DISCUSSION PAPER SERIES

DP11526

IMMIGRATION POLICIES, LABOR COMPLEMENTARITIES, POPULATION SIZE AND CULTURAL FRICTIONS: THEORY AND EVIDENCE

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LABOUR ECONOMICS

ISSN 0265-8003

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Discussion Paper DP11526
Published 23 September 2016
Submitted 23 September 2016

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JEL Classification: C72, F22, O3, R1

Keywords: Immigration quotas, Nash equilibrium, labor complementarity, cultural frictions, panel data, fixed effects

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Immigration Policies, Labor Complementarities, Population Size and Cultural Frictions: Theory and Evidence[1]

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February 2016

Abstract

In this paper we consider a simple model of international migration developed in Fujita and Weber (2009). There are two countries A and B, that differ in population size, degree of labor complementarity between natives and immigrants, as well as cultural attitudes towards immigrants. The countries select immigration quotas for the world population of immigrants. We apply the existence result of Fujita-Weber and show that in equilibrium the larger country attracts more immigrants, while choosing a lower quota than its smaller counterpart. It also turns out that higher degree of labor complementarity between natives and immigrants and a lower degree of cultural friction between two groups yield higher immigration quota. Finally, we test the empirical validity of the model using country-level data and demonstrate that both cross-section and panel data approaches support several of the key theoretical findings.

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[1]The paper represents an empirical and theoretical extension of Fujita-Weber (2010). Shlomo Weber wishes to express his gratitude to Masa Fujita, whose friendship and guidance was the most important outcome of their collaboration.

[2]The authors wish to acknowledge the support of the Ministry of Education and Science of the Russian Federation, grant No. 14.U04.31.0002.

1 Introduction

In describing an array of industries that require a high-skilled labor, one immediately comes to the conclusion that different production technologies in different countries impose distinct requirements on the level and distribution of labor skills and the workers' interaction with each other. For example, over the years Japan has achieved a very high level of performance in manufacturing industries (cars, sophisticated consumer goods) that require a high level of precision and consistent quality control. These industries are characterized by a large number of production stages where technological progress is usually achieved through the series of small but incessant improvements, called "kaizen" (see, e.g., Imai (1989)). This type of production requires not only highly educated and able workers, but also a consistent and extensive level of interaction between them. These demands result in emergence of a labor force that is relatively homogeneous in its educational, cultural, and linguistic background. On the other hand, the United States specialize in "knowledge", and especially, software industries that rely on talents and abilities of individuals coming from a wide range of vastly different educational and cultural environments. The success of Silicon Valley in the late nineties is often attributed to the diverse backgrounds of scientists, engineers and entrepreneurs who arrived from all corners of the world. However, the diversity did not prevent, and, in fact, even reinforced the commonality of workers' purpose and goals. Saxenian (1996) describes how workers in Silicon Valley enjoyed frequent and intensive exchange of information through variety of formal and informal contacts. The exchange was facilitated by frequent moves of workers from one firm to another (the average time spent by an individual in one firm was about two years), and flexible industry structure (it has been often claimed that in Silicon Valley "a firm is simply a vehicle allowing an individual to work.")

The nature of knowledge production indicates the importance of interaction between different workers and, especially, complementarity of their talents and skills, that is quite different from the multi-stage technological process in high-precision manufacturing (see Milgrom and Roberts (1990) and Kremer (1993)). In general, the labor complementarity is based on two sources, internal heterogeneity, that describes the diversity of talents within the

existing group of workers engaged in a given industry, and external heterogeneity, that captures the diversity between the existing group of workers and "newcomers" to the industry. The first type of heterogeneity has been the focus of the Grossman and Maggi (2000) two-country analysis, which introduced a model with a diverse talent pool within each country and examined, among other issues, an assignment of different individuals to complementary tasks, and its impact on trade patterns between two countries. Our goal is to examine an external labor complementarity between "native" population and immigrant workers in a given industry.

Following Fujita and Weber (2010), we consider two countries, A and B, and the world of immigrants, denoted by I. Each of the three groups, A, B, and I is homogeneous and consists of identical individuals. The countries' heterogeneity comes from three sources: (i) a different degree of labor complementarity between countries' native population and immigrants; (ii) a variance countries' population size; (iii) the magnitude of cultural friction between natives and immigrants. The cultural friction may manifest itself in language barriers caused by a difficulty of learning a local language, natives' bias towards to immigrants, distinct cultural, religious and behavioral attitudes exhibited by natives and immigrants. Different attitudes towards immigrants across various countries can be explained by the web of historical, cultural, linguistic, ethnic, religious, geographic, and economic reasons that are not examined here and we simply accept the fact that various countries exhibit different degrees of cultural friction between natives and immigrant population.

Fujita and Weber (2010) have shown the existence and uniqueness of Nash equilibrium in the non-cooperative quota game between two countries, where the spill-over effect is introduced through the world immigrant wages. Moreover, Fujita and Weber point out that the equilibrium immigartion quota are excessive and both countries would be better off coordinating the quota reducrtion. The goal of our paper is two-fold. In the theoretical part we compare the equlibrium quotas in two countries and show that the country with a higher labor complementarity and lower cultural friction admits a larger number of immigrants than its counterpart. It turns out that while the more populous country would attract a larger

number of immigrants, its relative immigration quota would nevertheless be lower than in the smaller country.

In the empirical part, we provide estimates for an empirical model that mimics the main features of the theoretical model. In addition to the explanatory variables identified by the theory, we include a number of additional control variables that are likely to matter for a country's share of immigrants. In addition to the usual cross-section estimation approach, we estimate the empirical model within a cross-section, time series framework that allows us to include country-specific dummies to control for unobserved, time-invariant country-specific variables. We find strong support for the prediction that cultural frictions play a major role in reducing a country's immigrant share, while the theoretical result that larger economies should have smaller immigrant shares is only marginally supported.

The paper is organized as follows. In the next section we present the model. In Section 3 we introduce the Fujita-Weber immigration game and compare the levels of the immigration quotas chosen by the countries in equilibrium. Sections 4 and 5 contain description of the data and the empirical model, respectively. We discuss the empirical results in Section 6. Finally, we provide the concluding remarks. The proofs of the theoretical results as well as the empirical findings are relegated to the Appendix.

