

DO FOREIGN GRADUATE STUDENTS CREATE EFFICIENCIES IN RESEARCH
UNIVERSITIES?

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ABSTRACT

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A vicious cycle has been created. It is not cost effective for a U.S. native to enter graduate school because the five or six years required to complete a Ph.D. imply an opportunity cost of hundreds of thousands of dollars in the form of employment in the private sector without the doctorate. On the other hand, research universities need graduate students to work in their laboratories and thereby generate federal grant revenue. The absence of U.S. natives creates openings for foreign students to fill. The swelling of foreign student enrollment in S&E constructed the argument that foreign students are now entering the programs that natives find too challenging; when in reality obtaining a Ph.D. does not pay. This thesis explored whether and how research universities are gaining additional expenditures by giving preference to foreign students over natives. Three regression analyses discovered foreign students were more “efficient” than their native counterparts. Annual reduction of R&D outlays of 14 million dollars was discovered. It is theorized the efficiencies are obtained due to visa restrictions placed on the foreign students as it guarantees that the training invested in the student is kept during the duration of the grant ensuring on-time delivery to the sponsor.

CHAPTER I: INTRODUCTION

Eric Weinstein uncovered the evidence of an effort by the National Science Foundation (NSF) to suppress Ph.D. salaries allowing for cheaper research that began in the mid to late 1980s. In 1985 a group within the NSF: the Policy and Research Analysis Division (PRA) under the direction of Peter House published a non-peer reviewed study entitled *The State of Academic Science and Engineering* (Greenberg, 2001) predicting a shortfall of scientists and engineers by 675,000 (as stated in one of the several versions of the report). Greenberg (2001) outlines the “shortfall” number was obtained by constituting the median age of twenty-two to receive a bachelor’s degree. Of those bachelor degree recipients only a minute amount would continue on to obtain a Ph.D.. Their age after the long process to obtain the Ph.D. was factored in. Using population statistics and conjecturing the “baby bust” from the early 1960s, the shortfall number of 675, 000 S&E graduates between 1986 and 2010 was born. Greenberg (2001) details the missing piece:

Keyed to domestic birth statistics, the pipeline controversy virtually ignored the continuing abundance of foreign born personnel in the American research enterprise. The immigrant population, trained abroad or in the U.S., has durably accounted for a sizable portion of the nation’s working scientists and engineers since World War II, and has demonstrated high “stay rates,” contrary to alarmist

warnings of an impending exodus to the homelands. This balance for the baby bust was scarcely mentioned by the shortfall theorists; skeptics of their ominous forecasts were reluctant to hinge their doubts on the availability of foreign scientists and engineers. (p.117)

The missing factor of foreign born personnel did not stop the division from making other predictions.

The division predicted a sharp increase in Ph.D. salary from \$52,000 in 1982 to approach \$100,000 beyond 2000. To combat this “problem” the NSF called for increases in foreign student enrollment for national interest. The internal NSF/PRA study (as cited in Weinstein, n.d.) stated:

A growing influx of foreign PhD’s into U.S. labor markets will hold down the level of PhD salaries to the extent that foreign students are attracted to U.S. doctoral programs as a way of immigrating to the U.S.. A related point is that for this group the PhD salary premium is much higher [than it is for Americans], because it is based on BS-level pay in students’ home nations versus PhD-level pay in the U.S..(The NSF’s Real Shortage Study, ¶11)

To encourage foreign scientists into the United States the internal study had two ideas. One was to grant equal access of graduate student support funds through federal agencies. The second idea was to provide foreign students that completed a Ph.D. degree at U.S. institutions permanent resident status. Greenberg’s (2001) analysis of the internal study concurs with Weinstein’s:

The prospect of intersectorial competition over an inadequate supply of science and engineering doctorates inspired a new argument for additional federal funds

to produce them: restrained wages. Introducing a barrage of seemingly authoritative numbers, House and colleagues stated, “The effect of expanded fellowship support of doctoral students in NS&E fields is expected to be highly favorable in terms of expanded supply of new doctorates and reduced salary inflation.” By spending an annual average of \$612 million on student support from 1989 to 2006, they asserted, the “program would generate average annual salary savings estimated at \$1.81 billion during the same period.” Again, any numbers beat no numbers. If the government would spend a bit more, academe and industry would save a great amount on payroll, they argued. (p.124)

The NSF got what they wanted – both methods transpired. As to the first, government grants & contracts compose up to 30% of revenue for public and private research universities in 2006 (Council on Government Relations [COGR], 2008) and federal funding supported 60% of universities and colleges research and development (R&D) expenditures in 2002, (Shackelford, 2004). North (1995) found “... *the further you are from U.S. citizenship the more likely you are to secure American funding*” (p.83). Bevis and Lucas (2007) cited that often-foreign students receive support through research assistantships. They explain:

Financial resources for research assistantships were provided to universities by federal government agencies, industry, and other nonfederal sources in the form of research grants. During the same period when academic research expenditures were growing, the number of foreign doctoral students supported by university science and engineering departments was also increasing. (pp.190-191)

The second NSF goal was achieved by the Immigration Act of 1990 which created a new visa type (H-1B) for immigrants with bachelor degrees or equivalent in their field. The link is explained by Matloff (2003):

The universities had very strong incentives to back industry on the shortage and H-1B issues: universities hoped to get increased government funding for science and engineering programs to cope with the labor “shortage”; many university postgraduate programs are populated largely by foreign students who hope to later work as H-1Bs in the U.S.; and the universities are major employers of H-1Bs themselves. (p.10)

What is the concern that world renowned universities in the United States provide opportunities for foreign students, often the “best and the brightest” to study? Borjas (2002) explained from a national perspective, “...the foreign student program does not seem to pay its way. The net gain from the employment of foreign students and foreign graduates may be around \$1 billion, while the subsidy accruing to foreign students is more than twice as high” (p.7). This subsidy provided to foreign students paves a path for them to obtain sensitive U.S. technologies that may be under export control to their own home countries. A Defense Security Service (DSS) 2009 report finds threats from East Asia and the Pacific through suspicious contact reports (SCRs) stating “growing reliance on collection methods that mask state-sponsored interest. Furthermore SCRs indicated regional entities continued to exploit non-traditional collectors, like graduate and post-graduate students applying for positions in United States defense industry, as a guise to acquire sensitive technologies” (p.18). There is another concern that is just as important as export control: national security.

Vaughan (2010) describes it was a student visa which allowed the Times Square bomber Faisal Shahzad entrance into the United States for attendance to the University of Bridgeport; where he received \$6,700 in grant money to cover his tuition. In 2000 he graduated working for a temporary staffing agency under Optional Practical Training status (OPT) moving to the H-1B visa in 2002 to work for Elizabeth Arden in a low level accounting position. In 2005 his U.S. citizen wife filed a green card petition paving the way for his green card approval in 2006. In 2008 he applied for citizenship and in April 2009 he was sworn in as a U.S. citizen. In May 2010 (13 months after gaining citizenship) he attempted to set off a bomb in Times Square. It is this immigration path the Immigration Act of 1990 provided. The foreign student program does not pay from a national perspective and it is a security concern.

A review of literature chapter will describe supporting documentation to show foreign students are actually “revenue enhancers” to research universities by merely following IRS tax laws. A methods chapter will detail the qualitative institutional data collected and summarize the data from publicly available databases that were used for analysis. In this chapter an analytical techniques section explains how the data were analyzed followed by the results chapter containing the analysis. Finally, the concluding chapter will present a summary of the important social and public policy implications of these data. A recommendation for future studies section is offered at the end.

CHAPTER II: REVIEW OF LITERATURE

Since the NSF/PRA internal report was released, foreign student enrollment has increased 41% during the period of 1995 to 2005 (Oliver, 2007, Table 1). A review of literature details the history of the NSF shortage report. It is explained that opportunity costs play a role in the increase, as well as the research universities' need to fill positions. Although it appears tuition revenue may be a source of income, often in science and engineering (S&E) it is waived through a mystical web of university accounting, which is why foreign students selected that field. Also investigated is how S&E students fund their education. To understand where the revenue enhancement is located, research university accounting is explained leading to where the money is: direct costs. Research microeconomics is described. To follow is a breakdown of the S&E glut. Finally, details of native students crowded out from research universities are explored.

Opportunity Costs

Why aren't natives choosing to obtain a Ph.D. in S&E? Rao (1995) described their opportunity costs are higher compared to foreign students. A U.S. native has an alternative: they can find a good full-time job, whereas foreign students by way of immigration restrictions cannot until they graduate. He explains "Furthermore, the real wage for even a good job in the primary source countries in Asia is much lower than that for almost any job in the United States" (p.279). This matches what the NSF had hoped.

Freeman (2005) agrees that the foreign students have lower opportunity costs and highlights an important point: “To many foreign born students or workers, obtaining an S&E education or job is their ticket to the US job market, a green card, and possible citizenship” (pp.15-16). He later warns:

If US economic growth and comparative advantage depend substantially on the work of scientific and engineering workers, relying so much on foreign born supplies could be risky. Any interruption or change in the flow of immigrant scientists and engineers would certainly harm US research and development. (pp.18-19)

Bevis and Lucas (2007) found an interruption already occurring – competition with other countries, and sometimes the students’ own home countries. Karen Hughes, Under Secretary of State for Public Diplomacy and Public Affairs, addressed 120 college leaders assembled in Washington. She acknowledged that competition for hosting international students had greatly intensified in recent years and (as cited by Bevis and Lucas, 2007) remarked:

‘Not too many years ago,’ she observed, ‘the United States was not only the best place to go, it was also one of the only places to go for serious study at the university level.’ She continued, ‘Today, hundreds of thousands of international students have many more opportunities to study at home, at centers of academic achievement in their own countries....’ (p.288)

The General Accountability Office’s 2009 report has findings which agree there is an interruption. In 2009, the GAO investigated efforts made by other countries to attract foreign students. Their study found, “While the United States continues to be the leading

destination for international students, the U.S. share of international students worldwide dropped –from 26 to 20 percent – between 2000 and 2008” (p.3).

In summary, for many U.S. natives a Ph.D. does not pay. During the five to six years it takes to obtain a Ph.D. the student is foregoing the thousands of dollars they can make in industry. Ph.D. salaries are higher, but it never matches the lost wages that could be made in industry (Matloff, 2003). This is a problem for the research universities who need bodies to perform research and obtain the revenues from this source.

Filling Positions

Although the NSF’s internal study investigated a shortage of S&E graduates in the mid to late 1980s the lack of demand for a Ph.D. degree has been going on for quite some time. Geiger (2004) summarizes how the market forces have been working over the past three decades:

Since the late 1970s the supply of qualified students seeking doctoral education in the sciences and engineering has tended to be less than the number of places potentially available for them. Market forces, in other words, have favored the applicants, with evident consequences. One effect has been a substantial increase in the number of international students. *Universities have thus enlarged and improved the supply of qualified applicants by substituting highly qualified international students for lower-ranked (or nonexistent) domestic ones* [italics added]. The number of doctorates granted to foreign nationals tripled from the late 1970s to the early 1990s, exceeding 50 percent of graduates in engineering and 30 percent in natural sciences. A second development has been the gradual improvement of the support packages given to doctoral students. As they

competed for better students, departments lengthened the time of guaranteed support and increased the value of stipends. (pp.18-19)

Matloff (2006) construes why there are nonexistent domestic students:

Note that universities are employers too. The graduate students receive a modest stipend for their work on university research projects. This stipend is too low to attract many American students, just as the NSF predicted. In other words, universities are just as addicted to cheap foreign labor as industry, not only for the low cost itself but also for docility, ..." (p.8)

A 1969 book by the National Academy of Science entitled *The Invisible*

University: Postdoctoral Education in the United States agreed with Geiger. A dean from their study (as cited by the National Academy of Science) states:

In the fields in which I am familiar, the large numbers of foreign postdoctorals simply reflects the fact that capacity for directing research, measured both in terms of faculty talent and government money exceeds the supply of American candidates. I should think that this is one of the more effective uses of United States funds if it were to be regarded as a type of foreign aid. (p.208)

Borjas (2002) offers, from the perspective of the research universities, why they may elect to enlarge their labor supply:

Consider the financial incentive faced by large research universities when they make their admission decisions. These universities need many workers to staff their physical science laboratories and teaching assistants to assign to large undergraduate classes, and they would obviously prefer to fill these positions at

low salaries. The foreign student program provided an almost limitless supply of these willing workers. (p.4)

To summarize, research universities do not have a demand for graduate degrees by domestic students as the stipend offered is too low to attract their interest. However, government money exceeds the supply of the domestic labor. To compensate, rather than increase the stipend amount, research universities elected to increase their labor supply by admitting foreign students.

Tuition Revenue

At first, one may think, since foreign born students are non US residents, they surely pay full tuition as claimed by the Institute of International Education (IIE). The IIE states that in 2007-2008 foreign students and their parents contributed 15.453 billion dollars to the economy. Borjas (2004) agreed that full tuition, if it exceeded the cost of providing the actual education, could generate revenues. He warned, “But the pricing of higher education in the United States is highly distorted in both private and public institutions, with the typical tuition payment not being sufficiently large to cover the actual cost of an education” (p.15). Even if foreign born students were paying full tuition, it is still a bargain. Donald M. Bishop, Minister-Counselor for Press and Cultural Affairs American Embassy in Beijing explained at the American Center for Educational Exchange in 2005 that in public universities tuition typically covers one-fourth the costs. The rest is subsidized by American tax payers. He elaborates further: “Another way to look at this is that every student admitted to an American university receives an (unstated) scholarship, or perhaps a subsidy, from American society” (§21). Geiger (2004) agrees:

American higher education is subsidized in numerous ways. Public colleges and universities rely chiefly on state appropriations, but other forms of public support, including student financial aid, flow to both public and private institutions.

Exemption from taxation is another implicit subsidy, predicated on a contribution to the public good. The capital costs of higher education constitute a huge sum that takes the form almost entirely of subsidy. (p.11)

He later warns: “But forms of coordination shaped by artificial prices will always be sensitive to fluctuations in the levels and conditions of subsidization” (p.265).

Vaughan (2007) explains, to obtain a student visa, foreign students must show they can support their education in order to qualify for the visa, but she cautioned “Some foreign students cut costs by obtain [*sic*] in-state tuition by using the address of relatives, and some institutions allow this” (Policy Implications, ¶ 7). How can these students be considered “cheap labor” when they are paying full price (though a bargain) for the privilege? They are not paying for the science and engineering field, for which they are applying, as compared to other fields such as liberal arts.

Why Science and Engineering?

Noll and Rogerson (1997) detail that the science and engineering fields account for “...virtually all federal support for university research” (p.28). S&E receives most of the research money and provides the best opportunity for a student to receive full funding (North, 1995). North reiterates reasons previously covered: Americans are not interested in graduate school due to the lost wages compared to entering industry, leaving vacancies for well-qualified foreign students. Moreover, the latter often see an American Ph.D. as a path to U. S. citizenship. He adds, “U.S. science and engineering degrees (and the

graduate education that they represent) are highly regarded world-wide” (p.30). North explains a S&E degree is not a country specific discipline like a law degree or a medical degree. Immigration laws provide ample opportunities for a foreign S&E graduate to stay and work in the United States by way of an H-1B visa, unlike other occupations.

Graduate Student Funding

North’s 1998 study found that only 10 percent of foreign student funding came from overseas. That percentage diminished as their graduate years passed. Bevis and Lucas (2007) agreed:

Financial support available from academic research activities was a major factor in attracting foreign students to U.S. doctoral programs. More than 75 percent of the 10,000 foreign doctoral recipients at American universities in 1996 reported their universities as the primary source of support for their graduate training – most in the form of research assistantships. (p.190)

Foreign students are not paying their way as claimed by the IIE. In fact the IIE’s methodology should be questioned. North (1995) shows that the IIE is not surveying the foreign students themselves but instead obtains second-hand estimates from foreign-student advisors, who may be motivated to understate the extent of federal subsidies.

After all, if foreign students are not paying their own way, how can they obtain a student visa, given the requirement of financial self-support? Vaughan (personal communication, February 10, 2010) explained that financial means can include scholarships and stipends in addition to the student’s own resources

It will be difficult to conclude that foreign graduate students in S&E are “cheap labor” if their stipends as graduate research assistants (GRA) and teaching assistants (TA)

are heavily subsidized by the American tax payer through federal research grants and tuition waivers. In S&E typical methods used to fund graduate education are employment as teaching assistants or research assistants, fellowships, and tuition waiving.

Teaching Assistants

North (1995) refers to TAs as “Class C”. Often a modest salary is paid. They typically work part time and help the university keep their costs low by providing work that a higher paid faculty member is not doing. Since this salary is considered a “payment involving services” it is taxable to the student, (The George Washington University, 2009).

Graduate Research Assistants

Referred to as “Class D” by North (1995), their roll is the most important in the university labor market as it is their work that keeps the flow of the lucrative federal research grants in operation. As with TAs Graduate Research Assistants (GRA) often receive a small salary. Hamel, Heiberger, and Vick (1994) explain “Research assistants (RA) may be found in areas where large training grants from the federal government are available. These areas are usually in the sciences and engineering...” (p.12). They work longer hours than part time. “Graduate research assistants under the oversight of the principle investigator likely perform much of the actual work for such projects” (Geiger, 2004, p.191). Like TAs the salary is considered a “payment involving services” and is taxable to the student. This salary can be charged to a federal grant as a “direct cost” (explained in more detail later).

Fellowships

Fellowships are a type of scholarship awarded in S&E by a grant funding organization or the university itself. They are considered a type of scholarship, and though these fellowships may be paid like a salary, they are not (University of Texas at Austin, n.d.). How the fellowship is handled tax wise depends on how it was awarded and where it was used. Hamel, Heiberger, and Vick (1994) clarifies fellowships “are actual dollars paid beyond tuition scholarship. These monies are meant to support students by making money available to cover room, board, books, and supplies and are taxable as income” (p. 9). Regardless of how the fellowship was awarded, a university is not required to report them to the IRS and is not required to withhold tax on them. It is the student’s responsibility to report the money to the IRS, (The George Washington University, 2009).

University Fellowships

Often universities will provide a tuition award to an outstanding student. This type of fellowship is a scholarship and is not a “payment involving services” (The George Washington University, 2009). Although it may be paid to a student like a salary, it is not. At times it may be merely a credit on a student’s account and the student never sees the money. It is not taxable to the student, as it is often used to pay for “qualified tuition and related expenses” (Harvard University). This type of fellowship can also be charged to a federal grant as a “direct cost” if the project is directly related to the student’s program of study.

Grant Fellowships

Some grant funding organizations, like the NSF, provide training funding and is awarded directly to the student (Hamel, Heiberger, & Vick, 1994). Though the student may receive this payment in the form of a salary and refer to it as a “stipend,” it is not a “payment involving services” (The George Washington University, 2009). They are “grants to participants to enable them to pursue programs of independent research, training, and original study, focusing on the experience to be gained by the recipient, rather than on the University’s benefit” (pp.1-2, Harvard University, 2007). This money is taxable, as a student will use this money as a living allowance and not “qualified tuition and related expenses” (The George Washington University, 2009).

Tuition Waiving

“Tuition scholarships are meant to reduce the amount of tuition a student has to pay” (Hamel, Heiberger, & Vick, 1994, p.9). When a university charges tuition remission as a direct cost to a grant funding organization it is “*not considered a scholarship and awards on federal grants are treated as student wages for IRS tax purposes*”, (University of Texas at Austin, n.d.). Between the university and federal grant relationship tuition is a wage, or a “payment involving services”. The university will then, in turn, take that money and “award” it to the student for “qualified tuition and related expenses,” where, for IRS tax purposes it is not taxable to the student. The George Washington University (2009) details:

Individuals who engage in such teaching, research and/or similar activities shall not be paid for these efforts through a tuition credit on their student account or by

being awarded a stipend, although their total support package may include a tuition award and/or stipend. (p.3)

In the university to student relationship the tuition award (a type of fellowship) is not a wage, and is not “payment involving services.”

