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A Global View of Cross-Border Migration

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Abstract

This paper evaluates the welfare impact of observed levels of migration and remittances in both origins and destinations, using a quantitative multi-sector model of the global economy calibrated to aggregate and firm-level data on 60 developed and developing countries. Our framework accounts jointly for origin and destination characteristics, as well as the inherently multi-country nature of both migration and other forms of integration, such as international trade and remittance flows. In the presence of firm heterogeneity and imperfect competition larger countries enjoy a greater number of varieties and thus higher welfare, all else equal. Because of this effect, natives in countries that received a lot of migration – such as Canada or Australia – are better off. The remaining natives in countries with large emigration flows – such as Jamaica or El Salvador – are also better off due to migration, but for a different reason: remittances. The quantitative results show that the welfare impact of observed levels of migration is substantial, at about 5 to 10% for the main receiving countries and about 10% for the main sending countries.

JEL Classifications: F12, F15, F22, F24

Keywords: Migration, Remittances, International Trade, Welfare

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1 Introduction

International migration has risen steadily over the last three decades. By the 2000s, substantial fractions of the total population in many receiving countries were foreign-born. For instance, immigrants account for $8-12\%$ of the population in several G7 countries, such as United States, United Kingdom, and France, and some 20% of the population in small, wealthy countries such as Australia, Canada, and New Zealand. By the same token, some developing countries have lost a substantial fraction of their population to emigration. Emigrants account for some 10% of the population of Mexico, and as much as $20-30\%$ in smaller countries such as El Salvador or Jamaica (Tables 1, 2).

The sheer scale of the cross-border movements of people has led to a growing interest in understanding their welfare effects. However, compared to the attention paid to the welfare analysis of international trade, very few estimates of the welfare effects of international migration are available. This paper provides a quantitative assessment of the global welfare impact of the observed levels of migration on both the origin and destination countries, taking explicitly into account the consequences of international trade and remittances. Our multi-country general equilibrium model is calibrated to match the world income distribution and world trade patterns. It incorporates several first-order features of the world economy that are important for obtaining reliable estimates of the welfare impact of migration. First, we calibrate labor productivity differences between and within countries. In order to develop reliable estimates of migrants' contribution to the host economies, our framework accounts for a great deal of worker heterogeneity, with worker productivity varying by skill level, country of origin, and country of residence. In addition, we match the levels of remittances observed in the data. Remittances transfer some of the gains from increased productivity of migrants back to the natives that remained in the home country.

Second, our model incorporates the insights of the recent literature on firm heterogeneity under monopolistic competition (e.g., Melitz, 2003). In recent years, a great deal of evidence has shown that these models are very successful at replicating both the key macro features (total trade flows, the gravity relationship) and key micro features (firm size distributions, systematically larger exporters) of the economy, making them especially suitable for quantitative analysis. Economically, the key mechanism linking migration and welfare in this type of model is product variety. Inflows of immigrants increase market size, and thus the range of varieties available to everyone for consumption and as intermediate inputs. Our quantitative analysis calibrates the key parameters of the model that determine equilibrium variety in both the short and the long run: relative country size and the firm size distribution. Thus, we can be precise about the magnitude of impact of migration on market size, and thus on the welfare of the natives.

Third, we take explicit account of the role of goods trade in affecting the gains from migration.

To that end, the model features both traded and non-traded sectors with intermediate input linkages between the two, and matches the overall levels of goods trade relative to GDP. The model is solved on a sample of 60 developed and developing countries comprising some 98% of world GDP, taking into account all the multilateral trade relationships between them.

Finally, we distinguish between the short-run and the long-run impact of migration. In the short run, the set of potential projects available in the economy is fixed, and thus it corresponds to the framework of Chaney (2008) and Eaton et al. (2011). In this case, migration has an impact on product variety by affecting the entry decision of only the marginal firms, which lie near the productivity cutoff for setting up a firm. Since these are the least productive firms in the economy, their economic impact is very limited. In the long run, the set of potential projects will change in response to migration to dissipate net profits (free entry) as in Krugman (1980) and Melitz (2003). Because some of those new firms will be quite productive, they can have a large impact on welfare. Thus the difference in the welfare impact of migration between the long and the short run depends crucially on the relative productivity of the marginal firms compared to the inframarginal ones. In evaluating this distinction quantitatively, the calibration to the observed distribution of firm size is central.

The main use of our calibrated model is to compute welfare in the baseline under the observed levels of bilateral migration and in the counterfactual scenario in which global migration is undone. Our findings can be summarized as follows. First, in the absence of migration the natives in practically every receiving country would have been worse off, and this welfare loss increases in the observed share of non-native population. Natives in the countries with the largest stocks of immigrants (relative to population) such as Australia, New Zealand, or Canada, have $5-10\%$ higher welfare under the current levels of migration compared to the no-migration counterfactual. This welfare effect is generated by the general equilibrium response of domestic variety. A lower population in the absence of migration implies a smaller equilibrium mass of domestically produced varieties, and thus lower per-capita welfare. At the same time, the welfare impact on the staying natives of the emigration countries depends on a trade-off. Symmetrically to the main migration receiving countries, these source countries would *ceteris paribus* be better off without emigration because a larger labor force implies more variety in their production and consumption. On the other hand, migrants send home remittances, which would stop if emigration were undone. For countries such as El Salvador or the Philippines, where remittances account for more than ten percent of GDP, the latter effect dominates and the average native stayer is about 10% worse off in the no-migration scenario. Underlying these results is the fact that the typical migrant moves from a low to a high TFP region, leading to an overall increase in the efficiency units of labor worldwide (as observed by Klein and Ventura, 2009). Part of the welfare benefit of that reallocation is enjoyed by the native stayers through remittances. However, the remittance effect is not always larger than the general equilibrium variety effect. Some important emigration countries, such as Mexico, Trinidad and Tobago, and Turkey, would actually be $1-5\%$ better off in the no-migration counterfactual.

In the short run, the welfare impact on the main in-migration countries is much smaller, at less than 1%. By contrast, the welfare impact of reversing migration on the main out-migration countries tends to be similar to the long-run impact: negative and large. This asymmetry between the long- and the short-run results is intuitive. For the main receiving countries, the long-run welfare impact is due primarily to the general equilibrium effect of increased variety, and because in the short run that channel is only of limited importance, there is a big difference in the welfare changes between the short and the long run. By contrast, for the main migration sending countries the welfare impact is driven mainly by the partial equilibrium channel of lost remittances, which works immediately in both the short and the long run.

We also compute the welfare changes of the migrants themselves. The magnitude of these changes is an order of magnitude larger than the welfare changes for stayers. For instance, according to our results the welfare of Mexican immigrants in the United States would fall by 80% in the long run. Analogously, the welfare of a Turkish immigrant in Germany would fall by 87%. As noted above, these individuals are going back to a country that typically has both much lower labor productivity and lower variety.

Our paper contributes to the (still sparse) literature that analyzes the welfare effects of international migration using calibrated models. Klein and Ventura (2007, 2009) evaluate the welfare costs of barriers to international labor mobility in a one-good, two-region economy without international trade, calibrating international differences in labor quality and total factor productivity.[1] In a similar spirit, Benhabib and Jovanovic (2010) investigate the optimal level of migration in a model with spillovers in human capital accumulation as in Lucas (1988). These studies assume away multilateral international flows of goods and remittances, both of which play a central role in our findings. This could be important: some recent large-scale immigration episodes affect very open economies, such as Israel, Ireland, Spain, and the U.K.. Davis and Weinstein (2002) investigate the welfare effects of migration in a two-country Ricardian model of trade (based on Dornbusch et al., 1977), in which migration flows from the low to the high TFP country. In their setup the host country is worse off while the origin country and the migrants themselves experience large welfare gains.

Iranzo and Peri (2009) develop a two-country model with a differentiated sector and endogenous variety, as well as skill differences between workers, and apply it to migration between Eastern and Western Europe.[2] Our paper shares with Iranzo and Peri (2009) the emphasis on market size and

[1] For work on the determinants of immigration restrictions see Benhabib (1996), Ortega (2005, 2010), Facchini et al. (2011), or Facchini and Steinhardt (2011). For empirical work on individual attitudes toward immigration see Mayda (2006) and Facchini and Mayda (2009), and Ortega and Polavieja (2012) in the European context.

[2] Ciccone and Hall (1996) explore the role of agglomeration economies and, in particular, product variety in

endogenous variety, but differs from it in several important respects. First and foremost, our model features bilateral remittances, which we show to be crucial for evaluating the overall welfare effect of migration in a number of sending countries. Second, our framework is implemented on 60 countries with multilateral trade and incorporates many important aspects of the world economy, such as a non-traded sector with two-way input-output linkages, among others. This allows for both greater realism, as well as a range of results on how migration affects a wide variety of countries depending on their characteristics. More substantively, while both studies find that welfare in the South is higher in the migration equilibrium, the mechanism is different: in Iranzo and Peri (2009) the main reason is the increase in imported varieties, in our analysis it is mainly due to remittances.

More broadly, our paper is also related to the large literature on the economic effects of migration and remittances. This body of work is predominantly empirical and too large to review comprehensively here (see Hanson 2009 for a recent survey of the literature on the economic effects of migration, and Yang 2011 on remittances), and thus we confine our discussion to the most closely related contributions. Several authors have recently studied firm-level responses to immigration-driven changes in the composition of the labor force. Lewis (2011) finds that unskilled immigration led to significantly lower rates of adoption of new automation techniques that substitute for low-skill labor. Using data on the universe of German firms, Dustmann and Glitz (2011) find that migration led to an increase in the size of firms that use the abundant factor more intensively, to a greater adoption of production technologies that rely on the more abundant factor, and to an extensive margin response.[3] Yang (2008) finds a positive effect of remittances on the number of household entrepreneurs (as well as investments in human capital) in the Philippines. His findings suggest the emergence of self-employed individuals setting up small firms in transportation, communications, and manufacturing. Our analysis shares with these papers the emphasis on the interaction between migration and firm decisions, but focuses on the general equilibrium perspective in which migration affects firm entry and exit through changes in overall size of the market and the labor force.

Methodologically, our paper draws on the recent quantitative international trade literature (see, among many others, Melitz, 2003; Alvarez and Lucas, 2007; Melitz and Ottaviano, 2008; Eaton et al., 2011; di Giovanni and Levchenko, 2010, 2011). We apply these models to a new set of questions, and incorporate a number of novel features that allow us to account for the composition of the labor force and heterogeneous worker productivity.

The rest of the paper is organized as follows. Section 2 describes the migration and remittance

accounting for regional disparities in productivity. In an earlier contribution combining monopolistic competition models with migration, Epifani and Gancia (2005) explore theoretically the impact of within-country migration on unemployment in a model combining regional agglomeration economies with costly job search.

[3]In a similar vein Doms et al. (2010) examine how the education and skill level of the local labor force are related to the creation and success of new businesses. Beaudry et al. (2010) study the rates of adoption of personal computers across U.S. cities as a function of the educational attainment of the local labor force. Ciccone and Papaioannou (2009) supply cross-country evidence of schooling fostering the adoption of skilled-labor augmenting technologies.

data sources and basic patterns. Section 3 presents the theoretical framework, while Section 4 discusses the quantitative implementation of the model economy. Section 5 presents counterfactual experiments and main welfare results. Section 6 concludes.

2 Migration and Remittances: Data Sources and Basic Patterns

To construct the labor force disaggregated by skill level, origin, and destination country we rely on two sources: the aggregate migration stocks for year 2006 from the OECD International Migration Database and the data for year 2000 on the labor force for each country in the world, disaggregated by education level, origin, and destination country produced by Docquier et al. (2009) and Docquier et al. (2010).

The OECD International Migration Database contains information on the stocks of immigrants by both destination and origin country (thus, it contains separate information on the number of natives of Mexico, and the number of natives of El Salvador, residing in the United States). We use data for 2006, the most recent year these data are available with comprehensive coverage. An important feature of these data is that it only contains information on 27 destination countries, namely members of the OECD. Thus, while we have data on hundreds of origin countries, we only have information on rich country destinations. As a result, strictly speaking, our counterfactual exercise analyzes the consequences of undoing South-to-North migration. Any South-to-South migration flows will be left unchanged.

The Docquier et al. (2010) data by education level is an update of the well-known dataset produced by Docquier and Marfouk (2004). We use these data to compute the share of skilled individuals among migrants in year 2000 (ages 25 and above). These shares are then applied to the 2006 aggregate migration stocks for each origin-destination country pair. Skilled individuals are those that completed at least one year or college or more. The skill distribution of the native stayers is sourced from Docquier et al. (2009).[4] Finally, remittances data are sourced from Ratha and Shaw (2007). The sources and details for the other data used in the quantitative exercise are described when we discuss the calibration.

We carry out the analysis on the sample of the largest 49 countries in the world by total GDP, plus a selection of 11 smaller countries that have experienced migration outflows of 10% or more of the native labor force. These 60 countries together cover 98% of world GDP. There is a 61st rest of the world country. We exclude the entrepôt economies of Hong Kong and Singapore, both of which have total trade well in excess of their GDP due to significant re-exporting activity. Thus, our model is not intended to fit these countries, though we do place them into the rest-of-the-world

[4]There is a small discrepancy in how the two datasets define a skilled individual, namely, a skilled native stayer is defined in Docquier et al. (2009) as someone who completed college, rather than had some college. We do not believe this discrepancy to have a material impact on the results.

category.

Table 1 lists the OECD countries in the sample and reports the share of immigrants (foreign born), the share of emigrants, the counterfactual population change, the size of net remittances relative to GDP, and the shares of skilled for stayers, immigrants, and emigrants. These are the countries for which data on immigrant stocks for 2006 are available. Table 2 reports the shares of emigrants, the population change in the counterfactual, and remittances as a share of GDP for the remaining countries in our sample (the South).

Several points are worth noting. First, the data reveal a great deal of dispersion in immigration and emigration shares. At one extreme there are countries such as Australia and New Zealand, where 25% of the population are foreign born. At the other, El Salvador, Trinidad and Tobago, and Jamaica display emigration shares in the 20−30% range.[5] Second, some of the OECD countries have large gross stocks of both immigrants and emigrants. Because of that, if migration had never taken place their population would be broadly the same (the third column). Ireland is the clearest example: its share of immigrants is 13%, but the share of emigrants is 16%. If migration had never taken place, its population would only be 3% higher.

The table also reports the net remittances in each country as a share of GDP. Negative values mean that a country is a net sender or remittances. Clearly, most OECD countries send more remittances than they receive, but the total net remittances are only a small share of GDP, ranging from −1% (Australia) to +1% (Portugal). In contrast, remittances are large, relative to GDP, for several non-OECD countries. For instance, Colombia, India, Mexico, and Nigeria report remittances of 3% of GDP. However, these are small compared to Jamaica (20%), Serbia and Montenegro (19.1%), El Salvador (17.8%), Philippines (15.5%) and the Dominican Republic (14.3%). Hence, for these countries it will be important to take remittances into account when evaluating the welfare impact of migration.

