

Higher Education and International Migration in Asia: Brain Circulation

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There has been much attention to how the emigration of skilled workers affects the returns to educational investments in low-income countries. Recently data have been put together that provides a global picture of the extent to which persons receiving their tertiary education in low-income countries end up residing in developed countries (Beine et al., 2006). The overall rates are high, suggesting that educational policies in low-income countries need to be attentive to skilled emigration. These “brain drain” statistics, however, ignore the facts that many students born and residing in low- (and high-) income countries acquired their tertiary schooling outside the country and that high-income countries are major sources of tertiary training for students from low-income countries.

The total numbers of international students in the world is large. In 2005, UNESCO reports that over two million students were enrolled in tertiary institutions as foreign (non-resident) students. 52.4% of these were from Asian countries, just slightly below the population share of Asia in the world (56.5%). Which countries are providing schooling to the world? Five countries - the United States, the United Kingdom, Australia, Japan and Germany - account for almost 80% of the stock of foreign students. Members of this group of five also dominate as the countries of destination for students from Asia, accounting for 76.3% of total Asian enrollments. As seen in Figure 1, the United States is by far the major destination for Asian students, accounting for almost a third of the total Asian population of students acquiring tertiary education abroad.

There is no information on the total numbers of tertiary-educated residents of low-income countries who acquired their higher education abroad. Thus it is not known to what extent the brain drain statistics over-estimate the net loss of human capital. Nor is there reliable information

up to now on the proportions of foreign students who do not return to their home country. The impact of externally-obtained higher education on the origin countries of foreign students can be large, however. Spilimbergo (2006) examined the educational backgrounds of the leaders of 113 countries of the world in 1990 and found that 57% of them were educated abroad, 22% of them educated in just three countries - the United States, the United Kingdom and France. Three of the leaders of the 13 Asian countries in his data base were educated outside their home country, two in the United States.

An older theoretical literature emphasized the loss of human capital to low-income countries and thus the potential negative effects on development of the emigration of skilled workers (e.g., Bhagwati and Hamada, 1974). An influential newer literature (Stark et al., 1998; Beine et al., 2001 and 2007; Mountford, 1997) suggests, however, that the emigration of skilled workers can increase sending-country educational investments. The idea is that prospects of emigration to countries where skills are rewarded more generously can lead not only to increased investment in skills in the home country but also to a larger higher-educated domestic population. The expected gains to schooling investments are thus a weighted average of the remuneration of the schooled in the home country and in a potential destination country, where the weights are based on the probability of emigrating.

There are two problems with the “brain gain” framework. First, for most countries of the world, the probability that a domestically-educated tertiary-educated person can permanently emigrate to a high-income country is very small, so that the effect of the “risk” of emigrating on the acquisition of domestic schooling cannot be large. Second, the literature ignores the endogeneity of the emigration probability. In particular, it ignores the fact that the choice of the

location of tertiary education significantly affects the probability that the person can emigrate. Potentially, a student receiving his or her education in a high-income country has advantages for obtaining a visa in both that country's marriage market¹ and labor market compared with a person who seeks a job or a mate in a high-income country while residing in a low-income country. That is, an important route to emigration is obtaining tertiary schooling abroad. Indeed, unlike for many visas, there are no country ceilings or kinship requirements for student visas. And, as we show in this paper, the probability that a foreign-trained student remains in the host country for the United States is on the order of 20%, far higher than the overall probability for the domestically-schooled.

Clearly higher-educational policy in low-income countries must be attentive not only to emigration issues but also to the alternative of outsourcing higher-education abroad. Deciding on higher-education policies in a poor country thus requires answers to a number of questions. Is educational outsourcing, and thus the exploitation of higher-education educational subsidies in high-income countries, a cost-effective alternative to expensive domestic investments in higher-education? Indeed, do investments in higher education at home even reduce the flow of students who seek schooling abroad? Is foreign schooling a reflection of lack of investments in domestic schooling, or just a reflection of the low rewards to schooling compared with the high-income countries where schooling is sought? How large is the permanent loss of internationally-trained students? These are the questions considered in this paper.

In section 1, a simple model of the international pricing of skills and schooling location

¹The largest proportion of permanent immigrants in the United States obtained a visa by marrying a US citizen. There are no country or overall ceilings on this visa class. We discuss below how US student 'stayers' become permanent immigrants.

choice is set out to clarify issues and motivate the subsequent empirical analysis. There are four key implications of the model: (i) More schooled persons always gain more from emigration to a country that provides higher rewards to skills. If students are seeking to maximize their gains from emigration then students are more likely to choose schooling abroad (ii) the larger the gap in the rewards to skills between the home country and the host country, (iii) the lower the quality of domestic schools, and (iv) the higher are incomes in the domestic economy. Section 2 is concerned with the measurement of the global rewards to skills - the prices of skills across countries. Estimates are presented of skill prices for 19 Asian countries, showing the enormous cross-country disparities in rewards to skills. In sections 3 and 4 estimates are presented of the determinants, respectively, of the distribution of the stocks of foreign students who obtain their schooling in the United States, the dominant host country for foreign students, and of the choices of students of which host country to obtain their schooling. Section 5 is concerned with the measurement of stay rates of foreign students and their determinants, and presents estimates of stay rates for US foreign-students from around the world and the determinants of the return rates of US foreign students across sending countries.

The main empirical findings are: 1. The patterns of student flows across countries are consistent with the hypothesis that students acquire schooling abroad to obtain jobs in the host countries - there are larger per-capita numbers of foreign students in the United States from lower skill-price countries than from high skill-price countries and host countries with higher skill prices attract the most foreign students, controlling for the quality and quantity of tertiary institutions in the sending and host countries. 2. Increasing the number of colleges and universities in a sending country with a low skill price, given the quality of the higher-education

institutions, increases, not decreases, the number of students who seek (graduate) education abroad as it increases the number of persons with higher gains from emigrating. 3. However, increasing the quality of domestic tertiary institutions decreases student outflows. 4. Higher-income students gain the most from foreign schooling: among countries with similar rewards to skills, those that are richer and closer to the host country send more students abroad for schooling, for given domestic educational quantity and quality. 5. Asian students are more likely to migrate to the United States for schooling, net of skill price and educational quality and quantity differences. 6. The proportion of foreign students who remain in the United States as permanent immigrants is approximately 20%, but is only about 14% for students from Asian countries. Those students from Asia who do immigrate are highly schooled compared to other origin groups and tend to be disproportionately computer scientists, engineers and natural scientists. There are few professionals among any of the immigrating foreign students. 6. Return rates of foreign students from the United States are higher for countries with higher skill prices, with Asian students more likely to return net of skill price effects. However, on net, lower skill price countries, for given population size, have greater domestic stocks of foreign-trained persons compared with high skill-price countries. Thus, although there is a tax in the form of the loss of a fraction of the highly-skilled to host countries that supply tertiary schooling that is highest for low skill price countries, such countries disproportionately accrue a net brain gain from the outsourcing of tertiary education.

1. Theoretical Framework

To understand how the economic returns to acquiring schooling in a foreign country are related to migration gains and to domestic schooling returns and school quality it is useful to set

out a simple theoretical framework. The simplest model is one with a single skill type. The earnings or wage W_{ij} of an individual I in country j is then the product of the country-specific price of skill ω_j - the skill price - and the number of skill units x_{ij} possessed by i :

$$(1) \quad W_{ij} = \omega_j x_{ij}.$$

Skill units are produced in school. The relationship between skill units and schooling S (in years) is given by

$$(2) \quad x_{ij} = \mu_{ij} e^{\beta S},$$

where μ_{ij} is the baseline skill of a worker and β is a parameter that translates years of schooling into skill units - a higher β implies that a year of schooling is more productive in producing skill units, so β naturally represents the quality of schooling. Within a country if β is high, school quality (the domestic “return” to schooling) is high, and higher- S individuals will earn proportionally more than lower- S individuals compared with a country in which β is low. Across countries, however, differences in earnings for a person with the same number of years of schooling S will reflect as well differences in the price paid for a unit of skill. As we will see, prices of skill ω_j differ substantially more across countries than do domestic schooling returns β . The gains from out-migration are dominated by cross-country differences in skill prices.

Consider now the choice of schooling location for a student I residing in country j . Schooling taken abroad has two potential benefits: First, it may enhance the prospects for receiving a job abroad, at a higher skill price. Second, schools abroad may be of higher quality, so that the foreign-trained student will earn more at home than if she acquires the schooling domestically. If p^A is the probability of getting a job in the destination country u where schooling is taken and α reflects the quality of schools there, then the expected wage if one unit of

schooling is taken abroad is given by

$$(3) \quad E(W_{ij})^A = p^A \omega_u e^\alpha + (1 - p^A) \omega_j e^{\gamma\alpha},$$

where γ ($0 < \gamma < 1$) measures the extent to which schooling acquired abroad is of less value in the home country than in the destination country.