2 The Model

Following Fujita and Weber (2010), our model contains two "industrialized" countries, A and B, each facing an unlimited source of immigrants from the "rest of the world". One of the main features of the model is that we allow for intra-country heterogeneity of levels of labor complementarity between native population (natives) and immigrants in two countries. Thus, two countries may face different effects of immigrants' contribution towards its production capabilities. More specifically, the production function of country $j = A, B$ is given by:

$$Q_j = (N_j^{\alpha_j} + I_j^{\alpha_j})^{\frac{1}{\alpha_j}}, \tag{1}$$

where N_j is the country population of natives and I_j is the number of immigrants to country j. The parameter α_j represents the reverse measure of labor complementarity between natives and immigrants in j. We assume that $0 < \alpha_j < 1$, and within this range, the smaller values of α_j reflect a higher degree of labor complementarity. Note also that when $\alpha_j \leq 0$, the complementarity is so strong that the output Q_j tends to zero when the number of immigrants I_j approaches zero. This would imply that the country is unable to survive without the influx of immigrants. In order to avoid this unrealistic situation, we rule out all non-positive values of α_j. On the other hand, when α_j exceeds 1, the iso-quant curves of country j are strictly concave, so that the mix of natives and immigrants is actually harmful for production purposes. This may happen if the cultural gap between two populations is too wide to allow a successful integration of the heterogeneous population into production process. In the case when $\alpha_j = 1$, the mix of two populations has the neutral effect and has neither positive nor negative benefit in production. Summarizing all these arguments, our analysis is focused on interesting and meaningful case of $0 < \alpha_j < 1$, where natives and immigrants posses a sufficient degree of diversity to enhance the productivity of the industry they engage in. At the same time, the degree of diversity is sufficiently small to allow beneficial integration of two populations into the production process.

The real immigrant wage, w_I, is the same in both countries. It is determined via supply function given by

$$w_I = c + \gamma I, \tag{2}$$

where c and γ are positive constants, and $I = I_A + I_B$ is the total number of immigrants in countries A and B. The high-skilled professionals is a scarce resource and we assume that intense world competition for their services drives up their wages that are increasing in the number of high-skilled immigrants I. Also, the decreasing marginal productivity in the immigrants' country of origin implies that a larger immigration flow to countries A and B leads to a smaller number of workers employed in the country of their origin, and a raise in their world wage w_I. As we alluded above, in addition to their size and labor complementarity parameters, two countries differ in the magnitude of cultural friction between their native

populations and immigrants. This type of the intra-country heterogeneity plays an important role in our analysis. In spite of the fact that the immigrant real wages are identical in both countries, the actual wages should take into account different cultural environments in two countries. Indeed, if the linguistic, cultural or religious obstacles faced by immigrants in country B are substantially higher than in country A, then the actual wages that are necessary to attract immigrants into country B should be higher than those needed in country A. Formally, we introduce a degree of cultural friction in both countries, f_A and f_B, such that the actual wages to be paid to immigrants in country $j = A, B$ are given by

$$w_j = w_I + f_j. \tag{3}$$

Then the welfare of country $j = A, B$ is[3]

$$W_j = Q_j - w_j I_j = Q_j - w_I I_j - f_j I_j. \tag{4}$$

The immigration quota of country $j = A, B$, given by

$$x_j = \frac{I_j}{N_j}, \tag{5}$$

represents the ratio of immigrants and the native population. The production levels in two countries are determined by

$$Q_A = N_A(1 + x_A^{\alpha})^{\frac{1}{\alpha}},\ Q_B = N_B(1 + x_B^{\beta})^{\frac{1}{\beta}}, \tag{6}$$

where, for simplicity of notation, the degrees of complementarity, α_A and α_B, are replaced by α and β, respectively. It is convenient to express the real immigrant wage and the country j's welfare level in terms of immigration quotas:

$$w_I = c + \gamma(N_A x_A + N_B x_B), \tag{7}$$

[3]Here we implicitly assume a circular flow of migration between country j and the rest of the world (called "temporary migration" (Wong (1995)), when immigrants do not stay in j for "too long". Thus, the welfare of country j is that of its natives only. More generally, we may replace the term $w_I I_j$ by $\theta_j w_I I_j$, where $\theta_j \in [, 1]$ is a parameter reflecting the degree of integration of immigrants in country j's society. $\theta = 1$ corresponds to our model whereas other extreme case $\theta =$ represents the case of the complete integration of immigrants where their earnings are fully accounted in the country welfare.

and

$$W_j = Q_j - w_I N_j x_j - f_j N_j x_j. \tag{8}$$

To illustrate the features of our model, consider the following examples discussed in Fujitand Weber (2010):

Example 2.1: Let country A be the United States and B Japan. Suppose that all immigrants are from China. Given different cultural background, Chinese immigrants do not easily integrate into production process in Japan that requires a high degree of cultural homogeneity and an intensive level of interaction and communication within the labor force. Thus, the degree of labor complementarity of Chinese immigrants in Japan is relatively low. The situation is different in the U.S., where, after receiving an appropriate education, Chinese immigrants exhibit a relatively high degree of labor complementarity. Thus, the reverse degree of complementarity of "natives" and immigrants in the U.S., α, is lower than β, the corresponding value in Japan.

As far as cultural friction is concerned, it is commonly recognized that the U.S. are more open to immigration than Japan. In addition, there are also linguistic and historical challenges for Chinese immigrants in Japan. Even though Chinese characters are used in both China and Japan, their pronunciation in two countries is completely different. More importantly, the Chinese language structure is very similar to that of English, while being quite distinct from Japanese. In addition, the lingering memories of painful historical events and relationship between the two countries, one may assume a higher degree of cultural friction faced by Chinese immigrants in Japan than in the U.S., implying $f_A < f_B$.

