The Effect of Openness to Immigration on Income per Person across Countries

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Abstract

Openness to knowledge, skills and ideas from the rest of the world may be one of the most important engines of economic growth, and technological advancement for a country. We show that openness to immigration, as predicted only by the "relative geography" of a country, i.e. by its location/geography vis-a-vis other countries, is a strong predictor of its income per person. The instrument based on relative geography works much better for immigration than for trade. Moreover openness to immigration seems more relevant to GDP per person in the long-run than openness to trade. This effect survives the inclusion of controls that account for absolute geography, climate, disease, colonial history, institutional quality, cultural and historical differences across countries. The positive effect of immigration works through human capital and productivity. We also find that emigration has no effect on income per worker and that the positive effect of immigration strongly depends on the "diversity" of immigrants. Finally, openness to immigration does not seem to produce any adverse effect on income inequality within countries.

Key Words: International Migration, Trade, Income per person, Relative Geography, Absolute Geography,Institutions, Diversity.

JEL Codes: F22, E25, J61.

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1 Introduction

Openness to interactions and exchange with the rest of the world may be one of the most powerful channel of economic development, technological change and social evolution for a country. This has been recognized and studied in depth by economists and historians. As interactions and exchanges with other people and other groups are at the very foundation of economic gains (from variety, specialization and spillovers) openness to the rest of the world should be relevant for growth, especially for relatively small countries (Alesina, Spolaore and Wacziarg 2000, 2005, Frankel and Romer 1999). In the empirical tests of this proposition the existing literature has focussed on measures of trade openness. Measures of policy openness to international trade (Sachs and Warner 1995, Lucas 2010), or measures of trade itself, as share of GDP (Frankel and Romer 1999, Rodrik, 2000, Rodriguez and Rodrik (2001), Noguer and Siscart (2005), Alcala and Ciccone (2004)) have been analyzed as determinants of long-run economic performance of countries. In particular, economists have analyzed the impact of these measures on the level and the growth of income per person, across countries, controlling for their size. The difficulty of measuring the effect of openness on income per person or other economic outcomes, stems from the very severe endogeneity and omitted variable problem faced by the researcher. Both trade policies and trade volumes in a country are affected by its level of development and by several of its determinants. Moreover actual trade is only an imperfect measure of openness to economic interactions with other countries. These issues, if one fails to properly account for them, would generate bias in the estimated effect of openness on income per person. In an influential paper Frankel and Romer (1999) suggested to use the part of trade driven by geographical location, relative to other countries, as proxied by a gravity-regression, in order to isolate cross-country variation in trade that does not depend on income and institutional and policy variation across countries. However, while it is reasonable to think that the main role of "*relative*" location of a country vis-a-vis is that of affecting their economic interactions, the relative location of a country may be correlated with its "*absolute*" location in the world. This in turn affects its climate, fertility of the land, disease environment and indirectly other determinants of long-run economic fortunes such as the probability of colonization and settlement by Europeans. Rodriguez and Rodrik (2001) were the first to emphasize the need to control for other geographic determinants of development when using that instrumental variable strategy. They found that the effects of trade did not survive inclusion of these controls. Noguer and Siscart (2005) and Alcala and Ciccone (2004) have also emphasized the importance of using better data, measuring trade openness correctly and the importance of controlling for institutional quality, a fundamental determinant of income per person across countries (as emphasized by Hall and Jones, 1999, and Acemoglu, Johnson and Robinson, 2001). They still found significant effect of trade openness on income per person.

In this paper we want to reconsider the idea of economic openness to other countries and its measure in relation to economic development of countries as measured by their GDP (gross domestic product) per person.

During the last century (especially before World War I and again since the 1980's) and certainly during the recent decades, a crucial aspect of openness has been the mobility of people across countries. The limited international migrations during the period 1930-1980 have driven economists who studied economic growth during the 1990's and the 2000's to omit this channel in their empirical analysis. However, for a large part of human history, and especially for a set of countries (in Europe, in the Americas, in part of Asia and in Oceania), local and long-distance migrations have been a fundamental way in which ideas, people and skills have arrived from the rest of the world producing long-lasting effects. Access to different skills and ideas, facilitated by migration, is an aspect of openness complementary to trade. It seems natural that we try to see if it had a measurable effect, beyond that of trade, in promoting economic development by increasing GDP per person. In analyzing the effect of migration on income per person we incur in formidable issues of endogeneity and omitted variable also faced in the analysis of trade and income: migrants are attracted by more developed countries; good institutions and good policies may encourage immigration as well as economic growth. Still, as for trade, a part of migration is related to its costs. Therefore the location and geographic characteristic of a country relative to the others, affect the flows. Migrants tend to move to closer countries, to countries that are easier to reach via sea or river from the country of origin and where the language spoken is the same as (or similar to) their home country. Moreover, these geographic-linguistic factors can compound each-other so that two close countries, speaking the same language, with easy access to each other present potential bilateral migrants with lower costs than two far away countries, isolated from each other and speaking very different languages. Hence, the location of a country relative to others affects its flow of immigrants. This facts has two consequences. First, following Frankel and Romer (1999) we can use a similar pseudo gravity-predicted migration, based on relative size and relative geography only, to proxy for the part of migration not correlated with income, policies and institutions and adopt a similar IV strategy. As we include several geographical determinants of trade and migration, with differential effects on those flows, we may have enough identifying variation to instrument both variables. Second, as the geographic determinants of immigration and trade are correlated the estimated effect of trade using gravity IV, even controlling for other geographical variables can be biased up, if we omit openness to immigration.

The novel contributions of this paper are three. First, using new data on bilateral stocks of migrants in 2000, we include the share of immigrant population as additional measure, besides trade, of openness of a country to other countries ideas, skills and abilities. Instrumenting both migration and trade flows with their bilateral geographical and language determinants we analyze their effect on income per person. Second, we consider a large set of robustness checks, to see whether the effects of migration and trade are robust to "absolute" geography controls (such as climate, quality of the land, disease environment) and institutional controls. We also distinguish the effect of migration from the effect of European Colonization, and other cultural and institutional variables. Third, we consider the effect of trade and migration on other country-level outcomes such as productivity, human capital accumulation and inequality. We also provide an exploration on the role of "diversity" of immigrants on productivity and income per person.

The goal of the literature is to estimate the effect of an exogenous change in openness on income per worker. Hence, the omission of immigration can have very important consequences. On one hand openness to immigration may be equally or more important than openness to trade for income per person, in the long run. On the other hand we would overestimate the effect of trade by omitting immigration which is certainly correlated with the Frankel and Romer (1999) trade instrument. Figure 1 shows the partial correlation between trade as a share of GDP and the share of foreign-born for 146 countries included in the Frankel and Romer (1999) sample, after we control for size of the country (as measured by the logarithm of population and the logarithm of the area). We notice a positive and significant correlation between trade and immigration. However, we also notice significant differences. Some countries (such as Singapore, Luxembourg and Malaysia) are more open, in relative terms, to trade than to immigrants. Others (such as Switzerland, Israel and Kuwait) are more open to immigrants than to trade. The inclusion of the share of immigrants allows us to separate how openness to people and openness to goods contribute to income per person in the long run and whether one is more relevant than the other.

Our results show that when we include both openness to trade and to immigrants instrumented by their geography-based gravity predictors in a cross-country regression of 147 countries, openness to immigrants has a significantly positive and large effect on income per person. An increase in the share of foreign born by 10% of the population, which is close to the standard deviation of our openness to immigrants across countries, is associated with an increase in income per person by a factor between 2.3 and 2.7 (hence by 130-170%) in the long-run. We then consider if the effect of immigration and trade is robust to a series of geographical, climate, institutional and historical controls. In particular we check that the effect of immigration is not simply driven by institutional quality differences instrumented using distance to the equator (Hall and Jones 1999) and the share of people with European origin (Alcala and Ciccone 2004, Acemoglu, Johnson and Robinson 2001). We find that the effect of immigration on the level of GDP per person of a country is very robust and stable. To the contrary the inclusion of basic geographic controls reduces the effect of openness to trade from large and significant to insignificantly different from 0.

We then differentiate our results from the findings of Putterman and Weil (2010) who find that countries whose ancestors came from highly developed countries, as of 1500, are also more developed today. We control for their measure of historical development of ancestors, and we also use their matrix of place of birth (pre-1500) of ancestors to control for the share of foreign ancestors. Even controlling for the place of origin of ancestors and their levels of civilization or controlling for the share of foreign ancestors, the share of foreign-born has a strong and positive effect on income per person.

We also perform several other checks by including the quality of institution and culture as controls. We decompose the effect of immigration and trade on productivity, human and physical capital levels. We study the effect of immigration on income inequality of countries and we measure whether the diversity of immigrants (by countries of origin) enhances their positive income effect. Our findings, overall, strongly suggest that mobility of people plays an important role in determining the economic success of countries the long-run. Even for given institutions, policies and geographic characteristics a larger inflow of immigrants drives significantly larger income per person. Once we account for immigration, the role played by trade openness is not significant.

The rest of the paper is organized as follows: In section 2 we review the related literature, in Section 3 we present a simple theoretical framework that justifies the main empirical specification. Section 4 presents the data and introduces the empirical model. In section 5 we reproduce the analysis of the effect of trade openness on income per person, while in section 6 we introduce our main specifications that includes the effect of openness to immigration. Sections 7, 8 and 9 explore whether the effects of immigration survives the inclusion of controls for institutions, culture, historical events and other checks. Section 10 shows the effect of immigration on each component of income per person, while section 11 explores the effect of diversity of immigrants and section12 tests whether immigration has an effect on income inequality. Section 13 concludes the paper.

2 Literature Review

There is a vast theoretical literature linking several aspects of openness to income per capita levels and growth[1]. A series of models (such as Grossman and Helpman 1991, Rivera-Batiz and Romer (1994), Eaton and Kortum 1996, Lucas 2010) emphasize the role of openness to trade in promoting innovation, technological diffusion and catch-up. Depending on the details of the model such process may affect the income of countries relative to the technological frontier or, in the case of endogenous growth, their growth rates. The effect of market size on innovation and growth, spurred by trade, has also been analyzed as driver of economic growth. The size of the market can affect the speed and type of technological adoption (Acemoglu 2003), it may encourage specialization and learning by doing (e.g. Matsuyama 1992, Galor and Mountford 2008). Other studies emphasize the role of openness in increasing the efficiency of production of domestic firms that are subject to international competition (e.g. Weil, 2005 page 321-322 and citations thereof).

More closely related to this paper are those studies that analyze empirically the relation between trade and income per capita, controlling for other determinants of growth and instrumenting openness with policies or

[1] There are some textbook treatments of theories of openness and growth. Chapter 18 and 19 of the texbook by Acemoglu (2009) present and overview of the effect of knowledge diffusion and trade on income per person. Chapter 8 of the textbook by Barro and Sala i Martin (2004) is devoted to the analysis of the diffusion of technology in models with endogenous growth. Chapter 11 of the textbook by David Weil (2005) analizes the relationship between growth and openness.

geographical determinants. A very influential early paper is Sachs and Warner (1995), which analyzes the effect of trade policies (classified for a group of countries over the period 1965-1990) on economic growth. Frankel and Romer (1999) (FR from now on) introduce the identification strategy based on the fact that geographic determinants of trade are orthogonal to policies and other income determinants and hence can be used as instrument for trade. They use this approach to estimate the impact of trade on income per person. After them Rodrik (2000) and Rodriguez and Rodrik (2001) questioned the validity of the results arguing that the initial findings disappeared when one controls for some simple geographical features such as the distance from the equator or the share of population in tropical area. Noguer and Siscart (2005) and Alcala and Ciccone (2004) emphasize how openness to trade still matter, even after controlling for Institutional quality, if one correctly measures openness as real openness and uses a larger database on trade flows. Also closely related to this literature are a series of paper by Alesina and Spolaore (1997), (2003), and Alesina, Spolaore and Wacziarg (2000), (2005). They focus on the effect of trade openness on growth, controlling for the size of countries. They develop further the analysis considering the size of a country as endogenous and determined by a trade off between economic benefits and political cost of size.

In comparison to the very large literature on trade and income per capita there is almost no study on the long-run effect of migration on income per person. While there are several papers on the analysis of cross-country determinants of migrations using a gravity equation (e.g. Clark et al. 2008, Pedersen et al 2004, and Mayda 2010) very few studies have looked at the opposite direction of causality from migration to income growth in the long run. Peri (2012) looks at the long-run effect of immigration on productivity and income per person across US states. Closely related to our paper is also Putterman and Weil (2008). In that paper the level of development of a country is related to the history of the ancestors of the country's inhabitants, constructed using a matrix of international migration flows since 1500. While immigration is considered as a key element for economic development in that paper, it is analyzed only in that it affects the past origins of current inhabitants. There is no effect of immigration "per se" on growth, however immigration of people from advanced countries would increase the economic success of receiving countries, in the long run, by bringing their human capital, culture and possibly institutions. In section 7 we will consider the Putterman and Weil (2010) story in greater detail, and we will borrow their long-run migration matrix. We will exploit more directly the contribution of immigration, from any other country, on current development and we will develop a more general story of benefit from varieties of skills/human capital.

Finally there have been several historical studies focussing on the increased openness (migration and trade) during the 1800, and its effects on growth. Among others, O'Rourke and Williamson (1994), O'Rourke, Taylor and Williamson (1997) and Williamson (1996) show the important role of mass migration and globalization on income per capita convergence in the late nineteenth century.

