Global Wage Differences and International Student Flows

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There has been a long-standing interest in the flows of persons across countries, and in particular the international flow of skilled migrants. There are two major components in the literature on international migration, each concerned with the skill composition of international migrants. One strand of literature focuses on the impact of immigration on the receiving-country economy. Because the impact of immigration depends on the skill composition of immigrants, understanding the determinants of the skills of new immigrants is an important element of this research program. Most of the analyses of the determinants of the magnitudes and skill composition of US immigrants use US Census data on the foreign-born.[1] There are two major shortcomings of this literature, however. First, Census data do not provide information on entry visas. The US immigration system selects immigrants according to a wide variety of criteria, including mainly family relationships to US citizens. And some foreign-born are temporary migrants or migrants without a legal basis for staying or working in the United States. This heterogeneity in selection criteria and the constraints on immigration associated with country and visa category ceilings are not typically taken into account in the analyses and so there is little known about migrants who are selected by skill. Recently-available survey-based data on legal immigrants, moreover, indicate that there are substantial educational difference across immigrants chosen by different criteria.[2]

The second shortcoming of the literature focusing on US immigration is that the

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1. Borjas (1987) was the first major systematic study of the determinants of immigration to the United States and his methodology has been followed by many others; e.g, Cobb-Clark (1992).

2. Jasso et al. (1999).

analytical framework used is based on a model originally designed to analyze the choice of occupations by workers of different skill in a domestic economy in which there are no differences in the rewards to skill.[3] The framework is thus not well-suited for studying international migration in a world in which there are large differences in earnings for workers of the same skill. In addition, given the importance of family connections, job networks and constraints on the number of immigrant visas, standard economic models of self-selection have not been wholly successful in providing empirical evidence on worker migration based on data on immigrant flows or the US stocks of foreign-born.[4]

A second literature is concerned about the impact of skilled migration from the perspective of sending countries. Many of the earlier contributions to this literature, focusing on the outflow of workers and using the rubric "brain drain", were mostly theoretical.[5] However, in recent studies global information on the stocks of foreign-born by education in developed countries has been assembled to quantify the magnitude of the outflow of skilled migrants.[6] And the recent analytical literature has taken a somewhat more nuanced view of the phenomenon.[7] This newer literature, however, has underappreciated how much of the training by individuals born in poor countries occurs in rich countries. Just four receiving countries of international

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3. The model is that of Roy (1951).

4. Even illegal immigrants make use of informal job networks (Munshi, 2004), which are not captured in the principal models used to study US immigration.

5. For example, Bhagwati and Hamada (1974).

6. Docquier and Marfouk (2006)

7. For example, Commander et al.(2004).

students - the United States, Australia, Canada, and Britain - are currently admitting over 525,000 students per year. And, as indicated in Figure 1, the United States accounts for more than half of this flow.[8] [figure 1 about here]

The flow of foreign students admitted to the United States is considerably larger than the two other skill-based flows of immigrants and non-immigrants to the United States. In contrast to the over 240,000 foreign-born admitted to the United States in 2004 to augment their skills as formal students, only 73,212 permanent immigrants who qualified for an employment visa based on their skills were admitted.[9] And only 65,000 foreign workers were admitted as temporary migrants in 2004 based on their skill qualifications, in the H1B category.[10] Even if half of the

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8. The US annual visa count understates the flow of foreign students to the United States because citizens of Canada who study in the United States are not required to obtain a visa. This understatement is non-trivial, as in 2006 almost 9% of the stock of 635,443 US foreign-born students are from Canada (SEVIS). Of course, there are many other countries that train large numbers of foreign students, including France and Germany.

9. This is the number of principal applicants in the third, fourth and fifth-preference categories. 82,118 persons were admitted in these categories because they were the spouse or children of the immigrants screened for skill. These family members were not themselves subject to employment criteria.

10. H1B non-immigrants, who generally must have a college degree, are admitted for a three-year period to work for a specific employer in a "specialty" occupation. The visa may be renewed for a subsequent three years, after which the worker must leave the United States for at least one year. This category also includes a small number of "fashion models."

students from abroad remain in the United States (and the fraction is considerably less), it is clear that the US immigration system on net *seeks* to attract fewer skilled immigrants than the number of international skilled workers it trains.

Another long-standing literature has also been concerned with the low level of skills in low-income countries. This literature suggests that the level of education is low in such countries because of lack of access to schools, and points to high within-country estimates of "rates of return" in such countries as indicating under-investment. Recent studies by World Bank economists provide these estimates for many countries of the world, suggesting that in countries such as Botswana the return to a college education is as high as 38%.[11] Although this literature ignores the outflow of skilled workers and students, the large flows of persons seeking to acquire schooling in developed countries could be interpreted as evidence supporting the idea that there is a shortage of training opportunities within low-income countries - the lack of a schooling capacity in low-income countries induces the demand for training abroad.

Whether students come to high-income countries to acquire skills they could not otherwise acquire at home or come because high-skill employment is under-rewarded at home is not obvious, however. There has been little analysis of the determinants of the flow of international students. Borjas' (2002) recent polemic about the US system of admitting students, while informative about the basic facts, does not contain any analysis of the demand for US student visas. Bratsberg (1995) examines the determinants of the "return" rates of foreign students. However, that analysis uses the same analytical framework employed by Borjas (1987) and others to study the determinants of immigration and, moreover, uses data on cross-border

11. Psacharopoulos (1994); Psacharopoulos and Patrinos (2002).

flows (admittances) of persons with visas reported by the Immigration and Naturalization Service rather than the appropriate information on student visas issued by the State Department. The former records border-crossings by students, the latter counts students. The differences in these numbers in a given year are enormous - in 2004 there were 620,210 foreign-born "admitted" with student visas, although only 237,791 students were given visas by the State Department in that year.[12] Because the discrepancy in the two numbers reflects the decisions by the students to visit their home, which may differ substantially across countries, the estimates in Bratsberg's study do not identify the determinants of the permanent return rates of students.

As noted, the literature examining the flows of immigrants has not developed self-selection models that take into account the legal constraints on immigrants. However, there are neither country-specific nor total ceilings pertaining to the admission of non-immigrant students to the United States. There are just two main criteria - ability to pay and admission to a certified educational program, of which there are thousands. And although admission to colleges "of choice" may be difficult, admission to some US institution of higher education, for those with money, is not difficult. There is little or no screening by DHS or the State Department (other than for criminal records or membership in terrorist organizations) and no need to have family ties to the United States in order to obtain a US student visa. International student flows thus are substantially more likely to be accounted for by behavioral models emphasizing economic costs and returns than are immigrant flows.

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12. Table 23, 2004 Yearbook of Immigration Statistics, US Citizenship and Immigration Services; Table XVII, Report of the Visa Office, 2004, US State Department (http://travel.state.gov/visa/frvi/statistics/statistics_2786.html).

In this paper we exploit administrative records and new data from the New Immigrant Survey (NIS) to examine empirically the determinants of the flow of students to the United States, the stock of US foreign-born students and the number of US foreign-born students who become US permanent immigrants (student stayers). In particular, we test competing models that might underlie the observed migration of students seeking training in high-income countries - a model of high schooling costs (schooling shortages) in low-income countries and a model of migration by workers seeking higher-paying skill jobs. Application of both models require that we know how skills are rewarded in countries. We show that the two models have opposite predictions with respect to how the domestic price of skill affects the outflow of students, as do investments in home-based university facilities. Information on the per-capita GDP of potential sending countries, used in prior studies of the determination of immigration, is thus insufficient, although not irrelevant, to the application of the models.[13] A significant part of the paper thus is concerned with the estimation of world-wide, country-specific "skill prices". To carry out this analysis we use two data sources - information on the home-country wages of immigrants to the United States, from the NIS Pilot, and information on wages within occupations and industries across countries, from Occupational Wages Around the World (OWW).

Part 1 of the paper sets out the two models of student outflows. The schooling constrain model implies that foreign students will predominantly come from countries with high rewards to skills and low opportunities to acquire schooling domestically, so that investment in schools in sending countries will reduce the number of students studying in high-income countries. In

13. See Borjas (1987) and Jasso and Rosenzweig (1990b).

contrast, the migration model of international student flows implies that students will acquire schooling abroad when skill prices at home are low, and that increasing capacity for domestic schooling in such countries will increase "student" outflows. Both models imply, however, that, for given skill prices, increases in per-capita GDP increase outflows. In part 2, the methods for estimating country-specific skill prices are described, and the determinants of the skill-price estimates from the two data sources, which appear to be similar, are presented and compared. Section 3 presents the estimates of the determinants of the demand for US visas, the stock of US foreign students and the number of students who stay on as permanent immigrants using both the NIS and OWW-based skill price estimates.

The econometric results for all three measures of US foreign students and for both measures of skill prices clearly reject the worldwide school shortage model. The numbers of students who come to the United States and who stay are higher when home-country rewards for skill are low, and increasing university capacity in such countries increases student out-migration. Moreover, consistent with the migration model in which students seek to acquire skills in high-skill-price countries to obtain higher-paying jobs there, the effect of increasing the number of home-country universities on the outflow of students is attenuated the higher is the domestic skill price. The results thus suggest that from a global perspective the domestic "rate of return" estimates by country are misleading indicators of where schooling investments have high payoffs. Our estimates suggest, for example, that investment in university capacity in Botswana, which evidently has a high rate of return domestically, would have a substantially lower domestic payoff than in Gabon, for example. The patterns of the international flows of students reflect not under-investment in school capacity in low-income countries, but low payoffs to skill there.

Nevertheless, it would appear that on net, high-income countries attracting large numbers of foreign students make a net contribution to the human capital stock of the sending countries, given the high fraction of students who do return and the total number of permanent, skill immigrants admitted, some of whom also return (Jasso and Rosenzweig, 1990b).

