowed with one unit of labor in the country of origin – with corresponding wage equal to w_c – is effectively endowed with $1/\delta_c$ units of labor in the host country. Consequently, firms from Home are willing to offer migrant workers a wage equal to $w_c^{\oplus}/\delta_c$. Positive supply of both immigrant and offshore workers in country c requires the indifference

[11]Home firms are assumed to be able to discriminate between natives and immigrants. For one unit of labor, they are willing to pay w to a native, but only $w^{\oplus} \leq w$ to an immigrant. For host countries implementing a minimum wage policy, we also assume $w_c^{\oplus}$ being larger than minimum wage.

[12]Notice that we propose a static model in which all migrants have to be considered as new arrived.

condition $w_c^{\oplus}/\delta_c = w_c$, which allows to rewrite equation (4) as:

$$w \geq w_c \delta_c \tau_c(k) \tag{5}$$

The right-hand side of equation (5) can be interpreted as an inverse measure of 'ease of migration'.

Next, a task is offshored to country c, rather than performed by migrant workers from c, if $[\omega(k)]_c^{MIG} \geq [\omega(k)]_c^{OS}$. This condition can be rewritten as:

$$\delta_c \tau_c(k) \geq \beta_c \chi_c(k) \tag{6}$$

Finally, to make sure that at least a task is assigned to native workers, we assume:

$$w < \min\{w_c \delta_c \tau_c(1), w_c \beta_c \chi_c(1)\} \tag{7}$$

This condition implies that sufficiently high-end tasks will be performed by native workers, a plausible result considering that high-end tasks are the most complex to accomplish. We let migrant and offshore workers only differ in offshoring and migration costs, not in productivity in the country of origin.[13] Therefore, $w_i = w_j = w^*$.

2.2. Task sorting

The functions $\tau_c(k)$ and $\chi_c(k)$ have different slopes and intercepts. This allows migration and offshoring costs to increase at different pace for different types of workers from different origin countries i and j, providing a sorting of tasks along the $[0,1]$ continuum. So far, it has been assumed that it is optimal to employ native workers for high-end tasks. To specify how low- and medium-end tasks will be allocated, we follow Ottaviano et al. (2013). Their empirical results show that low-end tasks (in their model, the 'easy' ones) are covered by migrant workers rather than offshored.[14] The natural sorting that replicates that of Ottaviano

[13] Notice that in the model both migrants and offshore workers have the same skill level (unskilled workers).
[14] Ottaviano et al. (2013) show that a reduction in migration costs does not affect the level of native employment, while a reduction in offshoring costs does. The fact that migrant workers do not compete with native

et al. (2013) in the current three-country setting is one in which migrant workers perform simpler tasks than offshore workers *within* each bilateral relation id. This is graphically represented in Figure 1 and expressed as follows:[15]

$$M_i < O_i < M_j < O_j \tag{8}$$

< Figure 1 about here >

This ordering is obtained by assuming:

$$\begin{cases} \delta_i \tau_i'(k) > \beta_i \chi_i'(k) > \delta_j \tau_j'(k) > \beta_j \chi_j'(k) \\ \delta_i \tau_i'(0) < \beta_i \chi_i'(0) < \delta_j \tau_j'(0) < \beta_j \chi_j'(0) < \frac{w}{w^*} \end{cases} \tag{9}$$

As shown in Appendix B, employment of immigrant workers from country i is equal to:

$$NM_i = \int_0^{M_i} N(z)\, dz = \lambda (\delta_i)^{1-\sigma} \rho \tag{10}$$

where λ and ρ are defined after equation (B-8). The relevant derivatives of NM_i with respect to migration and offshoring costs are:

$$\frac{\partial NM_i}{\partial \delta_i} = \lambda \left[(1-\sigma)(\delta_i)^{-\sigma} \rho + (\delta_i)^{1-\sigma} \frac{\partial \rho}{\partial \delta_i} \right] < 0 \tag{11}$$

$$\frac{\partial NM_i}{\partial \beta_i} = \lambda (\delta_i)^{1-\sigma} \frac{\partial \rho}{\partial \beta_i} > 0 \tag{12}$$

$$\frac{\partial NM_i}{\partial \delta_j} = \lambda (\delta_i)^{1-\sigma} \frac{\partial \rho}{\partial \delta_j} = 0 \tag{13}$$

workers indicates that easy tasks are performed by migrants rather than offshored. They therefore assume that the productivity of immigrants falls faster than the productivity of offshore workers as task complexity increases.

[15] In Figure 1, the marginal cost functions are linear just because of simplicity of exposition. All the results are derived without assuming any functional form, only using the assumptions in (9).

$$\frac{\partial NM_i}{\partial \beta_j} = \lambda \left(\delta_i\right)^{1-\sigma} \frac{\partial \rho}{\partial \beta_j} = 0 \tag{14}$$

Equation (11) shows that own migration costs reduce migrant employment. Equation (12) shows that own offshoring costs increase migrant employment. This sorting, therefore, predicts substitutability between migration and offshoring. Equations (13) and (14) respectively predict no impact of third-country migration and offshoring costs on own migrant employment. The null sign in equation (13) is of particular relevance, because it points to the absence of migration diversion across origin countries.

An alternative sorting that is broadly consistent with Ottaviano et al. (2013)'s result that low-end tasks are covered by migrant workers rather than offshored is the following: $M_i < M_j < O_i < O_j$. In this sorting, the allocation of low-end tasks to migrant workers and the allocation of medium-end tasks to offshore workers hold *across* origin countries. Following the same derivations of Appendix B, it is straightforward to show that this alternative sorting predicts the absence of direct substitutability between migration and offshoring and the presence of migration diversion: $\partial NM_i/\partial \beta_i = 0$; $\partial NM_i/\partial \delta_j > 0$.[16] None of these predictions is however borne by the data, as shown in Section 4.

To sum up, the theoretical framework implies a fragmented labor market in destination country d, where immigrants coming from different origins (i and j) perform different sets of tasks over the continuum of the task complexity. This is supported by the literature on the occupational choice of immigrants in destination countries. Patel and Vella (2013) show that US immigrants coming from different origin countries have developed local niches in specific occupations (for instance, Vietnamese hairdressers or Haitian food preparation workers in the USA).[17] Similarly, Chiswick and Taengnoi (2007) show that US immigrants whose mother tongue is linguistically far from English are more likely to be employed in occupations in which communication in English is not very important (as computer and engineering) or in

[16] The other derivatives in this alternative sorting are: $\partial NM_i/\partial \delta_i < 0$; $\partial NM_i/\partial \beta_j = 0$. The mathematical derivations are available upon request.

[17] This is true in local labor markets, whereas the same occupation might be dominated by different migrant groups in different parts of a country. However, this is suggestive evidence of the fractionalization of the destination country's labor market across different immigrant groups.

occupations providing services to immigrants from their same linguistic background.

3. From theory to empirics

The empirical analysis is conducted at the country-pair dimension across years. As mentioned in Section 1, high-income OECD countries are used as destinations and non high-income countries as origins. Although the task dimension is excluded, the composition of the sample implies that the focus is on low- and medium-end tasks on the complexity spectrum, as suggested by the theoretical framework. Indeed, there is ample empirical evidence that migrants tend to be more often over-educated than natives working in comparable occupations, mostly due to imperfect international transferability of human capital (see Green et al., 2007; Piracha et al., 2012 and the literature cited therein). It is reasonable to believe that this phenomenon is particularly relevant in the case of South-North migration.[18] Therefore, migrants from non-high income countries to high-income OECD countries are likely to compete for low-end tasks (in the complexity spectrum) in the destination country. Similarly, tasks that are offshored from developed to developing countries tend to be labor-intensive manual/routine ones (see Feenstra and Hanson, 1996). These belong to the low-medium segment of the complexity spectrum.

There are four relevant policy parameters affecting, *ceteris paribus*, migration flows from origin i to destination d: migration costs within a country pair id (in the model, δ_i); offshoring costs within a country pair id (in the model, β_i); migration costs between a third country j and destination d (in the model, δ_j); and offshoring costs between a third country j and destination d (in the model, β_j). As an (inverse) measure of the costs of migration, information on migration-specific provisions contained in PTAs is used. The δ parameters represent all factors responsible for the productivity loss that foreign workers incur when they migrate, including the policy-related cost of migration but also language barriers, homesickness, and the like. This might create a gap between theory and empirics, which is however justified by

[18]For instance, using data between 2008 and 2010 from the MAFE (Migration between Africa and Europe) dataset, Castagnone et al. (2014) show persistent stagnation of migrants from Senegal, the Democratic Republic of the Congo and Ghana in the lower segments of the labor market of various EU countries.

the policy focus of the paper and consistently attenuated by the structure of fixed effects and control variables included (see below). As an (inverse) measure of the costs of offshoring, offshoring-specific provisions contained in PTAs are used. Since the empirical proxies are meant to capture the policy determinants of offshoring costs (β), the potential gap between theory and empirics is not a concern. Section 4 provides details on how these proxies are constructed and further justification for their use.

The main interest lies in testing the substitutability between offshoring and migration and the extent of migration diversion. The theoretical model also includes direct effects of bilateral migration costs and indirect effects of third-country offshoring costs. The former are clearly – and trivially – expected to be negative. On the latter, it is difficult to come up with a good prior. The model predicts them to be equal to zero, implying the absence of 'offshoring-driven migration diversion' on bilateral migration flows.[19] To be as consistent as possible with the theory, the four relevant policy parameters are included in all econometric specifications.