It is also interesting to compare the share of skilled among stayers, immigrants and emigrants. Across all origin-destination pairs, the share of skilled is 0.25, with a standard deviation of 0.24. For practically all OECD countries the share of skilled (some college or beyond) among emigrants is substantially larger than among stayers (e.g. 0.58 versus 0.52 for the U.S.). However, there is large heterogeneity in the share of skilled among immigrants relative to the natives of the host country. For instance, while U.S.-born stayers exhibit a share of skilled equal to 0.52, the analogous share among its immigrants was 0.42. Thus U.S. immigrants were relatively unskilled, compared to native stayers, by this measure. In contrast U.K. immigrants were relatively skilled (0.42 share) compared to native stayers (0.18).

[5] Once again, for these countries we are reporting data on emigration to OECD countries only. Thus their total emigration shares are likely to be a bit higher. Since we lack data on immigration to the South, the counterfactual population change for these countries is equal to their emigration share. That is to say, in the counterfactual these countries only experience a return of their emigrants, but not the exit of the immigrants residing in these countries.

3 Theoretical Framework

3.1 Migration, Productivity, and Labor Force Composition

The world is comprised of $\mathcal{C}$ countries, indexed by $i, j = 1, \ldots, \mathcal{C}$. Labor is the only factor of production with effective country endowments given by L_j. Following the insight by Trefler (1993, 1995), the effective labor endowment is a combination of the number of people that live in the country and their efficiency units. These efficiency units are determined by worker-specific productivity as well as, albeit in reduced form here, by each country's endowment of capital.

We build on this approach by taking explicit account of migration. Each country's labor force is composed of natives and immigrants, who can be unskilled or skilled, indexed by $e = \ell, h$ respectively. In particular, denote by N^e_{ji} the number of workers with skill level e born in country i that live in country j (throughout the paper, we adopt the convention that the first subscript denotes the destination country, and the second subscript, the source). Immigrants will generically differ from native workers, conditional on skills, in how many efficiency units of labor they possess: workers of skill level e born in country i and working in country j have A^e_{ji} efficiency units of labor. Then the total effective labor endowment in country j is just the summation over all the efficiency units of labor of workers at each skill level coming from all the countries:

$$L_j = \sum_{i=1}^{\mathcal{C}} \sum_{e=\{\ell,h\}} A^e_{ji} N^e_{ji}, \tag{1}$$

where, of course, the summation includes the native workers and their efficiency, $A^e_{jj} N^e_{jj}$, $e = \ell, h$. We assume that, at each destination, skilled workers are more productive than unskilled workers from the same country of origin. Let $A^\ell_{ji} = A_{ji}$ denote the "baseline" productivity of an individual born in country i living in j, which we associate with an unskilled worker. Then, the skilled worker's productivity is $A^h_{ji} = \mu_j A_{ji}$, with $\mu_j > 1$.

It is well documented that when migrants cross the border, their wages change dramatically, often by an order of magnitude. To a large extent this is due to the large observed differences in factor prices across borders (Hendricks, 2002; Klein and Ventura, 2007). Another well established fact is that upon arrival immigrants tend to earn lower wages than comparable natives, and that this wage gap diminishes over time as immigrants acquire local skills (see Schultz, 1998; Borjas, 1999, for reviews). Thus at any given snapshot, we will observe a wage gap between natives and immigrants in the typical country. Hendricks (2002) reports that the gap between the earnings of immigrants and U.S. natives with the same observable skills is less than 25 percent for most source countries (1990 U.S. Census data).

To account for these empirical patterns, we allow for a productivity differential between immigrants and natives at the same skill level: $A^e_{ji} = \phi^e_i A^e_{jj}$. The total efficiency units of labor in country j can then be expressed as

$$L_j = A_{jj} \sum_{i=1}^{\mathcal{C}} \phi_i^{\ell} N_{ji}^{\ell} + \mu_j \phi_i^h N_{ji}^h. \tag{2}$$

In the quantitative implementation we consider several empirically relevant parameterizations of the productivity differential ϕ_i^e.

Our framework thus assumes that efficiency units of labor possessed by workers of different skill levels and countries of birth are perfect substitutes in production, the approach adopted, for instance, in development accounting (see, among many others, Klenow and Rodríguez-Clare, 1997; Hall and Jones, 1999). This differs from some of the recent analyses of the economic effects of immigration in a closed economy setting (Borjas, 2003; Manacorda et al., 2012; Ottaviano and Peri, 2012), that allow for imperfect substitutability between workers of different skill levels. Doing so would make it possible to analyze distributional consequences of migration between the skilled and the unskilled, on which our framework is silent. However, it is unlikely that allowing for imperfect substitutability across skills would have a large impact on the aggregate welfare effects of migration, which is the main object of analysis in our paper.

First and foremost, examination of Table 1 reveals that the shares of skilled among the natives and the immigrants in most countries are often quite similar, and total immigrants rarely represent more than 10% of the population, suggesting that in most countries migration does not lead to large swings in the relative supply of skilled to the unskilled, at least at the aggregate country level.[6]

Second, when skilled and unskilled labor are imperfect substitutes, differences in the skill composition between immigrants and natives will increase the natives' income gains from immigration (this is known in the migration literature as the *immigration surplus*, see Berry and Soligo, 1969; Borjas, 1995; Benhabib, 1996; Dustmann et al., 2008). The intuition for this is akin to the gains from trade in a factor proportions model, in which gains are larger the more different are the relative factor proportions of the trading partners. Thus, the aggregate income gains to the natives will actually be larger when the two types of labor are imperfect substitutes compared to our case of perfect substitutability. In that respect, for countries in which the relative proportion of skilled among immigrants differs widely from that of the natives, our results provide a lower bound on the welfare gains to immigration.

[6]Furthermore, there is a lack of consensus in the empirical literature on the question of whether changes in relative labor supply actually lead to changes in relative wages. A large number of empirical studies based on cross-city variation within countries find no evidence that unskilled immigration leads to a reduction in the unskilled-skilled relative wage (see Lewis, 2003; Card, 2005; González and Ortega, 2011; Dustmann and Glitz, 2011, among others). Lewis (2011) has argued that endogenous technology adoption can account for this puzzling empirical fact. Cortés and Tessada (2011) and Farré et al. (2011) provide an alternative explanation based on the effect of unskilled immigration on the labor supply of highly skilled native women through a reduction in the price of domestic services.

3.2 Preferences and Technology

In each country there are two broad sectors, the tradeable T and the non-tradeable N. In country i, the representative consumer maximizes

$$\max_{\{y_i^N(k), y_i^T(k)\}} \left(\int_{J_i^N} y_i^N(k)^{\frac{\varepsilon_N - 1}{\varepsilon_N}} dk \right)^{\frac{\alpha \varepsilon_N}{\varepsilon_N - 1}} \left(\int_{J_i^T} y_i^T(k)^{\frac{\varepsilon_T - 1}{\varepsilon_T}} dk \right)^{\frac{(1-\alpha)\varepsilon_T}{\varepsilon_T - 1}}$$

$$s.t.$$

$$\int_{J_i^N} p_i^N(k)\, y_i^N(k)\, dk + \int_{J_i^T} p_i^T(k)\, y_i^T(k)\, dk = Y_i,$$

where $y_i^s(k)$ is consumption of good k belonging to sector $s = N, T$ in country i, $p_i^s(k)$ is the price of this good, and J_i^s is the mass of varieties available in sector s in country i, coming from all countries. Total income Y_i is the sum of labor income $w_i L_i$, net profits (if any) in the two sectors $\Pi_i^N + \Pi_i^T$, and net remittances received from abroad R_i: $Y_i = w_i L_i + \Pi_i^N + \Pi_i^T + R_i$. Since consumer preferences are Cobb-Douglas in CES aggregates of N and T, it is well known that consumption expenditure on sector N is equal to αY_i, and on the T sector, $(1-\alpha)Y_i$.

The CES composites of both N and T are used both as final consumption and as intermediate inputs in production. Let X_i^s denote the total spending – final plus intermediate – on sector $s = N, T$ in country i. Given this total expenditure, it is well known that demand for an individual variety k in country i is equal to

$$x_i^s(k) = \frac{X_i^s}{(P_i^s)^{1-\varepsilon_s}} p_i^s(k)^{-\varepsilon_s}, \tag{3}$$

where P_i^s is the ideal price index of sector s in this economy,

$$P_i^s = \left[\int_{J_i^s} p_i^s(k)^{1-\varepsilon_s} dk \right]^{\frac{1}{1-\varepsilon_s}}. \tag{4}$$

Each country j is populated by a mass n_j^s of entrepreneurs in sector s. Each entrepreneur k in each $s = N, T$ and $j = 1 \ldots, \mathcal{C}$ has the ability to produce a unique variety in sector s valued by consumers and other firms, and thus faces the downward-sloping demand given by (3). There are both fixed and variable costs of production and trade. Each entrepreneur's type is given by the unit input requirement $a(k)$. On the basis $a(k)$, each entrepreneur in country j decides whether or not to pay the fixed cost of production f_{jj}^s, and which, if any, export markets to serve. In the N sector, we assume that trade costs are infinite, and thus a firm in country j may only serve its own market. In sector T, to start exporting from country j to country i, a firm must pay a fixed cost f_{ij}, and an iceberg per-unit cost of $\tau_{ij} > 1$, with the iceberg cost of domestic sales normalized to one: $\tau_{jj} = 1$.

Production in both sectors uses both labor and CES composites of N and T as intermediate inputs. In particular, a firm with unit input requirement $a(k)$ must use $a(k)$ input bundles to produce one unit of output. An input bundle in country j and sector s has a cost

$$c_j^s = w_j^{\beta_s} \left[\left(P_j^N\right)^{\eta_s} \left(P_j^T\right)^{1-\eta_s} \right]^{1-\beta_s}, \tag{5}$$

where w_j is the wage (i.e., the price of one unit of L) in country j. That is, production in sector $s = N, T$ requires labor, inputs of N, and inputs of T. The share of value added in total sales, β_s, and the share of non-tradeable inputs in total input usage, η_s, both vary by sector.

Firm k in sector s from country j selling to country i thus has a marginal cost $\tau_{ij} c_j^s a(k)$ of serving this market. As is well known, the profit-maximizing price is a constant markup over marginal cost, $p_i^s(k) = \frac{\varepsilon_s}{\varepsilon_s - 1} \tau_{ij} c_j^s a(k)$, the revenue is equal to $\frac{X_i^s}{\left(P_i^s\right)^{1-\varepsilon_s}} \left(\frac{\varepsilon_s}{\varepsilon_s - 1} \tau_{ij} c_j^s a(k) \right)^{1-\varepsilon_s}$, and the total ex-post variable profits from selling to market i are a constant multiple $1/\varepsilon_s$ of revenue. Not all firms will decide to serve all markets, and the production structure of the economy is pinned down by the number of firms from each country that enter each market.

We adopt the standard assumption that firm productivity in sector s, $1/a$, follows a Pareto(b_s, θ_s) distribution: $\Pr(1/a < y) = 1 - \left(\frac{b_s}{y}\right)^{\theta_s}$, where b_s is the minimum value labor productivity can take, and θ_s regulates dispersion.

Trade is not balanced due to remittances. Let country i receive a net transfer of resources R_i, which can be positive (for countries receiving remittances), or negative (for countries sending them). For the world as a whole, remittances sum to zero: $\sum_i R_i = 0$. The data on remittances used below to implement the model satisfy this requirement. Let Y_i^N and Y_i^T denote the value of output by firms located in country i in sectors N and T, respectively. The country's resource constraint states that total spending must equal the value of domestic production plus net transfers: $X_i^N + X_i^T = Y_i^N + Y_i^T + R_i$. Because N cannot be traded, it has to be the case that $X_i^N = Y_i^N$, and thus the aggregate resource constraint becomes:

$$X_i^T = Y_i^T + R_i. \tag{6}$$

In assessing the welfare impact of migration, we consider two types of equilibria. The two equilibria differ in their assumptions on the mass of potential entrepreneurs n_i^s in each country and sector. The short-run equilibrium assumes that the set of available projects n_j^s is fixed in each country and sector, as in Chaney (2008) and Eaton et al. (2011). Thus, in the short-run equilibrium the stock of productive project ideas cannot adjust instantaneously to changes in the labor force. In the long-run equilibrium, the stock of projects n_j^s adjusts to satisfy the free entry condition, as in Krugman (1980) and Melitz (2003). Thus, in the long run this variable will respond to changing economic conditions, in our case migration.

Though capital is not explicitly in the model, one can follow the interpretation suggested by Ghironi and Melitz (2005) and Bergin and Corsetti (2008) that the set of projects available to entrepreneurs is a form of the capital endowment. Similarly, the creation of new firms is a form of capital investment. This interpretation is natural in the sense that these projects are in effect a factor of production without which workers cannot generate output. Thus, the short-run equilibrium corresponds to a case in which the other factors of production – n_j^s here – have not had a chance to adjust to the new endowment of labor, whereas the long-run equilibrium is the one that obtains after the adjustment of other factors.

3.3 Short-Run Equilibrium

In the short-run equilibrium, n_i^s is fixed exogenously. This means that entrepreneurs with access to productive projects earn net profits in this economy. Straightforward steps (see, for instance, Proposition 1 in di Giovanni and Levchenko, 2010) establish that total profits in each sector and country are a constant multiple of the total sales by firms in that sector: $\Pi_i^s = \frac{\varepsilon_s-1}{\varepsilon_s\theta_s}Y_i^s$. This implies that the total spending on intermediate inputs in each sector is $(1-\beta_s)\left(1-\frac{\varepsilon_s-1}{\varepsilon_s\theta_s}\right)Y_i^s$. Final spending is the sum of all net income, which includes labor income, profits, and remittances: $Y_i = w_iL_i + \Pi_i^N + \Pi_i^T + R_i$. Market clearing in each sector implies that total spending equals final consumption spending plus purchases of intermediate inputs:

$$X_i^N = \alpha Y_i + (1-\beta_N)\,\eta_N\left(1-\frac{\varepsilon_s-1}{\varepsilon_s\theta_s}\right)Y_i^N + (1-\beta_T)\,\eta_T\left(1-\frac{\varepsilon_s-1}{\varepsilon_s\theta_s}\right)Y_i^T \tag{7}$$

$$\begin{aligned} X_i^T = {} & (1-\alpha)Y_i + (1-\beta_N)\,(1-\eta_N)\left(1-\frac{\varepsilon_s-1}{\varepsilon_s\theta_s}\right)Y_i^N + \\ & (1-\beta_T)\,(1-\eta_T)\left(1-\frac{\varepsilon_s-1}{\varepsilon_s\theta_s}\right)Y_i^T. \end{aligned} \tag{8}$$

A *short-run monopolistically competitive equilibrium* is a set of prices $\left\{w_i, P_i^N, P_i^T\right\}_{i=1}^{\mathcal{C}}$, and factor allocations such that (i) consumers maximize utility; (ii) firms maximize profits, and (iii) all goods and factor markets clear, given country endowments L_i and n_i^s.

3.4 Long-Run Equilibrium

In the long-run equilibrium, n_i^s will adjust to satisfy the free entry condition. As in Krugman (1980) and Melitz (2003), each country has a potentially infinite number of entrepreneurs with zero outside option. In order to become an entrepreneur, an agent must pay an "exploration" cost f_E. Upon paying this cost, the entrepreneur k discovers her productivity, indexed by a unit input requirement $a(k)$, and develops an ability to produce a unique variety of N or T valued by consumers and other firms.