1. Modeling International Student Outflows

In this section we set out two simple models aimed at highlighting the important factors affecting the flow of students from low- to high-income countries and that can exploit available data. We assume a world economy in which there is a continuum of skills and workers acquire different levels of skills. Most importantly, rewards to skills (skill prices) differ across countries due to country-specific conditions and imperfect factor mobility. Skill may also be initially imperfectly transferable across countries.

In each country j a worker i who has acquired x_i skill units earns a wage given by

(1) $$W_{ij} = \omega_j x_i,$$

where ω_j is the skill price in country j. Thus, variation in the average wages of workers across countries is due to inter-country differences in both average skill levels and differences in the value of skills - given by skill prices ω_j. How many skill units a worker acquires depends on the skill price, the costs of acquiring skill, and the worker's available resources to finance skill acquisition.

A. Constrained Domestic Schooling Model. We first assume that workers are always employed in their home country, but may acquire schooling anywhere. The relevant skill price is thus the home country skill price ω_j. Figure 2 illustrates a simple model in which the total amount of skill units in the economy X is determined at the point at which the marginal cost of adding

one more skill unit just equals the marginal cost of doing so. The two solid curved lines represent the marginal cost of adding skill units. The leftward cost curve represents the cost curve for schooling at home; the next over for schooling abroad. So we have assumed that adding skill units domestically at the extensive margin costs more than schooling abroad. The solid horizontal line labeled W_1 is the home country skill price (which can diminish as aggregate skill increases in the domestic economy). In this case, some workers obtain their schooling abroad - the home-country skill price is high enough to justify expensive schooling, which cannot be satisfied at lower cost at home. In particular, O-A units are produced at home and A-C skill units are obtained abroad. [figure 2 about here]

In this model, an increase in the supply (reduction in the cost) of domestic schooling, given by the rightward shift in the domestic schooling cost curve, with no change in the skill price, always reduces the number of skill units produced outside the country - O-B units are now produced at home and B-C units go abroad, with A-C>B-C. Domestic schooling and foreign schooling are substitutes. Note that as long as the marginal cost of schooling domestically is less than that of skill acquisition abroad (the home-country schooling supply increase is inframarginal) for a sufficiently high domestic skill price, the total number of skill units does not increase when domestic school costs are lowered. However, a rise in the domestic skill price given the initial schooling cost functions increases the total number of skill units acquired, all of which occurs outside the country - the number of skill units obtained abroad rises from the initial A-C to A-D and total skill units from O-C to O-D. Thus increases in the domestic "supply" of schools lowers the amount of schooling acquired abroad while increases in the marginal value of skills in the home country increases foreign schooling.

B. Migration Model. We now examine a framework in which schooling acquired outside the home country reflects the demand for jobs in higher-skill price environments. The expected initial earnings that worker i could earn in destination country u is given by

(2) $$pW_{iu} = \omega_u x_i^{\delta iu},$$

where ω_u is the destination-country skill price and δ_{iu}, $0 \leq \delta_{iu} \leq 1$, reflects the initial degree of transferability of a worker i's skills to the destination country's labor market, and p is the probability of obtaining a permanent destination-country job. A worker of given skill earns a different wage in her origin country and initially in the destination country for two reasons: the skill price differs across the two countries and the worker's own skill may not be fully transferable. A worker's skills may be incompletely transferable upon arrival in the destination country due to lack of job contacts, lack of familiarity with the job market or work practices, or poor English skills. With full transferability ($\delta_{iu}=1$), the migrant can initially make use of all of his skill in the destination country; if her skill is initially completely non-transferable across the origin and destination countries ($\delta_{iu}=0$),the migrant enters the destination labor market as if she had the lowest skill level (x=1). Both the probability of obtaining a destination-country job and the level of skill transferability are in part the outcomes of worker investments.

Given direct costs C_j and time costs $(1+\pi_j)W_{ij}$ of migrating from j to u, the economic gain from migrating from j to u, G_{ij}, for worker i is

(3) $$G_{ij} = x_i[p\omega_u x_i^{\delta i\, u-1} - \omega_j(1+\pi_j)] - C_j.$$

Expression (3) shows that for any level of direct migration costs C_j the gains from immigrating, given a positive expected destination-origin skill price differential net of migration time costs ($\omega_u > \omega_j(1+\pi_j)$), are always higher for more skilled workers and for workers for whom skill

transferability is high.[14] Moreover, the gain from migrating associated with an additional unit of skill is lower the higher the home country skill price.

Workers choose the number of skill units and can also invest in both the transferability of their skill and in augmenting the probability of obtaining a job abroad. If we assume that skill units are acquired at home, then in this framework lowering the costs of acquiring skill units in the home country and thus increasing x_{ij} raises the return to out-migration from j. Moreover, if augmenting skill transferability is less costly in the destination than in the home country and obtaining training in the destination country increases the probability of obtaining a permanent job there, then workers with higher numbers of skill units will more likely migrate to the destination country, where they will invest in skill transferability and in facilitating a permanent job offer.[15] In this framework, in contrast to the constrained domestic schooling model, schooling taken abroad is for the purpose of acquiring a higher skill price for skill (by migrating). And in contrast to that model, in which schooling abroad contributes to the home-country human capital stock, lowering the costs of domestic schooling increases the amount of schooling (additionally) acquired abroad - domestic schooling and foreign schooling are complements; increases in the home-country skill price reduce the number of workers acquiring schooling outside the country; and the number who leave the country as domestic schooling is increased is lower the higher the

14. Chiswick (2000) shows that if higher skill also lowers direct migration costs immigration will be more skill-intensive.

15. In the US context, the ability to obtain a permanent place in the US job market also depends on the ability to find a US citizen spouse. This may also be facilitated by acquiring US schooling.

skill price of the country.

2. Estimating World Skill Prices

a. Data. The preceding framework implies that to assess the determinants of the movements of students and thus whether such movements reflect home-country school scarcity or international labor arbitrage requires information on schools by country as well as country-specific skill prices. However, country-specific skill prices are not directly observed. In prior studies of the determinants of immigration flows and student return rates based on the Roy model, the ratio of income accruing to the top 10% and bottom 20% of the population is used to proxy the skill price.[16] This ratio, however, also reflects skill differences, and so confounds differences in rewards to skill across countries and skill distributions. Similarly, skill prices cannot be inferred from information on GDP per worker without concomitant information on the distribution of skills. To estimate the set of world skill prices that potentially affect the magnitude and composition of foreign student (immigrant) flows requires comparable information on wages across countries for workers of the same skill. We use data from two sources. The first is the predecessor survey to the NIS, the New Immigrant Survey Pilot (NIS-P), which provides the home-country earnings for a sample of new U.S. legal immigrants. The sampling frame for the NIS-P consists of the 148,987 persons who were admitted to legal permanent residence during the months of July and August of 1996. The sample of immigrants was drawn from the administrative records of the Immigration and Naturalization Service (INS), which provided information on the immigrants' age, type of visa, and country of origin as well as the address provided by each immigrant to which his or her "green card" (the paper evidence of

16. See Borjas (1987), Cobb-Clark (1992) and Bratsberg (195).

legal immigration status) was to be sent. The stratified random sample drawn from the records also oversampled migrants with employment visas and under-sampled children, and numbers 1,984 persons, of whom 1,839 were adult immigrants. Sample size for adult immigrants is 1032. Details on the survey are given in (Jasso et al., 2000).

332 of the sampled immigrants had worked in a foreign country in the ten years prior to the survey and provided earnings data for their last job there. These respondents provide information on worker earnings for 54 countries. Earnings in the last job abroad, provided by the immigrants in native currency units, were converted to dollar amounts based on estimates of the country-specific purchasing power of the currencies from the Penn International Comparisons Project, described in Summers and Heston (1991). These conversion factors are explicitly designed to take into account differences in the "cost of living" across countries and to avoid the distortions associated with exchange rate regimes in order to facilitate cross-country comparisons. The purchasing power parity (PPP) estimates thus permit comparisons of origin-country earnings across U.S. immigrants who have worked in many different countries and are comparable with their U.S. earnings, all denominated in dollars of purchasing power. Based on information on work time and pay periods, to adjust for labor supply differences across workers we converted all pay data to full-time earnings. The advantage of this data source is that earnings was elicited in a common survey frame and there is information on the number of years of schooling of the worker, gender and age. The disadvantage is that the immigrants are not a random sample of workers in the home country. Indeed, the migration model implies that the sampled workers will be positively selected with respect to unobservables. We will take this into account below.

The second source of information that can be used to estimate skill prices is the *Occupational Wages Around the World* (OWW) database, compiled by Freeman and Oostendorp. This source provides monthly wage data for men for 161 occupations in over 150 countries from 1983 to 2003 derived from the ILO October Inquiry database. Presumably within countries, the data are representative of all workers, but not all countries are represented in all years, and less countries appear to have participated in more recent years. We selected 1995, which is a year with a peak number of countries and close in time to the NIS-P information on wages. In that year there are 4924 observations representing 67 countries. We use monthly earnings from the series expressed in US dollars based on exchange rates, as estimated by Freeman and Oostendorp.[17] Disadvantages of this data set are that the information across countries may not be comparable, and there is no information on the schooling or age of workers. Table 1 presents descriptive statistics for both international samples of workers. [table 1 about here]

b. Identification and prediction of skill prices. To use the NIS-P data to estimate country-specific skill prices we assume that a worker's level of skill depends on unobservable and observable components, μ and S (schooling), respectively, such that

(4) $$x_{ij} = \mu_{ij}\exp(\beta S_{ij}).$$

Then the log of worker i's wage in country j, from (1), can be written as

(5) $$Ln(W_{ij}) = Ln\omega_j + \beta S_{ij} + Ln\mu_{ij}.$$

The intercepts , which are allowed to differ across countries, then provide the log of the skill

17. Specifically, we use the wages computed using exchange rate information and country-specific calibration with lexicographic imputation

price for the 54 countries in the data.