4. Empirical evidence

4.1. Methodology

A gravity model for migration as in Beine et al. (2014) and Figueiredo et al. (2016) is employed. However, we depart from the previous literature by including four different types of policies (potentially) affecting bilateral migration flows.[20] The conditional expectation of the dependent variable, MIG Flow, is expressed as:

$$E\left[\text{MIG Flow}_{idt}\,|\mathbf{x}_{idt},\mathbf{r}_{idt},\mathbf{w}_{idt}\right] = g(\mathbf{x}'_{idt}\beta + \mathbf{r}'_{idt}\theta + \mathbf{w}'_{idt}\gamma) \tag{15}$$

where $g(\cdot)$ is a function; i denotes the origin country (sender of immigrants); d denotes the destination country (recipient of immigrants); t indexes time (years); $\mathbf{x}_{idt}$ is a vector

[19] In the remainder of the paper, the term 'offshoring diversion' is used as a shortcut for 'offshoring-driven migration diversion', i.e. diversion of migration flows resulting from reduction in offshoring costs between a third country j and destination d.

[20] Although the theoretical framework delivers predictions on the stock of migrants, migration flows are used to exploit the time variation in offshoring and migration policies. However, a robustness check was conducted using bilateral migration stocks (see section 4.4).

of bilateral migration and offshoring policy measures; $\mathbf{r}_{idt}$ is a vector of standard gravity controls; $\mathbf{w}_{idt}$ is a vector containing control dummies; β and θ are vectors of coefficients to be estimated; and the dependent variable is the inflow of migrants from i to d.[21]

The estimation sample covers the period 1996-2010. The set of destinations d includes only 28 OECD high-income countries for which bilateral migration flows data is available in the OECD International Migration Dataset. The set of origin countries i includes 144 non high-income countries (classified as 'low income','lower-middle income' or 'upper-middle' income by the World Bank).[22] Therefore, in the dataset, no country is a sender and recipient of migrants at the same time.

The vector of bilateral migration and offshoring policy measures is crucial and its elements deserve detailed explanation. MIG PTA measures the direct effect of ease of migration on bilateral migration flows. It is a dummy variable equal to one if countries d and i have signed a Preferential Trade Agreement containing legally enforceable provisions either on trade in services (GATS), visa and asylum, or on labor market regulation. Orefice (2015) shows that visa-and-asylum and labor market regulation provisions, when included in PTAs, stimulate bilateral migration flows because they reduce migration costs.[23] The inclusion of GATS provisions can also ease bilateral migration. Indeed, some PTAs include provisions that go beyond GATS Mode IV and permit temporary entry of selected professionals from partner countries. This allows temporary migrants to gain experience in a foreign country and/or to join local workers' networks, which might facilitate longer-term stay into the destination country.[24] Therefore, a positive coefficient on MIG PTA is expected.

To test the offshoring-migration substitutability, the variable OS PTA is included. It is a

[21]The full list of variables, including the data sources, is available in Appendix table C-1. In the table, subscripts are omitted for notational simplicity.

[22]The 28 destination countries are the following: Australia, Austria, Belgium, Canada, Switzerland, Czech Republic, Germany, Denmark, Spain, Finland, France, United, Kingdom, Hungary, Iceland, Israel, Italy, Japan, Korea, Luxembourg, Netherlands, Norway, New Zealand, Poland, Portugal, Slovakia, Slovenia, Sweden, and the United States. A list of the 144 origin countries is available upon request.

[23]Visa and asylum provisions are aimed at reducing the administrative costs of migration by promoting the exchange of information among signatory countries and the drafting of legislation in the area of visas and asylum for migrants. Similarly, labor market regulation provisions reduce the migration cost by regulating and integrating the labor markets of signatory countries.

[24]See for instance the ASEAN-Australia-New Zealand and the US-Singapore agreements.

dummy equal to one if countries d and i share a PTA containing legally enforceable provisions either on intellectual property rights under the mandate of the WTO (TRIPS), competition policy, investment, movement of capital, or intellectual property rights out of the mandate of the WTO (IPRs). In Appendix D it is shown that the presence of at least one of the above-mentioned provisions boosts bilateral offshoring – proxied with production network trade. Therefore, OS PTA can reasonably be used to approximate reductions in offshoring costs between countries i and d. The literature surveyed above has found some degree of substitutability between migration and offshoring. If the empirical results are consistent with this finding, the sign on OS PTA should be negative.

Beyond the direct effects of migration and offshoring policy on migration from i to d, the theoretical framework allows for potential diversion effects, which depend on the marginal costs of using migrant or offshore workers along the task continuum. To test the migration diversion effect, a diversion dummy variable is used. It is equal to one if country d and a third country $j \neq i$ share a PTA including migration provisions (in the sense described above). In building such dummy variable, we follow the theoretical set-up suggesting that the third country j should be 'similar' to country i in terms of nominal wage rate, and should differ from i only in terms of migration and offshoring costs. Taking these two considerations into account, four versions of the migration diversion dummy variable are constructed:

i) Mig Div 50 is equal to one if country d has signed a PTA with migration provisions with *at least one* origin country $j \in J_1$. The set J_1 includes all j's similar to i, such that the similarity index in GDP per capita between i and j is above the median of its sample distribution.[25]

ii) The variable Mig Div 75 is constructed in like manner, but only using origin countries $j \in J_2$ – the set of all j's *very* similar to i, such that the similarity index is above the 75$^{\text{th}}$ percentile of its sample distribution.

iii) Mig Div region 50 is constructed using the set J_3, which includes only the j countries that

[25] Following Helpman (1987), the similarity index in GDP per capita between i and j is defined as $SI_{ijt} \equiv 1 - \left[GDP^i_{pc}/(GDP^i_{pc} + GDP^j_{pc})\right]^2 - \left[GDP^j_{pc}/(GDP^i_{pc} + GDP^j_{pc})\right]^2$. Per capita GDP is used as a proxy for nominal wages.

are similar to i (similarity index above the median) and belong to the same region as i.[26]

iv) Mig Div region 75 is constructed using the set J_4, which includes only the j countries that are *very* similar to i (similarity index above the 75th percentile) and belong to the same region as i.[27]

The sets J_1, J_2, J_3 and J_4 only include non-high income countries. Since only origin countries that are non-high income are considered, this strengthens the idea of similarity in income level. Furthermore, it should be noted that all the migration diversion dummies vary by country pair id and over time t. Thus, they have the same dimensionality as the dependent variable, idt.

To fix ideas, consider the following example. Let the United States be destination d and Colombia be origin i in 2005. There are, in the data, 141 other origin countries, apart from Colombia. The set J_1 corresponds to the subset of 75 countries with which Colombia has a similarity index above the overall sample median. For each of these 75 countries, there is information on whether they have a PTA with migration provisions with the United States. The variable Mig Div 50 is equal to one if at least one of these 75 countries has a PTA with migration provisions with the United States, zero otherwise. Similarly, there are 42 countries with which Colombia has a similarity index above the overall sample 75th percentile (set J_2). The variable Mig Div 75 is equal to one if at least one of these 42 countries has a PTA with migration provisions with country d, zero otherwise. Next, the set J_3 includes 23 countries with which Colombia has a similarity index above the overall sample median and belong to the same region as Colombia (Latin America and the Caribbean). The variable Mig Div region 50 is equal to one if any of these 23 countries has in place a PTA with migration provisions with the United States. Finally, the set J_4 of countries with which Colombia has a similarity index above the overall sample 75th percentile) and belong to the same region as Colombia only contains 12 countries. If any of the countries is J_4 has a PTA with migration provisions

[26]Regions are defined using the World Bank classification, and include: East Asia and Pacific; Europe and Central Asia; Latin America and the Caribbean; Middle East and North Africa; North America; South Asia; Sub-Saharan Africa; Western Europe.

[27]The reason to include the migration diversion dummies iii) and iv) is to be able to compare origin countries i and j with reasonably similar travel costs of migration (to d) and different administrative costs of migration.

with the United States, the variable Mig Div region 75 takes value one.

For the sake of consistency with the theoretical framework, we also include various versions of the 'offshoring diversion' dummy variable, equal to one if d and third country $j \neq i$ share a PTA with offshoring provisions. The four versions of this variable are constructed in the same way as the four versions of the migration diversion dummy variable described above.

The gravity control variables in $\mathbf{r}_{idt}$ capture the geographic costs of migration as distance, common language, common border and past colonial relationship between countries i and d. GDP per capita in both the origin and the destination country is also included, to control for the traditional push and pull factors in migration flows (Mayda, 2010). The subset of gravity control variables included in each regression depends on the set of dummy variables in $\mathbf{w}_{idt}$. This is detailed in the next section.

4.2. Identification

The inclusion of migration provisions in PTAs is far from being an ideal randomized treatment, as it is potentially related to country and/or pair characteristics.[28] In particular, one might be concerned that the presence of bilateral migration flows affects the probability that two countries include migration provisions in a PTA. This would lead to a self-selection (reverse causality) bias. But is this really the case? The answer is less clear than one might think. PTAs are primarily signed to promote bilateral trade, with migration as an afterthought. The presence of reverse causality would likely make past growth rates of bilateral migration flows affecting the probability that countries i and d sign a PTA with migration provisions. Appendix table C-4 presents results of a linear probability model and, alternatively, a Probit model with a dummy equal to 1 if a PTA with migration provisions was signed in any year between 2004 and 2010 in a given id pair as dependent variable. The set of explanatory variables includes the average growth rate of the variable MIG Flow between 1996 and 2000, standard gravity controls $\mathbf{r}_{id}$, and, in columns (2) and (4), origin and destination

[28] The influence of country-pair characteristics on the probability of signing PTAs is shown, among others, in Baier and Bergstrand (2004) and Baier at al. (2014). As argued by Chen and Mattoo (2008), "Country pairs that are similar in market size, sufficiently different in factor endowment, and geographically proximate are more likely to have a trade agreement in place".

dummies.[29] The coefficient on the variable of interest (average growth rate of migrant inflow) is not statistically significant. There is no evidence that past inflows of migrants affect the probability that a PTA with migration provisions is signed.