3 The Theoretical Framework

In this section we describe a simple model that justifies the basic regression specification used in section 6 that we will use to analyze the effect of openness to trade and openness to migration on income per person. The model is based on Alesina, Spolaore and Wacziarg (2000). As we consider the determinants of income per capita levels we use a simple static endowment economy. This can be interpreted as the steady state of a growth model, hence our predictions are about the long-run effects of openness on income. The goal of the model is simply to show how income per person, trade (as share of GDP) and immigration (as share residents), depend on the size and on the openness of a country.

Consider N identical regions in the world, indexed by $i = 1, 2...N$. They are grouped into to C countries. Each country contains S_c regions, $c = 1, 2...C$ so that S_c can be considered the size of the country (both as area and population). Each region is endowed with a given amount of labor (unskilled workers) L_i a given amount of physical capital K_i and a given amount of human capital (skilled labor) H_i. Labor is homogeneous across regions, while physical and human capital are differentiated and each region is endowed with its specific variety. Output$Y$, homogeneous across regions, is produced using the following production function:

$$Y_i = \left(\sum_{i=1}^{N} H_{ij}^{\alpha}\right)\left(\sum_{i=1}^{N} X_{ij}^{\beta}\right)(A_i L_i)^{1-\alpha-\beta} \tag{1}$$

Expression (1) implies that producers in region i combine different varieties of skilled labor. H_{ij} represents the human capital input of type j used in region i. They also combine different varieties of the intermediate goods. X_{ij} is the amount of intermediate good produced using physical capital specific to region j according to a linear function $X_{ij} = K_{ij}$ and used in region i. For simplicity we impose a strongly symmetric structure across regions. We assume that all regions have the same productivity level $A_i = 1$,the same capital endowment k and that the number of their unskilled and skilled workers is the same across regions and equal to 1 and h respectively. We also assume that all countries have the same size so that $N = S * C$.

Assuming output as the numeraire, each region will demand skilled workers, unskilled workers and intermediate goods to produce the final good. We assume that there is a cost in using an intermediate good produced in a region of a different country and in hiring a skilled workers from a different country. In particular, it is convenient to use an iceberg-type cost. When demanding a skilled workers from a different country only a fraction $(1-\gamma)$ of her human capital can be used in production because of downgrading of their skills, or due to time spent away from production to fulfill the immigration requirements. Similarly when using an intermediate input from another country only a fraction $(1-\delta)$ can be employed in production after paying the trade costs. The parameters γ and δ (between 0 and 1) can therefore be considered as measures of migration and trade costs. When using intermediate goods and human capital from different regions within the same country, there are no migration and trade costs.

Intermediate goods and skilled workers have an international market, hence their price/wage must be equal across regions. Unskilled workers are homogeneous across regions, hence in this perfectly symmetric world, if there is any migration cost, they would not migrate. Considering the production function (1) in region i of country c we can derive the demand for skilled workers from other regions of the same country (D_{ii} as in "Domestic" workers) and for skilled workers from regions of other countries (F_{ij} as in "Foreign-born" workers). Using the symmetry across regions and types we have that the wage paid to any skilled worker has to be the same so that $w = w_j = w_i$ and we have:

$$w = \alpha \left(\sum_{i=1}^{N} X_{ij}^{\beta} \right) (D_{ii})^{1-\alpha} = \alpha \left(\sum_{i=1}^{N} X_{ij}^{\beta} \right) (1-\gamma)^{\alpha} (F_{ij})^{1-\alpha} \tag{2}$$

Similarly for the demand of intermediate goods, given their international price p (equal across varieties because of symmetry) we can derive the demand for the varieties produced domestically X_{ii} and for those produced abroad X_{ij} as follows:

$$p = \beta \left(\sum_{i=1}^{N} H_{ij}^{\alpha} \right) (X_{ii})^{1-\beta} = \beta \left(\sum_{i=1}^{N} H_{ij}^{\alpha} \right) (1-\delta)^{\beta} (X_{ij})^{1-\beta} \tag{3}$$

Therefore there is the following relation between the number of skilled workers from each region working in another region of the home country and those working in a region abroad: $F_{ij} = \theta D_{ii}$ where $\theta = (1-\gamma)^{\frac{\alpha}{1-\alpha}}$ is between 0 and 1 and measures how "free" migration is. A similar relation exists between the amount of intermediate good produced for use in a domestic region and the amount produced for use in a foreign region: $X_{ij} = \phi X_{ii}$ where $\phi = (1-\delta)^{\frac{\beta}{1-\beta}}$ is between 0 and 1 and measures how "free" trade is.The market clearing conditions for each type of human capital and for each type of physical capital are as follows:

$$SD_{ii} + (C-1)S\theta D_{ii} = h \tag{4}$$

$$SX_{ii} + (C-1)S\phi X_{ii} = k \tag{5}$$

Equation (4) and (5) and the conditions $F_{ij} = \theta D_{ii}$ and $X_{ij} = \phi X_{ii}$ can be used to obtain:

$$F_{ij} = \theta D_{ii} = \theta \frac{h}{S(1-\theta) + \theta N} \tag{6}$$

$$X_{ij} = \phi X_{ii} = \phi \frac{k}{S(1-\phi) + \phi N} \tag{7}$$

3.1 Results

We can now derive the number of foreign-born as share of the population ($FBsh_i$) and the value of trade as share of GDP ($TRsh_i$) in each region i [2]. Those two are the most commonly used measures of immigration and trade intensity. Immigrants are the sum of highly skilled from all regions in the rest of the world $(N-S)$,while natives are the sum of all highly skilled from regions in country S plus the local unskilled:

$$FBsh_i = \frac{F_{ij}(N-S)}{F_{ij}(N-S)+D_{ii}S+1} = \left(\frac{h}{1+h}\right)\frac{\theta(N-S)}{\theta(N-S)+S} \tag{8}$$

It is easy to show that, for given country size S the share of foreign-born depends positively on the openness to immigration, $[\partial(FBsh_i)/\partial\ln\theta]\,\theta = a_1 > 0$. Conversely for given openness θ the share of immigrants depends negatively on the size of the country $\partial(FBsh_i)/\partial S = -a_2 < 0$. Expression 8 shows also other determinants of the share of foreign born, such as ratio of skilled to unskilled workers (h) and the size of the world economy (N).

Similarly trade (equal to import+export)[3] as a share of GDP in region i is given by:

$$TRsh_i = 2\beta\frac{X_{ij}(N-S)}{X_{ij}(N-S)+X_{ii}S} = 2\beta\frac{\phi(N-S)}{\phi(N-S)+S} \tag{9}$$

For given country size an increase in openness ϕ would increase trade as share of GDP $[\partial(TRsh_i)/\partial\ln\phi]\,\phi = b_1 > 0$ while an increase in size of the country, for given openness (as long as $\phi < 1$) will decrease trade $\partial(TRsh_i)/\partial S = -b_2 < 0$. Expression (9) shows that the share of trade depends also on the elasticity of final output to intermediates β sand on the overall size of the world economy N.

Finally, substituting 6 and 7 into 1 and dividing by population $(1+h)$ we get that output per person in region i, y_i, and hence in country S_c is as follows:

$$y_i = \left(\frac{A_i^{1-\alpha-\beta}h_i^{\alpha}k_i^{\beta}}{1+h}\right)[S(1-\theta)+N\theta]^{1-\alpha}[S(1-\phi)+N\phi]^{1-\beta} \tag{10}$$

It is easy to see that openness to migration θ and openness to trade ϕ both affect positively income per person (i.e. $\partial y_i/\partial\theta > 0$, $\partial y_i/\partial\phi > 0$) through an increase in the second and third terms in brackets which affect the productivity of factors. Similarly, for given openness, an increase in the size of the country, S, increases productivity (i.e. $\partial y_i/\partial S > 0$, $\partial y_i/\partial S > 0$) . Hence, expression (10) that shows income per capita in region i of country c can be re-written as:

[2] Those shares in the home country will be the same as in region i.

[3] Imports are equal to export in this model. Recall that the share β of income goes to pay for intermediate goods, whose price is the same. Hence the value of imports plus exports relative to the total value of intermediate goods used is equal to the ratio of their quantities.

$$y_c = TFP\left(\widetilde{A}_c, \phi, \theta, S_c\right)\widetilde{h}_c^{\alpha}\widetilde{k}_c^{\beta} \tag{11}$$

In (11) we substituted the country subscript and we use the notation $\widetilde{h}$ and $\widetilde{k}$ to denote human capital and physical capita per person. $\widetilde{A}_c$ is the part of total factor productivity that depends on country-specific factors such as institutions, norms and policies. Through the trade and migration interactions across regions openness to trade ϕ,and to migrations θ enhance the productivity of a country, once we control for its size[4]. The main implication of the model are two:

1) Controlling for country size trade as share of income and foreign-born as share of the population are directly related to openness to trade and openness to immigration, respectively.

2) Controlling for country size, income per person and productivity in a country are positively related to openness to trade and to immigration.

The channels of the beneficial effects of trade and migration are the positive effects of different varieties of human capital and different varieties of the intermediate goods on the regions' and country's productivity

4 Data and Summary Statistics

Our bilateral trade data is from the NBER-UN dataset.[5] This database uses National Accounts in order to obtain bilateral trade data and checks the importing as well as the exporting country statistics in order to obtain the most accurate values. We also checked this database with the International Trade database (BACI) available at CEPII[6] and the data for year 2000 are essentially identical, where they both exist[7]. The UN-NBER database has a slightly larger coverage filling some missing values especially for small and very small bilateral trade values. This dataset has information on imports for over thirty thousand bilateral pairs for year 2000. We then replace missing values by zeros. We note that this will have no effect on our linear-in-logs predictors since the zero values will be dropped anyway. However, it will allow us to increase the number of observations in the non-linear estimation (Poisson pseudo-maximum likelihood). We build the trade flow for each country pair by adding the bilateral imports for each country from the other country in the pair.

The bilateral migration data are from Docquier et al. (2010) and are described there in greater detail. They measure the number of people (older than 25) born in each of 194 world countries and resident in any of these countries in year 2000. The original source of these data are the national censuses of countries, conducted

[4] A log-linearized version of equation 11 with only trade openness is used in Frenkel and Romer (1999) as basis of their empirical analysis.

[5] We thank Rob Feenstra for sharing these data with us. The data are available and described in detail at this website http://cid.econ.ucdavis.edu/.

[6] Downloadable at http://www.cepii.fr/anglaisgraph/bdd/baci.htm.

[7] The correlation coefficient with the CEPII bilateral trade data is 0.99 when restricting to the same country pairs.

around year 2000. Specifically, for 194 countries we have their working-age population broken down by country of birth and education (college degree or not). The number of bilateral cells is 38,031 and it has no missing values (but a high fraction of zeros, about three quarters, corresponding to the fact that there are no migrants in many bilateral relations).

We complete the bilateral dataset with data on geography (bilateral distance, a dummy for sharing a border, and the number of landlocked countries in the pair), country size (in terms of population and area), language (common languages), and colonial ties. These data are from the BACI dataset, described in Head, Mayer and Ries (2010). The resulting dataset has over 33,000 bilateral observations for trade and migration flows. The subset of non-zero observations contains roughly 24,000 observations for trade flows and 8,000 observations for migration flows (see Table 2). In comparison FR had 3,220 bilateral trade flows and Noguer and Siscart (2005) had 8,906.

Let us now turn to our country-level dataset. These data cover 188 countries. Among these 146 countries were present in the FR dataset. To maintain comparability we will estimate our main models on this sub-sample. The remaining 42 countries tend to be low-income and very small in size, which raises some issues about the quality of their data. However, as we did a significant effort to extend the coverage for most variables, we will also present several results for the full sample, to confirm their robustness.

Our main variables of interest are real GDP per person (PPP-adjusted), measures of income inequality (Gini coefficient and the 90-10 percentiles income ratio), the trade share in GDP (defined as imports plus exports over PPP-adjusted GDP), real trade openness (as in Alcala and Ciccone 2000), the foreign-born share (both in terms of population and of human capital), and an index of institutional quality.

The GDP and trade shares are from the Penn World Tables (version 7.0), the foreign-born as share of the population are calculated using the Docquier (2010) data. Along the lines of Hall and Jones (1999) and Alcala and Ciccone (2005) we build a measure of institutional quality. Our index of institutional quality is based on the data in Acemoglu, Johnson and Robinson (2001) and is built as a simple average of an index of average protection against expropriation risk and an index of constraints on the executive (around year 1990).[8] Acemoglu, Johnson and Robinson (2001) is also the source of several variables that measure absolute geography, disease environment, climate, institutional characteristics and cultural traits. We use the database from Alesina et al. (2005) for ethnic, linguistic and religious fractionalization.

Table 1 reports some basic descriptive statistics and the source for the main variables of the paper. The mean real GDP per person is $10,682, with a standard deviation that is twenty percent larger than the mean. The mean Gini coefficient (from the UNU-WIDER dataset) is 41.53 (standard deviation 11.21). The mean trade share is 90%, with a standard deviation of 50 percentage points. The average degree of *real* trade openness is

[8] For more details see page 1397 in Acemoglu, Johnson and Robinson (2001).

0.50 (with a standard deviation of 0.42).[9]. The correlation coefficient between the two variables is 0.76. The foreign-born share, defined as the foreign-born population over the total population in the country has a mean of 0.04 (standard deviation 0.08), ranging from virtually zero to 0.52. In terms of human capital, the foreign-born share is 0.09 on average (standard deviation 0.15), ranging from zero to 0.80. These figures reflect the fact that immigrants are more educated than natives in many countries. As one would expect, the correlation coefficient between the two variables is very high (0.96).