Finally, since a larger population in the U.S. yields $N_A > N_B$. To summarize, this example satisfies the following relationship between the parameters of the model:

$$\alpha < \beta,\ f_A < f_B,\ N_A > N_B. \tag{9}$$

Example 2.2: The relationship indicated by (9) can be derived from a slightly different story, where the degree of complementarity of two populations in production depends

not only on their cultural heterogeneity but also on the industry they are employed. As in Example 2.1, let country A be the United States and B Japan, but now suppose that all immigrants come from India. One can assume that while Japan specializes in the production of high-quality manufacturing, the U.S. specialization lies in software development. Then the mix of heterogeneous populations of Japanese and Indians may be rather harmful in refining the high-quality manufacturing through incessant "kaizen" in the production process. In contrast, mixing appropriately heterogeneous populations of Americans and Indians generates higher complementarity in software development. Thus, the *reversed* degree of complementarity α in the U.S. would be lower than the corresponding value β in Japan. We may also assume that, in terms of cultural differences, Hindu is equally distant from Christianity and Buddhism. But, given the Indian colonial past, a large number of educated people in India speak English, so that the degree of cultural friction in the U.S. is lower than in Japan. Thus, inequalities (9) hold in this example as well.

As it is commonly known, the number of immigrants in the U.S. is larger than that in Japan. In Section 3 we shall re-examine the relationship described in (9) and demonstrate that our theoretical conclusions are consistent with the existing immigration gap between two countries.

3 The Quota Game

Formally, we consider a game between two countries, A and B, whose strategic choices are their relative immigration quotas, x_A and x_B, respectively. The payoff of country $j = A, B$, is represented by its welfare level, $W_j(x_A, x_B)$, that depend on their production, immigrant wages, and the cultural friction between the native population and immigrants in country j:

$$W_j(x_A, x_B) = Q_j - w_I N_j x_j - f_j N_j x_j. \tag{10}$$

The existence and uniqueness of a pure strategies Nash equilibrium in this game has been shown in Fujita and Weber (2010). Our goal is to examine how differences in population

size, degree of complementarity and cultural friction impact the variance in the equilibrium immigration quotas and welfare levels in two countries.

In the first proposition we consider the countries with the same population and examine two cases. One is where two countries have an identical degree of labor complementarity but differ with respect to the magnitude of the friction between natives and immigrants. The second case deals with two countries that are distinguished only on the basis of the labor complementarity between the native and immigrant population.

Proposition 3.1: Assume that $N_A = N_B$.

(i) Let $f_A = f_B$, whereas $\alpha < \beta$, i.e., the degree labor complementarity in country A is higher than in country B. (Recall that α and β are the reverse measures of complementarity in countries A and B, respectively.) Then $x_A^e(p) > x_B^e(p)$.

(ii) Let $\alpha = \beta$, $f_A < f_B$, whereas $f_A < f_B$, i.e., country A exhibits lower degree of cultural friction than country B. Then country A would accept more immigrants, i.e., $x_A^e(p) > x_B^e(p)$.

The intuition here is quite clear. If the countries are distinguished only on the basis of labor complementarity, they both pay identical wages to immigrants. However, since the marginal productivity is higher in the country with a higher degree of labor complementarity, assertion (i) states that country A would choose a higher immigration quota. In the case where countries differ with respect to their degree of cultural friction, the gross wages paid to immigrants are lower in A. The declining marginal productivity implies that the country A should accept a larger number of immigrants.

Let us now turn to the impact of population size in two countries on their strategic choice of immigration quotas. If the population of two countries is the same, there is no need, as Proposition 3.1 shows, to provide a separate examination of relative and absolute number of immigrants in A and B. However, for countries with heterogeneous population sizes, a distinction between absolute and relative number of immigrants is essential. In Proposition 3.2, we consider two countries with identical degrees of labor complementarity and cultural friction, but different population sizes. We will compare both the immigration quotas (the

relative number of immigrants with respect to the native population) and (absolute) the number of immigrants in two countries:

Proposition 3.2: Assume that $\alpha = \beta, N_A > N_B, f_A = f_B$. Then

(i) The immigration quota is lower in the more populous country A, i.e., $x_A^e(p) < x_B^e(p)$.

(ii) However, the larger country would accept a larger number of immigrants, i.e., $I_A > I_B$, or $N_A x_A^e(p) > N_B x_B^e(p)$.

Indeed, consider country A. Under identical degrees of labor complementarity in two countries, the higher population size and declining marginal product imply (see equations (18)-(19) in the Appendix) that country A will have a lower immigration quota. In the same time, a lower immigration quota in A yields a higher value of the per capita marginal productivity in that country. Since the difference between the per capita marginal product and the weighted number of immigrants is equal in both countries, it immediately implies that the number of immigrants into A is larger than into B.

The next corollary examines the aggregate effect of differences in population size, degree of complementarity and cultural friction. We consider the case where, as in Examples 2.1 and 2.2, country A is more populous, has higher degree of labor complementarity and lower degree of cultural friction than country B. Then the number of immigrants to country A exceeds the number of immigrants to country B, which is consistent with the fact that the number of immigrants in the U.S. is larger than in Japan.

Corollary 3.3: Assume that $p \in P$ be such that $\alpha < \beta$, $f_A < f_B$ and $N_A > N_B$. Then $I_A > I_B$.

Now let us turn to the welfare comparison between the countries that are distinct in their labor complementarity, population size and degree of cultural friction. Consider a point $p \in P$. The welfare levels of two countries in the equilibrium of the game $\Gamma(p)$, $W_A(x_A^e(p), x_B^e(p))$ and $W_B(x_A^e(p), x_B^e(p))$, will be denoted simply by $W_A^e(p)$ and $W_B^e(p)$, respectively.

Proposition 3.4: (i) Assume that $p = (\alpha, \beta, N_A, N_B, f_A, f_B) \in P$ is such that $\alpha < \beta$, $N_A = N_B$, and $f_A = f_B$. Then the country with higher degree of complementarity

attains higher level of welfare, i.e., $W_A^e(p) > W_B^e(p)$.

(ii) Let $p \in P$ be such that $\alpha = \beta$, $N_A > N_B$, and $f_A = f_B$. That is, the countries differ only with respect to their population size. Then the more populous country is better off relatively to its smaller counterpart: $W_A^e(p) > W_B^e(p)$.

(iii) Assume that $p \in P$ is such that $\alpha = \beta$, $N_A = N_B$ but $f_A < f_B$. Then the country with lower cultural friction attains higher level of welfare, i.e, $W_A^e(p) > W_B^e(p)$.