This test suggests the absence of reverse causality. However, the skeptical reader will not be moved by it. Assuming, *arguendo*, the presence of reverse causality, a four-pronged approach is proposed to address the issue. First, the lag of MIG PTA, rather than its current value, is used in the preferred specification. Second, we perform the strict exogeneity test proposed by Wooldridge (2002, p. 285) and used in a similar context by Baier and Bergstrand (2007) and Head and Ries (2010). Up to two leads of MIG PTA are included in the preferred specification. If MIG PTA is strictly exogenous with respect to bilateral migration, its leads should not be correlated with current migration flows.

Neither the use of a lagged explanatory variable, nor the strict exogeneity test are an ideal solution, due to the high correlation between MIG PTA and its past and future values (once a PTA is signed, it stays in force in most cases). The third step in addressing potential self-selection available with the data at hand relies on Propensity Score Matching (PSM). We build a sub-sample that includes only pairs with similar estimated probability of having a PTA with migration provisions (based on the estimated propensity score). In this subsample, the variable MIG PTA can reasonably be considered randomly assigned, allowing for causal inference. See section 4.4 for more details on the PSM.

Fourth, we propose Instrumental Variable (IV) regressions. An ideal instrument for MIG PTA would affect bilateral migration flows only indirectly, only through its impact on migration provisions in PTAs. Borrowing from Figuereido et al. (2016), the variable MIG PTA RoW is used as an instrument. MIG PTA RoW is equal to the total number of PTAs with migration provisions signed by origin country i and by destination country d with the rest of the world, with the exception of the bilateral id PTA, if signed. This variable captures the propensity of

[29]The time spans used in this test (2004-2010 for the dependent and 1996-2000 for the explanatory variable) have been chosen to test whether ex-ante migration flows affect ex-post realization of MIG PTA. However, results are qualitatively the same using different time spans to define the dependent variable and the main variable of interest. They are available upon request.

both origin and destination countries in including migration provisions in their PTAs with third countries – if countries i and d are inclined to cover migration provisions in their respective PTAs with third countries, they will likely include migration provision when signing a PTA among them – and can be thought as exogenous with respect to bilateral migration flows.[30]

The approaches outlined above address selection on observables. Possible estimation biases coming from omitted variables that are correlated with the explanatory variables also need to be addressed. The literature suggests to control for unobserved heterogeneity with country-year fixed effects, proxying for multilateral resistance terms to migration (see Bertoli and Fernández-Huertas Moraga, 2013). While this is easily accomplished in linear models, it can constitute an insurmountable challenge in non-linear models because of the incidental parameter problem. As detailed in section 4.4, in OLS regressions pair (id) and country-year (it and dt) fixed effects are used. This makes the inclusion of any variable in $\mathbf{r}_{idt}$ redundant. In non-linear regressions, as a second-best solution to address the omitted variable issue, pair fixed effects and year dummies are used, controlling for country-year gravity variables. Moreover, to address the concern that it might be the decision to sign a PTA *tout court* that explains both the inclusion of migration and offshoring provisions, the variable Bilateral PTA – equal to one if countries i and d have a PTA in force – is added as an additional control to all regressions, except the baseline OLS (used here only as benchmark). Indeed, one may argue that the variability in MIG PTA and OS PTA is simply driven by the signature of a PTA *tout court*, which might result in unclear identification of the coefficients of interest. A further concern is that other provisions included in PTAs (e.g. tariff cuts) can somehow affect bilateral migration flows, for example by increasing bilateral trade.[31] This might also introduce a bias in the estimation of the coefficients of interest. The inclusion of the PTA *tout court* dummy addresses both concerns. After controlling for the presence of a bilateral PTA, the coefficients on MIG PTA and OS PTA capture exactly the effect of migration and offshoring policies, respectively.

[30] Diversion dummies, conversely, are constructed using only PTAs with migration provisions signed by destination country d with third countries $j \neq i$.

[31] In a standard factor content of trade model, bilateral trade is expected to reduce incentives for migrating because of factor price equalization.

A final identification issue relates to the OS PTA dummy and the migration and offshoring diversion dummies. It is unlikely that such variables are subject to a reverse causal link with bilateral migration flows. The inclusion of offshoring provisions in PTAs may be affected by the prospect of furthering bilateral offshoring, but there is no reason to believe that bilateral migration flows have any impact. Concerning the diversion dummies, they are constructed using PTAs with migration provisions between country d and third countries $j \neq i$. Even if one cannot rule out the possibility that the signing of a few bilateral jd migration-PTAs is a response to the signing of the id migration-PTA, it is unlikely that the maximum (or the total) of jd migration-PTAs, used to construct the diversion variables, is endogenous.

4.3. Data

Migration data are from the OECD's International Migration Dataset. The measure of migrant employment is the inflow of foreign-born population in destination country d from origin i. The raw data contain information on migration from 144 origin countries to 28 OECD destination countries, for the period 1990-2010. However, because of lack in the availability of policy variables, the estimation sample shrinks to 1996-2010.

To compute the similarity index described above, data on GDP per capita from the World Bank's World Development Indicators is used. Gravity data are from the CEPII dataset assembled by Head et al. (2010). Finally, data on the presence/content of a preferential trade agreement (PTA) between country d and country i are from a comprehensive dataset assembled by the WTO and used in World Trade Report (2011).[32] Appendix tables C-2 and C-3 respectively present in-sample descriptive statistics and correlations.

4.4. Results

Preliminary results are shown in Table 1. They are based on a linear OLS estimation, with the $g(\cdot)$ function of equation (15) equal to the identity function. All specifications include

[32] A full list of PTAs with migration provisions from the WTO dataset is presented in tables A.1.1, A.1.2 and A.1.3 – respectively for visa and asylum provisions, provisions on labor market regulation and provisions on trade in services (GATS) – of Orefice (2015).

MIG PTA and OS PTA; columns (1)-(4) differ for the version of MIG Div and OS Div included. Despite suffering from the zero migration flows problem discussed below, OLS estimations constitute a benchmark, because they allow to condition on it, dt and id fixed effects. Two results emerge. First, the coefficient on MIG PTA is positive and significant in all specifications, indicating a positive effect of migration provisions included in PTAs on bilateral migration flows. This confirms the results of Orefice (2015) and Figuereido et al. (2016). Second, the coefficient on OS PTA is negative and significant in all specifications, indicating a negative effect of offshoring provisions included in PTAs on bilateral migration flows. This constitutes *prima facie* evidence that migration and offshoring are substitutes – a reduction in bilateral offshoring costs increases the span of circumstances in which offshoring is cheaper than using immigrants in production. Conversely, the sign and statistical significance of the coefficients on diversion variables are not consistent across specifications. Migration diversion dummies turn from being negative in columns (1)-(2) to positive in columns (3)-(4). Offshoring diversion dummies turn from positive in column (1) to non-statistically significant in column (2) to negative and significant in columns (3)-(4).

< Table 1 about here >

As largely discussed in the empirical gravity literature in trade (Head and Mayer, 2013; Santos Silva and Tenreyro, 2006) and migration (Beine et al. 2014), when the dependent variable has a significant share of zeros OLS estimation are biased, and estimations based on count data are to be preferred. In the sample, 16.5% of observations are zero. The preferred specification, therefore, relies on count data. Specifically, we let the function $g(\cdot)$ in (15) to be the exponential function, and estimate a fixed effects Poisson model, conditioning on pair fixed effects and including year dummies.[33] Since country-time specific effects cannot be controlled for, the set of control variables is augmented with GDP per capita and multilateral resistance. This is a standard practice in the gravity literature when the use of country-year fixed effects is prevented. Multilateral resistance is proxied by remoteness, measured as in

[33]A count data model with it and dt fixed effects could not be estimated because of convergence problems in the likelihood function. For the same reason, the Pseudo Poisson Maximum Likelihood (PPML) estimator could not be obtained. The fixed effects Poisson is, however, implemented as a pseudo ML estimator when standard errors are robust, as in this case.

Baldwin and Harrigan (2011) as the inverse of the Harris market potential.[34]

The results of the fixed effects Poisson estimation of equation (15) are in Table 2.[35] This table (as well as all the following ones, except when otherwise indicated in table footnotes) also include the variable Bilateral PTA as additional control; so, the coefficient on MIG PTA and OS PTA should be interpreted as the additional effect of the inclusion of migration and offshoring provisions to the effect of having a PTA in place. The coefficient on MIG PTA (OS PTA) is positive (negative), confirming our expectations and the results of OLS estimations. The presence of a migration policy stimulates bilateral migration flows (reduction in the bilateral cost of migration), while the presence of offshoring policy deters bilateral migration (migration-offshoring substitutability). A comparison of the magnitude of the coefficients yields interesting policy implications. Since the coefficients on MIG PTA and OS PTA have similar magnitude but opposite sign, PTAs including both migration and offshoring provisions have null (overall) effect on bilateral migration.

With the exception of a positive and statistically significant coefficient on MIG Div 50 in column (1), all the other coefficients on the migration diversion dummies are statistically not different from zero. Thus, there is no evidence of migration diversion. This is a novel and important result. Its importance is twofold. First, it implies that the concern that migration flows might be crowded out through selective immigration policies is largely unwarranted.[36] Second, the evidence of lack of migration diversion points to a substantial difference between trade flows (which are subject to diversion, as indicated by the literature surveyed in WTO, 2011) and migration flows. This, in turn, affects the economic rationale of PTAs' formation. The number of existing trade-liberalizing PTAs that a rich country signs with developing countries positively affects the likelihood of further trade-liberalizing PTA formation between that rich country and excluded developing countries, given the latter's objective of neutralizing

[34] $\text{Remoteness}_{kt} \equiv \left(\sum_c GDP_{c\neq k,t}/dist_{ck}\right)^{-1}$, where k and c index countries and t indexes time.