We also obtained two variables from Putterman and Weil (2010) that play an important role in our analysis. The first is an index or early development (the so-called *statehist* variable). This index characterizes the level of sophistication of the sociopolitical institutions in the region that is now a country around year 1500. This index is available for 160 of the countries in our sample. We also use their data to compute the share of the current population (year 2000) in each country whose ancestors in year 1500 lived in a different country. The average value is 0.24, but the standard deviation is large (0.32) and ranges from zero to 100 percent.

4.1 From Theory to Estimation

Taking a log linear approximation of expression (10) we can write the following relationship between income per person and openness to trade and immigration for country c:

$$\ln y_c = \beta_0 + \beta_1 \ln \theta_c + \beta_2 \ln \phi_c + \beta_3 \ln S_c + \boldsymbol{\beta}_4 \mathbf{X}_c + \varepsilon_c \tag{12}$$

The coefficients β_1 and β_2 represent the long-run elasticity of income per person to trade and migration openness. β_3 represents the long run elasticity of income per person to country size, while $\mathbf{X}_c$ is a vector that includes the other determinants of long-run output per person through productivity ($ln\widetilde{A}_c$), human capital ($\ln \widetilde{h}_c$)and physical capital ($\ln \widetilde{k}_c$). $\boldsymbol{\beta}_4$is a vector of coefficients.The zero-mean term ε_c allows for some idiosyncratic deviations of $\ln y_c$ from its steady state, uncorrelated with the other explanatory variables $\mathbf{X}_c$. A difference between and (11) is that in (12) we allow the trade and migration costs to be country specific (hence indexed by c). However we cannot estimate (12) because the migration and trade costs θ_c and ϕ_c are not observable. Hence, we will use 9 and 8 and rely on the dependence of migration and trade on their respective costs. In particular we can linearize the expression (8) around the average values of the parameters and obtain:

$$FBsh_c \approx \mathbf{A} + a_1 \ln \theta_c - a_2 S_c + \mathbf{a}\boldsymbol{\Xi}_{FB,c} \tag{13}$$

The scalar $\mathbf{A}$ is a function of the average values of the parameters, while $\mathbf{a}$ is a vector of partial derivatives of $FBsh_i$ with respect to h, N and other potential determinants of the share of foreign-born. The coefficients $a_1$and

[9] Following footnote 4 in Alcala and Ciccone (2004), real trade openness is defined as (nominal) openness times the price level, which undoes the dependence on relative nontradeable goods prices.

a_2 are defined in section 3.1 above as the semi-elasticities of the share of foreign-born to migration openness and to size of the country, respectively. The term $\mathbf{\Xi}_{FB}$ is a vector containing h, N and other potential, observable and unobservable determinants of $FBsh$.

Similarly we can linearize expression (9) to obtain:

$$TRsh_c \approx \mathbf{B} + b_1 \ln \phi_c - b_2 S_c + \mathbf{b}\mathbf{\Xi}_{TR,c} \tag{14}$$

The scalar $\mathbf{B}$ collects the average values of the parameters affecting trade. The coefficients b_1 and b_2 are defined in section 3.1 above as the semi-elasticities of the trade share to openness and to country size, respectively. The term $\mathbf{b}$ is a vector of partial derivatives of $TRsh_i$ with respect to β and N and other potential determinants of trade. $\mathbf{\Xi}_{FB}$ is the vector containing β, N and all the other other determinants of $TRsh$.

We can now solve (13) and (14) with respect to $\ln \theta_c$ and $\ln \phi_c$ respectively and substitute into (12) to obtain:

$$\ln y_c = \beta_0 + \beta_{FB}(FBsh_c) + \beta_{TR}(TRsh_c) + \beta_S \ln S_c + \boldsymbol{\beta}_4 \mathbf{X}_c + \boldsymbol{\beta}_5 \mathbf{\Xi}_c + \varepsilon_c \tag{15}$$

In expression (**??**) the coefficient β_{TR} is equal to β_1/a_1.The coefficient β_{FB} is equal to β_2/a_2 and $\beta_S = \beta_3 + \beta_1/b_1 + \beta_2/b_2$. Importantly, the term $\boldsymbol{\beta}_5\mathbf{\Xi}_c$ is a linear combination of the residual determinants of trade $\mathbf{b}\mathbf{\Xi}_{TR,c}$ and of immigration $\mathbf{a}\mathbf{\Xi}_{FB,c}$. Hence it is correlated with $FBsh_c$ and $TRsh_c$. If there are some unobservable factors in $\mathbf{\Xi}_c$ they will be confounded in the residual and will be correlated with the explanatory variables. In particular, if these factors are omitted variables that affect both income and trade/immigration they will cause an upward bias of the OLS estimator. If they are factors that only affect the correlation between openness and actual trade/immigration, they will act as a measurement error and bias the OLS estimates down. These two effects would cause inconsistency in the OLS estimates of β_{FB} and β_{TR} in the following regression:

$$\ln y_c = \beta_0 + \beta_{FB}(FBsh_c) + \beta_{TR}(TRsh_c) + \beta_S \ln S_c + \boldsymbol{\beta}_C \mathbf{Controls} + u_c \tag{16}$$

Where the term $\boldsymbol{\beta}_C\mathbf{Controls}$ includes $\boldsymbol{\beta}_4\mathbf{X}_c$ and the observable components of $\boldsymbol{\beta}_5\mathbf{\Xi}_c$

In order to obtain consistent estimates of β_{FB} and β_{TR} we identify the cost-driven determinants of trade and migration for country c.Namely we use expressions 14 and 13 and isolate factors that only affect trade costs (ϕ) and migration costs (θ) for each country. We follow FR who use the gravity regression as predictor of bilateral flows. In particular using a bilateral gravity model we first run the following regression to predict the logarithm of bilateral trade and migration shares:

$$
\begin{aligned}
\ln x_{cj} \quad = \quad & \gamma_1 \ln(Dist)_{cj} + \gamma_2 \ln(Pop)_c + \gamma_3 \ln(Pop)_j + \gamma_4 \ln(Area)_c + \gamma_5 \ln(Area)_j \\
& \gamma_6(Landlocked)_c + \gamma_7(Border)_{cj} + \gamma_8(ComLang)_{cj} + \gamma_9(Colony)_{cj} + \\
& \gamma_{10} \ln(Dist)_{cj}(Border)_{cj} + \gamma_{11} \ln(Pop)_c(Border)_{cj} + \gamma_{12} \ln(Pop)_j(Border)_{cj} \\
& + \gamma_{13} \ln(Area)_c(Border)_{cj} + \gamma_{14} \ln(Area)_j(Border)_{cj} + u_{cj}
\end{aligned} \tag{17}
$$

The dependent variable x_{cj} is, alternatively $FBsh_{cj}$,the stock of immigrants from country j to country c relative to the population of country c, or $TRsh_{cj}$the total value of trade between country c and j divided by the GDP of country c. The explanatory variables are the distance between the two countries, the population and area of each country, dummies for country c being landlocked, a dummy for country c and j sharing a border, a dummy for speaking a common official language and one for sharing a colonial past. Finally the interaction of the border dummies with distance and population and area are also included. Those factors are determined by the relative geography and the relative location of countries.

Once we have estimated the gravity regressions (17) we use them to obtain the predicted bilateral share of migrants and trade, and then we aggregate across j to obtain the predicted trade and immigration intensity for each country c. In particular, let's define as Z_{cj} the vector of explanatory variables included in (17) and as $\boldsymbol{\gamma}_{FB}$ the vector of coefficients in the regression for migration flows, while $\boldsymbol{\gamma}_{TR}$ is the vector of coefficients in the bilateral trade regression. Then we define the measure of (bilateral) cost-driven trade as share of GDP for country c as follows:

$$
\widehat{TRsh}_c = \exp(\sum_{j \neq c} \widehat{\boldsymbol{\gamma}}_{TR} Z_{cj}) \tag{18}
$$

Similarly we define the measure of gravity-predicted foreign-born population share of total population in country c as follows:

$$
\widehat{FBsh}_c = \exp(\sum_{j \neq c} \widehat{\boldsymbol{\gamma}}_{FB} Z_{cj}) \tag{19}
$$

We consider the gravity predictions as identifying the part of (bilateral) trade and migration driven by size, bilateral costs and relative geography of a country vis-a-vis the rest of the world. Hence, once we control for the size of the country the predicted $\widehat{TRsh}_c$ and $\widehat{FBsh}_c$ are function of trade costs θ_c and migration costs ϕ_c determined by relative geography only. Our identifying assumption is that they are uncorrelated with other determinants of income and they provide the identifying variation needed to instrument $TRsh_c$ and $FBsh_c$in equation 16. We will discuss this assumption further in section 5.1.

5 The effect of Trade on income per person

We begin our empirical analysis by estimating equation (16). We first check that we can reproduce the results of the previous literature, especially FR, Noguer and Siscart (2005) and Alcala and Ciccone (2004). Those studies focussed on trade openness only. Hence we first include trade as share of GDP only. In the next section we will include openness to immigrants as well. Table 3 includes estimates of coefficients from several variations of the following specification:

$$\ln y_c = \beta_0 + \beta_{TR}\left(TRsh_c\right) + \beta_P \ln Pop_c + \beta_A \ln Area_c + \boldsymbol{\beta}_C \mathbf{Controls} + u_c \tag{20}$$

In (20) the dependent variable is income per person in country c measured in 2000 US \$, corrected for PPP. We include as explanatory variables the logarithm of Area and of Population to capture the effect of country size. We use the constructed expression (9), using the log-linear gravity model (17) as instrument for $TRsh_c$, trade as share of GDP. Table 2 shows the estimated coefficients on the explanatory variables included in the gravity regression (17). In Column 1 we use the log-linear specification which omits the 0 observations. In Column 2 we use the non-linear Poisson maximum likelihood estimator (as suggested in Tenreyro and Santos-Silva, 2008) which includes the 0 observations. Both models explain a significant fraction of the variance of bilateral trade. We use mostly the linear predictor in Table 3 to be consistent with the previous studies. Results obtained using the non-linear predictor are very similar.

5.1 Instruments: the role of "Relative" and "Absolute" geography

The key identification assumption of our strategy is that the variables included in the gravity regression, and affecting the "relative geography" of a country are not affecting income per worker through any channel other than its openness to interaction with other countries (via trade or migration). In fact, once we control for the size of a country, the other variables included in (17) capture the relative location, and relative "connectedness" of a country vis-a-vis other countries (distance, sharing a border, sharing language and sharing colonial ties). While it is plausible that the "relative geography" of a country affects mainly its potential openness to interactions, it is also true that it is correlated with its "absolute geography". Namely where the country is located in the world affects its climate, its disease environment, its probability of being touched by some historical accidents. These factors may affect current income per capita through different channels. For instance the latitude and climate of a country affected the probability of being colonized or settled by Europeans (Hall and Jones 1999, Acemoglu et al 2001, 2002, Putterman and Weil, 2010). Hence they are correlated with the quality of its institutions (brought by Europeans). Alternatively the current probability of tropical diseases may deeply affect income per person (Weil, 2007). And the fertility of the land might have affected the development of agriculture and the subsequent technological development of countries (Comin et al. 2010). This raises the issue of properly controlling for institutions and historical patterns of colonization and settlements and more immediately, to control for features of "absolute geography" which may determine those. This is crucial if we want to claim that our instrument (based on relative geography) affects income through openness and not through its correlation with features of absolute geography.

Column 1-3 of Table 3 show the effect of trade openness on income, not including any control for absolute geography except for the measures of country's population and area. Trade is measured as share of TFP and instrumented using the linear gravity predictor. The estimated effect on income per person (Column 1), on income per worker (Column 3) using the FR sample (Column 1 and 3) or the full Sample (Column 2) is large, significant at the 5% level and comparable to that estimated by FR. The method of estimation is 2SLS. The point estimates are between 2.5 and 3, implying that an increase in (trade/GDP) by 1% increases income per worker by 2.5-3% in the long run. FR estimated a coefficient between 1.9 and 2.9 in their sample. Let us remind the reader that our database, relative to year 2000 includes many more bilateral trade observations than FR (34,000 versus 3,200) and hence we can estimate the gravity relation much more precisely. The trade predictor from gravity is a relatively strong instrument (F-stat between 9.3 and 13.7) which limits the concern of bias from weak instruments. Columns 4 to 8 of Table 3, however, show the sensitivity of the trade effect when including controls for absolute geography. This issue was already pointed out by Rodrik and Rodriguez (2001) and discussed in Noguer and Siscart (2005). It is enough to include distance from the equator (as done in Column 4) which is a very strong predictor of institutional quality via European settlements (Hall and Jones, 1999) or dummies for sub-Saharan Africa, East Asia, and Latin America (Column 5) to render the effect of trade on income per person insignificant. In Column 6 of Table 3 we include seven other controls for absolute geography. They are the percentage of land in the tropics, a dummy for land-locked countries, a measure of average distance to the coast, a measure of average yearly temperature, average yearly humidity, an index of soil quality, a measure of incidence of malaria, and an index of the incidence of yellow fever. These variables are all correlated to the agricultural productivity, the disease environment and the probability of European Settlements, factors that potentially affect income per person across countries. The effect of trade on income per person is still insignificant and small. Column 7 includes also controls for the colonial past of countries in the form of a dummy for being a former English colony and one for being a former French colony. We also include a dummy for the four largest settlements of Europeans abroad (the US, Canada, Australia and New Zealand). As before the effect of trade on income remains non-significant. Column 8 shows that the issue is not only related to the instruments. Once we control for absolute geography even the partial correlation between trade and income (OLS estimate) is not significant. This suggests that trade/GDP is a very imprecise and noisy measure of the economically relevant interactions between countries. Finally Column (9) shows that measuring trade shares in real terms, as suggested by Alcala and Ciccone (2004), correcting, that is, the value of GDP for PPP when evaluating openness, produces a more robust effect of trade on income per person. However this result crucially depends on including "distance from the equator" as additional instrument for trade as we do in column (9) and as Alcala and Ciccone (2004) do throughout their paper. If distance from the equator is not included as instrument but as a control, instead, the effect of trade is reduced to -0.23 (with a standard error of 1.69) and hence is not any longer a significant determinant of income per person. As that variable is a very strong predictor of European settlements and institutional quality we argue that it is not a valid instrument for trade.