If the net direct cost of acquiring schooling outside the country; e.g., travel costs, foreign language training, and the extra tuition, is C^A , then the expected gain from schooling broad G^A is

$$(4) \quad G_{ij}^A = p^A \omega_u e^\alpha + \omega_j [(1 - p^A) e^{\gamma\alpha} - e^\beta] - C_{ij}^A.$$

Note that (4) assumes that the probability of obtaining a permanent job abroad if schooling is acquired domestically is nil. What is necessary for the analysis is that p^A is greater than the probability of getting a job without foreign schooling. In the US case, the latter probability for a randomly-selected individual depends on the probability the person has an immediate relative abroad, an infinitesimal probability, or wins the diversity visa lottery. For a person in an eligible country, that probability is less than $\frac{1}{2}$ of one percent.² Moreover, for an analysis of schooling choice in Asia, it notable that six of the sixteen countries not eligible for the lottery visa are in Asia (China, India, Pakistan, the Philippines, South Korea, and Vietnam).³ For persons in these countries, there is even less opportunity to emigrate. As we will see, however, the probability that a foreign student in the United States obtains a permanent visa is as high as 20%.

We assume that a student will go abroad for schooling if (4) is positive, and will seek a destination among multiple destinations in which the net gain is highest. Thus, the fraction of

²There were 5.5 million applicants for the 2007 diversity lottery; there are approximately 25,000 winners (50,000 visas allocated to winners and their immediate family).

³A country's eligibility depends on the number of imigrants from that country in prior years. Populous countries are thus penalized, *ceteris paribus*.

students who migrate from country j to acquire schooling abroad will be a function of the determinants of the average gain from doing so; i.e.,

$$(5) \quad m_j = g(G_j^A) = g(p^A, \omega_u, \omega_j, C_j^A, \gamma, \alpha, \beta)$$

There a number of testable implications from the model. First, if direct costs of acquiring schooling are high, then parental resources will matter, or, at the country level, richer countries will be observed to have more students studying abroad, everything else the same. In contrast, however, in origin countries with high skill prices but with the same level of income the gains from schooling abroad are likely to be smaller. The effect on the gain and thus the magnitude of student out-migration from a rise in the domestic skill price is given by (6):

$$(6) \quad \partial G^A / \partial \omega_j = (1 - p^A) e^{\gamma\alpha} - e^\beta.$$

As an be seen, the relationship between the foreign-schooling gain and the home skill price is more likely to be negative the higher the probability P^A of obtaining a foreign job via schooling abroad and the less the premium for foreign schooling at home (γ low). Indeed, if domestic and foreign schooling yield approximately the same return in the home country and students seek (higher-paying) jobs abroad, the higher-skill price countries will always have fewer students abroad:

$$(7) \quad \partial G^A / \partial \omega_j = - p^A e^\beta < 0 \quad \text{if } \gamma\alpha \approx \beta.$$

Note that if acquiring schooling in a foreign country with a higher skill price does not increase employment prospects there ($P^A=0$) then the only reasons for acquiring schooling abroad are the lower costs or higher-quality of foreign schools. If the latter is true ($\gamma\alpha > \beta$), then countries with high skill prices (and low quality schools) will send more students abroad. The sign of the relationship between the number of students from a country studying abroad and its

skill price thus reveals whether studying abroad is in part motivated by permanent migration motives. Moreover, if job prospects abroad are a motive for foreign schooling it will also be true that an increase in the price of skill in a destination country will increase the expected gain from acquiring schooling in that country and lead to more foreign students studying there

$$(8) \quad \partial G^A / \partial \omega_u = p^A e^\alpha > 0.$$

Increasing the quality of domestic schooling β will, however, reduce the net gain from acquiring schooling abroad whether or not schooling abroad enhances employment at the destination and thus will reduce the outflow of students:

$$(9) \quad \partial G^A / \partial \beta = -\omega_j e^\beta < 0.$$

Finally, an increase in the quality of foreign schools will increase the gain from obtaining foreign schooling and thus attract more students from abroad, but that gain will be smaller the smaller the probability of getting a foreign job and the smaller the domestic gain from foreign schooling γ .

$$(10) \quad \partial G^A / \partial \alpha = p^A \omega_u e^\alpha + \gamma \omega_j [(1 - p^A) e^{\gamma \alpha}] > 0.$$

2. Estimating World Skill Prices

Using the skill-price framework to examine the determinants of the flows of students across countries requires information on the wages of workers with the same skills across all countries of the world. With such data it is relatively straightforward to identify skill prices. In particular, substituting (2) into (1) and taking logs, yields the familiar log-linear wage equation:

$$(11) \quad \ln(W_{ij}) = \ln \omega_j + \beta_j S_{ij} + \ln \mu_{ij}.$$

In this case each country has its own intercept, and perhaps a different domestic schooling return.

The country-specific intercepts in (11) are the country-specific skill prices.

All prior empirical analyses of international migration have used GDP per-capita, or in some rare cases, GDP per-worker as the relevant “wage” affecting migration gains. However, as the model makes clear, what matters is how cross-country earnings differ for a worker of given skill, which is the skill price. Per-capita GDP varies across countries due to differences in age-composition, in labor force participation rates, and in the average level of skill of the workforce, all of which is irrelevant from the perspective of a worker deciding on whether and where to migrate (or to acquire schooling).

The principal barrier to obtaining skill prices is the absence of comparable data on the earnings of workers by skill for many countries of the world. There are two sources that are used here. The first is the predecessor survey to the New Immigrant Survey, the New Immigrant Survey Pilot (NIS-P), which provides the home-country earnings for a sample of new U.S. legal immigrants admitted to legal permanent residence during the months of July and August of 1996. Sample size for adult immigrants is 1032. Details on the survey are given in (Jasso *et al.*, 2000). 332 of the sampled immigrants, representing 54 countries, had worked outside the United States prior to immigrating and provided earnings data for their last job there. Information on work time and pay periods were used to adjust for labor supply differences across workers in order to convert 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 each worker along with gender and age. Thus, the cross-country wage equation (11) can be estimated directly. The disadvantage is that the immigrants are not a random sample of workers in the home country.

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. For this analysis, data from 1995 were selected, 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. Monthly earnings from the series expressed in US dollars based on exchange rates, as estimated by Freeman and Oostendorp, are used.⁴ The disadvantages of this data set are that the information across countries may not be comparable. Moreover, there is no information on the schooling or age of workers. Instead, the set of occupational indicators must be used to standardize across workers for skills. In particular, for the OWW data set one assumes that skill units are a non-parametric function of industry and occupation; i.e.,

$$(12) \quad x_{ij} = \mu_{ij} \exp(\mathbf{I}_{ijk} \boldsymbol{\gamma}_k),$$

so that

$$(13) \quad \ln(W_{ij}) = \ln \omega_j + \mathbf{I}_{ijk} \boldsymbol{\gamma}_k + \ln \mu_{ij},$$

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 for 1995.

Both of the data sets at most provide comparable information on skill prices for only 67

⁴ Specifically, the wages computed using exchange rate information and country-specific calibration with lexicographic imputation are used.

countries. To predict skill prices for more countries, Rosenzweig (forthcoming) used 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 worldwide micro wage data. The analysis made use of the fact that the skill price is the marginal value product of skill and assumed that aggregate output for a country j is produced according to Cobb-Douglas technology. The estimation procedure also attempted to correct for the selectivity of the NIS-P immigrant sample, that selectivity being based on the decision to immigrate. The estimates were used to predict skill prices for countries without sampled workers. One shortcoming of the NIS-P base for predicting skill prices is that, because of the limited degrees of freedom, it is not possible to allow the return to schooling to differ across countries. Similarly, for the analysis of OWW earnings, the coefficient vector for industry and occupation is assumed to be invariant to country.

Figure 2 displays the NIS-P and OWW estimates of skill prices for 19 Asian countries. The figure shows that both sets of data yield similar, but not identical skill price estimates (the correlation across all countries is over .66). Both sets of estimates moreover indicate the substantial differences in skill prices across countries within Asia. For example, the skill price in Singapore is 9 to 12 times that in Bangladesh, the skill price in Korea is 3.4 to 5.5 times the skill price in Bangladesh. To see how these differences in skill prices translate into differences in earnings by levels of schooling we can compute earnings for any schooling level and return β using (11) for any country based on its skill price. Figure 3 shows the estimated earnings for a select number of countries around the world based on the NIS-P estimated skill price for each country under the assumption that the return to schooling β is the same in each country, and is

7% (the estimated world return in Rosenzweig, forthcoming). As can be seen, earnings for persons of comparable schooling differ substantially across countries.

There are two important features of Figure 3. First, the gains from migration (cross-country differences in earnings) are greater the higher the level of schooling of the individual. The migration of skilled persons from low to high skill price countries leads to greater global gains in output. Second, raising the level of schooling in each country, say so all have a college education, even ignoring the depressing of skill prices via a general-equilibrium effect, would do very little to decrease earnings differences across countries. Put another way, equalizing cross-country skill price differences would have a substantially greater impact on world inequality than would equalizing education levels across countries.

How do differences in domestic returns to schooling across countries affect global earnings differences? In Figure 4, earnings for high-school and college graduates are computed for Bangladesh and Korea, based on their NIS-P skill prices but assuming alternative rates of return to schooling of 7 and 10 percent. As can be seen, increasing domestic returns to schooling significantly affects earnings; if returns to schooling reflect school quality then increasing school quality in a low skill price country can, for given schooling levels, reduce earnings disparities relative to high skill-price countries. Thus, an increase in the return to schooling from .07 to .1 in Bangladesh, while keeping the Korea schooling return at .07, shrinks the absolute differential in the earnings of college graduates across the two countries by 26 percent. However, the absolute gap remains large. Moreover, an increase in the schooling return in both countries widens the gap even more at the college level. Of course, raising school quality, if it changes the amount of skill in the economy, would reduce the skill price (ignoring large trade effects). One question is

whether increasing the quality of domestic schooling for a given domestic skill price would decrease the outflow of students to study abroad, as suggested in the migration cum schooling model. We now turn to estimates of the determinants of foreign student outflows.