[35] Despite the inclusion of observations with zero migration flows, the number of observations is slightly lower than in the corresponding OLS regressions of Table 1. This is because fixed effects Poisson drops country pairs with only one observation (in column (1), 212 pairs for a total of 212 observation) and country pairs with all zero outcomes (in column (1), 151 pairs for a total of 1012 observations).

[36] This concern is raised by Sykes (2013). He claims that in the presence of migration diversion, countries should aim at "designing cooperative arrangements that afford an origin-neutral allocation of the opportunity to migrate and ensure that the most efficient migration occurs in relation to any allowed level of migration".

trade diversion (Baldwin and Jaimovich, 2012). Conversely, the number of existing migration-liberalizing PTAs signed by a rich country with the rest of the world should not affect the incentives of a developing country to seek forming a PTA with migration provisions with that rich country.

As in Table 1, offshoring diversion dummies are negative, but statistically significant only in the two specifications of columns (1) and (2). We do not have a strong prior on this coefficient. It should be noted, however, that the strategy of offshoring in country $j \neq i$ is at the opposite side of the strategy of employing immigrants from i (see Figure 1). Only a strong reduction in the offshoring cost to j can cause a reduction in migration from i – in terms of the model, when the profit curve from offshoring in j shifts downward close to the profit function from employing immigrants from i. Thus the negative sign is plausible and coherent with the nature of the model, though not overwhelmingly supported by the data.

< Table 2 about here >

Diversion variables were alternatively computed as the count, within the respective group $J_i, i = 1, 2, 3, 4$, of third countries $j \neq i$ with which country d has a PTA with migration or offshoring provisions in place.[37] The results, shown in Appendix table C-5, are qualitatively similar to the results with dummy variables of Table 2.

Next, the reader might be concerned that the list of the 28 high-income OECD countries (see footnote 22) also includes some Eastern European countries traditionally sending (more than receiving) migrants, such as the Czech Republic, Hungary, Poland, Slovakia and Slovenia. For this reason, Appendix table C-6 reports baseline estimations that exclude such countries. Again, the results are qualitatively similar to those of Table 2.[38]

Further note that the results are not affected by multicollinearity between direct and indirect effects. Separate fixed effects Poisson regressions were estimated for direct effects (MIG

[37]With this method, the diversion variables have the size of the respective J group. In the above example of United States and Colombia in 2005, MIG Div 50 is equal to 75; MIG Div 75 is equal to 42; MIG Div region 50 is equal to 23; and MIG Div Region 75 is equal to 12 in the year 2005.

[38]Inclusion, rather than exclusion, of the Czech Republic – a traditional destination country for Eastern European migrants – does not affect the results.

PTA and OS PTA) and for indirect effects (diversion dummies). The results, reported in Appendix table C-7, are similar to the baseline Poisson results of Table 2.

The baseline estimations rely on bilateral migration flows to exploit the time variation in both offshoring and migration policy. However, the theoretical framework delivers predictions on the bilateral stocks rather than flows of migrants. A robustness check was performed using bilateral stocks of migrants from the IAB brain-drain dataset – see Appendix E for more details. In this case, the data are available with disaggregation by skill level. To remain as close as possible to the theoretical framework, we use the stock of unskilled migrants. Results are reported in table 3 and are fully consistent with the evidence discussed so far. Appendix tables E-1 and E-2 report estimations using the stock of total and skilled migrants, and show the null effect of bilateral migration policies. This confirms that our argument applies mainly to unskilled migrants performing less complex tasks.

$<$ Table 3 about here $>$

4.4.1. Addressing identification concerns

As discussed in Section 4.2, potential reverse causality between MIG PTA and migration flows is addressed using various approaches. The first one is the use of lagged values of MIG PTA. The signature of a PTA with migration provisions at time $t-1$ might be driven by a bilateral migration shock at time t (recall that by including country pair fixed effects the identification is on differences with respect to the country-pair time average). Results reported in table 4 using lagged MIG PTA are qualitatively the same as those reported in table 2. Then, we run a strict exogeneity test, including one or two leads of the MIG PTA variable. Results reported in table 5 show that strict exogeneity cannot be rejected. In all specifications, the leads of the MIG PTA variable are not statistically different from zero, while the contemporaneous MIG PTA dummy retains its significance.

$<$ Tables 4 and 5 about here $>$

In the PSM approach, the first step is estimating the propensity score (probability of having a PTA with migration provision) in a linear probability model. The dependent variable is MIG PTA dummy. Bilateral distance, countries' GDP, and year dummies as explanatory variables. Then country pairs with MIG PTA (treated group) are matched with pairs without MIG PTA (control group) on the basis of the propensity score. Finally, equation (15) is estimated on the sub-sample of treated pairs with matched control pairs. Since this sub-sample only includes pairs with similar probability of signing a PTA with migration provisions, the variable MIG PTA can reasonably be considered randomly assigned. Results using the PSM approach are reported in Table 6. The sample size is much smaller than the one of Table 2 because it is determined by the number of country pairs with positive MIG PTA in the treated group that match with country pairs in the control group. Despite this, the results are qualitatively similar to the baseline ones. Namely, MIG PTA positively affects bilateral migration flows; OS PTA has a negative effect (substitutability between migration and offshoring); there is no evidence of migration diversion.

< Table 6 about here >

The final way of addressing potential reverse causality issues relies on intrumental variables. The results of the (linear) IV approach that uses the variable MIG PTA RoW (explained in Section 4.2) as an instrument for MIG PTA are in Table 7.[39] As expected, the coefficient on MIG PTA is larger than in baseline OLS regressions of Table 1, reflecting the attenuation bias of OLS due to positive covariance between MIG PTA and migration flows. The coefficient on OS MIG stays negative and significant. The coefficients on migration diversion variables are positive, but not consistently significant, suggesting that there is only weak evidence for migration diversion, namely, only when countries i and j are similar but not necessarily in the same region (columns (1) and (2)).

Table 7 also presents the results of the endogeneity test and first-stage regression results. The null hypothesis that the specified endogenous regressor (MIG PTA) can actually be

[39] Since the instrumental variable MIG PTA RoW (the propensity of country d and i in covering migration provisions in their PTAs with the RoW) is likely to be sticky over time, in the IV estimations standard errors are clustered within id pairs.

treated as exogenous is always rejected in the endogeneity test. Moving to first stage results, the coefficient on the instrument in the first stage is positive and significant. Moreover, the null hypotheses of weak identification (Sanderson and Windmeijer, 2016) and underidentification (Kleibergen and Paap, 2006; Sanderson and Windmeijer, 2016) are strongly rejected in the respective tests. Finally, the null hypothesis that the coefficients of the excluded instruments are jointly equal to zero is also rejected in the Stock-Wright LM test (Stock and Wright, 2000).

< Table 7 about here >

As a final step of the empirical strategy, a non-linear Poisson IV approach is used to solve at the same time the zero migration flow bias and the endogeneity of MIG PTA. The instrumental variable is the same as that used in the linear IV described above, but the set of fixed effects changes. Unfortunately, in the Poisson IV country-pair and year fixed effects cannot be included for computational reasons. We thus rely on country (i and d) and year fixed effects and augment the set of control variables by including country-pair specific gravity controls: distance, common border, language and colony. The results are reported in Table 8 and again confirm the presence of offshoring-migration substitutability and the absence of (policy driven) migration diversion.

< Table 8 about here >

5. Conclusions and policy implications

We have developed and empirically tested a trade-in-tasks model on the effects of migration and offshoring costs on employment of migrant workers. The two research questions we have focused on are: i) whether there is substitutability between migrant and offshore workers from a given developing country; ii) whether there is migration diversion across developing countries. Substitutability between migrant and offshore workers occurs if a reduction in the costs of hiring offshore workers reduces the flow of migrants. Migration diversion occurs if lower bilateral costs of migration from a developing to a developed country reduce the flow of migrants to the same developed countries from third origin countries.

The analysis has produced convincing empirical evidence of substitutability between migration and offshoring and of the absence of migration diversion effects. From the point of view of migration policy-setting in destination countries, these results imply that countries that would like to discourage immigration from a specific country for political or other reasons could encourage offshoring in this country. This can be relevant for governments that have their hands tied on bilateral migration policy (for instance, because of participation to international agreements on migration, like the Schengen Treaty).

From the point of view of origin countries, the results imply that reducing bilateral migration costs is, *per se*, a sufficient condition to increase the flow of migrants to a given destination country – independently on whether this country extends such 'preferences' to other origin countries.

It should be emphasized that the results of this paper should not be interpreted as implying that there are no externalities in migration policy. As shown by Giordani and Ruta (2013), there are indeed relevant spillovers in the immigration policy set by destination countries, with policy restrictions in one country increasing migratory flows in other receiving economies. These spillovers give rise to coordination failures that, although relevant, have remained outside the interest of this paper.

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Tables and Figures

Table 1 – OLS regressions

Dependent variable: Log(migration flow from origin to destination, Mig. flow)

	(1)	(2)	(3)	(4)
MIG PTA	0.564***	0.569***	0.501***	0.504***
	(0.047)	(0.047)	(0.047)	(0.048)
OS PTA	-0.340***	-0.340***	-0.327***	-0.325***
	(0.042)	(0.042)	(0.042)	(0.042)
MIG Div 50	-0.032*			
	(0.019)			
OS Div 50	0.074*			
	(0.038)			
MIG Div 75		-0.036*		
		(0.019)		
OS Div 75		-0.006		
		(0.038)		
MIG Div region 50			0.157***	
			(0.022)	
OS Div region 50			-0.126***	
			(0.022)	
MIG Div region 75				0.142***
				(0.023)
OS Div region 75				-0.072***
				(0.021)
Observations	33,853	33,853	33,801	33,726
Adjusted R-squared	0.952	0.952	0.952	0.952
Number of it	2,112	2,112	2,108	2,102
Number of dt	360	360	360	360
Number of id pairs	3,460	3,460	3,442	3,441

* p<0.10, ** p<0.05, *** p<0.01.
Robust standard errors in parentheses.
it, dt and pair fixed effects included in all regressions.