6 Including the share of immigrants: Basic specifications

Trade openness measured as share of income and immigrants as share of population both depend on geography. They both capture some crucial aspects of the economic interactions of a country with the rest of the world but still they measure only imprecisely the relevant degree of openness to firms, ideas and people that may affect economic outcomes. As argued above the growth literature[10] has considered openness to trade as the only relevant measure in determining income per person. However migration has been a very important way for people and ideas to come into contact and enrich each other for most of the human history. Moreover long-term migration may be a better proxy for temporary migration, business interactions and other economic interactions that encourage the exchange of skills and ideas, relative to trade which may involve only a limited number of agents. Economists, as correctly pointed out by Gordon Hanson (2009) have mostly studied the partial effect of immigration on employment and wages ignoring the long-run potential effect of immigrants on competition, scale and variety of skills and goods. These are all crucial channels emphasized by the growth literature in other contexts (see Jones and Romer, 2010 for a summary) as potential determinants of income per capita. It seems natural to analyze the effect of immigration in the present context.

In Table 4 we include openness to immigration (as measured by the share of foreign-born in the total resident population) as additional explanatory variable in the regressions of cross-country income per worker. We use the new and updated migration data from Docquier et al. (2010) to measure the stock of foreign born from any country in the world in any destination country and hence we can include 188 countries, including all those in the FR Sample. We estimate specification (16), including simultaneously openness to trade and to immigration as endogenous regressors. Mirroring what we did for trade we use the gravity-predictor described in (19) as instrument for openness to immigrants and we include both openness to trade and immigration as endogenous variables. Column 3 and 4 of Table 2 show the estimated coefficients on the explanatory variables from the gravity regression of migration using the log-linear (Column 3) or the Poisson non-linear (Column 4) model.

[10] See for instance the summary in the textbook by Weil (2007).

As we use the same relative geography variables to predict trade and migration, the variation that identifies each effect depends on the different impact of each geography variables on trade and migration flows. Focussing on the non-linear estimates, that we prefer as they are more robust for migration flows, notice that the bilateral distance and sharing a border as well as the area of the country of origin have a much larger effect on migration than on trade. Long distances discourage migrations much more than trade. On the other hand common colonial ties are more important determinants of trade. These and other differences allow our gravity predictor to generate predictions differentiated enough to be used for the two endogenous variables.

Interestingly, we can see in the four panels of Figure 2, which report the scatterplots of the predicted and the endogenous variables that openness to migration is well predicted by the relative geography of the gravity-regression. In particular the share of foreign-born and its predictor have very high correlation (Figure 2A). Moreover that correlation is not driven by any outlier. Omitting the two observations with highest share of predicted foreign-born (Belize and Qatar) leaves the correlation unchanged (Figure 2B). To the contrary the correlation between the gravity predictor of trade and the actual trade shares depends strongly on few outliers (Figure 2C). These are Ireland, Hong-Kong and Singapore. Omitting those (Figure 2D) the correlation between instrument and the endogenous variable is much weakened and not significant any longer. These disproportionate role of outliers in the predictive power of instruments trade fwas already noticed by the previous literature (see Figure 1 and following discussion of FR).

Table 4 shows the 2SLS estimates of the effect of trade and immigration on income per person including progressively more controls. In column 1-3 we only include the controls for the country-size. In this case both trade and immigration are significant as long-run determinants of income per person. An increase in trade by 1% of GDP increases income per person by 2.3-2.9%. An increase of immigrants by 1% of the population increases income per person by about 6%. While the instruments for the two endogenous variables, jointly, are not as strong as when including only trade the F-statistics are between 5 and 8. They are still above the less stringent Stock and Yogo critical values. The estimated effects are relatively precise. When we begin to include controls for absolute geography and for colonial past, however, the effect of trade disappears while the effects of the share of foreign-born remains very significant, large and stable. Including, progressively, the geography controls (distance from equator, continent dummies and then the measures for temperature, geography and disease), then dummies for being colonies of England and France and then the share of European settlers and their descendants measured as of 1900, the effect of immigration on GDP per person remains between 6.4 and 8.3, always significant at the 1% level. The trade openness, instead, is completely non significant with point estimates between -0.5 and 0.1. The openness measure based on immigration seems much more robust and relevant than the openness measure based on trade in affecting income per person. The inflow of short-term and long-term immigrants may have been historically crucial and is still crucial to enrich the skills and the set of ideas of a country. Moreover as the cost of migrations are larger than trade costs, the effect of geography on migration may be stronger, making our instrument a better predictor for migration than it is for trade. Column 9, however, show that the power of the instrument is not the only relevant part of the story. When we control for absolute geography, size and colonial past the partial correlation of immigration to GDP per person is still positive while there is no correlation with trade. We also notice that the IV estimate is not far from the OLS one, which implies that the omitted variable bias and the measurement error bias, both likely to be severe, may be of similar size. We will analyze several possible omitted variables in the remaining of the paper.

As trade openness is insignificant in all the specifications that include some absolute geography control (4-8 in Table 4), in order to strengthen the power of the instruments, Table 5 shows the same specifications as Table 4 but omitting the trade variable. Column 1-6 reproduce the corresponding specifications of Table 4. The point estimates of the effect of immigration are between 7.37 and 13.94, some 20 to 50% larger than in Table 4. All coefficients are significant at the 1% level and in all cases the F-statistics of the first stage for the instruments are always larger than 9 and well above the Stock and Yogo critical value at 15%. Column 7 of Table 5 then checks whether interacting the immigration openness variable with a dummy for countries with trade openness above or below the average reveals some complementarity or substitution pattern between trade and migration. Both coefficients are very significant and similar in size, implying that immigration has a similarly positive effect for countries with high and with low trade openness. Trade does not seem to be a substitute or a complement for migration when it comes to effects on income per person. Column (8) shows the OLS estimates, for a specification including geographical and colonial controls. The point estimate of the effect of immigration (6.36) is not far from the corresponding 2SLS estimate (7.41) again implying that the bias from the omitted variable is probably of similar size as the bias from measurement error.

Figure 3A shows the partial correlation, once we control for country-size, between immigration openness and logarithm of income per worker. Figure 3B shows the partial correlation between the gravity-predicted immigration and income per capita. These graphs dispel any concern for the role of outliers in identifying the effect of immigration on income per person. In fact in neither case there is any specific observation driving the result. Moreover it is interesting to notice that the most well-known cases of countries open to immigration and highly developed (USA, Canada and Australia) do not help at all our identification. They are relatively vast and somewhat isolated countries and therefore they do not have high "gravity predicted" immigration (see Figure 3B). Hence their level of GDP per person is not, in the prediction of our model, affected much by the gravity-predicted immigration variable.

The point estimates of the effect of immigration on income per worker is between 7 and 14 considering all the specifications of Table 5. Considering 10 as a median estimate, the implication on income per person are very important. Taking the average share of foreign-born in the bottom decile of the income per person distribution (equal to 1.1%) and the average in the top 90% (equal to 11.1%) and multiplying the difference (10%) by the median estimated effect (10) and taking the exponential we obtain an income ratio of 2.71. The actual 90-10 ratio in income per person across countries of our sample is 38. Equalizing the openness to migration across those two groups of countries will reduce their income per person ratio to around 14. The difference in income per person between those two groups of countries attributed to differences in schooling (Hall and Jones 1999) was around 3.1, hence very similar to the difference due to openness. Hence the effects of openness to immigration on income seem very important even in comparison with the effect of other important and studied determinants of income per person such as human capital accumulation.

Finally, in the last column of Table 5 we explore the possibility of combining trade and immigration as explanatory variables, using their first principal component, to increase their explanatory power. The new variable is very significant but the gravity-based instruments are weaker than for the immigration variable only. A change by two standard deviations of the explanatory variable (equal to 1 by construction) would generate an increase in income per person by a factor of 4.4. The explanatory power of this variable is not larger than using the immigration variable alone. Overall, immigration instrumented by relative geography, seems to be the measure of openness most relevant to explain income per capita.

7 History controls and the Putterman-Weil foreign ancestors variable

A recent paper by Putterman and Weil (2010) has emphasized the important role of international migration on economic development, measured as GDP per person, across countries. Their focus, however is different from ours. Our claim is that openness, as proxied by the higher propensity to receive immigrants due to the relative geography of a country, is a factor enhancing productivity of a country via access to diverse skills and ideas. Putterman and Weil (2010) consider instead the fact that the current population of countries in the world may have ancestors from different countries who, because of historical migrations, deportations, settlements and colonization, moved across borders. They argue that the current level of development of countries is related to historical (pre-1500) development of the countries of origin of the ancestors in proportion to the presence of each group in the country. They construct a matrix that, for each of 179 country, identifies what proportion of ancestors of the current population was living in each of the other 178 countries in the world, before 1500. Their matrix is based on genetic data, historical records of migration, deportation, and settlement. Then they find that the current level of institutional development and of income per person of a country is more strongly correlated with an average index of pre-1500 development of the countries of origin of the ancestors (weighted by the migration matrix) than to the pre-1500 development in the country of residence. Institutions, human capital and culture, they argue, follow people through migrations and hence tracking the ancestors of a population matters to understand its development. We think this is a very plausible determinant of current development. However it is different from our channel. If historical migration is related to current immigration, and if countries with a large fraction of historical immigrants, attracted people from highly developed civilizations and still attract immigrants these days, then our measure can be correlated with theirs.

Putterman and Weil (2010) data allow us to perform two interesting checks. In specifications 1-3 of Table 6 we include as a control their variable "*statehist*" which is an index, between 0 and 1, capturing for how many half-centuries before 1500 the ancestors of people in a country lived in a state-organized super-tribal civilization. This index captures the extent to which ancestors of people in each country lived in an advance society in 1500[11]. This variable has a strong explanatory power on current income per person (Column 1) but it does not affect at all the significance of openness to immigration. On the other hand when we include controls for European colonization and European ancestry, as well as predictors of European settlements (distance from the equator) as we do in specifications 2 and 3 of Table 6, the significance of *statehist* is drastically reduced while openness to immigrants remains large and significant. Then, in specifications 4-6 we also use the Putterman and Weil (2010) data to calculate the share of foreign (pre-1500) ancestors in each country. Their bilateral historical migration matrix which constructs for each receiving country the share of pre-1500 ancestors for each other country allows us to calculate the percentage of foreign "ancestors" in each country. This is a proxy for long-run historical migrations. Mirroring the micro cross-city literature (e.g. Altonji and Card 1991) that used long-lagged migration as instrument for current migration one could use the "share of foreign ancestors" as an alternative instrument for current share of foreign-born. While historical migration could have been driven by income differentials, if those are not too persistent the lagged immigration can also provide an alternative exogenous variation of immigrants, as long as migration patterns persist over centuries. In our case we can include this measure of old-time immigration together with the geographical instrument and we can test for its exogeneity. Alternatively, we can consider it as a control. Columns 4 and 5 of Table 6 add the variable "share of foreign ancestors" as additional instrument, or as control. The test of exogeneity of this variable does not reject exogeneity of the share of foreign ancestors at the 5% level (but it does reject it at the 10%). When we include it as a control its coefficient is significantly positive in the FR sample (column 5) but not in the full sample (column 6) . In all cases, however the instrumented share of foreign born stays very significant with a coefficient between 6.5 and 9.4. There is strong evidence that even controlling for past migrations and for the past level of civilization of ancestors, current immigration has a strong positive effect on income per person.

[11] The exact definiiton of the index can be found at page 1640 and 1641 of Putterman and Weil (2010).

8 Institutions and Culture

The institutional quality of a country has been considered as the main determinant of its long-run economic success by a series of very influential papers[12]. We have already alluded to the role of European Colonization in bringing different types of institutions such as free markets, democracy, checks and balances and the legal system. Economists have argued that differences in institutions could depend on the colonizing country (e.g. the distinction between different legal systems made by La Porta et al. 1999) or on the type of colonization (for settlement or for exploitation) as argued by Acemoglu et al (2001). Our strategy is to check that the effect of openness to immigrants on income survives the control for institutional quality. While openness to immigrants can affect institutions our idea is that the effect of immigrants derives mainly from their contribution to skills and ideas within a given institutional framework[13]. Hence in Table 7 we include measures of institutional quality as further explanatory variable and our goal is to check whether the effect of immigration survives to this control. Our measure of institutional quality follows Acemoglu et al (2001) and is the average between the "Protection against expropriation risk" and the "Constraint on the executive" both measured in the period 1975-85. These indices capture some fundamental aspects of protection of private property rights and of the limitation of the power of government, which have been found to be crucial for an institutional setting conducive to economic growth. As institutional quality is likely to be endogenous we instrument this variable too. In particular, following Hall and Jones (1999) and Acemoglu et al (2001) we use the fact that countries colonized and settled by Europeans were more likely to adopt institutions granting protection of private property and constraints on the executive. Hence we use distance from the equator and the percentage of people in the country speaking, as native, a language of European origin as instruments for the quality of institutions. Columns 1 includes the institutional quality control, Column 2 uses the index of protection against expropriation only and column 3 the index of constraints on the executives to measure institutions. In all cases both the measures of institutional quality and the share of foreign born have an effect on income per person positive and significant at the 5 or 1% level. The regressions also include the other geographic controls and the three continent dummies. The estimated effect of institutional quality on income per person is between 0.36 and 0.49. The size of this coefficient is smaller than what found in acemoglu et al (2001) (around 0.9) but still very significant. In particular the difference between our measure of institutional quality between the top 90% and the bottom 10% of the considered sample of countries is about 6 (the index varies between 1 and 9). This implies that, using the coefficient estimate of column 1, their income difference explained by institutions is equal to a factor of 14 [14]. By comparison, the difference in income explained by the 90-10 difference in openness to immigrants (equal to 0.14) is equal to a

[12] See for instance Hall and Jones (1999), Acemoglu et al (2001, 2002), Acemoglu and Johnson (2005), La Porta et al (1999), among others.

