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GRADUATE EDUCATION, INNOVATION AND FEDERAL RESPONSIBILITY

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Introduction

The ancient Jewish scholar, Rabbi Hillel, is said to have been challenged by a disbeliever to teach him the whole Jewish Torah while standing on one foot. Rabbi Hillel is reputed to have replied, "That which is hateful to you, do not do to your neighbor. That is the whole Torah; the rest is commentary."¹ My message in this paper is not quite as succinct, but can be summarized in five points:

1. Research and development lead to innovation and economic growth.
2. Graduate students in general, and foreign graduate students in particular, play a major role in the production of research and innovation.
3. Attempts to make statements about shortages of Ph.D. level scientists and engineers are almost certainly doomed to fail and miss the point that what is optimal from the perspective of different actors in the market (individuals contemplating graduate study, individual professors, academic departments and employers), is not necessarily optimal for the nation as a whole.
4. Financial stresses faced by American higher education institutions have very serious implications for the future flow of American college graduates into Ph.D. programs.
5. The mobility of college graduates in general, and Ph.D.'s in particular, will cause states to under-invest in their public higher education systems and provides a strong argument for an increased federal role in graduate education.

All that follows is an elaboration of these points and commentary.

Research and Development, Innovation and Economic Growth

A large and growing body of literature suggests that our nation's level of economic growth is related to the investments that we make in research and development. Some studies focus on the nation as a whole and ascertain the impact of research and development on productivity growth.² Others focus on local areas and study how innovative activity of firms in an area relates to the level of university research and development expenditures being conducted in the geographic area.³ Still others have looked at productivity growth rates in manufacturing industries over time and concluded that these are related, with a lag, to the stock of research that has been done that relates to the industry.⁴ The conclusion of all is that research in science and engineering plays an important role in economic growth.

The Role of Graduate Students

Graduate students have long been recognized as an important input into research and development activities, although only recently have attempts to quantify their importance been made. In an earlier paper and in research in progress, James Adams and his colleagues have used institutional-level panel data for over 100 major research universities and concluded that, other factors held constant, the research productivity of faculty members at a university, as measured by either publications or citations, is positively related to the stock of the university's Ph.D. students.⁵ Keith Maskus and his colleagues use national time-series data and similarly find that, holding other factors constant, an increase in the number of science and engineering Ph.D.'s is associated with increases in patent applications, university patents granted and non-university patents granted.⁶

Some new Ph.D.'s in science and engineering move into academic positions, but many move into industrial positions. In each of these roles they become inputs into the production of new knowledge. The movement of Ph.D.'s in science and engineering into industrial positions is also a route via which knowledge is transferred from universities to industry.⁷ Studies that have sought to quantify the importance of this route find this is a moderately important, but not the major, route via which knowledge flows from academia to industry. Furthermore, such flows are very industry specific.⁸

Finally, recent research has addressed the role that foreign graduate students play in innovation activities in the U.S. As background, concern is often expressed that foreign graduate students are displacing American graduate students in general, and under represented minority graduate students in particular, in Ph.D. programs in the United States. However, the only study that I know of that looked at the preferences of American universities for foreign graduate students found that a number of our nation's leading research universities "discriminated" against foreign students, in the sense that American citizen student applicants had a higher probability of being admitted to doctoral programs than did foreign applicants with the same admissions credentials (test scores). If this is the case, one might expect that, on average, foreign Ph.D. students are more highly qualified than domestic Ph.D. students and they will, on average, contribute more to research and innovation. This is, in fact, the conclusion of Keith Maskus and his colleagues, who find that, other factors held constant, an increase in the share of foreign graduate students in total graduate enrollments is associated with increases in patent applications, university patents granted and non-university patents granted.¹⁰

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Enrollments of foreign graduate students have declined in the United States in recent years due to a number of factors, including the increased difficulty of obtaining visas that resulted from the aftermath of 9/11, the sense by some foreigners that the U.S. is no longer a hospitable environment for them, and the growing strength of higher educational systems in other nations around the world. In 1990, former Harvard College Dean Henry Rosovsky asserted that, "Fully two thirds to three quarters of the best universities in the world are in the United States."¹¹ A recent quantitative ranking of world universities conducted by the Institute of Higher Education at Shanghai Jiao Tong University, which was based on faculty and alumni awards, citations and publications, concluded that 85% of the top 20 universities in the world in 2004 were in the United States.¹² However, the U.S. share of the top 100 was only 51%.