The equilibrium number of potential entrepreneurs n_j^s is then pinned down by the familiar free entry condition in each sector and each country. Entrepreneurs in sector s will enter until the expected profit equals the cost of finding out one's type:

$$\mathrm{E}\left[\sum_{i=1}^{\mathcal{C}} \mathbf{1}_{ij}\left[k\right]\left(\pi_{ij}^{V,s}(a(k)) - c_j^s f_{ij}^s\right)\right] = c_j^s f_E \tag{9}$$

for each country j and sector s, where $\mathbf{1}_{ij}\left[k\right]$ is the indicator function for whether firm k in j finds it profitable to enter market i, $\pi_{ij}^{V,s}(a(k))$ are ex post variable profits from selling there, and once again in sector N, profits can only be positive for $i = j$.

With free entry, the total profits in the economy are zero. Thus the total final spending equals labor income plus remittances, $Y_i = w_i L_i + R_i$, and total spending on intermediate inputs equals a fraction $(1 - \beta_s)$ of total sales by all firms in each sector s. Market clearing in each sector implies that total spending equals final consumption spending plus purchases of intermediate inputs:

$$X_i^N = \alpha Y_i + (1 - \beta_N)\,\eta_N Y_i^N + (1 - \beta_T)\,\eta_T Y_i^T \tag{10}$$

$$X_i^T = (1 - \alpha) Y_i + (1 - \beta_N)\,(1 - \eta_N)\, Y_i^N + (1 - \beta_T)\,(1 - \eta_T)\, Y_i^T. \tag{11}$$

A *long-run monopolistically competitive equilibrium* is a set of prices $\left\{w_i, P_i^N, P_i^T\right\}_{i=1}^{\mathcal{C}}$, equilibrium measures of potential projects $\left\{n_i^N, n_i^T\right\}_{i=1}^{\mathcal{C}}$, and factor allocations such that (i) consumers maximize utility; (ii) firms maximize profits, (iii) all goods and factor markets clear, and (iv) the net profits in the economy equal zero.

Appendix A.1 presents the complete equations defining equilibria in both models.

4 Quantitative Implementation and Model Fit

We numerically implement the general multi-country model laid out in Section 3. We use information on country sizes, fixed and variable trade costs, and bilateral migration flows and remittances to solve the model. Then we simulate the effects of un-doing the migration flows observed in the data. That is, we repatriate all individuals back to their countries of origin. Table 3 summarizes the calibrated parameter values of the model, and Appendix A.2 discusses the details of how the parameters are chosen.

4.1 Solution Algorithm

Using these parameter values we can solve the full model for a given vector of L_j. To find the values of L_j, we follow the approach of Alvarez and Lucas (2007). First, as described in Section 3.1 L_j is not population *per se*, but a combination of the number of workers and the efficiency units – or labor productivity – that workers possess in country j. To obtain the values of L_j that are internally consistent in the model, we start with an initial guess for L_j for all $j = 1, \ldots, \mathcal{C}$, and use it to solve the full model. Given the solution for wages, we update our guess for L_j for each country in order to match the GDP ratio between each country j and the U.S.. Using the resulting values of L_j, we solve the model again to obtain the new set of wages, and iterate to convergence (for more on this approach, see Alvarez and Lucas, 2007). Thus, our procedure generates vectors w_j and L_j in such a way as to match exactly the relative total GDPs of the countries in the sample. In practice, the results are not far from simply equating the relative total labor to the relative GDPs. In this procedure, we must normalize the population of one of the countries. We thus set L_{US} to its actual value of 300 million as of 2006, and compute L_j of every other country relative to this U.S. value. An notable consequence of this approach is that, controlling for population, countries with higher labor productivity A_{jj} will tend to have a greater number of potential productivity draws n_j^s, all else equal, since our procedure will give them a higher L_j. That is, population and efficiency enter symmetrically and multiplicatively in determining market size, which in turn determines equilibrium variety. This approach is common in the literature. For instance, Alvarez and Lucas (2007) and Chaney (2008) assume that the number of productivity draws is a constant multiple of equipped labor L_j. The difference in our approach is that we take labor-cum-productivity to be a measure of market size, we solve for n_j^N and n_j^T endogenously within the model.

4.2 Labor Productivity Parameters

Having obtained the estimates of the total efficiency-adjusted labor endowment L_j and using the data on bilateral immigrant stocks by skill for each destination and origin country $(N_{ji}^{\ell}, N_{ji}^{h})$, we obtain country-specific productivity A_{jj} for every country j from (2):

$$A_{jj} = \frac{L_j}{\sum_{i=1}^{\mathcal{C}} \phi_i^{\ell} N_{ji}^{\ell} + \mu_j \phi_i^h N_{ji}^h}. \tag{12}$$

Clearly, given data on the number of workers in each destination country, disaggregated by country of origin and skill level, the previous calculation requires assigning values to μ_j, ϕ_i^{ℓ} and ϕ_i^h. Regarding the skilled-unskilled relative productivity μ_j, we assume that one skilled worker corresponds to 1.5 unskilled workers.[7]

Next, we turn to the calibration of parameters ϕ_i^{ℓ} and ϕ_i^h. We shall adopt three approaches. The first approach is to assume that $\phi_i^{\ell} = \phi_i^h = 1$, common across all countries. In this case, the average equilibrium wages of natives and immigrants with the same skill level will be equal in all countries, although they will differ across countries. This will be our baseline scenario as we find it helpful in conveying the main mechanisms driving our results. It corresponds to the broad pattern in the data that the wages of migrants are well approximated by the wages of the natives in the

[7] In a Mincerian fashion, we infer productivity differences from wage differences. Assuming a five percent return to each year of schooling beyond elementary education delivers the 1.5 factor. Lacking earnings data for all countries in our sample, we find this to be a reasonable parameterization of μ_j. Alternatively, we could follow Grogger and Hanson (2011) and use data on average income and the Gini coefficient for each country. By making a (lognormal) distributional assumption they proxy the skilled-unskilled wage ratio using a ratio of percentiles of the wage distribution.

host country, and are often an order of magnitude larger than wages of similar workers in the source country (Pritchett, 2006).[8]

The second approach assumes that skills are imperfectly transferable across borders: $\phi_i^\ell = \phi_i^h = 0.75$ for all non-native born, again setting this value to be the same for all countries. Thus, conditional on the skill level, immigrants' wages will be 25 percent lower than natives' wages in all countries.[9] This specification thus reflects the possibility that migrants are less productive than natives due, for instance, to cultural and linguistic differences or labor-market discrimination. In the counterfactual we set $\phi_i^\ell = \phi_i^h = 1$, that is, when migrants return to their home country their skills have not depreciated in terms of their productivity in their home countries.

The third approach considers origin-specific native-immigrant relative productivities, calibrated following Hendricks (2002) based on the U.S. Census data for the year 2000 (one percent public-use micro-sample). The details are discussed in Section 5.4. This procedure accommodates a wide range of reasons for migrant-native productivity differentials, including cultural/linguistic differences, variation in the quality of human capital, as well as selection (positive or negative) into migration. Under this approach, ϕ_i^e's need not be less than 1, indeed they are greater than 1 in many cases.

Our counterfactual experiments will evaluate welfare under the assumption that all immigrants residing in OECD countries return to their countries of origin. In this scenario the counterfactual effective labor forces of each country j will be:

$$\widetilde{L_j} = A_{jj} \sum_{i=1}^{\mathcal{C}} \left(N_{ij}^\ell + \mu_j N_{ij}^h \right). \tag{13}$$

That is, all the workers native to j that ever migrated to any destination country i are returned home. Their labor productivity is assumed to be the same as for their compatriots with the same skill, regardless of whether and where they migrated.[10] Our main task ahead is the computation of welfare for both natives and migrants in the counterfactual world with labor endowments (13), distinguishing between the short- and the long-run effects in such an experiment.

[8] Moreover, we show below that the results are almost unchanged when we use country-specific parameters matched to data.

[9] Hendricks (2002) reports that the gap between the earnings of immigrants and U.S. natives with the same observable skills is less than 25 percent for most source countries (1990 U.S. Census data). Klein and Ventura (2009) assume that international migration entails a 15% permanent loss in skills. Their choice is consistent with the estimates in Borjas (1996) and in their model delivers realistic migration rates.

[10] In reality return migrants may bring back skills learned at the destination country. However, there are very few estimates available for the rates of return to those skills. For more details see Dustmann (2003), Dustmann (2008), and Dustmann et al. (2011). Because the third approach to setting ϕ_i^e's (calibration based on U.S. Census data) can be thought of as capturing selection into migration, under the third approach migrants keep their ϕ_i^e's when they return home: $\widetilde{L_j} = A_{jj} \sum_{i=1}^{\mathcal{C}} \left(\phi_i^\ell N_{ij}^\ell + \mu_j \phi_i^h N_{ij}^h \right)$.

4.3 Model Fit

Before describing the counterfactual results, we assess the model fit on overall and bilateral trade; as well as on how the total labor productivities implied by the model compare to GDP per capita at country level. The baseline is solved as the long-run equilibrium given the total populations (including migrants), total GDPs, and remittances in all countries as they are in the data in 2006.

Figure 1a reports the scatterplot of bilateral trade to GDP ratios in the model (on the x-axis) and in the data (the y-axis). Note that since in the data we only have bilateral trade as a share of GDP, not of total sales, we compute the same object in the model: $\pi_{ij} = X_{ij}/w_i L_i$.[11] This captures both the distinction between trade, which is recorded as total value, and GDP, which is recorded as value added; as well as the fact that there is a large non-traded sector in both the model and in the data. Note that the scatterplot is in log-log scale, so that the axes report the trade shares in levels. Hollow dots represent exports from one country to another, π_{ij}, $i \neq j$. Solid dots, at the top of the scatterplot, represent sales of domestic firms as a share of domestic absorption, π_{ii}. For convenience, we add a 45-degree line. It is clear that the trade volumes implied by the model match the actual data well. Most observations are quite close to the 45-degree line. It is especially important that we get the variation in the overall trade openness $(1 - \pi_{ii})$ right, since that will drive the contribution of trade to the welfare impact of migration in each country. Figure 1b plots the actual values of $(1 - \pi_{ii})$ against those implied by the model, along with a 45-degree line. We can see that though the relationship is not perfect, it is quite close.

Table 4 compares the means and medians of π_{ii} and π_{ij}'s for the model and the data, and reports the correlations between the two. The correlation between domestic shares π_{ii} calculated from the model and those in the data for this sample of countries is around 0.57. The correlation between export shares, π_{ij}, is actually higher at 0.78. Since we use estimated gravity coefficients together with the actual data on bilateral country characteristics to compute trade costs, it is not surprising that our model fits bilateral trade data quite well given the success of the empirical gravity relationship. Nonetheless, since the gravity estimates we use come from outside of our calibration procedure, it is important to check that our model delivers outcomes similar to observed trade volumes.

The model delivers a vector of implied baseline labor productivities A_{jj} for each country, and we would like to compare these estimates to the data. Unfortunately, as a model object A_{jj} reflects the physical productivity of a worker, which we cannot measure in the data. In addition, in the model one native (unskilled) worker will receive a wage equal to $w_j A_{jj}$, and, because of global market clearing, wages of a single efficiency unit of labor will differ across countries as well. To match the model precisely with the data, we calculate in the model the real, PPP-adjusted per capita income for an individual living in j, which is given by $w_j A_{jj}(1 - \omega_j + \mu_j \omega_j)/P_j$, with $P_j = (P_j^N)^\alpha (P_j^T)^{1-\alpha}$

[11] Since the baseline is solved as the long-run equilibrium, total profits are zero and GDP is simply labor income.

the consumption price level, and $\omega_j \equiv N_j^h/(N_j^h + N_j^\ell)$ is the share of skilled in the total population of country j.[12] This object is then directly comparable to income data from the Penn World Tables. Figure 2 presents the scatterplot of the real PPP-adjusted per capita income for 2006 from the Penn World Tables on the x-axis against the corresponding object in the model, along with the 45-degree line. The model matches the broad variation in per capita income in our sample of countries quite well. The countries line up along the 45-degree line, though it appears that the model tends to underpredict the relative income levels of poorer countries, and slightly over-predict the relative income levels of the richest countries. Overall, however, the simple correlation correlation between the model and the data is 0.91, and the Spearman rank correlation is 0.93.[13]

5 Counterfactuals

We are now ready to perform our main counterfactual exercise. Namely, we use the model to evaluate the welfare effects of sending all foreign-born individuals currently living in OECD countries back to their countries of birth.

As discussed in Section 3, in the short run the mass of potential firms (n_i^T and n_i^N) is fixed. Thus we compare the baseline equilibrium to the equilibrium when all migrants to the OECD return to their home countries, *given the benchmark values of* n_i^s. In the long-run counterfactual we let n_i^s adjust to the new size of the labor force.

The outcome of the welfare comparison between the baseline equilibrium and the return migration counterfactual is not ex ante obvious. Qualitatively, market size effects suggest that net population gains will be welfare enhancing. However, we need to keep in mind that the typical migrant will be moving back to a lower-TFP country. Thus the world as a whole will be shrinking in terms of efficiency units of labor. Additionally, countries that will receive net inflows of return migrants will simultaneously lose the remittances that those individuals were previously sending home. From a quantitative standpoint, the net welfare effects are ambiguous, and will depend on the particularities of each country's migration and remittance experiences, as well as on calibrated parameter values.

5.1 Welfare

Our main measure of welfare is the average utility of native stayers, taking into account the distribution of skill levels among them.[14] In the baseline scenario a generic country j's population can

[12] This calculation is under the baseline assumption that $\phi_i^e = 1\ \forall i, e$.

[13] The plots and the correlations are reported dropping United Arab Emirates, for which the model under-predicts real per capita income by about a factor of 2. U.A.E. is a very small, special economy for which we do not have immigration data, and thus the poor performance of the model regarding the U.A.E. is highly unlikely to affect any of the substantive results in the paper. Including U.A.E., the simple correlation between the model and the data is 0.9, and Spearman correlation is still 0.93.