Table 2 – Poisson regressions

Dependent variable: migration flow from origin to destination, Mig. flow

	(1)	(2)	(3)	(4)
MIG PTA	0.591***	0.576***	0.590***	0.604***
	(0.163)	(0.162)	(0.177)	(0.182)
OS PTA	-0.493**	-0.554***	-0.638***	-0.613***
	(0.198)	(0.211)	(0.214)	(0.218)
MIG Div 50	0.271***			
	(0.089)			
OS Div 50	-0.374***			
	(0.099)			
MIG Div 75		0.051		
		(0.070)		
OS Div 75		-0.246***		
		(0.084)		
MIG Div region 50			-0.023	
			(0.104)	
OS Div region 50			-0.045	
			(0.106)	
MIG Div region 75				-0.046
				(0.113)
OS Div region 75				-0.040
				(0.102)
Observations	31,395	31,395	31,350	31,276
Number of *id* pairs	3,003	3,003	2,991	2,991

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

Robust standard errors in parentheses.

Pair fixed effects, t dummies, it and dt gravity controls and Bilateral PTA included in all regressions.

Table 3 – Poisson regressions with migration stock: low-skill migrants

Dependent variable: stock of low-skill migrants from origin to destination

	(1)	(2)	(3)	(4)
MIG PTA	0.302***	0.259**	0.250**	0.197*
	(0.106)	(0.110)	(0.109)	(0.111)
OS PTA	-0.799***	-0.835***	-0.714***	-0.768***
	(0.137)	(0.142)	(0.150)	(0.163)
MIG Div 50	0.094*			
	(0.049)			
OS Div 50	0.212***			
	(0.065)			
MIG Div 75		0.051		
		(0.035)		
OS Div 75		0.231***		
		(0.069)		
MIG Div region 50			0.049	
			(0.047)	
OS Div region 50			0.214***	
			(0.048)	
MIG Div region 75				0.061
				(0.049)
OS Div region 75				0.180***
				(0.051)
Observations	8,156	8,156	8,156	8,124
Number of *id* pairs	2,171	2,171	2,171	2,170

* $p<0.10$, ** $p<0.05$, *** $p<0.01$.

Robust standard errors in parentheses.

Pair fixed effects, t dummies, it and dt gravity controls and Bilateral PTA included in all regressions.

Table 4 – Poisson regressions. Lagged MIG PTA

Dependent variable: migration flow from origin to destination, Mig. flow

	(1)	(2)	(3)	(4)
1 lag of MIG PTA	0.338***	0.313***	0.291**	0.294**
	(0.108)	(0.108)	(0.123)	(0.125)
OS PTA	-0.230	-0.297*	-0.464**	-0.452**
	(0.159)	(0.170)	(0.194)	(0.201)
MIG Div 50	0.269***			
	(0.090)			
OS Div 50	-0.365***			
	(0.103)			
MIG Div 75		0.052		
		(0.072)		
OS Div 75		-0.237***		
		(0.085)		
MIG Div region 50			0.078	
			(0.114)	
OS Div region 50			-0.111	
			(0.114)	
MIG Div region 75				0.074
				(0.120)
OS Div region 75				-0.092
				(0.111)
Observations	29,462	29,462	29,459	29,394
Number of *id* pairs	2,858	2,858	2,858	2,858

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

Robust standard errors in parentheses.

Pair fixed effects, t dummies, it and dt gravity controls and Bilateral PTA included in all regressions.

Table 5 – Poisson regressions. Strict exogeneity approach

Dependent variable: migration flow from origin to destination, Mig. flow

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1 lead of MIG PTA	-0.026	-0.050	-0.032	-0.034	0.051	0.033	0.040	0.033
	(0.121)	(0.125)	(0.119)	(0.121)	(0.056)	(0.060)	(0.061)	(0.060)
2 leads of MIG PTA					-0.051	-0.059	-0.060	-0.049
					(0.123)	(0.121)	(0.110)	(0.110)
MIG PTA	0.701***	0.702***	0.672***	0.683***	0.773***	0.783***	0.736***	0.747***
	(0.223)	(0.221)	(0.233)	(0.243)	(0.255)	(0.253)	(0.264)	(0.272)
OS PTA	-0.524**	-0.591**	-0.730***	-0.707***	-0.400*	-0.403*	-0.403*	-0.395*
	(0.226)	(0.241)	(0.243)	(0.246)	(0.215)	(0.212)	(0.215)	(0.217)
MIG Div 50	0.308***				0.309***			
	(0.096)				(0.101)			
OS Div 50	-0.419***				-0.450***			
	(0.103)				(0.108)			
MIG Div 75		0.065				0.064		
		(0.076)				(0.078)		
OS Div 75		-0.255***				-0.265***		
		(0.090)				(0.097)		
MIG Div region 50			0.039				0.108	
			(0.118)				(0.136)	
OS Div region 50			-0.089				-0.177	
			(0.128)				(0.166)	
MIG Div region 75				0.018				0.072
				(0.129)				(0.142)
OS Div region 75				-0.076				-0.126
				(0.123)				(0.154)
Observations	28,244	28,244	28,239	28,165	25,231	25,231	25,226	25,152
Number of *id* pairs	2,840	2,840	2,840	2,840	2,672	2,672	2,672	2,672

* p<0.10, ** p<0.05, *** p<0.01.
Robust standard errors in parentheses.
Pair fixed effects, t dummies, it and dt gravity controls included in all regressions.
Bilateral PTA included in columns (1)-(4) and excluded in columns (5)-(8) due to multicollinearity.

Table 6 – Poisson regressions. Propensity Score Matching approach

Dependent variable: migration flow from origin to destination, Mig. flow

	(1)	(2)	(3)	(4)
MIG PTA	0.582***	0.521***	0.492***	0.540***
	(0.125)	(0.127)	(0.126)	(0.121)
OS PTA	-0.276**	-0.226*	-0.261*	-0.227*
	(0.136)	(0.133)	(0.139)	(0.138)
MIG Div 50	0.118			
	(0.084)			
OS Div 50	-0.612***			
	(0.146)			
MIG Div 75		-0.031		
		(0.076)		
OS Div 75		-0.369***		
		(0.109)		
MIG Div region 50			0.047	
			(0.072)	
OS Div region 50			-0.459***	
			(0.097)	
MIG Div region 75				0.004
				(0.092)
OS Div region 75				-0.304***
				(0.111)
Observations	1,861	1,861	1,853	1,853
Number of *id* pairs	480	480	477	477

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

Robust standard errors in parentheses.

Pair fixed effects, t dummies, it and dt gravity controls included in all regressions.

Bilateral PTA excluded due to multicollinearity.

Table 7 – IV regressions

Dependent variable: Log(migration flow from origin to destination, Mig. flow)

	(1)	(2)	(3)	(4)
MIG PTA	0.831***	0.813***	0.809***	0.799***
	(0.102)	(0.101)	(0.108)	(0.111)
OS PTA	-0.616***	-0.624***	-0.704***	-0.692***
	(0.147)	(0.148)	(0.150)	(0.149)
MIG Div 50	0.105***			
	(0.023)			
OS Div 50	0.004			
	(0.062)			
MIG Div 75		0.043*		
		(0.023)		
OS Div 75		-0.077		
		(0.053)		
MIG Div region 50			0.047	
			(0.034)	
OS Div region 50			-0.092***	
			(0.029)	
MIG Div region 75				0.040
				(0.035)
OS Div region 75				-0.078***
				(0.030)
Observations	31,395	31,395	31,350	31,276
R-squared	0.135	0.134	0.135	0.135
Number of id pairs	3,003	3,003	2,991	2,991
Endogeneity test	11.74	11.12	12.25	10.72
(p-value)	0.00	0.00	0.00	0.00
First-stage regression results				
Coefficient on MIG PTA RoW	0.010***	0.010***	0.010***	0.010***
	(0.000)	(0.000)	(0.000)	(0.000)
Weak id SW test F stat	523.59	521.23	511.10	500.89
(10% maximal IV size for SY test)	16.38	16.38	16.38	16.38
Underid SW test Chi-sq	524.13	521.77	511.63	501.41
(p-value)	0.00	0.00	0.00	0.00
Underid KP rk LM stat	168.81	167.37	192.93	207.39
(p-value)	0.00	0.00	0.00	0.00
Stock-Wright LM test stat	51.17	49.36	47.08	45.29
(p-value)	0.00	0.00	0.00	0.00

* p<0.10, ** p<0.05, *** p<0.01.
Sample as in Table 2.
Standard errors clustered within i pairs in parentheses.
Pair fixed effects, t dummies, it and dt gravity controls and Bilateral PTA included in all regressions.
MIG PTA instrumented with MIG PTA RoW.
SW = Sanderson and Windmeijer (2016). SY = Stock and Yogo (2005). KP = Kleibergen and Paap (2006).

