FACTORS INFLUENCING RESEARCH AND DEVELOPMENT FUNDING TO HISTORICALLY BLACK COLLEGES AND UNIVERSITIES

By

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TABLE OF CONTENTS

LIST OF TABLES

Table page

LIST OF FIGURES

Abstract of Dissertation Presented to the Graduate School
of the University of Florida in Partial Fulfillment of the
Requirements for the Degree of Doctor of Philosophy

FACTORS INFLUENCING RESEARCH AND DEVELOPMENT FUNDING
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By

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This study is an analysis of geographic, economic, and institutional factors that effect the amounts of research and development dollars historically black colleges and universities receive from external sources. Funds received in fiscal year 2000 by fifty-seven institutions are examined to determine which factors are relevant, and to what degree.

The findings of this study show that institutional proximity, to resource-rich centers performing academic research and development directly and indirectly support historically black colleges and universities that are high in degree production. Some of these institutions have active degree doctorate degree programs which further enhance their attraction. The combination of number of total degrees conferred, number of doctorate degrees conferred, and shared metropolitan location with research class mainstream universities explains sixty-six percent of the influencing factors on research and development expenditures received by the black colleges and universities in this study.

CHAPTER 1
INTRODUCTION AND STATEMENT OF THE PROBLEM

Historically black colleges and universities (HBCUs) came into being during a time when blacks were denied access to institutions of higher learning in the United States, primarily in the South, and they faced restricted access outside of the racially segregated South. Their collective purpose has been to provide black students with opportunities for scholarship and professional training. Now in a more racially and ethnically integrated society, HBCUs still remain very relevant. The general relevance of black colleges and universities can be seen in their abilities to provide a more socially cohesive environment for minority students. They are also remarkably successful at preparing students for leadership roles in their community and the greater society. Lastly, and most pertinent to this study, HBCUs successfully prepare students for the job market, particularly in the fields of the hard sciences and engineering (Wenglinsky 1997).

The economic advancement and stability of the United States is linked to a number of critical factors, none more important than a strong science and technology labor force that draws from homegrown talent. With ever-increasing regional and international competition, as a given, the development, retention, and growth of the American science and technology labor force strengthens the competitive advantages the United States holds in terms of scope and scale. The ongoing global competition for the best ideas, talent, facilities, and financing makes the development of human capital a national priority.

Funding for science and technology related activities, conducted by colleges and universities, is the life's blood of what is called "academic research and development."

The tremendous administrative and operational costs involved with these activities cannot be met and maintained without support from outside sources. The very nature of institutions of higher learning as centers principally formed to create and facilitate knowledge place some limits on the degree to which and how they generate financial profits. Therefore funding from outside sources is critical for every academic institution engaged in research. The history, accomplishments, and comparative status of HBCUs to non-HBCUs make the support for scientific research at HBCUs worthy of study.

The Purpose and Goals of this Study

The purpose of this research is to identify what factors influence R&D funding to HBCUs. Geographic, economic, and institutional variables examined in this study based the literature that factors of agglomeration, such as size, scope, access, proximity, resource concentration, urbanization, formal political and economic relationships, and regional development, along with academic prestige are relevant in answering the research questions examined here (Malecki 1986, 1991, and 1991a; Smilor and el at. 1991; Gertler 1995; Feldman 1994, 1994a, 2003; Feldman and Desrochers 2003; Florida 1995; Storper 1995; Storper and Walker 1989; Mowery and Rosenberg 1993, 1996; Rosenberg and Nelson 1996). The independent variables used in this resarch are good indicators for these factors.

The geographic themes of location, place, and region are particularly relevant to this study. The theme of location is significant because it conceptualizes the power that fixed sites have to draw (or not draw) specific human activities, and the opportunities and growth that may ultimately result. The theme of place is critical as it represents the importance of the human and physical differences of each location. The general

similarities of any two or group of locations also informs us in this research endeavor. Yet it is the uniqueness of locations (in a relative sense) that reinforces the geographic value of this study. The theme of region is germane to this study because the formal (i.e.), administrative boundaries of states, academic institutions, and populated areas largely determine the nature and function of the places and institutions examined (Camagni 1991; Malecki 1991; Tassey 1991; Sweeney 1991; Feldman 1994; Gertler 1995; Smilor and el. at. 1993; Feldman and Desrochers 2003; Storper 1995).
In essence, form defines function, so recognizing region conceptually, and how it is perceived, will be very useful in this research. Development outcomes often hinge on the perception of region (Storper 1995; Tassey 1991; Malecki 1991).

