

OPENING (AND CLOSING) DOORS

Country-Specific Shocks in U.S. Doctoral Education

EMILY BLANCHARD, JOHN BOUND, AND SARAH TURNER

The representation of students from abroad among doctorate recipients—particularly in science and engineering—in U.S. universities has increased dramatically in recent decades, rising from 27 percent in 1973 to over 50 percent in the 2005 year of observation. This growth has not been uniform across source countries, and increases in doctorate attainment have been particularly large among those countries where the rate of growth in undergraduate degree attainment has exceeded that in the United States (Bound, Turner, and Walsh, forthcoming).

Although some of the changes in doctorate attainment by country of origin reflect relatively smooth adjustments in the choices of students from nations with long-standing diplomatic and trade ties with the United States, other adjustments reflect sharp changes in access to the U.S. education market. Perhaps the most dramatic examples of the latter type are the entry into the United States of PhD students from China in the early 1980s and from Eastern Europe and the former Soviet Union in the late 1980s and early 1990s.

Such sharp changes present both challenges and opportunity for economic analysis. In this chapter, we are interested in modeling the flow of students from abroad into U.S. doctoral programs. As a starting point, we show how changes in access to the U.S. education market correspond to changes in the granting of U.S. doctorates to students from

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particular countries. More generally, we suggest the potential for an important dynamic whereby the initial flow of students into the United States from countries with sufficiently strong growth trajectories eventually expands the capacity of the local higher education institutions and skill-intensive industries. To the extent that doctoral recipients return to their home countries, then, “brain drain” and attendant negative net flows are not inevitable consequences from the flow of students into the United States at the graduate level.

We will begin with a review of the overall rise in the participation of foreign students in U.S. doctoral programs and then focus on specific political transformations and the associated opening of doors to graduate education in the United States to additional foreign students. We will then sketch a model of transition in the pattern of PhD attainment before turning to empirical analysis of entry to U.S. programs among doctoral students by country of origin after political transitions open access to U.S. universities. Focusing on China, Eastern European countries, and the former Soviet states, we will note a clear pattern: opening markets to trade and reducing travel restrictions coincide with an immediate and sharp increase in the entry of foreign graduate students, leading to U.S. doctorates for students from other nations. Our analysis suggests that access to U.S. universities and their doctoral programs may be important for those nations with transitioning economies, which may have long-term demand for highly skilled labor but little short-term capacity within their own universities to produce these skills. Although changes have been more gradual in other countries with strong development trajectories, such as India and South Korea, there is good reason to suggest that access to higher education in the United States also has served to build the pool of highly trained labor and to facilitate the expansion of higher education in the home country.

FOREIGN PARTICIPATION OVER TIME IN U.S. DOCTORAL EDUCATION

As early as the first part of the twentieth century, universities in the United States attracted a substantial number of students from abroad, particularly in the sciences. For example, in the period from 1936 to 1956, nearly 20 percent of PhDs in engineering and about 12 percent of PhDs in the life sciences were awarded to students who had completed undergraduate studies in their countries of origin. Advances in air travel and global communication combined with the strengthening of U.S. universities in the 1950s and 1960s (stimulated by the growth of

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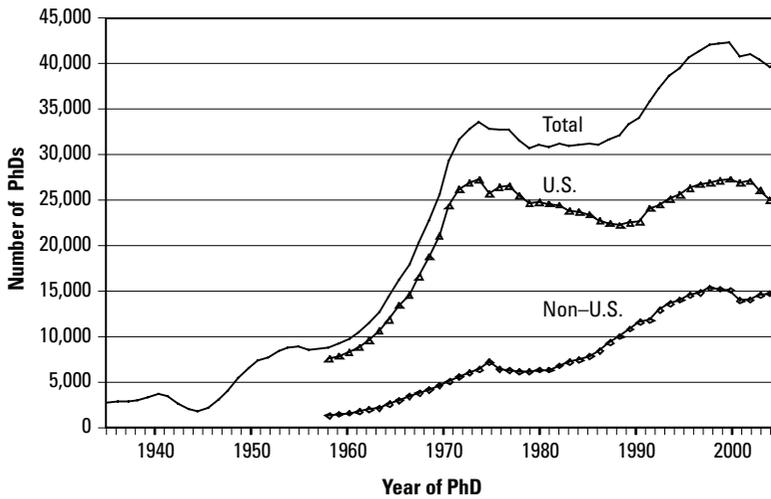


Figure 16.1. PhDs awarded by U.S. universities, by national origin, 1958–2003.

Source: NSF Survey of Earned Doctorates microdata and, before 1958, National Academy of Sciences 1958.

Note: National origin is defined by the country in which an individual went to high school.

federal research investments) made advanced study in the United States increasingly attractive to foreign students thereafter.

The Survey of Earned Doctorates provides a comprehensive picture of PhD recipients from U.S. universities by country of origin from the late 1950s to 2005; Figure 16.1 shows the overall trend in PhDs awarded by U.S. universities and the respective series for U.S. and non-U.S. degree recipients.¹

The overall rise in PhDs awarded to students from abroad from the late 1950s to the mid-1990s is clear, with a considerable acceleration in growth beginning in the late 1970s. This pattern is accentuated in the sciences (see figures 16.2A–D).

In economics and engineering, degrees awarded to students from abroad have outnumbered those awarded to U.S. students for a number of years; in all but the life sciences, the foreign-born share has equaled or exceeded the share of U.S.-born PhD recipients.

Focusing on explaining the rise in the participation of students from abroad in U.S. doctoral programs, Bound, Turner, and Walsh (forthcoming) emphasize that much of the rise in foreign doctorate attainment can be explained by the growth in demand for U.S. degrees from abroad, with countries such as India and South Korea expanding undergraduate degree attainment at a rate greater than that observed in the United

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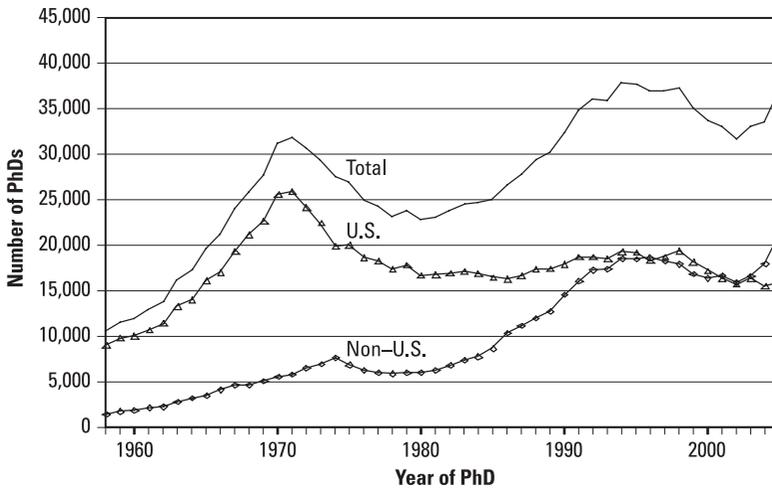


Figure 16.2A. Physical sciences PhDs awarded by U.S. universities, by national origin, 1958–2003.

Source for figures 16.2A–D: NSF Survey of Earned Doctorates microdata.

Note for figures 16.2A–D: National origin is defined by the country in which an individual went to high school. Fields defined using NSF classification, from SED annual reports.