3. Where Do US Foreign Students Come From? Determinants of Student Outflows to the United States

We will first estimate an approximation to the student outflow equation (5) using data on the number of students by origin country studying in tertiary institutions in the United States. As we have seen, the United States is the dominant country of destination for foreign students both globally and for students from Asia. But we also choose to use data from the United States because there is reasonably precise information on student enrollments by source country in tertiary institutions and because, as discussed below, there is unique information on US foreign students who remain in the United States after completing their schooling so that the loss of human capital associated with foreign study can be estimated.

There are two data sources on US foreign students - counts of F-1 student visas issued each year by the State Department and the Student and Exchange Visitor Information System (SEVIS), which provides information by country on the stock of current foreign-born students. The advantage of the latter is that all foreign-born students are required to register in the system. Because Canadian citizens do not need an F-1 visa to study in the United States, they are not included in the State Department flow data. Moreover, the SEVIS data exclude family members of students, who are included in the visa flow information. And the State Department visa counts include persons who do not actually use their visas to come to the United States. We use here the

current stocks (2006) of students in United States by country from SEVIS.⁵

Inspection of the SEVIS data indicate that all of the top five sending countries for students enrolled in US schools are in Asia - in order Korea, India, China, Japan, Taiwan make up the top five. Indeed, seven of the top ten countries of origin are in Asia (Thailand and Indonesia are 9 and 10). This list obviously contains a mixture of high and low skill price Asian countries, as well as countries of very different size, and thus is not very informative about how origin-country skill prices influence students flows. To carry out the analysis of how skill prices and college and university quantity and quality affect the numbers of students who come to the United States to study we need more information than the skill prices.

To characterize the number and quality of domestic universities and colleges we add 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 Times Higher World University Rankings 2005*. We also computed the mean rank of the ranked universities, if any. If domestic quality lowers the gains from foreign study, we would expect that countries with ranked universities would, everything else the same, experience smaller outflows of students. Similarly, the lower the mean rank of the universities, the greater the outflow. The effects on student outflows of the number of universities, for given quality, is less clear.

Approximately half of foreign students in the United States come as graduate students (IIE, 2006); increasing the supply of college graduates in a country thus increases the potential supply of graduate students who study abroad. To the extent that graduate study in a foreign country

⁵In fact the results reported below are similar if the State Department visa information is used instead of the SEVIS data.

increases, relative to undergraduate study there, foreign job and thus immigrant visa prospects, building domestic capacity in universities, without increasing quality, could increase per-capita rates of (graduate) study abroad and thus increase the risk of losing the best and brightest.

Three variables are included that are related to the cost of acquiring schooling abroad. 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. The second variable is whether or not English is an official language of the sending country. Presumably, given that the medium of instruction in the United States is English, students from countries in which English is prevalent face lower costs of studying in the United States. Finally, financing education abroad is also costly - as reported by the Institute of International Education (IIE, 2006) the primary source of funding is “personal and family” for about 64% of foreign students (about half for graduate students and over 82% for undergraduates). Thus, income will matter for study abroad. We add the sending country’s GDP per adult equivalent to the database, which we assume is positively related to the average capacity 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. Economic growth can increase out-migration, if it is not accompanied by sufficient increases in skill prices. Note that in prior analyses of international migration, GDP is used to proxy wage rates, thus mixing together skill prices and financing constraints.

Table 1 reports descriptive statistics for the country data base and Table 2 reports estimates of the origin country-specific determinants of the number of foreign students studying in the United States for two specifications: one using the NIS-P skill price estimates and the other

the OWW-based estimates of skill prices. Both specifications include the size of the sending-country population. All variables are in log form.

The skill price coefficient estimates are consistent with the implication of the model that students obtaining schooling outside their home country are in part motivated by the gains from permanent migration in the country where they go for their schooling - the number of US students from a country outside the United States is *negatively* and significantly related to its skill price. Recall that if all students expect to return, a rise in the domestic skill price would increase the demand for schooling, and given the stock of available schools, increase the amount of schooling taken abroad. The skill price point estimates are also relatively large, a doubling of the skill price (for example, raising the skill price of India to that of the Philippines) reduces the stock of students abroad by from 26 (NIS-P) to 73 percent (OWW).

Costs of foreign schooling matter too. For given skill price and (per-capita) number of universities, countries with higher incomes per-capita, and thus greater ability to finance education, have greater stocks of students in the United States, but distance to the United States lowers the numbers there. Moreover, if an official language of the home country is English, this facilitates study in the United States. It is interesting to compare the point estimates for income per-capita (adult-equivalent) and skill price. A doubling of both, without increasing domestic schooling capacity on net results in an increase in study abroad - by from 26 to 33 percent.

What are the estimated effects of investments in tertiary education? The estimates indicate that increases in the *quality* of higher-education institutions significantly reduce the outflow of students - a country with any ranked university, at the mean average rank (118), has a 18.6 to 33 percent smaller stock of students in the United States compared with a country with

the same number of universities per-capita but no ranked universities.⁶ Increasing the average rank of universities by one standard deviation (lowering the rank number) further decreases student outflow by from 30 to 35 percent. Increasing university quality raises the return to schooling at home, evidently increasing the opportunity cost of foreign schooling and out-migration. In contrast, increasing the number of universities per-capita increases study abroad - doubling the number of universities on average increases the number of students studying abroad by from 28 to 31 percent. This seeming paradoxical result is again consistent with foreign schooling as a route to permanent out-migration. Increasing university capacity, for given average quality, increases the number of students who are eligible for graduate training abroad and who thus have enhanced prospects for obtaining a higher-paid job abroad.

4. Where do Foreign Students Go? Determinants of the Host Countries for Foreign Students

To further assess to what extent study abroad is in part motivated by job prospects and returns abroad we estimate the determinants of where foreign students choose to acquire their schooling. A key implication of the schooling/employment model is that students will flow to countries with higher skill prices, for given school place availability and quality, if they in part view schooling abroad as a means of entry into higher-priced labor markets. Indeed, the top countries attracting foreign students seen in Figure 1 have skill prices substantially above the average for the world. We use information compiled by UNESCO for the year 2003⁷ on the

⁶For the NIS-P estimate, this is $-1.18 + .00842*118$; the OWW estimate is $-1.49 + .00983*118$.

⁷There appears to be more comprehensive coverage for this year than for subsequent years.

stocks of foreign students in tertiary institutions across countries combined with our data on skill prices and schools. In this case the variables pertain to the host countries, not the sending countries. We use the same specification as used for the determinants of student out-flows except that we exclude distance to the United States and the host-country per-capita GDP. We also employ maximum-likelihood Tobit to estimate the coefficients. This estimation procedure is used because for many countries of the world there are essentially no foreign students, so there is a large concentration of observations at zero (53%).⁸ As we wish to explain why students go to some countries and not others for tertiary schooling we do not want to exclude these countries from the analysis.

We also divide up the foreign student populations into those students from Asian countries and those from elsewhere in the world. The estimates of the determinants of the supply of foreign students in Table 2 indicated that, given skill prices, income, distance, population size, and the quality and quantity of home universities, stocks of foreign students in the United States were still 4.5% higher for Asian countries compared with non-Asian countries. The question addressed here is whether the choice of destination countries differs across Asian and non-Asian students.

Table 3 reports the maximum-likelihood Tobit estimates of the host-country determinants of the cross-country distribution of foreign students. The estimates indicate that the capacity of host countries to absorb students matters - the number of foreign students is significantly higher where there are more universities per-capita. The key finding, however, is that stocks of students,

⁸UNESCO truncates the numbers from below at 400; i.e., if the total number of foreign students is less than 400 the number is not reported, and is set to zero.

both Asian and non-Asian, are significantly larger in countries with higher skill prices, given university capacity and quality. In contrast, the variables measuring university quality, for given capacity, do not appear to affect the choice of where students attend school abroad. Job returns thus seem to dominate in the host-country choice of foreign students. The set of skill price point estimates suggest that an increase in a host country's skill price by 10% would increase the stock of students by 14 to 17 percent for non-Asians and by 20 to 23 percent for Asian students. Asian students thus appear to be more return-sensitive than non-Asian students, although the difference is only significant at the 10% level.

Finally, the set of variables appear to fully explain why the stock of foreign students is so much larger in the United States compared with other host countries. Inclusion in the specification of a dummy variable for whether the host country is the United States (not shown) did not increase the explanatory power of the specification - the dummy variable coefficient was statistically insignificant. The estimates thus suggest that the United States is an attractive destination for international students because its labor market pays a premium for skills and because of the large numbers of US universities. Indeed, the United States has more universities than any other country, by a factor of 3.5 over the country with the next highest total number (Japan).⁹ The US dominance among foreign students is evidently not explained by university quality (which is also higher than elsewhere based on the ranking data); nor is it due to the United States being an English-speaking country. The estimates suggest that everything else the

⁹The United States does not rank high, however, in universities per-capita worldwide. The estimates suggest that absolute numbers of universities matter, as populations size, given university totals, does not have a statistically significant (negative) affect on students stocks.

same students avoid countries in which English is an official language. This is more so for Asian students.