With regard to the broader national perception of historically black colleges and universities, the significance of HBCUs as a group can be easily overlooked considering the academic prestige and more visible social impact, better known elite research universities and ivy-league institutions. HBCUs have had an under-valued, yet important role in America's national scientific and technological infrastructure. The U.S. science and technology community is comprised of the worlds of academia, industry, and of course, government – local, state and federal. Channels to funding and maxim use of those channels are indispensable to the perpetuation of science and technology (S&T) activities by U.S. universities and colleges.

My basic underlying assumption prior to the start of this research was as follows: access to and possession of more resources by HBCUs produces more college graduates and higher graduation rates, and these are therefore likely to attract greater outside funding support.

Research Question and Hypotheses

The research question explored in this study is: What are the main factors that influence external R&D funding received by HBCUs?

The test hypotheses capture the relevance of each independent variable employed in this study. All sixteen variables are examined.

H_o1:Metropolitan statistical area size (MSA) has no effect on funding.
H_a1: Metropolitan statistical area (MSA) size affects funding.

H_o2: State (or federal) capital home location has no effect on HBCU funding.
H_a2:State (or federal) capital home location affects funding.

H_o3: The number of other HBCUs in the state receiving federal R&D funds has no effect on funding.
H_a3: The number of other HBCUs in the state receiving federal R&D funds affects funding.

H_o4: The number of research non-HBCUs in the same (MSA) with HBCU has no effect on funding.
H_a4: The number of research non-HBCUs in the same (MSA) with HBCU effects funding.

H_o5: State personal income level (per capita) has no effect on funding.
H_a5: State personal income level (per capita) affects funding.

H_o6: State R&D concentration has no effect on funding.
H_a6: State R&D concentration affects funding.

H_o7: State higher education current fund expenditures have no effect on funding.
H_a7: State higher education current fund expenditures affect funding.

H_o8: State academic R&D performance has no effect on funding.
H_a8: State academic R&D performance affects funding.

H_o9: Control of institution has no effect on funding.
H_a9: Control of institution affects funding.

H_o10: The size of student enrollment has no effect on funding.
H_a10: The size of student enrollment affects funding.

H_o11: The total number of degrees conferred has no effect on funding.
H_a11: The total number of degrees conferred affects funding.

H_o12: The number of doctorate degrees conferred by a HBCU has no effect on funding.
H_a12: The number of doctorate degrees conferred by a HBCU affects funding.

H_o13: HBCU graduation ratios have no effect on funding.
H_a13: HBCU graduation ratios affect funding.

H_o14: The size of HBCU library holdings has no effect on its funding.
H_a14: The size of HBCU library holdings affects funding.

H_o15: HBCU student / faculty ratio have no effect on funding.
H_a15: HBCU student / faculty ratio affects funding.

H_o16: Land-grant status held by a HBCU has no effect on funding.
H_a16: Land-grant status held by a HBCU affects funding.

The significance of these test hypotheses can lead to an advancement of research and possible theorization that will help us better understand what combination of factors for HBCUs best attract R&D dollars. The significance can lead to better understanding and support, both internally and externally, of the factor endowments HBCUs have and need to develop in order to compete more effectively and consistently for R&D dollars.

Testing of these hypotheses also gives us an opportunity to discover more about the role of place, location, and region as geographic themes in a decentralized system of multiple institutions and agencies, multiple needs and expectations, interdependencies and economic pressures.

Structure of the Research

Chapter 1 is the introduction and includes the rationale, significance and need for the study, statement of the problem to be investigated, hypotheses and research questions to be answered, and the limitations of this study.

Chapter 2 focuses on the nature and dynamics of university funding and academic research and development (R&D). What is known and not known about this relationship will be examined as it has been addressed in the research literature. This chapter will conclude with a statement about contributions this study will make to the research literature in the areas of university funding and HBCUs.

Chapter 3 presents a profile of historically black colleges and universities, their origin and history, objectives, and role in higher education. Also included is a comparison of HBCUs as a group will be made to a comparable set of non-HBCUs in the United States. A brief comparison helps to contextualize HBCUs as institutions in the decentralized American educational system in which they co-exist, collaborate, and compete.

Chapter 4 presents the research design. The chosen general method, specific procedures, and the research population will be described here. Instrumentation and data collection methods used will precede a discussion of the treatment of the data.