For the OWW data set we assume that skill units are a non-parametric function of industry and occupation; i.e.,

(6) $x_{ij} = \mu_{ij}\exp(\mathbf{I_{ijk}}\boldsymbol{\gamma_k})$, so that

(7) $\text{Ln}(W_{ij}) = \text{Ln}\omega_j + \mathbf{I_{ijk}}\boldsymbol{\gamma_k} + \text{Ln}\mu_{ij}$

where $\mathbf{I_{ijk}}$ is a vector of occupation/industry dummies for worker i in country j and $\boldsymbol{\gamma_k}$ is a vector of coefficients. Again, the country-specific set of intercepts provides the set of skill prices, for 67 countries.

Both of the data sets at most provide comparable information on skill prices for only 67 countries. To predict skill prices for more countries we can use information on aggregate country characteristics that are available for a large number of countries to estimate the proximate determinants of skill prices from the comparable wage micro data countries. We can then use those estimates to predict skill prices for countries without sampled workers. We assume that the skill price is the marginal value product of skill and that aggregate output Y_j in country j is produced according to Cobb-Douglas technology

(8) $Y_j = AL_j^{\alpha}\Pi K_{nj}^{\gamma}$,

where the K_{nj} are country j's stock of non-labor resources (e.g., land, capital, minerals) and L_j is the country's aggregate stock of labor in skill, given by

(9) $L_j = N_j(a(x_{ij}))$,

where N_j is the total number of workers in j and a() is an inverse function yielding the average skill units per worker in country j in terms of observables.

The skill price ω_j is the marginal product of an efficiency unit of labor, given by

(10) $\omega_j = \alpha Y_j/N_j(a(x_{ij}))$

so that

(11) $Ln(\omega_j) = Ln\alpha + Ln(Y_j/N_j) - Ln(a(x_{ij}))$ or, for individual worker data on wages,

(12) $Ln(W_{ij}) = Ln\alpha + Ln(Y_j/N_j) - Ln(a(x_{ij})) + \beta S_{ij} + Ln\mu_{ij}$

Thus, the log of the skill price for any country j is just the log of labor output coefficient (in skill units), plus the log of output per worker in country j, with a coefficient of 1.0, minus the log of country j's average skill per worker. Equations (11) and (12) imply that among workers residing in countries with the same output per worker, those workers residing in countries where workers have higher average skill levels are paid lower skill prices, while among workers in countries with the same average worker skill levels, those in countries with higher output per worker receive higher skill prices.

Estimating (11) or (12) to predict country skill prices requires economic information at the country level. However, although there is information on comparable measures of output per worker for all countries, the transform function $a(x_{ij})$ converting measured variables like schooling into aggregate skill units for the economy is not known, and needs to be estimated. For the NIS-P sample of world workers we appended to each record information on the characteristics of the immigrant's origin country using information on the last country of residence; for the OWW sample we used the worker's country of employment. To estimate skill prices in accordance with the model, we used the real (PPP-converted) GDP per worker estimates from the Penn World Table, Mark 5.6 supplemented with updated 1995 estimates from the ICP.[18] We assume that in the transform function a aggregate worker skills depend on schooling

18. Summers and Heston (1991).

years and schooling quality, and thus we assembled estimates of the average schooling levels of the population aged 25 and over and student-teacher ratios for primary and secondary schools.[19] Average schooling estimates are available for a large but not complete subset of countries for which there are PPP GDP estimates. For those countries for which there is no information on schooling characteristics estimates we constructed a variable indicating that schooling was missing and set the schooling variable to zero.

In using the NIS-P sample of workers we need to take into account that immigrants are not randomly (self-) selected from the population of a country's workers. In particular, there will be selection on the unobservable component of skill μ, such that among workers with the same schooling those workers from high skill-price countries will have higher levels of unmeasured skills (positive selectivity on unobservables). The error term in (12) containing the unobservable component of worker earnings μ will be correlated with the determinants of the country skill price, leading to biased estimates. For example, it can be shown that due to immigrant selectivity the coefficient on GDP per-worker will be greater than one, biased upwards. To obtain consistent estimates of (12) using the NIS-P sample requires that this selectivity be taken into account.

One remedy is to use the standard selection-correction model (Heckman, 1979). This requires that we obtain estimates of the probability that a worker is observed in the sample, which in this case is the probability that a worker in a sending country migrates to the receiving country, compute the relevant Mills ratio λ, for each immigrant, and include it among the regressors in (12). In the second immigration-based model of student flows, the probability of sample inclusion (immigration) depends on the determinants of the home-country skill price and

19. Barro and Lee (1993).

factors affecting the costs of migration and the degree of cross-country skill transferability, from (4) and (5). The latter two sets of variables do not directly affect the home-country skill price, and thus the selection model is identified.

To carry out the selection correction procedure for the NIS-P sample, country-specific information related to the costs of immigration and transferability were appended to the NIS-P data on workers. To characterize direct migration costs we obtained the surface distance of every potential origin country's capital to the closest major entry city in the United States. We also obtained information from the PWT 6.1 (Heston et al., 2002) on GDP *per adult-equivalent*, to proxy the resources available to finance migration. Finally, we appended information on the population, in 1990, of the origin countries, representing the potential pool of immigrants.[20] The number of countries for which we have information on at all of these variables is 125. Jasso and Rosenzweig (2005) estimated and report a blocked probit regression incorporating all of the country-specific variables to estimate the determinants of the probability of migrating to the United States, using as the population at risk of migration the population of the sending country and the number of U.S. immigrants in the NIS-P sample as the dependent variable. These estimates are used to correct the skill-price estimates for sample (immigration selectivity), reported below.

c. Skill price estimates. The first two columns of Table 2 report the estimates of the skill price determinants based on the home-country wages of the sample of U.S. immigrants based on

20. A more refined analysis would use the population of persons in the age group 25-59, corresponding to the age group of the migrants. This would require accurate information on the population age structure for all countries.

equation (12). The first specification omits the Mills-ratio λ from the (not reported) probit selection (immigration) estimates, while the second includes it as a regressor. The sets of country and individual worker characteristics explain 35% of the total variation in home-country wages among the immigrants and all coefficients but that for the gender variable are statistically significant. The sign patterns for per-worker GDP and for schooling, moreover, conform to the model - wages are higher for workers of given education and age in countries with greater output per worker, given average country skill levels, and worker wages are lower among countries with the same output per-worker but with higher average schooling levels. The point estimate in column one for per-worker GDP is above one, consistent with positive selectivity. And, indeed the coefficient on the Mills-ratio coefficient based on the probit selection equation λ in column two is positive. Inclusion of the Mills-ratio moreover lowers the coefficient on per-worker GDP such that the hypothesis that the coefficient is one as indicated by equation (11) cannot be rejected. [table2 about here]

We can assess how well the estimates from the NIS-P sample do in predicting skill prices using the "out-of-sample" skill prices obtained from the OWW sample of workers, estimated from (11). First, we can use the estimates from column 2 of Table 2 to predict skill prices for all countries with the requisite (and more available) aggregate data, and then examine the association between the predicted skill prices and the skill prices obtained for the common set of 67 countries represented in the OWW worker data. We can also estimate the country-specific determinants of skill prices obtained from the OWW sample, using (7), and then compare those estimates to those obtained for the NIS-P worker sample.

Figure 3 displays the scatterplot between the NIS-P based predicted skill prices and the

OWW skill prices estimated from equation (7) from the sample of OWW wages for the 67 OWW countries; the correlation between the predicted NIS-P based estimates and those skill prices obtained (not predicted) from the OWW is .78. The third column of Table 2 reports estimates of the country-specific determinants of the OWW skill prices, to be used to predict the OWW skill prices for all countries, based on (11). The set of regressors explains 82% of the variation in skill prices across the 67 countries. The coefficient on the log of per-worker GDP is closer to one than that estimated from the immigrant sample, and one cannot reject the hypothesis that the coefficient is one. The sign patterns are the same for the OWW and the NIS-P data sets. In sum, these independently collected worldwide worker data appear to yield similar estimates of worldwide skill prices. [figure 3 about here]

One advantage of the NIS-P sample of worldwide workers is that one gets an estimate of the average within-country return on schooling β, which is evidently around seven percent (columns one and two in Table 2). We can use the estimates of β and the country-specific skill prices to illustrate that even if the within-country "return" to schooling is the same for all countries, the large inter-country differences in skill prices make the contribution of investments in schooling across countries highly unequal.[21] That is, investment in building schools in low-skill price countries, while increasing earnings there, adds substantially less to global output than investing in schooling in high skill-price countries.

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21. The restriction that the contribution of schooling to skill units is the same across countries is necessitated by the limitations of the data. With enough observations within each country it is possible to estimate country-specific schooling returns, but not with 332 workers across 54 countries. The OWW data has no information on schooling.

Figure 4 displays the annual PPP$ full-time earnings of high school and college graduates for seven selected countries - Nigeria, India, Indonesia, Mexico, Korea and the United States. These figures are based on an identical 7% within-country return to schooling and the estimated country-specific skill prices based on the estimates from column 2 of Table 2 for all but the United States.[22] For that country information on the mean earnings of foreign-born full-time workers in the 1990 Census Public Use sample is used. As can be seen, within schooling levels, earnings differences across countries are substantial - the estimated PPP earnings of high school graduates in Nigeria is $400 compared with $4500 for Mexican high-school graduates, which is in turn $30,000 lower than the earnings of US foreign-born high school graduates. Relatedly, college graduates in Nigeria earns $121 more than high school graduates, while Mexican (Indonesian) workers with a college education earn $490 ($1392) more than Mexican (Indonesian) high school graduates. Average schooling differences are clearly swamped by differences in the country-specific valuation of skills in accounting for worldwide inequality and in the gains from investing in schooling.[figure 4 about here]

3. Estimating the Determinants of the Flow and Stock of US International Students

a. Data. With the (two) estimates of skill prices for 125 countries, we can examine how cross-country variation in skill prices and the quantity and quality of domestic schools influence the transnational flow of students to assess whether such flows reflects a shortage of schools in poor countries or skill-price arbitrage. There are now a number of different data sources describing the flows to and stocks of foreign students in the United States. The State Department provides annually the number of new student (F-1) visas issued by country to those persons who

22. The formula is: $W_j = \exp(\ln\omega_j + .07S_i)$, where $S_i = 12$ or 16.

are neither US citizens nor permanent resident aliens. We use the average number of F-1 visas issued by country for 2003 and 2004. One deficiency of these data is that Canadian citizens are not required to obtain a visa for study in the United States so they are excluded from the visa counts. The citizens of all other countries are required to obtain some kind of student visa.[23]

A second source of information on US foreign students is the Student and Exchange Visitor Information System (SEVIS), which provides information by country on the stock of current foreign-born students. All foreign-born students with F-1 and other non-immigrant visas and all Canadian citizens studying in the United States are required to register in the system. We use the current stocks (2006) of students in United States by country from this data source. Relative to the visa flow data, students who have stayed in the United States longer are more heavily weighted in these data and family members of students are not included.[24]

A third variable we construct is the annual flow of students who become permanent

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23. Some students obtain exchange visitor visa. These are a small proportion of all US foreign students. Some F-1 visas holders are immediate family members of foreign students. This is also a small portion of F-1 visas.