Summary of Funding

Salary rates for TAs and GRAs vary from department to department. Often it is the dean that decides the annual salary rate within the maximum and minimum rates posted by the human resource department, (University of Texas at Austin, n.d.). Typically a GRA will receive a three-part support package that includes a fellowship from a federal grant (taxable), a salary from the university (taxable) and a tuition award (nontaxable). It is important to note that, in general for S&E, a tuition award is complete remission, referred to as “tuition waving”. Likewise, fellowships are often not considered to be salaries, though they are referred to as stipends. The word stipend is often interchanged with salary, but there is a difference. Salaries are “payments involving services” and are wages. Stipends, although often paid like a salary for living expenses, are for training, but are not “wages” or “payments involving services”. From the viewpoint of S&E graduate students, what they actually receive is normally a paycheck (their “stipend”) from which taxes may or may not have been withheld; they rarely receive a tuition bill with an outstanding balance since that has been waived.

Research University Accounting

North (1995) remarks:

Meanwhile, the low salaries of the RAs and postdocs, who are often foreign born, help perpetuate the universities’ continuing ability to secure high overhead rates

on government scientific and engineering research contracts; we have not seen this linkage suggested before, but it seems an obvious one. (p.127)

Where can one find this linkage? It is not in the research university's so-called "overhead costs"; instead, the linkage is to be found in their "direct costs". Let's take a closer look at university accounting.

How Funding is Found

A primary investigator (P.I.) is a leading research scientist at the university, based on the university's own definition. This person, or support staff will peruse federal websites or lists to determine what funding is available, relevant to the PI's areas of expertise. Among the websites of interest for S&E are: Grants.gov, National Institutes of Health, National Science Foundation, Defense Advanced Research Projects Agency (DARPA), and the U.S. Department of Energy, to name only a few (University of Texas at Austin, n.d.). Once potential funding has been identified, a proposal is written detailing the scope of the research and the associated costs, which are classified either as indirect costs or direct costs. Circular A-21 of the Office of Management and Budget (OMB) defines some of the cost accounting for federal funding. University of Texas at Austin (n.d.) plainly explains, "Thus, determining whether or not a cost incurred by institutions of higher education is allowed to be reimbursed by federal awards (i.e., allowability) is determined in accordance with the provisions of OMB Circular A-21" (section 6.1, p.35). Noll and Rogerson (1997) summarize:

Therefore, not surprisingly, R&D contracts are essentially contracts over inputs instead of outputs. That is, in a research contract, a university promises to make certain types of expenditures and the federal government makes payments on the

basis of cost estimates that are secured by an offer of proof that the university did spend the funds in the way that was promised. (p.5)

Indirect Costs

Indirect Costs were originally referred to as F&A (facilities & administrative) costs in the Circular A-21. A 1996 change to the circular replaced F&A with the phrase “indirect costs” (Goldman, C., Williams, T., Adamson, D.M. & Rosenblatt K., 2000).

These costs are often denoted “overhead” costs by the research universities. The University of Texas at Austin (n.d.) details what these costs are specifically:

Facilities and Administrative (F&A) costs are sometimes called indirect costs (IDC) or overhead costs. These refer to those costs incurred by the university in support of the project that are not easily allocable as direct costs. These costs are usually associated with facility operation and maintenance, utilities and building and equipment depreciation, etc. Most sponsors recognize that universities that conduct research incur these costs in addition to those direct costs that are that are directly allocable and included in a project's budget. And, they have agreed that the portion of F&A costs identified with organized research is distributed by applying a cost rate(s) which is negotiated between the university and the federal government. This process allows the university to recover some portion of the costs associated with conducting research. (p.20, section 4.2.8)

Noll and Rogerson (1997) remark that “nearly a third of federal support takes the form of indirect cost recovery (overhead)” (Abstract). To determine the negotiated rate an audit is conducted by the research university to justify their rate. This audit is reviewed by a funding organization to determine if the rate is correct (Ehrenberg and Mykula, 1999).

The audit is administered according to Circular A-133 “Audits of States, Local Government, and Non-Profit Organizations.” The circular covers the rules grant agencies must follow when they audit the research universities. The negotiated rate is typically that of the main funding organization, for example, the National Institute of Health (NIH) or Office of Naval Research (ONR) (Noll and Rogerson, 1997). Ehrenberg and Mykula (1999) note “Many faculty do not understand that a university is not permitted to over-recover its indirect costs and believe that, at the margin, their grant imposes no extra indirect costs on a university but generates indirect cost recovery for it” (p.5).

“Cost recovery” is an important term, as the research universities believe they do not receive full reimbursement for the research in indirect costs. A July 2000 Office of Science and Technology Policy report notes that “most universities have two rates: the negotiated F&A rate and what many university representatives referred to as their ‘effective’ F&A rate. The effective F&A rate is a reflection of what is actually recovered” (Issue Two: Distribution of F&A Rates by Spending Category, ¶4). A study by the Council on Government Relations (COGR) in 2008 comments a 26 percent administrative F&A cap (the “A” part of indirect costs), imposed in 1991 resulted in under-recovery of reimbursement. The council notes, “F&A costs incurred by universities are real costs of doing research, and caps result in under-recovery of reimbursement, which then forces universities to cover the unreimbursed costs *through other unrestricted revenue sources* [italics added]” (p.10). The requirement to follow such accounting rules created more bureaucracy. Greenberg (2001) summarizes:

With large sums at stake, the intricacies of indirect-cost computation have spawned a subdivision of micro-accountancy with two branches: one, on the

administrative side of universities, seeks to get as much as it can from the federal research agencies that support university science; the other, on the government side, is dedicated to minimizing the expenditures. Looking on, and aggrieved, are the scientists, convinced that “their” money is being squandered for nonscientific purposes. (pp.83-84)

Direct Costs

Geiger (2004) clarifies: “The direct costs of research are separately budgeted and for the most part externally funded. These expenditures thus vary independently from other internal costs” (p.29). Noll and Rogerson (1997) detail further:

On average, approximately seventy percent of a federal research grant to a university consist of so-called ‘direct costs:’ costs that can be easily and nonarbitrarily associated with performing a single research project, such as the salaries of the personnel and the cost of the lab equipment and supplies that are used in the project. (p.2)

They later explain that it is the PI’s have very “...close control over direct costs, and have considerable latitude to the transfer expenditures among categories of direct costs, so that typically there is no large discrepancy between the amount awarded and the amount spent” (pp.18-19). It is important to emphasize here that direct costs include specifically: faculty salaries, student salaries (such as graduate research assistants), university fellowship stipends (when specifically to provide training and approved by the sponsoring agency), tuition remission, fringe benefits, consultants, equipment (specifically for the project), publication costs, travel, computer time, and various others

pertaining to the project, only as allowed by OMB Circular A-21, (University of Texas at Austin, n.d.). It is here that full reimbursement for the specific research is received.

How Funding is Granted

Litwin (2007) defined the process of receiving funding is a peer review process. He details further institutional reputation, and "...proposals that are the highest relative price are more likely to be funded" (p.5). Ehrenberg and Mykula (1999) agree with this opinion, explaining:

Our major finding is that higher indirect cost rates are associated with higher levels of direct and indirect cost funding for institutions that initially are among the largest recipients of federal funding. In contrast, for universities initially in the lower tail of funding recipients, higher indirect cost rates are associated with lower levels of direct and indirect costs funding. (Abstract)

Their research disproved faculty concerns that the higher indirect cost rates were penalizing their funding awards. High indirect cost rates in fact signal to the funding organization that the research university has the infrastructure to provide the quality research the organization seeks. Ehrenberg and Mykula (1999) emphasize, "If a decline in an institution's indirect cost rate is associated with a reduction in its research infrastructure, this may make its faculty members' grant applications less competitive" (p.7). Geiger (2004) agrees stating the academic competitiveness "of universities reflects the quality of the personnel and infrastructure at individual institutions..." (p.239).

Where the Money Is: Direct Costs

Is it possible that, frustrated with their universities' high overhead cost, PIs attempt to decrease their direct costs (the only control they have) by reducing their labor

costs (they believe) in the hope of winning more federal funding? North (1995) states: “The overhead rates of academic institutions and other nonprofit organizations are often cloaked in complex accounting formulae and regulations, but in the end they, like profits in a for-profit context, are what the market will bear” (p.126). How can foreign students be considered “cheap labor” when they are receiving the same stipends and tuition remission as natives? The answer is that they do not.

A Closer Look at Foreign Graduate Student Stipends

Koryto (2006) on the Miller, Johnson, Snell & Cumiskey P.L.C. website interprets the Internal Revenue Service’s (IRS) tax codes for foreign students. It is explained that, due to their “non-resident” alien status, the students by law are considered to be engaged in trade or business and must report those activities as income on tax returns. Although foreign students must file income tax returns, U.S. income tax treaties offer some foreign students more take home pay than their native counterparts.

Tax Treaties

Koryto (2006) also discusses U.S. income tax treaties:

Moreover, all U.S. income tax treaties include provisions exempting income of international students from tax. Treaties may eliminate U.S. tax on (1) payments from abroad for maintenance, education, and training; (2) U.S. or foreign scholarship and fellowship grants, or both; and (3) a limited amount of earned income. However, because the tax treaties are negotiated separately with each foreign country, and many times vary among the various nations, non-resident international students may receive disparate tax treatment. (¶4)

According to the IRS U.S. Tax Treaties Publication 901 some of these countries include:
The People's Republic of China, India, Egypt, Canada, Germany, Japan, and the
Republic of Korea. Table 1 provides a U.S. tax comparison between foreign grad students
to U.S. grad students. For the most part foreign students pay about the same or more U.S.
taxes compared to the U.S. counterparts.

Table 1
Comparative Income Tax Levels for Foreign Grad Students in U.S. Less Than Five Years

(With foreign students filing the 1040NR, and domestic ones the 1040)

Category	Rough %	Pay more or less than comparable U.S. grad students			
		More	About the same	Little less	Much less
Those with dependents (except from India)	8	X			
From India	2		X		
Single Students (about 90%)					
From non-treaty countries*	46	X			
From other treaty countries	6			X	
From India	20		X		
From China, campus jobs	16			X	
From China, fellowships	2				X
Approximate totals	100	54%	22%	22%	2%

* also includes countries with tax treaties that give minimal or no benefits to their graduate students vis-a-vis U.S. grad students. For example, the Thailand treaty gives Thai grad students in the U.S. a \$3,000 deduction for income earned while studying, but they do not benefit from the \$5,700 standard deduction that U.S. students get. Only treaties that give students at least a \$5,000 deduction for campus jobs are included in the other treaty countries category above.

There are five main variables at work here: 1) the fact that these foreign students must file the 1040NR (nonresident) form that usually offers fewer tax breaks than the 1040; 2) the number of graduate students from various countries; 3) the right of only a minority of these students (notably those from India) to claim the standard deduction of \$5,700 each; 4) the right of only a minority to claim exemptions for dependents, again India and ; 5) and the existence of, and the terms of, the various tax treaties. The net balance of all these considerations is estimated above. While the total percentage of graduate students from India and China (not shown above) is drawn from the *Open Doors* report of the Institute for International Education, the percentage estimates are those of David North. IRS Publication 901 *U.S. Tax Treaties* (rev. April 2009) was used to prepare this table. The percentage of students from non-treaty countries and treaty countries was calculated by cross-hatching the *Open Doors* and IRS data.

! Printed with permission David North, August 2010

A Closer Look at Foreign Graduate Student Tuition Remission

The Government Accountability Office (GAO) in 1998 was asked to investigate the practices by the University of California brought to the legislatures' attention through a *Qui Tam* lawsuit. A *qui tam* plaintiff (a “whistleblower”) sues under the False Claims Act. The False Claims Act is a law, which allows an individual not affiliated with the government to “file actions against federal contractors claiming fraud against the government,” (Wikipedia, False Claims Act, 2010). The case, referred to in the GAO report as “pending”, is *Relator v. University of California, (Tax Payers Against Fraud, 1998)*; it was originally filed in 1996, (Phillip E. Benson, Esq. personal communication, February 24, 2010).

Relator v. University of California

The practice investigated was the University of California (UC) charging the federal government the non-resident tuition rate for foreign students for federal research projects. North (2000) explains the issue:

Although the GAO does not say so, virtually all Ph.D. candidates in science and engineering have assistance packages that include waived tuition, with either research projects (usually federal) or the university picking up the tuition costs.

While it is common for state universities to set higher tuition rates for out-of-state students than for state residents, most allow U.S. citizens and green card holders to move from out-of-state status after one year. The universities do not, however, make similar provisions for foreign students on temporary visas. (¶3)

On the surface this practice appears to be acceptable. Foreign students are not residents nor are they green card holders, why should the university alter their policies?

One must not forget the fact emphasized earlier: foreign students (like most native graduate students) pay no tuition as it is typically waived. North (2000) estimates, “the actual billings for the waived tuition and fees of graduate research assistants to the various federal buyers of scientific research run about twice as high as do those for citizens” (§5).

The attorney for *Relator v. University of California*, Phillip E. Benson, Esq. comments via e-mail, “This case was voluntarily dismissed after the Supreme Court issued its decision in *Vermont v. Stevens* which stated that relators (qui tam plaintiffs) cannot sue state entities under the False Claims Act”. He later explained the withdrawal occurred early in 2003 (personal communication, February 24, 2010).

Robert C. Baum v. Deloitte and Touche et al.

Phillip E. Benson, Esq. (personal communication, February 24, 2010) explained since a *qui tam* plaintiff cannot sue the government as found in the Supreme Court decision, it was decided to sue the executives involved. *Robert C. Baum v. Deloitte and Touche et al.* was filed on January 30, 2006. “Deloitte and Touche was named as a defendant because they provided auditing and advisory services to the University encompassing the graduate program issues” (personal communication, March 15, 2010).

The judgment for the second case is as follows: based on the original case, the practice was brought to the government entities attention. Since nothing was done to stop the practice, they apparently have no problem with the practice and it must be allowed – therefore, there is no fraud (Benson, personal communication, February 24, 2010).

Allowing the University of California to receive twice the billings for a foreign student as compared to a native is *not fraudulent* in the eyes of the federal government and the grant

granting institutions. Let's investigate residency for tuition purposes and visa classifications in more detail.

Residency for Tuition Purposes

Residency for tuition purposes has become big business for colleges and universities. In the past decade most states have reduced their funding requiring the institutions to make up the revenue by charging individuals who are not residents of the state higher tuition as they do not pay local taxes. There is a difference between residency for the state and "residency for tuition purposes" (RTP). Though an individual may be considered a resident of the state, they may not necessarily be considered a resident for tuition purposes. Students who have not achieved RTP are referred to by the university as a "nonresident" student or an "out-of-state" student. It is more difficult to obtain RTP than it is to achieve state residency. To reach RTP often the student must maintain a domicile and show intent to make the state their home. A domicile can be a rented apartment or a home ownership. Merely owning property in the state is not considered a domicile. Intent frequently entails the student converting over their documentation (driver's license, voter's registration, car registration, etc.) to their new state as well as paying state income taxes. Typically such criteria must be established for one year. If a student is able to establish RTP the student is referenced as a "resident" student or an "in-state" student.

Visa Classifications

Students often enter the country on F-1 or J-1 visas. The F-1 is for student visas and the J-1 visas are reserved for exchange visitors. Both are considered "non-immigrant", "nonresident", or "temporary" visas as a requirement of the visa the student

must return home shortly after their studies. Entering the country on an F-1 or J-1 visa often removes the student from RTP eligibility. By way of the visa type the student is ineligible to maintain a domicile and show intent. Green card holders are considered “permanent” or “residents” as they are in the process of obtaining U.S. citizenship. Green card holders are held to the same RTP standards as a native student.

Higher Tuition Remission

Aren't PIs concerned that a more expensive grant proposal will reduce their chances of winning funding? Why would they charge the federal government twice the tuition for a foreign student in direct costs (where they have the most control) since this would increase their proposal budget and threaten the funding? The answer is that the PIs have no choice. A University of Texas at Austin memo dated September 5, 2001 distinctly informs their personnel that, under a new policy, all proposals must have tuition remission included. This memo was intended to address the PIs' practice of excluding tuition remission in an attempt to keep their funding proposals competitive and successful. The memo assures university personnel that this practice is an industry standard and the “Proposals that do not ask for tuition remission are often leaving money on the table” (p.2).

Summary of Tuition Remission

It is common practice for state universities after one year of study to move non-resident students (U.S. and green card holders only) to resident status allowing for cheaper in-state tuition. Foreign students are not offered this benefit as they are considered temporary immigrants and are charged the non-resident rate. However, in S&E, foreign and native students often receive complete tuition remission or “tuition

waiving” as this cost can be charged to the federal government as a direct cost to cover the universities’ costs of conducting research. The case *Relator v. University of California* brought attention to the practice of the UC system charging the federal government the higher non-resident tuition rate for foreign students as opposed to the cheaper in-state tuition rate.

A North (2000) summarizes the concern:

UC does not argue that is costs more to educate aliens than citizens, nor does it contend that it is good public policy to spend more on aliens than citizens, *it simply has taken advantage of loosely-written federal guidelines to extract more money from the U.S. Treasury* [italics added]. (¶4)

The case *Robert C. Baum v. Deloitte and Touche et. al.* later found in 2006 the practice was not fraudulent in the eyes of the federal government.

Background

Doesn’t admitting a large amount of foreign students ultimately increase a research university’s indirect costs by way of international departments and other such specialized programs to help foreign students acclimate? Yes, but as found earlier, faculty are frustrated by indirect costs. They believe the higher rate removes funding from their projects, reduces their chance to win funding, and their projects should not cover basic university costs. The Pennsylvania State (n.d) website spoke plainly to faculty:

Whether they recognize it or not, faculty experience the benefits of the F&A [indirect] cost recovery every day -- when they turn on the lights, when their graduate student gets paid, when they order a piece of equipment, when they ask for a time extension on their project, when they file an invention disclosure, when

they pick up the telephone, when they use the library, when they ask a staff assistant to type up a report, when they get on the Internet . . .(Concluding Remarks, ¶2)

Likewise North (1995) found that most foreign students already had a higher education degree before they entered their educational program. Kannankutty and Burreilli (2007) agreed: “Immigrants whose highest degree was a U.S. master’s or a doctorate were more likely than those with bachelor’s degree to come for educational opportunities” (p.7). These foreign students are the cream of the crop from their countries. As Geiger (2004) pointed out previously: “Universities have thus enlarged and improved the supply of qualified applicants by substituting highly qualified international students for lower-ranked (or nonexistent) domestic ones” (p.19). Though the S&E departments are admitting students that do require specialized services they are getting exceptional talent at bargain-basement prices.

Research Microeconomics

Microeconomic theory examines various forms of market structure that are ranked according to a company’s ability to set the price of its product or service. These market-structure models range from perfect competition (where many small firms produce identical products and have no control over the price) through monopolistic competition (many small firms making different versions of the same product and having some limited pricing power) and oligopoly (a few dominant companies with substantial pricing power) to pure monopoly (a unique single supplier having total control over the price). To complete the taxonomy, it may be noted that a monopsonist is defined as the exclusive or dominant *buyer* of a product --the demand-side counterpart of a monopolist. Given the

pivotal role of federal funding in academic research, it appears that the U. S. government is a quasi-monopsonist in that market (Mankiw, 2001). Described below is an explanation of the research market, and research labor economics.

The Research Market

Geiger (2004) agrees with Ehrenberg and Mykulas' (1999) findings. Geiger summarizes the research market:

Academic research constitutes an administered market with unique characteristics. When viewed as a part of national R&D, it dominates the sub sector for basic research. In this market, university scientists are the sellers of research; outside funders are the purchasers. The service for sale – research – is priced at cost, direct costs in this case being defined by conventions, with a mark-up allowed for indirect costs. The crucial element in these transactions is the quality of the researcher proffered. Purchases seek to maximize the quality of the investigations they support; scientists compete for this support chiefly on the basis of the quality of the research they propose. (p.249)

He later depicts the market as “beautifully efficient”. Buyers and sellers know one another extremely well. The efficiency is from units within the federal government independently purchasing a small portion (two percent) of research. The combined total is 60 percent. Litwin (2007) took Geiger’s explanation and attempted to classify the market economically.