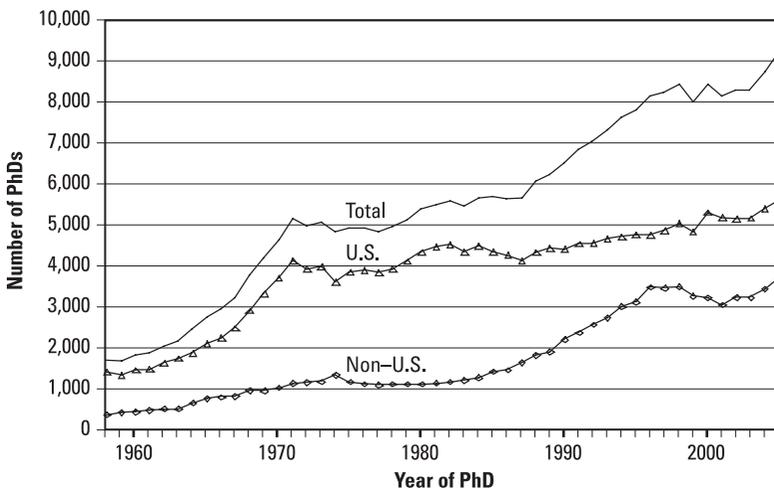


Figure 16.2B. Life sciences PhDs awarded by U.S. universities, by national origin, 1958–2003.

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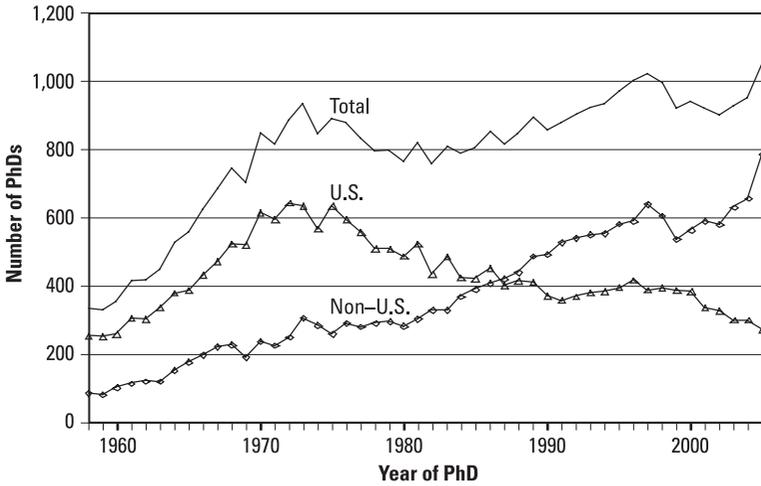


Figure 16.2C. Economics PhDs awarded by U.S. universities, by national origin, 1958–2003.

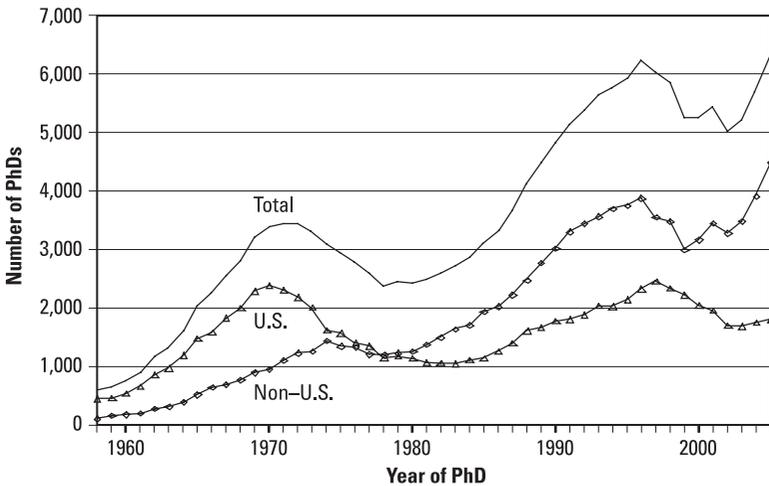


Figure 16.2D. Engineering PhDs awarded by U.S. universities, by national origin, 1958–2003.

States. In addition, political shocks in countries such as China have opened a new source of “realizable demand” for U.S. graduate education that had been largely closed in the 1960s and 1970s. A final explanation offered by Bound, Turner, and Walsh (forthcoming) is that substantial increases in public support for science and engineering research (and, in turn, for graduate education) may yield somewhat greater expansion in the demand for doctoral education among foreign students.²

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A point of emphasis of the Bound, Turner, and Walsh (forthcoming) analysis is that there has been considerable heterogeneity across source countries, both in the overall representation of PhD students in the United States over time and in the quality of programs attended by foreign students. The returns of a U.S. doctoral degree relative to the best alternative in the home country determines the decision to pursue graduate education in the United States; thus, selection varies markedly across countries. The result is differences in the rate at which foreign students pursue U.S. PhDs and the extent to which these students are concentrated in the most highly ranked PhD programs. Necessarily, weaker options in the home country pull more students toward study in the United States, while stronger home country universities produce lower aggregate levels of foreign study in the United States, though often higher levels of skills among those students who do choose to study in the United States. The focus of this analysis is on what happens as other nations open (and close) opportunities for doctoral study in the United States. A particular advantage of the Survey of Earned Doctorates for this analysis is that it permits us to organize recipients of doctorates from U.S. universities by country of origin (distinguishing place of birth, place of high school, and bachelor's degree institution) and year of entry into graduate school. The year of entry into graduate school, as distinguished from the year of receipt of the PhD, is particularly helpful because time to degree varies appreciably, and it is thus difficult to discern sharp changes in access to U.S. higher education from year of receipt alone. We will discuss relevant economic theory before illustrating the link between political shifts and doctorate attainment in the data.

EXPECTED RESPONSES WITH THE OPENING OF THE U.S. MARKET

Beyond exchanges in goods and services, one of the most visible demonstrations of the opening of trade relations with the United States is the development of education exchanges. Some educational exchange is largely symbolic, wrapped in the rhetoric of improving cross-cultural understanding. Yet the visible flows of foreign students to U.S. institutions following political and economic transformations are grounded in basic economics of skill acquisition and comparative advantage.

As with the more general pattern of foreign study in the United States, it is the strong advantage of graduate education that leads to the immediate draw of students to universities in the United States.³ Because few students from nations with economies in transition can negotiate the hurdles to enter education programs that require full payment

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of tuition (undergraduate and professional programs), students from these countries studying in the United States are found disproportionately in doctoral programs, as these programs are likely to offer financial support through fellowships, research assistantships, and teaching assistantships. Moreover, pursuing a PhD in the United States offers not only the direct advantage of skill acquisition but also the indirect benefit of greater access to the U.S. labor market.

Of theoretical and empirical importance in modeling the educational flows in transition economies is the extent to which transition countries hold (or actively seek through government initiatives) a long-term comparative advantage in the production of goods and services intensive in the type of highly skilled labor represented by PhD recipients. If this is the case, there is good reason to believe that the flow of students from abroad to receive doctorates in this country is an intermediate input in the production of these skill-intensive export goods. To the extent that the infrastructure of the home country improves over time, and as PhD recipients educated in the United States return to their home countries, we would expect that the steady-state demand for U.S. doctorates will decline in the (very) long run.⁴ In this scenario, foreign students' attainment of U.S. PhDs can be viewed quite legitimately as an important component of future development and growth for both the private and public sectors in countries of origin.

If, on the other hand, the economy in the home country has few economic opportunities for highly skilled workers, or if educational institutions there do not improve, we would anticipate the continuation of the flow of foreign students into U.S. PhD programs.⁵ Moreover, for those (primarily "least-developed") countries in which there is little or no production of skilled-labor intensive goods, the flow of students into U.S. PhD programs will likely be permanent, fulfilling developing country fears of "brain drain."⁶

Our hypothesis about the flow of students subsequent to political shocks is captured by the simple time path sketched in figure 16.3.