[14] Below we will also report estimates of the welfare changes for the migrants themselves.

be divided into three groups: individuals born in country j that stayed in the country (stayers), individuals born in country j that migrated to another country (emigrants) and individuals born in other countries that migrated to country j (immigrants). Individual welfare corresponds to the indirect utility function. Since the direct utility function is Cobb-Douglas-CES and homothetic, indirect utility is simply an individual's income divided by the consumption price level. In the presence of remittances, we have to consider natives and migrants separately. We assume that outgoing remittances are sent by the migrants only, that is, natives living in their home country are not transferring any of their income abroad. We also assume that incoming remittances are received by the natives only, that is, remittances from abroad coming into the country go to natives, and not to immigrants living in that country.[15]

In the baseline equilibrium the utility levels enjoyed by the native stayers (born and residing in j) are given by

$$W_{jj} = \frac{w_j A_{jj}(1 - \omega_{jj} + \omega_{jj}\mu_j) + (\Pi_j^N + \Pi_j^T)/\sum_{k=1}^{\mathcal{C}} N_{jk} + R_j^{in}/N_{jj}}{P_j}, \tag{14}$$

while the income of immigrants from i living in j is

$$W_{ji} = \frac{w_j A_{jj}((1 - \omega_{ji})\phi_i^\ell + \omega_{ji}\phi_i^h\mu_j) + (\Pi_j^N + \Pi_j^T)/\sum_{k=1}^{\mathcal{C}} N_{jk} - R_{ji}^{out}/N_{ji}}{P_j}, \tag{15}$$

where $\omega_{ji} \equiv N_{ji}^h/(N_{ji}^\ell + N_{ji}^h)$ is the share of skilled among those born in i and residing in j, $N_{ji} = N_{ji}^\ell + N_{ji}^h$ is the total number of individuals born in i residing in j (thus $\sum_{k=1}^{\mathcal{C}} N_{jk}$ is the total population of country j, including both immigrants and natives of both skill levels), and $P_j = (P_j^N)^\alpha (P_j^T)^{1-\alpha}$ is the consumption price level for all residents of country j. In this notation, R_j^{in} is the total gross amount of remittances received by the native stayers in country j from the rest of the world, R_{ji}^{out} are the total gross remittances that individuals born in country i and working in country j send to their country of origin.[16] We make the assumption that all residents of a country have an equal number of shares to domestic profits, regardless of their skill level or nativity status. As discussed earlier, there are positive profits in the short run. In the long run, due to free entry, profits are zero.

In the counterfactual scenario each country's population is composed by the individuals that were born in that country, including both those that never left and returnees.[17] Our measures of

[15] For example, remittances from Mexicans working in the United States are received by native Mexicans living in Mexico, and not by Guatemalan immigrants living in Mexico or by Mexicans living in Spain. We lack data to evaluate the plausibility of this assumption but it appears reasonable and unlikely to bias the results in any economically important manner.

[16] Recall that R_j was used to denote the total net remittances received by country j from the rest of the world, which can take both positive and negative values.

[17] Recall the caveat that we lack data on the distribution of immigrants by origin country for non-OECD countries. Hence, the counterfactual population in these countries includes native stayers, immigrants and returnees from OECD countries. Thus the change in population experienced by these countries is equal to their baseline share of emigrants.

individual welfare in the counterfactual equilibrium where all migrants return to their countries of origin are analogous to the previous expressions, with the proviso that all remittances disappear from the equations. Now all residents of country j are natives of that country: some had never left and others did but now have returned. Hence, counterfactual individual utility of a native stayer in country j is given by

$$\widetilde{W_{jj}} = \frac{\widetilde{w_j} A_{jj}(1 - \omega_{jj} + \omega_{jj}\mu_j) + (\widetilde{\Pi_j^N} + \widetilde{\Pi_j^T})/\sum_{k=1}^{\mathcal{C}} N_{kj}}{\widetilde{P_j}},$$

where the tilde denotes the counterfactual equilibrium value. Note also that we are implicitly assuming that immigrants' human capital remains unaffected by the migration experience. That is, upon return to their home country migrants bring no new skills and display the same skill level as the natives from their home country that never left the country. Though a bit simplistic, this is a reasonable starting point.[18]

5.2 The Long Run

Table 5 reports our main results. For each country, we report the percent change in the real average income of native stayers (across the two skill levels) in the counterfactual relative to the benchmark scenario. Positive (negative) values represent welfare gains (losses) from undoing international migration. We break up the sample into OECD countries and non-OECD countries. Roughly, we can think of the first group (left panel) as the migrant-receiving countries (the North) and the second group (right panel) as the migrant-sending countries, though keeping in mind that there is substantial North-North migration as well.

The first important observation to emerge from the Table is that the large majority of countries in the North would be worse off in the absence of migration. The average country in the North would experience a welfare loss of 2.37%, with substantial dispersion in outcomes (standard deviation of 3.09%). In this group, the largest losses are experienced by the natives of the countries with the largest observed shares of the foreign-born in the population: Australia (−11.72%), Canada (−7.15%), and New Zealand (−6.85%). However, it is worth noting that a handful of countries in the North would experience welfare gains: Greece, Korea and Portugal would all be about 1% better off in the no-migration counterfactual. As Table 1 shows, these are the OECD countries with noticeable net out-migration. Thus these countries actually gain population in the counterfactual scenario: 5.2%, 2.8%, and 11.1%, respectively.

Our remittance data include South-South remittances, but those account for only 21% of remittances received by a typical non-OECD country (16% when receiving countries from the former Soviet bloc are excluded). Thus South-South remittances are unlikely to have have a significant impact on our results.

[18]See Rauch and Trindade (2002) and Rauch and Trindade (2003) for estimates of the effects of migration on enhancing trade flows via the information conveyed through ethnic networks. In the third approach of calibrating ϕ_i^e's, we do allow returning migrants to retain their ϕ_i^e, reflecting the possibility that emigrants are more talented than staying natives.

Secondly, we note that the majority of countries in the South would also experience a welfare loss, although dispersion in country outcomes is substantial. The average loss is 2.09% with an associated standard deviation of 3.58%. The highest welfare losses are to native stayers in El Salvador, the Dominican Republic, Jamaica, and the Philippines, at around $7-10\%$. Interestingly, a handful of countries in the South experience welfare gains: mainly, Trinidad and Tobago (4.83%), Mexico (1.29%), and Turkey (1.07%). A quick glance at Table 2 shows that these countries are characterized by substantial emigration rates but small incoming remittances relative to their GDP and to their emigration rates. For instance, while Mexico has an emigration rate over 10%, remittances account for only 3.1% of its GDP. In contrast, the emigration rate of the Philippines is around 3% but their incoming remittances are equal to 15.5% of its GDP.

Thus, both the North and the South tend to gain from the observed levels of migration. The fundamental reason for the positive welfare impact is that the allocation of labor is more efficient in the baseline equilibrium since migrants tend to move from low to high TFP countries. As a result there is an increase in the world's total efficiency units of labor. However, the proximate mechanisms through which receiving and sending countries benefit are different. In the North, net immigration leads to a larger market size. In the presence of positive trade costs, this implies higher equilibrium variety and thus higher per capita welfare. For the native stayers in the South, the losses from lower variety due to emigration are in most cases more than offset by the fact that their emigrants experience large increases in earnings, and a fraction of those is being shared with the native stayers through remittances.

We now isolate the roles played by changes in population size, international trade, and remittances. We shall present these results using scatterplots. The horizontal axis in all the following figures is the percentage change in the total population in the counterfactual relative to the baseline (column 3 of Table 1 and Table 2), with positive values corresponding to increases in population. Figure 3 summarizes the main results. Solid dots depict the welfare change in the long-run counterfactual (the first column of Table 5). As discussed above, most countries in the North suffer a population loss as migrants return to their home countries, while most countries in the South gain population. Among the countries in the North there is a clear positive association between the population change and the percentage change in long-run welfare: the countries with the largest population losses suffer the largest welfare losses. For instance, Australia would lose 22.6% of its population, leading to a 11.72% welfare loss for its native stayers. The picture is much less clear for the countries in the South. Most of these countries experience net population gains. However, some suffer large welfare losses while others even experience (small) welfare gains. It is particularly interesting to compare the predictions for El Salvador and Trinidad and Tobago. These two countries would experience similar population gains due to return migration, at 19% and 17.9% respectively. But while the former would suffer a welfare loss of 8.89%, the latter would experience a welfare gain of 4.83%. As we now show, the diverging effects of return migration on these two countries are explained by the role of remittances.

Figure 3 plots the results from two additional counterfactual scenarios. In the first case, hollow dots report the welfare changes that would result assuming there are no remittances. Strikingly, the relationship between population and welfare changes becomes roughly monotonically increasing, with a concave shape. In particular, we note that El Salvador and Trinidad and Tobago would now experience practically the same welfare gain (about 5%). The key is that remittances are a very large share of income in El Salvador, while this is not the case in Trinidad and Tobago. Note also that for the countries in the North the welfare impact remains practically unchanged. This is because the remittances originating in these countries are very small relative to the country's GDP, and the native stayers are not the ones sending them abroad.

Next, we examine the scenario where both remittances and international trade are assumed away. The corresponding welfare changes are depicted using hollow triangles. We note that the relationship between population and welfare changes becomes practically linear (with a slope of 0.5), and steeper than under trade. This is because when a country in the South experiences net population growth it will respond by producing a wider set of varieties. In autarky, consumers in that country clearly benefit from the increase in variety. However, in the presence of trade the resulting welfare gain is moderated by the reduction in the number of varieties that are available through imports, implying a smaller marginal welfare gain.

5.3 The Short Run

Let us now analyze the effects of undoing migration in the short run. We reallocate all individuals to their countries of origin but we keep unchanged the baseline mass of potential entrepreneurs in each country n_i^N and n_i^T. Changes in a country's labor force will thus affect the number of operating firms *only* through changes in the operating and exporting cutoffs.

The changes in the welfare of native stayers for each country are in the second column of Table 5. Welfare for natives in the North is practically unchanged in the short run (an average change of -0.45%, compared to -2.37% in the long run). In the South, all countries would experience a welfare loss (with the exception of Saudi Arabia). Furthermore, the short-run loss is uniformly larger than the long-run loss (-3.35%, compared to -2.09% in the long run). The intuition for the differences between the short and long run effects is as follows. The typical country in the North experiences a net reduction in its labor force. As a result, some of the firms operating in the North shut down. In the short run, the set of potential projects available in the economy is fixed. Hence, the reduction in the number of firms/varieties is attained by an increase in the productivity cutoff for operating a firm. As a result, the firms that exit are those with the lowest productivity. Losing these marginal varieties has practically no effect on the welfare of natives in the North. At the other end, the South receives a net inflow of workers. This increase in the labor force will induce a reduction in the productivity cutoff for operating a firm in the South, and new firms will be established. However, these will be the least productive firms, that before the inflow of new workers did not find it worthwhile to operate. Thus, their positive contribution to welfare-adjusted equilibrium variety is minor.

Figure 4 reports the short-run results graphically and isolates the roles of remittances and international trade. As was the case in the long run, once country heterogeneity in remittances is removed, the relationship between population and welfare changes becomes roughly monotonic. As illustrated by the hollow dots, under trade but no remittances, larger population *gains* in the counterfactual lead to larger welfare *losses* among countries in the South. In the North the relationship appears practically flat. In other words, in the short run the increase in domestic varieties experienced by countries in the South is not enough to compensate for the loss in imported varieties. The main reason for this is that return migrants are leaving high-productivity countries in the North to go back to their low-productivity countries of origin, which entails a large loss in worldwide efficiency units of labor. Turning now to the role of international trade, in the counterfactual exercise without either remittances or cross-border trade, the relationship between population and welfare changes becomes again fairly linear and now features a weak *positive* slope. This reflects the fact that the increased labor force in the South will deliver a net increase in varieties available for consumption, obviously with no change in imported varieties.

Quantitatively, in the short run, what matters crucially is *how much* less productive new entrants are relative to the firms that are already in the market. For this, the calibration to the observed firm size distribution (Zipf's Law) plays an important role. Essentially, the observed firm size distribution contains information on the relative productivity of the marginal firms compared to the inframarginal ones. The extremely skewed firm size distribution observed in the economy implies that the inframarginal, existing firms are vastly more productive, and thus matter much more for welfare, than the marginal ones (for a detailed exploration of this result, see di Giovanni and Levchenko, 2010). In comparison, the main benefit in the long run from having a larger population lies in the additional net entry of potential firms – a larger n_i^s. When an increase in population leads more entrepreneurs to draw their productivity, stimulating entry everywhere in the productivity distribution. Because the long-run entry will feature some very productive firms, it will have a much larger impact on welfare.

5.4 Imperfect Skill Transferability and Selection into Emigration

In our baseline scenario the overall long-run welfare gains from migration stemmed from an increase in the global efficiency units of labor, because most migrants move from low- to high-TFP countries.

However, migrant productivity may differ from that of the natives of similar skill levels, for a variety of reasons. On the one hand, it is well documented that migrants suffer a reduction in human capital associated to imperfect transferability of skills across countries, at least in the short run.[19] If this is the case then the findings described above may overstate the effects of migration on the labor force (in efficiency units) of the host country. On the other hand, some immigrants appear to be permanently more productive (i.e. earn higher wages) than natives with similar schooling levels. This could be due to non-random positive selection into migration: migrants may tend to be above-average in terms of unobservable skills (such as talent or ability) relative to individuals that are observationally equivalent in terms of education, work experience, gender, and so on, in the origin and destination countries. Alternatively, immigrant-native relative wage differentials (controlling for educational attainment) may reflect differences in the quality of education or other factors. In this case the results presented above would understate the effects of migration. Of course, negative selection into emigration is also possible, and the type of selection may well vary substantially by origin country.[20]

In order to gain further insight on these issues, and as a robustness check on the findings above, we implement two alternative approaches, introduced in Section 4.2. The first one assumes that immigrants have a 25% productivity disadvantage relative to natives with the same skill level: $\phi_i^\ell = \phi_i^h = 0.75$ for all countries. In the counterfactual scenario we assume that when these individuals return to their home country they are equally productive as their compatriots that never left. We refer to this approach as *imperfect skill transferability.*

The second alternative approach allows for a much broader set of reasons – most notably selection into migration – why migrants would differ systematically from natives with the same observable skill level at the origin and destination. We refer to this setup as *origin-specific selection*, and discipline the choice of the ϕ_i^e parameters using earnings data. Ideally, one would be able to allow for productivity differences that vary by both origin and destination. However, this would require earnings data for migrants disaggregated by country of origin for all destination countries, which are not available. Instead we follow Hendricks (2002) and use the U.S. Census data for the year 2000 to compute native-immigrant hourly wage ratios, controlling for skill level, for each immigration country of origin. The sample includes only individuals 18−65 years of age with positive salary income in year 2000, excluding individuals living in group quarters. Then we set

$$\phi_i^e = \frac{W_{US,i}^e}{W_{US,US}^e}$$

for origin country i and skill level $e = \ell, h$. This approach assumes that, controlling for skill, the relative immigrant-native productivity of, say, Mexican immigrants in the U.S. is the same as that of Mexican immigrants in Canada or Spain. Though restrictive, this assumption appears reasonable

[19] This would lead to immigrant-native relative wages (controlling for education) below unity.

[20] Borjas (1987) explores the conditions for one type of selection or the other to take place.

and transparent. Figure 5 presents the resulting ϕ_i^e's for all origin countries as a scatterplot of ϕ_i^h on the y-axis against ϕ_i^ℓ on the x-axis, along with a 45 degree line. The mean values for the unskilled and skilled relative productivities are 1.14 and 1.06, respectively. For most countries the values are in the $0.75-1.25$ range, consistent with the findings in Hendricks (2002), suggesting that controlling for schooling removes a great deal of heterogeneity. However, several countries exhibit large ϕ_i^e's. For instance, Finnish migrants appear to be roughly 50% more productive (based on their hourly wages in the U.S.) than natives with a similar education.[21] In contrast, Mexican migrants appear to be roughly 25% less productive than natives with a similar education.

In the counterfactual exercise the return migrants keep the same values of ϕ_i^ℓ and ϕ_i^h in their country of origin. If one particular country of origin had suffered positive selection into emigration, that is, its best and brightest had emigrated, now these exceptionally productive individuals are returning home and will earn higher wages than stayers with the same observable skills.