Litwin (2007) defined the research market as either an oligopoly or monopolistic competition and not perfect competition or monopsony-perfect competition. He explains how one may find the market monopsony-perfect competition “...monopsonist, having

perfect knowledge of the performer's costs, would alter market conditions to ensure that it earned all available profits, thereby removing welfare loss from the market" (p.7). As evidence that the market is not perfectly competitive, Litwin cites an Energy and Commerce Committee, 103rd Congress minutes where the imposed overhead rate on the market was intended to prevent some universities from earning excessive profits. Later he discounts monopsony-perfect competition completely by stating "...the primary operational model in the research market is that universities can earn profits by conducting research" (p.7).

Research Labor Economics

Foreign graduate students provide a research university not necessarily "cheap labor" but rather "revenue enhancement" since the PI's can be required in their research budgets to bill the federal government double the tuition for a foreign student compared to a native. Of course, research proposals are often prepared before the graduate assistants have been selected individually. How is this handled? The University of Texas at Austin (n.d) advises for salaries:

If personnel are included in the budget on a "to be determined" basis, (not actually employed at the university when the proposal is submitted), be sure they are included and justified in the research plan, and use accurate salary information based on the titles... (Section 7.1.1, p.41)

Rutgers (2009) recommends for tuition remission "When budgeting, assume all tuition remission and fees are for out-of-state students" (Section 82000 Student Aid - Out-of-State Tuition Fees). UC, Davis (2009) instructs in their Nonresident Tuition Remission Policy (NRTR) "If the granting agency considers nonresident tuition to be an allowable

expense, then NRTR must be charged to the fund source that provides the GSR's salary. This category includes most federal agencies such as NIH and NSF” (Section 2 Consistency, Subsection Exceptions, #1). The *ex ante* allocation for research assistants is; the PI probably budgets the tuition remission rate for the student they hope to admit and uses the dean’s GRA salary figure. If the grant is awarded, the indirect and direct costs are now ready to be charged to the grant funding organization.

Foreign Student Labor

Consider a foreign student who becomes a research assistant receiving nonresident tuition remission. Let us “follow the money.” The funding organization has reviewed and funded a research proposal in which an aggregate bloc of money is modularly budgeted and labeled “direct costs”; but the university sees the expenditures in detail, line item by line item. The student is charged the nonresident tuition; however, a deduction is provided to their account paid by their department as the grant has reimbursed the tuition. The university captures the additional tuition money because as found previously public university tuition charged covers only a fraction of the costs as it is subsidized by American society.

The university is happy because they have achieved additional revenue from the foreign student. The PI is also happy since visa restrictions guarantee that foreign research assistants are semi-captive employees. They cannot get a full time job and leave the university completely (Rao, 1995) taking the valuable training their professor provided them with. Though they can move their visa to another university they have already built a relationship with their current university and professor, to whom they tend to be loyal.

In summary, graduate research assistants receive valuable training, which is potentially “portable” to another campus or to a job. If the graduate student in fact decamps with this training prior to graduation, it could be said that the university and the PI were unable to appropriate all the benefits of the training they provided –a situation that economists label an “externality,” a disincentive to using graduate students as research assistants. However, the preceding analysis shows that portability is much less feasible or practical for foreign students than for their native counterparts.

Native Student Labor

In the case of an out-of-state native graduate research assistant, the university still enjoys the higher tuition remission rate. If the state allows after a year for the native student to become an in-state resident for tuition purposes that doesn’t help the university’s direct costs as much as the admission of a foreign student does. A student is not considered key personnel so citizenship does not require a budgetary adjustment. A simple call by the PI to the university’s support department reallocates that money slated for the nonresident tuition remission to another direct-cost line item such as equipment or travel. Future grant money is now reduced as the tuition remission is at the lower “direct cost” rate. Perhaps the native student decides that they are unable to pay their bills on the modest salary they were awarded. Unlike the foreign students, they can leave the university and get a full time job, possibly imposing a considerable externality cost on the PI. In short, native students do not have immigration restrictions to keep them as loyal as a foreign student to their employer the university.

The Glut

A “general glut” in macroeconomics occurs when supply exceeds demand (Wikipedia, General Glut, 2010). It is a glut the NSF in the mid-to-late 1980s had hoped to create by increasing their labor supply through the admission of foreign students.

Benderly (2010) focuses on those that benefit from the science:

The groups that benefit from the science labor glut include senior professors, who receive the great bulk of federal grant funding, and the research universities that employ them (and the graduate students and postdocs) while receiving overhead payments from the grants. (¶47)

Greenberg (2001) points out: “For decades, the reproductive urge in science and engineering was abetted by policies that sanctified and subsidized the training of doctoral students, with little or no regard to their employability, except as cheap labor in the academic research system” (p.89). Indeed there is a detachment from the job market. Greenberg cites a 1995 Stanford Institute for Higher Education Research study, which concluded (as cited by Greenberg, 2001) that:

the natural production rates of doctorates is driven by departmental needs [in universities] for research and teaching assistants, and that departmental doctoral-student intake is limited by financial constraints rather than output market considerations....Faculty tend to believe that more scientifically-trained manpower is better than less, and that job opportunities will materialize somehow...In any case, the department’s shortrun requirements for inexpensive research and teaching labor, and the desire of faculty to replicate their own skills,

is of stronger relevance to admissions decisions than the more abstract and distant concept of labor market balance. (p. 145)

Benderly (2010) asks, “So what can be done to rescue the American scientific labor market from self-destruction” (§54)? She is pessimistic, but offers a solution:

There has been relatively little attention given to possible solutions for the scientist glut – in no small part because the scientific establishment has been busy promoting the idea that the U.S. has a shortage of science students. Any change in the science labor market would, of course, require dismantling the current system and erecting something that would value young scientists for their future potential as researchers and not just for their present ability to keep universities’ grant mills humming. This would mean paying them more and exploiting them less. It would also mean limiting their numbers by both producing and importing fewer scientists, so incomes could rise to something commensurate with the investment in time and talent and the high-level skills of a Ph.D. ” (§55-56)

Greenberg (2001) believes research universities are caught in a cycle they do not want to break. A cycle which began in the World War II postwar years:

That faith, in tandem with the labor requirements of an expanding research system, inevitably produced that recurring paradox of the postwar years: bigger budgets for research and training leading to greater financial cries in the community of science. More money for science was deified as indispensable to national well-being by the National Academy of Sciences, the National Science Foundation, and the lobbying associations working in Washington for the universities that awarded the bulk of the graduate degrees. More money for

science education at all levels, but especially for graduate training, was a basic part of their prescription for assuring American leadership and safety. With access to the congressional and executive agencies that ultimately controlled the money they sought, these organizations – disputed by few if any dissenting voices – sketched the reality that guided the politics of science. (p.90)

The glut created by the NSF and enjoyed by research universities causes one to ask – Will there ever be enough money for research universities? Greenberg (2001) doesn't think so as there is no established way to correlate the direct relationship between the money spent and the achievements in science. There is one measureable method he explains:

The volume of money, however, is countable, and comprehensible to scientists, politicians, and the public. Understood by all is the necessity of money for the training and well-being of scientists and the nurturing and advance of science. In the politics of science, the golden ages of sciences are thus usually equated with money, not with discovery, though the underlying assumption is that more money will produce more science. (pp.59-60)

Despite the S&E glut Borjas (2004) found research universities crowd out native students in admissions.

Crowd Out

Is it possible research universities are selecting to admit foreign students over natives because foreign students are “revenue enhancers”? Borjas (2004) summarized a university's admission decisions:

A university's decision to admit additional foreign students to its graduate program obviously depends on many factors, including the relative quality of the applications, the possibility that foreign students pay for a higher fraction of their education, the widespread adoption of the axiom that "diversity" is beneficial in a university setting, and the relative marginal products of the foreign and native students as employees of the university (since many graduate students typically work as research assistants or teaching assistants). Some of these factors may imply that, other things being equal, admission officers would prefer to admit a foreign student over a native-born applicant. (pp.3-4)

It has been emphasized earlier foreign students are not paying a higher fraction of their education, but rather they are often receiving complete funding. The University of California is gaining twice the tuition remission from federal grants for a foreign student than a native. This led the North (2000) to ask, "Does this cause the University of California to tilt toward admitting more foreign students" (¶5). Though Borjas (2004) did not mention this practice, he did find that "The evidence presented in this paper documents a strong negative correlation between the enrollment of white native men in graduate programs and the enrollment of foreign students" (p.14). Earlier he explained, "After all, the greatest declines in the enrollment of white native men occurred at high-quality institutions" (p.14). Based on current enrollment at research universities, does a university's RTP policy allow them to expend more money on research? We now turn to the evidence on this question.

CHAPTER III: METHODOLOGY

The data will be used for a study on the institutions of interest to determine if their RTP policy enables more R&D expenditures. To conduct the study qualitative institutional data will be collected combined with information from public databases.

Qualitative Institution Data

The decision in *Robert C. Baum v. Deloitte and Touche et al.* found that the University of California's practice of receiving twice the billings for a foreign student as compared to a native is not fraudulent in the eyes of the federal government and the grant funding institutions. The practice was achieved by the strict following of the state's residency for tuition purposes policy as defined by the Regents of the University of California under the California Education Code. The policy qualitative data will give an insight to other research universities and the possibility they are practicing these guidelines, as it is not fraudulent to do so. North (2010) summarizes best why the actual direct cost data or the Nonresident Tuition Remission (NTR) policy was not collected by the thesis candidate:

As to the practices in other state universities, finding out what such universities charge to federal agencies regarding NTR is a bit like learning the sex of an unborn baby in the womb of a woman not known to you. It is potentially

knowable, but only after a series of some awkward and not-always successful conversations. (p.5)

Direct cost billing practices can vary from department to department within an institution. Though a university may have guidelines as to how a PI should handle budgeting, the guidelines are mere suggestions. As long as the PI's budgeting does not conflict with Circular A-21, the PI has freedom to budget as they feel necessary. In the interest of obtaining documentable data, the thesis candidate chose to collect RTP data rather than the direct cost data as the RTP data can be found clearly detailed on the institution's website. Likewise finding a knowledgeable individual on the topic at the institution was considerably easier as often the institutions had a Residency Office under the control of the Registrar, which employed an individual entitled "Residency Officer". It was this person who was required to be the expert on residency for tuition purposes on state laws. This was not the case with NTR, which would create noise in the data, as the policy variation was vast. The requirement to follow state law is concise and clear.

Institutions of Interest

The 2005 Carnegie Classification system found there are 96 research universities (RU), which are very high research (VH). The Carnegie Classification system established 103 research universities are high research (H). These institutions are the "institutions of interest" in the study providing a total of 199 institutions allowing for flexibility of sample size. Though data collection did occur for 199 institutions, only the RU/VH intuitions were investigated for analysis. The data for the RU/VH institutions is provided in Appendix A.

The following policy information was gathered from the institutions of interest pertaining to their graduate student population only:

- Can an out-of-state native student achieve residency for tuition purposes during their graduate student career?
- Can a foreign student on an F-1 or J-1 visa achieve residency for tuition purposes during their graduate student career?
- Does the department pay the out-of-state/in state tuition difference?
- Is there a cap in their state on nonresidents?

The data points were obtained either from scouring the respective institution's website, a governing body's website, or through personal communication (phone or e-mail) to a university representative to complete the entire data group of 4 data points for the institution or state. If a phone survey was required to obtain the data point the phone survey document was used as a record of the discussion and phone call attempts. The phone survey document was used for the data group and not separated into individual data points. Detailed below are the collection techniques used for the residency for tuition purposes, department tuition difference, and the enrollment cap data points.

Residency for Tuition Purposes Data Collection

Forty public institutions belonged to states, which determined RTP through state statutes or law. Since it was state law that was investigated for data collection, once the data group for the state was collected, the data point was applied to all the institutions for that state. Eleven states allow their individual public institutions autonomy to determine

their RTP guidelines. Twenty-three universities from the institutions of interest fell into an autonomous state. In total – 63 data groups containing 4 data points were collected.

Profile of a Native Graduate Student

Students can obtain residency for tuition purposes through a variety of methods. For apples to apples comparison between native out-of-state students and foreign students a centerline between the two types of individuals was created. The only different between the two student types was a visa requirement and citizenship. To ensure consistency with data collection a profile for a hypothetical student was documented. When interpretation of the state law was necessary the profile was available on hand for review to determine if the hypothetical student fell within the requirements. The profiles used for both the native out-of-state student and the foreign student are provided below.

Native Out-of-state Student Profile

- I am a 23-year-old married individual. I am not a military veteran and I am not currently serving in the armed forces. I do not qualify as an under representative minority. I do not qualify for a regional tuition waiver.
- I moved to the state with my spouse solely to attend graduate school. It is my intent to become a resident of the state. My parents are not residents of the state nor did they attend this college.
- According to FAFSA (Free Application for Federal Student Aid) my dependency status is INDEPENDENT.

- After a year I pay taxes to the state, I registered to vote in the state and I have obtained a state driver's license. I rent an apartment in the state. I do not qualify for a regional tuition waiver.
- I entered graduate school as a full-time GRA. I am not considered an outstanding student. I will attend for my Master's degree with the hope to continue on for my Doctorate. I will be going to graduate school full-time which is registered for 9 credit hours each semester.

Foreign Student Profile

- I am a 23-year-old married individual. I do not qualify as an under representative minority.
- I moved to the country with my spouse and into the state solely to attend graduate school. I have a J-1 or F-1 visa while my spouse has a J-2 or F-2 visa. It is my intent to become a resident of the state if possible. My parents are not residents of the state nor did they attend this college. I do not qualify for a regional tuition waiver. The foreign city I am moving from is not a sister city or has a sister province relationship with the intuition's city I am moving to.
- My dependency status is INDEPENDENT.
- After a year I pay taxes to the state and I have obtained a state driver's license. I rent an apartment in the state.
- I entered graduate school as a full-time GRA. I am not considered an outstanding student. I will attend for my Master's degree with the hope to continue on for my

Doctorate. I will be going to graduate school full-time, which is registered for 9 credit hours each semester.

Though the collection methods were the same for universities, which followed RTP under state laws, and universities in states, which provide autonomy, institutional focus varied. State controlled universities did not require specific universities to be investigated for their policies as the guidelines were state laws where autonomous universities required data collection for their specific campuses.

State Control

The term “Residency for Tuition Purposes” followed by the state name was searched using Google. It was assumed if the institution took the care to provide enough RTP details to rank high on Google then they must have the staff and resources knowledgeable on the RTP state laws. Documentation from the university’s website was downloaded and filed for review to determine if the hypothetical students could achieve RTP. If the website documentation was not detailed enough to determine if the student could achieve RTP, a phone call was placed to an individual listed on the website as a “Residency Officer” or documented as a person to contact for “more information” regarding RTP. The data collected via this method were documented on the phone survey document. At times the individual was not reachable by phone, or suggested another university official who could answer the missing qualitative data point. If either method was unfruitful, an e-mail was sent to a university official to collect the answer. When a university did not provide support to help answer the missing data point, a different university in the state was attempted. The data collected were based on state law and its interpretation for the institutions under state control. Therefore, the data point is the same

for all universities located in that state. Contacting a different public university provided the same state law interpretation. This was not the case for the universities provided autonomy in their state.

Autonomy

Eleven states allow the individual institutions autonomy to determine their RTP guidelines. These states include: Michigan, New Hampshire, Indiana, Illinois, Louisiana, Maryland, Massachusetts, Arkansas, Nebraska, Vermont and Wyoming. Unlike the universities under state control where several campuses could be contacted to collect the missing data point, in this case the specific institution had to be covered. Some universities in the institutions of interest did fall under a university system whose Board of Trustees' dictated the institutional policies. The institutions are: The University of Illinois System (2 campuses), Purdue University System in Indiana (2 campuses), Louisiana State University System (2 campuses), and the University System of Maryland (2 campuses). Similar to the state control universities if one institution's website was not detailed or their staff was not helpful another campus in the system could be investigated for the missing data point. Any data found by a phone survey were documented using the phone survey document.

Enrollment Cap Data Collection

Enrollment cap data were never available on the universities' websites. Though internet searches did provide newspaper articles offering insights to the states which posed enrollment caps, e-mail was still used most to gather this data point. Often the question was directed to the admissions department and in particular the graduate admissions department if the university had such an office. When the website did not

provide a specific individual to contact for admission questions the general e-mail was used. Any enrollment data found through a phone survey, the phone survey document was used.

Department Difference Data Collection

To gain a glimpse as to specifically what the universities may be charging to the federal government for tuition remission as a direct cost, the data point of “Does the department pay the in-state/out-of-state tuition difference” was collected. Any S&E departments in the university were eligible for the data collection. The selected department ranked first from the RTP search. The following search terms were applied to gather this data point from the institution’s website:

- graduate research assistant
- graduate student manual
- assistantship
- research assistant tuition
- graduate tuition remission

If the website was not helpful in providing perception into if whether or not the university did allow individual departments to pay the in-state/out-of-state tuition difference phone calls were made to an actual S&E department in the university. Often the department selected was the Electrical and Computer Engineering Department as this department is most familiar to the thesis candidate. If a staff member could be easily identified from the department’s website as a person who directly worked with graduate research assistants a

phone call was made to this specific person using the phone survey document. Otherwise an e-mail was sent to their contact information listed to collect the missing data point.

Public Databases

The institutions of interest in this study include research universities labeled by the Carnegie Classification System as very high research activity (RU/VH) and research universities that are high research activity (RU/H). Though RU/H university data were collected focus was on RU/VH colleges and universities. Key data sources were the Integrated Postsecondary Education Data System (IPEDS) and publicly available NSF data in the Computer-Aided Science Policy Analysis and Research on the Web (WebCASPAR) and Scientists and Engineers Statistical Data System (SESTAT) databases.

Integrated Postsecondary Education Data System

The National Center for Education Statistics' (NCES) core postsecondary educational data collection program is the Integrated Postsecondary Education Data System (IPEDS). The IPEDS Data Center User Manual (n.d.) explains "Information is collected annually from all providers of postsecondary education in fundamental areas such as enrollments, program completion and graduation rates, institutional costs, student financial aid, and human resources" (p.1). Two data sources were examined; the first utilizing NCES' QuickStats and The 2007-2008 National Postsecondary Student Aid Study, the second, the trend of a variable from the IPEDS data center.

2007-2008 National Postsecondary Student Aid Study

The Postsecondary Student Aid Study queries both *graduate* and *undergraduate* students.

However, the data group selected is graduate and first-professional students when interviewed in 2008. The following variables were studied:

- Legal residence
- Citizenship
- Institutional aid total
- Tuition and fees minus all grants
- Graduate research assistantship amount
- Cumulative amount borrowed for grad
- Prior degree
- Job: Have job prior to enrollment at NPSAS school
- Job: Number (exclude work study or assistantship)
- Number of Jobs (include work study or assistantship)
- Job: Type of employer
- Job: Can afford school without working
- Job affects school: Limited the class schedule
- Carnegie: Basic Classification (collapsed): Doctoral/Research

- Field of study: STEM focus
(Math/Computer/Sciences/Engineering/Technologies)

Though the data provided by NCES are averages or aggregates from the original survey, it provided insight into institutional aid (which can be charged to a federal grant as a direct cost) as well as an indication of the background of the students attending the institution.

Trend from the IPEDS Data Center

To create an enrollment trend the data available between the years 1980 to 2008 will be used.

- Fall enrollment
- Level of student: Full time student total & Graduate
- Race/ethnicity: nonresident alien total
- Race/ethnicity: grand total
- Carnegie: Basic Classification (collapsed): Doctoral/Research

The total fall enrollment trend line provided a historical reference to understand enrollment occurrences before and after key events in history.

National Science Foundation

The NSF's office of Division of Science Resources Statistics (SRS) fulfills a legislative mandate of the National Science Foundation Act to (as cited in NSF a.) "...provide a central clearinghouse for the collection, interpretation, and analysis of data on scientific and engineering resources, and to provide a source of information for policy

formulation by other agencies of the Federal Government...” (§2). The NSF further explains:

To carry out this mandate, SRS designs, supports, and directs about 11 periodic surveys as well as a variety of other data collections and research projects. These activities yield the materials for SRS staff to compile, analyze, and disseminate qualitative information about domestic and international resources devoted to science, engineering, and technology. (§3)

The surveys of interest in this study are the surveys of Earned Doctorates, Federal Science and Engineering Support to Universities, Colleges, and Nonprofit Institutions, Graduate Students and Postdocs in S&E, and R&D Expenditures at Universities and Colleges.