Before the opening of educational exchange there is little (if any) doctorate attainment in the United States among students from the host country. The establishment of full trade and diplomatic relations yields a sharp increase in study in the United States. Yet, unlike trade in final products, which may continue indefinitely on an upward trajectory, doctorate attainment eventually declines from this peak. One mechanism behind the sharp peak is the presence of pent-up demand; had the market not been closed, one would have expected at least some previous flow into U.S. doctoral programs. Although many of those denied opportunities to pursue U.S. PhDs will have made other investments or will be of an age at which there are insufficient years left to accrue the benefits

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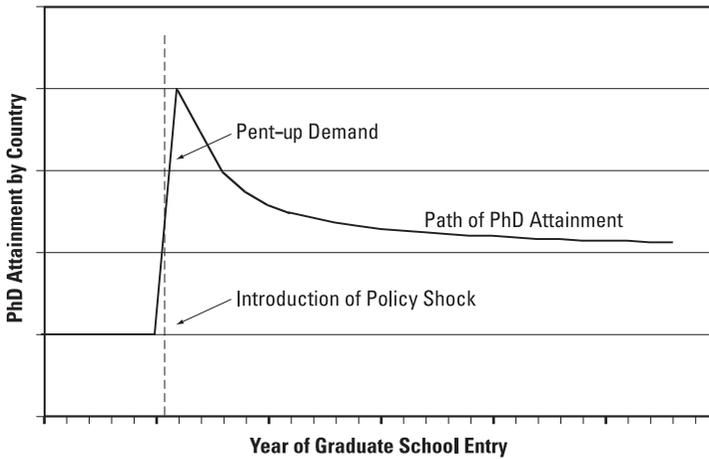


Figure 16.3. Dynamic effect of policy shock on U.S. PhD attainment for transitioning countries.

of a PhD, there will be some marginal older students still likely to have a positive demand for U.S. doctoral study opportunities. If this is the case, the age distribution of students entering U.S. doctoral programs in the years immediately following a diplomatic shock may be somewhat wider, including more older students than those entering in later years—a hypothesis that may be checked easily within our data set.

After the initial peak has subsided, the longer-term trajectory of PhD attainment may increase or decrease in response to shifting economic and institutional conditions. If, holding higher education resources and infrastructure fixed, the economy in the home country expands in relatively skill-intensive sectors that demand engineering and science PhDs, the demand for U.S. degrees may reasonably be expected to continue to rise. If, on the other hand, the educational infrastructure in the home country improves with the rest of the economy, then “residual” demand for U.S. PhD degrees may level off or even decrease as the institutions in the home country become better substitutes for U.S. universities. The time path of U.S. degree attainment in this scenario would depend, predictably, on the relative rate of growth of the local high-tech sectors (demand for PhD holders) and local institutions (supply). Further, as local education institutions improve, we would expect to observe a greater concentration of students at the best U.S. institutions; we are also able to examine this proposition in our data.

Although we focus primarily on the opening of markets in this chapter, it is natural to discuss the closing of markets brought about by regime shifts that close off trade and diplomatic exchange with the United States. Such shifts include the Hungarian Revolution of 1956 or the Iranian

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Revolution of 1979. The outcome of market closure leading to sustained decline in the flow of students into U.S. doctoral programs is, perhaps, tautological. What we predict (and observe) is somewhat more complex, with a short-term period resembling refugee emigration, as some very able potential students outside the current regime escape through U.S. graduate education, producing a short-term spike in doctorate attainment.

OPENING MARKETS AND FOREIGN DOCTORATE ATTAINMENT

The data show clearly that opening markets—both politically and economically—generally leads to a substantial and rapid flow of students into U.S. PhD programs. Perhaps not surprisingly, those students coming to U.S. institutions after political transitions disproportionately study in the sciences.⁷ We present here the data on PhD recipients by country of origin organized by year of graduate school entry.⁸ Because year of PhD receipt reflects variation in time to degree as well as year of program entry, the changes tied to market transitions are much more visible when we organize the data by year of entry into graduate school. One downside of organizing the data by year of entry to graduate school is that the most recent cohorts have somewhat fewer years to complete graduate study within the time frame of our data availability, as such total degree attainment for these cohorts is truncated. Moreover, as will be shown in the empirical work that follows, the data on year of entry appears to represent year of entry to master's degree programs in cases (such as China's) where it is common for students to finish a master's degree in their home country before studying in the United States. Assuming that students go directly from master's degree to PhD programs, we make some adjustment to project the year of entry to U.S. doctoral programs as the year of master's completion for those students with foreign master's degrees. We will proceed now with an overview of the specific of cases of China, Eastern European countries, and the former Soviet states, and then turn to a discussion of the general findings from these cases.

China

There has been a decisive increase in the number of U.S. degrees, largely in the sciences, awarded to students from China over the last twenty-five years. These numbers rise from tens in the 1970s to thousands of degrees awarded in the 1990s. Corresponding to the growth in degrees awarded in the 1990s in figure 16.4A, figure 16.4B shows degrees attained as arranged by year of graduate school entry, along with an adjustment

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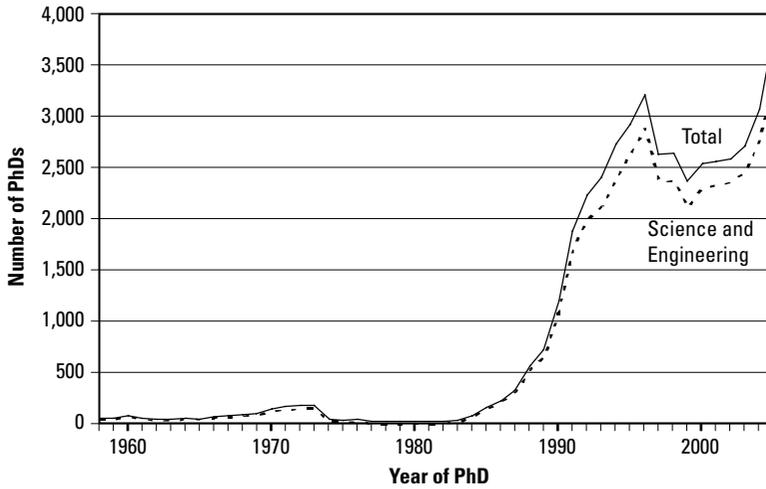


Figure 16.4A. PhDs awarded by U.S. universities to students from China, by year of PhD.

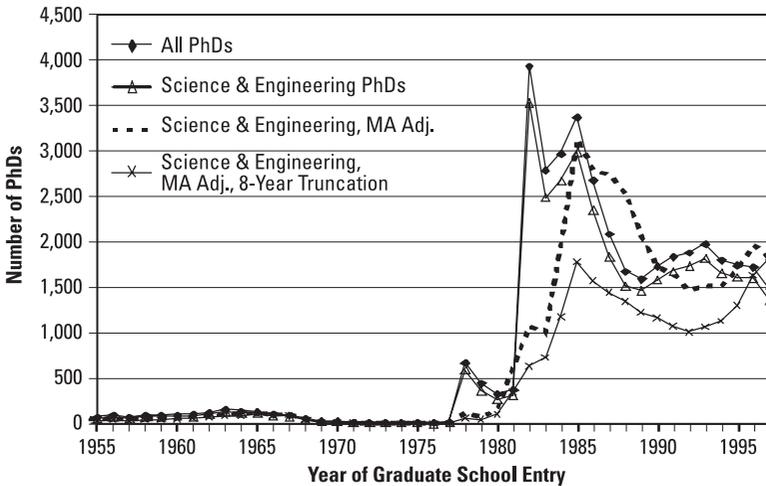


Figure 16.4B. PhDs awarded by U.S. universities to students from China, by year of graduate school entry.

for students receiving master’s degrees in China before coming to the United States, which is particularly common in the initial cohorts.