24. Another source of data on the stocks of students is from the Institute of International Education (IIE). The research department of IIE carries out a survey each spring and fall in which all accredited institutions of higher education in the United States (2700) report on foreign students who are enrolled. Statistics from the survey are presented in the annual "Open Doors" report. The IIE claims that the response rate for the survey is "approximately 90%." In principle, all students are registered in SEVIS.

resident aliens - and thus who can enter the US labor market permanently - based on information from the New Immigrant Survey (NIS). The adult portion of the NIS sampled 4.3% of the 289,478 persons 18 and over who were admitted as permanent resident aliens, including principal applicants and accompanying spouses, in the 7-month period May through November of 2003. The survey over-sampled principal-applicant employment and diversity immigrants, and sampling weights need to be used to obtain representative statistics from the survey. The data provide a large array of information on these "new" immigrants, including a complete history of their prior trips to the United States and the documentation they had for each trip. From these histories it is possible to identify those new permanent resident aliens who had once held F-visas, and thus who were formerly US foreign students. We computed the weighted number of these former student immigrants for all of the home countries of the immigrants. This variable, the number of former student permanent immigrants, effectively weights foreign students by their permanence.

The NIS data indicate that about 5% of permanent resident aliens were once foreign students students in the United States. Assuming that the rate of adjustment is in a steady state, we can also use the NIS and non-immigrant visa data from the State Department to a rough estimate of the fraction of all foreign students who become permanent resident aliens, which is the ratio of the (survey-estimated) number of permanent resident aliens who once held F- visas to the total number of F visas issued in a year. Taking the visa flows for 2003 reported by the State Department (and excluding Canada), we estimate that about 10% of foreign students become legal immigrants. This figure is surely an underestimate of the non-return rate - the appropriate construct is the cumulative number of persons from a given cohort of students who become

permanent resident aliens. We only have information for one cohort of permanent resident aliens. The estimate from the NIS is similar to the estimate of Bratsberg (1995), 12.5%, who did cumulate the number of permanent immigrants who were once students by the year they obtained their student visa across many cohorts of new immigrants. However, as noted, that estimate is based on the inflated INS visa admittances data and only counts those who immediately adjusted their status from student to immigrant, so it is likely to be too small, perhaps 1/3 the true number. Even these lower-bound estimates are substantially higher than the probability of winning a US immigrant visa through the diversity lottery system, an alternative route to US immigration for those without family connections in the United States - in FY 2005, 6.3 million applications were received in response to the DV program, from which 90,000 winners were chosen (1.4%).[25]

The NIS also provides, from the USCIS immigrant record, the immigrant visa of the respondents, which indicates by what route immigrants gained permanent resident status. Figure 5 reports the fraction of former students and non-students who became permanent immigrants (a) by marrying a US citizen, (b) by getting a job (employment visa), (c) by obtaining a visa through the diversity lottery, and (d) via sponsorship by other family members. Not surprisingly, former US students were substantially more likely than other immigrants to obtain a visa by getting a job offer or by marrying a US citizen - while only 4% of those who never attended a US institution of higher learning received an employment visa, over 20% of former student immigrants did so. With respect to the marriage market, 32% of those who were never US students (in the higher education system) married a US citizen, while 56% of former students obtained a green card via

25. The student adjustment rate is also higher than getting a paper accepted in the *AER* or getting into Yale. Both institutions receive large numbers of submissions or applications.

marriage. [figure 5 about here]

Of course, students are of marriageable age and are thus likely to be married around the time and in the place they are students. To put this is additional perspective, however, we can compare the probability of marrying a US citizen, and thus obtaining a green card, for a person who remains in his or her home country and a student from that country who attends an institution of higher learning in the United States. We will use India as an example: in 1999, there were an estimated 212,984,000 persons aged 15-24 residing in India.[26] In 2003, 20,300 student visas were issued by the State Department to persons from India.[27] The NIS data indicated that 321 persons from India married a US citizen and received a green card in 2003, of whom 6 were former students.[28] This suggests that the probability of an Indian student in the United States marrying a US citizen is almost 200 times that of a resident of India.[29] Clearly, being a US student provides an advantage in the US marriage and labor markets.

Table 3 reports the top ten sending countries for US foreign students for each measure of foreign students stocks and flows. Interestingly, for all three measures of student outflows the top five countries are all located in Asia. Moreover, they are countries with high growth rates, although not necessarily high skill prices (China and India). They are also countries far from the

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26. Population Projections for India and States 1996-2016, Registrar General, Ministry of Home Affairs, Govt. of India.

27. Table XVII, Report of the Visa Office, 2003, US State Department.

28. India has a substantially smaller fraction of immigrants who obtain a visa via marriage compared with other groups.

29. The rates are .000295 (6/20,320) and .00000148 ((321 - 6)/212,984,000).

United States, with at least one university ranked in the top 200. It is thus difficult to assess from these limited data the patterns underlying the determinants of the flows of international students. Thus we look jointly at how cross-country variation in skill prices, domestic schooling costs and migration costs affect student migration using data for 125 countries. [table 3 about here]

In addition to obtaining information on US foreign student flows and stocks by country, we obtained information characterizing the cost (supply) of domestic schooling and the determinants of the cost C of migrating. In particular, we added to the database the number of universities in each country and a variable indicating whether any of the country's universities were ranked in the top 200 of all universities in the world from the *The Times Higher World University Rankings 2005.* We assume that countries with more universities (per-capita), with higher quality universities, and with smaller numbers of pupils per teacher deliver skill units at lower marginal cost. Thus all of these home country variables will be negatively associated with the outflow of students to the United States if students are domestically-oriented and will be positively associated if students are seeking to maximize earnings by exploiting international skill price gap.

Finally, we included two variable reflecting the direct costs of migration. The first is the surface distance from the capital of each country to the nearest port of entry for immigrants in the United States, which we assume to be positively correlated with migration costs. Distance also affects the cost of returning home, and so may be a determinant of the number of students who stay. Bratsberg (1995) indeed finds that distance to the home country affects positively his measure of the fraction of students who stay. But, because he uses the number of admittances rather than the number of students in the denominator of his dependent variable, some of the

variation across countries in permanent "return" rates reflects variation in the propensity of students to visit their homeland while students. Indeed, in our data, the ratio of the number of students crossing the US border (admittances) to the number of students (persons) issued visas in 2004 in that year is negatively and statistically significantly related to distance, indicating that migration costs affect temporary visits, and not necessarily long-term commitments as interpreted by Bratsberg.

Financing education abroad is also costly. We added the sending country's GDP per adult equivalent to the database, which we assume is positively related to the average ability of individuals to finance migration. Thus, for given skill prices, a country with a higher GDP per-adult equivalent should be observed to send more migrants. Thus, economic growth can increase out-migration, if it is not accompanied by sufficient increases in skill prices. This contrasts with prior analyses, which inadequately control for skill prices and thus in which per-capita GDP partly proxies wages. Table 4 reports descriptive statistics for the 125 countries for which we have US foreign student data, skill price estimates and school information.[table 4 about here]

b. Estimates. Tables 5 through 7 report the estimates for the three dependent variables measuring US international student flows and stocks, for two specifications, using alternatively the NIS-P-based skill price estimates and the OWW skill prices. All variables are in logs. The first specification is linear in logs; the second specification adds an interaction term for the log skill price and the log number of universities to permit an assessment of whether the impact of increasing the domestic supply of schools on student out-migration is attenuated when the home-country skill price is high, as suggested by the schooling migration model. [tables 5-7 about here]

The set of skill price and university stock coefficients in the non interactive specification

are estimated with precision - five of the six skill price and all six university stock coefficients are statistically significant at at least the 5% level. Most importantly, for all three measures of the flows of foreign students, the sign patterns are consistent with the model of student migration for employment rather the model of schooling supply constraints in sending countries. In particular, the number of US visas issued annually to students, the stock of US foreign-born students and the number of students who remain as US permanent immigrants are higher for countries with low skill prices and for countries that have a larger number of universities per-capita. The coefficients for the crude university quality measure are also all positive, consistent with the migration model, but none are statistically significant in the non-interactive specifications.[30] Migration costs also evidently influence student flows and stocks - countries farther from the United States, for given skill price, per-capita GDP and schooling stocks, send significantly fewer students, while for given distance and the domestic price of skill, countries with higher per-capita incomes send more students. All six distance coefficients and five of six per-capita GDP coefficients are statistically significant at the .05 level.