5. How Many US Foreign Students Stay? Determinants of the Return Rates of US Foreign Students

A full assessment of the effects of students studying abroad on sending countries requires information on the return rates of foreign students. If no students return, then clearly the phenomenon of “external” education represents a net loss of human capital, or potential human capital, for the sending country. On the other hand, if all students return then the stocks of students studying abroad from a country represents a net gain in human capital for the country, subsidized by the host countries. The number of foreign-trained students who return to the home country is R_j is

$$(14) \quad R_j = (1 - r_j)m_j,$$

where r_j is the fraction of students from j who remain in the host country and m_j is the stock of students from j in the host country. We would like to know both the magnitudes of r_j and what determines its variation across countries.

To compute return rates of foreign-trained students we need to know how many persons who ever came as foreign students are represented in the stock of permanent immigrants, the number of student stayers. Census data provide information on the stocks of foreign-born, but these counts contain unknown proportions of persons who are not permanent immigrants (including students). Only three countries of the world with significant inflows of immigrants provide nationally-representative information on permanent immigrants: (1) the Longitudinal Survey of Immigrants to Australia (LSIA2), which sampled approximately 10% of primary

applicants aged 15 and over who became new immigrants and who entered Australia in the one-year period September 1999 to August 2000, (2) the Longitudinal Survey of Immigrants to Canada (LSIC), a sample from 20,000 people aged 15 who settled in Canada between October 2000 and September, and (3) the US New Immigrant Survey (NIS), which sampled 4.3% of all persons 18 and over who were admitted as permanent resident aliens in the 7-month period May through November of 2003.

A major shortcoming of both the LSIA2 and the LSIC for this purpose is that both surveys only sampled *new-arrival* immigrants, those who were outside of Australia or Canada prior to being admitted. These two surveys thus exclude anyone who adjusted their status from a student visa. It is then not possible to estimate the number of student stayers in either Canada or Australia. The NIS, however, sampled all immigrants who attained permanent residence status, including those who adjusted their status and who were thus already residing in the United States. The NIS also includes a complete history of visits by each of the immigrants to the United States, including the visa held at each visit, prior to becoming a permanent resident alien. Thus it is possible for the first time to identify US student stayers - those permanent immigrants who ever held an F-1 (student) visa.

About 6% of the total immigrant cohort sampled by the NIS are student stayers.¹⁰ The

¹⁰What are the principal routes by which US foreign students become permanent immigrants? Rosenzweig (forthcoming) shows using the NIS that 56% of the student stayers became permanent immigrants by marrying a US citizen and another 21% by obtaining a “skilled” employment visa. These proportions are, respectively, double and seven times the proportions for immigrants who were not formerly US students, more than half of whom

NIS data indicate that student stayers are indeed highly educated. Figure 5 displays the proportions of Asian- and non-Asian origin student stayers who have post-graduate schooling, with a comparison to the rest of the immigrant cohort. 63% of the student stayers from Asia have post-graduate training, compared with 33% for non-Asian student stayers and only 11% for all other immigrants. Student stayers from Asia are also highly concentrated in science and engineering. Figure 6 shows that 23% of Asian-origin student stayers are computer scientists or computer engineers and another 12% are natural scientists or engineers. This compares with the six and eight percent of non-Asian-origin student stayers in those occupational categories. Non-Asian-origin stayers are, however, significantly more represented in the management occupational categories. The figure also shows that very few student stayers from either set of countries are health professionals.

As Figures 5 and 6 clearly show, origin countries are losing some talent, to the United States, as a consequence of outsourcing tertiary schooling. The questions we now address are how much talent is lost and what sending-country characteristics determines who stays - which countries lose the most talent?. Only one prior study has attempted to estimate the stay rates of students for the United States (Bratsberg, 1995), using published statistics on immigrants and non-immigrant students. However, that study used an incorrect numerator and an incorrect denominator, resulting in stay rate estimates that are too low. In particular, Bratsberg used counts of immigrants who directly adjusted their status from student to immigrant in order to estimate student stayers. However, according to the NIS, only 30% of immigrants who once held students visas adjusted directly from student to immigrant. Bratsberg's student stayer counts are thus

obtained a visa based on their kinship (other than marriage) to a US citizen or immigrant.

substantially too small. For the denominator, Bratsberg used annual student visa numbers issued by the Immigration and Naturalization Service. This set of statistics overestimates the size of student cohorts. The reported numbers are counts of border crossings by students. A student who travels home for two holidays in a year is counted three times, for example. The INS numbers are about double the actual numbers of student visas issued annually by the State Department.

Using the (appropriate) NIS student stayer counts and the SEVIS information on country-specific stocks of students, we can construct the “depreciation” rate of the stock of students from a country j , r_j , as the ratio of student stayers to the stock of US students. We use the stock data on foreign students rather than annual flow data because, as noted, the US State Department flow data on student visas excludes students from Canada (a major source of US foreign students and student stayers) and the stock data smooth variations across years in student flows. The combined data indicate that the average student stay or depreciation rate r , weighted by the stocks of students per country, is 4.7%, 2.7% for Asian-origin countries and 6.6% for students from outside of Asia. These rates may seem low, but they are relative to the stocks of students. If, say, there are five cohorts in the population of foreign students, these rates would be multiplied by five to obtain probabilities that a student in a single entry cohort of students did not return, which would be about 20% (13.5% and 33%, for Asian and non-Asian countries, respectively). The flow of students per year to the United States is about 250,000; the (NIS) estimated count of about 50,000 student stayers from a cohort of immigrants thus also suggests a stay rate of 20%. As expected, this figure is higher than the lower-bound rate of 13% obtained by Bratsberg using a too-small numerator and an inflated denominator.

Although the estimated depreciation rate is lower overall for students from Asia, the rates

vary widely across countries within Asia. Figure 7 displays the estimated foreign student stock depreciation rates for 19 Asian countries. As can be seen, Cambodia, Burma and the Philippines have the highest rates of stay of all the countries - 18% to 22% of the student stocks from these countries become US permanent immigrants each year. In contrast, only about 2.5% of the student stocks from India, Taiwan and Singapore “depreciate” each year. These three countries with a similar stay rates are obviously very different in other dimensions (i.e., skill prices), so it is difficult to discern from Figure 7 what accounts for the country-specific patterns of stay rates.

Table 4 reports estimates of the determinants of the log of return rates $1 - r_j$ of US foreign students across 136 sending countries. The specification is similar to that determining the stocks of US foreign students except that GDP per adult-equivalent is excluded, as financing cost should not be a significant factor for the decision to return. Indeed, as seen in the table the distance of the United States to the home country is not a significant factor in explaining return rates, even though it evidently did significantly deter studying abroad. The key finding from Table 4, however, is that student return rates are significantly higher when the net economic gain from remaining in the host country is lower. That is, return rates are higher for countries with higher skill prices. The point estimates indicate that a doubling a country’s skill price increases the return rate by from 1.5 to 1.9 percent. Note that the return rates relative to the stocks are on average over 95%, so these effects are relatively large - doubling the skill price decreases the stay rate, relative to the stock, by 32 to 41 percent. None of the other factors included in the specification, which did affect student out-migration, appear to be significant determinants of return rates, except perhaps whether English is an official language of the sending country, for which English-medium schooling may be more relevant. However, Asian students are more

likely to return compared with students from other countries, even net of skill prices.

The estimates of skill price effects from Tables 2 and 4 can be combined to obtain an estimate of the elasticity of the stock R_j of foreign-trained students in the home country to the country's skill price. Taking logs of both sides of (14) and noting that the specifications of the estimating equation are in logs, we get

$$(15) \quad d\log R_j / d\log \omega_j = \eta_m + \eta_{(1-r)},$$

where η_m is the estimated skill price coefficient in Table 2 for the country's stock of students obtaining training in the United States and $\eta_{(1-r)}$ is the estimate of the effect of log skill price on the log return rate. The combined estimates of (15) are -.24 (NIS-P) and -.71(OWW). These estimates imply that on net higher skill price countries, even though their foreign-trained students are more likely to return, have smaller stocks of foreign-trained students (per-capita) in their economies than do lower skill price countries, because fewer of their students travel abroad for schooling. Thus even though more foreign-trained students do not return to low skill-price countries compared with high skill-price countries, the subsidies to schooling in host countries evidently flow disproportionately to countries with low skill prices.

6. Conclusion

In this paper we have considered a neglected component of the international mobility of skilled individuals, the supply of schooling to the foreign-born in high-income countries. We have shown that much of the mobility of students can be explained by the same factors as explain all international migration in general - the search of workers for jobs at better pay. Student out-migrate more from low-income sending countries and select host countries with the highest skill prices. However, student outflows also respond directly to domestic investments in higher

education. The results indicate that upgrading the quality of higher-education reduces student outflows, but increases in the numbers of colleges and universities per-capita on average increase the outflow of students for foreign (post-graduate) training. This latter results from the fact that increasing the number of college graduates increases the population of workers who benefit more from migrating to high skill-price countries.

The most important feature of student mobility is that a large fraction of students schooled abroad return to their home country, more so for students from Asian countries. And while the return rates of foreign-trained students are lower for low-wage countries, such countries have larger domestic populations of foreign-trained graduates, because they export more students, compared with high-wage sending countries. The incidence of the subsidization of foreign students in high-income countries thus is disproportionately to low-wage countries.