Figure 6 reports the long-run welfare changes under the three approaches to migrant productivity: benchmark ($\phi_i^\ell = \phi_i^h = 1$), imperfect skill transferability, and origin-specific migrant selection. All scenarios in the Figure allow for both international trade and remittances. The benchmark values are depicted by solid dots, and coincide exactly with the values in Figure 3. The imperfect skill transferability case is depicted by hollow dots. Compared to the benchmark results, two observations stand out. First, the welfare *gains* associated to return migration are now uniformly higher across all countries. However, the increase is only noticeable for countries in the North (for which return migration implies a net reduction in their labor force). This is intuitive: for these countries the loss of immigrants now implies a 25% smaller reduction in total efficiency units of labor compared to the benchmark. Australia's long-run welfare loss assuming imperfect skill transferability is -9.1%, as opposed to -11.72% in the benchmark. By contrast, the origin countries receive the same efficiency units of labor as they did under the benchmark approach. It is important to keep in mind that our welfare measure is based on the average utility of native stayers. Hence, for the emigration countries the differences in welfare changes across approaches are driven solely by the global general equilibrium effects.

Let us now turn to the *origin-specific selection* approach, depicted in Figure 6 by hollow triangles. Again, there is virtually no change in the welfare impact for the countries in the South. However, the typical country in the North suffers a slightly larger loss than in the benchmark. This is driven by the fact that ϕ_i^ℓ and ϕ_i^h are on average larger than one. As a result, the reduction in the total efficiency units of labor in the North countries is now larger than in the benchmark. As a caveat it is important to recall that the calibration of these parameters was based solely on the U.S. data. If one believes that the selectivity of migrants (conditional on education) from a given

[21] Recall that our definition of skilled is binary: educational attainment of some college or above. Hence, substantial within-group heterogeneity remains.

country of origin varies substantially across destinations then these results can be questioned.

As it turns out, the two approaches implemented in this section deliver very similar results to those obtained in the benchmark model. For countries in the South the welfare changes are virtually identical to the previous ones. For the North they are somewhat different, but none of the basic conclusions about either the average magnitude of welfare changes or the ranking of the impact across countries are materially affected. Since the differences are relatively small, we conclude that our benchmark results appear to be robust to alternative parameterizations of the productivity of migrants relative to native individuals in the host countries.

5.5 The Welfare of Migrants

The discussion above describes the welfare impact of migration on the native stayers, and thus highlights primarily the general equilibrium effects of migration through population changes and the role of remittances. The model can also be used to evaluate the impact of migration on the welfare of the migrants themselves. The dominant mechanism here is the labor productivity differential between the source and destination countries, which in the case of developing-developed comparisons is quite large. Thus, an individual of skill level e from country i produces with A_{ii}^e in her home country, and with $\phi_i^e A_{jj}$ in foreign country j. Since the differences between A_{ii}^e and $\phi_i^e A_{jj}$ are often several-fold, the welfare impact of migration on migrants' earnings is large, as has been commonly observed in micro data (see Hanson, 2009; Clemens et al., 2008).

Table 6 reports, for selected country pairs, the percentage change in a migrant's welfare in the counterfactual (in which she is living in the home country) compared to the baseline (in which she is living in the host country).[22] Thus, a negative number means that the migrant would be worse off if she returned to the home country. Throughout we assume that skills are perfectly transferable and ignore migrant selection ($\phi_i^\ell = \phi_i^h = 1$). Columns 1 and 2 report, respectively, the long-run and the short-run changes in the migrant's welfare associated with returning to the home country.

Clearly, the welfare losses to the migrants themselves associated with returning all migrants to their home countries would be large. In the long run, a Canadian immigrant to the U.S. would lose 33.5% of her initial real income upon returning to Canada, while a Spanish immigrant to the U.S. would suffer a 12.6% loss. A Salvadorean (Mexican) in the United States that returned to El Salvador (Mexico) would suffer a 93.0% (80.0%) loss in real income, and the real income of an Indian in Australia who returned to her home country would fall by 97.6%. Likewise a Turkish worker in Germany that returns to Turkey would see her real earnings fall by 86.8%. The average migrant would lose 61.3% of her real earnings in the long run. The short-run effects are uniformly

[22] Note that these welfare changes are somewhat different from the evaluations of the similar question in the empirical literature. Those studies compare the earnings of comparable individuals across locations for given factor prices. In our experiment, we compute the earnings before and after *all* the migrants in the world are returned to their home countries, allowing for general-equilibrium effects on all prices.

more muted but still very sizeable. For the average migrant the short-run loss in real earnings is 47.0%. This is sensible: one of the benefits of migration in the long run is in stimulating net entry and raising welfare through increased variety. That channel is largely turned off in the short run.

Thus the loss from return migration for the migrants themselves is very large. This is primarily due to the fact that most individuals migrated from low- to high-TFP countries. It is also interesting to aggregate native stayers and migrants and compute the change in welfare for the average individual in the world, pooling both groups. The resulting figures for the short run and the long run, respectively, are -2.2% and -2.5%.[23] These figures are very close to what we obtained earlier for native stayers, reflecting the fact that migrants represent a small share of the world population.

5.6 The Long-Run Scale Effect

The key mechanism through which natives in the destination countries gain from migration in the long run is increased variety. Because equilibrium variety responds endogenously to market size, and because larger markets exhibit greater equilibrium variety, individuals living in larger markets enjoy greater welfare, all else equal. This phenomenon is often referred to as the "scale effect." Scale effects are common and well-studied in both economic growth (e.g., Romer, 1990) and international trade (e.g., Krugman, 1980). Nonetheless, it is important to justify this type of mechanism in our quantitative exercise, and to benchmark it to existing empirical estimates of scale effects.

Jones (2002) and Jones and Romer (2010) posit the following relationship between real per capita income and population size:

$$\frac{Income_j}{P_j} = constant \times N_j^{\gamma}. \tag{16}$$

They argue that empirically the elasticity γ of real per capita income with respect to population size is between 0.25 and 1. That is, larger countries have greater PPP-adjusted per capita income, all else equal. We can estimate this same relationship inside our model, and compare the γ implied by our model to the Jones and Romer (2010) values. It is important to note that our calibration strategy does not target any moment directly related to the scale effect. The magnitude of the scale effect in the model is driven by parameters chosen for other reasons, most importantly ε_s, θ_s, β_s, as well as international trade costs τ_{ij}.

Fitting the simple bivariate relationship (16) inside our model yields γ is actually negative at -0.38: countries with the larger population have *lower* per capita income. However, this negative coefficient is driven by the negative correlation between N_j and A_{jj} in our estimates, and is thus uninformative about the magnitude of the scale effect operating in the model through endogenous variety. Since A_{jj} is kept constant as we evaluate the impact of migration, we can isolate the scale

[23] To be precise, we take the simple average of the percentage welfare change across all the individuals in the world, migrants and the non-migrants.

effect driving the welfare changes in our model by estimating instead the relationship between the return to an efficiency unit of labor and population: $w_j/P_j = constant \times N_j^{\gamma}$. If we use the actual population (number of persons N_j living in the country), the resulting $\gamma = 0.17$, which is below the range suggested by Jones and Romer (2010). If we instead use the labor force in efficiency units L_j as the right-hand side variable, the elasticity of real per capita income with respect of L_j is 0.38, still quite close to the bottom of the range of empirical estimates.

Our scale effect operates through greater equilibrium variety available in larger countries. Unfortunately, it is not possible to measure directly all the varieties available even in a single country, much less in a large set of countries. However, we can use existing estimates from the international trade literature to benchmark the model. Hummels and Klenow (2005) demonstrate that larger countries export a greater number of products. Although that paper does not use firm-level data, it employs highly disaggregated product categories. These authors estimate that the elasticity of the extensive margin of exports to total country GDP is 0.61. Estimating this relationship inside our model yields an elasticity of 0.8. Though slightly higher, it is comparable in magnitude. In addition, in the model we can only compute the elasticity of the number of exporting firms with respect to total GDP, whereas Hummels and Klenow (2005)'s relationship is with respect to the number of product varieties. If multiple firms exported the same product variety – a reasonable assumption – our model elasticity would be somewhat lower.

Finally, we review some sub-national evidence on availability of varieties. Handbury and Weinstein (2011) use grocery store scanner data to show that larger U.S. cities have greater variety, with an elasticity of variety with respect to city size of about $0.2-0.3$. Since U.S. cities are much more integrated than the countries in our sample, this elasticity does not have a direct counterpart in our model. The Handbury and Weinstein (2011) findings nonetheless imply that scale effects exist even across locations within the same country. To our knowledge, Mazzolari and Neumark (2012) is the only paper to report empirical estimates of the association between product variety and levels of immigration. Using data for California they find that immigration into a local economy leads to a wider range of varieties in the restaurant industry.

We conclude from this benchmarking exercise and review of the literature that (i) scale effects appear to be present in the data, and (ii) the scale effect exhibited by our model has a magnitude that is in line with existing empirical estimates.

6 Conclusion

The cross-border movements of people are large relative to the overall population of many countries. This paper is the first global-scale assessment of the welfare impact of migration in a large cross-section of both sending and receiving countries. Migration affects welfare through two main channels. First, a typical migrant moves from a low-labor-productivity country to a high-labor-productivity one. This has a direct impact on the migrants themselves, as well as on the remaining natives of emigration countries through remittances. An important feature of our calibration is that we match GDP and cross-border remittances for all countries.

The second channel is that an inflow of migrants increases the size of the labor force, thereby increasing the mass of varieties available for consumption and as intermediate inputs. All else equal, this raises the welfare of the natives of receiving countries, and lowers the welfare of the remaining natives in the sending countries. Quantitatively, our model evaluates the relevance of this effect by calibrating the efficiency-adjusted labor endowments in each country and using data on observed migration flows to compute the resulting changes in the labor force. In addition, since international trade has an impact on the set of varieties available in each economy, we model all the multilateral trade relationships between the countries, and match the observed overall and bilateral trade volumes. Throughout, the paper distinguishes between the short run, during which equilibrium variety adjusts by adding or removing only the lowest-productivity varieties, and the long run, in which equilibrium variety can change throughout the productivity distribution.

Our main finding is that the long-run impact of observed levels of migration is large and positive for the remaining natives of *both* the main sending countries and the main receiving ones. Relative to the counterfactual scenario in which no migration takes place, some countries in both groups are as much as 10% better off. Interestingly, while the overall numbers are similar, the salient reason for the welfare changes is different. For the countries with the highest immigration rates (Australia, New Zealand, Canada), migration raised welfare through increased equilibrium variety. For the countries with the highest emigration rates (El Salvador, Jamaica), the staying natives were better off because of remittances. These forces are also at work for all other countries, but the relative strength of each varies substantially among them. Our findings also suggest that failing to account for the role of remittances would produce a welfare evaluation that would be severely biased for a number of migration-sending countries.

Appendix A Complete Model and Calibration

A.1 Complete Model Equations

There is a cutoff unit input requirement a_{ij}^s, above which firms in country j do not serve market i. This cutoff a_{ij}^s is obtained from evaluating whether the profits from serving market i are positive or negative, and is given by the following condition:

$$a_{ij}^s = \frac{\varepsilon_s - 1}{\varepsilon_s} \frac{P_i^s}{\tau_{ij} c_j^s} \left(\frac{X_i^s}{\varepsilon_s c_j^s f_{ij}^s} \right)^{\frac{1}{\varepsilon_s - 1}}. \tag{A.1}$$

Standard steps of combining the definition of the price level (4), the cutoffs (A.1), and the Pareto distributional assumption lead to the following expressions for prices:

$$P_i^N = \frac{1}{b_N} \left[\frac{\theta_N}{\theta_N - (\varepsilon_N - 1)} \right]^{-\frac{1}{\theta_N}} \frac{\varepsilon_N}{\varepsilon_N - 1} \left(\frac{X_i^N}{\varepsilon_N} \right)^{-\frac{\theta_N - (\varepsilon_N - 1)}{\theta_N (\varepsilon_N - 1)}} \left(n_i^N \left(c_i^N \right)^{-\theta_N} \left(c_i^N f_{ii}^N \right)^{-\frac{\theta_N - (\varepsilon_N - 1)}{\varepsilon_N - 1}} \right)^{-\frac{1}{\theta_N}} \tag{A.2}$$

and

$$P_i^T = \frac{1}{b_T} \left[\frac{\theta_T}{\theta_T - (\varepsilon_T - 1)} \right]^{-\frac{1}{\theta_T}} \frac{\varepsilon_T}{\varepsilon_T - 1} \left(\frac{X_i^T}{\varepsilon_T} \right)^{-\frac{\theta_T - (\varepsilon_T - 1)}{\theta_T (\varepsilon_T - 1)}} \left(\sum_{j=1}^{\mathcal{C}} n_j^T \left(\tau_{ij} c_j^T \right)^{-\theta_T} \left(c_j^T f_{ij}^T \right)^{-\frac{\theta_T - (\varepsilon_T - 1)}{\varepsilon_T - 1}} \right)^{-\frac{1}{\theta_T}}. \tag{A.3}$$

Using the expression for total sales of a firm with unit input requirement $a(k)$ and adding up all the sales of all firms serving that market, the total sales from country i to country j can be written as:

$$X_{ji}^T = \frac{X_j^T}{\left(P_j^T \right)^{1-\varepsilon_T}} \left(\frac{\varepsilon_T}{\varepsilon_T - 1} \tau_{ji} c_i^T \right)^{1-\varepsilon_T} n_i^T \frac{b_T^{\theta_T} \theta_T}{\theta_T - (\varepsilon_T - 1)} \left(a_{ji}^T \right)^{\theta_T - (\varepsilon_T - 1)}.$$

Using expressions for a_{ji}^T in (A.1), and P_j^T in (A.3), the total exports from i to j become:

$$X_{ji}^T = \frac{n_i^T \left(\tau_{ji} c_i^T \right)^{-\theta_T} \left(c_i^T f_{ji}^T \right)^{-\frac{\theta_T - (\varepsilon_T - 1)}{\varepsilon_T - 1}}}{\sum_{l=1}^{\mathcal{C}} n_l^T \left(\tau_{jl} c_l^T \right)^{-\theta_T} \left(c_l^T f_{jl}^T \right)^{-\frac{\theta_T - (\varepsilon_T - 1)}{\varepsilon_T - 1}}} X_j^T.$$

Adding up these across all destinations j and using (6), we obtain the market clearing condition for country i's total T-sector output:

$$Y_i^T = X_i^T - R_i = \sum_{j=1}^{\mathcal{C}} \frac{n_i^T \left(\tau_{ji} c_i^T \right)^{-\theta_T} \left(c_i^T f_{ji}^T \right)^{-\frac{\theta_T - (\varepsilon_T - 1)}{\varepsilon_T - 1}}}{\sum_{l=1}^{\mathcal{C}} n_l^T \left(\tau_{jl} c_l^T \right)^{-\theta_T} \left(c_l^T f_{jl}^T \right)^{-\frac{\theta_T - (\varepsilon_T - 1)}{\varepsilon_T - 1}}} X_j^T. \tag{A.4}$$

The **short-run equilibrium** is obtained as a solution to $(\mathcal{C} - 1) + 2 \times \mathcal{C}$ equations in w_i, P_i^N, and P_i^T, that satisfies equations (A.2), (A.3), (A.4), (7), and (8) for each $i = 1, \ldots, \mathcal{C}$. Equations (7) and (8) imply that X_i^T is linear in $w_i L_i$ and R_i, which allows us to express (A.4) as a system of equations in relative wages given the vector of R_i and sectoral price levels. These equations do not admit an analytical solution for a realistic number of countries and reasonable parameter values, but are straightforward to solve numerically.