Chapter 5 reports the research findings. The tested research questions of the study will be reviewed in light of the findings.

Chapter 6 is the final chapter with explanations and conclusions based on the findings. Strengths and limitations of the study will be examined followed by a section on the implications of the study's findings. Recommendations for further research,

changes in professional practice, theoretical constructs, and institutional policies and organization will be given.

There are limitations in this study in several areas. This study does not include all of the HBCUs in the United States. The primary reason is the absence of sufficient data. However this sample population of fifty-seven schools is very representative of the diversity and range of black institutions of higher education in the U.S. The National Science Foundation's requirements related to acquisition and use of funding restricted the sample population size. Nevertheless over half (55%) of all HBCUs in the United States are included in this research. The independent variables number sixteen. There was a need to work with a manageable number of indicators so the cut off point was made at sixteen as an arbitrary limit.

This research is undertaken to make a contribution towards the literature on external funding of academic research as it relates to the HBCUs.

The literature primarily focuses on the necessity of funding academia, and technology transfer – an institutional activity that attracts R&D funds, but a broader approach at capturing less competitive institutions like HBCUs has not been done. Thanks to the National Science Foundation (NSF) data on the distribution of academic research and development funding and subsequent academic research and development performance is consistently made available to the public.

Conceptual limitations are perceived in an exploratory study of this type because of the political dimensions of institutional and system-level interactions that will not or cannot be measured here. Governmental, industrial, and academic components form a

complex and changing environment that results in the nature and look of academic R&D funding.

Notably, at times, it was necessary to use data from the closest approximate years to the time frame of the study. Also in a few cases, HBCU data for some variables are approximated or not available. A list of selected key terms and definitions useful to this study are to be found in Appendix C.

CHAPTER 2
ACADEMIC R&D FUNDING

This chapter presents the basics of research and development funding, a general overview of U.S. academic R&D funding, a summary report of R&D expenditures in the U.S., a section on the concept of a national innovation system, followed by a look at HBCUs in the context of academic research and development funding.

The Basics of Research and Development Funding

Basic research, applied research, and development form the character of the work called research and development (R&D). Those who conduct R&D are the recipients of the funding for the work. Performers of R&D include the federal government, industry, academia, non-profit institutions, and federally funded R&D centers. There are four possible funding sources for research and development, regardless of who conducts the work and the character of the work: federal government, state and local government, industry, academia, and non-profit institutions. The funds that finance research and development are in the monetary unit of current U.S. dollars. These funds are spent, and the work is performed geographically within the nation's 50 states, the District of Columbia, and the Virgin Islands.

It is important to remember that, in this study and in science resource statistical reports, R&D expenditures are used as a proxy for R&D performance, meaning once research and development expenditures are received the funds are reported as research and development performance (NSF 2006, 06-306).

Recent U.S. R&D Expenditures – Character of Work, Performing Sector & Source of Funds

Distribution percentages best tell the story of the relationships between the entities and factors that define and create research and development. Table 2-1 tells us much about the character of work of the main entities of the R&D system, industry, federal government, universities and colleges, and other non-profit institutions. In total research and development performance, industry is by far the largest R&D performer. In 2006, industry at 65% did twice the work of the federal government (28.2%), with universities and colleges at only 3.5%. Industry does more than half of the applied research in the U.S. with 61%, receiving 65.5% of its R&D expenditures in 2006. Industry performed 82.2% of the development and received 90% of all funding for development activities in 2006. For its leading role in R&D, the industrial sector garnered 70.5% of the total amount of R&D expenditures ($342,886,000,000).

Industry received only 15.9% of expenditures for basic research, doing 16.2% of its work in 2006. The federal government is the primary facilitator of 60.4% of basic research receiving 9.8 % of the expenditures, 31.7% of applied research with 9.8% of the total funds spent on applied research in 2006. The federal government performed 16.6% of development with 5.9% of the expenditures. The role of the federal government as R&D performer intentionally is minimized through its establishment and support of federally funded research and development centers (FFRDCs) administered by industry, universities and colleges, or non-profit institutions (NSF 2006, 06-306).