The point estimates (elasticities) for the skill price are large in absolute value, particularly for the estimates based on the OWW data. They suggest that a doubling of the skill price (e.g. raising India's skill price to that of Indonesia) would lower by 36% (95%), 34% (83%) and 13% (75%) the number of student visas, the stock of foreign students and the number of students stayers, respectively, using the NIS-P (OWW)-based estimates. On the other hand, doubling per-adult-equivalent GDP, without any change in the skill price, would increase student out-migration - by 68% (135%), 60% (117%), and 12% (79%) for the three student outflow

30. Two of the six coefficients are statistically significant in the interactive set.

measures. The estimates also suggest that doubling the number of universities in a country on average would also increase the number of students obtaining US visas, the number of students from the country studying in the US, and the number of students from the country who become immigrants by 24%, 33%, and 18%, respectively.[31]

The interactive specification, consistent with the migration model, suggests that the effects of increasing the number of universities on student outflows is not the same across countries, however, with the out-migration of students declining as the magnitude of the skill price increases, particularly with respect to the number of students who stay in the United States. Three of the six interactive coefficients are statistically significant at the .05 level, both of those for the student stayer measure. Figure 6 displays the percentage increase in the number of US student stayers from doubling the number of domestic universities for Nigeria, India, Indonesia, Mexico and Korea based on the NIS-P and OWW estimates. As can be seen, the student "brain drain" from a country that results from investing in domestic university capacity depends importantly on the how skills are valued domestically. Thus, in Nigeria doubling university capacity evidently would result in a 33% to 35% increase in the permanent outflow of students, while Korea, which has 13 (NIS-P) to 23 (OWW) times the skill price of Nigeria, would lose only from 5.5% to 6.9% more student stayers.[figure 6 about here]

The interactive estimates also can be used to identify which (high-skill-price) countries would lose little human capital from university expansion - for which there would be no net

31. The university stock coefficients are similar whether the NIS-P or OWW skill prices are used; the estimated percentages are based on averages of the university number coefficients across each of the two estimates for each dependent variable.

increase in student outflows from increasing the number of universities. The set of countries outside the OECD evidently consists of Malaysia, Tunisia, Gabon, Hong Kong, Kuwait, Singapore, Iran, Bahrain, Taiwan, Qatar, Oman, Saudi Arabia. Relaxing the constraint to less than 5% "brain leakage", adds Mauritius, Lebanon, Estonia, Latvia, Botswana, Turkey, Egypt, Greece, Belize, Algeria and Uruguay to the list of countries in which, from a global perspective, investment in higher education would appear to have high payoffs that principally benefit the population of the country.

4. Conclusion

International migration by persons to acquire schooling appears to be the least regulated and restricted among migration flows and is a substantial fraction of the international movement of skilled persons. In this paper we have used a variety of recently-available data sources to explore the relationship among the flow to and the temporary and permanent stocks of foreign students in the United States and the global distribution of the prices of skill and the level and quality of schools. The patterns in the merged data appear to be consistent with a model in which students from low-wage countries seek schooling in high-wage countries as a means of augmenting their chances of obtaining a high-wage job in those countries and inconsistent with the view that the large flows of international students reflect constraints on opportunities for schooling in low-wage countries. In particular, higher skill prices in home countries are negatively associated with student outflows, while given skill prices greater domestic investment in skills is associated positively with greater student out-migration. Higher home-country income and smaller distances between high and low-wage countries are also associated with more student outflows to high wage countries.

Although the interpretation of the relationship between domestic schooling and migration in the model is that greater schooling at home augments the returns to migration, given skill-price gaps, it is not necessarily the case that the school stock-outflow association is causal. It is possible that the stock of schools in a country reflects demand factors. However, the fact that the positive association between student outflows and the domestic stocks of schooling is strongly attenuated the higher is the home-country skill price is again not supportive of the view that there is too little domestic investment in schools. In any case, the key determinant of student migration is the gap in skill rewards across developed and under-developed countries. The results thus strongly suggest that we need to understand better the fundamental determinants of global wage disparities in order to determine the optimal distribution of additional investments in schooling across countries given an increasingly global labor market. No doubt this means attention to trade policy, governance, traditional and historical institutions, legal structures, and geography, that have been the focus of development economists.

It is also clear that to better understand even the proximate causes of student or any component of international migration improved data on the wages of workers by skill group that are comparable across a large set of countries are needed. Relaxing the assumption of the model here, for example, that there is one homogeneous skill would require more detailed and comparable information on schooling and other determinants of skill as well as wages across workers of the world. Also, much better data are needed characterizing the quality of schooling across countries. It would also be interesting to assess the importance of networking in student flows, using information on prior stocks of students. To investigate this, however, would require multiple years of information on country characteristics and student flows and attention to the

fact that lagged student stocks are endogenous.

Finally, the finding that student migration principally reflects wage arbitrage in the face of massive world differentials in rewards to skills, and not schooling constraints, does not necessarily imply that the more open policy of high-wage countries to foreign students is to the detriment of the sending countries. The data suggest that only a small fraction of students become immigrants in the host country, although current estimates likely overstate the number who eventually leave the United States. An appropriate analysis of the determinants of "return" rates of students needs to be carried out.[32] This would require information across many cohorts of foreign students and immigrants, with information on the latter similar to that in the NIS. However, information on the number of students who adjust to permanent resident status is insufficient to gauge the impact of student migration on sending and receiving countries, as even permanent immigrants are not permanent. In the NIS data on new US immigrants ("permanent" resident aliens), 17% of those who were formerly foreign students in the United States (the student "stayers" analyzed here) indicated that they were not going to stay in the United States "the rest of their life."[33] Those returnees will presumably contribute to the development of their home countries, though their contributions will be greater in those places in which the marginal product of skill is high.

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32. Students who do not remain in the United States do not necessarily return to their home country.

33. This proportion is over 50% higher than that for new immigrants who were not students.

References

Barro, Robert and Jong Wha Lee, "International Comparisons of Educational Attainment," Journal of Monetary Economics 32, December 1993, 363-94.

Bhagwati, Jagdish and Koichi Hamada, "The Brain Drain, International Integration of Markets for Professionals, and Unemployment," Journal of Development Economics 1, 1, 19-42, 1974.

Borjas, George J., "Self-Selection and the Earnings of Immigrants," American Economic Review 77, September 1987, 531-553.

Borjas, George J., "An Evaluation of the Foreign Student Program," Backgrounder, Center for Immigration Studies, June 2002.

Bratsberg, Bernt, "The Incidence of No-return Among Foreign Students in the United States," Economics of Education Review 14, No. 4, 1995, pp. 373-384.

Chiswick, Barry, "Are Immigrants Favorably Self-Selected? An Economic Analysis," Institute for the Study of Labor, Discussion Paper No. 131, March 2000.

Cobb-Clark, Deborah, "Immigrant Selectivity and Wages: the Evidence for Women," American Economic Review 83, 1993, pp. 986-993.

Commander, S. M. Kangasniemi, and L. A. Winters, "The Brain Drain: A Review of Theory and Facts," Brussels Economic Review 47, 1, 29-44, 2004.

Docquier, Frederick and Abdeslam Marfouk, "International Migration by Education

Attainment," in Caglar Ozden and Maurice Schiff (eds.), International Migration, Remittances & the Brain Drain. Washington: World Bank and Palgrave Macmillan, 2006.

Heston, Alan, Robert Summers and Bettina Aten, Penn World Table Version 6.1, Center for International Comparisons at the University of Pennsylvania (CICUP), October 2002.

International Institute of Education, Open Doors, 2005, Report on International Educational Exchange, New York: IIE.

Jasso, Guillermina, Doug Massey, Mark Rosenzweig, and James Smith, "The New Immigrant Survey Pilot: Overview and New Findings About Legal Immigrants at Admission," Demography, February 2000.

Jasso, Guillermina, and Mark Rosenzweig, "Selection Criteria and the Skill Composition of Immigrants: A Comparative Analysis of Australian and US Employment Immigration," paper presented at the Council of Foreign Relations, 2004.

Jasso, Guillermina, and Mark Rosenzweig, The New Chosen People: Immigrants in the United States, New York: Russell Sage Foundation (Census Monograph Series), 1990a.

Jasso, Guillermina and Mark Rosenzweig, "Self Selection and the Earnings of Immigrants: Comment," American Economic Review, March 1990b.

Lalonde, Robert J. and Robert H. Topel, "Economic Impact of International Migration and the Economic Performance of Migrants," in Rosenzweig, Mark R. and Oded Stark, eds., Handbook of Population and Family Economics, Amsterdam: North Holland, 1997, 799-850.

Lee, Jong-Wha and Robert J. Barro, "Schooling Quality in a Cross Section of Countries," National Bureau of Economic Research Working Paper: 6198. September 1997.

Martin, Philip, "Migration," in Lomborg, Bjorn, ed., Global Crises, Global Solutions,

Cambridge: Cambridge University Press, 2004.

Munshi, Kaivan, "Networks in the Modern Economy: Mexican Migrants in the US labor Market," Quarterly Journal of Economics 188, 2, 549-99.

Psacharopoulos, George, "Returns to Investment in Education: A Global Update," World Development 22, 9, 1994.

Psacharopoulos, George and Harry Patrinos, "Returns to Investment in Education: A Further Update," World Bank, 2002.

Roy, A.D., "Some Thoughts on the Distribution of Earnings," Oxford Economic Papers 3, 1951, pp.135-146.

Summers, Robert and Alan Heston, "The Penn World Table (Mark 5): An Expanded Set of International Comparisons, 1950-1988," Quarterly Journal of Economics 106, May 1991, 327-368.