It would be unwise for us to assume that our leadership in graduate education and research will persist in the future, absent our taking steps to strengthen our graduate programs. The mere fact that a Chinese university undertook this study suggests what the aspirations of that large nation are for its higher education system. Hence a continual flow of talented foreign students into U.S. science and engineering Ph.D. programs and into postdoctoral research positions in the U.S. in the future should not be taken for granted by us.

Shortages and the Financial Pressures Faced by Public Higher Education

The idea that shortages or surpluses exist in markets in which prices are free to adjust, such as the market for Ph.D. scientists and engineers, is somewhat alien to economists, such as myself, because ultimately price changes will bring markets into equilibrium. Rather economists worry about the time that it takes markets to adjust; in situations in which there are long lags in the response of supply to price, such as in the production of Ph.D. scientists and engineers. In these situations, public policies might be called for that facilitate adjustments to equilibrium, such as temporarily changing the number of government sponsored assistantships, fellowships or traineeships provided for Ph.D. students.

While there have been numerous attempts to forecast whether a shortage or surplus of Ph.D.'s will occur in the future, these have all been doomed to fail because of the adjustments that labor markets can make.¹³ To take but one example, which I will return to below, financial pressures faced by American higher educational institutions, have led them to substitute cheaper part-time and full-time non-tenure track faculty for full-time tenured and tenure track faculty in recent years; thereby rendering any forecast of the replacement demand for retiring tenure track faculty inaccurate.¹⁴

The question of whether a shortage or surplus exists, is also often in the eyes of the beholder. From the perspective of Ph.D. students and postdoctoral fellows seeking jobs, restrictions on the number of full-time tenure track faculty positions at academic institutions looks a lot like a surplus situation. From the perspective of individual faculty members involved in the scientific enterprise, increased research project budgets lead to increased demands for graduate research assistants and postdoctoral fellows. Each faculty member wants to maximize his or her own research output and this puts pressure on graduate schools to expand enrollments. Concern about future employment prospects for one's students often falls by the wayside. Inasmuch as the prestige of an academic department is based upon the research accomplishments of its faculty members, department behavior often mimics the behavior of its individual faculty members.

From the perspective of U.S. employers of Ph.D. level scientists and engineers, their goal is to attract and retain talented Ph.D.'s at the

lowest possible costs. Hence immigration policies that enhance the ability of foreign students to study in the U.S. and foreign Ph.D.'s, whether they receive their training in the U.S. or abroad to work here, will be favored by them.

From the perspective of an academic institution, budget situations dictate the extent to which the institution has the resources to bid for top faculty prospects or is forced to settle for lesser quality faculty whose salaries it can afford. Most American college students are educated at public institutions and hence most American faculty members are employed at public institutions. Over the last quarter of a century, state government budget problems, coupled with the increased demand on their budgets for expenditures in areas other than higher education (health, criminal justice, elementary and secondary education), have led state appropriations per student in public higher education to decline relative to tuition levels at private academic institutions. Even with roughly equal percentage increases in tuition at public and private higher education institutions during the period, because public tuitions started at much lower levels, expenditure per student levels in public higher education have progressively fallen behind expenditure per student levels in private higher education.

The result, which I have discussed in detail elsewhere, has been a substantial decline in full-time faculty salaries at public higher education institutions relative to full-time faculty salaries in private higher education institutions and the growing tendency, to which I have already alluded here, to substitute part-time and full-time non-tenure track faculty for full-time tenure track faculty.¹⁵ Not surprisingly, voluntary faculty turnover is also higher at public higher education institutions than at private higher education institutions, but this turnover does not lead to the creation of an equal number of new full-time tenure track faculty positions.¹⁶

Perhaps paradoxically, at the same time that fewer new full-time tenure track faculty positions are being created, the competition to attract the very top young scientists and engineers has heated up and start up cost packages have become important in the competition for faculty. These packages may include funding for the construction and renovation of laboratories, materials and equipment, graduate assistants and postdoctoral fellows, summer salaries for faculty members, reduced teaching loads, travel money and unrestricted research accounts.

A recent survey conducted by the Cornell Higher Education Research Institute found that start up cost packages for new assistant professors at our nation's private research universities were typically in the \$400,000 to \$500,000 range, with packages at the public somewhat lower.¹⁷ Packages needed to attract senior faculty are considerably larger and often exceed \$1,000,000. Because private universities more often have access to endowment income and annual giving streams from which they can obtain funds for startup cost packages, it is not surprising that public universities, more often than private universities, reported to us that they obtained at least part of the funding needed for startup cost packages by keeping faculty positions for scientists and engineers vacant until salary savings could be accumulated to cover these costs. To the extent that public universities face a continual need to attract new faculty, this suggests that there will be a permanent level of vacancies at these universities and thus a further de facto reduction in the size of the full-time faculty at them.