Universities and colleges (U&C) strongest work percentage contribution is in the area of basic research (13.1% in 2006, with 58% of all basic research funds). In applied R&D, universities and colleges performed only 3.8% of the work and 0.3% respectively

in 2006. Academia's percentage of applied research performed in 2006 (3.8%) dropped from its 2004 percentage in 2004 (at 4.2%). As with basic research, universities and colleges received greater percentages of the expenditures for the work performed, with 13% of the total funds for applied research and less than 1% (0.9%) of the total funds for development (NSF 2006, 06-306). Universities and colleges traditionally have provided much of the foundational work that is advanced at the development stage by industry (Feller 1999).

Figure 2-1 shows that during the 50-year period of 1953 to 2004, there was a large increase in both the R&D performance and R&D funding sectors. Industry-financed R&D is mostly for internal projects or R&D projects contracted to other businesses. Less than 2% of industrial funding is external to other non-industry performers. In contrast, the federal government supports external funding with only 40% of its funding to federally funded research and development centers (FFRDCs) and its own agencies. Beneficiaries of external federal R&D funding include universities and colleges, state governments, non-profit organizations, and industry (NSF 2006, 06-306).

An Overview of Academic R&D Funding

This section will explore the current trends of R&D funding in the United States. The most current detailed data available is from fiscal years 2005 and 2006. Several themes will be addressed here: the general dispersion of academic research in the past 20 years, funding by academic field and federal agency, the federal government and industry as funding sources, non-science and engineering R&D expenditures, top academic research performers, pass-through funds, and top ranking R&D performing states.

Geiger and Feller (1995) looked at two of the prominent features of the American research system during the 1980s, the features of growth and dispersion. Growth was measured in terms of dollar increases for academic R&D. Dispersion was measured in terms of changes in shares of total R&D expenditures for the top 200 academic institutions between FY 1979-80 and FY 1989-90 (two-year averages). Their findings revealed a clear dispersal pattern of expenditures within the quality hierarchy determined by peer ratings of research doctorate programs.

Four tiers were formed based on their findings. The most evident loss of research share was among distinguished institutions (tier I). Share gain was greatest in the group of schools directly below top institutions (tier II).

However, smaller below-average performing institutions (tier III) exhibited an overall loss of research share (Geiger and Feller 1995, 346). Tier IV schools (medical and quasi-medical universities) did not fit the general dispersion pattern. These schools tended to gain research share irrespective of their institutional size or quality rating. The unique production function of medical schools explains why they do not fit the general pattern.

From this study, we learn that an institution's share of a given funding source could rise or fall while that source's share of total R&D might be rising or falling. This is a very important point to remember as it speaks to the relative effects of changes in funding sectors shares and in the institutional shares from these sectors (Geiger and Feller 1995, 340-349). Due to the selection of variables and the single time frame of this study it would be possible to examine the relative effects of changes over time in funding sectors on our sample population.

A brief, yet current, sense of academic research funding and its dispersion is possible through a consideration of several of its key aspects: funding by academic field, by federal agency and industry, and the role of pass-through funds. Top performing institutions and top performing states also will be briefly discussed.

Funding by Academic Field

When considering funding by academic field, including all sources of funding, the medical sciences (at $14.9 billion) and biological sciences (at $8.8 billion) account for the largest field shares of academia's R&D performance total (Table 2-2). Together, these two fields account for about one-half of R&D at universities and colleges. The largest percentage increases for FY 2005 were in the life sciences not elsewhere classified (15.3%) and in bioengineering biomedical (13.4%). There has been a significant rise in spending by universities and colleges on bioengineering and biomedical R&D in the last four years, with the amount almost doubling between FY 2001 ($213 million) and FY 2005 ($420 million).

A Rand Corporation's Science and Technology Institute report by Fossum and et al. (2004) highlighted issues of funding proportionality. From 1996 to 2002, the two-thirds of federal funds to academia for R&D concentrated on only one field of science – life science; also the funding was concentrated at only a relatively few research universities. The report addresses concerns about the implications of unmet national research and development needs in the areas of energy, environment, education, and homeland security, in addition to the shortchanging of science students at schools that receive little to no federal R&D funding (Fossum and et al. 2004).

Funding by Federal Agency

The most generous source of academic R&D funding is the federal government. Two federal agencies dominate as funding sources. The U.S. Department of Health and Human Services (HHS) provided the largest share of federal funding in FY 2005 ($15.9 billion), primarily in support of the medical and biological sciences (Table 2-3). The National Science Foundation (NSF) has provided the second largest amount of federal funding ($3.5 billion), with most (84%) of the funding going toward research and development in engineering and in the biological, computer, environmental, and physical sciences.