Figure 1. Annual Number of Foreign Student Visas Issued, by Receiving Country

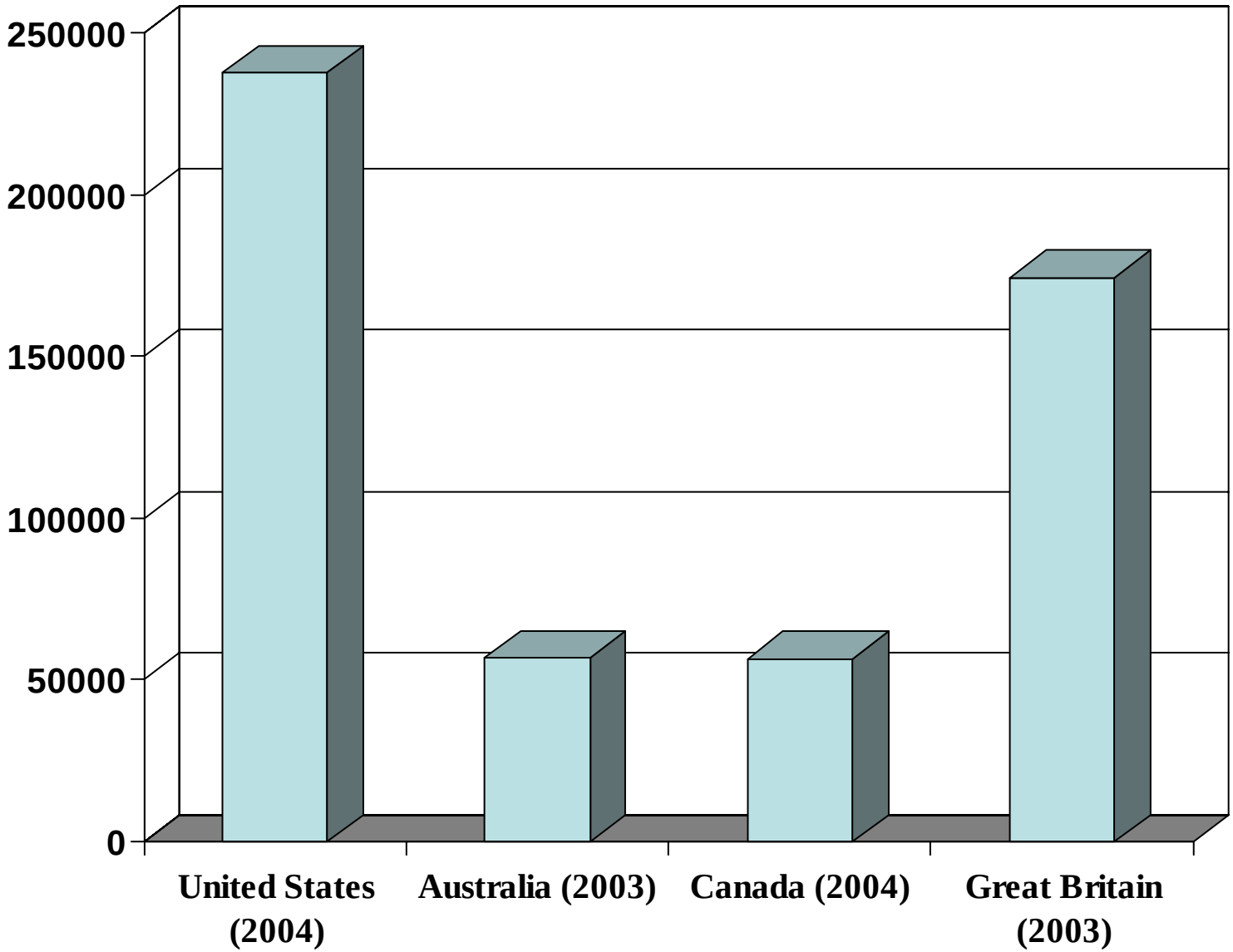
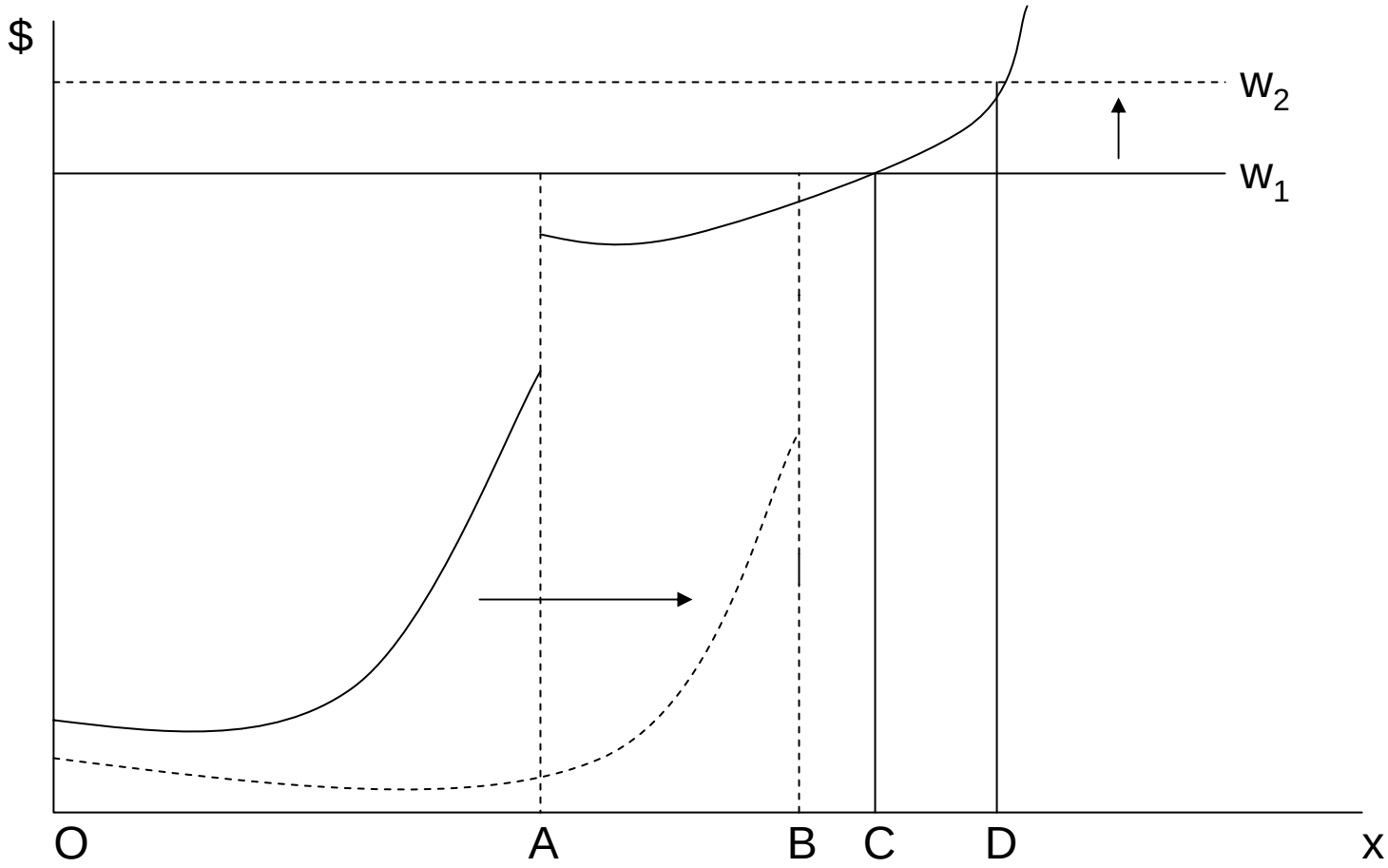
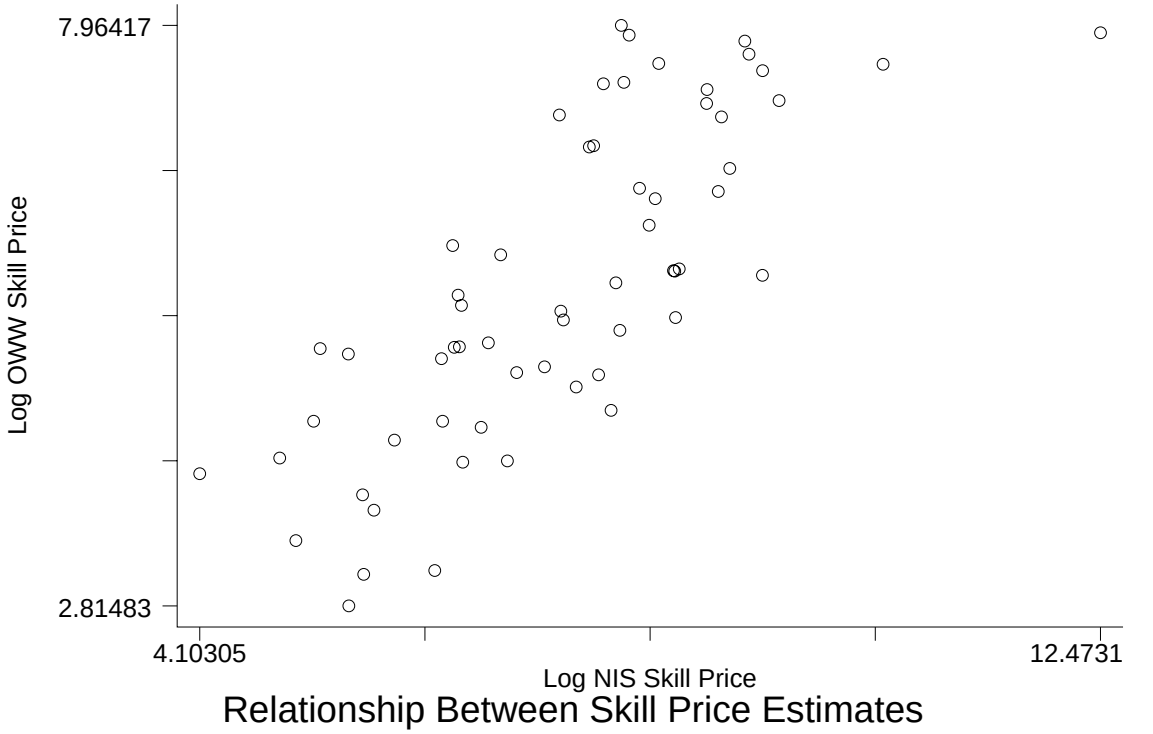


Figure 2. Constrained Domestic School Supply Model





Relationship Between Skill Price Estimates

Figure 4. Estimated (Purchasing-Power Adjusted 1996) Earnings of High School and College Graduates Across Selected Countries Around the World