Proposition 3.4 allows us to examine some possible policy implications of the results stated here. Among three parameters, labor complementarity, the size of native population, and the degree of cultural friction between natives and immigrants, it seems that the first two parameters are unlikely to be altered in short or medium run. However, the last aspect, that of cultural friction, should be become a subject of active public policy debate and action. Indeed, in order to enhance the national welfare, it is important to undertake concrete measures aimed at reducing the value of cultural frictions between natives and immigrants.

4 Empirical Model

The above analysis makes distinct predictions about the relationship between immigration quotas and a number of its determinants. In particular, propositions 3.1 to 3.4 state that a country's immigrant quota should be positively correlated to both the degree of labor complementarity between native and immigrant workers and negatively correlated with the degree of cultural frictions between immigrants and natives. Furthermore, more populous countries should have smaller immigrant quotas then smaller smaller countries. Such distinct predictions lend themselves to an empirical investigation which is the topic of the remainder of this paper. To test the theoretical predictions, we first derive an empirical model that captures the main features of the theoretical investigation.

$$x_{it} = \mu_i + \gamma_1 LC_{it} + \gamma_2 CF_{it} + \gamma_3 N_{it} + \gamma' \mathbf{X_{it}} + \epsilon_{\mathbf{it}} \tag{11}$$

where x_{it} is ratio of immigrants to native workers in country i at time t, LC_{it} is a measure of labor complementarities between immigrants and natives, CF_{it} is a measure of cultural frictions between immigrants and natives, N_{it} is the size of the population and $\mathbf{X_{it}}$ is a vector of additional time-varying covariates that matter in determining a country's immigrant ratio. The term μ_i captures all time-invariant, unobserved heterogeneity between countries, and ϵ_{it} is an idiosyncratic random disturbance to be assumed iid and normally distributed. If the theoretical predictions are born out by the empirical estimates, we expected the parameter estimates to have the following signs:

$$\gamma_1, \gamma_2 > 0; \gamma_3 < 0 \tag{12}$$

We estimate the above model by applying the standard fixed effect (FE) estimator to a panel data set. We also report two alternative specifications, the random effects (RE) estimator and a simple cross-section estimator where all time-varying variables have been replaced by their time averages.

5 Data

Various data sources are used to construct the variables needed to estimate equation 1. The immigrant ratio, x_{it} is approximated by the foreign born ratio available from the U.N. migration statistics website. The level of complementarity between immigrants and native workers is approximated by a series of variables measuring the attitudes of natives toward immigrants. These variables, discussed in more detail in Table 1 below, are obtained from various waves of the World Value Survey. We use two measures as proxies for cultural frictions between immigrants and native workers: Language and cultural proximity. Language proximity is the linguistic distance between a country's main language(s), obtained from the CIA Factbook, and English. The metric for the linguistic distance measure was first introduced by Hart-Gonzalez and Lindemann (1993), extended to more languages in Grimes and Grimes (1993) and further discussed in Chiswick and Miller (2004, Table 1). The idea here is that the closer a country's main language is linguistically to English, the less friction we

would expect between native and immigrant workers in terms of language barriers regardless of the immigrant's native language. For example, Japanese, with a score of 1, is considered to be the most distant language to English and thus the hardest to learn for immigrants. On the other hand, Norwegian and Swedish, with a score of 3, are the least distant languages and hence are easiest to learn. If a country has more than one official language (e.g. English and French in Canada), we used the weighted average of the language scores using the fraction of that population that speaks a given language as weights (from CIA Factbook).

We use the KOF Index of Globalization as the second proxy for cultural frictions. The KOF Index is a weighted average of the number of McDonald's restaurants and the number of IKEA stores per capita, as well as the trade in books (as percent of GDP). Here, the idea is that the higher the KOF Index, the more open the economy is to foreign (i.e. Western) culture and the lower the frictions between immigrants and natives.

Finally, the size of a country's native population is approximated by the size of the country's total population (Pop).

In addition, we include a set of control variables comprised of the total trade share in GDP (Openness) and two variables that measure the quality of government institutions: The amount of contract-intensive money (CIM) in circulation and the quality of contract enforcement, police and courts (Law and Order).

Summary statistics as well as the expected sign for each variable are given in Table 2.

6 Empirical Results

The results for the baseline panel data estimation with fixed effects (FE) are given in Table 3. In terms of theory predictions, we find no evidence that larger countries have smaller immigrant shares. On the contrary, larger countries tend to have larger immigrant shares, with all point estimates significant at the 10% level. Both cultural frictions variables, language and cultural proximity, have the expected positive signs except for language proximity in column five. While cultural proximity is not statistically significant, language proximity is significant at the 10% level except for columns one and five. With regard to labor complementarity,

we introduce the seven measures one at a time. With the exception of Jobs (employers should give priority to native workers), all labor complementarity measures demonstrate the expected sign. Among those, measures three and four (neighbors and immigrant policy) are highly statistically significant, while the other four measures are moderately significant in the 20% - 30% range. The control variables for institutional quality display the expected positive sign in all specifications. While CIM is moderately significant at the 20% level, Law & Order is highly significant at the 1% level. Trade openness has the wrong sign, but is not statistically significant and hence does not appear to affect a country's immigrant share.

We test the robustness of the estimation results given in Table 3 through various robustness checks. In Table 4, we show another set of panel data FE estimates, but this time for different numbers of included labor complementarity variables, ranging from 2 (column 1) to all seven variables (column 8). We find that in addition to Job, both Assist and Moral Duty display the incorrect positive signs. However, only Moral Duty is statistically significant at the 10% level, while Job is statistically insignificant in the first three specifications and only moderately significant in the others. Among the complementarity variables with the correct sign, Immigration Policy is strongly significant (at the 1% level), while both Sympathy and Help vary in significance, though most of their estimates are significant at the 15% level. Only Neighbors is not statistically significant in any specification.

In terms of the cultural friction variables, Cultural Proximity continues to have the expected positive sign, but once again the estimates are not statistically significant. Surprisingly, Language Proximity now shows the wrong (negative) sign, but none of the estimates are significant except for column 8. The controls for institutional quality continue to display the correct positive sign. As in the previous table, the level of significance of Law & Order exceeds that of CIM in all specifications.