Health and Human Services accounted for 60% of all federal FY 2006 academic science and engineering (S&E) obligations. Three federal agencies, National Science Foundation (14%), Department of Defense (10%), and Health and Human Services, when combined provided 85% of total federal academic science and engineering funding. The Department of Agriculture, the Department of Energy, and NASA provided most of the remaining academic S&E total (11%). Of these six agencies, only the Department of Defense and the National Science Foundation showed increased constant 2000 dollar levels for academic S&E in FY 2006 (NSF 2008, 08-316).

Federal funding of academic R&D reached $29.2 billion in FY 2005 and maintained its 64% share of total academic R&D support. Research and development that is federally financed grew by a comparatively moderate 5.6% in FY 2005, ending the trend of annual double digit growth seen earlier this decade (13.75 in FY 2002, 13.2% in FY 2003, and 11.6% in FY 2004). Research and development expenditures financed by state and local government funding grew by 2.2% in FY 20005, to $2.9 billion.

From nongovernmental sources, research and development expenditures increased by their largest percentage this same year. In addition to the increase in industrial funding, institutional (internal) funding increased 6.5% in 2005 to $8.3 billion, and funding from all sources combined (non-profits and other non-governmental entities) increased 8.4% to $3.1 billion (NSF 2007, 07-311).

Funding by Industry

Industrial funding of academic R&D has much to do with the changing role of universities in the present day U.S. R&D system. In FY 2005 industrial funding for R&D in academic science and engineering (S&E) fields saw a recovery from a 3-year decline and grew by 7.7%, representing an all-time high of $2.3 billion. This increase was enough to stabilize the corresponding decline in industry's share of total academic funding, which fell from a high of 7.4% in 1999 to 4.9% in 2004 (Figure 2-2). Industry's share in FY 2005 of 5% is comparable to the share it held in FY 1983 (NSF 2007, 07-311).

Overall, universities and colleges reported R&D expenditures of $45.8 billion in 2005. This is 5.8% more than in the previous year ($43.2 billion) and a total that represents an increase of 52.1% over the $30.1 billion reported in FY 2000. In short, when adjusted for inflation, academic research & development rose 3% in FY 2005 to $45.8 billion, as shown in Table 2-4.

Non-Science and Engineering Expenditures

Not all academic research and development is performed in the fields of science and engineering. A total of $1.4 billion in non science and engineering R&D expenditures was reported in 2003 (this $1.4 billion is the amount from approximately 82% of the

institutions surveyed providing data in this area). In FY 2004, a slightly higher percentage of schools provided data (83.3%), and the reported amount of expenditures in these areas increased to $1.6 billion. The percentage of institutions providing non-science & engineering expenditures increased to 94.1% in FY 2005, and the reported amount of non science and engineering R&D expenditures increased to 1.8 billion (Table 2-5).

This amount is in addition to the $45.8 billion expanded on science and engineering R&D. The largest amounts reported for individual non science and engineering fields were in education ($761 million), business and management ($220 million), and humanities ($194 million). More than half of the federally funded non science and engineering expenditures (55.8% or $426 million) were in the field of education.

Pass-Through Funds

To the extent that research and development collaboration can be measured briefly and mentioned here, some data is available that reflects the portion of R&D expenditures that pass from the original recipient institutions through to other institutions. Pass through funds reflect the amount of joint work performed on R&D projects as well as funds received by sub-recipient institutions. Academic research and development expenditures that were passed through to higher education sub recipients increased from $1.3 billion in FY 2004 to $1.5 billion in FY 2005. This is compared to $1 billion passed through to non-higher education sub-recipients during the same period. Almost 90% ($1.4 billion) of the funds passed through to higher education sub recipients originated from federal sources.

Universities also reported an increase in R&D expenditures received as a sub-recipient from other higher education pass-through entities, from $1.4 billion in FY 2004 to $1.5 billion in 2005. As noted above, more than 90% ($1.4 billion) of the funds received from higher education pass-through entities originated from federal sources.

Top R&D Performing Universities

A small group of universities perform a significant percentage of academic research and development in the United States. The top 20 institutions, in terms of total R&D expenditures, accounted for nearly half a third (30%) of total academic R&D spending of the 640 institutions surveyed (Table 2-6). The top 100 research performers accounted for 80% of all research and development dollars in fiscal year 2005.