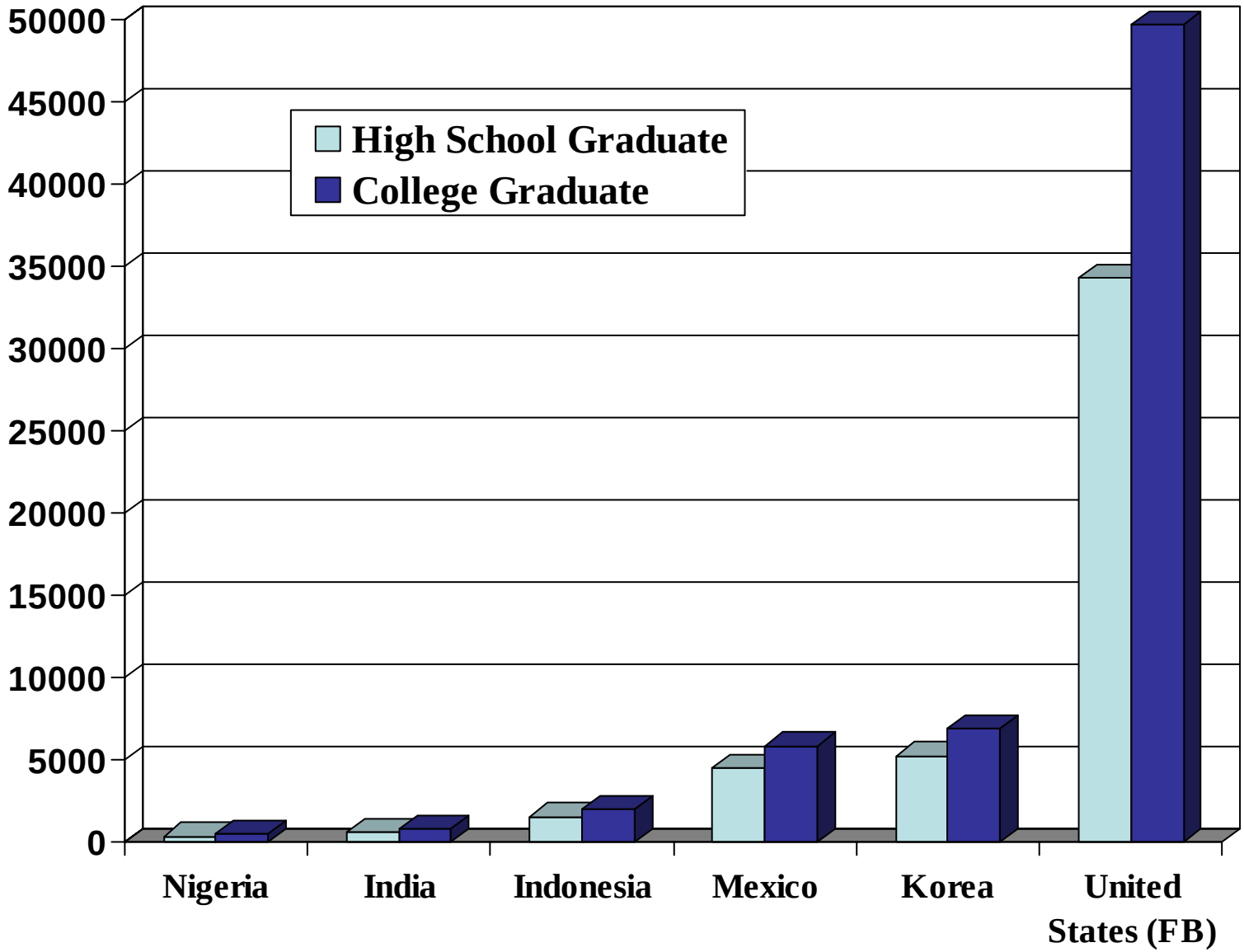


Figure 5. Visa Categories of Admission to Permanent Resident Status: Prior US Students and non-Students

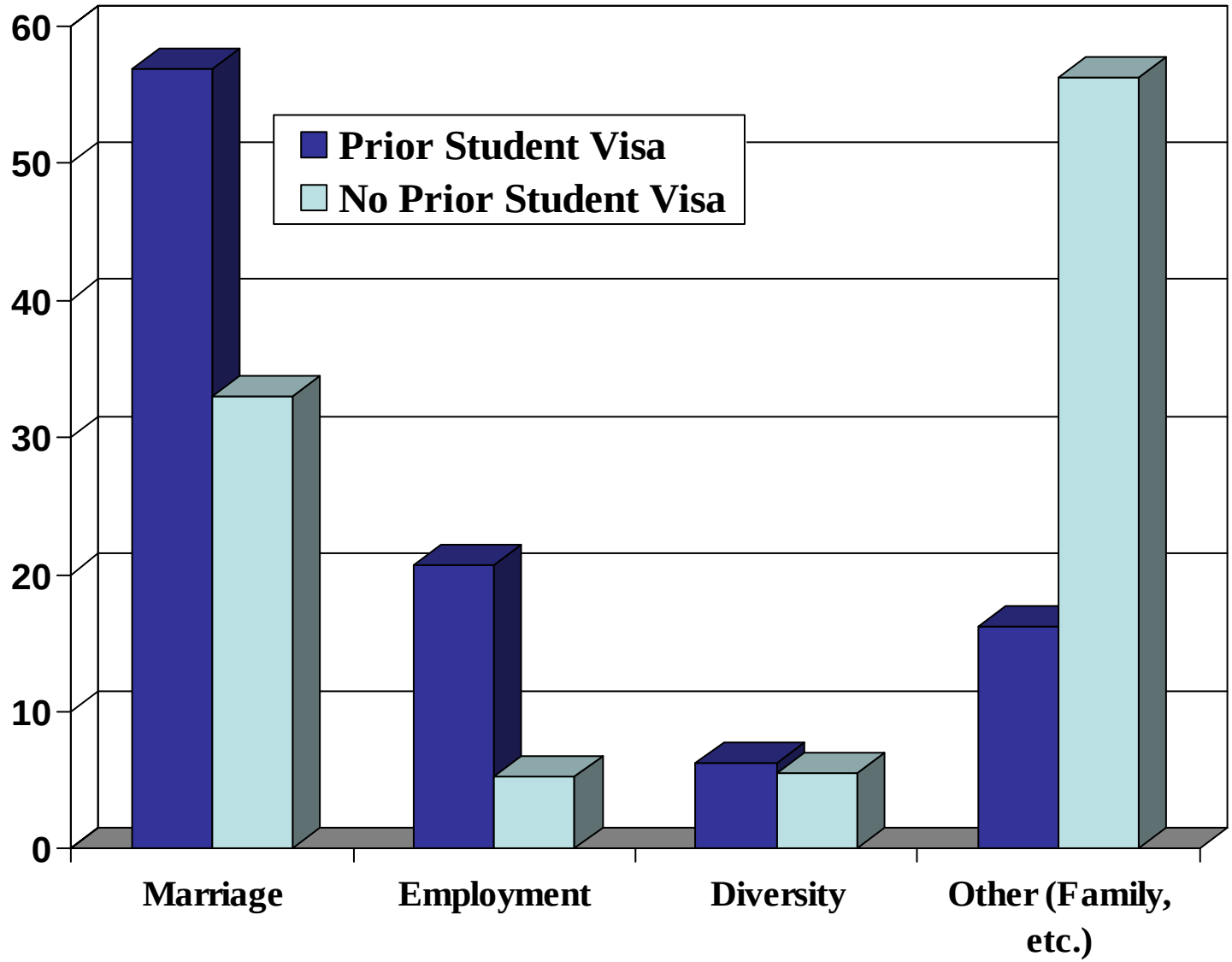


Figure 6. Estimated Percentage *Increase* in the Number of US Student Stayers from Doubling the Number of Home Universities, by Selected Countries