The Social Interest

A declining availability of full-time tenure track faculty positions in American higher education institutions surely will reduce the attractiveness to American college

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Federal Relations: Mid-year Congressional Update

by Patricia H. McAllister, Director of Government Relations and Public Affairs

As we approach the mid-point of the year, Congress is turning its full attention toward consideration of spending bills to fund the federal government in 2006. The new fiscal year begins on October 1, but in recent years Congress has not met this deadline and the annual appropriations process has dragged on sometimes for months. It is highly likely that this pattern will be repeated again this year.

As of June 15, the House of Representatives has approved six of its 11 FY 06 appropriations bills including Agriculture, Energy and Water, Homeland Security, Interior and Military Quality of Life. Most recently, the House is considering the FY 06 Science/State/Commerce Justice appropriations bill and the Defense appropriations bill.

Appropriations bills and specific provisions of interest to graduate deans follow:

Department of Agriculture, H.B. 2744, includes about a 1 percent increase in spending for academic research, including \$4.5 million for higher education graduate fellowship grants. The bill passed the House of Representatives on June 8.

Science, State, Justice and Commerce, H.R. 2862 was approved by the House Appropriations Committee on June 7.

The NSF budget was increased by \$170.6 million, or 3.1 percent above the FY 05 level. The research and related activities portions were increased by \$157 million and the Committee report encourages NSF to develop "innovation inducement prizes" to undertake projects to solve specific scientific problems. The Education and Human Resources allocation is increased by \$34.4 million above the FY 05 level. This total level funds graduate education at \$155 million.

The House Appropriations Committee approved the Defense appropriations bill H.R. 2863, on June 7. The bill funded the expanded National Defense Education Program at \$10.28 million, the requested level. However, the basic research allocation of \$1.45 billion was reduced by about 4 percent, while the applied research account was increased by 4.3 percent.

The House Appropriations Subcommittee for Labor, HHS, and Education marked up its spending bill on June 9. The GAANN and Javits programs were level funded at \$30.4 million and \$9.8 million respectively, and the Fulbright Hays Doctoral Research Abroad program appears to be level funded at \$2.2 million.

The Subcommittee approved bill increased the Pell grant by \$50 million in FY 06 for a maximum Pell grant of \$4,100. The TRIO programs were level funded at \$836.5 million, GEAR UP was level funded at \$306 million, and Leveraging Educational Assistance Partnership (LEAP) was also level funded at \$65.6 million. All three of these programs had been slated for termination in the President's budget request.

The House passed the appropriations bill for the Departments of Interior, Environment and related agencies, H.R. 2361, funding EPA graduate fellowships at \$12.03 million, a level slightly below the 2005 allocation and \$3.7 million above the President's budget request. The bill is now moving through the Senate.

The status of the current appropriations bills we are following are contained in the chart below:

Appropriations in millions	FY2005 Final	President's	House Approps Subcmte	FY 2006		
				House Approps Full Cmte	House Final	Senate Approps Subcmte
National Science Foundation						
All Graduate Fellowships	154.7	155	155	155	TBD	TBD
Department of Education						
GAANN	30.4	30.4	30.4	TBD	TBD	TBD
Javits	9.8	9.8	9.8	TBD	TBD	TBD
Fulbright-Hays Doctoral Research Abroad	2.2	2.2	2.2	TBD	TBD	TBD
Environmental Protection Agency						
General fellowships	12.04	8.33	12.03	12.03	12.03	12.04
Department of Agriculture						
Graduate fellowship grants	3	4.5	4.5	4.5	4.5	TBD
Department of Defense						
SMART/NDEA Phase I	2.5	10.3	10.3	10.3	TBD	TBD

Higher Education Reauthorization Update

Recently, the House began marking up its higher education reauthorization bills, focusing on specific titles. The House Subcommittee on Select Education marked up its bills dealing with Titles VI and VII on Thursday, June 16. H.R. 520 reauthorizes Title VII which includes the GAANN and Javits programs. The Bill H.R. 510 includes changes to the GAANN program, specifically requiring the Secretary of Education to establish a priority for grants in order to prepare individuals for the professoriate who will train highly qualified elementary school teachers of math, science, special education and English as a second language. The existing statute does not specify areas of national need which are determined by the Secretary of Education and are currently focused on STEM fields. CGS staff has been in communication with key staff on the House Subcommittee on Select Education to urge that provisions concerning the preparation of teachers be addressed in Title II which focuses on teacher preparation and accountability. We are also working with other associations that share our view.