There were some position changes in the rankings between 2005 and 2006. Two universities were displaced from the top 20 in FY 2005: the University of Colorado slipped from 20th in 2004 to 22nd in FY 2005, and the University of Illinois at Urbana-Champaign fell from 18th in FY 2004 to 24th in FY 2005. The institutions replacing them were Columbia University in New York, which rose from 23rd in FY 2004 to 18th in FY 2005, and the University of Florida, which rose from 27th position to 20th place.

The most significant change of rank within the top 20 was Duke University, which had an increase of more than $100 million in academic R&D spending. This change elevated Duke from 14th place in FY 2004 to 10th place in FY 2005. (NSF 2007, 07-311) Table 2-7 shows the federal academic S&E support to the 20 leading universities in order of total S&E obligations by federal agency in FY 2006. John Hopkins University (including its Applied Physics Laboratory) continued to be the leading academic recipient of federal S&E obligations. Health and Human Services (HHS) and the

Department of Defense (DOD) combined gave John Hopkins University 86% of its federal S&E funds. The overwhelming majority (93%) of the university's total science & engineering obligations ($1.34 billion) supported R&D programs, with other S&E activities and FTTGs accounting for most of the remainder.

The leading 20 universities in Table 2-7 represent a little over one-third (35%) of the federal academic S&E total in fiscal year 2006. Nineteen of these 20 schools were also ranked among the top 20 in FY 2005. Vanderbilt University (ranked 20th in FY 2006, after being 23rd the prior year) replaced Cornell University, all campuses – which ranked 22nd in FY 2006, after being 19th the previous year (NSF 2008, 08-316).

Top R&D Performing States

As it is with R&D performance amongst academic institutions, a significant percentage of R&D performance in the United States takes place in a relatively small number of states. Research and development expenditures are highly concentrated in a limited number of states in the union. A little less than ten years ago, R&D data became available on a state by state basis. In 2000, the twenty highest ranking states in R&D expenditures accounted for 87% of the national total (Table 2-8). The lowest ranking 20 states had only 4% of the total (NSF 2003, 03-303). The same year, California led the nation in R&D performance with one-fifth of the U.S. total of $247 billion with $55 billion. California's expenditure total increased by nearly $11 billion (from its $44 billion) in fiscal year 1998. The six states with the highest levels of R&D expenditures – California, Michigan, New York, New Jersey, Massachusetts, and Illinois (in decreasing order of magnitude) – accounted for one-half of the total national effort.

Going further, adding (in descending order) Texas, Washington, Pennsylvania, and Maryland, the top ten states were responsible for two-thirds of the entire U.S. effort.

Considering the high level of concentration of R&D spending among U.S. states, it may not be surprising that among the top ten states there is also a high level of concentration. With $55 billion, California performed more than three times the dollar amount of the second ranking state – Michigan (over $18 billion). In the 2000, Pennsylvania and Maryland, in 9th and 10th positions respectfully, performed approximately one half of the research and development of the state of Michigan. Both states were under $10 billion in R&D expenditures.

Most of the states that lead the nation in total R&D performance are also the top ranked leaders in academic and industrial performance. Maryland is replaced by Ohio as a top 10 industrial R&D state. North Carolina and Georgia replaced New Jersey and Washington in the top 10 academic R&D states in 2000. This is most likely because of the strength of the major research universities that comprise in North Carolina Research Triangle and growing research activities at Georgia Tech and Emory University in the city of Atlanta.

States vary greatly in the size of their economies, population profiles, land areas, natural resources, infrastructure systems, and histories.

Therefore variations in R&D expenditure levels of states to a large degree reflect these differences (NSF 2003, 03-303).

Several of the top R&D performing states are ranked highly because they are the geographic locations of major national R&D centers. Maryland, Virginia, and the District of Columbia are states that form the metropolitan statistical area of the nation's capital.

This area has a strong concentration of federal R&D facilities and the administrative offices of federal agencies. Florida, Alabama, and New Mexico are homes to major national laboratories, national defense and aerospace facilities (NSF 2001, 01-320). The most recent statistics from the National Science Foundation (NSF) Survey of Federal Science and Engineering Support to Universities, Colleges, and Nonprofit Institutions show that government agencies reached a new high in current dollars of $28.7 billion to 1,226 academic institutions for science and engineering (S&E) activities in FY 2006.