To understand the dynamic in the evolution of student flows from China, it is important to consider the link between political and educational transitions. University activity during Mao Zedong’s Cultural Revolution (1966–1976) was largely disrupted, and many facets of universities ceased operations. Immediately thereafter, China sought to jump start its development process through access to science and engineering

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technology via U.S. universities. The establishment of diplomatic relations with the United States in 1979 led to the (re)opening of educational exchange between the two countries. A disproportionate share of the first wave of exchange students coming to the United States were related to high-level Chinese officials, including the son of former Chinese Communist Part head Deng Xiaoping and the son of foreign minister Huang Hua (Wong 1981), though there was also considerable competition among U.S. universities to identify the most talented among the Chinese students.

The several age cohorts that went to college in 1976, immediately after the end of the Cultural Revolution, had a dramatic impact on doctoral degree attainment. Yet, with very few college graduates available in the 1970s, the surge in Chinese participation in U.S. graduate education was delayed until the mid-1980s; students had first to acquire the necessary undergraduate credentials before they could apply for graduate education.⁹ Most notable is the group of students receiving bachelor's degrees in China in 1982, with many students from this cohort entering graduate school that same year.¹⁰ Many in this cohort appear to have finished master's degrees in China before entering U.S. PhD programs in about 1984 (compare "S&E" and "S&E, MA adj" in figures 16.4A and B).¹¹ Note that after this initial large influx of doctoral students, we see some retrenchment with current levels of PhDs awarded well below the initial post-transition peak. From the early 1980s to the early 1990s, U.S. universities awarded more PhDs to students from China than did Chinese universities. In the last decade, doctoral-level instruction in China has continued its exponential growth, and degrees awarded to Chinese students by Chinese universities now exceed the number awarded by U.S. institutions.

Eastern European Countries and the Former Soviet States

For Eastern Europe, access to Western markets in general, and U.S. education in particular, came to different countries at different points in time. Some cases of political change, such as Romania's, were unambiguously revolutionary, while other countries, most notably Hungary and Poland, experienced more gradual political transitions. This differential rate of opening across Eastern European countries is clearly in stark contrast with China's experience. A further fundamental difference between the Eastern European countries and China is that higher education institutions continued to operate under Communist Party rule and a number of Eastern European countries had relatively uninterrupted collegiate traditions going back several centuries.

Figures 16.5A–F present the pattern of award of PhDs to students from Eastern European countries and the former Soviet states by year of graduate school entry. Bulgaria, Czechoslovakia (we combine both the

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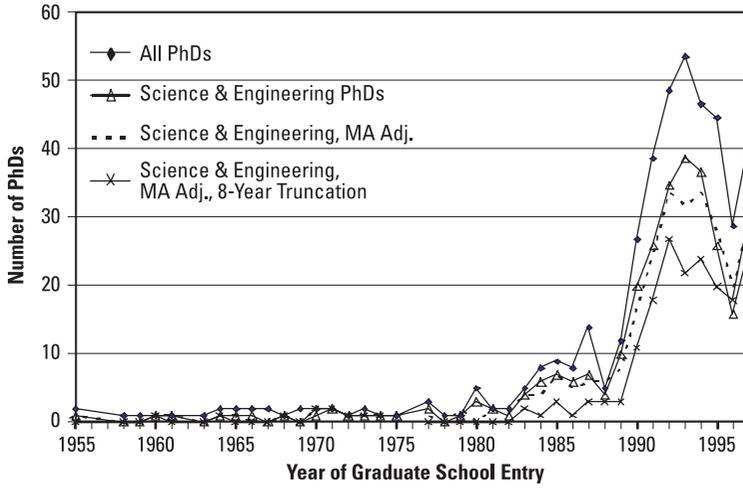


Figure 16.5A. PhDs awarded to students from Bulgaria.

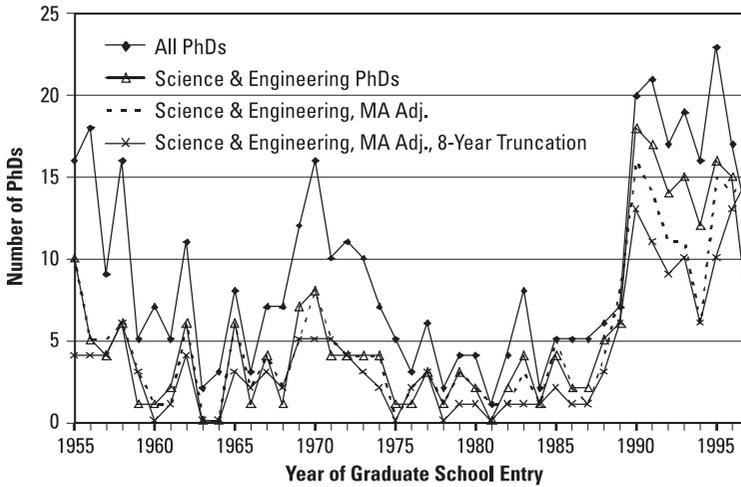


Figure 16.5B. PhDs awarded to students from Czech Republic.

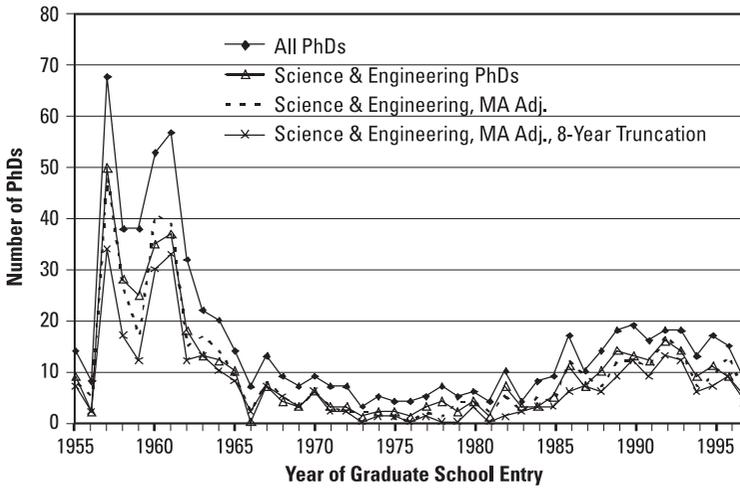


Figure 16.5C. PhDs awarded to students from Hungary.

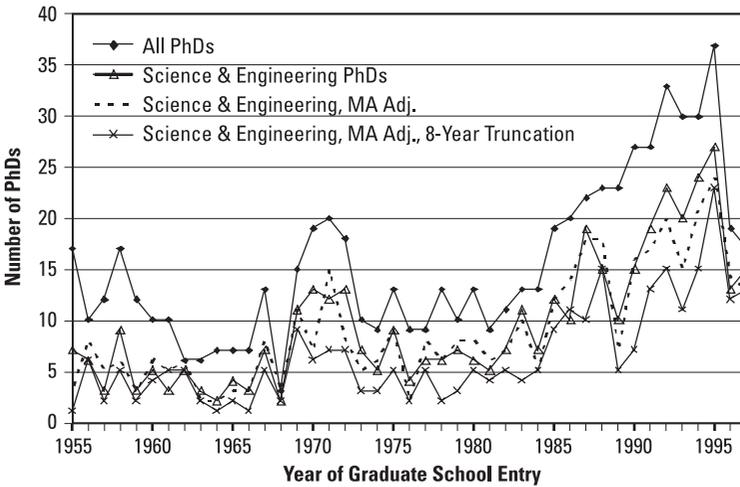


Figure 16.5D. PhDs awarded to students from Poland.