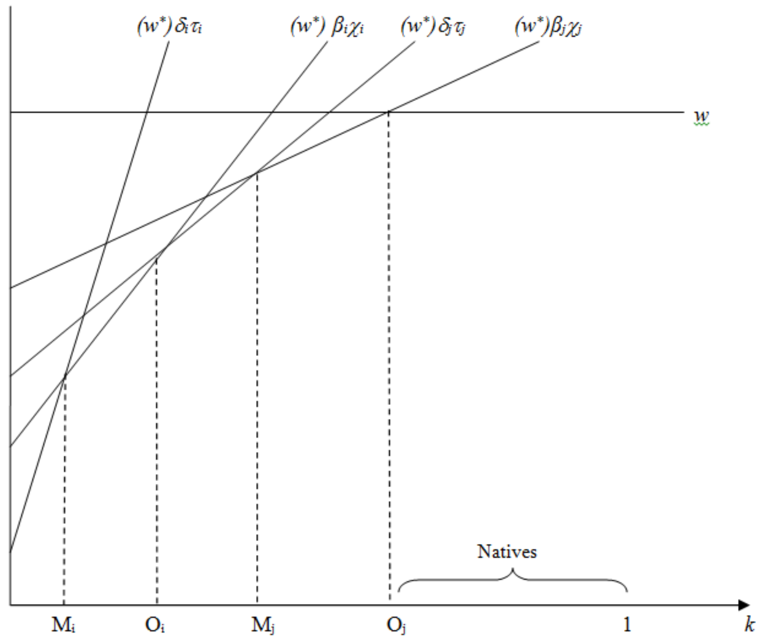
Table 8 – IV Poisson regressions

Dependent variable: migration flow from origin to destination, Mig. flow

	(1)	(2)	(3)	(4)
MIG PTA	0.512**	0.501**	0.568**	0.562**
	(0.211)	(0.211)	(0.238)	(0.251)
OS PTA	-0.496*	-0.528*	-0.563*	-0.577*
	(0.296)	(0.289)	(0.297)	(0.298)
MIG Div 50	0.166			
	(0.104)			
OS Div 50	-0.381***			
	(0.126)			
MIG Div 75		0.018		
		(0.089)		
OS Div 75		-0.318***		
		(0.111)		
MIG Div region 50			-0.057	
			(0.123)	
OS Div region 50			-0.123	
			(0.111)	
MIG Div region 75				-0.051
				(0.137)
OS Div region 75				-0.188*
				(0.106)
Observations	31,395	31,395	31,350	31,276

* p<0.10, ** p<0.05, *** p<0.01.
Robust standard errors in parentheses.
i, d and t dummies, id, it and dt gravity controls and Bilateral PTA included in all regressions.

Figure 1 – Task sorting



Appendices

A. Elasticity of substitution

The estimation of the elasticity of substitution among tasks in a production function with a continuum of tasks is a theoretical exercise which is hardly amenable to empirical estimation. Wright (2011) argues that the choice of such elasticity can be narrowed down by using the elasticity between manual and communication tasks estimated by Peri and Sparber (2009). Their estimate is between 0.63 and 1.42, depending on the model specification. As argued by Wright (2011), most tasks are likely more substitutable on the task continuum than these two broad task types. Therefore, the upper bound, which is larger than one, seems to be a sensible estimate for σ in our model.

The results of some studies that have estimated the elasticity of substitution between workers of different education levels to be between 1.5 and 2 (Angrist, 1995; Ciccone and Peri, 2005) also support the assumption $\sigma > 1$. Moreover, a wide literature has estimated elasticities of substitution among three factors in a CES production function with physical capital and two types of labor: white and blue collar. In an influential article, Chiswick (1985) concludes: "[...]

when human capital is properly specified in the aggregate production function, the elasticity of factor substitution is greater than unity. [...] This production function has three factors (physical capital, high level human capital and other human capital) and is characterized by a moderately high elasticity of substitution (about 2.5) between each pair of factors". The fact that, with a continuum of tasks, there is likely more substitutability than across three factors of production further justifies the assumption that σ is larger than one.

B. Derivations of the results in Section 2.2

If the ordering of tasks is as in (8), marginal cost is:

$$\omega(k) = \begin{cases} (w^*)\,\delta_i\tau_i(k) & 0 \leq k \leq M_i & (MIG_i) \\ (w^*)\,\beta_i\chi_i(k) & M_i < k \leq O_i & (OS_i) \\ (w^*)\,\delta_j\tau_j(k) & O_i < k \leq M_j & (MIG_j) \\ (w^*)\,\beta_j\chi_j(k) & M_j < k \leq O_j & (OS_j) \\ w & O_j < k \leq 1 & (NAT) \end{cases} \tag{B-1}$$

The cutoffs M_i, O_i, M_j and O_j are implicitly determined by the iso-cost conditions:

$$\begin{cases} [\omega(M_i)]_i^{MIG} = [\omega(M_i)]_i^{OS} & \Rightarrow & \delta_i\tau_i(M_i) = \beta_i\chi_i(M_i) \\ [\omega(O_i)]_i^{OS} = [\omega(O_i)]_j^{MIG} & \Rightarrow & \beta_i\chi_i(O_i) = \delta_j\tau_j(O_i) \\ [\omega(M_j)]_j^{MIG} = [\omega(M_j)]_j^{OS} & \Rightarrow & \delta_j\tau_j(M_j) = \beta_j\chi_j(M_j) \\ [\omega(O_j)]_j^{OS} = [\omega(O_j)]^{NAT} & \Rightarrow & \beta_j\chi_j(O_j) = w \end{cases} \tag{B-2}$$

From (B-2), using the Implicit Function Theorem and the assumptions in (9), we can compute and sign the derivatives of the marginal tasks with respect to offshoring and migration costs:

$$\frac{\partial M_i}{\partial \delta_i} = -\frac{\tau_i(M_i)}{\delta_i\tau_i' - \beta_i\chi_i'} < 0 \quad \frac{\partial M_i}{\partial \beta_i} = \frac{\chi_i(M_i)}{\delta_i\tau_i' - \beta_i\chi_i'} > 0 \quad \frac{\partial M_i}{\partial \delta_j} = 0 \quad \frac{\partial M_i}{\partial \beta_j} = 0 \tag{B-3}$$

$$\frac{\partial M_j}{\partial \delta_i} = 0 \quad \frac{\partial M_j}{\partial \delta_j} = -\frac{\tau_j(M_j)}{\delta_j\tau_j' - \beta_j\chi_j'} < 0 \quad \frac{\partial M_j}{\partial \beta_i} = 0 \quad \frac{\partial M_j}{\partial \beta_j} = \frac{\chi_j(M_j)}{\delta_j\tau_j' - \beta_j\chi_j'} > 0 \tag{B-4}$$

$$\frac{\partial O_i}{\partial \delta_i}=0 \quad \frac{\partial O_i}{\partial \beta_i}=-\frac{\chi_i(O_i)}{\beta_i\chi_i'-\delta_j\tau_j'}<0 \quad \frac{\partial O_i}{\partial \delta_j}=\frac{\tau_j(O_i)}{\beta_i\chi_i'-\delta_j\tau_j'}>0 \quad \frac{\partial O_i}{\partial \beta_j}=0 \tag{B-5}$$

$$\frac{\partial O_j}{\partial \delta_i}=0 \quad \frac{\partial O_j}{\partial \delta_j}=0 \quad \frac{\partial O_j}{\partial \beta_i}=0 \quad \frac{\partial O_j}{\partial \beta_j}=-\frac{\chi_j(O_j)}{\beta_j\chi_j'}<0 \tag{B-6}$$

Labor demand for each task is:

$$N(k)=\begin{cases}\delta_i\tau_i(k)L(k) & 0\le k\le M_i\\ \beta_i\chi_i(k)L(k) & M_i<k\le O_i\\ \delta_j\tau_j(k)L(k) & O_i<k\le M_j\\ \beta_j\chi_j(k)L(k) & M_j<k\le O_j\\ L(k) & O_j<k\le 1\end{cases} \tag{B-7}$$

which, using (2) and (B-1), gives the following employment of immigrant, offshored and native workers:

$$\begin{cases} NM_i=\int_0^{M_i}N(z)\,dz=\lambda\rho(\delta_i)^{1-\sigma}\\ NO_i=\int_{M_i}^{O_i}N(z)\,dz=\lambda\phi(\beta_i)^{1-\sigma}\\ NM_j=\int_{O_i}^{M_j}N(z)\,dz=\lambda\eta(\delta_j)^{1-\sigma}\\ NO_j=\int_{M_j}^{O_j}N(z)\,dz=\lambda\nu(\beta_j)^{1-\sigma}\\ NN=\int_{O_j}^{1}N(z)\,dz=\theta(1-O_j)\end{cases} \tag{B-8}$$

where $\lambda\equiv(w^*)^{-\sigma}\frac{W}{\Omega^{1-\sigma}}>0$, $\rho\equiv\int_0^{M_i}[\tau_i(z)]^{1-\sigma}dz$, $\phi\equiv\int_{M_i}^{O_i}[\chi_i(z)]^{1-\sigma}dz$, $\eta\equiv\int_{O_i}^{M_j}[\tau_j(z)]^{1-\sigma}dz$, $\nu\equiv\int_{M_j}^{O_j}[\chi_j(z)]^{1-\sigma}dz$ and $\theta\equiv(w)^{-\sigma}\frac{W}{\Omega^{1-\sigma}}>0$.

Notice that the exact price index of the task composite L is equal to:

$$\Omega\equiv w^*\left[\Phi+\left(\frac{w}{w^*}\right)^{1-\sigma}(1-O_j)\right]^{\frac{1}{1-\sigma}} \tag{B-9}$$

where $\Phi\equiv\rho(\delta_i)^{1-\sigma}+\phi(\beta_i)^{1-\sigma}+\eta(\delta_j)^{1-\sigma}+\nu(\beta_j)^{1-\sigma}$.