However, this new high does represent in 2.3% inflation-adjusted decrease in constant 2000 dollars over FY 2005. Between FY 2004 and FY 2005 there was a 3.8% current dollar increase or a 0.6% increase in constant 2000 dollars (NSF 2008, 08-316). Overall, American universities and colleges reported science and engineering R&D expenditures of $47.8 billion in FY 2006. This is 4.3% more than FY 2005 ($45.8 billion). When adjusted for inflation, academic research and development rose by 1.2% in fiscal year 2006.

There are larger contextual reasons why academic R&D funding is important. They have to do with innovation and national resource investments. Therefore, some discussion of a U.S. or national innovation system is fitting.

The National Innovation System

What is the national innovation system? In this study, the term “national innovation system” is interpreted quite broadly to capture the dynamic activities and investments that result in economic, scientific, and technological gains on the national and

international level. No presumption exists that this system has been consciously designed or even that the entities involved work together in a smooth manner.

Any analysis or description of a nation's innovation system would be forced if it was presented as something separable from that nation's economic system if its innovation policies were presented as distinctive from issues related to national education and national security (Rosenberg and Nelson 1993, 13).

The concept of a national system of innovation is based on the competitive prowess of America's firms and the technological capabilities rooted in national resources and national action. Firms, universities, and governmental entities represent the three central components that interact in systematic patterns to promote innovation associated with economic performance.

National economic conditions are influenced greatly by the successes and setbacks of innovative firms. This intricate, massive innovative system relies heavily on the formation of new companies and firms. Also relying heavily on a diversity of resources and ideas, it has evolved to establish a large role for universities and colleges.

Nelson and Rosenberg (1993) remind us that the modern industrial laboratory and the modern research university matured together as companions.
Academic institutions have a critical role to play in technological advancement, as places where industrial scientists and engineers are trained and as the source of research findings and techniques pertinent to technical advance in industry. Universities, through applications-oriented fields like computer science, materials

science, and pathology, help develop the foundations of industrial technologies (Nelson and Rosenberg 1993, 11-12).

Some scholars, like Gregory Tassey (1991, 350), refer to this system as the “U.S. technology infrastructure”- defined as the combination of industry, the public sector, and increasingly by joint public-private operations, with academia providing scientific and technical expertise. He points out that joint industry - university research programs have helped to reshape university curricula over time. This technology infrastructure also includes the important subgroup of 22 labs that are known as the Federal Laboratory System – committed to basic scientific knowledge, the development of early phase technology research and the production of nonproprietary infra-technologies.

Smilor, Dietrich, and Gibson (1993, 2) have investigated academic institutions as “entrepreneurial universities” highlighting the role of U. S. higher education in America’s technology commercialization and economic development efforts. In responding to environmental changes, the original paradigm of the American university has been altered to accommodate the hypercompetitive realities of globalization. Smilor et al. (1993) remind that the traditional norms, values and professional standards are still present as the need to profit from research efforts that add economic value to the institution and all invested parties have been added to the paradigm.

Mowery (2001) suggests that despite the long-standing link between industrial innovation and the American university research, the role of U.S. universities within the national R&D system is changing due to shifts in sources of academic R&D funding. He and others (Mowery and Sampat 2001; Mowery, and et. al 2001) point to the rise in university patents and licensing, and other related trends.

Eckel and King (2004) at the American Council on Education report that many believe that the marketplace has surpassed state government, across the board, as the dominant external force shaping and reshaping American higher education. The above studies uncover evidence of the presence of the entrepreneurial university - in concept and in practice.

There are critical differences between the traditional U.S. university paradigm and the entrepreneurial U.S. university paradigm. The differences can be seen in the drivers and the outcomes reflected in the model of each paradigm. Often the worldview of academic institutions in the past could afford to be more insular and highlight its own distinctiveness. Along with funding sources, universities and colleges in the past were driven by academic prestige and basic research yielding the then acceptable outcomes of professional and institutional recognition, in addition to educated students and broad understanding that comes with knowledge creation.

However, the impact of fast changing times has brought about the need to face growing realities that make this earlier thinking dangerously ineffective. The university's more contemporary purpose is to reflect the challenges and opportunities brought about by economic globalization and the hyper-competitive international environment. There exists a combination of internal and external forces that drive academic institutions, which of course include basic and applied research. However there are many drivers that go well beyond these two mainstays. Smilor et al. (1993) remind us that public policy, industrial needs, entrepreneurial faculty, and the nature of revolutionary technologies are but a few.