[13] In a regression of institutional quality on openness to immigrants, not reported, including geographic controls, we did not find a significant effect of the second on the first.

[14] Using the coefficient in column 2 we obtain exp(0.44*6)= 14.01

factor of 3.5.

An alternative strategy is pursued in column (4). In it, rather than including the measures of institutional quality as endogenous regressors, we include the proxies for settlement (distance from equator and share of people speaking a European language) as controls. Ultimately we are not interesting in estimating the actual effect of institutions on income but only to control for the fact that the relative geography instrument may pick up the effect of geographical determinants on institutions. Hence this approach increases the precision of the estimates, still controlling for geographical variation that may affect income via institutions. Even in specification (4) the coefficient on foreign-born share is large and significant.

Column 5 and 6 add to the institutional controls two types of further controls. There is a large and growing recent literature (see the review by Guiso et al. 2006) that looks at the role of "culture" meant, mainly, as ethnic and religious affiliation on some social and economic outcomes (such as trust, entrepreneurship, provision of public goods) and indirectly on income per person. Part of this literature empathizes how ethnic or linguistic fractionalization of a country may increase conflict and reduce the provision of public goods (Alesina, Baqir and Easterly, 1999). Alesina et al (2005) however do not find clear and robust effects of ethnic fractionalization on economic growth. Moreover there is a long tradition (from Weber, 1930, to McCleary and Barro, 2006) of considering religion as a determinant of economic success, or alternatively (e.g. Becker and Woessman, 2009) as a determinant of human capital accumulation. While immigration could affect the composition of culture, religion and ethnicity in a country, we are thinking that its main effect is to enrich and extend productive skills and ideas. Hence we consider whether immigration openness has an effect on income even controlling for the ethnic and religious composition of a country. In specifications (5) of Table 7 we include indices of ethnic, religious and linguistic fractionalization (from Alesina et al. 2005) to a specification, otherwise identical to the one in column (1). In specification (6) we include, instead, the share of Muslim, Catholic and Protestants (the three largest world religions) as controls. The effect of migration on income per capita remains unchanged. Overall, the role of immigration in increasing income per capita survives the control for institutional quality and for cultural characteristics of a country. We will come back to the analysis of migration and its diversity in section 11.

9 Other Robustness checks

We have argued that immigrants are an important source of skills, ideas and human capital for a country. This goes beyond their formal education. Recent evidence (Grogger and Hanson 2011, Docquier et al 2010) has also shown that immigrants have a larger college intensity than non migrants. As the database on bilateral stocks of migrants contains information about them being college educated or not, we use this information and calculate immigration as share of human capital in each country. We do this by multiplying each college educated by the wage ratio of college/non college obtained using the returns to education commonly used in cross-country analysis (Hall and Jones 1999) and equal to 6.8% per year. We assume a difference equal to 6 years of schooling between college and non college educated. Hence a college educated turns out to count as 1.503 units of non college educated equivalents[15]. By doing this immigration as share of human capital increases in most cases, due to the fact that immigrants are over-represented among college educated.

Table 8 column 1-4 shows the estimated effect of immigration on income counting foreign-born as share of total human capital, rather than of population. The estimates are very precise and the effect are similar to before. Immigration as share of human capital is around 2% for countries in the bottom decile of the income per capita distribution. To the contrary immigrants count for 22% of the human capital share in countries at the top decile. Hence using the median estimate in Table 8 (3.91) we can explain with differences in openness to immigrants, an income ratio of 2.18 between those two group of countries.

In the last two columns of Table 8 we check whether emigration has a damaging effect. We have been arguing that immigration bring ideas, and skills to a country. This may happen at the expenses of the country of origin, which might suffer a loss of economic opportunities (brain drain). There are however several channels through which the country of origin can benefit from emigration: remittances, returns, development of international networks, increased trade and FDI. In specification (5) of Table 8 we include emigration as a control in our regression. Emigrants as share of the resident population is the variable included. We find that it has no effect on income per person and that its inclusion does not alter the effect of immigration. A regression of income on emigration rate only controlling for geography (not included) gives a similarly non-significant effect of emigration on income per worker (point estimate of -0.6, standard error of 0.92). Unfortunately, if we try to include emigration as endogenous variable and instrument both immigration and emigration with the gravity instrument we obtain very weak first stage and very large standard errors. The last column of Table 8 uses net immigration (stock of immigrants minus stock of emigrants divided by population) as explanatory variable and the usual gravity predictor as instrument. We find effects of net immigration on income per worker similar to the case of total immigration. Overall the estimates of Table 8 confirm that immigration, measured as contribution to human capital, has a significant positive effect on income per person, while emigration does not hurt the country of origin. Openness to migration, by moving people where they have highest productivity in the world, generates benefits for the receiving countries in the long run, but no losses for the sending country which may experience offsetting positive effects from remittances, return and circulation of ideas.

[15] Namely, we define country c's stock of human capital as $H_c = U_c + 1.503 * S_c$, where S_c and U_c denote the number of college graduates and non-college graduates in the population, respectively. The coefficient on S_c is the corresponding Mincerian return to a college degreeused in the cross-country analysis by Hall and Jones (1999).

10 Decomposition of the effect

Our thesis is that openness to immigration brings new ideas, high skills and diverse abilities to the receiving country. This, in the long run, is associated with higher income per person. In Table 9 we decompose more carefully the effect of openness to immigration on the different components of income. First of all (consistently with Alcala and Ciccone 2004 and Hall and Jones 1999) we use income per worker as dependent variable, instead of income per person as we did so far. Income per worker captures more directly the productivity of a country. Then, we consider the three components of income per workers according to the following decomposition, based on a simple aggregate Cobb-Douglas production function as in Hall and Jones (1999):

$$\ln y_c = \frac{\alpha}{1-\alpha}\ln(K_c/Y_c) + \ln(h_c) + \ln(TFP_c) \tag{21}$$

In expression 21, the parameter α (set equal to 0.33) is the share of income going to labor. The variable K_c/Y_c is the capital-output ratio which measure the capital intensity of a country. The variable $h_c = \exp(\gamma s_c)$ is the average human capital per person calculated as the exponential of average years of schooling times their Mincerian return. Finally TFP_c is the total factor productivity calculated as a residual. The data on physical capital and output per worker are from the Penn World Table 7.0 while the data on average schooling are from the Barro and Lee (2011) and the Cohen and Soto (2007) databases.

Column 2-4 of Table 9 show the impact of openness to immigration on each component of income. The results presented in Table 9 use either a measure foreign-born as share of the population (first row) or as share of human capital (second row). We report in the table only the coefficients on the share of foreign-born, estimated using 2SLS and the non-linear gravity predictor as instrument. The regressions, however, include controls for the absolute geography, colonial history and European ancestry just as in specification (5) of Table 5. In all specifications we find a significant and large effect of immigration on income per worker. This effect is due to significant effects of openness to immigrants on human capital and on TFP. To the contrary no significant effect of immigration is found on capital intensity. The largest part of the effect is via TFP, consistently with the theoretical results of section 3.1. If immigrants enrich the skill and idea set of a country, this would mainly show on TFP. Openness to immigration has also positive effect on human capital, consistently with the fact that the college intensity of immigrants is relatively large. Moreover these findings for the long run, are consistent with the findings that also the second generation of immigrants tends to have very high human capital levels (Card, DiNardo and Estes, 2000). This is an additional way through which immigrants increase human capital of the receiving country in the long-run.

11 The effect of Diversity of Immigrants

If immigration affects productivity by increasing the variety of skills and ideas in a country then diversity of migrants should be good. Migrants from different countries may combine their abilities, promote productive specialization along lines of comparative advantages, increase the set of goods and services available to people. In a paper on US cities Ottaviano and Peri (2006) find that not only the share of foreign-born but their diversity, as measured by an index of fractionalization by country of origin, increased the efficiency and productivity of US cities. Similarly Broda and Weinstein (2006) quantify the productivity gains of trading different goods with a variety of foreign countries. In this section we analyze whether, besides the simple openness to immigration, income per capita is also positively affected by the degree of diversity of the immigrant population. To do this we construct the index of diversity of immigrants across countries of origin. We use the so called "fractionalization index" constructed as:

$$Div_c = 1 - \sum_j (FB_{jc})^2 \tag{22}$$

In expression (22), FB_{jc} is the share of foreign-born from country j in the total of foreign-born in country c. The index equals 0 if all immigrants are from the same country and approaches 1 if they are all from different countries. In principle the diversity of immigrants can be correlated with other determinants of income and it certainly can measure with error the skill-idea diversity which is relevant for economic productivity. Hence, we may instrument it with the gravity-predicted degree of diversity of immigrants, by using the gravity regression to predict bilateral shares. It turns out that using the openness to immigrants and their diversity as endogenous variables together, instrumented with the gravity-imputed proxies, produces very weak first stage when used jointly (the F-statistic is always well below the less stringent Stock and Yogo critical value). Hence we first consider immigrant diversity as exogenous, and include it in the regression directly, together with the endogenous share of foreign born which we still instrument with the gravity predictor (specification 1 and 2). Then we allow for diversity to be endogenous, and we instrument it with the gravity-predicted diversity, but we omit the share of foreign-born (specification 3 and 4). Finally, as comparison, we show the OLS regression of log income on the share of foreign-born and on the index of diversity assuming both as exogenous. Given that the OLS and 2SLS estimates of the effect of immigrants on income per person are not too different, and as diversity of immigrants is likely to be only mildly determined by income, we may only hope that the endogeneity bias in the OLS is no too severe.

The index of diversity is always significant, often at the 1% level and, especially when controlling for geographic and colonial variables, it absorbs a good part of the effect of immigration on income. For instance, specification (2) is the same as specification (4) in Table (5) except for the included Diversity control. The coefficient on openness to immigration is reduced from 7.37 to 3.74, hence by almost half. At the same time the index of diversity is large. An increase in diversity of migrants from 0.05 (the value for Sri Lanka, whose immigrants are essentially all Indian or East-Timor, whose immigrants are essentially all from Indonesia) to 0.95 (the value for the UK) implies a corresponding increase in the effect on output per person by a factor of 3.5. When considering diversity as endogenous, and instrumenting it with the predicted gravity-based diversity we obtain a larger coefficient (3.87 in column 4) significant at the 10% level, but with a relatively large standard error. The problem (as we can see from the F-statistic of the first stage) is that relative geography is not a very strong predictor of the index of diversity of immigrants. Finally the OLS regression show a significant partial correlation both of immigration and of its diversity to income per worker. While the limited power of the geographic instruments does not allow us to find unequivocal proof, there seem to be reasonable evidence that one channel through which immigration increases income per person is via its diversity, which may correspond to variety of ideas, skills, cultures and a selection of human capital types, very important to enhance productivity and efficiency.

12 Effect of immigration and trade on Inequality

In this last section we analyze whether immigration affects the income distribution of the receiving country. Traditionally the labor literature has focussed on low-skill immigration and emphasized its potential effect in increasing income inequality (e.g. Borjas 2003). In this paper, focussing on the long-run effect of immigration, we have emphasized its contributions to ideas and human capital. If immigration brings a "horizontal" differentiation in skills and ideas, or if it stimulates productivity it needs not have any implication on inequality. On the other hand if it contributes more to human capital than to pure labor (as we found), it may even decrease income inequality, by increasing the abundance of the more expensive factor (human capital) relative to the more abundant (Labor). Also, our decomposition in Table 9 showed that openness to immigration did not affect the capital intensity of a country, hence it did not affect the relative distribution of income between capital and labor. As last check we analyze the impact of openness to immigrants on income distribution in the receiving country. In particular we use two measures of income inequality. We use the Gini coefficient (between 0 an 1, with 0 representing perfect equality) which is available for a larger set of countries, and the 90-10 income ratio. Both measures are obtained from the UNU-WIDER database (version WIID 2C), which documents income inequality in each country of the world. The database collects studies based on population surveys and census data, for a very large number of countries. We select countries for which data are available in a year close to 2000.

Table 11 shows the results of openness to immigration on the Gini coefficient (Column 1 and 2) and on the 90-10 income ratio (columns 4 and 5). We find mild evidence that openness to immigrants reduces income differences within a country. The point estimates are always negative but rather imprecise and only the effect of immigration on the Gini coefficient without controlling for absolute geography is significant at the 10% level. We also analyze, for comparison, the effect of openness to trade on the Gini coefficient and on the 90-10 income ratio. The estimate show a marginally significant negative effect on Gini and a non significant effect on the 90-10 percentile. These results are rather interesting in their own right. There is a literature beginning in the 80's (e.g. Borjas, Freeman and Katz 1992) that analyzes the effects of immigration and trade on income inequality, using individual country data, mopstly in the US. Those studies, found only a small effect (if at all) of trade and migration on US income inequality. Here we use a much broader and long-run approach. Within this frame we do not find any evidence that trade and immigration, at least the part predicted by the relative geography of countries in the world, has a positive effect on their inequality.