Comparative statics for migrant employment

The negative sign in (11) is obtained because

$$\frac{\partial \rho}{\partial \delta_i} = \frac{\partial M_i}{\partial \delta_i} \left[\tau_i \left(M_i\right)\right]^{1-\sigma} < 0 \tag{B-10}$$

The derivative $\frac{\partial NM_i}{\partial \beta_i}$ is predicted to be positive in (12) because

$$\frac{\partial \rho}{\partial \beta_i} = \frac{\partial M_i}{\partial \beta_i} \left[\tau_i \left(M_i\right)\right]^{1-\sigma} > 0 \tag{B-11}$$

The derivative $\frac{\partial NM_i}{\partial \delta_j}$and $\frac{\partial NM_i}{\partial \beta_j}$ are predicted to be equal to zero in (13) and (14) because

$$\frac{\partial \rho}{\partial \delta_j} = \frac{\partial M_i}{\partial \delta_j} \left[\tau_i \left(M_i\right)\right]^{1-\sigma} = 0 = \frac{\partial M_i}{\partial \beta_j} \left[\tau_i \left(M_i\right)\right]^{1-\sigma} = \frac{\partial \rho}{\partial \beta_j} \tag{B-12}$$

Notice that the signs of the derivatives above easily follow from the results in (B-3).[40]

[40] Using the results in (B-3)-(B-6), it is possible to sign all the derivatives of migrant and offshore employment from countries i and j and native employment with respect to δ_i, δ_j, β_i and β_j. We only report the results of the derivatives of migrant employment because it is the focus of the empirical application.

C. Appendix tables

Table C-1 – Variables list

Variable	Description	Data source
Dependent variable (idt)		
MIG flow	Inflow of migrants from origin i to destination d (in units)	OECD International Migration dataset
Migration and offshoring policies (idt)		
MIG PTA	Dummy equal 1 if i and d have PTA with migration provisions	WTO Anatomy of PTAs dataset
OS PTA	Dummy equal 1 if i and d have PTA with offshoring provisions	– " –
Mig Div 50	Dummy equal 1 if j and d have PTA with migration provisions, $j \in J_1 : (SI_{ijt} > 50^{th}$ percentile)	– " –
OS Div 50	Dummy equal 1 if j and d have PTA with offshoring provisions, $j \in J_1 : (SI_{ijt} > 50^{th}$ percentile)	– " –
Mig Div 75	Dummy equal 1 if j and d have PTA with migration provisions, $j \in J_2 : (SI_{ijt} > 75^{th}$ percentile)	– " –
OS Div 75	Dummy equal 1 if j and d have PTA with offshoring provisions, $j \in J_2 : (SI_{ijt} > 75^{th}$ percentile)	– " –
Mig Div region 50	Dummy equal 1 if j and d have PTA with migration provisions, $j \in J_3 : (SI_{ijt} > 50^{th}$ percentile & i, j belong to same region)	– " –
OS Div region 50	Dummy equal 1 if j and d have PTA with offshoring provisions, $j \in J_3 : (SI_{ijt} > 50^{th}$ percentile & i, j belong to same region)	– " –
Mig Div region 75	Dummy equal 1 if j and d have PTA with migration provisions, $j \in J_4 : (SI_{ijt} > 75^{th}$ percentile & i, j belong to same region)	– " –
OS Div regon 75	Dummy equal 1 if j and d have PTA with offshoring provisions, $j \in J_4 : (SI_{ijt} > 75^{th}$ percentile & i, j belong to same region)	– " –
Gravity controls		
Log distance (id)	Log of weighted distance between i and d (pop-wt, km)	CEPII gravity dataset (Head et al., 2010)
Contiguity (id)	Dummy equal 1 if i and d share a common border	– " –
Common language (id)	Dummy equal 1 if i and d share an official or primary language	– " –
Colony (id)	Dummy equal 1 if i and d were in a colonial relation post 1945	– " –
Log GDP_{pc} orig. (it)	Log of GDP per capita (constant 2000 US$) in i	World Development Indicators (WDIs)
$LogGDP_{pc}$ dest. (dt)	Log of GDP per capita (constant 2000 US$) in d	– " –
Log remote orig. (it)	Log of remoteness (Baldwin and Harrigan, 2011 definition) in i	WDIs and CEPII gravity dataset
Log remote dest. (dt)	Log of remoteness (Baldwin and Harrigan, 2011 definition) in d	– " –

Table C-2 – In-sample descriptive statistics

Variable	Mean	Median	Std Dev	Min	Max
Mig Flow	1366.54	42.00	7467.24	0.00	271443.00
Log GDPpc orig.	7.11	7.18	1.14	4.06	9.43
Log GDPpc dest.	10.10	10.11	0.41	8.62	10.94
Log remote orig.	-17.53	-17.45	2.33	-23.46	-8.87
Log remote dest.	-23.07	-23.06	1.57	-26.04	-19.05
Variable	Zeros	Ones	Std Dev	Min	Max
PTA	26618	4777	0.36	0	1
MIG PTA	30061	1334	0.20	0	1
OS PTA	26646	4749	0.36	0	1
Mig Div 50	13672	17723	0.50	0	1
OS Div 50	1947	29448	0.24	0	1
Mig Div 75	16670	14725	0.50	0	1
OS Div 75	2618	28777	0.28	0	1
MIG Div region 50	24493	6857	0.41	0	1
OS Div region 50	16672	14578	0.50	0	1
MIG Div region 75	25714	5562	0.38	0	1
OS Div region 75	18789	12487	0.49	0	1

Summary statistics computed from sample of column (1) of Table 2.

Table C-3 – In-sample correlations

	Mig Flow	Bilateral PTA	MIG PTA	OS PTA	Mig Div 50	OS Div 50	Mig Div 75	OS Div 75	MIG Div reg. 50	OS Div reg. 50	MIG Div reg. 75	OS Div reg. 75	Ln GDP pc orig.	Ln GDP pc dest.	Ln rem. orig.	Ln rem. dest.
Mig Flow	1															
Bilateral PTA	0.09*	1														
MIG PTA	0.11*	0.50*	1													
OS PTA	0.10*	0.99*	0.50*	1												
Mig Div 50	0.038*	0.16*	0.16*	0.15*	1											
OS Div 50	-0.09*	0.10*	0.05*	0.10*	0.29*	1										
Mig Div 75	0.02*	0.17*	0.18*	0.17*	0.83*	0.24*	1									
OS Div 75	-0.10*	0.12*	0.05*	0.12*	0.23*	0.85*	0.28*	1								
MIG Div region 50	0.06*	0.30*	0.32*	0.31*	0.46*	0.14*	0.49*	0.13*	1							
OS Div region 50	0.03*	0.40*	0.21*	0.40*	0.35*	0.24*	0.39*	0.25*	0.56*	1						
MIG Div region 75	0.06*	0.33*	0.37*	0.33*	0.41*	0.12*	0.49*	0.14*	0.88*	0.49*	1					
OS Div region 75	0.04*	0.44*	0.24*	0.44*	0.29*	0.21*	0.34*	0.25*	0.55*	0.87*	0.57*	1				
Log GDPpc orig.	0.05*	0.31*	0.22*	0.32*	0.45*	0.19*	0.38*	0.18*	0.42*	0.40*	0.37*	0.41*	1			
Log GDPpc dest.	0.01*	-0.07*	-0.01	-0.07*	0.03*	-0.09*	-0.00	-0.12*	-0.03*	-0.12*	-0.04*	-0.11*	-0.01*	1		
Log remote orig.	-0.20*	-0.31*	-0.15*	-0.31*	-0.15*	-0.05*	-0.15*	-0.06*	-0.18*	-0.22*	-0.16*	-0.24*	-0.32*	0.01*	1	
Log remote dest.	-0.17*	0.05*	-0.01	0.05*	-0.11*	0.20*	-0.06*	0.26*	-0.05*	0.07*	-0.03*	0.07*	-0.00	0.04*	-0.08*	1

Correlations computed from the sample of column (3) of column (1) of Table 2.
* $p<0.05$.

Table C-4 – Long-run relation between past migration flows and MIG PTA

Dependent variable: MIG PTA 2004-2010

	LPM		Probit	
	(1)	(2)	(3)	(4)
MIG flow growth 1996-2000	-0.000	-0.002	0.004	0.015
	(0.006)	(0.003)	(0.025)	(0.065)
Log distance	-0.138***	-0.134***	-0.595***	-2.335***
	(0.013)	(0.023)	(0.058)	(0.499)
Contiguity	0.153	0.007	-0.024	
	(0.138)	(0.047)	(0.550)	
Common language	-0.047**	-0.068***	-0.607***	-2.262***
	(0.019)	(0.021)	(0.189)	(0.396)
Colony	-0.010	-0.017	0.252	0.848*
	(0.036)	(0.025)	(0.335)	(0.500)
Log GDP_{pc} orig.	0.093***		0.639***	
	(0.007)		(0.052)	
Log GDP_{pc} dest.	-0.043		-0.349**	
	(0.028)		(0.168)	
Log remote orig.	0.009**		0.060***	
	(0.004)		(0.022)	
Log remote dest.	-0.001		0.016	
	(0.005)		(0.032)	
Observations	1,712	1,745	1,712	494
R-squared	0.207	0.670		

* p<0.10, ** p<0.05, *** p<0.01.
Robust standard errors in parentheses.
i and *d* dummies included in columns (2) and (4).
Variables MIG PTA 2004-2010 and MIG flow growth 1996-2000 defined in Section 4.2.
Contiguity dropped in column (4) because of multicollinearity.