Survey of Earned Doctorates

The Survey of Earned Doctorates (SED) provides annual first-hand data of doctorate recipients receiving a research doctorate (NSF b.). Public data are available on the WebCASPAR database for years 1966-2006. The key variables of examination are:

- Academic Institution
- Institutional Control
- Citizenship
- Academic Discipline Broad (standardized): [STEM focused] Engineering, Physical Sciences, Geosciences, Math and Computer Sciences, Life Sciences
- Carnegie Classification (standardized): Research I

The public data on this survey extends to 1966 which will provide insight for trend analysis. A comparison between the two types of institutional control: public and private was investigated.

Survey of Graduate Students and Postdocs in S&E

An annual survey given to the academic departments, it “provides data on the number and characteristics of graduate students, postdoctoral appointees, and doctorate-holding non-faculty researchers in science and engineering (S&E) and health fields” (NSF c., ¶ 1). Data from this survey are available in the WebCASPAR data system for years 1972-2007. The key variables to be investigated are:

- Citizenship
- Primary source of support (e.g., by specific federal agency)
- Primary mechanism of support (e.g., fellowship, research assistantship)
- Academic institution name
- Institutional control (public vs. private)

Institution specific scrutiny from this data can enhance the discernment of which institutions may be experiencing revenue enhancement by way of charging the federal government higher direct costs through the primary mechanism of support. Similarly the data can explain which federal agencies are providing the most revenue enhancement.

Survey of R&D Expenditures at Universities and Colleges

Known as the academic R&D expenditures survey, it has been conducted annually since 1972. Unlike the Survey of Federal Science and Engineering Support to Universities, Colleges, and Nonprofit Institutions which investigates R&D inputs, this evaluation considers R&D expenditures or (outputs) by querying the U.S. universities,

colleges, and federally funded research and development centers (NSF d.). Noll and Rogerson (1997) explained "... in a research contract, a university promises to make certain types of expenditures and the federal government makes payments on the basis of cost estimates that are secured by an offer of proof that the university did spend the funds in the way that was promised" (p.5). The key variables to examine institutional specific R&D expenditures are:

- Federally funded expenditures by S&E field and federal agency
- Academic institution/FFRDC

Survey data from 1972 are publicly available at the WebCASPAR data system to 2008.

Analytical Techniques

Five research questions will be explored in detail to determine if a university's RTP policy allows more expenditures for research.

Question 1

What is the residency for tuition purposes policy for the institutions of interest?

The qualitative data were collected following the methods outlined and an evaluation of variables from the NCES database provided the answer to this research question. In particular the variables from NCES' DataLab QuickStat were used with The 2007-2008 National Postsecondary Study Aid as the data source. The data provided by NCES are averages or aggregates from the original survey, which is how the respective tables were assembled.

Question 2

What is the trend for foreign student enrollment for the past several decades? The variables from the IPEDS Data Center were used to investigate this research question.

Native and resident (permanent) student enrollment will be derived by subtracting the nonresident alien total from the grand total number as IPEDS does not allow the option for selection of native and resident (permanent) in the Race/ethnicity variable. The trend from 1980 to 2008 was plotted for evaluation around key historical events. For instance Vaughan (2007) noted the IIE claimed there was a dip in nonresident (foreign) student enrollment after the September 11th terrorist attacks. The trend will provide insight as to whether or not this dip did occur.

Question 3

What is the background of the students (citizenship detailed) doctoral and research institutions are receiving in STEM fields? Using data from NCES particularly from the source: The 2007-2008 National Postsecondary Study Aid offered a suggestion on the quality of students the institutions are admitting into graduate school. North (1995) explains, “One hears abundant comments from science and engineering faculty members that the foreign born students come to graduate school with good preparation and good work habits. Many have done some graduate work in their home countries before they arrive in the U.S., as well” (p.74). An investigation for student background will offer evidence on the claims that foreign students are better prepared.

Question 4

Is there a connection between universities' R&D expenditures and their RTP policy? A matrix containing the qualitative data collected and two combined NSF surveys: Survey of Graduate Students and Postdoctorates in Science and Engineering and the Survey of Research and Development Expenditures at Universities and Colleges were the data sources for the regressions. Three log linear regression analyses were performed.

The first examined a model incorporating just three independent variables: the log of all graduate students, the log of all foreign graduate students, and control type. The second extended the regression one model to include the institutional data, adding the independent variables: enrollment cap, RTP for native students, RTP for foreign students, the number of Department of Agriculture (DOA) research assistants, and the number of Department of Energy (DOE) research assistants. Based on the results from the second regression, the third model expanded upon the first by changing the dependent variable from federal R&D expenditures to only all R&D expenditures.

Question 5

What is the trend for foreign student doctorate recipients for the past several decades? The variables of concentration were obtained from the NSF's SED data available on the WebCASPAR data system for the years 1966 to 2006. The trend line of earned doctorate in STEM fields was plotted for evaluation. A comparison between the two institutional control types will be conducted. What are the answers to these research questions? We now turn to the results of the study.

CHAPTER IV: RESULTS

Combining the publicly available data with the qualitative institutional data provided an interesting insight into the market of research universities. Appendix A summarizes the sample and their respective qualitative data collected. The research questions' results are analyzed in detail below.

RTP Policy for the Institutions of Interest - Question 1

Residency for tuition purposes data was collected only. What is specifically charged as a "direct cost" was not collected. That decision is something that can differ from university to university. The data are gathered by referring to state law and in some cases institutional policy (in the autonomous states). State law is more exact and reduced "noise" in the model as often the institutions employed a "Residency Officer" whom, as a requirement for their job, had to be familiar with the state's latest residency laws. Likewise it is the interpretation of the state's residency policy, which was the core of the UC lawsuits. It was the focus on the state's residency laws the University of California at Davis followed in detail. UC cited these laws as an explanation as to why it was acceptable to charge the federal government twice the billings for a foreign student, (North, 2000). This is why the residency data is not noisy. North's 2010 report acknowledged the difficulty in obtaining the data and provided in his Table 2 the few institutions he could collect.

Table 2 compares the collected qualitative institutional data with North's collected "direct cost" data.

Table 2
A Comparison Between Qualitative RTP Institutional Data and North's 2010 Direct Cost Data

Institution	North's Direct Cost Data	RTP Data	Match?
			X
University of California at Davis	Different	Different	
Cornell University	Same	Different	
University of Michigan	Same	Same	X
University of Maryland	Same	Same	X
Pennsylvania State	Same	Same	X
Delaware	Same	Same	X
University of North Carolina at Chapel Hill	Same	Same	X
Ohio State	Same	Different	
University of Minnesota	Same	Same	X
University of Virginia	Same	Different	
Virginia Tech	Same	Different	
University of Colorado	Same	Different	

* reprinted with permission from David North.

Seven of the 12 institutions have matching residency and "direct cost" data providing for 58% accuracy. Though 5 data points do not match, it is important to note that the University of Colorado, and the institutions: the University of Virginia and Virginia Tech, all have out of state student enrollment caps in their states. The results from the qualitative data collection are provided in Table 3.

Table 3
 Qualitative Institutional Data Results
 Very High Research (RU/VH) Institutions

89%	allow out-of-state natives to obtain in-state tuition
60%	allow foreign students to obtain in-state tuition
11%	impose out-of-state student enrollment caps
35%	are considered IIE leading institutions
45%	Of the 11 institutions which impose out-of-state student enrollment caps, 5 are IIE leading institutions
High Research (RU/H) Institutions	
85%	allow out-of-state natives to obtain in-state tuition
53%	allow foreign students to obtain in-state tuition
9%	impose out-of-state student enrollment caps
6%	are considered IIE leading institutions
0%	Of the 9 institutions which impose out-of- state student enrollment caps, 0 are IIE leading institutions

For the most part RU/VH and RU/H institutions allow an out-of-state native student to obtain in-state tuition. The percentages are 89% and 85% respectively. The results are similar regarding foreign students providing in-state tuition 60% of the time from RU/VH and 53% at RU/H colleges and universities. Though they are not considered “residents for tuition purpose” in most states being a GRA itself allows the in-state tuition rate. The “loop hole” often cited is that the student, as a GRA, is an employee of the university. As per the university’s guidelines – all employees receive in-state tuition. It is assumed another reason the universities charge the lower tuition rate for GRAs is because they believe the lower value when used for grant budgeting will allow their proposals to be more cost competitive. Though Litwin (2007) as well as Ehrenberg and Mykula (1999) found the grant process is peer reviewed and budget quantity does not affect awarding, this misconception is rampant in academia. Only 11% of the RU/VH and nine percent of the RU/H schools impose an enrollment cap on out-of-state graduate

student enrollment. Thirty-five percent RU/VH and 6% HR schools are considered IIE leading institutions. This acknowledgement is awarded by the IIE to those schools which have high foreign student enrollment. Of the RU/VH universities in states that impose an enrollment cap (11), 45% (5) are considered IIE leading institutions. Regarding HR colleges and universities, nine fall into states which impose enrollment caps. Of those colleges and universities zero percent are considered IIE leading institutions. This indicates enrollment caps at RU/VH institutions do not affect their foreign student enrollment figures. The qualitative data point: "Does the department pay the out-of-state/in state tuition difference?" is not listed. A detailed discussion of this point follows.

A Closer Look at: Does the department pay the out-of-state/in state tuition difference?

Regarding the qualitative data point: Does the department pay the out-of-state/in state tuition difference? This is a very noisy data point. Though it was collected it, using it in an analysis was concerning. It was collected because the thesis candidate wanted an idea as to what the universities are charging to the federal government as a direct cost. Paying the difference has to come from somewhere. With the exception of Kansas who made it clear the university pays for any tuition difference most get the money through research grants. In fact, conversations with various departments or reading their manuals specifically stated that GRAs are covered by grant money. For instance the Wayne State University website details:

In most cases, GRAs are paid from non-general fund accounts, i.e. grants or sponsored program accounts. The Graduate School receives funding to pay tuition for only a specific number of general fund positions. The tuition scholarship money is to be used for only those positions. (About Tuition, Question 12).

Since this data point is noisy, extra detail is explored from NCES in the matter of citizenship specifics. Data from the 2007-2008 National Postsecondary Student Aid Study was the source. NCES only allowed for two filter options. It is noted for each figure how the filtering was handled. Residency, institutional aid, tuition, total grants, and debt amount are discussed below.

Residency of Graduate Students

Figure 1 finds U.S. citizens do attend colleges and universities in the state in which they meet legal residency requirements. Foreign students, obviously, do not. Filtering was focused to STEM focused fields of study and Carnegie schools under the 2000 classification of public doctoral, private doctoral.

National Center for Education Statistics PowerStats

Attend institution in state of legal residence by Citizenship, for Field of study: STEM focus (Math/Computer/Sciences/Engineering/Technologies) and Carnegie code (2000) with control (Public doctoral,Private nfp nondoctoral except lib arts,Private nfp doctoral and liberal arts).

	Yes (%)	No (%)	Foreign or international student (%)	Total
Estimates				
Total	47.5	20.6	31.8	100%
Citizenship				
US citizen	71.6	28.4	0.0	100%
Resident alien	51.6	48.4	0.0	100%
Foreign or international student	0.0	0.0	100.0	100%

NOTE: Data users who plan to compare student loan estimates from NPSAS:08 with prior years should be aware that the data on Stafford loans are currently only directly comparable with NPSAS:04. For more information, visit <http://nces.ed.gov/das>.

The names of the variables used in this table are: STEMMAJ, CITIZEN2, SAMESTAT and CC2000A. The variable names are unique identifiers. To locate these variables, enter the variable name in the search box.

Source: U.S. Department of Education, National Center for Education Statistics, 2007-08 National Postsecondary Student Aid Study (NPSAS:08).

Computation by NCES PowerStats on 8/27/2010.

Figure 1. Full-time graduate student enrollment. U.S. citizens often select to attend school in their home state. Foreign students obviously do not.

Institutional Aid Total

When total institutional aid is investigated (Figure 2), foreign students do receive slightly more aid than US natives. The data was filtered to Carnegie schools classified under the basic system: research and doctoral, and STEM focused fields. Interestingly

resident aliens do not. This chart matches Beavis and Lucas (2007) and North's 1995 and 1998 findings that foreign students enter S&E fields as often they receive high institutional aid and tuition & fee waivers in this area of study. However, the chart hints the direct cost tuition remission charged to a federal grant is more often than not the same amount.

National Center for Education Statistics PowerStats

Average Institutional aid total, average Institutional tuition & fee waivers by Citizenship, for Carnegie: Basic Classification (collapsed) (Research & Doctoral) and Field of study: STEM focus (Math/Computer/Sciences/Engineering/Technologies).

	Institutional aid total (Avg)	Institutional tuition & fee waivers (Avg)
Estimates		
Total	13,116.7	2,209.9
Citizenship		
US citizen	12,838.2	2,110.2
Resident alien	5,444.8	868.7 !!
Foreign or international student	15,179.6	2,668.4

!! Interpret data with caution. Relative standard error (RSE) > 50 percent.

NOTE: Data users who plan to compare student loan estimates from NPSAS:08 with prior years should be aware that the data on Stafford loans are currently only directly comparable with NPSAS:04. For more information, visit <http://nces.ed.gov/das>.

The names of the variables used in this table are: STEMMAJ, CITIZEN2, CC2005C, INSTAMT and INSWAIV. The variable names are unique identifiers. To locate these variables, enter the variable name in the search box.

Source: U.S. Department of Education, National Center for Education Statistics, 2007-08 National Postsecondary Student Aid Study (NPSAS:08).

Computation by NCES PowerStats on 8/27/2010.

Figure 2. Average institutional aid total. Foreign students receive more aid than U.S. citizens and resident aliens.

Tuition Minus All Grants

Here Figure 3 offers the comparison between out-of-state U.S. natives to foreign students (apples to apples). The U.S. natives are paying more in tuition and fees minus grants than a foreign student. Though it appears resident aliens pay the least, the relative standard error (RSE) is too high to confidently interpret the data. Data is filtered to STEM fields and students who are not attending an institution in state of legal residence. This figure matches Figure 2 where it does appear the direct cost tuition charge to a

federal grant is the same. Since two filters were selected, the filtering to Carnegie schools classified under the basic system: research and doctoral was not allowed.

National Center for Education Statistics PowerStats

Average Tuition and fees minus all grants by Citizenship, for Attend institution in state of legal residence (No, Foreign or international student) and Field of study: STEM focus (Math/Computer/Sciences/Engineering/Technologies).

	Tuition and fees minus all grants (Avg)
Estimates	
Total	8,852.1
Citizenship	
US citizen	9,404.7
Resident alien	5,494.4 !!
Foreign or international student	8,822.0

!! Interpret data with caution. Relative standard error (RSE) > 50 percent.

NOTE: Data users who plan to compare student loan estimates from NPSAS:08 with prior years should be aware that the data on Stafford loans are currently only directly comparable with NPSAS:04. For more information, visit <http://nces.ed.gov/das>.

The names of the variables used in this table are: STEMMAJ, CITIZEN2, NETCST9 and SAMESTAT. The variable names are unique identifiers. To locate these variables, enter the variable name in the search box.

Source: U.S. Department of Education, National Center for Education Statistics, 2007-08 National Postsecondary Student Aid Study (NPSAS:08).

Computation by NCES PowerStats on 8/27/2010.

Figure 3. Average tuition and fees minus all grants. US citizens pay more tuition and fees than foreign and resident alien students.

Total Grants, Institutional Tuition & Fee Waivers, Total Assistantships Amount

Figure 4 is another apples to apples comparison for average graduate research assistantship amount. Data are filtered to students who are not attending an institution in state of legal residence in STEM fields. This chart details on average foreign students receive more GRA money than natives agreeing with North's 1995 and 1998's findings. However, the institutional tuition and fee waiver is comparable. This matches the findings in Figure 2 where the possibility was found that tuition remission charged as a direct cost to a federal grant is not different based on citizenship.

National Center for Education Statistics PowerStats

Average Graduate research assistantship amount, average Institutional tuition & fee waivers by Citizenship, for Field of study: STEM focus (Math/Computer/Sciences/Engineering/Technologies) and Attend institution in state of legal residence (No, Foreign or international student).

	Graduate research assistantship amount (Avg)	Institutional tuition & fee waivers (Avg)
Estimates		
Total	4,792.4	2,111.6
Citizenship		
US citizen	3,659.8	2,014.7
Resident alien	2,254.0 !!	434.7 !!
Foreign or international student	5,641.4	2,307.2

!! Interpret data with caution. Relative standard error (RSE) > 50 percent.

NOTE: Data users who plan to compare student loan estimates from NPSAS:08 with prior years should be aware that the data on Stafford loans are currently only directly comparable with NPSAS:04. For more information, visit <http://nces.ed.gov/das>.

The names of the variables used in this table are: GRRESAMT, INSWAIV, STEMMAJ, CITIZEN2 and SAMESTAT. The variable names are unique identifiers. To locate these variables, enter the variable name in the search box.

Source: U.S. Department of Education, National Center for Education Statistics, 2007-08 National Postsecondary Student Aid Study (NPSAS:08).

Computation by NCES PowerStats on 8/27/2010.

Figure 4. Average graduate research assistantship amount. For those who obtain GRAs, foreign students are awarded more money than U.S. citizens and resident aliens.

Debt Amount

Figure 5 illustrates out of state natives accumulate higher borrowing debt than foreign students. The data are filed to STEM fields for students not attending an institution in the state of their legal residence (out-of-state) allowing for apples to apples comparison. Additional filtering to Carnegie schools classified under the basic system: research and doctoral was not available. One could say that this is because foreign students are paying and not borrowing. The literature review did not support that. It is interpreted as they are receiving more aid (as found in earlier figures). It is unknown where the foreign student is borrowing money, as they are ineligible to borrow from federal student loan programs. The borrowing must be occurring from their home countries.

National Center for Education Statistics PowerStats

Average Cumulative amount borrowed for grad by Citizenship, for Field of study: STEM focus (Math/Computer/Sciences/Engineering/Technologies) and Attend institution in state of legal residence (No,Foreign or international student).

	Cumulative amount borrowed for grad (Avg)
Estimates	
Total	7,769.6
Citizenship	
US citizen	16,351.4
Resident alien	6,372.8 !!
Foreign or international student	3,074.4

!! Interpret data with caution. Relative standard error (RSE) > 50 percent.

NOTE: Data users who plan to compare student loan estimates from NPSAS:08 with prior years should be aware that the data on Stafford loans are currently only directly comparable with NPSAS:04. For more information, visit <http://nces.ed.gov/das>.

The names of the variables used in this table are: STEMMAJ, CITIZEN2, BORAMT2 and SAMESTAT. The variable names are unique identifiers. To locate these variables, enter the variable name in the search box.

Source: U.S. Department of Education, National Center for Education Statistics, 2007-08 National Postsecondary Student Aid Study (NPSAS:08).

Computation by NCES PowerStats on 8/27/2010.

Figure 5. Average cumulative amount borrowed. U.S. citizens borrow more money for school rather than resident aliens or foreign students.

The data's findings did agree with North's 1998 study and Bevis and Lucas (2007) wherein S&E foreign students are not paying their own way as often they are employed as graduate research assistants. Their work is paid by research grant money. Almost all states that refuse RTP to foreign students do allow university departments to fund the tuition difference for those foreign grad students. In the states that do not allow foreign students to become residents for tuition purposes they will fund foreign graduate students (and native out of state students) by:

- They will either pay the in-state/out of state difference, possibly charging the difference to the grant as a direct cost in the hopes the small amount makes their proposal "competitive", or they are pocketing the rest of the tuition.
- They will waive the out of state difference and then pay the in-state rate, possibly charging the smaller tuition rate to the grant as a direct cost in the hopes the small amount makes their proposal "competitive".

- They will waive the entire out of state tuition, as in the UC case - knowing smaller proposal budgets does not affect grant award winning and pocketing a good portion of the tuition for the university.

As one can see the "slight of hand" math is noisy and complicated to code so as to reflect what is going on. It is just not as blank and white as the residency data.