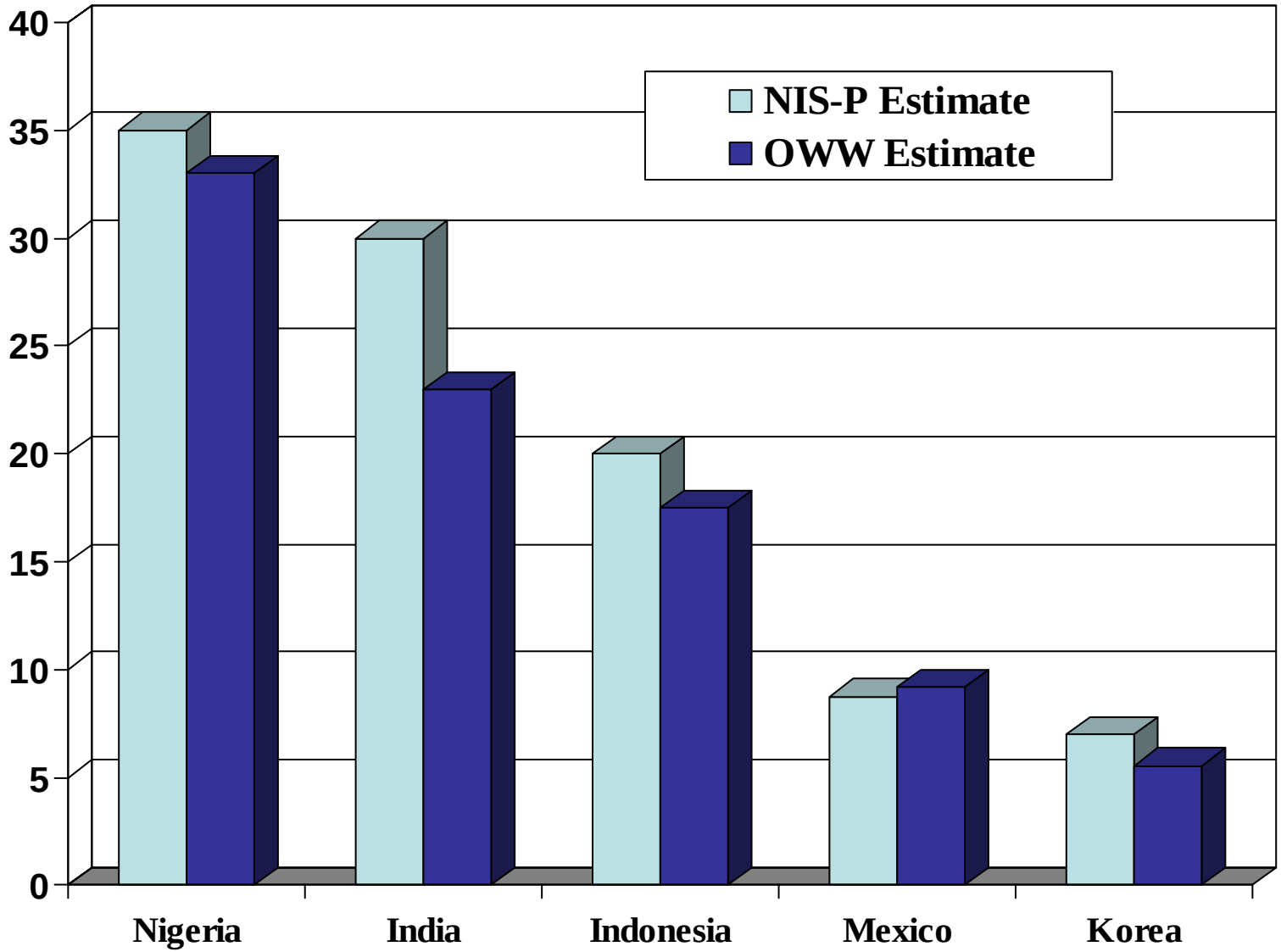


Table 1
Characteristics of Global Earnings Data Sets

Data set/variable	NIS-P Home-Country Workers	OWW, 1995
Mean annual earnings of respondents (US$)	14719[a] (2602)	10208[b] (13289)
Mean age of respondents	34.6 (8.53)	-
Mean years of schooling of respondents	14.4 (4.5)	-
Number of industries	-	49
Number of occupations	-	161
Number of countries	54	67
Number of workers	332	4924

a. PPP-adjusted
b. Exchange rate adjusted, country-specific calibration with lexicographic imputation

Table 2
Estimates of the Determinants of the Country Log Skill Price

Sample	US Immigrant Home Wages		OWW Wages
Variable/Estimation Procedure	GLS	GLS with Selection Correction	GLS
Country characteristics:			
Log GDP per worker	1.41 (5.01)[a]	1.35 (5.21)	1.10 (10.4)
Log mean schooling	-1.77 (3.18)	-1.97 (3.23)	-.330 (1.47)
Log teacher-pupil ratio, primary schools	-1.90 (3.68)	-2.17 (3.80)	-.509 (1.83)
Log teacher-pupil ratio, secondary schools	1.44 (2.51)	1.36 (2.56)	.457 (1.60)
Immigrant skill characteristics:			
Schooling	.0683 (3.50)	.0745 (3.79)	-
Age	.0428 (4.32)	.0436 (4.50)	-
λ	-	.800 (1.46)	-
Constant	-1.02 (2.10)	.713 (2.04)	-3.75 (2.60)
Number of countries	54	54	57
Number of immigrants	332	332	-
F (d.f.,d.f.)	17.02 (10,53)	25.33(11,53)	46.0(7,51)
R^2	.35	.36	.82

a. Absolute value of t-statistics corrected for clustering at the country level in parentheses.

Table 3
Top Ten Sending Countries of US Foreign Students, by Measure

Student Visas Issued, 2003 (Sate Department)[a]		Number of Foreign Students, 2006 (SEVIS)		Number of Student Stayers, 2003-4 (NIS)	
Country	Number	Country	Number	Country	Number
Korea	34,697	Korea	86,626	China	1,328
Japan	25,962	India	77,220	India	1,151
India	20,230	China	59,343	Korea	893
China	19,251	Japan	54,816	Japan	697
Taiwan	12,071	Taiwan	36,091	Taiwan	682
Mexico	9,077	Canada	32,153	Mexico	534
Brazil	7,625	Mexico	14,863	Kenya	516
Turkey	5,592	Turkey	12,795	Canada	459
Germany	5,376	Thailand	10,940	Turkey	419
UK	5,076	Indonesia	8,610	Indonesia	353

a. Canadian citizens who become US students are not required to obtain a US visa.

Table 4
Characteristics of Cross-Country Data Set,125 countries

Variable	Mean	Standard Deviation
Number of US student visas (F-1) issued in 2003/4, excluding Canada	1687	4668
Number of foreign-born students registered in SEVIS, 2006	4562	12685
Number of prior students (F-1 visa holders) who became permanent resident aliens in 2003/4	168.6	349.1
Estimated country skill price based on NIS-P (annual PPP $ earnings, 1996)	2799	4027
Estimated country skill price based on OWW (annual $ earnings, 1995)	4866.2	234
GDP per adult equivalent (PPP $, 2000)	2798.8	4026.7
Total number of universities	40.4	73.8
Any universities ranked in the top 200 world universities	.224	.419
Students per teacher, primary schools	25.0	17.1
Students per teacher, secondary schools	14.9	10.5
Surface distance to nearest US city of entry (miles)	4964	2197
Population in 2000 ($x10^{-3}$)	40076	138847

Table 5
Determinants of the Demand for (Log)US Student Visas, 2003/4

Country characteristics	NIS-P Skill Price		OWW Skill Price	
Log of country skill price	-.361	-.234	-.947	-.883
	(2.42)	(1.32)	(2.41)	(2.23)
Log of GDP per adult-equivalent	.682	.692	1.35	1.35
	(2.95)	(3.00)	(2.95)	(2.96)
Log of number of universities	.218	.768	.266	.435
	(1.90)	(2.28)	(2.26)	(1.60)
Log of number of universities x log of country skill price	-	-.0796	-	-.0328
		(1.86)		(0.67)
Any ranked universities (top 200)	.467	.630	.312	.381
	(1.72)	(2.20)	(1.10)	(1.36)
Log of students per teacher, primary schools	-.377	-.418	-.240	-.246
	(1.17)	(1.31)	(0.77)	(0.79)
Log of students per teacher, secondary schools	.783	.770	.659	.628
	(2.09)	(2.03)	(1.86)	(1.75)
Log of population	.476	.492	.487	.491
	(3.57)	(3.60)	(3.47)	(3.44)
Log of distance to nearest US city of entry (miles)	-.293	-.289	-.313	-.315
	(1.98)	(1.92)	(1.95)	(1.94)
Constant	-.801	-1.73	-4.04	-4.19
	(0.30)	(0.66)	(1.30)	(1.34)
Number of countries	124	124	124	124
R^2	.733	.741	.729	.730

Absolute values of robust t-ratios in parentheses.

Table 6
Determinants of the (Log) Stock of US Foreign Students (SEVIS), 2006

Country characteristics	NIS-P Skill Price		OWW Skill Price	
Log of country skill price	-.342	-.156	-.829	-.666
	(2.45)	(0.95)	(2.17)	(1.72)
Log of GDP per adult-equivalent	.603	.618	1.17	1.16
	(2.64)	(2.72)	(2.65)	(2.69)
Log of number of universities	.308	1.12	.354	.808
	(2.46)	(3.64)	(2.75)	(3.02)
Log of number of universities x log of country skill price	-	-.117	-	-.0885
		(2.92)		(1.76)
Any ranked universities (top 200)	.281	.522	.150	.333
	(0.95)	(1.79)	(0.48)	(1.11)
Log of students per teacher, primary schools	-.355	-.426	-.195	-.222
	(1.04)	(1.31)	(0.59)	(0.68)
Log of students per teacher, secondary schools	.954	.940	.813	.737
	(2.35)	(2.37)	(2.09)	(1.90)
Log of population	.404	.429	.410	.424
	(3.03)	(3.13)	(2.97)	(2.95)
Log of distance to nearest US city of entry (miles)	-.205	-.207	-.215	-.229
	(2.71)	(2.64)	(2.68)	(2.72)
Constant	-.133	-1.42	-3.03	-3.41
	(0.05)	(0.53)	(1.00)	(1.12)
Number of countries	125	125	125	125
R^2	.695	.713	.690	.698

Absolute values of robust t-ratios in parentheses.

Table 7
Determinants of the (Log) Number of Prior Students
Who Became Permanent Resident Aliens in 2003/4

Country characteristics	NIS-P Skill Price		OWW Skill Price	
Log of country skill price	-.133	-.0392	-.751	-.588
	(1.48)	(0.47)	(2.56)	(2.03)
Log of GDP per adult-equivalent	.121	.135	.792	.782
	(0.91)	(1.07)	(2.58)	(2.53)
Log of number of universities	.164	.916	.191	.644
	(2.00)	(4.56)	(2.35)	(3.14)
Log of number of universities x log of country skill price	-	-.109	-	-.0884
		(3.85)		(2.22)
Any ranked universities (top 200)	.407	.631	.248	.0556
	(1.54)	(2.45)	(0.89)	(0.20)
Log of students per teacher, primary schools	.179	.113	.0825	.190
	(0.61)	(0.40)	(0.29)	(0.65)
Log of students per teacher, secondary schools	.190	.178	.265	.628
	(0.64)	(0.62)	(0.93)	(1.75)
Log of population	.182	.206	.194	.209
	(2.05)	(2.54)	(2.20)	(2.41)
Log of distance to nearest US city of entry (miles)	-.108	-.111	-.117	-.131
	(2.59)	(2.58)	(3.04)	(3.20)
Constant	-1.96	-3.16	-4.52	-4.89
	(1.10)	(1.96)	(2.43)	(2.57)
Number of countries	125	125	125	125
R^2	.456	.500	.479	.501

Absolute values of robust t-ratios in parentheses.