The **long-run equilibrium** is obtained as a solution to $(\mathcal{C}-1)+2\times\mathcal{C}+2\times\mathcal{C}$ equations in w_i, P_i^N, P_i^T, n_i^N and n_i^T that satisfies equations (A.2), (A.3), (A.4), (9), (10), and (11) for each $i=1,\ldots,\mathcal{C}$. As in the short-run case, (10) and (11) allow us to express X_i^T as a linear function of $w_i L_i$ and R_i, implying that (A.4) can be solved numerically for wages given R_i and price levels.

A.2 Parameter values

We implement the economy under the following parameter values (see Table 3 for a summary). The elasticity of substitution is $\varepsilon_s = 6$, for both $s = N, T$. Anderson and van Wincoop (2004) report available estimates of this elasticity to be in the range of 3 to 10, and we pick a value close to the middle of the range. The key parameter is θ_s, as it governs the firm size distribution. As described in much greater detail elsewhere (see, e.g., di Giovanni and Levchenko, 2010, 2011; di Giovanni et al., 2011), in this model firm sales follow a power law with the exponent equal to $\frac{\theta_s}{\varepsilon_s-1}$. In the data, firm sales follow a power law with the exponent close to 1. Axtell (2001) reports the value of 1.06, which we use to find θ_s given our preferred value of ε_s: $\theta_s = 1.06\times(\varepsilon_s-1) = 5.3$. We set both the elasticity of substitution and the Pareto exponent to be the same in the N and the T sectors. Di Giovanni et al. (2011) show that the reduced form exponent in the empirical distribution of firm size, which corresponds to $\theta_s/(\varepsilon_s-1)$ in sector s is similar between the traded and non-traded sectors. It still could be the case that while $\theta_T/(\varepsilon_T-1)\approx\theta_N/(\varepsilon_N-1)$, the actual values of θ_s and ε_s differ. Since we do not have reliable information about how these two individual parameters differ across sectors, we adopt the most agnostic and neutral assumption that both θ_s and ε_s are the same in the two sectors.

We set the value of α – the share of non-tradeables in consumption – to be 0.65. This is the mean value of services value added in total value added in the database compiled by the Groningen Growth and Development Center and extended to additional countries by Yi and Zhang (2010). It is the value also adopted by Alvarez and Lucas (2007). The values of β_N and β_T – share of labor/value added in total output – are calibrated using the 1997 U.S. Benchmark Input-Output Table. We take the Detailed Make and Use tables, featuring more than 400 distinct sectors, and aggregate them into a 2-sector Direct Requirements Table. This table gives the amount of N, T, and factor inputs required to produce a unit of final output. Thus, β_s is equal to the share of total output that is not used pay for intermediate inputs, i.e., the payments to factors of production. According to the U.S. Input-Output Matrix, $\beta_N = 0.65$ and $\beta_T = 0.35$. Thus, the traded sector is considerably more input-intensive than the non-traded sector. The shares of non-traded and traded inputs in both sectors are also calibrated based on the U.S. I-O Table. According to the data, $\eta_N = 0.77$, while $\eta_T = 0.35$. Thus, more than 75% of the inputs used in the N sector come from the N sector itself, while 65% of T-sector inputs come from the T sector. Nonetheless, these values still leave substantial room for cross-sectoral input-output linkages.

Next, we must calibrate the values of τ_{ij} for each pair of countries. To do that, we use the gravity estimates from the empirical model of Helpman et al. (2008). Combining geographical characteristics such as bilateral distance, common border, common language, whether the two countries are in a currency union and others, with the coefficient estimates reported by Helpman et al. (2008) yields, up to a multiplicative constant, the values of τ_{ij} for each country pair. We vary the multiplicative constant so as to match the mean and median imports/GDP ratios observed in the data in our sample of countries. The advantage of the Helpman et al. (2008) estimates is that they are obtained in an empirical model that accounts explicitly for both fixed and variable costs of exporting, and thus correspond most closely to the theoretical structure in our paper. Note that in this formulation, $\tau_{ij} = \tau_{ji}$ for all i and j.

Next, we must take a stand on the values of f_{ii}^s and f_{ij}^s. To do this, we follow di Giovanni and Levchenko (2010) and use the information on entry costs from the Doing Business Indicators database (The World Bank, 2007). This database collects information on the administrative costs of setting up a firm – the time it takes, the number of procedures, and the monetary cost – in a large sample of countries in the world. In this application, the particular variable we use is the amount of time required to set up a business. We favor this indicator compared to others that measure entry costs either in dollars or in units of per capita income, because in our model f_{ii}^s is a quantity of inputs rather than value. We must normalize the f_{ii}^s for one country. Thus, we proceed by setting $f_{US,US}^s$ to a level just high enough to ensure an interior solution for production cutoffs.[24] Then, for every other country f_{ii}^s is set relative to the U.S.. To be precise, if according to the Doing Business Indicators database, in country i it takes 10 times longer to register a business than in the U.S., then $f_{ii}^s = 10 \times f_{US,US}^s$. Since we do not have data on fixed costs of operating a business that vary by sector, we set f_{ii}^s to be equal in the N and T sectors.

To measure the fixed costs of international trade, we use the Trading Across Borders module of the Doing Business Indicators. This module provides the costs of exporting a 20-foot dry-cargo container out of each country, as well as the costs of importing the same kind of container into each country. Parallel to our approach to setting the domestic cost f_{ii}^s, the indicators we choose are the amount of *time* required to carry out these transactions. This ensures that f_{ii}^T and f_{ij}^T are measured in the same units. We take the bilateral fixed cost f_{ij}^T to be the sum of the cost of exporting from country j and the cost of importing into country i. The foreign trade costs f_{ij}^T are

[24]That is, we set $f_{US,US}^s$ to a level just high enough that $a_{ji}^s < 1/b_s$ for all $i, j = 1, ..., \mathcal{C}$ in all the baseline and counterfactual exercises, with $1/b_s$ being the upper limit of the distribution of a.

on average about 40% of the domestic entry costs f_{ii}^T. This is sensible, as it presumably is more difficult to set up production than to set up a capacity to export.[25]

Finally, we set the value of the "exploration cost" f_E such that the long-run equilibrium number of operating firms in the U.S. is equal to 7 million. According to the 2002 U.S. Economic Census, there were 6,773,632 establishments with a payroll in the United States. There are an additional 17,646,062 business entities that are not employers, but they account for less than 3.5% of total shipments. Thus, while the U.S. may have many more legal entities than what we assume here, 7 million is a sufficiently high target number. Since we do not have information on the total number of firms in other countries, we choose to set f_E to be the same in all countries. In the absence of data, this is the most agnostic approach we could take. In addition, since f_E represents the cost of finding out one's abilities, we do not expect it to be affected by policies and thus differ across countries. The resulting value of f_E is 15 times higher than $f_{US,US}^s$, and 2.4 times higher than the average f_{ii}^s in the rest of the sample. The finding that the ex-ante fixed cost of finding out one's type is much higher than the ex-post fixed cost of production is a common one in the quantitative models of this type (see, e.g., Ghironi and Melitz, 2005).

[25]The results are very similar if we instead set the bilateral fixed cost to be the sum of domestic costs of starting a business in the source and destination countries: $f_{ij}^T = f_{ii}^T + f_{jj}^T$. This approach may be preferred if fixed costs of exporting involved more than just shipping, and required, for instance, the exporting firm to create a subsidiary for the distribution in the destination country.

References

Alvarez, Fernando and Robert E., Jr. Lucas, "General Equilibrium Analysis of the Eaton-Kortum Model of International Trade," *Journal of Monetary Economics*, September 2007, *54* (6), 1726–1768.

Anderson, James and Eric van Wincoop, "Trade Costs," *Journal of Economic Literature*, 2004, *42* (3), 691–751.

Axtell, Robert L., "Zipf Distribution of U.S. Firm Sizes," *Science*, September 2001, *293* (5536), 1818–1820.

Beaudry, Paul, Mark Doms, and Ethan Lewis, "Should the Personal Computer Be Considered a Technological Revolution? Evidence from U.S. Metropolitan Areas," *Journal of Political Economy*, 2010, *118* (5), 988 – 1036.

Benhabib, Jess, "On the political economy of immigration," *European Economic Review*, December 1996, *40* (9), 1737–1743.

_ and Boyan Jovanovic, "Optimal Migration: A World Perspective," December 2010. Forthcoming, *International Economic Review*.

Bergin, Paul and Giancarlo Corsetti, "The Extensive Margin and Monetary Policy," *Journal of Monetary Economics*, 2008, *55* (7), 1222–1237.

Berry, R. Albert and Ronald Soligo, "Some Welfare Aspects of International Migration," *Journal of Political Economy*, September/October 1969, *77* (5), 778–94.

Borjas, George, "The economic effects of Mexican immigrants in the United States," *Journal of Development Economics*, 1996, *51* (1), 69–98.

_ , "The Economic Analysis of Immigration," in O. Ashenfelter and D. Card, eds., *Handbook of Labor Economics*, Amsterdam, NL: Elsevier Science Publishing, 1999.

_ , "The Labor Demand Curve is Downward Sloping: Reexamining the Impact of Immigration on the Labor Market," *Quarterly Journal of Economics*, November 2003, *118* (4), 1335–1375.

Borjas, George J, "Self-Selection and the Earnings of Immigrants," *American Economic Review*, September 1987, *77* (4), 531–53.

Borjas, George J., "The Economic Benefits from Immigration," *Journal of Economic Perspectives*, Spring 1995, *9* (2), 3–22.

Card, David, "Is the New Immigration Really so Bad?," *Economic Journal*, November 2005, *115* (507), F300–F323.

Chaney, Thomas, "Distorted Gravity: The Intensive and Extensive Margins of International Trade," *American Economic Review*, September 2008, *98* (4), 1707–1721.

Ciccone, Antonio and Elias Papaioannou, "Human capital, the structure of production, and growth," *Review of Economics and Statistics*, 2009, pp. 66–82.

_ and Robert E. Hall, "Productivity and the Density of Economic Activity," *American Economic Review*, March 1996, *86* (1), 54–70.

Clemens, M., C. Montenegro, and L. Pritchett, "The great discrimination: borders as a labor market barrier," 2008. Mimeo.

Cortés, Patricia and José Tessada, "Low-Skilled Immigration and the Labor Supply of Highly Skilled Women," *American Economic Journal: Applied Economics*, July 2011, *3* (3), 88–123.

Davis, Donald R. and David E. Weinstein, "Technological Superiority and the Losses From Migration," June 2002. NBER Working Paper No. 8971.

di Giovanni, Julian and Andrei A. Levchenko, "Firm Entry, Trade, and Welfare in Zipf's World," August 2010. NBER Working Paper No. 16313.

_ and _ , "Country Size, International Trade, and Aggregate Fluctuations in Granular Economies," August 2011. NBER Working Paper No. 17335.

_ , _ , and Romain Rancière, "Power Laws in Firm Size and Openness to Trade: Measurement and Implications," *Journal of International Economics*, September 2011, *85* (1), 42–52.

Docquier, Frédéric, Abdeslam Marfouk, Çağlar Özden, and Christopher Parsons, "Geographic, Gender and Skill Structure of International Migration," November 2010. mimeo, Université Catholique de Louvain, World Bank, and University of Nottingham.

_ and _ , "Measuring the international mobility of skilled workers (1990-2000): release 1.0," August 2004. World Bank Policy Research Working Paper 3381.

_ , B. Lindsay Lowell, and Abdeslam Marfouk, "A Gendered Assessment of Highly Skilled Emigration," *Population and Development Review*, 2009, *35* (2), 297–321.

Doms, Mark, Ethan Lewis, and Alicia Robb, "Local labor force education, new business characteristics, and firm performance," *Journal of Urban Economics*, January 2010, *67* (1), 61–77.

Dornbusch, Rudiger, Stanley Fischer, and Paul Samuelson, "Comparative Advantage, Trade, and Payments in a Ricardian Model with a Continuum of Goods," *American Economic Review*, 1977, *67*, 823–39.

Dustmann, Christian, "Return migration, wage differentials, and the optimal migration duration," *European Economic Review*, April 2003, *47* (2), 353–369.

_ , "Return Migration, Investment in Children, and Intergenerational Mobility: Comparing Sons of Foreign- and Native-Born Fathers," *Journal of Human Resources*, 2008, *43* (2), 299–324.

_ and Albrecht Glitz, "How Do Industries and Firms Respond to Changes in Local Labour Supply," September 2011. CReAM Discussion Paper No. 18/11.

_ , Itzhak Fadlon, and Yoram Weiss, "Return migration, human capital accumulation and the brain drain," *Journal of Development Economics*, May 2011, *95* (1), 58–67.

_ , Tommaso Frattini, and Ian Preston, "The Effect of Immigration along the Distribution of Wages," April 2008. CReAM Discussion Paper 0803.

Eaton, Jonathan, Samuel S. Kortum, and Francis Kramarz, "An Anatomy of International Trade: Evidence from French Firms," *Econometrica*, September 2011, *79* (5), 1453–1498.

Epifani, Paolo and Gino A. Gancia, "Trade, Migration and Regional Unemployment," *Regional Science and Urban Economics*, 2005, *35*, 625–644.

Facchini, Giovanni and Anna Maria Mayda, "Does the Welfare State Affect Individual Attitudes toward Immigrants? Evidence across Countries," *The Review of Economics and Statistics*, November 2009, *91* (2), 295–314.

_ and Max Friedrich Steinhardt, "What drives U.S. immigration policy? Evidence from congressional roll call votes," *Journal of Public Economics*, August 2011, *95* (7-8), 734–743.

_ , Anna Maria Mayda, and Prachi Mishra, "Do interest groups affect US immigration policy?," *Journal of International Economics*, September 2011, *85* (1), 114–128.

Farré, Lidia, Libertad González, and Francesc Ortega, "Immigration, Family Responsibilities and the Labor Supply of Skilled Native Women," *The B.E. Journal of Economic Analysis and Policy*, 2011, *11* (1), 34.

Ghironi, Fabio and Marc J. Melitz, "International Trade and Macroeconomic Dynamics with Heterogeneous Firms," *Quarterly Journal of Economics*, August 2005, *120* (3), 865–915.

González, Libertad and Francesc Ortega, "How Do Very Open Economies Absorb Large Immigration Flows? Evidence from Spanish Regions," *Labour Economics*, 2011, *18*, 57–70.

Grogger, Jeffrey and Gordon H. Hanson, "Income maximization and the selection and sorting of international migrants," *Journal of Development Economics*, May 2011, *95* (1), 42–57.

Hall, Robert and Charles Jones, "Why Do Some Countries Produce So Much More Output per Worker then Others," *Quarterly Journal of Economics*, 1999, *114*, 83–116.