Summary of the Qualitative Institutional Data

Is the prohibition of RTP of much consequence? The universities gain substantially if they make it very difficult for a student not to be able to gain residency for tuition purposes as they are getting more money for the student from either:

- The student actually paying the tuition
- Charging the federal government more money for the non resident student

As explained previously, tuition does not accurately reflect the actual costs imposed by the university to educate the student (Geiger, 2004). If you can get a student to pay more, or obtain more money from that student by charging a federal grant more tuition remission due to state law the university wins.

Foreign Student Enrollment Trend - Question 2

What is the trend for foreign student enrollment for the past several decades? IPEDS chronicled full-time graduate student enrollment with ethnicity specific data back to 1980 providing data approximately every two years. IPEDS does not allow for a distinction between U.S. citizens and permanent resident students. First-time enrollment was not accessible for all years; therefore, for consistency purposes, full-time enrollment was selected only. This reflected the total enrollment at the institution for the survey year. Similarly, STEM curriculum naming conventions varied across the survey years. To

ensure compatibility, total student enrollment, at the graduate level, for very high research institutions (as defined by the 2005 Carnegie classification system) were chosen to create the trend line plotted in Figure 6.

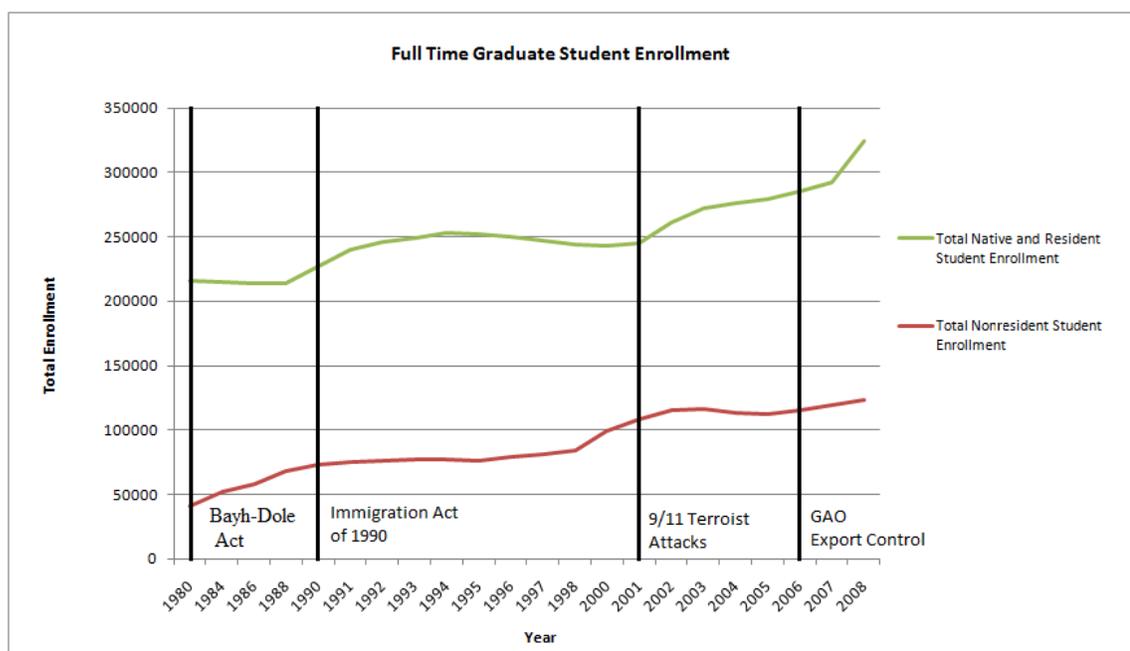


Figure 6. Full-time graduate student enrollment. Key events are marked for their respective year.

Evaluation of the Enrollment Trend Line

Several critical events took place during the period 1980 to 2008 recorded by the enrollment trend line. The Bayh-Dole Act passed in 1980, the Immigration Act of 1990, in 2001 the terrorist attacks transpired, and in 2006 a report on export control concerns was released by the GAO. Likewise since 1980 four recessions occurred. Investigated further was each event and the trend line activity following in more detail.

Bayh-Dole Act

In 1980 the Bayh-Dole Act passed which allowed universities intellectual property control of their inventions (Geiger, 2004). The Act provided an excellent reason

to produce more research with the goal to discover new inventions, which can be patented and gain the additional revenue from this new source. Unfortunately IPEDS does not chronicle enrollment data before 1980. However, a 42% increase in nonresident (foreign) student enrollment the decade to follow does occur. Native and resident enrollment experiences only a subtle increase of five percent during the same period.

Immigration Act of 1990

The Immigration Act of 1990 introduced a new resident visa type: the H-1B. From 1991 to 1994, shortly following the Act, native and resident student enrollment increased six percent while nonresident (foreign) student enrollment only gained two percent. The decade does experience from 1991 to 2000 a total nonresident (foreign) student enrollment increase of 32%, yet only a one percent increase for native and nonresident enrollment. Perhaps the gain in the few years after the Act allowed those eligible for permanent resident status the opportunity to covert their visa type and enroll as a resident to obtain in-state tuition. Similarly foreign students may have seen the opportunity to stay in the country and obtain the coveted green card was now available creating the 32% enrollment jump.

September 11th Terrorist Attacks

The dip in nonresident (foreign) student enrollment as claimed by the IIE after September 11th (Vaughan, 2007) is not visible in Figure 6. Vaughan, explained visa issuances did drop 25% from 2001 to 2004 creating a slight decline of 2% for total foreign student enrollment. Vaughan thinks the decrease of visa issuances was created by the restoration of an interview requirement after the September 11th terrorist attacks, which previously were the exception not the rule. Perhaps the decline in visa issuances

after the terrorist attacks created a delayed reaction causing the dip seen in Figure 6 from 2003-2006 as the trend line reflects total full-time enrollment and not first-time enrollment. Foreign students may have held back on enrollment into U.S. institutions after September 11th as it was assumed the visa process would be more difficult whereas it had not been before. A NSF *InfoBrief* (Oliver, 2007) found total enrollment for graduate students in the S&E fields declined from 2001 to 2005 but first-time, full-time enrollment rebounded in 2005. The decline Oliver discusses from 2001 to 2004 originated particularly in the engineering fields. Oliver explains, “The increase in 2005 in first-time, full-time enrollments of temporary visa holders is largely the result of enrollment increases in engineering and computer sciences—the two fields attracting the largest numbers of foreign students” (p.1). Despite the small two percent decline of foreign student enrollment during the years from 2001 to 2004, total foreign student full-time fall enrollment has experienced an increase of 197% from 1980 to 2008.

GAO Export Control Document

In late 2006 (December) the GAO put out a report on export control concerns citing “U.S. policymakers recognize that foreign students and researchers have made substantial contributions to U.S. research efforts, but the potential transfer of knowledge of controlled defense-related technologies to their home countries could have significant consequences for U.S. national interests” (pp.1-2). Meeks (1997) documented in a NSF report the DOD accounted for 47% federal R&D obligations, which is a substantial piece of the federal R&D obligation pie. This percentage has gotten bigger. After the release of the GAO document was there a noticeable change in nonresident (foreign) student enrollment based on the concerns of research universities violating export controls? Since

the report was released near 2007 and IPEDS only provides data to 2008, only a year's worth of enrollment data is available for analysis. Nonresident (foreign) student enrollment only grew three percent where an average increase of seven percent was experienced annually since 1980. During the same years (2007-2008) native and resident enrollment increased 11% where an average of two percent was occurring annually. Perhaps the enrollment difference is due to the GAO report creating panic amongst research universities on concerns of export control violations. Maybe the enrollment increase happened due to an increased interest in graduate school by natives to enhance their career during economic recessions.

Recessions

Often when recessions occur, those jobless use the opportunity to go back to college and obtain additional training as it is assumed the new skills will make the individual more valuable in the job market. According to the National Bureau of Economic Research (NBER) four recessions occurred during the period of 1980 to present. These recessions occurred:

- 7/81 - 11/82 16 months
- 7/90 - 3/91 8 months
- 3/01 - 11/01 8 months
- 12/07 - 6/09 18 months

Figure 7 illustrates the enrollment trend line with shaded areas detailing recessions as defined by the NBER.

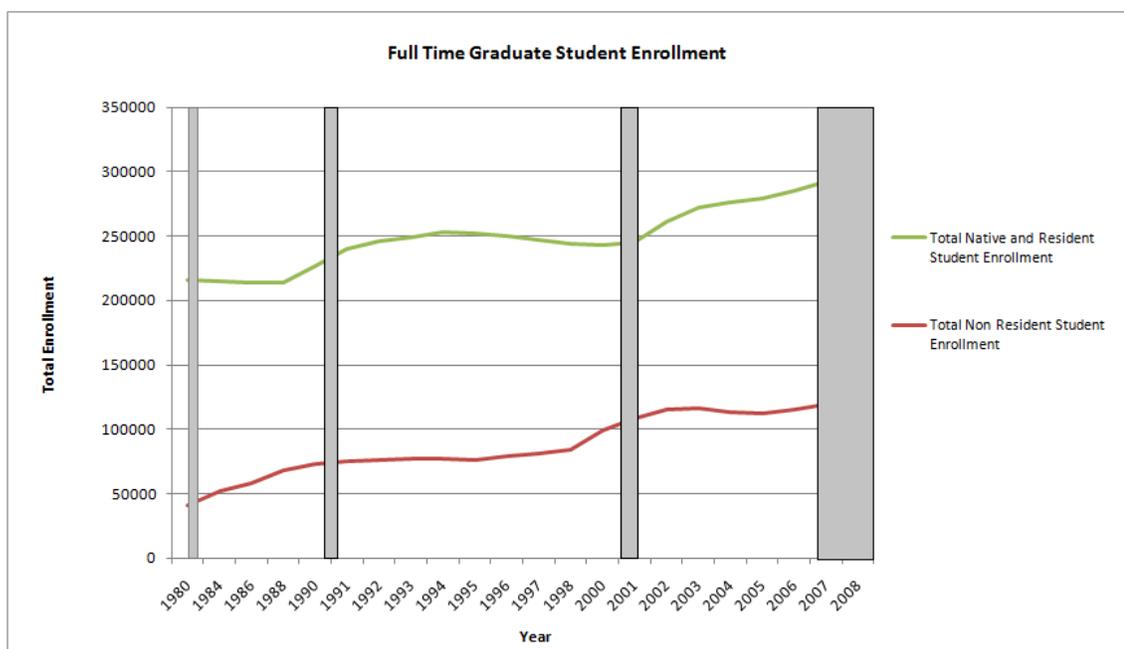


Figure 7. Full-time graduate student enrollment over recessions. The areas in gray represent recession periods as defined by the NBER.

The first recession (81-82) did not have an increase in enrollment. The second (90-91) and third (2001-2002) recessions experienced a six percent gain where on average the enrollment increase was two percent annually. As found previously, after the release of the GAO export control report a jump in total native and permanent resident enrollment did occur, however the document itself may not have created the increase as a recession was also in progress during this period of time; which may also be the reason behind the 11% gain from 2007 to 2008. Recessions do create a gain in native and permanent resident enrollment compared to the average annual increase by percentage. However, the small gain is nothing compared to the seven percent annual enrollment increase experienced by research universities from opening their labor pool to nonresident (foreign) students.

Summary of the Enrollment Trend Line

Several critical events occurred from the 1980s to 2008, for which IPEDS chronicles data on full-time graduate student enrollment (ethnic specific). The dip in nonresident (foreign student) enrollment from the September 11th terrorist attacks is not found as claimed by the IIE. Though visa issues did decline, the total enrollment in years preceding kept the effect on enrollment numbers minimal where a decline of two percent was experienced. Native and permanent resident enrollment did increase in periods after recessions as well as after the release of a late 2006 GAO report on export control. Nonresident (foreign) student enrollment improved after the Immigration Act of 1990 and the Bayh-Dole Act of 1980.

Graduate Students' Background -Question 3

What is the background of the students (citizenship detailed) the institutions of interest are receiving in S&E? Geiger (2004) suggested research universities were replacing less qualified native students with more qualified foreign students. North (1995) finds "Many have done some graduate work in their home countries before they arrive in the U.S., as well" (p.74). NCES' DataLab QuickStats provided the tables to answer this research question. The 2007-2008 National Postsecondary Student Aid Study was used for the data source. Graduate students were the group selected. Data filtering focused on STEM fields at institutions Carnegie classified (using the collapsed system) categorized as research and doctoral institutions providing analysis of 99 universities and colleges. Investigated in detail are experience history of the graduate students and their employment characteristics.

Experience History

What is the experience history of a STEM graduate student? Do they enter graduate school with prior degrees and with some work experience? These two key details which make an individual desirable are examined below.

Prior Degree

Figure 8 provides the prior degree (citizenship specific) obtained by students. This chart does not match the literature review. Here it is found U.S. citizens more often have prior degrees compared to their foreign counterparts. What is odd about this chart is that it is often required to have prior degrees before entering graduate school. However, this does not match Kannankutty and Burreilli (2007) findings: “Immigrants whose highest degree was a U.S. master’s or a doctorate were more likely than those with bachelor’s degrees to come for educational opportunities (p.7)”. Here it is found foreign students do not have the credentials to properly enter graduate school.

National Center for Education Statistics PowerStats				
Citizenship by Prior degree: Associate's degree, Prior degree: 4-year bachelor's degree and Prior degree: Master's degree, for Field of study: STEM focus (Math/Computer/Sciences/Engineering/Technologies) and Carnegie: Basic Classification (collapsed) (Research & Doctoral).				
	US citizen (%)	Resident alien (%)	Foreign or international student (%)	Total
Estimates				
Total	61.5	6.4	32.1	100%
Prior degree: Associate's degree				
Yes	67.9	7.9 !!	24.2 !	100%
Prior degree: 4-year bachelor's degree				
Yes	64.5	6.1	29.5	100%
Prior degree: Master's degree				
Yes	53.3	7.7	39.0	100%
! Interpret data with caution. Relative standard error (RSE) falls between 30 and 50 percent.				
!! Interpret data with caution. Relative standard error (RSE) > 50 percent.				
NOTE: Data users who plan to compare student loan estimates from NPSAS:08 with prior years should be aware that the data on Stafford loans are currently only directly comparable with NPSAS:04. For more information, visit http://nces.ed.gov/das .				
The names of the variables used in this table are: STEMMAJ, CITIZEN2, CC2005C, DEGPRMS, DEGPRBA4 and DEGPRAA. The variable names are unique identifiers. To locate these variables, enter the variable name in the search box.				
Source: U.S. Department of Education, National Center for Education Statistics, 2007-08 National Postsecondary Student Aid Study (NPSAS:08).				
Computation by NCES PowerStats on 9/21/2010.				

Figure 8. Graduate students’ prior degree. U.S. citizens are more prepared for post secondary school than foreign students.

Work Experience

Natives (61.5%) more than foreign students (32.1%) had a job prior to enrollment into graduate school (Figure 9). Excluding work studies and assistantships natives often have more jobs than a foreign student. When work studies and assistantships are included the foreign student percentage of one job number (32.7%) increases from 17.9% indicating employment they have is often in this form. Vaughan (2007) states:

Foreign students also compete with U.S. students for employment opportunities.

At some schools, they have first dibs on campus jobs, including the heavily subsidized work-study program, under the dubious rationale that U.S. students have greater options and access to financial aid and off-campus employment.

(Policy Implications, ¶5)

This matches Vaughan's findings where on campus jobs are held for foreign students under the guise native students have better access to financial aid. Let's probe more into graduate student employment characteristics.

National Center for Education Statistics PowerStats

Citizenship by Job: Have job prior to enrollment at NPSAS school, Job: Number (exclude work study or assistantship) and Number of jobs (include work study or assistantship), for Field of study: STEM focus (Math/Computer/Sciences/Engineering/Technologies) and Carnegie: Basic Classification (collapsed) (Research & Doctoral).

	US citizen (%)	Resident alien (%)	Foreign or international student (%)	Total
Estimates				
Total	61.5	6.4	32.1	100%
Job: Have job prior to enrollment at NPSAS school				
Yes	80.2	11.2 I	8.6	100%
Job: Number (exclude work study or assistantship)				
1	71.2	10.9	17.9	100%
2	83.1	3.9 II	13.0 I	100%
Number of jobs (include work study or assistantship)				
1	60.2	7.1	32.7	100%
2	73.6	5.6 I	20.8	100%
3	83.9	2.5 II	13.5 I	100%

I Interpret data with caution. Relative standard error (RSE) falls between 30 and 50 percent.

II Interpret data with caution. Relative standard error (RSE) > 50 percent.

NOTE: Data users who plan to compare student loan estimates from NPSAS:08 with prior years should be aware that the data on Stafford loans are currently only directly comparable with NPSAS:04. For more information, visit <http://nces.ed.gov/das>.

The names of the variables used in this table are: JOBPRIOR, JOBNUM, STEMMAJ, CITIZEN2, CC2005C and JOBNUM2. The variable names are unique identifiers. To locate these variables, enter the variable name in the search box.

Source: U.S. Department of Education, National Center for Education Statistics, 2007-08 National Postsecondary Student Aid Study (NPSAS:08).

Computation by NCES PowerStats on 9/21/2010.

Figure 9. Graduate students' work experience. Foreign students do not have the work experience U.S. citizens have.

Employment Characteristics

As found previously foreign students do have work in the form of assistantships and work study. Graduate students' employer type, their work experience prior to graduate school, whether the job affects their schooling, and finally their reason for working is explored next.

Type of Employer

Figure 10 finds 32.1% of foreign students are working. Of those employed 48.4% work for the school they are attending. A higher percentage of native students (61.5%) work. Of those that work they typically work for the government (local or state), a nonprofit organization, or a for-profit company. This too matches Vaughan's findings. Do these jobs affect their schooling?

National Center for Education Statistics PowerStats

Citizenship by Job: Type of employer, for Field of study: STEM focus (Math/Computer/Sciences/Engineering/Technologies) and Carnegie: Basic Classification (collapsed) (Research & Doctoral).

	US citizen (%)	Resident alien (%)	Foreign or international student (%)	Total
Estimates				
Total	61.5	6.4	32.1	100%
Job: Type of employer				
NPSAS school	46.3	5.3 †	48.4	100%
A for-profit company	78.4	12.5 †	9.1	100%
A nonprofit organization	85.8	8.2 †	6.1 ††	100%
A local, state, or federal government	86.8	8.1 †	5.2 ††	100%
The military	‡	‡	‡	100%
Self-employed	‡	‡	‡	100%

‡ Reporting standards not met.

† Interpret data with caution. Relative standard error (RSE) falls between 30 and 50 percent.

†† Interpret data with caution. Relative standard error (RSE) > 50 percent.

NOTE: Data users who plan to compare student loan estimates from NPSAS:08 with prior years should be aware that the data on Stafford loans are currently only directly comparable with NPSAS:04. For more information, visit <http://nces.ed.gov/das>.

The names of the variables used in this table are: STEMMAJ, CITIZEN2, CC2005C and JOBEMPL. The variable names are unique identifiers. To locate these variables, enter the variable name in the search box.

Source: U.S. Department of Education, National Center for Education Statistics, 2007-08 National Postsecondary Student Aid Study (NPSAS:08).

Computation by NCES PowerStats on 9/21/2010.

Figure 10. Graduate students' type of employer. Foreign students often work for the school they are attending.

Job Affects School

Here it is illustrated (Figure 10) often native students can afford school without working. Of the 61.5% that work, only 63.3% believe of their job does affect the school schedule. This is not the case with foreign students as of the 32.1% that work, only 28.0% believe their job does limit their class schedule. What are the students' reasons for working?

National Center for Education Statistics PowerStats

Citizenship by Job: Can afford school without working and Job affects school: Limited the class schedule, for Field of study: STEM focus (Math/Computer/Sciences/Engineering/Technologies) and Carnegie: Basic Classification (collapsed) (Research & Doctoral).