For our second robustness check, we time-average all time-varying variables (Foreign Born, Pop, CIM, Openness, and Cultural Prox) and re-estimate equation (10) as cross-section equation. This change increases the sample size by 30% since the sparsity of some of the time-varying variables is now less of an issue. The cross-section estimation results

are shown in Table 5. The estimates mirror those of Table 3. Except for Job, the labor complementarity measures have the expected sign and all of them are now highly significant. Cultural Prox has the expected positive sign and is statistically significant at the 10% level in two of the seven specifications. Language Prox too shows the expected positive sign (except for column 1) and is statistically significant at the 10% level in all but one specification. For the first time, Population displays the expected negative sign in all seven specifications, but is statistically significant at the 5% level five of them.

The controls for institutional quality have the anticipated positive signs (except for Law and Order in column 1), as in the previous tables. While CIM is not statistically significant, Law % Order is highly significant at the 1% level.

7 Concluding Remarks

The purpose of this paper is twofold. First, we derive a theoretical model that links a country's immigrant share to a number of country specific variables such as the country's population size, the complementarity between native and immigrant workers, and the cultural frictions that exist between native and immigrant workers. For each of these conditioning variables, the model makes precise predictions about the expected correlation with the country's immigrant share. Second, in the empirical part of the paper, we provide estimates for an empirical model that mimics the main features of the theoretical model. In addition to the explanatory variables identified by the theory, we include a number of additional control variables that are likely to matter for a country's share of immigrants. While the theoretical model is static, we estimate the empirical model within a cross-section, time series framework that allows us to include country-specific dummies to control for all unobserved, time-invariant country-specific variables. We find that many, but not all of the theoretical predictions are supported by the empirical results. In general we find the strongest support for the prediction that cultural frictions play a major role in reducing a country's immigrant share. We find mixed support for the hypothesis that greater labor complementarities between natives and immigrants should increase a country's share of immigrants. We find the

least support for the theoretical claim that larger economies should have smaller immigrant shares. Given the severe data limitations that constrained our empirical investigation, we are not surprised that our robustness checks are not as strong and clear-cut as we would have liked. Nevertheless, the majority of the results obtained from several robustness checks confirm our baseline findings described above. Furthermore, when switching from a fixed effect panel approach to a basic cross-section approach, we find evidence in supports of all three predictions of the theoretical model including the inverse correlation between population size and immigrant share.

8 Appendix A

Before proceeding with the proofs of our results, notice that the welfare of two countries in terms of immigration quotas can be presented as:[4]

$$W_A(x_A, x_B) = N_A(1 + x_A^{\alpha})^{\frac{1}{\alpha}} - [c + \gamma(N_A x_A + N_B x_B)]N_A x_A - f_A N_A x_A, \tag{13}$$

$$W_B(x_A, x_B) = N_B(1 + x_B^{\alpha})^{\frac{1}{\alpha}} - [c + \gamma(N_A x_A + N_B x_B)]N_B x_B - f_B N_B x_B. \tag{14}$$

It would be also useful to note that

$$\frac{\partial W_A(x_A, x_B)}{\partial x_A} = N_A \left(g(\alpha, x_A) - c - \gamma(2N_A x_A + N_B x_B) - f_A\right) = 0 \tag{15}$$

and

$$\frac{\partial W_B(x_A, x_B)}{\partial x_B} = N_B \left(g(\beta, x_B) - c - \gamma(2N_B x_B + N_A x_A) - f_B\right) = 0, \tag{16}$$

where the function $g : (0,1) \times \Re_{++} \to \Re_{++}$ is defined by

$$g(\delta, x) \equiv (1 + x^{\delta})^{\frac{1}{\delta}-1} x^{\delta-1} = (1 + x^{-\delta})^{\frac{1}{\delta}-1}. \tag{17}$$

The following lemma summarizes some properties of the function g that will be utilized to prove our results:

Lemma $\mathcal{A}$: (i) For every $\delta \in (0,1)$, the function $g(\delta, \cdot)$ is decreasing on $\Re_{++}$.

(ii) For every $\delta \in (0,1)$, the function $g(\delta, x) \cdot x$ is increasing in x on $\Re_{++}$.

(iii) For every positive x, the function $g(\cdot, x)$ is decreasing on $(0,1)$.

(iv) For every $\delta \in (0,1)$, $\lim_{x\to} g(\delta, x) = +\infty$.

(v) For every $\delta \in (0,1)$, $\lim_{x\to+\infty} g(\delta, x) = 1$.

Assertion (i) states that the marginal product declines in the number of immigrants. (ii) implies, however, that the rate of decline is not "very steep." Assertion (iii)) states that the marginal product is positively correlated with the value of labor complementarity. (iv) and (v) describe the limit value of marginal product at corner points, zero and infinity.

[4]Since the welfare of each country is decreasing in immigration quota of the other country, it follows that the immigration quotas are, in fact, *strategic substitutes* (Bulow, Geanakoplos and Klemperer (1985)).

Note that the function g satisfies the following conditions

$$g(\alpha, x_A) = \frac{1}{N_A}\frac{\partial Q_A}{\partial x_A} \tag{18}$$

and

$$g(\beta, x_B) = \frac{1}{N_B}\frac{\partial Q_B}{\partial x_B}. \tag{19}$$

That is, the values of the function $g(\delta, x)$ for $\delta = \alpha, x = x_A$ and $\delta = \beta, x = x_B$ represent per capita marginal product induced by changing the immigration quota in countries A and B, respectively. Since the conditions in (14)-(15) can be rewritten as:

$$g(\alpha, x_A) - \gamma N_a x_A = c + \gamma(N_A x_A + N_B x_B) + f_A = w_I + f_A = w_A, \tag{20}$$

$$g(\beta, x_B) - \gamma N_B x_B = c + \gamma(N_A x_A + N_B x_B) + f_B = w_I + f_B = w_B, \tag{21}$$

the difference between the per capita marginal product and the weighted number of immigrants is equal to the actual immigrant wages paid in the country.