Handbury, Jessie and David E. Weinstein, "Is New Economic Geography Right? Evidence from Price Data," May 2011. NBER Working Paper No. 17067.

Hanson, Gordon H., "The Economic Consequences of the International Migration of Labor," *Annual Review of Economics*, 2009, *1*, 179–207.

Helpman, Elhanan, Marc Melitz, and Yona Rubinstein, "Estimating Trade Flows: Trading Partners and Trading Volumes," *Quarterly Journal of Economics*, May 2008, *123* (2), 441–487.

Hendricks, Lutz, "How Important is Human Capital for Development? Evidence from Immigrant Earnings," *American Economic Review*, March 2002, *92* (1), 198–219.

Hummels, David and Peter Klenow, "The Variety and Quality of a Nation's Exports," *American Economic Review*, June 2005, *95* (3), 704–723.

International Monetary Fund, "Directions of Trade Statistics," 2007.

Iranzo, Susana and Giovanni Peri, "Migration and Trade: Theory with an Application to the Eastern-Western European Integration," *Journal of International Economics*, 2009, *79* (1), 1–19.

Jones, Charles I., "Sources of U.S. Economic Growth in a World of Ideas," *American Economic Review*, March 2002, *92* (1), 220–239.

_ and Paul M. Romer, "The New Kaldor Facts: Ideas, Institutions, Population, and Human Capital," *American Economic Journal: Macroeconomics*, January 2010, *2* (1), 224–245.

Klein, Paul and Gustavo Ventura, "TFP Differences and the Aggregate Effects of Labor Mobility in the Long Run," *B.E. Journals in Macroeconomics*, 2007, *7* (1).

_ and _ , "Productivity Differences and the Dynamic Effects of Labor Movements," *Journal of Monetary Economics*, 2009, *56*, 1059–1073.

Klenow, Peter J. and Andrés Rodríguez-Clare, "The Neoclassical Revival in Growth Economics: Has It Gone Too Far?," *NBER Macroeconomics Annual*, 1997, *12*, 73–103.

Krugman, Paul, "Scale Economies, Product Differentiation, and the Pattern of Trade," *American Economic Review*, 1980, *70* (5), 950–959.

Lewis, Ethan, "Local Open Economies Within The U.S.: How Do Industries Respond To Immigration?," 2003. Federal Reserve Bank of Philadelphia WP 04-1.

_ , "Immigration, Skill Mix, and Capital Skill Complementarity," *The Quarterly Journal of Economics*, 2011, *126* (2), 1029–1069.

Lucas, Robert Jr., "On the mechanics of economic development," *Journal of Monetary Economics*, July 1988, *22* (1), 3–42.

Manacorda, Marco, Alan Manning, and Jonathan Wadsworth, "The Impact Of Immigration On The Structure Of Wages: Theory And Evidence From Britain," *Journal of the European Economic Association*, February 2012, *10* (1), 120–151.

Mayda, Anna Maria, "Who Is Against Immigration? A Cross-Country Investigation of Individual Attitudes toward Immigrants," *The Review of Economics and Statistics*, 04 2006, *88* (3), 510–530.

Mazzolari, Francesca and David Neumark, "Immigration and Product Diversity," *Journal of Population Economics*, July 2012, *25* (3), 1107–1137.

Melitz, Marc J., "The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity," *Econometrica*, November 2003, *71* (6), 1695–1725.

_ and Giancarlo I. P. Ottaviano, "Market Size, Trade, and Productivity," *Review of Economic Studies*, January 2008, *75* (1), 295–316.

Ortega, Francesc, "Immigration quotas and skill upgrading," *Journal of Public Economics*, September 2005, *89* (9-10), 1841–1863.

_ , "Immigration, Citizenship, and the Size of Government," *The B.E. Journal of Economic Analysis & Policy*, 2010, *10* (1), 26.

_ and Javier Polavieja, "Labor-market Exposure as a Determinant of Attitudes toward Immigration," *Labour Economics*, 2012, *19*, 298–311.

Ottaviano, Gianmarco I. P. and Giovanni Peri, "Rethinking The Effect Of Immigration On Wages," *Journal of the European Economic Association*, February 2012, *10* (1), 152–197.

Pritchett, Lant, *Let their people come: breaking the gridlock on global labor mobility*, Washington, D.C.: Center for Global Development, 2006.

Ratha, Dilip and William Shaw, "South-South Migration and Remittances," April 2007. World Bank Working Paper No. 102.

Rauch, James E. and Vitor Trindade, "Ethnic Chinese Networks in International Trade," *Review of Economics and Statistics*, 2002, *84* (1), 116–130.

_ and _ , "Information, International Substitutability, and Globalization," *American Economic Review*, 2003, *93* (3), 775–791.

Romer, Paul M., "Endogenous Technological Change," *Journal of Political Economy*, October 1990, *98* (5), S71–S102.

Schultz, Paul T., "Immigrant Quality and Assimilation: A Review of the U.S. Literature," *Journal of Population Economics*, 1998, *11* (2), 239–252.

The World Bank, "Doing Business Indicators," 2007.

Trefler, Daniel, "International Factor Price Differences: Leontief was Right!," *Journal of Political Economy*, December 1993, *101*, 961–987.

_ , "The Case of the Missing Trade and Other Mysteries," *American Economic Review*, December 1995, *85*, 1029–1046.

Yang, Dean, "International Migration, Remittances and Household Investment: Evidence from Philippine Migrants' Exchange Rate Shocks," *Economic Journal*, April 2008, *118* (528), 591–630.

_ , "Migrant Remittances," *Journal of Economic Perspectives*, Summer 2011, *25* (3), 129–152.

Yi, Kei-Mu and Jing Zhang, "Structural Change in an Open Economy," April 2010. Mimeo, Federal Reserve Bank of Philadelphia and University of Michigan.

Table 1. Developed Countries: Migrant Stocks, Skill Composition, and Remittances

Country	Share Immigrants	Share Emigrants	Pop. Chg. in Counterfactuals	Remittances /GDP	Share skilled Stayers	Share skilled Immigrants	Share skilled Emigrants
Australia	0.242	0.015	-0.226	-0.009	0.29	0.45	0.55
Austria	0.108	0.046	-0.062	0.001	0.23	0.12	0.33
Belgium	0.108	0.030	-0.078	0.014	0.28	0.19	0.34
Canada	0.185	0.032	-0.154	-0.016	0.49	0.58	0.60
Czech Rep.	0.023	0.026	0.003	0.005	0.10	0.11	0.34
Denmark	0.058	0.038	-0.019	0.001	0.21	0.17	0.41
Finland	0.034	0.053	0.019	0.002	0.26	0.23	0.27
France	0.076	0.017	-0.060	-0.001	0.24	0.16	0.33
Germany	0.064	0.033	-0.031	-0.004	0.25	0.21	0.39
Greece	0.014	0.066	0.052	-0.002	0.15	0.15	0.20
Hungary	0.034	0.030	-0.005	-0.003	0.12	0.13	0.39
Ireland	0.129	0.156	0.026	-0.007	0.17	0.40	0.33
Italy	0.025	0.042	0.018	-0.002	0.18	0.15	0.16
Japan	0.015	0.005	-0.010	-0.001	0.23	0.28	0.61
Korea, Rep.	0.011	0.038	0.028	-0.001	0.25	0.37	0.50
Netherlands	0.101	0.047	-0.055	-0.002	0.21	0.22	0.43
New Zealand	0.251	0.128	-0.122	0.003	0.21	0.41	0.48
Norway	0.086	0.030	-0.056	-0.002	0.21	0.28	0.38
Poland	0.001	0.046	0.045	0.012	0.11	0.13	0.37
Portugal	0.023	0.134	0.111	0.010	0.12	0.18	0.10
Slovak Rep.	0.005	0.041	0.036	0.006	0.11	0.27	0.18
Spain	0.116	0.016	-0.100	-0.003	0.15	0.18	0.18
Sweden	0.106	0.022	-0.083	-0.005	0.17	0.25	0.46
Switzerland	0.137	0.035	-0.103	-0.007	0.20	0.21	0.40
United Kingdom	0.084	0.060	-0.024	-0.003	0.18	0.34	0.46
United States	0.119	0.003	-0.116	-0.008	0.52	0.42	0.58

Notes: This table presents the developed country sample, for which inward migration data are available for 2006. The first column presents the percentage of foreign born in total population. The second column presents the share of emigrants from each country to the receiving countries in the sample, as a share of the remaining population. The third column presents the percentage change in the population if all the emigrants never left, and all the immigrants never arrived. This is the percentage change in the population evaluated in the counterfactual. The remaining columns report remittances as a share of GDP (negative numbers signify net outflows of remittances), and the shares of skilled among the native stayers, immigrants, and emigrants. Data sources and variable definitions are described in detail in the text.

Table 2. Developed Countries: Migrant Stocks and Remittances

Country	Share Immigrants	Share Emigrants	Pop. Chg. in Counterfactuals	Remittances /GDP
Algeria	–	0.025	0.025	0.023
Argentina	–	0.012	0.012	-0.004
Belarus	–	0.005	0.005	0.001
Brazil	–	0.005	0.005	0.005
Bulgaria	–	0.037	0.037	0.082
Chile	–	0.016	0.016	-0.002
China	–	0.003	0.003	0.012
Colombia	–	0.023	0.023	0.034
Croatia	–	0.103	0.103	0.020
Dominican Rep.	–	0.097	0.097	0.143
Ecuador	–	0.068	0.068	0.050
Egypt, Arab Rep.	–	0.004	0.004	0.042
El Salvador	–	0.190	0.190	0.178
India	–	0.003	0.003	0.030
Indonesia	–	0.002	0.002	0.007
Iran, Islamic Rep.	–	0.011	0.011	0.006
Israel	–	0.021	0.021	-0.023
Jamaica	–	0.317	0.317	0.200
Malaysia	–	0.010	0.010	-0.006
Mexico	–	0.107	0.107	0.031
Nigeria	–	0.003	0.003	0.031
Pakistan	–	0.005	0.005	0.044
Philippines	–	0.030	0.030	0.155
Romania	–	0.070	0.070	0.058
Russian Fed.	–	0.008	0.008	0.001
Saudi Arabia	–	0.004	0.004	-0.049
Serbia and Mont.	–	0.106	0.106	0.191
South Africa	–	0.011	0.011	0.001
Thailand	–	0.006	0.006	0.002
Trinidad and Tob.	–	0.179	0.179	0.006
Turkey	–	0.038	0.038	-0.001
Ukraine	–	0.019	0.019	-0.010
U.A.E.	–	0.003	0.003	–
Venezuela	–	0.011	0.011	-0.004
Rest of World	–	0.011	0.011	0.021

Notes: This table presents the developing country sample, for which only outward migration data to the developed countries are available for 2006. The second column presents the share of emigrants from each country to the receiving countries in the sample relative the remaining population. The third column presents the percentage change in the population if all the emigrants never left. This is the percentage change in the population evaluated in the counterfactual. The last column reports remittances as a share of GDP (negative numbers signify net outflows of remittances). Data sources and variable definitions are described in detail in the text.

Table 3. Calibrated Parameter Values

Parameter	Baseline	Source
ε^s	6	Anderson and van Wincoop (2004)
θ^s	5.3	Axtell (2001): $\frac{\theta}{\varepsilon-1} = 1.06$
α	0.65	Yi and Zhang (2010)
$\{\beta_N, \beta_T\}$	$\{0.65, 0.35\}$	1997 U.S. Benchmark Input-Output Table
$\{\eta_N, \eta_T\}$	$\{0.77, 0.35\}$	
τ_{ij}	2.30	Helpman et al. (2008)
f_{ii}^s	14.24	The World Bank (2007); normalizing $f_{US,US}$
f_{ij}	7.20	so that nearly all firms the U.S. produce
f_E	34.0	To match 7,000,0000 firms in the U.S. (U.S. Economic Census)

The details of how these parameters are chosen are described in Appendix A.2.

Table 4. Bilateral Trade Shares: Data and Model Predictions

	Model	Data
Domestic sales as a share of domestic absorption (π_{ii})		
mean	0.7559	0.7286
median	0.7468	0.7697
corr(model,data)	0.5662	
Export sales as a share of domestic absorption (π_{ij})		
mean	0.0041	0.0042
median	0.0018	0.0042
corr(model,data)	0.7822	

Notes: This table reports the means and medians of domestic output (top panel), and bilateral trade (bottom panel), both as a share of domestic absorption, in the model and in the data. Source: International Monetary Fund (2007) and model output.

Table 5. Percentage Change in Native Welfare in the Counterfactual Relative to Benchmark

Country	Long Run	Short Run	Country	Long Run	Short Run
	Destination and Source Countries			*Source Only Countries*	
Australia	-11.72	-0.72	Algeria	-1.54	-2.14
Austria	-3.03	-0.39	Argentina	0.07	-0.19
Belgium	-4.59	-1.34	Belarus	-1.24	-1.03
Canada	-7.15	0.20	Brazil	-0.26	-0.42
Czech Republic	-0.94	-0.80	Bulgaria	-5.66	-6.59
Denmark	-1.26	-0.29	Chile	0.35	-0.10
Finland	-0.12	-0.55	China	-0.79	-0.90
France	-3.08	-0.36	Colombia	-2.00	-2.74
Germany	-1.53	-0.08	Croatia	-0.33	-3.28
Greece	1.18	-0.59	Dominican Republic	-9.08	-11.59
Hungary	-0.42	-0.10	Ecuador	-2.25	-4.42
Ireland	0.04	-0.47	Egypt, Arab Rep.	-3.47	-3.39
Italy	0.43	-0.15	El Salvador	-8.89	-14.19
Japan	-0.48	-0.01	India	-2.56	-2.56
Korea, Rep.	1.08	-0.04	Indonesia	-0.66	-0.64
Netherlands	-2.51	-0.07	Iran, Islamic Rep.	-0.14	-0.52
New Zealand	-6.85	-1.17	Israel	0.08	-0.06
Norway	-2.51	-0.04	Jamaica	-7.04	-15.87
Poland	0.20	-1.30	Malaysia	-0.53	-0.52
Portugal	1.44	-1.99	Mexico	1.29	-2.60
Slovak Republic	-0.05	-1.08	Nigeria	-2.74	-2.59
Spain	-4.91	-0.42	Pakistan	-3.50	-3.48
Sweden	-3.43	0.17	Philippines	-10.40	-11.47
Switzerland	-4.47	0.02	Romania	-2.71	-4.88
United Kingdom	-1.48	-0.24	Russian Federation	-0.16	-0.37
United States	-5.35	0.16	Saudi Arabia	-0.30	0.63
			Serbia and Montenegro	-11.55	-14.47
			South Africa	-0.04	-0.30
			Thailand	-0.55	-0.59
			Trinidad and Tobago	4.83	-1.37
			Turkey	1.07	-0.30
			Ukraine	-0.31	-0.56
			United Arab Emirates	-0.11	-0.10
			Venezuela, RB	0.10	-0.14
Mean	-2.37	-0.45	Mean	-2.09	-3.35
Std. Dev.	3.09	0.55	Std. Dev.	3.58	4.63

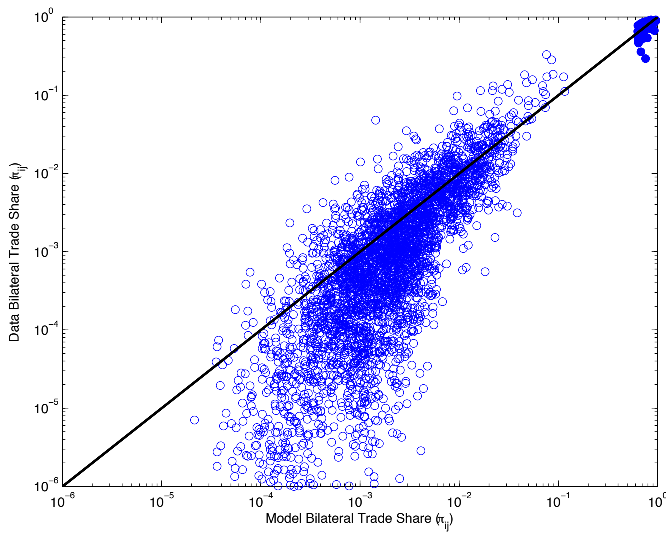
Notes: This table presents the percent change in welfare between baseline and counterfactual equilibria, assuming $\phi_i^\ell = \phi_i^h = 1$ for all countries. The measure of welfare employed here is the real income of the average native stayer. The first column reports the welfare change in the long run, the second column in the short run.