13 Conclusions

This paper explores the long-run relationship between openness to immigrants and income per person across countries. Because of the formidable endogeneity problem very few people have tackled this issue. We adopt a strategy first used by FR to assess the impact of openness to trade on income per person to make some progress. Namely, we use features of relative geography (as captured by distance between countries, their size, their common border and commonality of language and of colonial ties) to predict the openness of a country to immigrants. The identifying assumption is that relative geography of a country affects its long-run income mainly by affecting the potential of interactions with other people, via trade and migration. However, relative geography can be correlated with absolute geographical features such as climate, disease environment or latitude which may affect income via ancient agricultural development,disease or by affecting the probability of being colonized and adopting some institutions. First we show that the relative geography predictor for immigration is strong. It also works better than for trade and the instrumented share of foreign born has a very strong and positive effect on income per worker, as much as the instrumented trade openness. Then we show that controlling for many features of "absolute geography" and for past colonization and settlement by Europeans, only the openness to immigrants maintain its significance (while openness to trade does not). We then control explicitly for the long-past history of countries, for their institutional quality, for their cultural traits and we still find immigration to have an important effect on income. We also find that immigration affects mostly a country's total factor productivity and that it augments its human capital. Finally we find some evidence that diversity of immigrants (according to their countries of origin) is beneficial and that immigration does not affect, or affects mildly and negatively, income inequality. We interpret these results as consistent with the idea that immigration enriches the skill and idea variety of countries, increases their productivity and efficiency and, in the long run, it is an important contributor to their economic success.

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Tables

Table 1: Descriptive statistics of the main variables and sources.

Variable	Obs	Mean	Std. Dev.	Min	Max	Source
Real GDP per person in 2000, PPP US $	184	10682	12881	117	74162	PWT, 7.2
Trade/GDP	184	0.90	0.50	0.02	3.78	PWT, 7.2
Trade/GDP, corrected for PPP	184	0.50	0.42	0.01	2.72	Alcala and Ciccone (2004), PWT 7.2
Foreign Born/Resident Population	188	0.04	0.08	0.00	0.52	Docquier et al (2010)
Emigrated/ Resident Population	188	0.06	0.09	0.00	0.49	Docquier et al (2010)
Foreign-Born as share of human capital	175	0.09	0.15	0.00	0.80	Docquier et al (2010)
Institutional Quality Index	157	5.45	2.01	1.00	8.50	Acemoglu et al (2001)
Logarithm of Population	183	1.71	2.01	-3.12	7.14	PWT, 7.2
Logarithm of Area	186	11.34	2.68	3.22	16.65	BACI dataset
Distance from Equator	187	25.07	17.00	0.00	67.47	BACI dataset
Share of tropical land	153	0.49	0.48	0.00	1.00	BACI dataset
landlocked	156	0.20	0.40	0.00	1.00	BACI dataset
Average distance from Coast or river	153	452	552	1.04	3418	Acemoglu et al (2001)
average temperature	153	19.07	8.10	-4.00	32.00	Acemoglu et al (2001)
average humidity	153	67.48	16.41	18.00	97.00	Acemoglu et al (2001)
soil step low	153	0.22	0.41	0.00	1.00	Acemoglu et al (2001)
malaria	150	0.30	0.40	0.00	1.00	Acemoglu et al (2001)
yellow fever	156	0.48	0.50	0.00	1.00	Acemoglu et al (2001)
Former British Colony	155	0.32	0.47	0.00	1.00	Acemoglu et al (2001)
Former French Colony	155	0.15	0.36	0.00	1.00	Acemoglu et al (2001)
Percentage of European descendants in 1900	153	28	40	0	100	Acemoglu et al (2001)
Share of foreign Ancestors	188	0.24	0.32	0.00	1.00	Putterman- Weil (2009)
Statehist (Putterman-Weil)	160	0.48	0.23	0.00	0.96	As above
Percentage of population speaking a European Language, 1975	149	31.01	43.01	0.00	100.00	Acemoglu et al (2001)
Gini Coefficient	130	41.53	11.04	21.80	76.60	UNU-WIDER
90-10 income ratio	71	11.57	11.21	3.16	67.58	UNU-WIDER
Gravity imputed trade share (linear specification)	188	0.27	0.30	0.00	2.43	Our calculations
Gravity imputed trade share (Non-linear specification)	188	0.85	0.42	0.00	2.14	Our calculations
Gravity imputed foreign-born share (linear specification)	188	0.01	0.01	0.00	0.06	Our calculations
Gravity imputed foreign-born share (Non-linear specification)	188	0.04	0.03	0.00	0.16	Our calculations

Table 2. gravity models for bilateral trade flows and bilateral stocks of immigrants.

Estimation Method	OLS	Poisson PML	OLS	Poisson PML
	(1)	(3)	(2)	(4)
Dependent variable	ln [(Imports_ij+Imports_ji) / GDP_j]	(Imports_ij +Imports_ji) / GDP_j	ln (Foreign Born_ij / Pop_i)	Foreign Born_ij / Pop_i
Logarithm of distance	-1.371***	-0.806***	-1.120***	-1.412***
	[0.0216]	[0.0445]	[0.0281]	[0.0704]
Logarithm of population$_{orig}$	0.0313**	-0.212***	-0.397***	-0.302***
	[0.0148]	[0.0307]	[0.0214]	[0.0417]
Logarithm of population$_{dest}$	1.093***	0.834***	0.646***	0.743***
	[0.0149]	[0.0426]	[0.0216]	[0.0724]
Logarithm of area$_{orig}$	-0.0880***	0.0387	0.207***	0.146***
	[0.0128]	[0.0271]	[0.0162]	[0.0423]
Logarithm of area$_{dest}$	-0.262***	-0.210***	-0.0861***	-0.0816*
	[0.0128]	[0.0544]	[0.0179]	[0.0487]
Sum Landlocked	-0.866***	-0.643***	-0.260***	-0.674***
	[0.0344]	[0.0689]	[0.0471]	[0.140]
Border Dummy	-2.125**	-1.684	0.492	-2.343**
	[0.980]	[1.281]	[0.917]	[1.179]
Border*ln(distance)	0.319	0.172	-0.278	0.934**
	[0.203]	[0.388]	[0.228]	[0.364]
Border*ln(Population$_{orig}$)	-0.324***	0.0185	-0.213**	-0.0778
	[0.0805]	[0.0915]	[0.0916]	[0.107]
Border*ln(Population$_{dest}$)	-0.343***	-0.288***	-0.262***	-0.584***
	[0.0773]	[0.0953]	[0.0901]	[0.124]
Border*ln(Area$_{orig}$)	0.0638	-0.116	-0.0601	-0.343***
	[0.0958]	[0.128]	[0.105]	[0.116]
Border*ln(Area$_{dest}$)	0.122	0.231	0.322***	0.214
	[0.0934]	[0.222]	[0.0979]	[0.154]
Border*Landlocked	0.844***	0.832***	0.318**	0.496**
	[0.111]	[0.138]	[0.127]	[0.199]
Common language	0.607***	0.997***	0.893***	0.853***
	[0.0826]	[0.264]	[0.104]	[0.188]
Common official language	-0.000139	-0.382	0.432***	0.126
	[0.0824]	[0.264]	[0.102]	[0.195]
Share colonial ties	3.066***	1.431***	1.245***	1.024***
	[0.122]	[0.127]	[0.172]	[0.230]
Observations	24,627	33,108	8,022	34,782
R2	0.394	0.2186	0.420	0.2332

NOTES: All models contain an intercept (not shown here). Heteroskedasticity-robust standard errors. The bilateral trade flows are from the NBER-UN dataset. The bilateral migration flows are from Docquier et al (2010).

Table 3: The Effect of Trade openness on Income per person

	(1) FR sample	(2) Full sample	(3) GDP per worker	(4) Distance from equator	(5) Continental dummies	(6) All geographic controls	(7) Geographic and colonial controls	(8) OLS	(9) Real openness
Estimation	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	OLS	2SLS
Trade/GDP	2.52*** (0.94)	3.08** (1.20)	2.45** (0.97)	-0.58 (0.77)	-0.14 (0.75)	-0.94 (1.02)	-0.39 (0.95)	0.32 (0.21)	1.40*** (0.67)
Ln(Population)	0.10 (0.11)	0.10 (0.12)	0.08 (0.10)	0.02 (0.08)	-0.12 (0.07)	-0.25** (0.11)	-0.19 (0.11)	-0.13 (0.07)	-0.10 (0.07)
Ln(Area)	0.10 (0.15)	0.10 (0.15)	0.12 (0.15)	-0.25** (0.11)	-0.06 (0.09)	0.04 (0.10)	0.03 (0.08)	0.07 (0.07)	0.16** (0.06)
Distance to equator				0.05*** (0.005)		0.03*** (0.01)	0.03*** (0.01)	0.02*** (0.008)	
Continental dummies	No	No	No	No	Yes	Yes	Yes	Yes	Yes
Other Geography Controls	No	No	No	No	No	Yes	Yes	Yes	Yes
Colonial Controls	No	No	No	No	No	No	Yes	Yes	Yes
First stage									
Excluded instruments	Linear gravity predictor	Linear gravity predictor	Linear gravity predictor	Linear gravity predictor	Linear gravity predictor	Linear gravity predictor	Linear gravity predictor	n.a.	Linear gravity and distance equator
Wald F-statistic of the first stage	13.71	9.31	13.71	9.37	7.65	8.93	7.30	n.a.	6.35
Observations	146	181	146	146	146	146	146	146	146

NOTES: All regressions include an intercept. **Continental Dummies** includes dummy variables for sub-Saharan Africa, East Asia, and Latin America.
Other Geography Controls include the percentage of land in the tropics, a landlocked dummy, average distance to the coast, average yearly temperature, average yearly humidity, an index of soil quality, an index of the incidence of malaria, and an index of the incidence of yellow fever. **Colonial Controls includes d**ummy variables for former French colony, former English colony, and a dummy the 4 neo-Europe (US, Canada, Australia and New Zealand)
Heteroskedasticity-robust standard errors. *,**,***= significant at 10%, 5% and 1% confidence level.
For columns 1 through 7 (including one endogenous regressor and one excluded instrument) the Stock and Yogo (2005) critical values range from 5.53 to 16.38, respectively, for the less stringent to the most stringent test (the 25% to 15% maximal IV size). For column 9 (one endogenous regressor and two excluded instruments) the analogous range for the critical values is 7.25 to 19.93.

Table 4: The Effect of Trade Openness and Openness to Immigrants on Income per Person

	(1) FR sample	(2) Full sample	(3) GDP per worker	(4) With distance from equator	(5) With all geographic controls	(6) Plus colonial controls	(7) Plus European Settlements	(8) Like (7) with Linear predictors	(9) OLS
Estimation	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	OLS
Trade/GDP	2.31**	2.90**	2.23**	-0.50	-0.32	0.001	-0.46	-0.25	0.15
	(0.91)	(1.22)	(0.93)	(0.63)	(0.62)	(0.70)	(1.17)	(1.19)	(0.18)
Foreign Born / Population	5.89**	6.53*	6.01**	6.40***	7.02***	7.37***	8.37***	10.59***	6.30***
	(2.98)	(3.87)	(2.90)	(1.85)	(2.16)	(2.03)	(2.51)	(3.07)	(1.04)
Ln(Population)	0.11	0.09	0.09	0.05	-0.06	-0.05	-0.08	-0.03	-0.05
	(0.11)	(0.12)	(0.11)	(0.07)	(0.06)	(0.07)	(0.10)	(0.11)	(0.05)
Ln(area)	0.10	0.13	0.12	-0.21**	0.10	0.12	0.10	0.14	0.12**
	(0.15)	(0.16)	(0.15)	(0.08)	(0.07)	(0.06)	(0.07)	(0.08)	(0.05)
Distance to equator				0.05***	0.03***	0.03***	0.01	0.02	0.014
				(0.005)	(0.008)	(0.01)	(0.01)	(0.01)	(0.011)
European Settlements in 1900							0.007**	0.007*	0.007**
							(0.003)	(0.004)	(0.003)
Continental Dummies	No	No	No	No	Yes	Yes	Yes	Yes	Yes
Other Geography controls	No	No	No	No	Yes	Yes	Yes	Yes	Yes
Colonial Controls	No	No	No	No	No	Yes	Yes	Yes	Yes
Wald F-statistics of the first stage	8.17	5.53	8.17	4.26	6.83	4.60	1.52	1.33	N.A.
Observations	146	181	146	146	123	122	121	121	121

NOTES: All regressions include an intercept. **Continental Dummies** includes dummy variables for sub-Saharan Africa, East Asia, and Latin America.
Other Geography Controls include the percentage of land in the tropics, a landlocked dummy, average distance to the coast, average yearly temperature, average yearly humidity, an index of soil quality, an index of the incidence of malaria, and an index of the incidence of yellow fever. **Colonial Controls includes d**ummy variables for former French colony, former English colony, and a dummy the 4 neo-Europe (US, Canada, Australia and New Zealand)
Heteroskedasticity-robust standard errors. *,**,***= significant at 10%, 5% and 1% confidence level.
For columns 1 and through 7 (two endogenous regressors and two excluded instruments) the Stock and Yogo (2005) critical values range from 3.63 to 7.03, respectively, for the less stringent to the most stringent test (the 25% to 15% maximal IV size).