Table C-5 – Poisson regressions. Diversion variables as count

Dependent variable: migration flow from origin to destination, Mig. flow

	(1)	(2)	(3)	(4)
MIG PTA	0.598***	0.589***	0.561***	0.567***
	(0.171)	(0.181)	(0.172)	(0.175)
OS PTA	-0.588***	-0.646***	-0.604***	-0.631***
	(0.199)	(0.218)	(0.215)	(0.219)
MIG Div 50	0.000			
	(0.018)			
OS Div 50	-0.008			
	(0.017)			
MIG Div 75		0.014		
		(0.021)		
OS Div 75		-0.021		
		(0.021)		
MIG Div region 50			0.008	
			(0.033)	
OS Div region 50			-0.016	
			(0.030)	
MIG Div region 75				0.011
				(0.036)
OS Div region 75				-0.007
				(0.031)
Observations	31,395	31,395	31,350	31,276
Number of id pairs	3,003	3,003	2,991	2,991

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

Robust standard errors in parentheses.

Pair fixed effects, t dummies, it and dt gravity controls and Bilateral PTA included in all regressions.

Table C-6 – Poisson regressions excluding 5 Eastern EU countries

Dependent variable: migration flow from origin to destination, Mig. flow

	(1)	(2)	(3)	(4)
MIG PTA	0.595***	0.580***	0.593***	0.608***
	(0.164)	(0.163)	(0.179)	(0.184)
OS PTA	-0.492**	-0.548**	-0.638***	-0.614***
	(0.202)	(0.215)	(0.218)	(0.221)
MIG Div 50	0.268***			
	(0.090)			
OS Div 50	-0.371***			
	(0.100)			
MIG Div 75		0.054		
		(0.071)		
OS Div 75		-0.255***		
		(0.084)		
MIG Div region 50			-0.020	
			(0.106)	
OS Div region 50			-0.049	
			(0.106)	
MIG Div region 75				-0.044
				(0.115)
OS Div region 75				-0.046
				(0.103)
Observations	30,161	30,161	30,116	30,042
Number of *id* pairs	2,652	2,652	2,640	2,640

* p<0.10, ** p<0.05, *** p<0.01.
Robust standard errors in parentheses.
Pair fixed effects, t dummies, it and dt gravity controls and Bilateral PTA included in all regressions.
Excluded i countries: Czech Republic, Hungary, Poland, Slovakia and Slovenia.

Table C-7 – Poisson regressions. Easiness variables-specific regressions

Dependent variable: migration flow from origin to destination, Mig. flow

	Direct effects	Migration diversion				Offshoring diversion			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
MIG PTA	0.584***								
	(0.165)								
OS PTA	-0.614***								
	(0.205)								
MIG Div 50		0.081							
		(0.071)							
MIG Div 75			-0.067						
			(0.057)						
MIG Div region 50				0.046					
				(0.093)					
MIG Div region 75					0.047				
					(0.096)				
OS Div 50						-0.210***			
						(0.065)			
OS Div 75							-0.231***		
							(0.058)		
OS Div region 50								-0.080	
								(0.085)	
OS Div region 75									-0.070
									(0.082)
Observations	31,395	31,395	31,395	31,350	31,276	31,395	31,395	31,350	31,276
Number of *id* pairs	3,003	3,003	3,003	2,991	2,991	3,003	3,003	2,991	2,991

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

Robust standard errors in parentheses.

Pair fixed effects, t dummies, it and dt gravity controls and Bilateral PTA included in all regressions.

D. Results of offshoring gravity regressions

To build evidence that the variable OS PTA positively affects bilateral offshoring, the following gravity regression is estimated:

$$X^{p\&c} = \beta * OS\ PTA + \mathbf{r}'\theta + \mathbf{w}'\gamma + \varepsilon \tag{D-1}$$

where the indexes i, d and t (origin, destination, year) have been omitted. Following Yeats (2001) and Hummels et al. (2001), trade in parts and components ($X^{p\&c}$) is used as a proxy for offshoring.[41] As in equation (15), the vectors **r** and **w** respectivelly contain gravity controls and control dummies. All the 182 importing and exporting countries with available data between 1996 and 2009 are used in the estimations.

Results in Table D-1 show a positive and statistically significant coefficient on the variable of interest across all specifications, with the exception of column (5), where the coefficient is not statistically different from zero. This is, however, a Poisson regression with the full set of country pair fixed effects and time dummies. Since identification is within pairs that sign a PTA with offshoring provisions during the sample period, the absence of statistical significance can be explained by the little amount of variation in the variable OS PTA over time. The preferred specification is in column (4), with o, d and t dummies. The coefficient $\widehat{\beta}$ on OS PTA is equal to 0.421, with a standard error $\widehat{\sigma}_{\beta}$ of 0.024. This implies that the presence of a PTA with offshoring provisions stimulates offshoring by $\exp\left\{\widehat{\beta} - 1/2(\widehat{\sigma}_{\beta})^2\right\} =$ 42.1%.

[41] The methodology described in WTO (2011, pp. 64-5) is employed to define parts and components. They are the SITC Rev. 3 equivalent of codes 42 and 53 in the Broad Economic Categories (BEC) classification, supplemented with unfinished textile products in division 65 of the SITC classification.

Table D-1 – Offshoring gravities

Dependent variable: $log(X_{p\&c})$ (OLS regressions); $X_{p\&c}$ (Poisson regressions)

	OLS			Poisson	
	(1)	(2)	(3)	(4)	(5)
OS PTA	0.694***	0.223***	0.641***	0.421***	0.013
	(0.019)	(0.058)	(0.034)	(0.024)	(0.083)
Log(distance)	-1.913***		-1.736***	-0.719***	
	(0.010)		(0.023)	(0.011)	
Contiguity	1.434***		1.716***	0.318***	
	(0.055)		(0.079)	(0.026)	
Colony	1.851***		1.796***	0.238***	
	(0.060)		(0.088)	(0.058)	
Common language	1.402***		1.351***	0.301***	
	(0.018)		(0.035)	(0.025)	
Log GDP_{pc} origin	0.711***	1.113***		1.468***	1.529***
	(0.046)	(0.047)		(0.098)	(0.150)
Log GDP_{pc} destination	0.916***	0.521***		1.450***	1.479***
	(0.045)	(0.048)		(0.082)	(0.118)
Observations	411,684	411,684	507,428	411,684	337,385
Adjusted R-squared	0.768	0.820	0.758		
Pseudo-R-squared				0.956	
Number of i	182			198	
Number of d	182			198	
Number of id		16,463			13,400
Number of it			2,733		
Number of dt			2,752		

* $p<0.10$, ** $p<0.05$, *** $p<0.01$.
Robust standard errors in parentheses.
Columns (1) and (4): d, o and t fixed effects.
Column (2): od and t fixed effects.
Column (3): ot and dt fixed effects.
Column (5): od fixed effects and t dummies.
Log remote (origin and destination) included in all regressions.

E. Results using bilateral migration stocks

This Appendix reports regression results that use bilateral migration stocks instead of flows. Data come from the IAB brain-drain dataset (Brücker et al., 2006) for the years 1995, 2000, 2005.[42] To the extent possible, we use similar sets of origin and destination countries as in the main regressions of Table 2.[43] Given the availability of migration stocks by education level,the baseline estimations are replicated respectively on total, skilled and unskilled migration stocks. Results on unskilled migrants are reported in the main text (Table 3), while results on total and skilled are reported in tables E-1 and E-2.

Table E-1 – Poisson regressions with migration stock: total migrants

Dependent variable: total stock of migrants from origin to destination

	(1)	(2)	(3)	(4)
MIG PTA	0.236*	0.218	0.207	0.185
	(0.142)	(0.144)	(0.145)	(0.146)
OS PTA	-0.738***	-0.758***	-0.713***	-0.770***
	(0.157)	(0.159)	(0.181)	(0.191)
MIG Div 50	0.116**			
	(0.048)			
OS Div 50	0.029			
	(0.063)			
MIG Div 75		0.077**		
		(0.035)		
OS Div 75		0.012		
		(0.066)		
MIG Div region 50			0.016	
			(0.055)	
OS Div region 50			0.149***	
			(0.054)	
MIG Div region 75				0.031
				(0.062)
OS Div region 75				0.095
				(0.064)
Observations	8,370	8,370	8,370	8,340
Number of *id* pairs	2,236	2,236	2,236	2,236

* p<0.10, ** p<0.05, *** p<0.01.
Robust standard errors in parentheses.
Pair fixed effects, t dummies, it and dt gravity controls and Bilateral PTA included in all regressions.

[42]The IAB brain-drain dataset is available at: http://www.iab.de/en/daten/iab-brain-drain-data.aspx.
[43]In particular, when using stocks, 140 of the 144 origin countries are preserved (a list is available upon request). The set of destination countries, conversely, shrinks to 19 and includes Australia, Austria, Canada, Switzerland, Germany, Denmark, Spain, Finland, France, United Kingdom, Greece, Ireland, Luxembourg, Netherlands, Norway, New Zealand, Portugal, Sweden, and the United States.

Table E-2 – Poisson regressions with migration stock: high-skill migrants migrants

Dependent variable: Stock of high-skill migrants from origin to destination

	(1)	(2)	(3)	(4)
MIG PTA	0.142	0.132	0.129	0.122
	(0.160)	(0.158)	(0.160)	(0.161)
OS PTA	-0.504***	-0.499***	-0.483***	-0.520***
	(0.172)	(0.171)	(0.187)	(0.192)
MIG Div 50	0.062			
	(0.046)			
OS Div 50	-0.014			
	(0.056)			
MIG Div 75		0.056		
		(0.042)		
OS Div 75		-0.072		
		(0.057)		
MIG Div region 50			0.009	
			(0.060)	
OS Div region 50			0.099*	
			(0.054)	
MIG Div region 75				0.011
				(0.065)
OS Div region 75				0.052
				(0.061)
Observations	8,280	8,280	8,280	8,250
Number of id pairs	2,208	2,208	2,208	2,208

* $p<0.10$, ** $p<0.05$, *** $p<0.01$.

Robust standard errors in parentheses.

Pair fixed effects, t dummies, it and dt gravity controls and Bilateral PTA included in all regressions.