Proof of Lemma $\mathcal{A}$: (i), (iv) and (v) are straightforward. For (ii) note that

$$\frac{\partial[g(\delta, x)x]}{\partial x} = (1 + x^{-\delta})^{\frac{1}{\delta}-2}[-(1-\delta)x^{-\delta} + 1 + x^{-\delta}] = (1 + x^{-\delta})^{\frac{1}{\delta}-2}[\delta x^{-\delta} + 1] > 0. \tag{22}$$

Finally, to prove (iii), we have

$$g(\delta, x) = e^{(\frac{1}{\delta}-1)\log(1+x^{-\delta})}. \tag{23}$$

Then

$$\frac{\partial g(\delta, x)}{\partial \delta} = g(\delta, x)\left[-\frac{1}{\delta^2}\log(1 + x^{-\delta}) - \frac{(\frac{1}{\delta}-1)x^{-\delta}\log x}{1 + x^{-\delta}}\right]. \tag{24}$$

This expression is, obviously, negative when $x \geq 1$. If $0 < x < 1$, we have

$$\begin{aligned}\frac{\partial g(\delta, x)}{\partial \delta} &= -\frac{g(\delta, x)x^{-\delta}}{\delta^2(1 + x^{-\delta})}\left[x^{\delta}\log(1 + x^{-\delta}) + \log(1 + x^{-\delta}) + \delta\log x - \delta^2\log x\right] \\ &= -\frac{g(\delta, x)x^{-\delta}}{\delta^2(1 + x^{-\delta})}\left[x^{\delta}\log(1 + x^{-\delta}) + \log(1 + x^{\delta}) - \delta^2\log x\right] < 0.\end{aligned} \tag{25}$$

□

Proof of Proposition 3.1: (i) Let $\alpha < \beta$, $N_A = N_B$, $f_A = f_B$. From (18)-(19),

$$[g(\alpha, x_A^e(p)) - \gamma N_A x_A^e(p)] - [g(\beta, x_B^e(p)) - \gamma N_A x_B^e(p)] = 0. \tag{26}$$

Since, by Lemma $\mathcal{A}$, $g(\alpha, x_A^e(p)) > g(\beta, x_A^e(p))$, we have

$$[g(\beta, x_A^e(p)) - \gamma N_A x_A^e(p)] - [g(\beta, x_B^e(p)) - \gamma N_A x_B^e(p)] < 0. \tag{27}$$

Invoking Lemma $\mathcal{A}$ again, we conclude that the function $g(\beta, x) - \gamma N x$ is declining in x, yielding $x_A^e(p) > x_B^e(p)$.

(ii) Let $\alpha = \beta$, $N_A = N_B$, $f_A < f_B$. Note that the substraction of (19) from (18) implies that for every $p \in P$

$$[g(\alpha, x_A^e(p)) - \gamma N_A x_A^e(p)] - [g(\beta, x_B^e(p)) - \gamma N_B x_B^e(p)] = f_A - f_B. \tag{28}$$

Let $\alpha = \beta$, $N_A = N_B$ and $f_A < f_B$. Then (34) yields:

$$[g(\alpha, x_A^e(p)) - \gamma N_A x_A^e(p)] - [g(\alpha, x_B^e(p)) - \gamma N_A x_B^e(p)] < 0. \tag{29}$$

Since, by Lemma $\mathcal{A}$, the function $g(\alpha, x) - \gamma N_A x$ is declining in x, it follows that $x_A^e(p) > x_B^e(p)$. $\square$

Proof of Proposition 3.2: Let $\alpha = \beta$, $N_A > N_B$ and $f_A = f_B$.

(i) Invoking (26), we obtain

$$[g(\alpha, x_A^e(p)) - \gamma N_A x_A^e(p)] - [g(\alpha, x_B^e(p)) - \gamma N_B x_B^e(p)] = 0, \tag{30}$$

and, since $N_A > N_B$,

$$[g(\alpha, x_A^e(p)) - \gamma N_A x_A^e(p)] - [g(\alpha, x_B^e(p)) - \gamma N_A x_B^e(p)] > 0. \tag{31}$$

Since, by Lemma $\mathcal{A}$, the function $g(\alpha, x) - \gamma N_A x$ is decreasing in x, it immediately follows that $x_A^e(p) < x_B^e(p)$.

(ii) Since $x_A^e(p) < x_B^e(p)$, by Lemma $\mathcal{A}$ and (28), we have

$$[g(\alpha, x_A^e(p)) - g(\alpha, x_B^e(p))] = [\gamma N_A x_A^e(p) - \gamma N_B x_B^e(p)] > 0. \tag{32}$$

Moreover, since, by Lemma $\mathcal{A}$, $g(\alpha, x_A^e(p)) > g(\alpha, x_B^e(p))$, it follows that $N_A x_A^e(p) > N_B x_B^e(p)$.$\square$

Proof of Corollary 3.3: Let $\alpha < \beta$, $N_A > N_B$ and $f_A < f_B$. If $x_A^e(p) \geq x_B^e(p)$, the statement is straightforward. Let $x_A^e(p) < x_B^e(p)$, Since $f_A < f_B$, (26) implies that

$$[g(\alpha, x_A^e(p)) - \gamma N_A x_A^e(p)] - [g(\beta, x_B^e(p)) - \gamma N_B x_B^e(p)] < 0. \tag{33}$$

By Lemma $\mathcal{A}$, $g(\alpha, x_A^e(p)) > g(\beta, x_A^e(p))$, and we have

$$[g(\beta, x_A^e(p)) - g(\beta, x_B^e(p))] - [\gamma N_A x_A^e(p) - \gamma N_B x_B^e(p)] < 0. \tag{34}$$

Since, by Lemma $\mathcal{A}$, $g(\beta, x_A^e(p)) > g(\beta, x_B^e(p))$, it immediately yields $N_A x_A^e(p) > N_B x_B^e(p)$.$\square$

Proof of Proposition 3.4: Equations (11)-(12) imply that the equilibrium welfare levels of two countries, $W_A^e(p)$ and $W_A^e(p)$, respectively, are given by:

$$W_A^e(p) = N_A(1 + (x_A^e(p))^\alpha)^{\frac{1}{\alpha}-1} + \gamma N_A^2 (x_A^e(p))^2 = N_A\, g\left(\alpha, \frac{1}{x_A^e(p)}\right) + \gamma N_A^2 (x_A^e(p))^2 \tag{35}$$

$$W_B^e(p) = N_B(1 + (x_B^e(p))^\beta)^{\frac{1}{\beta}-1} + \gamma N_B^2 (x_B^e(p))^2 = N_B\, g\left(\beta, \frac{1}{x_B^e(p)}\right) + \gamma N_B^2 (x_B^e(p))^2 \tag{36}$$

(i) Let $\alpha < \beta$, $N_A = N_B$, and $f_A = f_B$. By assertion (i) of Proposition 3.1, $x_A^e(p) > x_B^e(p)$. Since, by Lemma $\mathcal{A}$, the function $g(\alpha, \frac{1}{x})$ is increasing in x, equations (35)-(36) imply that $W_A^e(p) > W_B^e(p)$.