Table 5: The Effect of Openness to Immigrants on Income per person

	(1) FR sample	(2) Full sample	(3) GDP per worker	(4) With geographic and colonial controls	(5) With geographic colonial and European settlements	(6) As 5 with linear gravity instruments	(7) As 5 interacting immigration with trade openness	(8) As (5) estimated using OLS	(9) First Principal Comp. Immigration-trade
Method of estimation	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	OLS	2SLS
FB/Population	10.83*** (2.49)	13.94*** (3.73)	10.78*** (2.52)	7.37*** (2.00)	7.41*** (1.80)	10.09*** (3.02)		6.36*** (1.02)	0.74** (0.20)
(FB/Population)*open							7.39*** (1.77)		
(FB/Population)*non-open							7.55*** (2.96)		
Ln(Population)	0.13* (0.07)	0.06 (0.09)	0.11 (0.07)	-0.05 (0.05)	-0.05 (0.05)	-0.02 (0.05)	-0.05 (0.05)	-0.07 (0.05)	0.01 (0.06)
Ln(area)	-0.14** (0.06)	-0.07 (0.10)	-0.12* (0.06)	0.12** (0.06)	0.12** (0.06)	0.15** (0.07)	0.12** (0.06)	0.11** (0.05)	0.15** (0.06)
Distance to equator				0.03*** (0.008)	0.015 (0.010)	0.18 (0.012)	0.03*** (0.01)	0.02*** (0.008)	0.01 (0.01)
European Settlements in 1900					0.007** (0.003)	0.007** (0.003)	0.007** (0.003)	0.007* (0.004)	0.006* (0.003)
Continental Dummies	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Other Geography controls	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Colonial Controls	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
First stage									
Instrument	Non-Linear gravity predictor	Non-Linear gravity predictor	Non-Linear gravity predictor	Non-Linear gravity predictor	Non-Linear gravity predictor	Linear gravity predictor	Non-Linear gravity predictor	n.a.	Trade and immigration linear predictors
Wald F-statistics of the first stage	12.36	9.93	9.12	11.03	10.64	12.45	5.065		5.75
Observations	146	181	146	122	121	121	121	121	121

NOTES: All regressions include an intercept. **Continental Dummies** includes dummy variables for sub-Saharan Africa, East Asia, and Latin America.
Other Geography Controls include the percentage of land in the tropics, a landlocked dummy, average distance to the coast, average yearly temperature, average yearly humidity, an index of soil quality, an index of the incidence of malaria, and an index of the incidence of yellow fever. **Colonial Controls includes d**ummy variables for former French colony, former English colony, and a dummy the 4 neo-Europe (US, Canada, Australia and New Zealand). Heteroskedasticity-robust standard errors. *,**,***= significant at 10%, 5% and 1% confidence level.

Table 6: Including controls for history of migration and origin of ancestors

	(1) Basic	(2) Geographic and colonial controls	(3) Plus share of European ancestors	(4) Foreign Origin of ancestors as Instrument	(5) Foreign origin of ancestors as control	(6) Like (5) in the full sample
Method of estimation	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
FB/Population	12.04***	7.49***	7.60***	9.56***	6.43***	7.01***
	(3.36)	(1.94)	(1.76)	(1.67)	(1.64)	(2.06)
Ln(Population)	-0.06	-0.05	-0.05	-0.03	-0.03	-0.01
	(0.08)	(0.06)	(0.05)	(0.06)	(0.05)	(0.05)
Ln(area)	-0.06	0.12**	0.12**	0.13**	0.12**	0.16***
	(0.07)	(0.05)	(0.05)	(0.06)	(0.05)	(0.05)
Putterman-Weil "Statehist"	2.52***	0.13	0.13	0.19	0.11	0.17
	(0.50)	(0.37)	(0.36)	(0.36)	(0.36)	(0.36)
Putterman-Weil Share of foreign ancestors					0.90***	0.66
					(0.35)	(0.42)
Distance to equator		0.03**	0.01	0.01	0.01*	0.01*
		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Continental Dummies	No	Yes	Yes	Yes	Yes	Yes
Other Geography controls	No	Yes	Yes	Yes	Yes	Yes
Colonial Controls	No	Yes	Yes	Yes	Yes	Yes
First stage						
Instrument	PPML gravity predictor	PPML gravity predictor	PPML gravity predictor	PPML gravity and P-W share of foreign ancestors	PPML gravity predictor	PPML gravity predictor
Wald F-statistics of the first stage	7.8	11.42	11.04	6.44	10.93	10.84
Hansen J-test of exogeneity (p-value)				3.56		
				(0.06)		
Observations	133 (FR sample)	119 (FR sample)	118 (FR sample)	118 (FR sample)	118 (FR sample)	131 (Full sample)

NOTES: All regressions include an intercept. **Continental Dummies** includes dummy variables for sub-Saharan Africa, East Asia, and Latin America.
Other Geography Controls include the percentage of land in the tropics, a landlocked dummy, average distance to the coast, average yearly temperature, average yearly humidity, an index of soil quality, an index of the incidence of malaria, and an index of the incidence of yellow fever. **Colonial Controls includes d**ummy variables for former French colony, former English colony, and a dummy the 4 neo-Europe (US, Canada, Australia and New Zealand)
For all columns except (4), the Stock and Yogo (2005) critical values range from 5.53 to 16.38 (one endogenous regressor and one excluded instrument), respectively, for the less stringent to the most stringent test (the 25% to 15% maximal IV size). For column 4 the analogous range of critical values is 7.25 to 19.93 (one endogenous regressor and two excluded instruments). Heteroskedasticity-robust standard errors. *,**,***= significant at 10%, 5% and 1% confidence level.

Table 7: Including Controls for endogenous institutions and cultural variables

	(1) Includes Endogenous Inst. Quality Index	(2) Endogenous Inst. Qual.= Protection against expropriation	(3) Endogenous Inst. Qual.= Exec. Constr.	(4) Control for the exogenous determinants of institutions	(5) As (1) plus fractionalizati on controls	(6) As (1) plus Religion Controls
Method of estimation	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
FB/Population	9.03*** (2.03)	3.82** (1.75)	12.48*** (2.53)	6.77*** (2.00)	10.45*** (2.39)	9.09*** (2.02)
Ln(Population)	-0.06 (0.07)	-0.11 (0.06)	0.04 (0.07)	-0.05 (0.05)	-0.04** (0.07)	-0.04 (0.08)
Ln(area)	0.11 (0.07)	0.08 (0.06)	0.15** (0.07)	0.11** (0.05)	0.20*** (0.07)	0.15** (0.07)
Distance to Equator	No	No	No	0.009 (0.006)	No	No
Institutional quality	0.44*** (0.10)	0.49** (0.10)	0.36*** (0.09)	No	0.34*** (0.10)	0.31* (0.17)
Fractionalization indices	No	No	No	No	Yes	No
Religion Shares	No	No	No	No	No	Yes
Continental Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Other Geography controls	Yes	Yes	Yes	Yes	Yes	Yes
First stage						
Instruments	gravity predictor, distance from equator, % of European descent	gravity predictor, distance from equator, % of European descent	gravity predictor, distance from equator, % of European descent	gravity predictor	gravity predictor, distance from equator, % of European descent	gravity predictor, distance from equator, % of European descent
Wald F-statistics	7.79	7.80	8.55	8.05	5.55	3.18
Hansen J-test of exogeneity (p-value)	0.01 (0.91)	0.20 (0.65)	0.24 (0.61)	NA	NA	NA
Observations	107 (FR sample)	120 (FR sample)	119 (FR sample)	122 (FR sample)	128 (Full sample)	121 (Full sample)

NOTES: All regressions include an intercept **Continental Dummies** include one dummy for Africa, one for East Asia and one for Latin America. **Other Geography** controls include percentage of area in the topics, land-lock dummy, the average distance to the coast, the average yearly temperature, the average yearly humidity, an index of soil quality, a measure of incidence of malaria and an index of incidence of yellow fever. **Colonial Controls:** Dummy for French colony, dummy for English colony, dummy for the 4 neo-Europe. **Fractionalization Indices**: Includes a measure of Ethnic fractionalization, one of linguistic fractionalization and one of religious fractionalization **Religion Shares:** includes the share of Catholics, Protestants and Muslims. *,**,***= significant at 10%, 5% and 1% confidence level.

Table 8: Measuring Immigrants as share of human capital and controlling for emigration

	(1) Basic	(2) With geographic and Colony Control	(3) With geography, colonial and settlers controls	(4) As (3) in the Full Sample	(5) Controlling for emigration	(6) Dependent variable: net immigration rate
Method of estimation	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
FB as share of Human Capital	6.01*** (1.48)	3.52*** (1.11)	3.66*** (0.99)	3.91*** (1.09)	3.65** (1.13)	5.34*** (2.01)
Emigrants/ Population					0.77 (0.71)	
Ln(Population)	0.18** (0.08)	-0.06 (0.05)	-0.066 (0.05)	-0.03 (0.05)	-0.05 (0.06)	-0.17** (0.07)
Ln(area)	-0.15 (0.06)	0.11* (0.06)	0.11 (0.06)	0.14** (0.06)	0.12** (0.06)	0.10 (0.07)
Distance to Equator	No	0.027** (0.007)	0.011 (0.09)	0.14** (0.09)	0.026** (0.007)	0.03*** (0.008)
Continental Dummies	No	Yes	Yes	Yes	Yes	Yes
Other Geography controls	No	Yes	Yes	Yes	Yes	Yes
Colonial Controls and European Settlers in 1900						
First stage						
Instruments	gravity predictor	gravity predictor	gravity predictor	gravity predictor	gravity predictor	gravity predictor
Wald F-statistics	15.44	16.31	15.96	16.26	16.71	8.95
Observations	141 (FR sample)	122 (FR sample)	121 (FR sample)	134 (Full sample)	117 (FR sample)	122 (FR sample)

NOTES: All regressions include an intercept **Continental Dummies** includes dummy variables for sub-Saharan Africa, East Asia, and Latin America. **Other Geography Controls** include the percentage of land in the tropics, a landlocked dummy, average distance to the coast, average yearly temperature, average yearly humidity, an index of soil quality, an index of the incidence of malaria, and an index of the incidence of yellow fever. **Colonial Controls includes d**ummy variables for former French colony, former English colony, and a dummy the 4 neo-Europe (US, Canada, Australia and New Zealand). *,**,***= significant at 10%, 5% and 1% confidence level.

Table 9: Effect of immigration on components of income per worker and on growth 1970-2000

Dependent variable	**(1) Ln (income per worker)**	**(2) Ln(capital intensity)**	**(3) Ln(human capital)**	**(4) Ln(TFP)**
FR Sample				
FB as share of population	7.53*** (2.43)	0.97 (0.96)	1.26* (0.78)	5.29*** (2.48)
FB as share of human capital	3.75** (1.22)	0.48 (0.47)	0.63* (0.38)	2.64** (1.29)
Observations	99	99	99	99

Note: the coefficient reported are those on the share of foreign born (in population or human capital) in a regression that includes as explanatory variables ln(population), ln(area), geographic and colonial controls and uses the non-linear gravity predictor as in Regression (4) of Table 5. In the growth regression we also control for the log of initial GDP per person. *,**,***= significant at 10%, 5% and 1% confidence level.

Table 10: The effect of diversity of immigrants on income per person

	(1) Immigrant Diversity as exogenous variable	(2) As (1) plus geography and colonial controls	(3) Immigrant Diversity as only endogenous variable	(4) As (3) plus geography and colonial controls	(5) Assuming exogenous immigration and diversity	(6) As (5) with geography and colonial controls
Method of estimation	2SLS	2SLS	2SLS	2SLS	OLS	OLS
FB/Population	7.07**	3.74*			4.32***	5.24***
	(2.95)	(2.17)			(0.95)	(1.05)
Index of Immigrant Diversity	2.40***	1.42***	3.76***	3.87*	1.76***	1.27***
	(0.49)	(0.37)	(1.18)	(2.29)	(0.29)	(0.37)
Ln(Population)	0.16**	-0.09	-0.05	-0.11	-0.01	-0.06
	(0.07)	(0.05)	(0.06)	(0.06)	(0.05)	(0.05)
Ln(area)	-0.22***	-0.04	-0.17**	-0.05	-0.12***	0.06
	(0.05)	(0.05)	(0.07)	(0.09)	(0.05)	(0.05)
Distance to equator	Yes	Yes	Yes	Yes	Yes	Yes
Continental Dummies	No	Yes	Yes	Yes	Yes	Yes
Other Geography controls	No	Yes	No	Yes	No	Yes
Colonial Controls	No	Yes	No	Yes	No	Yes
First stage						
Wald F-statistics of the first stage	9.00	8.57	6.35	2.95	NA	NA
Observations	138 (FR sample)	119 (FR sample)	138 (FR sample)	119 (FR sample)	138 (FR sample)	119 (FR sample)

NOTES: All regressions include an intercept**. Continental Dummies** includes dummy variables for sub-Saharan Africa, East Asia, and Latin America. **Other Geography Controls** include the percentage of land in the tropics, a landlocked dummy, average distance to the coast, average yearly temperature, average yearly humidity, an index of soil quality, an index of the incidence of malaria, and an index of the incidence of yellow fever. **Colonial Controls includes d**ummy variables for former French colony, former English colony, and a dummy the 4 neo-Europe (US, Canada, Australia and New Zealand). *,**,***= significant at 10%, 5% and 1% confidence level.