The Senate staff is working in a bi-partisan manner on the development of the Senate HEA bill but as of this writing a bill has yet to be introduced. Last week Senator Chris Dodd (D-CT) reintroduced the Getting Results for Advanced Degrees (GRAD) Act and some provisions of this bill are likely to be included in the Senate HEA bill. This bill would encourage students to pursue graduate degrees and increases the authorization levels for the GAANN and Javits programs to \$50 million and \$35 million respectively. It also eliminates the Title IV needs analysis for both programs and clarifies that the GAANN and Javits stipends link to National Science Foundation Fellowships. The bill authorizes Stafford loan limits for graduate and professional students to be raised to \$12,000. Finally, this bill creates the Patsy Mink Fellowship program to encourage more women and minorities to pursue careers and work in the higher education professoriate.

At present, it is uncertain whether the reauthorization will be completed this year. CGS staff will provide updates on activities as events progress.

Data Sources: Reviewing Recent Reports on Graduate Education

by Heath Brown, Director of Research and Policy Analysis

Diversity and the Ph.D.

Promoting inclusiveness and diversity in graduate education is a major CGS priority and the subject of much recent scholarship, as well as many major national initiatives. The facts related to underrepresentation of minority groups across graduate education, and particularly in the sciences and engineering, are well known to most in the educational community. Less understood is the effectiveness of the many programs and policies aimed at addressing this multifaceted problem. A new report by the Woodrow Wilson National Fellowship Foundation, "Diversity and the Ph.D.: A Review of Efforts to Broaden Race and Ethnicity in U.S. Doctoral Education," presents a critical examination of national efforts to address inequities in doctoral education for racial and ethnic minorities.

Method

The study conducted a series of interviews with the managers of 13 programs which address these issues. The chosen programs are all national in scope, they each focus on doctoral education, and, as a group, represent a variety of program types and a sample of major disciplines. The Gates Millennium Scholars, the Sloan Foundation: Minority Ph.D. Program, the NSF-Alliance for Graduate Education and the Professoriate program, the CGS and Peterson's Award for Innovation in Promoting an Inclusive Graduate community, and others were included in the study.

Program Types

One major contribution of this report is the presentation of a typology of programs. The authors present four major categories based on the central thrust of each program: individual fellowship programs, institutional-based fellowship programs, support services, and general programs emphasizing inclusiveness (See Table 1). The typology permits a clearer understanding of the relative merits of each approach, but also highlights the changing national emphasis in addressing these critical issues.

Table 1: Characteristics of Surveyed Programs	
<i>Individual Fellowship Programs</i>	
•	The Ford Foundation: Predoctoral, Dissertation, and Postdoctoral Fellowships
•	The National Endowment for the Humanities: Faculty Research Awards at Historically Black Colleges and Universities, Hispanic-Serving Institutions, and Tribal Colleges
•	The Southern Regional Education Board: Doctoral Studies Program
•	The Bill & Melinda Gates Foundation: Gates Millennium Scholars
<i>Institution-Based Fellowship Programs</i>	
•	The GE Fund: Faculty for the Future
•	The Sloan Foundation: Minority Ph.D. Program
<i>Support Services</i>	
•	The KPMG Foundation: The Ph.D. Program
•	The Mellon Foundation: Mellon Mays Undergraduate Fellows
•	The U.S. Department of Education: Ronald E. McNair Post-Baccalaureate Achievement Program
•	The National Science Foundation: Alliances for Graduate Education and the Professoriate (AGEP)
<i>General Programs Emphasizing Inclusiveness</i>	
•	The American Sociological Association: Minority Opportunities through School Transformation (MOST)
•	The Council of Graduate Schools: CGS/Peterson's Award for Award for Innovation in Promoting an Inclusive Graduate Community
•	The National Science Foundation: Integrative Graduate Education and Research Traineeship (IGERT)
Source: Diversity and the Ph.D. (2005)	

Financial Support

The financial dimension of doctoral education is a primary focus of this report. The authors address this issue from two primary perspectives: in terms of overall levels of funding, and the relationship of funding arrangements to outcomes for minority students. The report shows that targeted funding for minority students has dropped recently. In addition to declining support for higher education in general, this is in part a result of legal challenges to targeted program design that has resulted in a move toward broadening eligibility rules. This move has had the effect of increasing the number of applicants to a relatively fixed pool of support dollars, thereby reducing the amount programs can spend on individual students.

The report observes some key differences that exist between funding schemes. For instance, they suggest that institutional-based fel-

lowships "use the level of foundation grants to elicit matching commitments of institutional and organizational resources," which helps streamline the process of application on funding agencies. The report also observes the trend and potential positive outcomes of the move toward comprehensive fellowships and away from direct fellowship programs.