Table 6. Percent Change in Migrants' Welfare

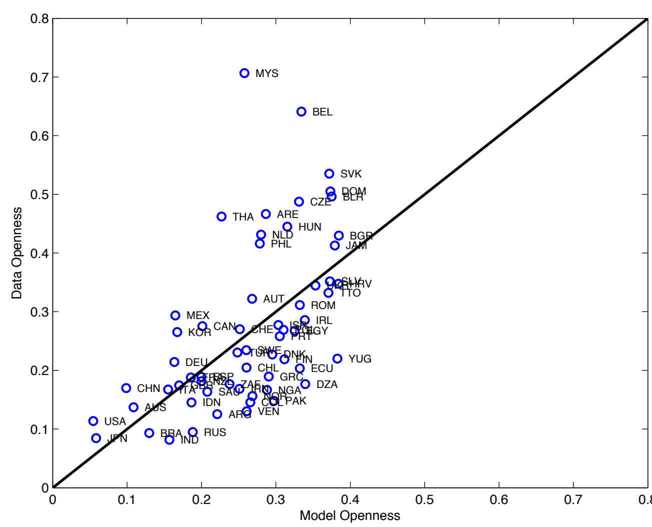
	Long Run	Short Run
Canada → United States	-33.52	-22.59
Spain → United States	-12.60	-7.48
Mexico → United States	-80.02	-56.32
El Salvador → United States	-92.97	-69.53
Poland → United Kingdom	-81.49	-63.84
Turkey → Germany	-86.79	-63.34
New Zealand → Australia	-26.94	-18.20
India → Australia	-97.59	-73.94
Migrant Mean	-61.34	-47.00
Change in Global Welfare	-2.47	-2.18

Notes: This table presents the percent welfare (real income) change for the migrants themselves between baseline and counterfactual equilibria. Notation X → Y denotes an individual born in country X that migrated to country Y.

Figure 1. Benchmark Model vs. Data



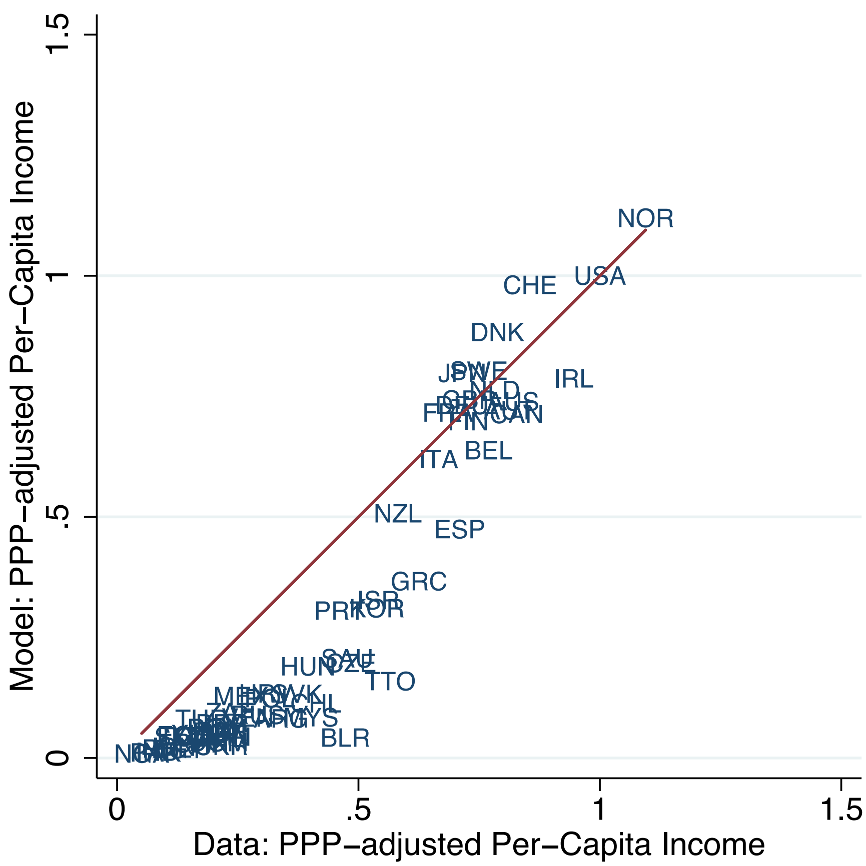
(a) Bilateral Trade Shares



(b) Overall Openness

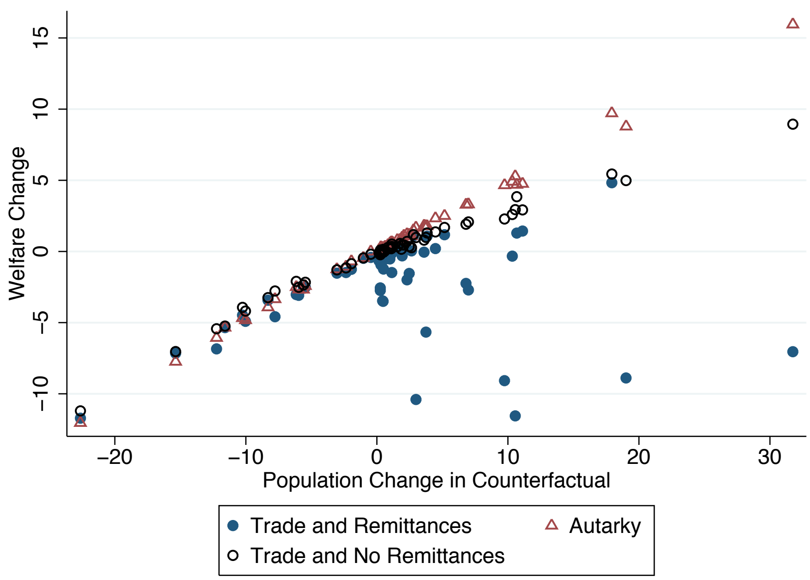
Notes: This figure presents the scatterplots of bilateral trade shares and overall imports/GDP, model (x-axis) against the data (y-axis). The straight line in each plot is the 45-degree line.

Figure 2. Real Incomes: Model vs. Data



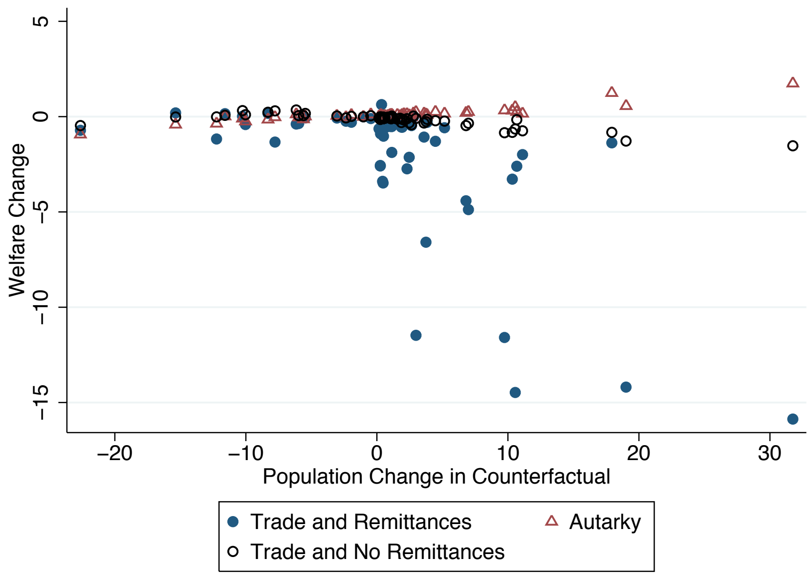
Notes: This figure reports the scatterplot of the real PPP-adjusted per capita income from the Penn World Tables (x-axis) against the real PPP-adjusted per capita income implied by the model. Both are expressed relative to the U.S..

Figure 3. Change in Native Welfare in the Long Run: Autarky, Trade, and Remittances



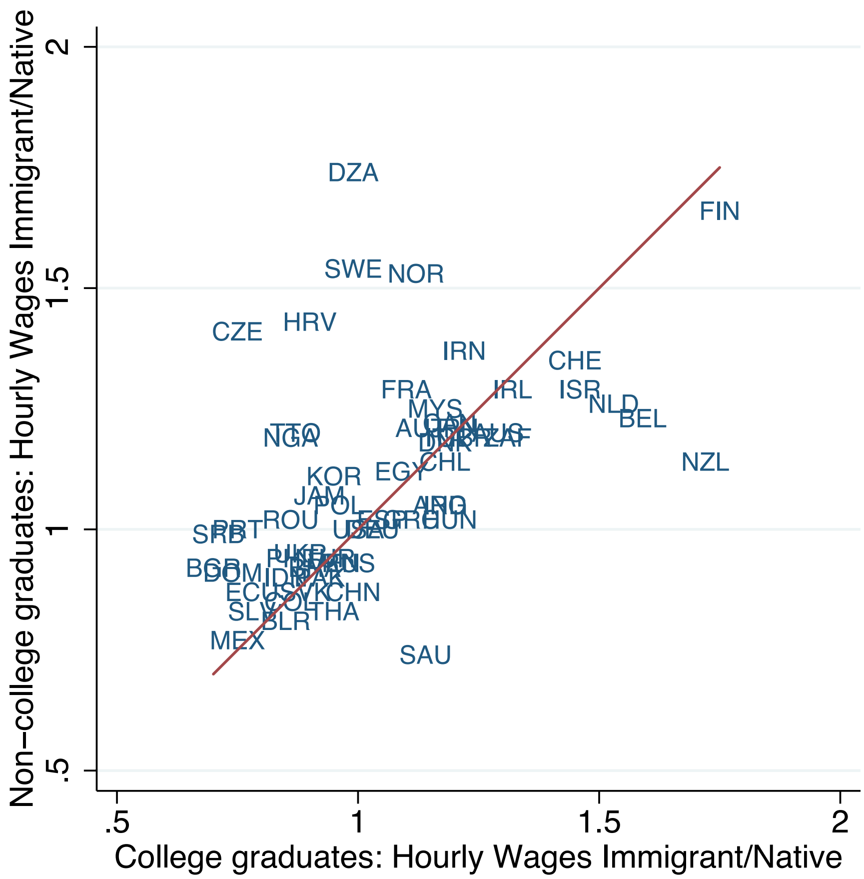
Notes: This figure reports the percentage change in welfare in the long-run counterfactual relative to the baseline (assuming $\phi_i^\ell = \phi_i^h = 1$ for all countries i) in three different scenarios. Solid dots depict the welfare change with both trade and remittances. Hollow dots, depict the welfare change with international trade but keeping remittances constant at zero in the baseline and counterfactual equilibria. Hollow triangles depict the welfare changes under prohibitive trade costs and no remittances. The measure of welfare is the real income of the average native stayer. On the y-axis is the percent change in the population in the counterfactual relative to the baseline.

Figure 4. Change in Native Welfare in the Short Run: Autarky, Trade, and Remittances



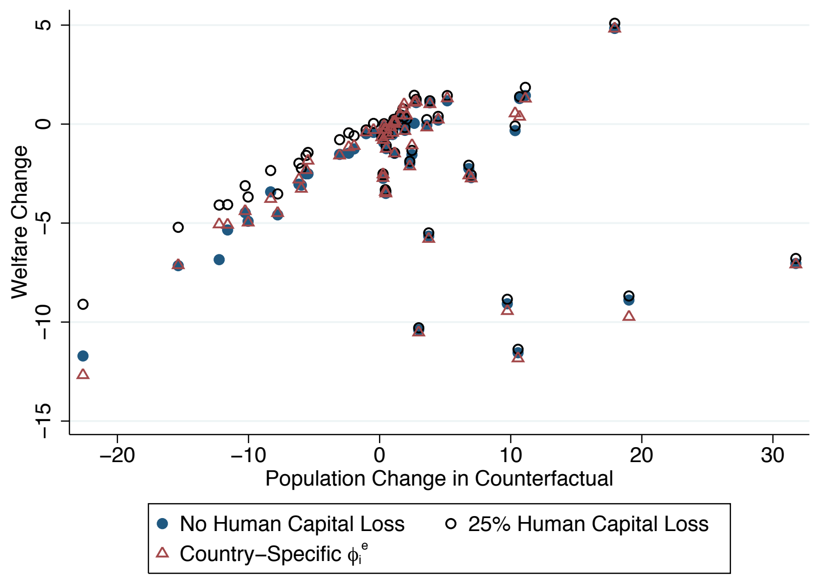
Notes: This figure reports the percentage change in welfare in the short-run counterfactual relative to the baseline (assuming $\phi_i^{\ell} = \phi_i^h = 1$ for all countries i) in three different scenarios. Solid dots depict the welfare change with both trade and remittances. Hollow dots, depict the welfare change with international trade but keeping remittances constant at zero in the baseline and counterfactual equilibria. Hollow triangles depict the welfare changes under prohibitive trade costs and no remittances. The measure of welfare is the real income of the average native stayer. On the y-axis is the percent change in the population in the counterfactual relative to the baseline.

Figure 5. Migrant-native relative productivity by origin country



Notes: Each point in the scatterplot reports the ratio of the hourly wage of an individual born in a particular origin country relative to a U.S.-born individual with the same skill level. The calculations are based on the 2000 U.S. Census. The line through the data is the 45 degree line.

Figure 6. Change in Native Welfare in the Long Run: Imperfect Skill Transferability and Migrant Selection



Notes: This figure reports the percentage change in welfare in the long-run counterfactual relative to the baseline equilibrium under three approaches: benchmark ($\phi_i^\ell = \phi_i^h = 1$, solid dots), imperfect skill transferability ($\phi_i^\ell = \phi_i^h = 0.75$, hollow dots), and origin-specific selection (ϕ_i^ℓ and ϕ_i^h, hollow triangles) calibrated as described in Section 5.4. The measure of welfare is the real income of the average native stayer. On the y-axis is the percent change in the population in the counterfactual relative to the baseline.