Even though on net low-income countries appear to be net beneficiaries of the international circulation of students, some may worry about two issues related to the international circulation of students. First, the individual private beneficiaries of foreign schooling are likely to be among the high-income elite within a country. Tuition/travel costs are high for obtaining schooling abroad relative to home and most foreign schooling is self-financed, although subsidized at the same rate as host-country students, consistent with the finding that richer countries rewarding skills at the same rate as poorer countries send more students abroad. Given the large number of non-selective colleges and universities in host countries, it is not clear that this allocation mechanism provides education resources to a sending-nation's best and brightest. A country experiencing or considering the outsourcing of higher education may wish to provide a scholarship program based on merit and need in order to maximize the returns to schooling

investments.

A second problematical aspect of the outsourcing of higher education is the 20% elite from low-income countries who are “captured” by high-income countries. There is evidence, however, that return rates of students are higher than those indicated by examining the conversion of students to immigrants. A significant proportion of “permanent” immigrants eventually return to their home country. The NIS provides some indication of this. A random sample of the new immigrants were asked the question: “Do you intend to live in the United States for the rest of your life?” Figure 8 reports the fraction answering “no” or “not sure” for student stayers and the rest of the immigrant cohort, by area of origin (Asian and non-Asian). Over a third of the student stayers either do not intend to stay or are not sure about staying compared with about 20% for the other immigrants. Interestingly, a higher fraction of the student-stayers from Asia were uncertain about staying, no doubt reflecting the uncertain prospects (sustainability of growth rates?) of the region.

Finally, it is important to note that although students stayers are very skilled, particularly those from Asia, we do not know, given existing data, how these students who do not return to their home countries compare with those students who do. Nor do we know the numbers of persons in low-income countries who have received training abroad in order to more accurately characterize the net brain from low-income countries. Most importantly, we know little about the contribution of externally-obtained higher education compared with domestically-obtained education in contributing to a country’s development. Higher-education policies in countries with low skill prices, however, cannot be appropriately formulated without attention to the causes of and returns to the out-migration of students for higher education, and higher-paying jobs.

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Figure 1
Percentage Share of All Asian Students Studying Abroad in Tertiary Schools,
in Top Five Receiving Countries (2004)

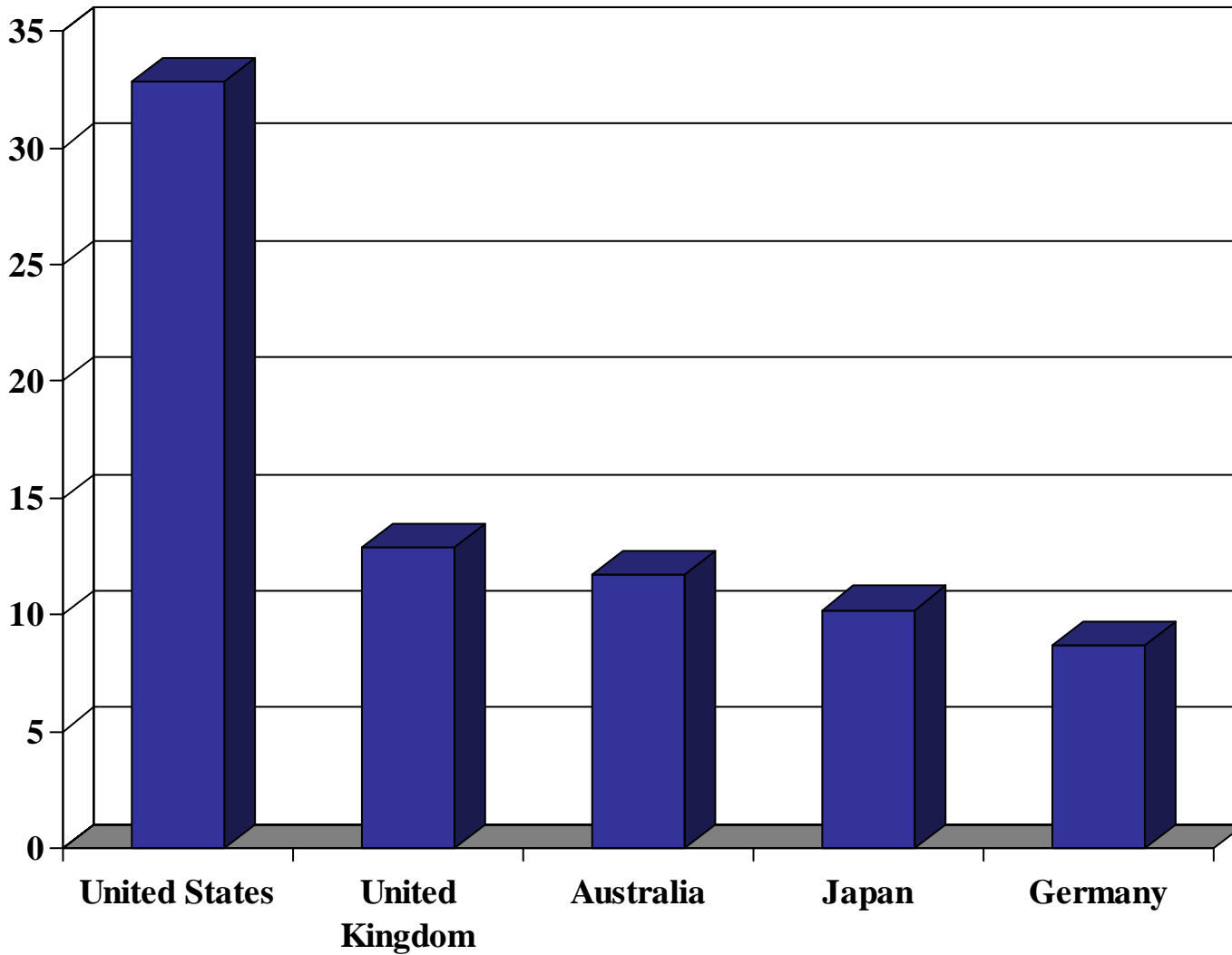


Figure 2

Estimated PPP \$ (1995) Skill Prices for 19 Asian Countries, by NIS-P and OWW Sources

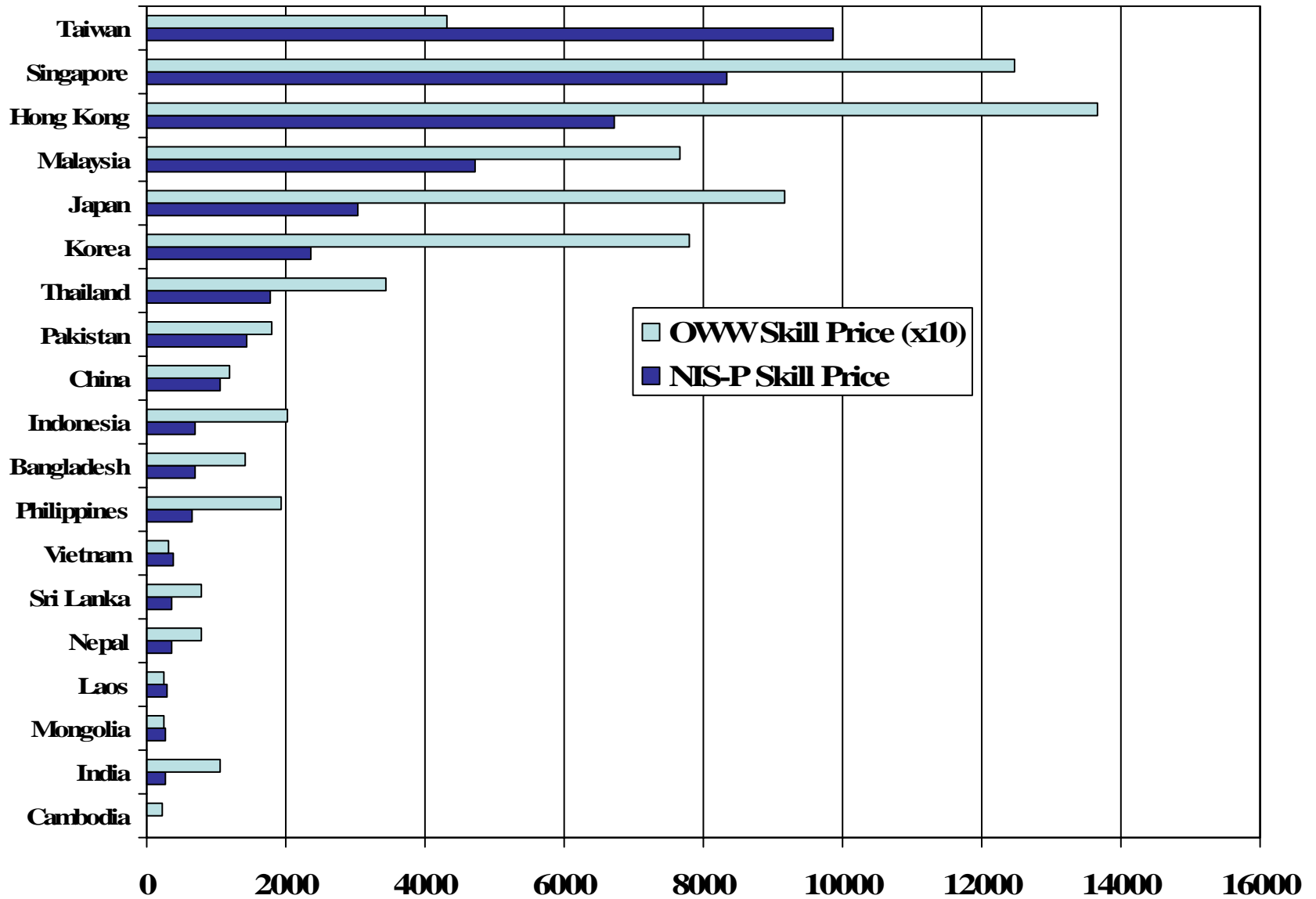


Figure 3

Estimated (PPP Adjusted 1996 \$ using NIS-P Skill Prices) Earnings of High School and College Graduates Across Selected Countries with a Common 7% “Return” to Schooling