Mentoring and Professional Opportunities

Related to this shift in funding approach, the report makes a strong claim for the importance of mentoring both for racial and ethnic minority students, and students overall. The authors suggest that there has been a shift away from basic fellowship programs to more integrated programs that "couple fellowship support with intense mentoring, summer institutes, community building, and networking." These new efforts have aimed to reduce the student isolation that fellowship-only programs may have unintentionally fostered. Many of these types of new programs have been linked to professional and career outcomes and drawn support from private companies and foundations, all of which may improve the preparation of minority students and be a model for better preparation of all doctoral students.

Recommendations

The report makes several recommendations to improve doctoral education: 1) communication, 2) research, 3) vertical integration, 4) intellectual support, 5) mentoring and professionalizing experiences, 6)

race and need together, 7) leadership. The authors lament the lack of quality data and research, particularly of the longitudinal variety, that would allow for rigorous assessment of program outcomes and the accumulation of a set of proven reform strategies.

Implications

The Woodrow Wilson report contributes to our common understanding of the landscape of inclusiveness initiatives and also the direction of doctoral education. It is interesting to note that CGS, in partnership with Pfizer Inc, the Ford Foundation, and graduate schools across the country, is now conducting the Ph.D. Completion Project. Though initiated long before the release of this report, the project builds on many of these recommendations and will provide some of the hard data needed to evaluate the effectiveness of campus-based initiatives.

For more information, you can view the full

report at:

http://www.woodrow.org/newsroom/News_Releases/WWV_Diversity_PhD_ExecSum.pdf

New Report on Graduate Education in China

An area of curiosity for many in the graduate community are the remarkable developments in China. Until recently, this curiosity has been met with little reliable research on graduate enrollment and degrees from Chinese universities. The recent work of the National Science Foundation, Institute of International Education, and others has begun to fill this void. In particular, a report by Song Weiguo and Xuan Zhaohui, "Preliminary Analysis of China's Doctor Education, National Research Center for S & T for Development," provides detailed information on doctoral degrees, master's degrees, and fields of graduate study.

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graduates of Ph.D. study in the sciences and engineering. Is the trend of substituting part-time and full-time non-tenure track faculty positions for full-time tenure track positions, especially at public institutions, likely to continue in the future? To the extent that governors and state legislatures are concerned more about the undergraduate degrees that are generated by their public higher education institutions and less about these institutions' graduate degree production, I fear that the answer will be yes, unless researchers can demonstrate that the shifts in faculty composition are having adverse effects on undergraduate students. After all, from the perspective of an economist, substituting cheaper for more-expensive inputs to minimize the costs of achieving a given level of output is very rational. In recent research, Liang Zhang and I have shown that the increasing use of contingent faculty is associated with higher drop-out rates and lower graduation rates, other factors held constant, but more studies of this type need to be undertaken to make this case.¹⁸

Cutbacks by states in their funding for public higher education institutions may seem irrational, given the research I cited above that ties economic growth to science and engineering research, both at the national and local levels. Many states seem aware of the importance of scientific and engineering research to their states and are engaged in major efforts to boost research infrastructure in their states. However, boosting research infrastructure is not the same as providing funding for educating undergraduate and graduate students in science and engineering. So why the disconnect? Why are states starving their public higher education systems at the same time they are funding the research infrastructure.

Perhaps the answer is that the mobility of highly educated workers severely limits the returns that state governments receive from investing in public higher education. Research suggests that the proportion of the adult population in a state that is college educated is only very loosely tied to the expenditures that state governments are currently making on their public higher education systems.¹⁹ Paula Stephan and her colleagues have also shown that some states are big net importers from other states of new Ph.D.'s in science and engineering working in industry (for example, California and Massachusetts), while other states are big net exporters (for example, many of the Midwestern states).²⁰ While the latter states benefit from the research that their Ph.D. students help to produce during their graduate careers, these states will not reap as much of the benefits from the research of new Ph.D.'s when they move to out-of-state employment.

Hence the policy dilemma: evidence suggests that our nation's level of economic growth depends upon the investments we make in research and development and these in turn depend upon a steady flow of new science and engineering Ph.D.s. However, state budget problems, coupled with the mobility of new science and engineering Ph.D.s, do not provide states with the incentive to make socially optimal levels of investment in graduate education in science and engineering at their public higher education institutions. This suggests that ultimately it must be the federal government that plays the role of guaranteeing that our nation generates an adequate supply of graduate scientists and engineers.