	US citizen (%)	Resident alien (%)	Foreign or international student (%)	Total
Estimates				
Total	61.5	6.4	32.1	100%
Job: Can afford school without working				
Yes	63.3	5.7 !	31.1	100%
Job affects school: Limited the class schedule				
Yes	62.5	9.5 !	28.0	100%

! Interpret data with caution. Relative standard error (RSE) falls between 30 and 50 percent.

NOTE: Data users who plan to compare student loan estimates from NPSAS:08 with prior years should be aware that the data on Stafford loans are currently only directly comparable with NPSAS:04. For more information, visit <http://nces.ed.gov/das>.

The names of the variables used in this table are: STEMMAJ, CITIZEN2, CC2005C, JOBEFFD and JOBAFFOR. The variable names are unique identifiers. To locate these variables, enter the variable name in the search box.

Source: U.S. Department of Education, National Center for Education Statistics, 2007-08 National Postsecondary Student Aid Study (NPSAS:08).

Computation by NCES PowerStats on 9/21/2010.

Figure 11. Graduate students' job. U.S. citizens have jobs which affect their schooling, where foreign students do not.

Reason for Working

Native students have jobs typically to gain work experience, and they need it to pay educational/living expenses to minimize debt explained by Figure 12. Interestingly of the foreign students that do work (32.1%) only 23.6% cite job experience as their reason for working. Only 25.1% and 29.4% of those that work need to, to pay for educational and living expenses respectively. These data conflict with the literature review where foreign students are not paying their educational expenses. Bevis and Lucas (2007) found "More than 75 percent of the 10,000 foreign doctoral recipients at American universities in 1996 reported their universities as the primary source of support for their graduate training – most in the form of research assistantships" (p.190). North (1995) agrees stating "... *the further you are from U.S. citizenship the more likely you are to secure American funding*" (p. 83). Later North's 1998 study found that only 10 percent of foreign student funding came from overseas. That percentage diminished as their

graduate years passed. Perhaps foreign students' assistantship employment increases outside of the master's degree and into the doctorate degree.

National Center for Education Statistics PowerStats

Citizenship by Reason for working: Gain job experience, Reason for working: Minimize debt, Reason for working: Pay educational expenses and Reason for working: Pay living expenses, for Field of study: STEM focus (Math/Computer/Sciences/Engineering/Technologies) and Carnegie: Basic Classification (collapsed) (Research & Doctoral).

	US citizen (%)	Resident alien (%)	Foreign or international student (%)	Total
Estimates				
Total	61.5	6.4	32.1	100%
Reason for working: Gain job experience				
Yes	68.1	8.3 !	23.6	100%
Reason for working: Minimize debt				
Yes	80.4	2.8 !!	16.8 !	100%
Reason for working: Pay educational expenses				
Yes	68.4	6.5 !	25.1	100%
Reason for working: Pay living expenses				
Yes	65.1	5.6 !	29.4	100%

! Interpret data with caution. Relative standard error (RSE) falls between 30 and 50 percent.
 !! Interpret data with caution. Relative standard error (RSE) > 50 percent.

NOTE: Data users who plan to compare student loan estimates from NPSAS:08 with prior years should be aware that the data on Stafford loans are currently only directly comparable with NPSAS:04. For more information, visit <http://nces.ed.gov/das>.

The names of the variables used in this table are: JOBSRNE, STEMMAJ, CITIZEN2, CC2005C, JOBSRNF, JOBSRNC and JOBSRNB. The variable names are unique identifiers. To locate these variables, enter the variable name in the search box.

Source: U.S. Department of Education, National Center for Education Statistics, 2007-08 National Postsecondary Student Aid Study (NPSAS:08).

Computation by NCES PowerStats on 9/21/2010.

Figure 12. Graduate students' reason for working. U.S. citizens work to pay for educational expenses, gain experience and minimize debt. Foreign students do not cite these reasons for employment.

Summary of Graduate Students' Background

It is native students and not foreign students who are better qualified to enter graduate school in regards to work history and prior degree attainment. Natives often maintain employment during their graduate school career to pay for educational/ living expenses for minimal debt. Though 63.3% of those that work can afford school without working, most believe their job does affect their school schedule. Thirty-two percent of foreign students do work. Of those that work, only 31.1% believe they could afford graduate school without working. Likewise only 28% find their job affects their schooling indicating their job is school related (as an assistantship).

R&D Expenditures with RTP Policy - Question 4

Compared to native graduate students, do foreign graduate students generate R&D cost savings? Are foreign graduate students in some sense more efficient? This section describes an exploratory regression analysis to examine that question. In regressions 1 and 2 reported below, the dependent variable is the natural log of annual federal R&D expenditures; for regression 3, the model's dependent variable is a broader measure, the natural log of all annual R&D expenditures, including foreign, private and state funding for R&D. Although the universities and the federal funding agencies frequently tout larger R&D outlays as an achievement, it is worth emphasizing that the expenditures are per se outlays (costs) from the viewpoint of taxpayers, the general public, and economic analysis. On the other hand, the actual achievements or benefits are the successful research: a new vaccine or semiconductor, a better understanding of a geological or physical phenomenon, and so on. Greenberg (2001) agrees there is one established measurable method to correlate the direct relationship between the money spent and the achievements in science but warns:

The volume of money, however, is countable, and comprehensible to scientists, politicians, and the public. Understood by all is the necessity of money for the training and well-being of scientists and the nurturing and advance of science. In the politics of science, the golden ages of sciences are thus usually equated with money, not with discovery, though the underlying assumption is that more money will produce more science. (pp.59-60)

The regression model properly views the expenditures themselves as costs and explores whether the available data provide any evidence that cost savings are achieved

when native graduate students are replaced by foreign graduate students. In other words, does this substitution reduce federal or total R&D cost per graduate student? Finding a cost savings implies efficiency of the student type. If a cost reduction is achieved due to efficiency, the university can potentially channel the savings into additional resources for research.

Data

Specifically, the data are from two National Science Foundation surveys:

- Survey of Graduate Students and Postdoctorates in Science and Engineering
- Survey of Research and Development Expenditures at Universities and Colleges

The data set covers 93 Very High Research Universities in 2007 and 2008 (186 total observations in the panel). The academic fields in my data sets are science, technology, engineering and mathematics (STEM) -- the fields most closely related to R&D expenditures.

As mentioned above, the model's dependent variable for regressions 1 and 2 is $\log(\text{federal R\&D expenditures})$ for each university in each of the two years, while the dependent variable for regression 3 is $\log(\text{all R\&D expenditures})$. The independent variables are summarized in Table 4.

Table 4
Independent Variables for the Regression Analysis

enrollcap	1 = if the university does have an enrollment cap on their out-of-state graduate students 0 = if there is no cap
rtpnative	1 = if native students can receive in-state tuition at some point during their graduate studies 0 = otherwise
rtpforeign	1 = if a foreign student can receive in-state tuition at some point during their graduate studies 0 = otherwise
public1	1 = for a public university 0 = for a private university
lallgs	Log(the number of all graduate students in STEM programs)
lforgs	Log(the number of foreign graduate students in STEM programs)
rschasstdoa	The number of graduate research assistants on a Department of Agriculture (DOA) grant
rschasstdoe	The number of graduate research assistants on a Department of Energy (DOE) grant

The last two variables are included because R&D spending in agriculture and energy has accelerated in recent years, and its impact on graduate-student productivity is of interest.

The Analysis

Using ordinary least squares (OLS), three regression analyses were conducted (see Table 5). Regression 1 examined a log linear model incorporating just three independent variables: lallgs, lforgs, and public1. Regression 2 extends that log linear model to include the institutional data, adding the independent variables: enrollcap, rtpnative, rtpforeign, rschasstdoa and rschasstdoe. Based on the results from the second

regression, the third model expands upon the first by changing the dependent variable from federal R&D expenditures only to all R&D expenditures. For all three regressions I tried a dummy variable for 2007 versus 2008, but there was no statistically-significant difference in the average log(federal R&D expenditures) between the two years. Each analysis is discussed further.

Table 5
Regression Analysis

Variable	Regression 1	Regression 2	Regression 3
Intercept	13.07610***	5.68526***	13.68466***
Enrollcap	N/A	0.06115	N/A
Rtpnative	N/A	-0.22650*	N/A
Rtpforeign	N/A	-0.00349	N/A
public1	-0.44781***	-0.46107***	-0.13938**
Lallgs	1.35003***	1.44536***	1.13085***
Lforgs	-0.55815***	-0.54119***	-0.35173***
Rschasstdoa	N/A	-0.00301*	N/A
Rschasstdoe	N/A	-0.00213*	N/A
R-squared	0.4974	0.5290	0.5381

The significance criterion is noted as follows:

No asterisk: $p > 0.10$. * $p < 0.10$. ** $p < 0.05$. *** $p < 0.01$.

Regression 1

The R-squared for regression 1 is 0.4974, indicating that the independent variables jointly account for 50% of the total variation in the dependent variable. All three independent variables are statistically significant with a p value less than 0.01. A robust regression using the least trimmed squares (LTS) method did not detect any outliers that would skew the OLS results.

Regression 2

The following variables have regression coefficients that are statistically significant at conventional levels: *rtpnative*, *public1*, *lallgs*, *lforgs*, *rschasstdoa*, and *rschasstdoe*. The independent variables together account for 53% of the total variation in the dependent variable, which seems acceptable for a panel data set. Moreover, the robust LTS method revealed no egregious outliers.

To explore the implications of this regression, consider a hypothetical but fairly typical university in the sample: it has \$250 million in annual federal R&D expenditures and an equal number of native and foreign graduate students in STEM programs. At the margin, what is the expenditure effect of replacing 10 percent of the native graduate students by (an equal number of) their foreign counterparts? In the model, *lallgs* is unchanged; and since the estimated coefficient of *lforgs* is -0.54, the change in R&D outlay is $(-0.54)(0.10)(\$250 \text{ million}) = -\13.5 million –not a trivial reduction in cost. Assuming that it does not impair the final research results, this adjustment in the mix of graduate students improves federal R&D efficiency.

Like any linear model, mine is valid for marginal (incremental) changes in the independent variables but not for extrapolation far outside the range of the sample data. Pushed to its logical conclusion, the model implies that universities should admit only foreign graduate students to STEM fields. This is absurd since it ignores the economic “law of diminishing returns,” not to mention demographic and political constraints.

My model tentatively quantifies the cost savings from the incremental replacement of native graduate students by their foreign counterparts, but it does not

pinpoint the sources of those savings. The summary of this question's analysis will explore what these sources might be.

Regression 3

Can it be assumed foreign graduate students achieve efficiencies with respect to academic R&D outlays in general? Regression 3 replaces the dependent variable in regression 2 with Log(annual R&D expenditures) rather than federal R&D expenditures only. This method provides a broader measure of R&D expenditures which strengthens the argument that efficiencies may result when foreign graduate students replace their native counterparts. R-squared is 0.5381.

Pursuing the thought experiment, consider a university with \$387 million in total annual R&D expenditures (about the average in the sample) and an equal number of foreign and native graduate students. If again 10 percent of the native graduate students are replaced by an equal number of foreign graduate students, the annual reduction in R&D outlays is $(-0.35)(0.10)(\$387 \text{ million}) = -\13.5 million , which suggests that foreign graduate students produce general R&D efficiencies that may be similar in magnitude to the savings in federal R&D. As with regression 2, the assumption is that the adjustment in the mix of graduate students does not somehow impair the final research results.

Diminishing returns to graduate-student substitution

For a log-linear model $\text{Log}(y) = a + b\text{Log}(x) + c\text{Log}(z)$,

$\partial \text{Log}(y) / \partial x = (1/y)\partial y/\partial x = b/x$ so $\partial y/\partial x = b(y/x)$. In the context of regression 2, the latter partial derivative is the rate of change of federal R&D expenditures with respect to the number of foreign graduate students, holding constant the total number of graduate students. Clearly $\partial y/\partial x$ depends on the regression coefficient b and on y/x , the ratio of

federal R&D expenditures per foreign graduate student in a real or hypothetical university. The second column of Table 6 shows that, in my data set, the partial derivative is -\$52,242 for universities at the fifth percentile of federal R&D expenditures per foreign graduate student. However, the partial derivative is much larger for universities at higher percentiles like the median or the 95th percentile. The third column of Table 6 shows the differential $\Delta\text{Fedrdexp} = (\partial\text{Fedrdexp} / \partial\text{Forgs}) \Delta\text{Forgs}$ when $\Delta\text{Forgs} = 100$, that is when 100 foreign graduate students replace 100 native graduate students. As common sense suggests, the substitution of foreign for domestic graduate students is subject to diminishing returns: the cost saving is much larger for universities with a high level of federal R&D expenditures per foreign graduate students (e. g. the 95th percentile) than for universities that have already reduced their federal R&D expenditures per foreign graduate student, possibly by substitutions (e. g. the 5th percentile). So the replacement of native by foreign graduate students would be a self-limiting process that could not reasonably be pursued to an extreme degree.

Table 6
Diminishing Returns to Substitution

Fedrdexp/Forgs	$\frac{\partial\text{Fedrdexp}}{\partial\text{Forgs}}$	$\Delta\text{Fedrdexp}$ when $\Delta\text{Forgs} = +100$
5 th Percentile	-\$52,242	-\$5.2 million
Average	-\$231,459	-\$23.1 million
Median	-\$152,329	-\$15.2 million
95 th Percentile	-\$690,548	-\$69.1 million

Finally, I note in passing several additional implications of the regression analysis, “other things equal and on average”: public universities have substantially smaller federal R&D expenditures than private universities; it is probably efficient to let native students qualify for in-state tuition; and research assistantships sponsored by DOA

or DOE may be relatively efficient funding mechanisms. Investigated below are some possible reasons foreign students provide efficiency.

Possible Reasons for Foreign Student Efficiency

The relationship between a graduate student and their advisor is important. A 2008 Clemson University graduate student manual states:

The relationship between a faculty advisor and a graduate student is a unique one. Regardless of the form of financial support (and even without support) students must maintain a professional relationship with both their advisor and their peers. Early departure from a program can result in substantial delays to the research including its delivery to the sponsor. (p.21)

Rao (1995) explained that immigration restrictions keep foreign graduate students in school until they graduate, resulting in less employee turn-over. Since employee turn-over is inefficient, this is a substantial benefit for the university (their employer) as it guarantees that the training invested in the student is kept during the duration of the grant ensuring on time delivery to the sponsor. Otherwise, delays would occur while the principal investigator recruited and trained a new graduate research assistant. Foreign students in this sense guarantee efficiency. A 2008 Louisiana State FAQ document speaks plainly to foreign students should they be unable to complete their studies on time:

You must obtain documentation from your department/professor(s) explaining why you were unable to finish....Unless there were factors beyond your control, *USCIS looks unfavorably upon students who fail to complete their studies by the program completion date* [italics added] on the most recently issued I-20, especially if they have applied for OPT based on a projected completion date....

You are not allowed to work full-time on OPT until all coursework has been completed, even if an EAD card has been received. (p.10)

If graduate students leave with their training prior to the completion of the research, then in the parlance of economics it is said that the university and the principal investigator were unable to appropriate all the benefits of the training they provided, imposing an “externality cost” on the university and the grant’s sponsor. In general, labor economists use the term “poaching” when employees trained by one company are recruited by a rival firm that seeks to avoid the expense of training (Leuven, 2005).

Poaching of graduate research assistants has some unique features. After all, universities typically encourage their newly produced Ph.D.s to start their careers on another campus; this policy promotes a faculty with diverse academic backgrounds and avoids “inbreeding.” Thus it is understood that graduate research assistants, regardless of citizenship, will normally graduate and leave their employer (the university), taking their training with them. Mohrenweiser, et al. (2010) cite Acemoglu and Pischke (1998): “employment of apprenticeship graduates is not contractible since apprenticeships legally terminate at the day after the last exam (non-enforceable contract) ...” (p.3). However, this does not diminish the stake that principal investigators have in protecting their research projects from poaching and externality costs. It remains an open question whether principal investigators consider the visa restrictions to which foreign graduate students are subject as a kind of insurance against externality costs. If so, does this account for a significant portion of the apparent cost savings that the regression analysis imputes to foreign graduate students?

Evaluation of the Earned Doctorates Trend Line

It is found for the most part public universities produce more Ph.D.s than their private counterparts. Around the mid 1980's the Ph.D. production among temporary residents from public universities surpassed the production of Ph.D. among U.S. Citizens and permanent residents. It was in this time frame the “shortage study” was released. Figure 13 emphasizes the cross over. Investigated in more detail is the production of doctorates by citizenship type: U.S. and permanent residents and temporary residents (foreign students).

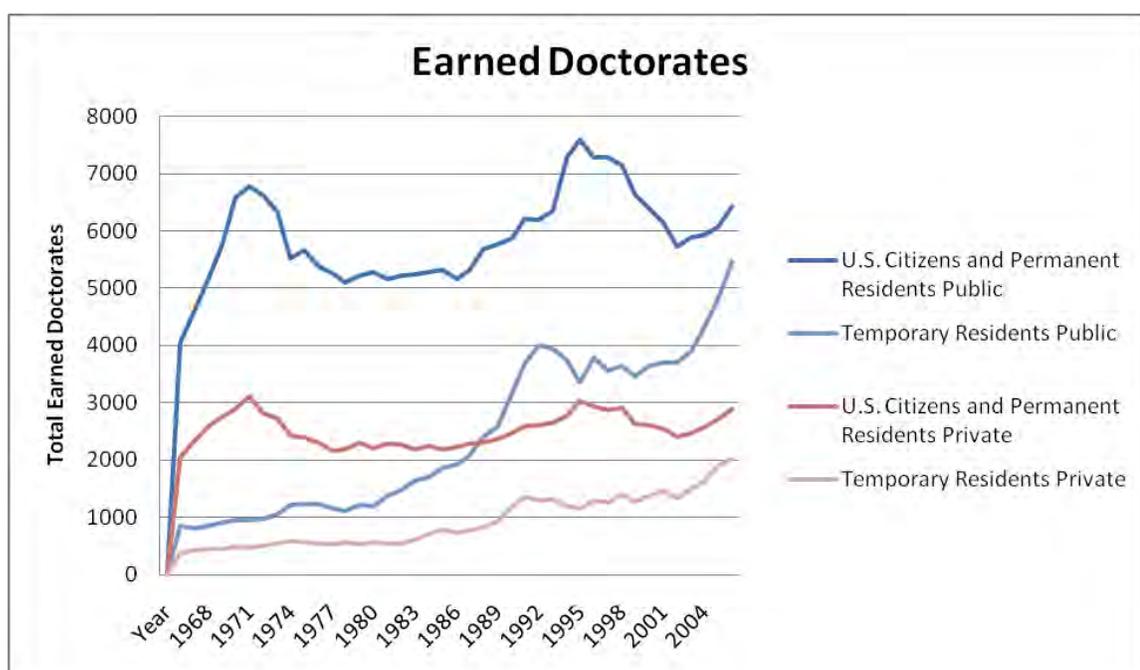


Figure 13. Earned doctorates trend line. Temporary residents at public institutions surpasses U.S. citizens and permanent residents at private institutions in the mid 1980s.

U.S. Citizen and Permanent Resident Ph.D. Production

The trend line for U.S. citizens and permanent residents at public and private universities for the most part coincide with one another. Figure 14 illustrates this. Where peaks and valleys occur in one, it is found in the other. Two peaks occurred in U.S.

citizen and permanent resident Ph.D. production at private universities. The first in the early 1970s and the second in the mid 1990s. A gradual dip is found from the late 1970s to the early 1990s. The second peak at private universities never surpassed the 1970s peak. This is not true at public universities where the total earned doctorates peak in the mid 1990s did surpass the 1970s peak.