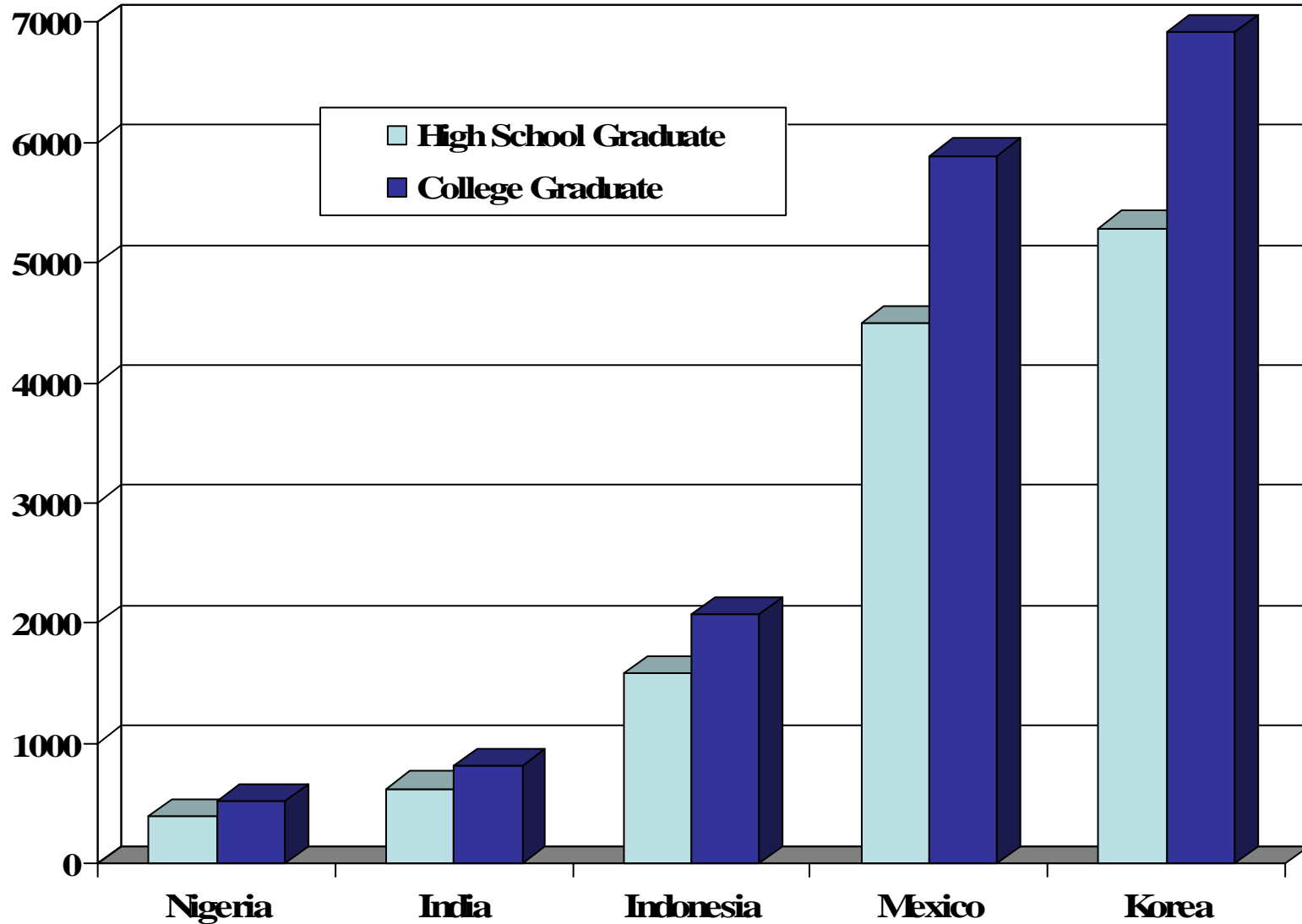


Figure 4

**PPP-Adjusted 1996 Estimated Annual Earnings (NIS-P Skill Prices) in Bangladesh and Korea,
By Schooling Level and Schooling Return**

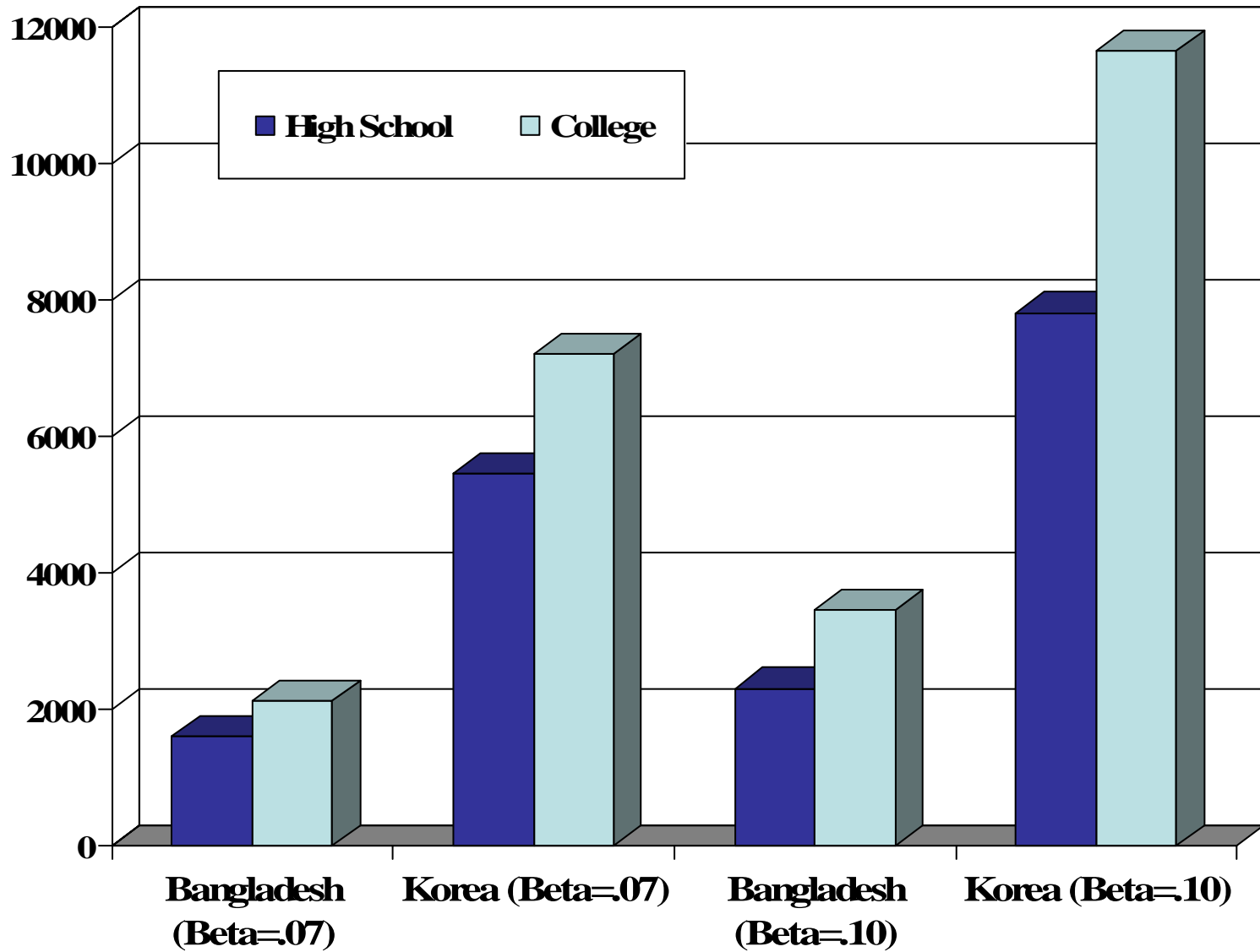


Figure 5
Percentage of New US Permanent Immigrants in 2003 with Post-Graduate Training, Student Stayers and All Other Immigrants, by Origin Region