How this is translated into changes in federal policy is an open question. However, as one of the many Ph.D.s who was attracted to Ph.D. study by the availability of multiyear National Defense Education Act Fellowships in the mid 1960s, enhancing funding for Ph.D. fellowships and traineeships surely is one option. So too is providing incentives to institutions to increase the fraction of their graduates who receive undergraduate degrees in science and engineering and policies

that encourage innovation in graduate training programs in the sciences and engineering that will explicitly prepare Ph.D. students for careers outside academia.²¹

I am grateful to the Andrew W. Mellon Foundation and the Atlantic Philanthropies (USA) Inc. for their support of CHERI and to Paula Stephan for numerous discussions on the topic. However, the views that I express here are solely my own. An earlier version of this paper was presented at the ORAU/CGS Conference on Graduate Education and American Competitiveness, Washington DC, March 9, 2005.

Citations

- ¹As quoted at <http://www.mechon-mamre.org/jewfaq/sages.htm>
- ²Basu, Fernald and Shapiro (2001), Basu, Fernald, Oulton and Srinivasan (2003), Gordon (2004a, 2004b)
- ³Jaffe (1989), Anselin, Varga and Acs (1997, 2000), Feldman and Audretsch (1999)
- ⁴Adams (1990)
- ⁵Adams and Grilliches (1998) and Adams, Marsh and Clemmons (2005)
- ⁶Chellaraj, Maskus and Mattoo (2005)
- ⁷Sumell, Stephan and Adams (2003)
- ⁸Cohen, Nelson and Walsh (2002) and Agrawal and Henderson (2002)
- ⁹Attiyeh and Attiyeh (1997)
- ¹⁰Chellaraj, Maskus, and Mattoo (2005)
- ¹¹Henry Rosovsky (1990)
- ¹²See <http://ed.sjtu.edu.cn/ranking.htm>.
- ¹³Ehrenberg (1991)
- ¹⁴Ehrenberg and Zhang (2005)
- ¹⁵Ehrenberg (2003)
- ¹⁶Nagowski (forthcoming)
- ¹⁷Ehrenberg, Rizzo and Condie (2003)
- ¹⁸Ehrenberg and Zhang (forthcoming)
- ¹⁹Bound et al. (2004)
- ²⁰Sumell, Stephan and Adams (2003)
- ²¹Romer (2000)

References

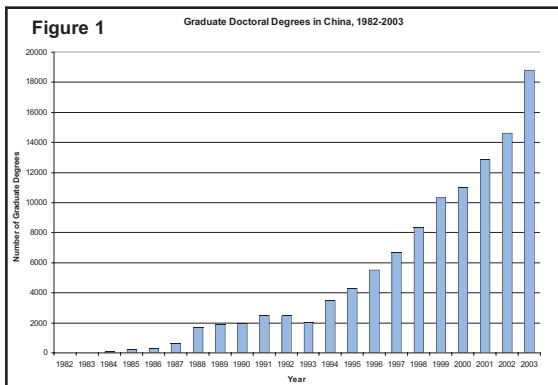
- James D. Adams, "Fundamental Stocks of Knowledge and Productivity Growth," *Journal of Political Economy* 98 (August 1990): 673-702.
- James D. Adams and Zvi Grilliches, "Research Productivity in a System of Universities," *Annales D'Economie et de Statistique* 49/50 (January/June 1998): 128-162.
- James D. Adams, John Marsh and J. Roger Clemmons, "Research, Teaching and the Productivity of the Academic Labor Force," (Working Paper, Department of Economics, Rensselaer Polytechnic Institute, 2005).
- Ajay Agrawal and Rebecca Henderson, "Putting Patents in Context: Exploring Knowledge Transfers from MIT," *Management Science* 48 (January 2002): 44-60.
- Luc Anselin, Attila Varga and Zoltan J. Acs, "Local Geographic Spillovers between University Research and High Technology Innovations," *Journal of Urban Economics* 42 (November 1997): 422-448.
- Luc Anselin, Attila Varga and Zoltan J. Acs, "Geographic Spillovers and University Research: A Spatial Econometric Perspective," *Growth and Change* 31 (Fall 2000): 501-515.
- Gregory Attiyeh and Richard Attiyeh, "Testing for Bias in Graduate School Admissions," *Journal of Human Resources* 32 (Summer 1997): 524-528.
- Susanto Basu, John G. Fernald, Nicholas Oulton and Sylaja Srinivasan, "The Case of the Missing Productivity Growth: or Does Information Technology Explain Why Productivity Accelerated in the U.S. but not in the U.K.," National Bureau of Economic Research Working Paper No. 10010 (Cambridge MA: National Bureau of Economic Research, October 2003).
- Susanto Basu, John G. Fernald and Matthew D Shapiro,

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Data Sources continued from page 4

Historic Trends in Graduate Degrees

In Figure 1, we see a substantial increase in the number of doctoral degrees over the last twenty years. From 1993 to 2003 alone, there was an 800% increase in the number of doctoral degrees awarded by Chinese universities, nearing 20,000 by 2003. This growth is, at least in part, the result of government investments in graduate capacity, the broadening of access to all levels of education across China, as well as China's substantial population.