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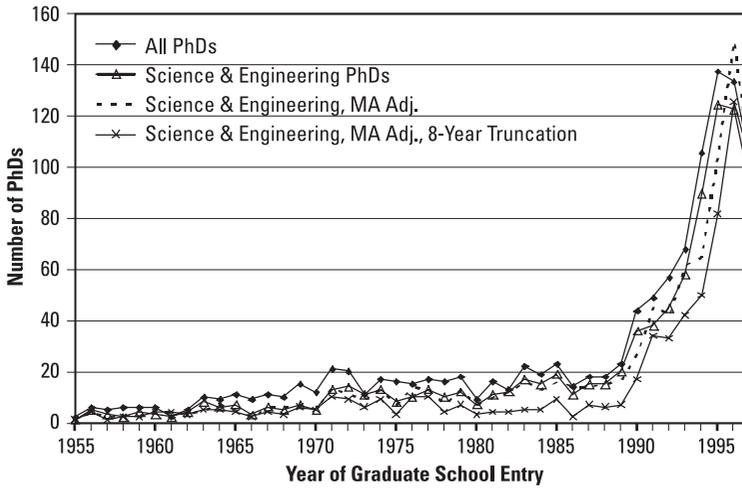


Figure 16.5E. PhDs awarded to students from Romania.

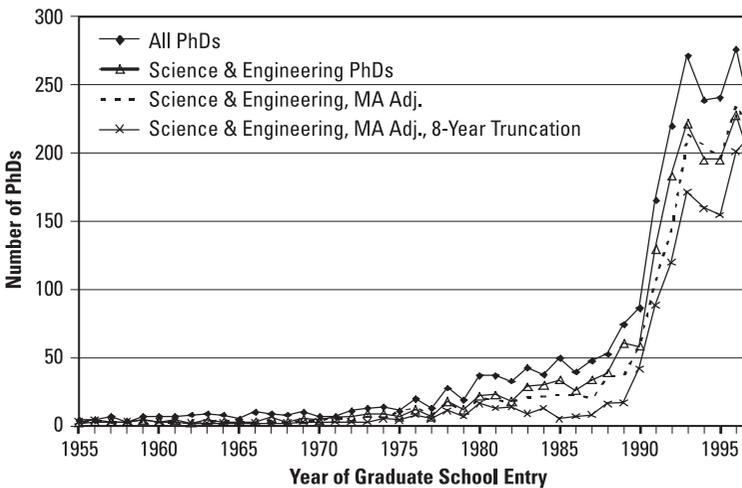


Figure 16.5F. PhDs awarded to students from former Soviet states.

Czech Republic and Slovakia in later years), Romania, and the former Soviet states demonstrate sharp increases in entry into U.S. programs among doctorate recipients. In the Czech Republic, student protests led to the Velvet Revolution and the end of Communist rule in November of 1989. The transition from Communist rule was somewhat more violent in Romania with the overthrow of the Communist regime of Nicolae Ceaușescu in December 1989.

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For Poland and Hungary, the transition is much more gradual, appearing to start in the early 1980s. At the frontier, labor turmoil and the *Solidarność* (Solidarity) movement in Poland during the early 1980s were quite visible to the West, generating considerable support from the United States throughout the decade; the end of Communist Party rule in 1989 could be viewed, therefore, as perhaps more evolutionary than revolutionary. One manifestation of this gradual opening of exchange with Poland is the incremental increase in Polish students pursuing PhDs at U.S. universities that began in the mid-1980s.

After the fall of the Berlin Wall in 1989, notable initiatives among the governments of Eastern Europe included efforts to reconstruct systems of higher education, moving away from the compartmentalized and specialized organizations adopted under Soviet influence. Moreover, other Western countries and U.S. philanthropic interests were eager to promote the development of university infrastructure (libraries and computing facilities) as well as advanced graduate capacity. To illustrate, Quandt (1992) notes, "One of the first projects [as an adviser to the Andrew W. Mellon Foundation] was the establishment of the Center for Economic Research and Graduate Education, a joint effort by Charles University (Prague) and the University of Pittsburgh to create a Western-style PhD program in economics." Similarly, other major U.S. institutions such as the Ford and Soros foundations have been active in attempting to strengthen higher education in Eastern Europe.

While a quite different type of change than the opening of access to U.S. universities that occurred in the early 1990s, the most visible episode in the graph for Hungary is the spike in students entering U.S. graduate programs in 1957, subsequent to the revolution. With the Soviet occupation and ensuing violence after student protests in October 1956, many students and citizens fled to the West. In the United States, nonprofit organizations and universities made considerable efforts to aid refugee students from Hungary, with one estimate suggesting that about 1,000 students received financial assistance to continue education (Ficklen 2006). This is a salient example of what in other contexts economists have described as "refugee sorting" (Borjas 1987), with the clear implication of a loss of talent for the home country as many of the best students left the country.

On the surface, the dissolution of the Soviet Union and the opening of U.S. education to these formerly Soviet students would appear very similar to the case of the Eastern European countries. In the years before 1989, barely a trickle of students from the Soviet Union completed doctoral degrees in the United States, with most of those students likely related to political émigrés. Then, during the Soviet presidency of Mikhail Gorbachev, *perestroika* initiated the modest exchange of

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graduate students and scholars (Raymond 1989) and much more significant numbers of graduate students came to the U.S. with the collapse of the Soviet Union in 1991. But the collapse of the former Soviet Union also led to significant declines among the traditional Soviet universities, which had long-standing strengths in the physical sciences and had been generously supported by the government during the Cold War.¹² By one estimate, funding for science in Russia declined 44.2 percent between 1989 and 1991 (Shkolnikov 1995). With the formal dissolution of the Soviet Union in 1991, students entered graduate programs in the United States in substantial numbers, with further increases through 1993. As former Soviet universities have continued to lose funding rather than increase in strength—as is the case in a number of the Eastern European countries—there has been less motivation for U.S.-educated students to return to their home countries as there are few prospects for employment and high-level scientific research funding.

GENERALIZATIONS FROM MULTIPLE MARKET OPENINGS

From this set of countries experiencing the opening of access to U.S. higher education as well as trade more generally, there are some common themes. Beyond the increases in PhD pursuit in the initial years following opening of study in the United States, there is not a continued increase in PhD receipt for students from these countries. Quite the contrary, doctorate receipt tends to decline among later cohorts of graduate school entrants. The case of China is, perhaps, the most dramatic in this regard. The cohort that entered college in 1978 and, in turn, started graduate study between 1981 and 1985, is extraordinary in representation among U.S. PhD recipients in the sciences. To illustrate the unusual impact of this single cohort, we note that of the PhD degrees awarded to students from China in the decade between 1985 and 1994, 46.6 percent of the 11,197 awardees had started college in 1978. The same pattern appears to some degree in the East European countries and former Soviet states.¹³

In considering the mechanism generating the transition, we have suggested that one element in this dynamic is that opening the option of doctoral study in the United States comes with high initial flows from pent-up demand. As such, we might expect PhD recipients from these initial cohorts to be somewhat older than those pursuing U.S. doctoral study in the subsequent years. Figures 16.6A–C start with age distribution at the time of entry into graduate study among PhD recipients in the case of China, in comparison with U.S. doctorates and doctorates from nontransitioning countries, in three-year intervals.