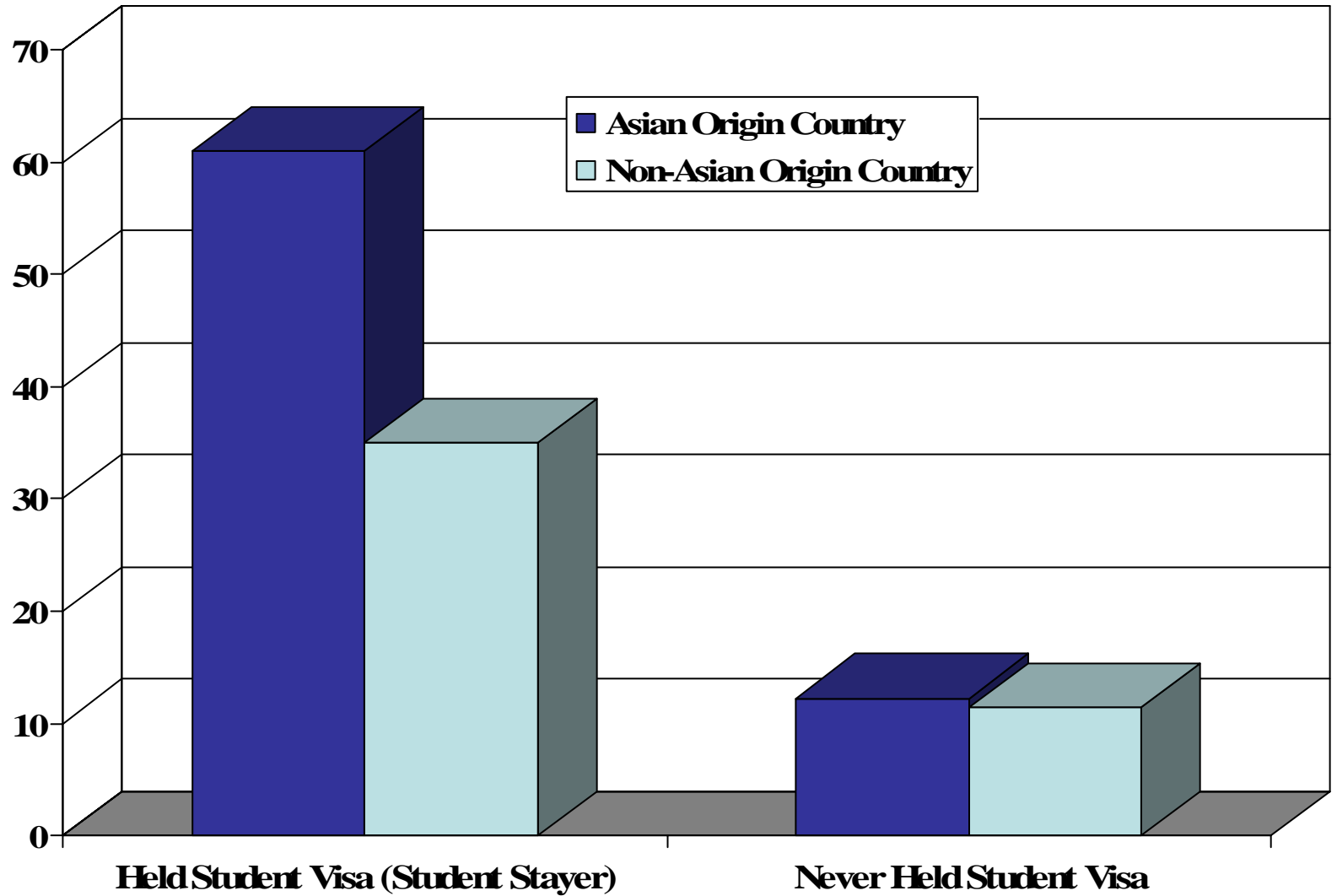


Figure 6
Occupational Distribution of Student Stayers:
New US Permanent Immigrants in 2003 Who Had Held a Student Visa, by Origin Region