Graduate Degrees by Field

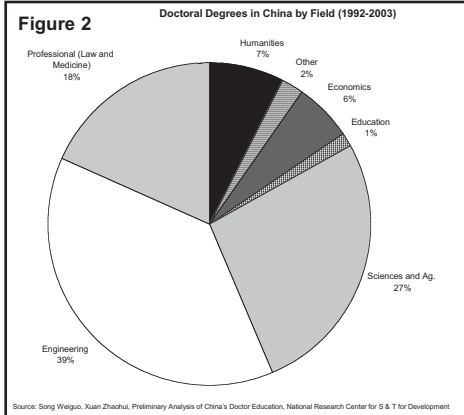
Another interesting dimension of this report is the presentation of doctoral degrees by field (See Figure 2). These figures include professional fields like medicine and law, but still present an interesting comparison to U.S. domestic patterns of doctoral and advanced degree production. Engineering is by far the largest field for doctoral study, with nearly 40% of the doctoral degrees. Large numbers of students are also engaged in fields across the sciences, (27%), as well as professional programs, (18%). Relatively few students in China are earning degrees in the humanities or education.

While international comparisons are limited by the lack of common data collection methods and degree definitions, a rudimentary comparison can be made with information on the number of degrees granted in the U.S. According to the U.S. Department of Education,

National Center for Education Statistics, in 2002, there were 44,160 doctoral degrees awarded in the U.S., 38,981 law degrees, and 15,237 medical degrees.¹ This means in the U.S. more than half, around 55%, of advanced degrees (both doctoral and first-professional), are awarded in law and medicine, versus only 18% in China.

Implications

This report places the recent CGS findings on declines in the enrollment of graduate students from China in the U.S. in a better context. China has clearly enhanced their efforts to support and train their own students at home, and this report documents the extent to which these efforts have paid off. The report also shows the concentration of students in engineering and the sciences, another finding that can help the graduate community in the U.S. better understand the nature of graduate education in China. Looking forward, the sustainability of expansion of doctoral education in China and the, as of yet, undocumented level of quality of Chinese doctoral education, are both issues to monitor in the years to come.



¹Digest of Education Statistics. (2003). Table 259 and 249. Available at : <http://nces.ed.gov/programs/digest/d03/tables/dt259.asp> and <http://nces.ed.gov/programs/digest/d03/tables/dt249.asp>

Applications Sought for CGS-Peterson's Award

There have been some important changes this year for the CGS-Peterson's Award for Innovation in Promoting an Inclusive Graduate Community. The amount of the award has been increased to \$20,000 over a three-year period, with a match of \$10,000 by the selected institution. Institutions which have previously received an award are now eligible to re-apply after a ten-year period.

The award is a matching grant to one institution per academic year, for either start-up efforts or efforts to expand or deepen existing initiatives to enhance diversity and inclusiveness in graduate education. The deadline for applying is September 7, 2005. For more information please see the CGS website at: <http://www.cgsnet.org/ProgramsServices/index.htm#awards> or call Cheryl Flagg at 202-223-3791.



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**NATIONAL SPACE BIOMEDICAL RESEARCH INSTITUTE
 GRADUATE EDUCATION RESEARCH PROGRAM**



The National Space Biomedical Research Institute (NSBRI) is soliciting proposals for a Graduate Education Program to broaden students' academic and career skills in space life science. NSBRI encourages the leveraging of existing academic programs and infrastructure to develop cost-effective approaches that will prepare students for entry level careers at NASA, NSBRI consortium member institutions, private industry partners in the space initiative or other public or private organizations involved in NASA's space exploration endeavors.

NSBRI is a non-profit organization competitively selected by NASA in 1997 to lead a national effort for accomplishing the integrated biomedical research necessary to support long-term human presence, development, and exploration of space and to enhance life on Earth by applying the resultant advances in human knowledge and technology acquired through living and working in space.

Applicants must submit proposals with the demonstrated support and commitment of the home institution, and must represent accredited, degree-granting U.S. institutions offering the Doctor of Philosophy (Ph.D.) or equivalent degree in the biomedical sciences, engineering or other fields applicable to space life sciences. *Proposals will be accepted only from U.S. citizens, permanent residents, or persons with pre-existing visas obtained through the sponsoring institution.* All proposals will be evaluated by a peer-review panel.