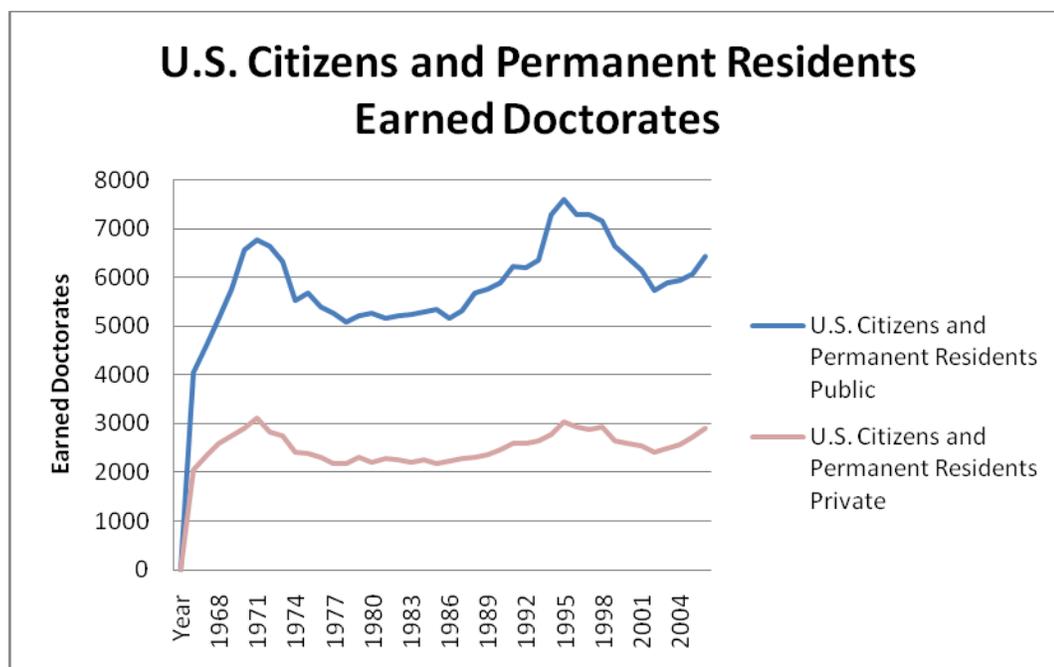


Figure 14. Earned doctorates trend line for U.S. citizens and permanent residents at private and public institutions. Public institutions produce more earned doctorates.

A noticeable dip that occurs at the turn of the decade does begin to recover yet never surpassing the first peak in the early 1970s. Interestingly despite the fact Ph.D. production was very high, this did not stop two deans in a 1969 book by the National Academy of Science entitled *The Invisible University: Postdoctoral Education in the United States* in their study (as cited by the National Academy of Science) to state:

This does not mean that there is no exploitation of the foreign postdoctoral. The dean at a Midwestern university said, ‘It has been said that foreign postdoctoral appointees are a cheap source of labor. I am afraid that in some cases this is true.’

The dean at another university was more explicit:

...I suspect that the particular mix between foreign postdoctorals and citizens of the United States depends upon the drawing power of a particular professor. He will normally pick the most promising men applying to work with him, although he may be influenced somewhat by his desire to be known and have influence in particular foreign countries. Some of the so-called foreign postdoctorals are simply hired hands and reflect the fact that some foreigners, often with not too great ability, are willing to do kinds of work which American postdoctorals or graduate students will not do. (p.208)

Postdoctorals are the next career move in academia following receiving a Ph.D. Often working for a professor of their choice to continue learning. North (1995) explains they are a “highly-educated junior professional” (p.92). *Foreign postdoctorals are willing to do what American postdoctorals will not do.* Let’s take a closer look at the temporary resident (foreign student) earned doctorate trend line.

Temporary Residents

For the most part since 1966 foreign earned doctorates have been on a steady rise in both institutional control types (Figure 15). An interesting peak is found in the early 1990s at public institutions. The cause for the peak is unknown. It is assumed The Immigration Act of 1990 would have encouraged foreign graduate students to continue on for the Ph.D., as they would have known their stay could be extended after with an

H1-B visa. Perhaps what occurred is that foreign students, knowing it was easier to obtain employment, elected to not continue on for the Ph.D. because employment options were available allowing them the chance to leave the workforce earlier. Their opportunity costs increased during that time period.

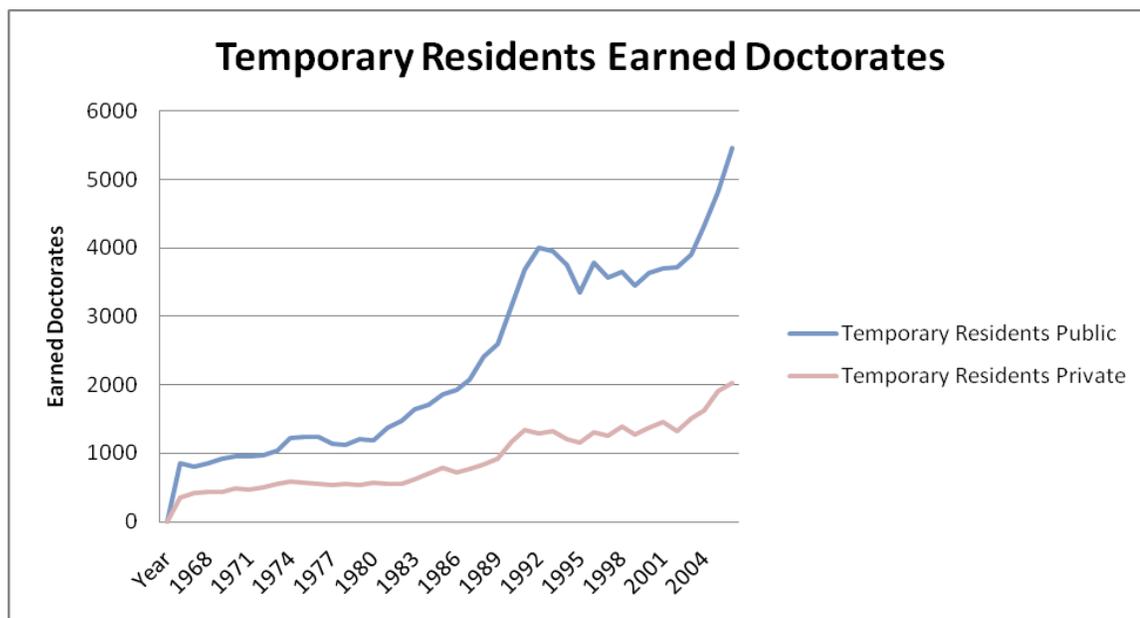


Figure 15. Temporary resident earned doctorates trend line. Public institutions produce more earned doctorats than private institutions.

Strangely the peak is not as evident at private institutions. A substantial rise is found in the late 1990s to present in earned doctorates of foreign students. Oliver (2007) finds the same: “The number of foreign postdocs has increased by 53% since 1995... (p.4)” When viewing the trend lines together (both U.S. citizens and permanent residents and temporary residents) by institutional type (Figures 16 and 17) it is discovered the number of temporary resident (foreign) earned doctorates is quickly encroaching on the number of U.S. citizens and permanent resident doctorates at both institutional control types.

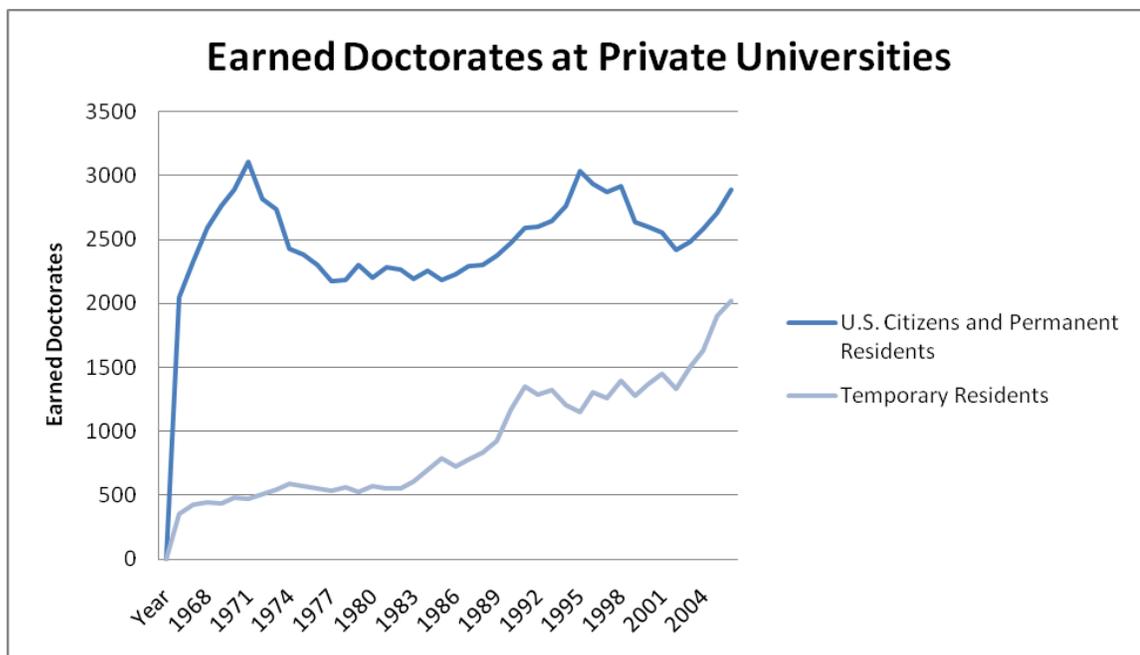


Figure 16. Earned doctorates at private universities trend line. More earned doctorates are produced by U.S. citizens and permanent residents. However, the temporary resident earned doctorates are quickly encroaching.

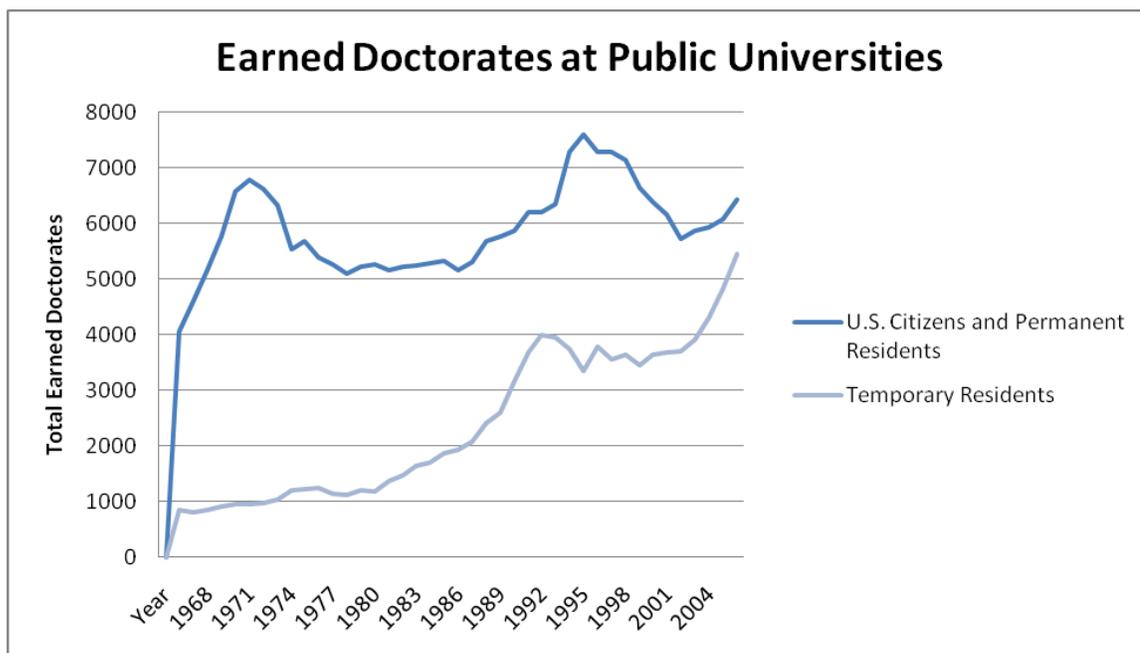


Figure 17. Earned doctorates at public universities trend line. U.S. citizens and permanent residents receive more earned doctorates than temporary residents. However, the temporary resident number is gaining on the U.S. citizen and permanent residents.

Summary of the Earned Doctorates Trend Line

U.S. citizen and permanent resident earned doctorates for the most part have remained relatively flat falling between 5000 to 7000 annually since 1968 to present for public universities. With the exception of the mid 1990s where earned doctorates did exceed 7000, only a fluctuation of 2000 earned doctorates is found between the years 1968 to 2006. The results are similar at private universities where the fluctuation occurred around 1000 with earned doctorates falling between 2000 and 3000. Exceptions occur at the years 1971 and 1995 where earned doctorates fall slightly to above 3000. Temporary resident (foreign) earned doctorates on the other hand have been increasing steadily providing a 464% rise since 1966 for private universities and 539% at public universities. A NSF *InfoBrief* written by Oliver in 2007 expresses excitement on a 53% foreign postdoctoral increase found in 1995 yet never discusses a concern on the lack of growth in native and permanent resident earned doctorates. The number of earned doctorates of temporary residents (foreign) has been increasing close to the number of U.S. citizen and permanent residents. This is evident especially at public universities. The trend indicates the temporary resident (foreign) earned doctorates will surpass U.S. citizen and permanent residents in approximately 10 years at public universities. It is important not to forget what Freeman (2005) warned:

If US economic growth and comparative advantage depend substantially on the work of scientific and engineering workers, relying so much on foreign born supplies could be risky. Any interruption or change in the flow of immigrant scientists and engineers would certainly harm US research and development.
(pp.18-19)

If the desire is to increase U.S. citizen earned doctorates Benderly (2010) offered the following solution:

Any change in the science labor market would, of course, require dismantling the current system and erecting something that would value young scientists for their future potential as researchers and not just for their present ability to keep universities' grant mills humming. This would mean paying them more and exploiting them less. It would also mean limiting their numbers by both producing and importing fewer scientists, so incomes could rise to something commensurate with the investment in time and talent and the high-level skills of a Ph.D. ” (§55-56)

Based on the literature review it is doubtful research universities have an interest in following those suggestions as they have done nothing in the past 40 years to increase native earned doctorate recipients.

CHAPTER V: CONCLUSION

My study attempted to ascertain if research universities achieved additional R&D expenditures by admitting foreign students in preference to natives. My hypothesis was that, as North (1998) found, only 10% of foreign-student funding came from overseas, and it is likely that they seldom pay the out-of-state tuition rate charged to the federal government. The latter procedure was deemed not to be fraudulent in the case *Robert C. Baum V. Deloitte and Touche et al.* The qualitative institutional data collected provided insight into what the colleges and universities were charging the federal government as a direct cost to their research grants. It was found foreign students and out-of-state students could obtain in-state tuition. For the most part the in-state tuition was received by the student becoming a graduate research assistant. Regarding foreign students 60% of very high research universities and 53% high research universities authorized in-state tuition. Eighty-nine percent of very high research universities allowed this and 85% high research universities practiced this policy for native students. Interestingly foreign students are found not to be more prepared for graduate school as compared to their native counterparts. Native students often have more education and longer work experience. The analysis did not determine whether if institutions choose to crowd-out foreign students or out-of-state students for in-state students is unknown.

Borjas (2004) did find there is a crowding-out effect for white native males and that universities are giving priority to the admission of foreign students. Crowding-out is suggested in the graduate student enrollment trend line. Enrollment for native and resident students have only increased on average two percent annually where enrollment for nonresident (foreign) students has increased seven percent annually since 1980. Interpretation of the data suggests most natives choose not to continue for the Ph.D. and stay with a Master's degree only. This is found when the earned doctorate trend line is explored further. Crowding-out here is implied. For most of the past 40 years native and permanent resident student earned doctorates have fluctuated between 5000-7000 at public universities and 2000-3000 at private institutions. However, temporary (foreign) student earned doctorates have increased 464% at private institutions and 539% at public institutions since 1966.

Three regression analyses discovered foreign students were more "efficient" than their native counterparts. It is theorized the efficiencies are obtained due to visa restrictions placed on the foreign students as it guarantees that the training invested in the student is kept during the duration of the grant ensuring on-time delivery to the sponsor. Principle investigators have a high stake in protecting their research projects from poaching and externality costs.

It is incorrect to refer to foreign students as "cheap labor." Foreign and native students receive about the same graduate research assistant salary. All graduate assistants are "cheap labor" by way of research universities increasing their labor supply through the recruitment of foreign students. Though tax treaties do afford some foreign students additional take home pay, the principle investigator does not benefit from this. They

benefit from the immigration restrictions placed on the foreign students and the higher out-of-state tuition rate charged to the federal government as a direct cost.

Recommendations for Further Study

It was my goal to obtain restricted data from the NSF's SED. Unfortunately three months into the process to obtain the restricted data it was discovered by the NSF there was a conflict between federal and state (Texas) laws. A copy of the e-mail from the NSF detailing the issue has been provided in Appendix C. An explanation of the survey is summarized. A section follows which details why the data of interest is considered "restricted" including the security requirements for them. Finally, a section explaining the research questions the data would have answered is provided.

Survey of Earned Doctorates

The SED provides annual first-hand data of doctorate recipients receiving a research doctorate (NSF c.). Unlike the SDR, the SED asks specifically about financial support the respondent received for their educational studies. The evaluation is inquired of the respondent during the year they graduated offering solid up to date data on the institution's practices without the error of poor recollection. The data of interest were considered "restricted".

Restricted Micro Data

The micro data designated by the NSF as "restricted" are not publicly available and requires security measures for analysis. The NSF's website (NSF e.) explains why the data of interest are not public and is considered restricted:

In some cases SRS [Division of Science Resources Statistics], staff believe that protection of respondent confidentiality would require such extensive recoding

that the resulting file would have little, if any, research utility. In these cases we do not issue a public use file. However, we have developed a variety of methods to assist individuals in using the data in this situation. In some cases, researchers are able to state their needs for tabulations or other statistics with sufficient specificity that necessary summary information can be provided without the need for access to microdata. In other cases, NSF and the researcher can execute a license agreement that permits the researcher to use the data files at NSF's offices in Arlington, Virginia or at the researcher's academic institution. (Microdata Files and Data Licensing, ¶4)

Dr. Deniz Gevrek, Assistant Professor at TAMU-Corpus Christi who used restricted data for her dissertation, explained through e-mail that receiving restricted micro data is time consuming, and approximately 6 months should be budgeted to receive the data from the NSF, (personal communication, March 6, 2010). This timeframe has been found to be completely accurate based on my interaction with the NSF.

The restricted SED is first hand micro data, which provides extraordinary insight into the policies being practiced by the institutions of interest. To obtain the restricted micro data a license is required. Dr. Mark Fiegenger, Project Officer at the NSF, of the SED was contacted. He explained through e-mail that Texas State University–San Marcos was eligible to receive a restricted-use data license (personal communication, April 1, 2010). Only those who are employees of the institution are qualified to obtain the data (National Science Foundation, 2008).

The restricted data require security procedures. One necessity is a computer formatted to the security guidelines in a room with limited access. As stated in the NSF/SRS Restricted-Use Data Procedures Guide the security requirement includes:

- A non-laptop stand-alone computer
- Password requirements
- Boot-up warning screen
- No connections to networks

Using the restricted data three research questions would have been investigated.

The research plan as edited with help from the NSF is provided in Appendix B.

Restricted Data Question 1

What financial support packages (citizenship detailed) are the institutions of interest providing in S&E? The interest here is to investigate if the financial support packages provided to foreign students match North's 1998 study where only 10% foreign students' support came from overseas. North (1995) also found "... the further you are from U.S. citizenship the more likely you are to secure American funding" (p. 83). The first hand data will be an updated enhancement to North's 1998 study and his 1995 findings. Unlike the public data, the restricted data are more detailed allowing a better understanding into the financial support packages offered.

Restricted Data Question 2

Of these primary support packages provided by the institutions of interest in S&E, which can be charged to a federal grant as a direct cost? The answer to this question will examine which institutions are benefiting from charging the federal government higher direct costs for the student's financial support package. Noll and Rogerson (1997)

explained 30% charged to a federal grant are indirect costs. Therefore, 70% charged to a federal grant are direct costs. Though the primary support packages that can be charged to a federal grant as a direct cost do not encompass all the expenses that can be charged as a direct cost, the answer will give a hint of which universities are enjoying higher direct cost reimbursement.

Restricted Data Question 3

What is the quality of the students (citizenship detailed) the institutions of interest are receiving in S&E? North (1995) found that the foreign students admitted were the “cream of the crop” from their country; however, Borjas (2002) explains the foreign student does not pay. This question will probe the quality of the foreign students further.