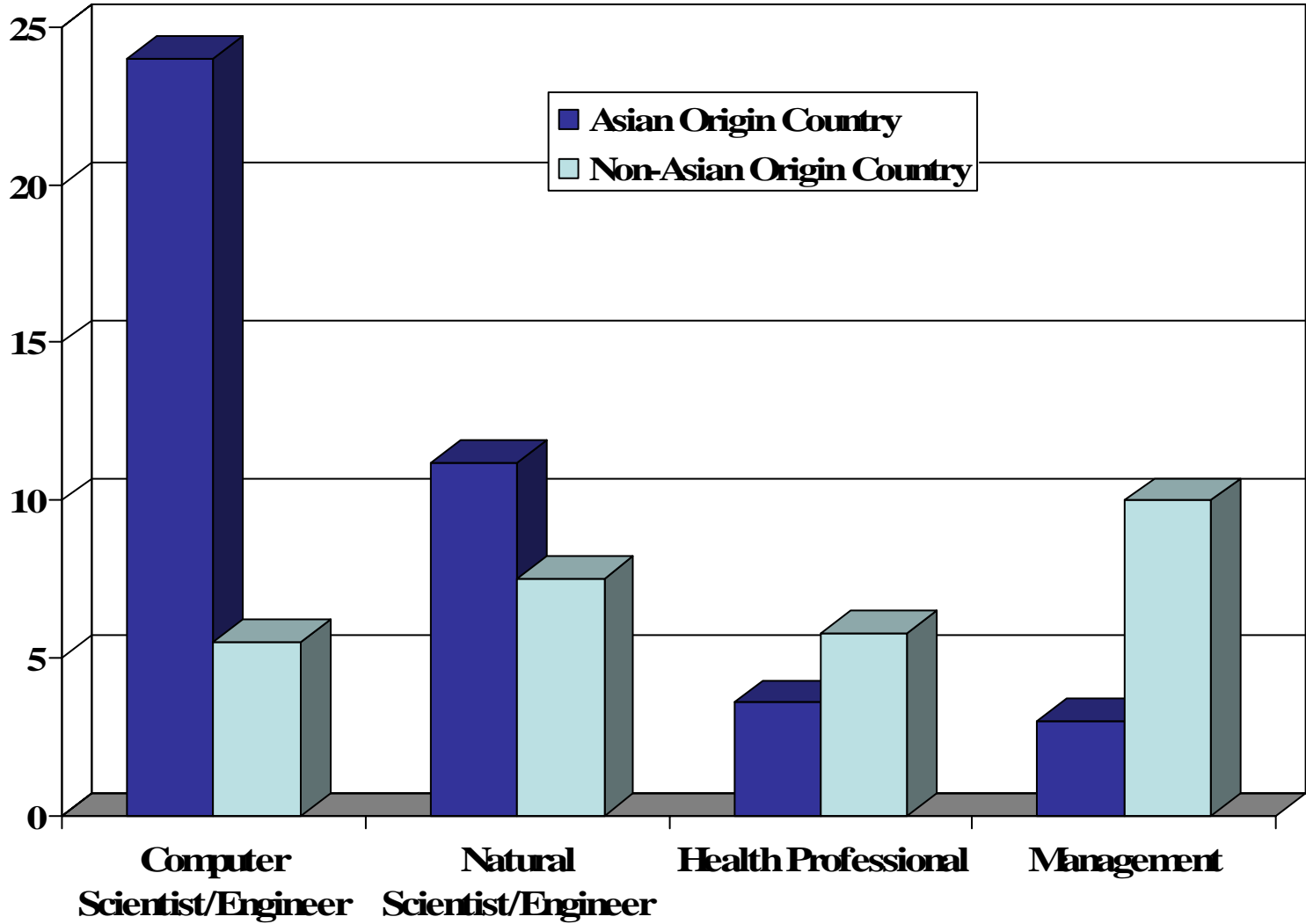


Figure 7
Estimated Annual Student “Depreciation” Rates for 19 Asian Countries

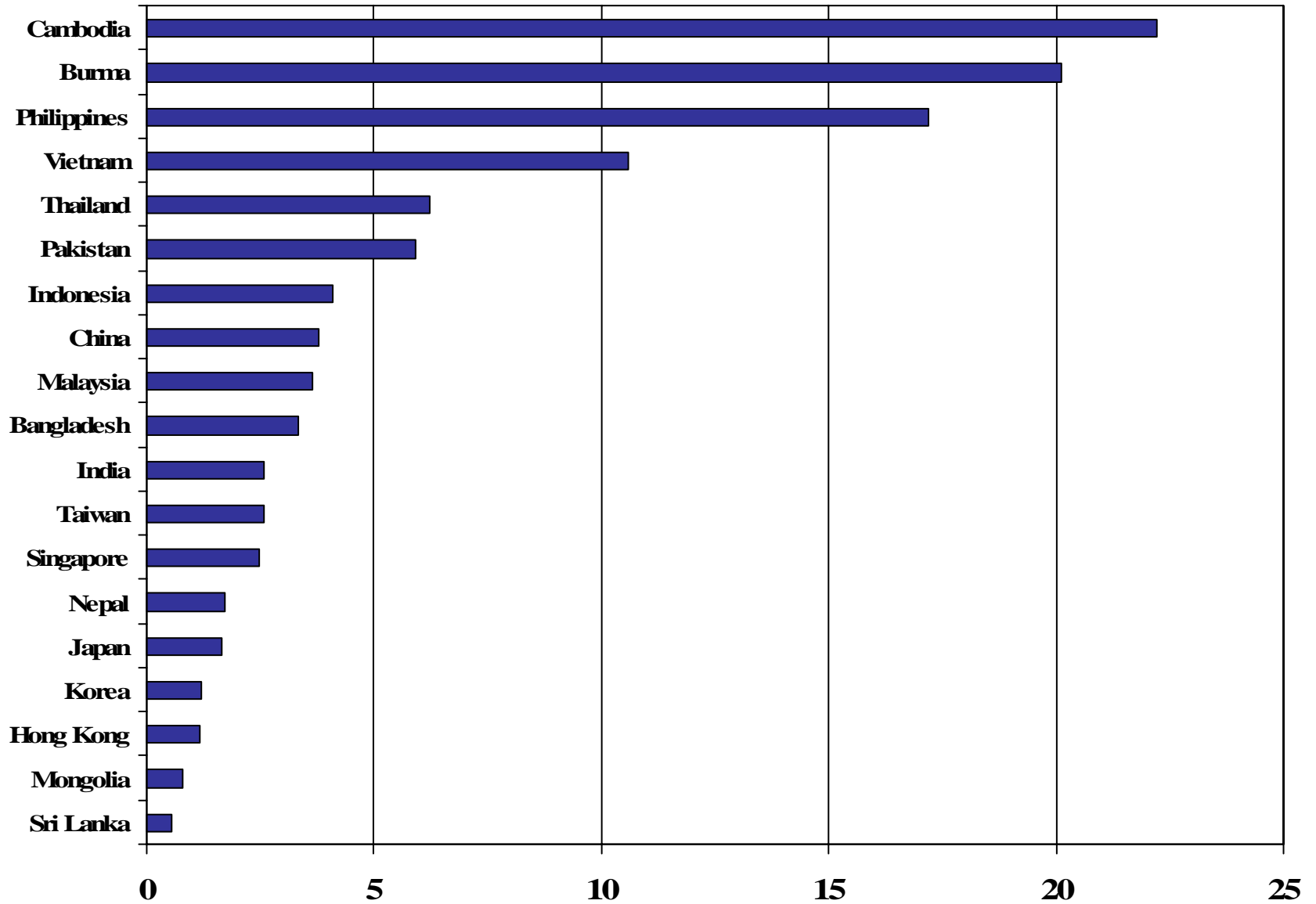


Figure 8

**Distribution of Responses to “Do you intend to live in the United States for the rest of your life?” ,
New US Immigrants in 2003, by Prior Visa Status and Region of Origin**

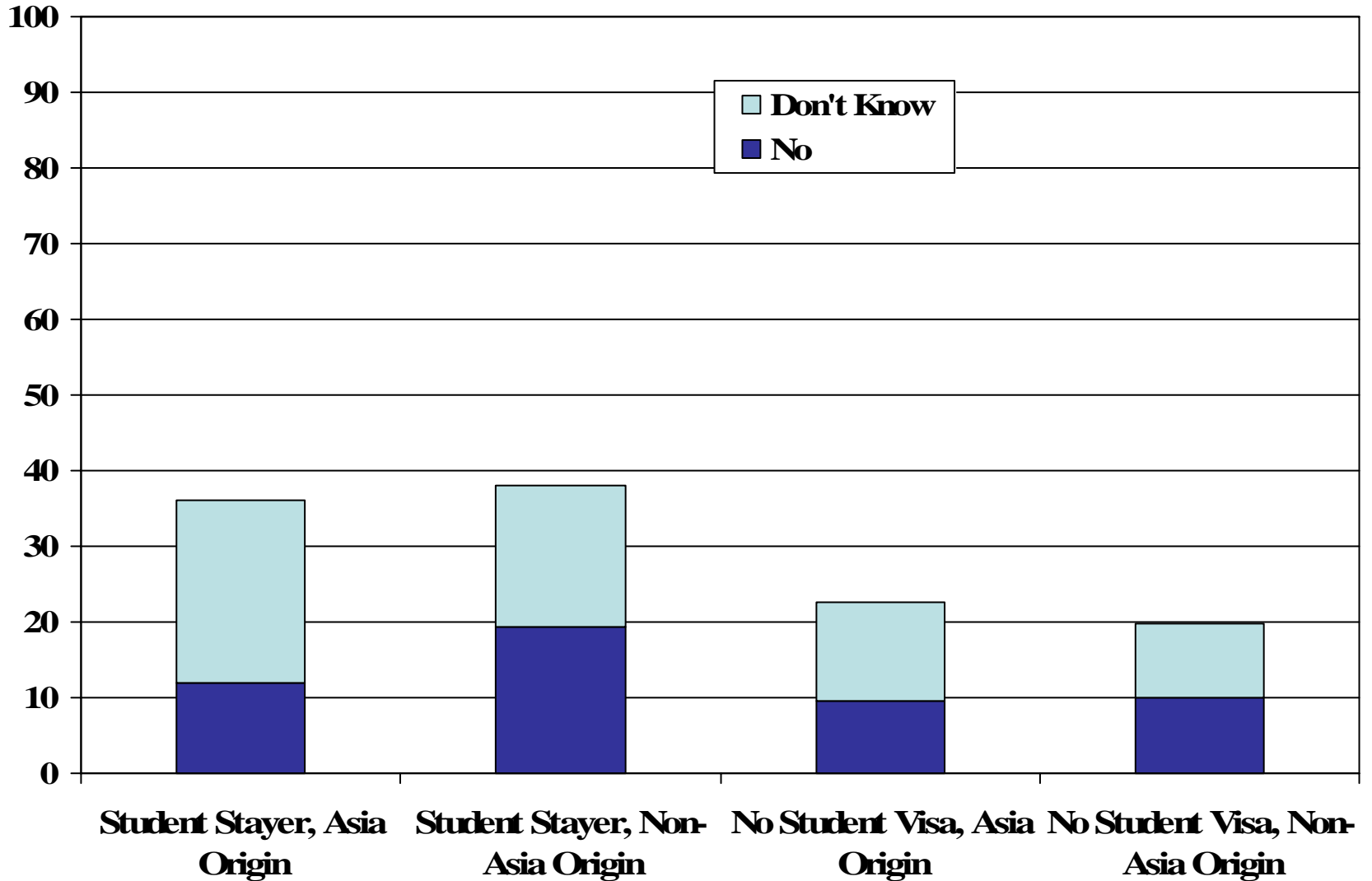


Table 1
Descriptive Statistics: Cross Country Data Set

Variable	Mean	SD
Number of foreign students in the United States in 2004 (US SEVIS)	3569.9	11060.7
Number of Asian students in host countries in 2003 (UNESCO)	5489.6	30673.2
Number of non-Asian students in host countries in 2003 (UNESCO)	6834.8	27031.3
Return rate of foreign students in the United States in 2004 (NIS and SEVIS)	.957	.0541
Skill price- PPP 1995 \$ per month (OWW)	420.7	487.4
Skill price - PPP 1995 \$ per year (NIS-P)	4884.0	21014.9
Real GDP per adult-equivalent in 1995 (Penn World Table)	9923.3	9526.0
Total number of universities	39.2	156.7
Any ranked universities	.169	.375
Average rank of ranked universities, if any ranked	118.0	35.7
English an official country language	.212	.410
Distance of country to the United States, in miles	5063.9	2256.3
Total country population (000's)	33843.7	123050
Asian country	.111	.315

Table 2
Determinants of the Log Number of Foreign Students in the United States in 2004

Origin-country variable/Skill price data set	NIS-P	OWW
Log skill price	-.259 (2.17)	-.730 (2.14)
Log Real GDP per adult-equivalent	.516 (2.85)	1.06 (2.71)
Log total number of universities	.275 (2.47)	.313 (2.82)
Any ranked universities	-1.18 (1.66)	-1.49 (2.04)
Average rank of ranked universities	.00842 (1.62)	.00983 (1.87)
English an official country language	.738 (3.49)	.782 (3.76)
Log distance of country to the United States	-.298 (4.30)	-.309 (4.44)
Log of country population	.426 (3.90)	.438 (4.00)
Asian country	1.44 (4.81)	1.44 (4.81)
R ²	.766	.766
Number of sending countries	125	125

Absolute values of t-ratios in parentheses. Specification also includes primary-school and secondary-school teacher-pupil ratios. Dependent variable source: US SEVIS.

Table 3
ML Tobit Estimates: Determinants of the Log Number of Foreign Students in Host Countries,
by Asian and non-Asian Sending Countries, 2003

Country set	Non-Asian		Asian	
	NIS-P	OWW	NIS-P	OWW
Host-country variable/ Skill Price				
Log skill price	1.36 (2.23)	1.73 (2.31)	1.95 (3.02)	2.32 (2.96)
Log total number of universities	2.21 (3.55)	2.03 (3.14)	2.21 (3.57)	2.18 (3.41)
Any ranked universities	-.904 (0.23)	-.895 (0.23)	2.41 (0.66)	2.49 (0.68)
Average rank of ranked universities	.0158 (0.55)	.0145 (0.51)	-.00639 (0.24)	-.00685 (0.26)
English an official country language	-2.41 (1.66)	-2.45 (1.69)	-3.24 (2.06)	-3.16 (2.02)
Log of country population	-.793 (1.33)	-.639 (1.04)	-.531 (0.90)	-.515 (0.85)
Pseudo R ²	.174	.174	.211	.209
Number of host countries	157	156	157	156

Absolute values of asymptotic t-ratios in parentheses. Specification also includes primary-school and secondary-school teacher-pupil ratios. Dependent variable source: UNESCO.

Table 4
Determinants of the Log Return Rate of Foreign Students in the United States in 2004

Origin-Country variable/Skill price data set	NIS-P	OWW
Log skill price	.0152 (2.31)	.0193 (3.61)
Log total number of universities	.00717 (0.91)	.00623 (0.81)
Any ranked universities	-.0368 (1.28)	-.0233 (0.85)
Average rank of ranked universities	.000315 (1.75)	.000168 (0.98)
English an official country language	.0424 (1.97)	.0372 (1.77)
Log distance of country to the United States	.00163 (0.52)	.00237 (0.75)
Asian country	.0456 (3.23)	.0458 (3.16)
R ²	.183	.202
Number of sending countries	136	136

Absolute values of t-ratios in parentheses. Specification also includes primary-school and secondary-school teacher-pupil ratios. Observations are weighted by the country-specific stocks of students. Dependent variable sources: US SEVIS and NIS.