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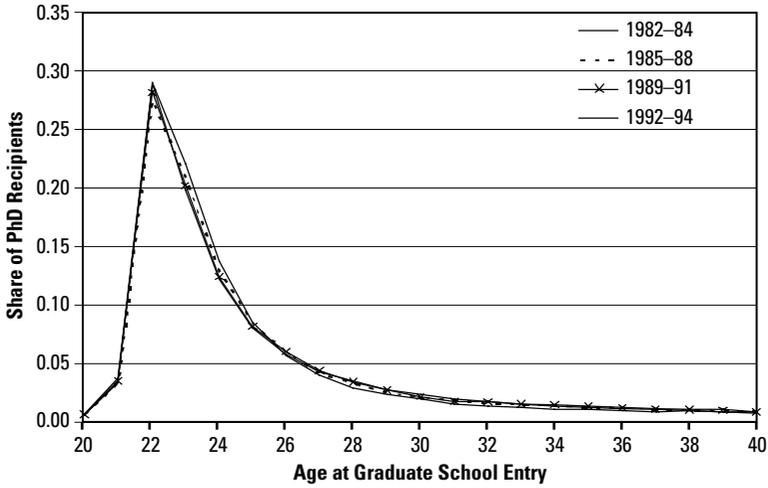


Figure 16.6A. PhDs awarded to students from the United States by age and year of graduate entry.

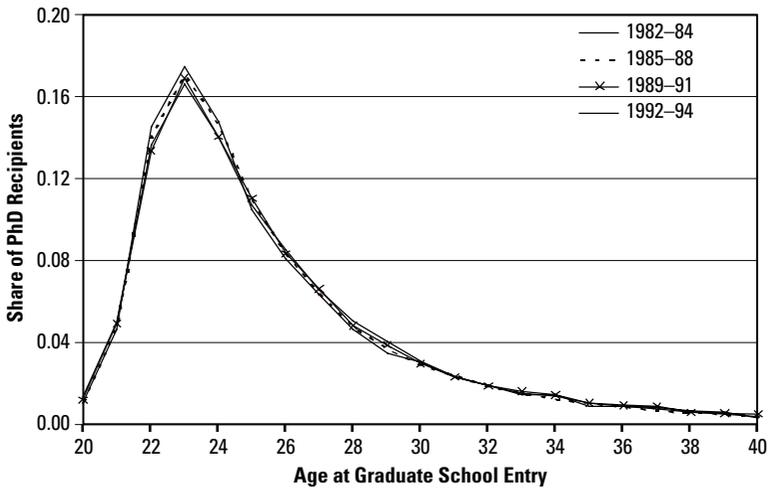


Figure 16.6B. PhDs awarded to students from other nontransitioning countries by age and year of graduate entry.

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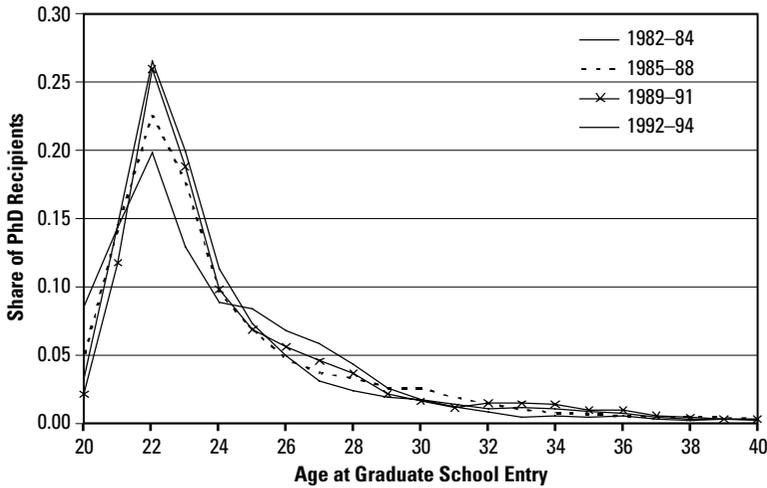


Figure 16.6C. PhDs awarded to students from China by age and year of graduate entry.

While there is little change over the twelve-year interval in the control groups, doctorate recipients from China are increasingly “younger” with ages at graduate school entry more tightly clustered near the ages 22–23. In turn, the mean age at entry among Chinese doctorate recipients fell from about 24.2 years in the early 1980s to 23.7 years for those entering graduate programs between 1992 and 1994. Turning to the Eastern European countries, we see a similar pattern in all but Poland and Romania in figures 16.7A–F.

While the exhaustion of the pent-up demand is potentially one of the factors that explains the stabilization in the rate of doctorate attainment among transitioning countries, it is also possible that growth in home country university sectors reduce the flow of students into the United States in subsequent cohorts.

A second suggested demonstration of the connection between U.S. doctorate attainment and economic transition is the potential for changing selection into doctorate-granting institutions in the United States. In the case of China, where we have observed PhD attainment for about two decades since the start of that country’s transition, there have been substantial changes in the concentration of students by program quality (see table 16.1).

Particularly in the early 1980s, it is clear that students from China were concentrated in relatively low-ranked programs, with more than 50 percent of degree recipients starting their degrees between 1981 and 1984 in chemistry, physics, and life sciences receiving doctorates from institutions outside the top fifty programs. Yet, over the course of a decade

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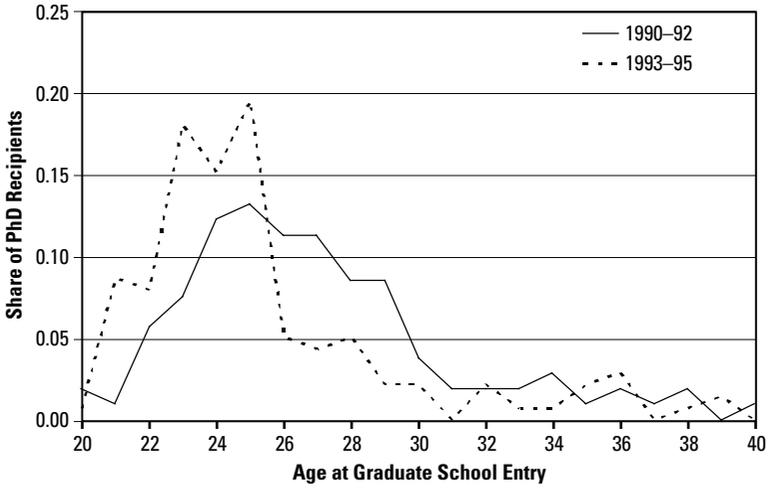


Figure 16.7A. PhDs awarded to students from Bulgaria by age and year of graduate entry.

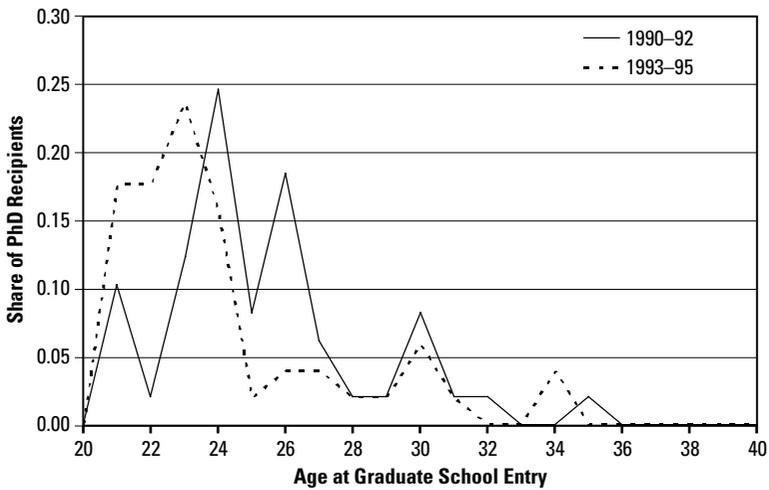


Figure 16.7B. PhDs awarded to students from the Czech Republic by age and year of graduate entry.