The conflict between state and federal law was unfortunate. The SED data would have provided extraordinary insight into individual institutions and their financial support packages, citizenship specifically. A more detailed investigation on to the quality of students they admit could have occurred. Future researchers are encouraged to continue this work in a state that does not contain the conflict.

APPENDIX A

Institutions of Interest - RU/VH

Name	Control	IIE Leading Institution	RTP Native	RTP Foreign	Enrollment Cap
University of Alabama at Birmingham	1	1	1	1	0
Arizona State University at the Tempe Campus	1	1	1	0	1
University of Arizona	1	0	1	0	1
California Institute of Technology	0	0	1	1	0
Stanford University	0	0	1	1	0
University of California-Berkeley	1	1	1	0	0
University of California-Davis	1	0	1	0	0
University of California-Irvine	1	0	1	0	0
University of California-Los Angeles	1	1	1	0	0
University of California-Riverside	1	1	1	0	0
University of California-San Diego	1	0	1	0	0
University of California-Santa Barbara	1	0	1	0	0
University of California-Santa Cruz	1	0	1	0	0
University of Southern California	0	0	1	1	0
Colorado State University	1	0	1	0	1
University of Colorado at Boulder	1	1	1	0	1
University of Colorado at Denver and Health Sciences Center	1	1	1	0	1

Institutions of Interest - RU/VH (*continued*).

Name	Control	IIE Leading Institution	RTP Native	RTP Foreign	Enrollment Cap
University of Connecticut	1	1	1	0	0
Yale University	0	1	1	1	0
Georgetown University	0	0	1	1	0
University of Delaware	1	0	0	0	0
Florida State University	1	0	1	1	0
University of Florida	1	1	1	1	0
University of Miami	0	1	1	1	0
University of South Florida	1	0	1	1	0
Emory University	0	1	1	1	0
Georgia Institute of Technology-Main Campus	1	1	1	1	0
University of Georgia	1	0	1	1	0
University of Hawaii at Manoa	1	1	0	0	1
Iowa State University	1	0	1	1	0
University of Iowa	1	1	1	1	0
Northwestern University	0	0	1	1	0
University of Chicago	0	1	1	1	0
University of Illinois at Chicago	1	0	1	1	0
University of Illinois at Urbana-Champaign	1	0	1	1	0
Indiana University- Bloomington	1	0	1	0	0
Purdue University-Main Campus	1	1	1	1	0
University of Notre Dame	0	0	1	1	0
Kansas State University	1	1	1	1	0
University of Kansas Main Campus	1	1	1	1	0
University of Kentucky	1	1	1	0	0
Louisiana State Univ & Ag & Mech & Hebert Laws Ctr	1	0	1	1	0
Tulane University of Louisiana	0	0	1	1	0
Boston University	0	0	1	1	0
Brandeis University	0	1	1	1	0
Harvard University	0	1	1	1	0
Massachusetts Institute of Technology	0	0	1	1	0
Tufts University	0	0	1	1	0

Institutions of Interest - RU/VH (*continued*).

Name	Control	IIE Leading Institution	RTP Native	RTP Foreign	Enrollment Cap
University of Massachusetts- Amherst	1	1	1	1	0
Johns Hopkins University	0	0	1	1	0
University of Maryland- College Park	1	0	1	1	0
Michigan State University	1	0	1	1	0
University of Michigan- Ann Arbor	1	0	0	0	0
Wayne State University	1	1	0	0	0
University of Minnesota- Twin Cities	1	0	1	1	0
University of Missouri- Columbia	1	0	1	0	0
Washington University in St. Louis	0	0	1	1	0
Montana State University- Bozeman	1	0	0	0	0
Duke University	0	0	1	1	0
North Carolina State University at Raleigh	1	1	1	1	1
University of North Carolina at Chapel Hill	1	0	1	1	1
University of Nebraska at Lincoln	1	0	1	1	0
Dartmouth College	0	0	1	1	0
Princeton University	0	1	1	1	0
Rutgers University-New Brunswick	1	0	0	0	0
University of New Mexico- Main Campus	1	0	1	1	0
Columbia University in the City of New York	0	0	1	1	0
Cornell University- Endowed Colleges	0	1	1	1	0
New York University	0	0	1	1	0
Rensselaer Polytechnic Institute	0	0	1	1	0
SUNY at Albany	1	1	1	0	0
SUNY at Buffalo	1	1	1	0	0
SUNY at Stony Brook	1	0	1	0	0
University of Rochester	0	0	1	1	0

Institutions of Interest -
RU/VH (continued).

Name	Control	IIE Leading Institution	RTP Native	RTP Foreign	Enrollment Cap
Yeshiva University	0	0	1	1	0
Case Western Reserve University	0	0	1	1	0
Ohio State University-Main Campus	1	0	1	0	0
University of Cincinnati- Main Campus	1	1	1	0	0
Oregon State University	1	0	0	0	0
Carnegie Mellon University	0	0	1	1	0
Pennsylvania State University-Main Campus	1	0	0	0	0
University of Pennsylvania	0	0	1	1	0
University of Pittsburgh- Main Campus	1	1	0	0	0
Brown University	0	0	1	1	0
University of South Carolina-Columbia	1	1	1	1	0
University of Tennessee, The	1	0	0	0	0
Vanderbilt University	0	0	1	1	0
Rice University	0	1	1	1	0
Texas A & M University	1	1	1	1	0
University of Texas at Austin, The	1	0	1	1	0
University of Utah	1	0	1	0	0
University of Virginia- Main Campus	1	0	1	0	1
Virginia Polytechnic Institute and State Univ	1	0	1	0	1
University of Washington- Seattle Campus	1	0	1	0	0
Washington State University	1	0	1	0	0
University of Wisconsin- Madison	1	0	0	0	1

APPENDIX B

Attachment #1:

Data Requirements June 18, 2010

Doctorate Records File Data Requested for the Research (requested June 2010):

Cases requested:

Years of Interest

1980 to 2008

Fields of Study

Computer & Information Sciences 400, 410 and 419

Engineering 300, 303, 306, 309, 312, 315, 318, 321, 324, 376, 327, 330, 333, 336, 339,
342, 345, 348, 351, 357, 360, 363, 366, 369, 372, 398, 399

Mathematics 425, 430, 420, 460, 435, 440, 445, 465, 450, 455, 498, 499

Physical Sciences

Astronomy

500,505,

Atmospheric Science & Meteorology

510, 512, 514, 518, 519

Chemistry

520, 522, 526, 530, 532, 534, 538, 539,

Geological & Earth Sciences

542, 540, 552, 544, 548, 546, 550, 558, 559,

Ocean/Marine Sciences

585, 590, 595, 599,

Physics

560, 576, 561, 565, 574, 568, 569, 564, 570, 572, 578, 579

Variables requested:

TUITREMS Tuition remission - full or partial

SRCEA Fellowship, scholarship

SRCEB Grant

SRCEC Teaching assistantship

SRCED Research assistantship

SRCEE Other assistantship

SRCEF Traineeship

SRCEG Internship, clinical residency

SRCEH Loans (from any source)

SRCEI Personal savings

SRCEJ Personal earnings during graduate school (other than sources listed above)

SRCEK Spouse's, partner's, or family's earnings or savings

SRCEL Employer reimbursement/assistance

SRCEM Foreign (non-U.S.) support

SRCEN Other source of support

SRCEPRIM Primary source of support
 SRCE1ED Edited primary source of support
 SRCESEC Secondary source of support
 UDEBTLVL Undergraduate debt level
 GDEBTLVL Graduate debt level
 DEBTLVL Cumulative debt level
 PHDINST Doctoral institution
 PHDCARN Doctoral institution Carnegie classification
 PHDCARNP Doctoral institution Carnegie public/private indicator
 CITIZ Type of citizenship
 CNTRYCIT Country of citizenship
 DOCCODE Type of Doctorate
 PHDDISS Dissertation field
 PHDTYPE1 Type of Doctorate
 PHDTYPE2 Applied research Doctorate type
 PHDY Fiscal year of Doctorate
 MAINST Master's institution
 MAFIELD Master's field
 MAMONTH Month of Master's
 MAYEAR Year of Master's
 GEMONTH Month of graduate entry
 GEYEAR Year of graduate entry
 TOBAGE Time out Baccalaureate-graduate entry
 TOGEMA Time out graduate entry-Master's
 MACARN Master's institution Carnegie classification
 MACARNP Master's institution Carnegie public/private indicator
 BAINST Baccalaureate institution
 BAFIELD Baccalaureate field
 BAMONTH Month of Baccalaureate
 BAYEAR Year of Baccalaureate
 BAPLACE Place of Baccalaureate institution
 BANONE No Master's and/or Baccalaureate indicator
 TOCEBA Time out college entry-Baccalaureate
 BACARN Baccalaureate institution Carnegie classification
 BACARNP Baccalaureate institution Carnegie public/private indicator
 TTDBAPHD Total elapsed time from Baccalaureate to Doctorate
 TTDGEPHD Total elapsed time from graduate entry to Doctorate
 YRSCOURS Years of Doctoral coursework
 YRSDISST Years preparing dissertation
 YRSNOTWRK Years not working on Doctoral degree
 YRSGRAD Years from graduate entry to Doctorate
 MSPREREQ Prerequisite Master's degree for Doctoral program
 PHDENTRY First year at Doctoral institution
 PHDMONTH Month of Doctorate
 PHDCY Calendar year of Doctorate
 TOGEPHD Time out graduate entry-Doctorate

TICEPHD Time in college entry-Doctorate
TOMAPHD Time out Master's-Doctorate
PHDCOUNT Number of research Doctorates received
PROFDEG Type of professional Doctorate
PROFYEAR Year of professional Doctorate
TICEPHD Time in college entry-Doctorate

**Attachment #2:
Research Plan
June 18, 2010**

Introduction

A vicious cycle has been created. It is not cost effective for a U.S. native to enter graduate school because the five or six years required to complete a Ph.D. imply an opportunity cost of hundreds of thousands of dollars in the form of employment in the private sector without the doctorate. On the other hand, research universities need graduate students to work in their laboratories and thereby generate federal grant revenue. Science and engineering (S&E) fields account for a majority of all federal support for university research. S&E receives most of the research money and provides the best opportunity for a student to receive full funding. The absence of U.S. natives creates openings for foreign students to fill. The swelling of foreign student enrollment in S&E constructed the argument that foreign students are now entering the programs that natives find too challenging; when in reality obtaining a Ph.D. does not pay. This thesis explores whether and how research universities are enhancing their revenues by giving preference to foreign students over natives.

The Survey of Earned Doctorates (SED) offered by the National Science Foundation (NSF) provides first-hand data of doctorate recipients receiving a research doctorate. The principal researcher is interested in institutional comparisons of the financial support packages (Question 1) they are providing their native and foreign born students independently in the science and engineering (S&E) fields. These institutions are expending these costs to the government as a direct cost (Question 2). The quality of students these institutions are charging for such expenses will be investigated (Question 3).

Research Questions

QUESTION 1

What financial support packages (citizenship detailed) are specific institutions providing in science and engineering?

The main variables investigate for this question focus on the sources of financial support, tuition remission, most support, and debt level. Insights gleaned from this question will provide a glimpse as to how specific institution's foreign born students are financing their education compared to their native counterparts.

QUESTION 2

Of these primary support packages provided by these specific institutions in science and engineering, which can be charged to a federal grant as a direct cost?

The answer to this question will examine which institutions are benefiting from charging the federal government higher direct costs for the student's financial support package. 70% charged to a federal grant are direct costs. Though the primary support packages that can be charged to a federal grant as a direct cost do not encompass all the expenses that can be charged as a direct cost, the answer will give a hint of which universities are enjoying higher direct cost reimbursement. Tuition remission, sources of financial support and most support are the main variables of interest.

A comparison to the Survey of R&D Expenditures at Universities and Colleges may be investigated to illustrate an institution which benefits from more direct cost reimbursement has the capability to expend more money. Likewise a comparison to the Survey of Federal Science and Engineering Support to Universities, Colleges, and Nonprofit Institutions may also be explored to demonstrate an institution with higher direct costs receives more federal funding for research.

QUESTION 3

What is the quality of the students (citizenship detailed) these specific institutions are receiving in science and engineering?

It is often stated the foreign students admitted are the “cream of the crop” from their country. A defined method for student quality will offer evidence on the claims that foreign students are better prepared. This defined method will be an algorithm which will take into account the individual’s Bachelor and Master’s degree institutions using the Carnegie classification, their background field, possible work experience by considering time elapsed between degrees, and total time to graduate for their undergraduate and graduate careers.

Although only a very small number of individuals receive more than one doctorate clearly having an additional doctorate would add to the individual’s quality. Therefore the PHDCOUNT variable is important.

Anticipated Analytical Methods

The collaborating researcher anticipates on using three methods to analyze the data: trend, regression and comparison charts.

Trend

Trend analysis will be used to investigate changes made by specific institutions based on the political environment at that time. Trends from the 1980 to 2008 is of interest.

Regression

Regression analysis is an anticipated analytical method. For instance, total financial support that can be charged as a direct cost to research expenditures by that institution using data from the Survey of Research and Development Expenditures at Universities and Colleges.

Comparison Charts

To neatly document institutional comparisons visual charts will be used. Anticipated comparisons include: percentages detailing primary financial support, student quality, and total financial support that can be charged to a federal grant as a direct cost.

Appropriateness of the restricted data for the research

The SED is the only single source of information documented by the actual individual. Unlike other surveys which collect the data from the academic departments it is the individual who would know best their background and how their education was funded as it is a first-hand account without bias.

The public data on WebCASPAR does not provide the detail of primary financial support packages itemized. There are few resources on primary financial support listed. Tables and charts found in NSF reports and InfoBriefs also lack detail. The NSF reports and InfoBriefs that do separate by citizenship do not indicate the institution the individuals attended. Often the tables and figures detail race, which is not the focus of the study as the foreign born and U.S. citizens can categorize into all categories of race/ethnicity. Likewise the study is not interested in debt in dollars, but rather primary financial support itemized provided by each specific institution. Numerous tables and figures found in the publicly available data split into fields which are not the interest of the study. The study's focus is on science and engineering as a whole.

Investigating a trend analysis from the 1980s to 2008 is impossible with the publicly available data on WebCASPAR as the variables of interest are not provided. Any NSF reports and InfoBriefs that do have an element of the interested variables provide mere parts of the data only for a one year. It is unfeasible to answer the research questions accurately by applying the disjointed tables and charts publicly available. However, it is important to note doing so does increase error in the analysis. All tables and charts are displayed for only one year and the data is displayed differently for those years. Using the SED restricted micro data provides the best data source in it's entirety to answer the research questions without bias and error.

Why the publicly available data is not sufficient

The SED, unlike the Survey of Doctorate Recipients (SDR), asks specifically about financial support the respondent received for their educational studies. This level of detail: fellowships, grants, assistantships and tuition remission are not provided in the public data broken out by institution. Similarly, the public data does not provide bachelor degree and master degree data which will be used in the measurement of quality.

Summary

The data absent from the public data are: primary financial support in citizenship detail for specific institutions. Similarly, to determine the quality of student admitted the TTD and RTD is never divided by institution and the type of degrees these individuals obtained. Trend analysis is desired and the public data provides for only one year such as 2006 and 2007-2008 where the study is interested in analysis from 1980 to 2008.

Anticipated Data Use

The data will be used for institutional comparisons to determine if there are similar characteristics based on their policies. Probable comparisons include: very high research universities (based on the Carnegie classification system) to low research universities, public to private universities, and universities with high foreign student enrollment to those with low foreign student enrollment.

List of Collaborating Researchers at University of Texas – San Marcos:

Marcie Gard

Eric Blankmeyer Ph.D.

Robert B Habingreither Ed.D.

Dean Showalter Ph.D.

**Attachment #3:
Restricted-Use Data Security Plan
June 18, 2010**

Limit Room/Area Access

The stand alone Dell computer (Service Tax DDW6351) will be located in Room 4219 in the Roy F. Mitte building at Texas State University – San Marcos. This room is adjacent to the Principle Researcher's office (RFM 4221). Access to the computer will be restricted to the Principle Researcher and the Collaborating Researchers only. Entrance to the room will be limited to the Principle Researcher, the Collaborating Researchers, and Custodial Staff. When the room is cleaned by custodial staff after hours the computer will be shut down enabling the power-on password.

Backup Copy

One backup copy of the restricted-use data will be made and stored on a CD ROM. The additional backup copy will be secured in a locked filing cabinet in room RFM 4219.

Handling Security

The following procedure will be conducted when working with Collaborating Researchers outside of room RFM 4219 and in their respective offices:

1. The tables and charts needed for the discussion will be printed on a dedicated printer.
2. The printed documents will be hand carried to a Collaborating Researcher's office.
3. After the meeting the documents will be hand carried back to room RFM 4219.
4. The documents will be secured in a locked filing cabinet.

This procedure was deemed acceptable by NSF's Confidentiality Officer (and Chief Statistician) c/o Mark Fiegenger, Ph.D. Project Officer, Survey of Earned Doctorates by e-mail on May 13, 2010.

APPENDIX C

Your application for a license

Kannankutty, Nirmala [nkannank@nsf.gov]

Sent: Thursday, July 22, 2010 3:38 PM

To: [Batey, Andy H](#); [Gard, Marcie A](#)

Cc: [Kannankutty, Nirmala \[nkannank@nsf.gov\]](#); [Cohen, Stephen H. \[scohen@nsf.gov\]](#);

[McQueen, Adrian V \[amcqueen@nsf.gov\]](#)

Dr. Batey and Ms. Gard,

I know you have been working with us for a couple of months on obtaining a license for the SED data. While the focus of the early part of the process has been on the research plan, we had now moved to the portion where the research plan was almost complete, and we begin looking at the rest of the documents that must be finalized.

I had shared your application materials with our chief statistician, who is also our confidentiality officer and reviews license applications. He immediately raised a legal issue with me that has just very recently come up with regard to license applications from state schools in Texas. The State of Texas has in place an open records law, which impacted another recent license applicant from Texas. Under this law, once the NSF data was in your possession, it would have to be made available to anyone who asked for it. However, this is not allowed under our licensing procedures and various federal laws protecting this data. It was not possible for a license to be initiated with this other applicant, and it seems unlikely that we could do so at your institution.

You may, of course, continue to use our publicly-available data. And SRS is currently working on setting up a virtual data center that would house the SED data where you could access the data without physically having it at your institution. However, that facility is not yet ready for you to use - it will be some time before it is ready. We do not currently see a clear path for you to obtain a license. The only additional step you could take would be to initiate a dialogue between the Texas State-San Marcos general counsel and our confidentiality officer (Dr. Stephen Cohen).

I'm sorry that we have hit this roadblock - we certainly want to encourage new users for our data. If there is anything further that I can do to help, please don't hesitate to let me know. I am going to keep your research plan on file, if the virtual data center or some other mechanism becomes a possibility for you to use.

Sincerely,
Nimmi

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and engineering enterprise,
see <http://www.nsf.gov/statistics>

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VITA

Marcie Gard graduated from SUNY College of Technology-Alfred State in 2000 with a Bachelor of Science in Electromechanical Engineering Technology. She selected the field because of the “worker shortage”. Upon graduation she worked for Corning Incorporated. Telecom was growing at the time causing the company to conduct massive hiring. In 2002 telecom busted and layoffs ensued. Selecting to be voluntarily laid off she saw co-workers who entered the country on H-1B visas forced to leave the country immediately. Those with Ph.D.s were laid off without care for their advanced degree. Why these individuals were let go is unknown. After all, there was a “worker shortage”. Fortunately, a local company Keller’s Inc. hired her. Unfortunately two years later the company laid off her and her husband one week after Christmas. They decided to move to Austin without jobs as the economy was growing in Texas. She obtained temporary employment at Ultra Clean Technology in 2004. Marcie found a permanent position for EMIT Inc, a systems integrator for Dell. In 2005, she obtained a position with the Institute for Advanced Technology (IAT). In June 2007, she entered the Graduate College of Texas State. Currently Marcie was able to survive two layoffs at the IAT. She doesn’t know why there were layoffs because research and government jobs were more stable than industry. Perhaps they don’t know about the “worker shortage”.

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This thesis was typed by Marcie A. Gard