(ii) Let $\alpha = \beta$, $N_A > N_B$ and $f_A = f_B$. By assertion (i) of Proposition 3.2, $x_A^e(p) < x_B^e(p)$. By Lemma $\mathcal{A}$, the function $g(\alpha, x)x$ is increasing in x. Thus

$$g\left(\alpha, \frac{1}{x_A^e(p)}\right)\frac{1}{x_A^e(p)} > g\left(\alpha, \frac{1}{x_B^e(p)}\right)\frac{1}{x_B^e(p)} \tag{37}$$

or

$$\frac{g\left(\alpha, \frac{1}{x_A^e(p)}\right)}{g\left(\alpha, \frac{1}{x_B^e(p)}\right)} > \frac{x_A^e(p)}{x_B^e(p)}. \tag{38}$$

Since, by assertion (ii) of Proposition 3.2, $\frac{x_A^e(p)}{x_B^e(p)} > \frac{N_B}{N_A}$, (35)-(36) imply that $W_A^e(p) > W_B^e(p)$.

(iii) Let $\alpha = \beta$, $N_A = N_B$ and $f_A < f_B$. By assertion (ii) of Proposition 3.1, $x_A^e(p) > x_B^e(p)$. Thus, $N_A x_A^e(p) > N_B x_B^e(p)$, and (35)-(36) guarantee that $W_A^e(p) > W_B^e(p)$. $\square$

9 Appendix B

Table 1: Variable Definitions and Sources

Variable	Definition	Source
Foreign Born Ratio$_{it}$	Ratio of foreign born to total population	United Nation
Population$_{it}$	total population, in millions	World Bank
CIM$_{it}$	Contract-intensive money: The ratio of non-currency to total money	Bittik, 2004
Openness$_{it}$	Trade share: Ratio of exports and imports to GDP	World Bank
Law and Order$_i$	Quality of contract enforcement, police and courts, as well as likelihood of crime and violence	Kaufmann and Mastruzzi, 2003
Cultural Prox$_{it}$	Cultural proximity to the "West": # of McDonald's, # of Ikea (per capita), Trade in Books (% of GDP)	KOF Index of Globalization
Language Prox$_i$	Country's main language proximity to English	Various
Job$_i$	Employers should not give job priority to native workers	World Value Survey
Neighbors$_i$	Would not like to have immigrants as neighbors	World Value Survey
Immigration Policy$_i$	Government policies should limit immigration	World Value Survey
Help$_i$	Do you refuse to help immigrants?	World Value Survey
Assist$_i$	No need to do something in return for immigrants	World Value Survey
Moral Duty$_i$	No Moral Duty to help immigrants	World Value Survey
Sympathise$_i$	No Sympathy for immigrants	World Value Survey

Table 2: Summary Statistics and Expected Sign of Coefficient Estimate

Variable	Obs	Mean	Min	Max	Expected Sign
Foreign Born Ratio$_{it}$	469	0.073	0.0003	0.724	n/a
Population$_{it}$	515	40.01	0.156	1280	-
Openness$_{it}$	487	75.48	2.57	404.78	n/a
CIM$_{it}$	287	0.815	0.196	0.98	+
Law and Order$_i$	478	32.505	1	96.823	+
Cultural Prox$_{it}$	312	7.072	1.67	10	+
Language Prox$_i$	508	0.3937	0	1	+
Job$_i$	92	1.58	0	2.458	+
Neighbors$_i$	92	0.115	0	0.356	-
Immigration Policy$_i$	92	2.359	0	2.705	-
Help$_i$	92	1.67	0	3.337	-
Assist$_i$	92	1.73	0	4.333	-
Moral Duty$_i$	92	1.34	0	2.647	-
Sympathise$_i$	92	1.269	0	2.896	-

Table 3: Panel Data Estimates with Fixed Effects

Dependent Variable: Foreign Born Share

Variable	1	2	3	4	5	6	7
Population$_{it}$	8.15E-02*	8.15E-02*	8.15E-02*	8.15E-02*	8.15E-02*	8.15E-02*	8.15E-02*
	(0.091)	(0.091)	(0.091)	(0.091)	(0.091)	(0.091)	(0.091)
Openness$_{it}$	-5.46E-07	-5.46E-07	-5.46E-07	-5.46E-07	-5.46E-07	-5.46E-07	-5.46E-07
	(0.999)	(0.999)	(0.999)	(0.999)	(0.999)	(0.999)	(0.999)
CIM$_{it}$	0.119	0.119	0.119	0.119	0.119	0.119	0.119
	(0.209)	(0.209)	(0.209)	(0.209)	(0.209)	(0.209)	(0.209)
Law and Order$_i$	0.028**	0.027**	0.027**	0.019**	0.017**	0.028**	0.027**
	(0)	(0)	(0)	(0.004)	(0.001)	(0)	(0)
Cultural Prox$_{it}$	4.6E-05	4.6E-05	4.6E-05	4.6E-05	4.6E-05	4.6E-05	4.6E-05
	(0.769)	(0.769)	(0.769)	(0.769)	(0.769)	(0.769)	(0.769)
Language Prox$_i$	0.007	0.05*	0.054*	0.072**	-0.014	0.056**	0.053*
	(0.811)	(.085)	(0.058)	(0.007)	(0.584)	(0.049)	(0.059)
Job$_i$	-0.09**						
	(0.001)						
Neighbors$_i$				-.519**			
				(0.002)			
Immigration Policy$_i$					-0.116**		
					(0.0)		
Help$_i$		-0.008					
		(0.296)					
Assist$_i$			-0.007				
			(0.3)				
Moral Duty$_i$						-0.009	
						(0.316)	
Sympathise$_i$							-0.013
							(0.198)
Constant	-0.081	-0.213**	-0.215**	-0.107*	0.147**	-0.218**	-0.211**
	(0.199)	(0.0)	(0.0)	(0.089)	(0.047)	(0.0)	(0.0)
Number of obs	66	66	66	66	66	66	66
Number of countries	22	22	22	22	22	22	22
R-squared	0.497	0.285	0.284	0.374	0.554	0.284	0.291

p-values in parenthesis; **/* indicates statistical significance at 5% / 10% level