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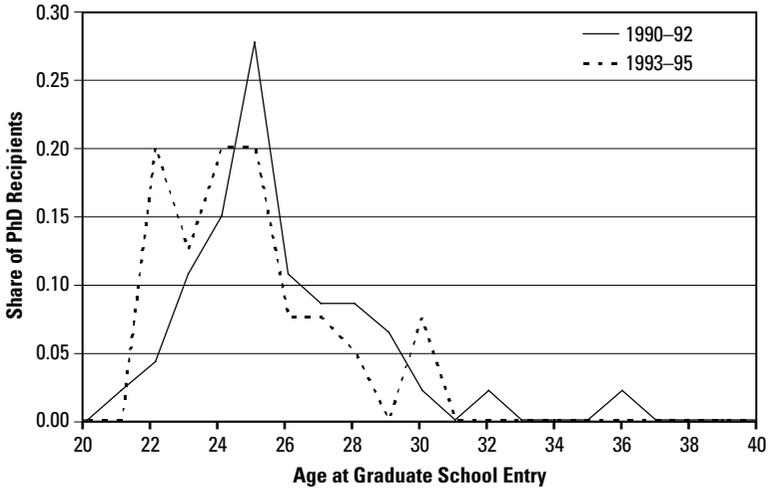


Figure 16.7C. PhDs awarded to students from Hungary by age and year of graduate entry.

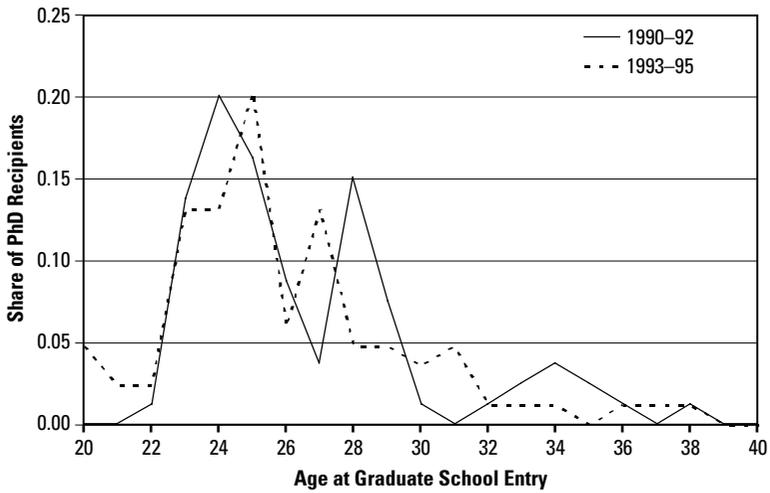


Figure 16.7D. PhDs awarded to students from Poland by age and year of graduate entry.

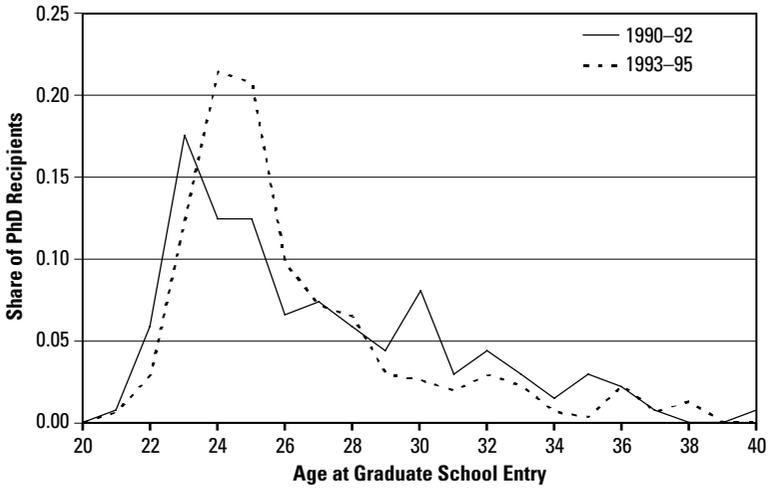


Figure 16.7E. PhDs awarded to students from Romania by age and year of graduate entry.

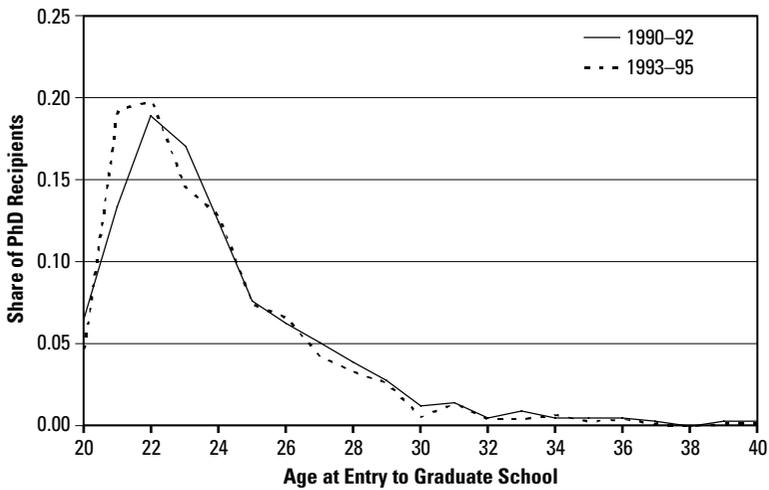


Figure 16.7F. PhDs awarded to students from former Soviet states by age and year of graduate entry.

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TABLE 16.1
Share of Degrees Awarded to Students in Top-Fifteen U.S. Doctoral Programs, by Field and Place of Origin

Country of Origin	Year of Graduate Entry	Physics	Chemistry	Biochemistry	Economics	Engineering
China	1980–84	0.151	0.131	0.093	0.201	0.202
	1985–89	0.189	0.131	0.104	0.222	0.183
	1990–94	0.211	0.159	0.141	0.312	0.262
	1995–99	0.218	0.190	0.121	0.247	0.300
India	1980–84	0.121	0.094	0.047	0.167	0.257
	1985–89	0.190	0.092	0.035	0.208	0.284
	1990–94	0.163	0.094	0.076	0.178	0.267
	1995–99	0.256	0.125	0.083	0.246	0.348
South Korea	1980–84	0.202	0.198	0.114	0.269	0.328
	1985–89	0.191	0.218	0.155	0.269	0.309
	1990–94	0.241	0.227	0.147	0.250	0.395
	1995–99	0.338	0.215	0.257	0.317	0.471
Taiwan	1980–84	0.204	0.153	0.133	0.166	0.307
	1985–89	0.183	0.155	0.157	0.298	0.332
	1990–94	0.240	0.237	0.188	0.217	0.443
	1995–99	0.360	0.250	0.320	0.235	0.470
USSR	1990–94	0.218	0.184	0.133	0.226	0.338
	1995–99	0.319	0.163	0.077	0.358	0.387

Source: Authors' tabulations from the Survey of Earned Doctorates (restricted access file).

it appears that the representation has shifted toward higher-ranking programs and recent entry cohorts are appreciably more likely to receive degrees from the top fifteen programs than those entering in the early 1980s, presumably as educational options improve in China.