Detailed program and application submission information is available at the NSBRI web site: <http://www.nsbri.org/Announcements/rfp05-02.html>. Letters of intent, which are requested, but not required, and proposals must be submitted through the NSBRI's Internet-based Electronic Proposal Submission System. Letters of intent are due by August 3, 2005; the proposal deadline is September 14, 2005.

Questions may be directed to Jeanne Becker, Ph.D., Associate Director, NSBRI, telephone: 713-798-7412; email: director@www.nsbri.org.



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- The application deadline for the CGS/ Thomson Peterson's Award for Innovation in Promoting an Inclusive Graduate Community is fast approaching. Be sure to send applications postmarked on or before **September 7, 2005**. For more information, visit www.cgsnet.org.

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"Productivity Growth in the 1990s; Technology, Utilization or Adjustment?" *National Bureau of Economic Research Working Paper No. 8359* (Cambridge, MA: National Bureau of Economic Research, July 2001).

John Bound, Jeffrey Groen, Gabor Kedzi and Sarah Turner, "Trade in University Training: Cross-State Variation in the Production and Use of College-Educated Labor," *Journal of Econometrics* 121 (July/August 2004): 143-173.

Gnanaraj Chellaraj, Keith E. Maskus and Aadita Mattoo, "The Contribution of Skilled Immigration and International Graduate Students to U.S. Innovation" (working paper, Department of Economics University of Colorado, Boulder, 2005).

Wesley M. Cohen, Richard R. Nelson and John P. Walsh, "Links and Impacts: The Influence of Public Research on Industrial R&D," *Management Science* 48 (January 2002): 1-23.

Ronald G. Ehrenberg, "Academic Labor Supply" in Charles T. Clotfelter, Ronald G. Ehrenberg, Malcolm Getz and John J. Siegfried, *Economic Challenges in Higher Education* (Chicago, IL: University of Chicago Press, 1991).

Ronald G. Ehrenberg, "Studying Ourselves: The Academic Labor Market," *Journal of Labor Economics* 21 (April 2003): 267-287.

Ronald G. Ehrenberg, "Does America Face a Shortage of Scientists and Engineers?" in Terrence Kelly et al. eds. *The U.S. Scientific and Technical Workforce: Improving Data for Decision Making* (Santa Monica, CA: Rand Corporation, June 2004).

Ronald G. Ehrenberg, Michael Rizzo and Scott S. Condie, "Start Up Costs in American Research Universities," *Cornell Higher Education Research Institute Working Paper No. 33* (Ithaca, NY: Cornell Higher Education Research Institute, March 2003). (available at www.ilr.cornell.edu/cheri).

Ronald G. Ehrenberg and Liang Zhang, "The Changing Nature of Faculty

Employment" in Robert Clark and Jennifer Ma, eds. *Recruitment, Retention and Retirement: Building and Managing the Faculty of the Future* (Northampton, MA: Edward Elgar Publishing, 2005).

Ronald G. Ehrenberg and Liang Zhang, "Do Tenured and Tenure-Track Faculty Matter?" *Journal of Human Resources* (forthcoming).

Marianne Feldman and David B. Audretsch, "Innovation in Cities: Science Based Diversity, Specialization and Localized Competition," *European Economic Review* 43 (February 1999): 409-429.

Robert J. Gordon, "Five Puzzles in the Behavior of Productivity, Investment and Innovation," *National Bureau of Economic Research Working Paper No. 10660* (Cambridge, MA: National Bureau of Economic Research, August 2004). (2004a)

Robert J. Gordon, "Why Was Europe Left at the Station When America's Productivity Locomotive Departed," *National Bureau of Economic Research Working Paper No. 10661* (Cambridge, MA: National Bureau of Economic Research, August 2004). (2004b)

Matthew Nagowski, "Associate Professor Turnover at American Colleges and Universities," *American Economist* (forthcoming).

Paul Romer, "Should the Government Subsidize Supply or Demand in the Market for Scientists and Engineers?" *National Bureau of Economic Research Working Paper No. 7723* (Cambridge, MA: National Bureau of Economic Research, June 2000).

Henry Rosovsky, *The University: An Owner's Manual* (Cambridge, MA: Harvard University Press, 1990).

Albert J. Sumell, Paula E. Stephan and James D. Adams, "Capturing Knowledge: The Location Decisions of New Ph.D.s Working in Industry," (Working Paper, Andrew Young School of Policy Studies, Georgia State University, October 2003).

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