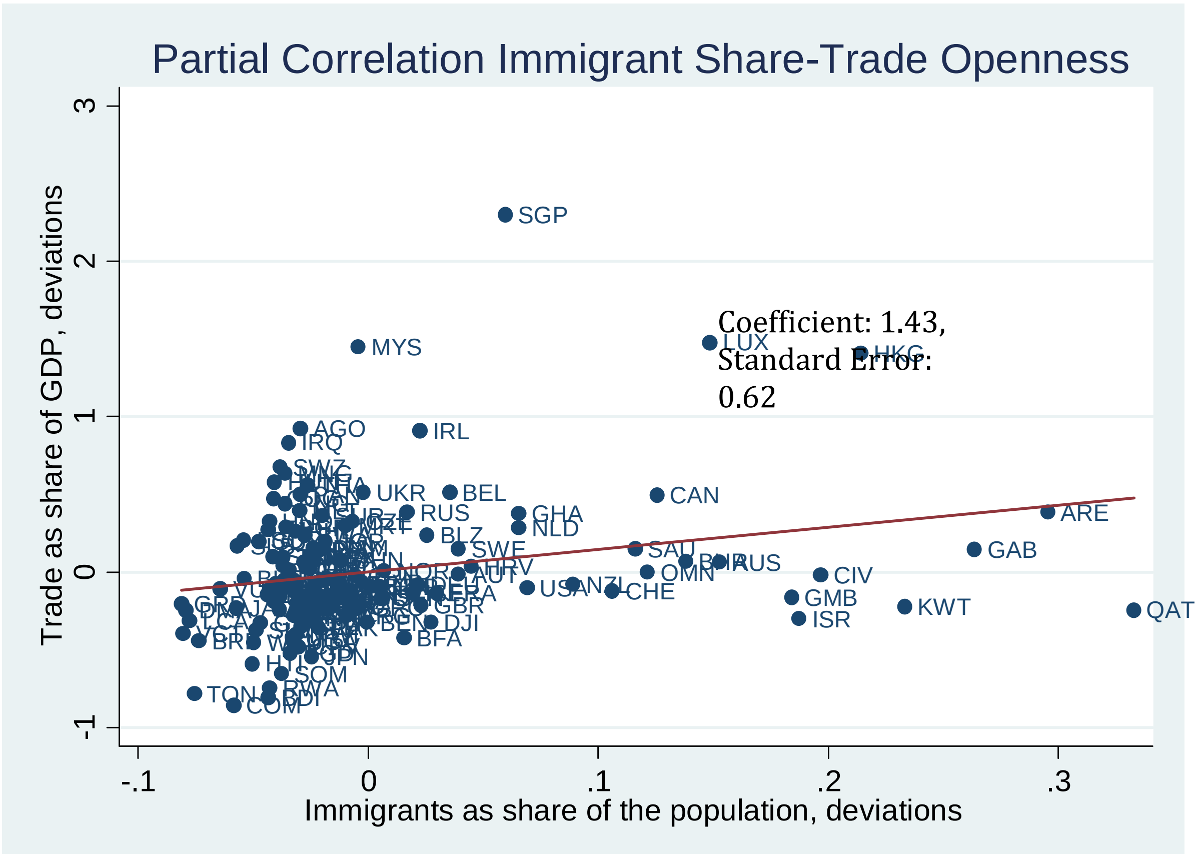
Table 11: The effect of Openness to Immigration on Income inequality

	(1) Gini coefficient, basic specification	(2) Gini Coefficient, specification with geographic and colonial controls	(3) Gini coefficient and trade openness as explanatory	(4) 90-10 income ratio, basic specification	(5) 90-10 income ratio, specification with geographic and colonial controls	(6) 90-10 income ratio and trade openness as explanatory
Method of estimation	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
FB/Population	-2.07* (1.11)	-0.22 (0.36)		-207.6 (150.9)	-50.4 (42.8)	
Trade/GDP			-0.49* (0.30)			-17.9 (0.26)
Ln(Population)	-0.01 (0.01)	-0.003 (0.007)	-0.02 (0.02)	-2.31 (1.87)	-1.43 (1.28)	-2.59 (1.37)
Ln(area)	-0.005 (0.017)	-0.0007 (0.009)	-0.06 (0.05)	-0.51 (3.34)	1.06 (1.22)	-1.06 (5.26)
Distance to Equator	No	Yes	No	No	Yes	No
Continental Dummies	No	Yes	No	No	Yes	No
Geography and Colonial controls	No	Yes	No	No	Yes	No
First stage						
Instruments	gravity predictor	gravity predictor	gravity predictor	gravity predictor	gravity predictor	gravity predictor
Wald F-statistics	4.41	14.02	3.69	2.54	9.05	0.85
Observations	130 (FR sample)	115 (FR sample)	130 (FR sample)	71 (Full sample)	66 (FR sample)	71 (FR sample)

NOTES: All regressions include an intercept**. Continental Dummies** includes dummy variables for sub-Saharan Africa, East Asia, and Latin America. **Other Geography Controls** include the percentage of land in the tropics, a landlocked dummy, average distance to the coast, average yearly temperature, average yearly humidity, an index of soil quality, an index of the incidence of malaria, and an index of the incidence of yellow fever. **Colonial Controls includes d**ummy variables for former French colony, former English colony, and a dummy the 4 neo-Europe (US, Canada, Australia and New Zealand). *,**,***= significant at 10%, 5% and 1% confidence level.

Figures

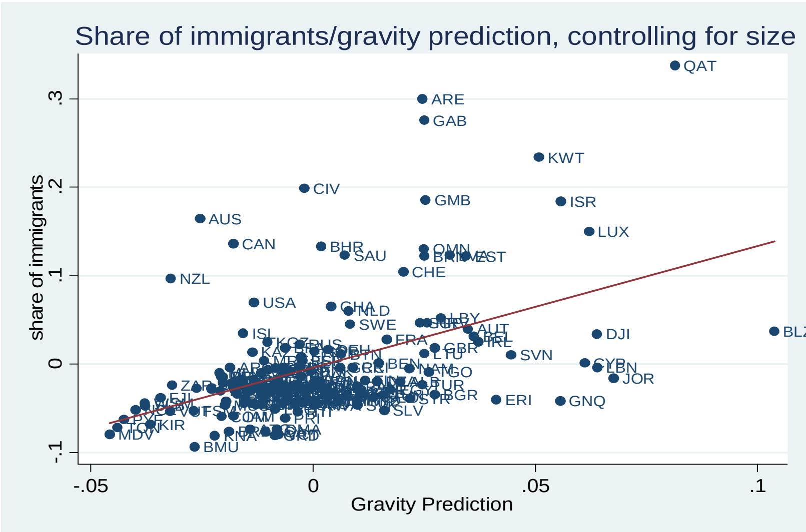
Figure 1



Note: The data are relative to 147 countries in year 2000. The sources and construction of the trade as share of GDP and of immigrant as share of population is described in the text

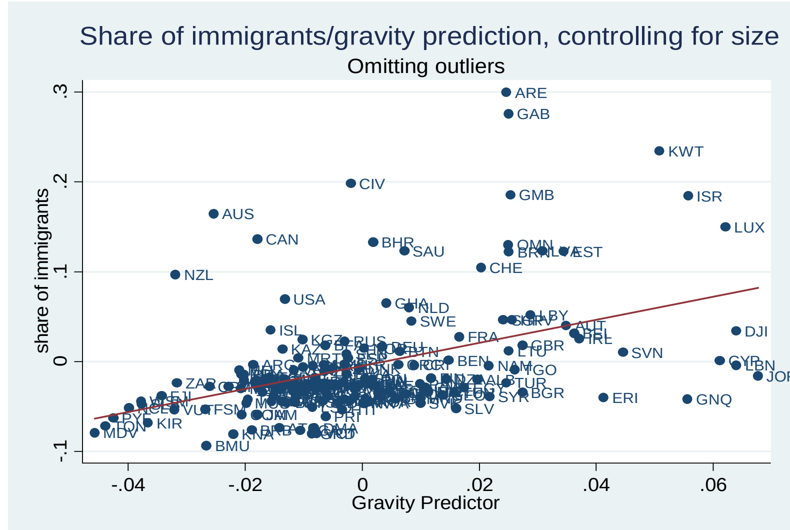
Figure 2

2A: Fit of the immigration gravity instrument, controlling for size



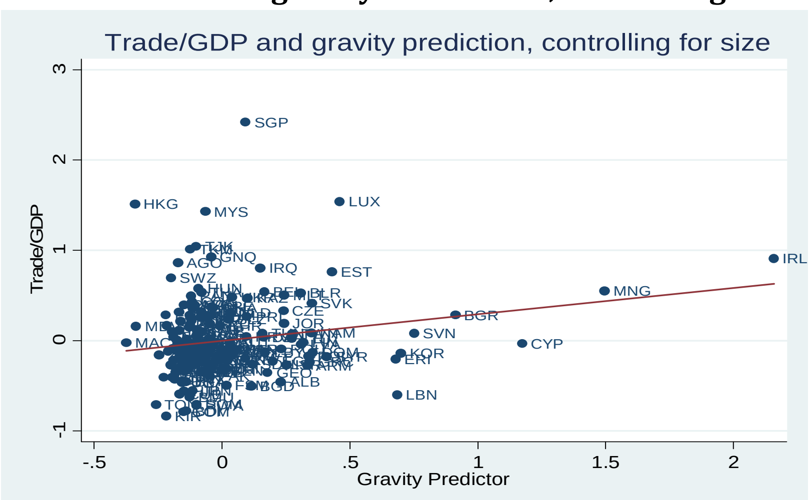
Slope: 1.37, standard error: 0.30 F-stat: 20.56

2B: Excluding 2 outliers



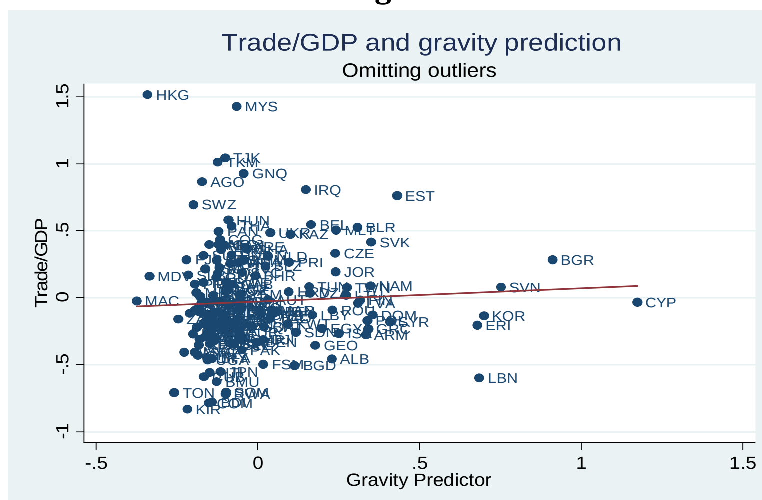
Slope: 1.28, standard error: 0.26 F-stat: 22.90

2C: Fit of the trade gravity instrument, controlling for size



Slope: 0.29 std. error 0.09, F-test 9.39

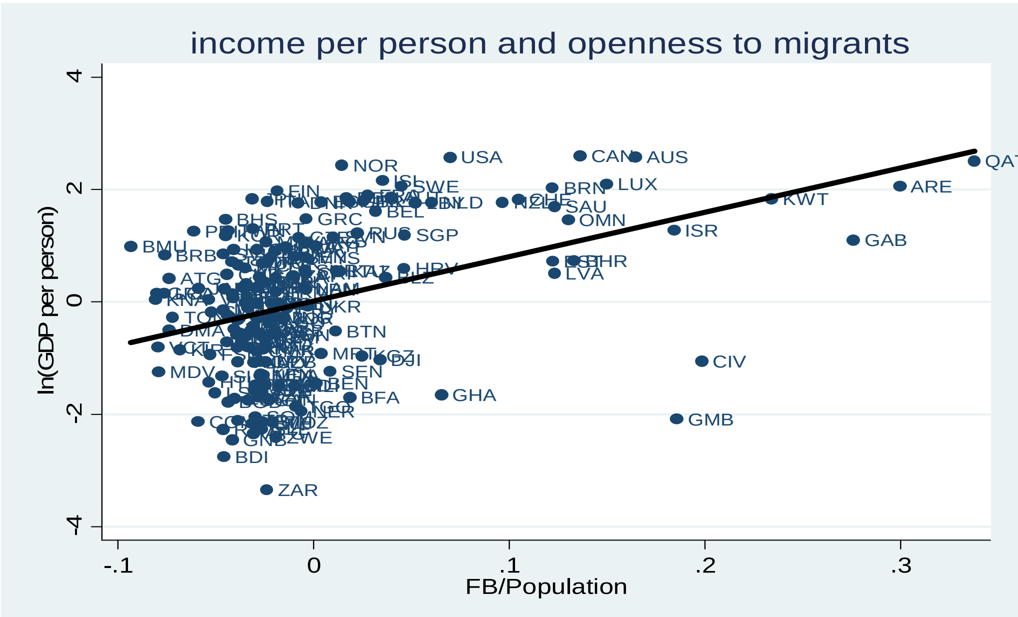
2D: Excluding 4 outliers



Slope: 0.09 std. error 0.11, F-test 0.39

Figure 3: Openness to immigrants and GDP per person

3A: foreign-born share and GDP per person



3B: gravity-predicted immigration and GDP per person