Thus, a clear point from this descriptive presentation is that political transitions that open education markets, such as those that occurred in China in the early 1980s and Eastern Europe in the early 1990s, have substantial effects on participation in U.S. doctoral education. To the extent that these countries have been on steep growth trajectories, what we expect is that the initial rise in PhD pursuit in the United States will plateau or decline, accompanied by greater selectivity among those choosing U.S. universities for study as educational options in their home countries increase. While this dynamic is most clearly demonstrated in the cases of countries with sharp policy changes, the basic intuition can be extended to countries like India and South Korea and the Chinese island of Taiwan (formerly an independent republic). In these places, economic policies that began in the mid-1970s and generated substantial expansion of trade were also accompanied by a growth in PhD attainment at U.S. institutions (see figures 16.8A–C).

What we see in these figures is that there was a period of quite rapid expansion in the number of students starting (and completing) PhD programs in the United States, followed by a substantial decline that began

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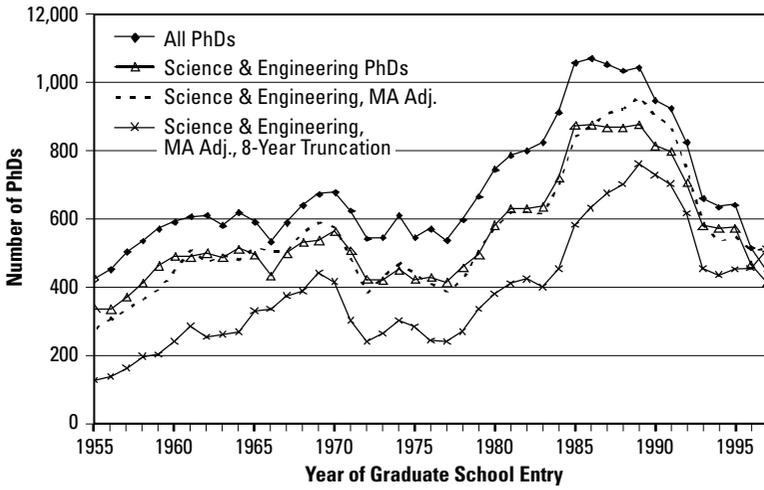


Figure 16.8A. PhDs awarded to students from India by year of graduate school entry.

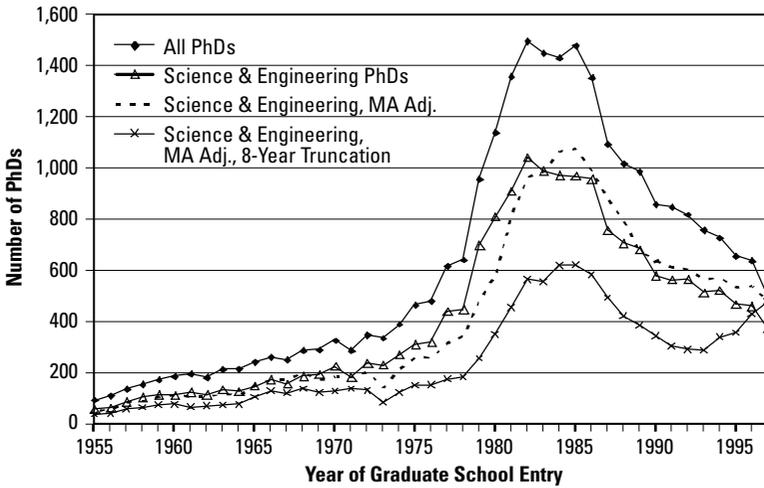


Figure 16.8B. PhDs awarded to students from South Korea by year of graduate school entry.

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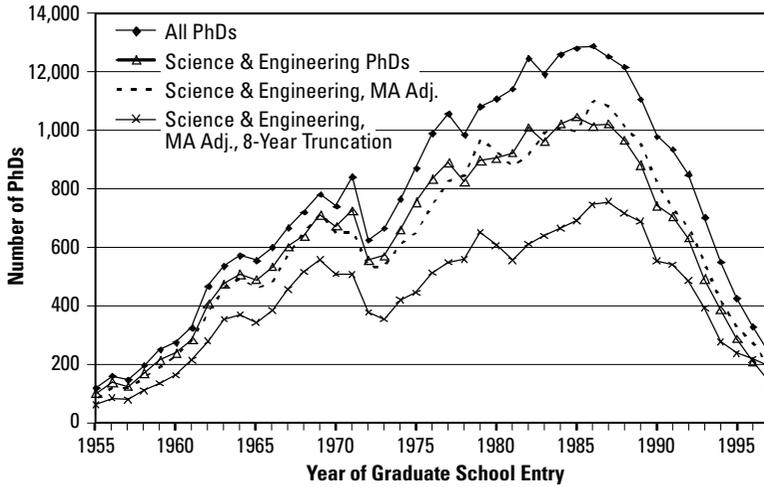


Figure 16.8C. PhDs awarded to students from Taiwan by year of graduate school entry.

in the late 1980s. We also find that recipients of U.S. PhDs from these countries are much more concentrated today in the top U.S. graduate programs than they were in the late 1970s, as table 16.1 shows clear increases in the share receiving degrees from the top fifteen U.S. programs.

Yet, as fewer students from these countries are pursuing PhDs in the United States, table 16.2 makes clear that the higher education sectors—and advanced degrees in the sciences, specifically—have grown at an extraordinary pace during the last 15 years. To illustrate, the number of science and engineering PhD holders produced in Taiwan increased from 109 in 1985 to 1,167 in 2003, while in South Korea the number grew from 281 in 1983 to 3,225 in 2002. Such evidence is suggestive of a process of transition whereby substantial doctorate attainment from U.S. universities among students from these countries was part of the development of robust universities producing advanced degrees in the home country, as well as more general expansion into industries dependent on scientific research and engineering skills.

The story that we have sketched, in which bright students from developing countries go abroad (perhaps even encouraged by their home governments) and eventually return to fuel economic growth is not inevitable, but depends on the persistence of positive prospects and the development of higher education institutions in the countries of origin. We suspect that the continued deterioration of universities in the former Soviet states has generated a circumstance in which few of the U.S.-educated PhD holders will return, thus more closely resembling traditional presentations of “brain drain.”

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TABLE 16.2
PhDs Awarded in Science and Engineering Fields in
Asian Growth Countries

	China	India	South Korea	Taiwan
1983	—	3,886	281	58
1985	125	4,007	548	109
1987	218	4,123	759	197
1989	1,024	4,209	984	257
1991	1,198	4,294	1,135	370
1993	1,895	4,320	1,421	513
1995	3,417	4,000	1,920	650
1997	5,328	4,764	2,189	839
1999	6,778	5,317	2,607	892
2000	7,304	5,395	2,865	931
2001	8,153	5,394	—	970
2002	—	5,527	3,225	—
2003	—	6,318	—	1,167

Source: National Science Board, 2006, appendix table 2–43.

THE NEXT STEPS

What we take away from this short analysis is that political shocks in other nations, represented by the opening of trade and educational exchange, have had demonstrable effects on the flow of students into U.S. doctoral education programs. With large increases in the flow of students from China during the 1980s and subsequent increases in the flow of students from Eastern European and the former Soviet countries in the early 1990s, there is a common theme present in the data characterized by a sharp increase in the entrance of new doctoral students followed by the establishment of a steady-state flow.

Much work remains to be done on the question of how exchange in postsecondary education affects economic outcomes in the sending and receiving countries. We suggest that the impact of educating foreign students from transitioning economies like those of China and Eastern Europe has important long and short term differences from the case for poor developing countries. For transitioning economies, doctorate attainment from U.S. institutions may well prove to be an “intermediate product” used in the development of education and industry in the home country. To this end, transitioning economies may generate return migration among U.S. PhD recipients if they have strong institutions and investment in universities. As such, “brain drain” is far from an inevitable consequence of the advanced training of students from transitioning countries at U.S. universities.

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