Table 4: Robustness Check 1: Panel Data Estimates with Fixed Effects (Alternative Model Specifications

Dependent Variable: Foreign Born Share

Variable	1	2	3	4	5	6	7	8
Population$_{it}$	8.2E-02*	8.2E-02*	8.2E-02*	8.2E-02*	8.2E-02*	8.2E-02*	8.2E-02*	8.2E-02*
	(0.091)	(0.091)	(0.091)	(0.091)	(0.091)	(0.091)	(0.091)	(0.091)
Openness$_{it}$	-5.46E-07	-5.46E-07	-5.46E-07	-5.46E-07	-5.46E-07	-5.46E-07	-5.46E-07	-5.46E-07
	(0.999)	(0.999)	(0.999)	(0.999)	(0.999)	(0.999)	(0.999)	(0.999)
CIM$_{it}$	0.119	0.119	0.119	0.119	0.119	0.119	0.119	0.119
	(0.209)	(0.209)	(0.209)	(0.209)	(0.209)	(0.209)	(0.209)	(0.209)
Law and Order$_i$	0.015**	0.014**	0.014**	0.012**	0.012**	0.01*	0.012**	0.009**
	(0.009)	(.0120)	(0.017)	(0.03)	(0.041)	(0.089)	(0.04)	(0.012)
Cultural Prox$_{it}$	4.6E-05	4.6E-05	4.6E-05	4.6E-05	4.6E-05	4.6E-05	4.6E-05	4.6E-05
	(0.769)	(0.769)	(0.769)	(0.769)	(0.769)	(0.769)	(0.769)	(0.769)
Language Prox$_i$	-0.008	-0.0095	-0.002	-0.019	-0.035	-0.035	-0.022	-0.0488*
	(0.751)	(.713)	(0.931)	(0.472)	(0.253)	(0.253)	(0.447)	(0.07)
Job$_i$	0.0309	0.033	0.026	0.061	0.057	0.05	0.062	0.557
	(0.354)	(0.33)	(0.453)	(0.121)	(0.172)	(0.219)	(0.13)	(0.16)
Neighbors$_i$			-0.099		-0.061	-0.123	-0.005	-0.062
			(0.549)		(0.715)	(0.466)	(0.977)	(0.707)
Immigration Policy$_i$	-0.14**	-0.14**	-0.13**	-0.16**	-0.15**	-0.16**	-0.16**	-0.17**
	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
Help$_i$		-0.0025		-0.0303	-0.029	-0.056**	-0.032	-0.067**
		(0.691)		(0.144)	(0.17)	(0.029)	(0.124)	(0.01)
Assist$_i$				0.0247	0.0234	0.028	0.04*	0.05**
				(0.159)	(0.192)	(0.114)	(0.057)	(0.015)
Moral Duty$_i$						0.031*		0.038**
						(0.066)		(0.024)
Sympathise$_i$							-0.021	-0.028**
							(0.127)	(0.044)
Constant	0.16**	0.164**	0.163**	0.193**	0.192**	0.236**	0.208**	0.266**
	(0.034)	(0.033)	(0.034)	(0.015)	(0.016)	(0.004)	(0.01)	(0.001)
Number of obs	66	66	66	66	66	66	66	66
Number of countries	22	22	22	22	22	22	22	22
Adj. R-squared	0.561	0.5612	0.563	0.576	0.577	0.602	0.594	0.63

p-values in parenthesis; **/* indicates statistical significance at 5% / 10% level

Table 5: Robustness Check II: Cross-Section Estimates

Dependent Variable: Foreign Born Share

Variable	1	2	3	4	5	6	7
Population$_{it}$	-2.4E+00**	-3.9E-02**	-3.7E-02**	-3.7E-02	-8.9E-03	-3.6E-03**	-3.8E-02**
	(0.021)	(0.038)	(0.047)	(0.934)	(0.383)	(0.036)	(0.035)
Openness$_{it}$	-1.3E-02**	-1.4E-03	-5.5E-07	1.9E-02	-1.1E-02	1.6E-02	-1.3E-04
	(0.006)	(0.93)	(0.999)	(0.184)	(0.212)	(0.312)	(0.993)
CIM$_{it}$	0.0003	-0.0002	-0.0003	-0.002*	-0.001	-0.001	-0.0004
	(0.444)	(0.858)	(0.834)	(0.087)	(0.324)	(0.475)	(0.757)
Law and Order$_i$	-0.027**	0.024**	0.025**	0.018**	0.008**	0.024**	0.026**
	(0.0)	(0.0)	(0.0)	(0.0)	(0.02)	(0.0)	(0.0)
Cultural Prox$_{it}$	0.002	0.001	0.0004	0.0002	0.002**	0.001	0.0002
	(0.778)	(0.349)	(0.769)	(0.62)	(0.0)	(0.272)	(0.7)
Language Prox$_i$	-0.004**	0.04*	0.045**	0.072**	-0.003	0.05**	0.04*
	(0.0)	(0.07)	(0.045)	(0.0)	(0.809)	(0.02)	(0.062)
Job$_i$	-0.206**						
	(0.0)						
Neighbors$_i$				0.072**			
				(0.0)			
Immigration Policy$_i$					-0.135**		
					(0.0)		
Help$_i$		-0.015**					
		(0.015)					
Assist$_i$			-0.01**				
			(0.03)				
Moral Duty$_i$						-0.029**	
						(0.0)	
Sympathise$_i$							-0.02**
							(0.003)
Constant	0.255**	-0.062	-0.06	0.102	0.38**	-0.065	-0.05
	(0.0)	(0.54)	(0.55)	(0.278)	(0.0)	(0.485)	(0.61)
Number of obs	86	86	86	86	86	86	66
Adj. R-squared	0.79	0.49	0.44	0.575	0.82	0.513	0.47

p-values in parenthesis; **/* indicates statistical significance at 5% / 10% level

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