The means by which the factors that drive universities translate into positive outcomes in academia have everything to do with the support systems and linkage mechanisms that perpetuate academic institutions. The complexities are required as part of the research-oriented school's survival. Therefore, the need for external funding of academic R&D is not debated as optional.

Some of the contemporary outcomes for a university operating under an entrepreneurial paradigm are as broad as global competitiveness, job creation, and technology transfer, and as specific to the institution as hands-on programs, course development, and new funding sources (Smilor et al. 1993).

Gemunden and et al. (1992) found from empirical study that there are kinds of technology-oriented external relationships proven to be of special importance: close contacts with customers, R&D co-operations with other companies, and linkages to universities and research institutes.

Mansfield's study (1998) provided an update of empirical findings that confirm the cause and effect relationship between academic research and commercial outcomes. His research presents evidence from 1986 to 1994 that confirms earlier results for the ten year period of 1975 to 1985 that more than 10% of the new products and processes introduced in six select industry sectors could not have been developed (without significant delay) in the absence of timely academic research. Mansfield also notes that in this second period, average lack time between academic research and commercial application decreased. This is evidence of greater cohesion and partnership in American innovation over time. Greater synchronicity has economic

rewards for all parties involved. Adaptations have led to the (still) changing structure of the U.S. national innovation system (Mowery 1998).

Federal R&D Funding to HBCUs

Federal science and engineering obligations for HBCUs in the 1995 fiscal year increased by 17% over the previous year, totaling $328 million. Research and development programs accounted for 62% of all HBCU funding, smaller than the 84% share among all U.S. universities and colleges (NSF 2007, 07-326). By fiscal year 2006, federal academic S&E obligations to 78 HBCUs (from a total of 102 institutions) totaled $444 million, representing a decrease of 7.3% from FY 2005. This level was the first current-dollar decrease in HBCU funding since FY 1998. The Department of Health and Human Resources (HHS) contributed approximately one-third of all federal academic S&E expenditures to HBCUs with USDA funding over one-fourth of the total (Table 2-9). R&D programs accounted for over three-fifths of the HBCU total with other S&E activities totaling near 25 percent.

Howard University was the leading HBCU recipient of federal S&E expenditures, receiving $34 million (of which $28 million was for research and development) in FY 2006, with 70% of the total from HHS. The leading 20 HBCUs ranked by federal academic S&E support accounted for 70% of the academic science and engineering total for HBCUs in FY 2006. Fifteen of these 20 institutions were also ranked among the leading 20 HBCU recipients in fiscal year 2005 (NSF 2008, 08-316).

A side by side comparison of HBCUs and non-HBCUs with regards to federal R&D funding is a useful reminder of the dominance of non-HBCUs as a group in the realm of R&D funding acquisition and R&D performance. Table 2-10 shows the top 50 HBCUs

and non-HBCUs, including medical schools, provided federal R&D funds in FY 2002. The average amount of the top 50 HBCUs receiving federal R&D funds was $5,200,875. Compared to this the average amount of the top 50 non-HBCUs receiving R&D funds at $28,320,186.

The amount differences represent the research and development capacity and R&D performance advantages top non-HBCUs have over the top HBCUs. The figures from FY 2002 show that the top 50 non-HBCUs in R&D expenditures garner over five times the funding amounts of the top HBCUs. The least funded of the top non-HBCUs – the University of Texas, MD Anderson Cancer Center, at $137,474,907 is a dollar amount approximately three and on half times greater than the highest funded HBCU – Howard University, at $39,489,251. The top non-HBCU in federal R&D expenditures – John Hopkins University at $968,346,779 had a dollar advantage of over 24 to one compared with Howard University (NSF 2008, 08-319).

Going beyond the comparison of the top schools in both categories, the average of all HBCU receiving federal R&D expenditures in FY 2002 is $3,596,350, to be compared to $12,083,713 – which is the average amount of all non-HBCUs receiving R&D federal funds (Fossum and et al. 2004). In this instance, we find a better than three to one dollar advantage for non-HBCUs. Also notable is the fact that the average research and development funding amount of all non-HBCUs is over twice that of the top 50 HBCUs in fiscal year 2002. These figures for FY 2002 are reflective of consistent funding patterns in the highly stratified and concentrated funding patterns that are a part of the academic R&D funding environment.

Chapter Summary

The character of the work called research and development (R&D) is comprised of basic research, applied research, and development. The federal government, industry, academia, non-profit institutions, and federally funded R&D centers perform research and development. There are five possible funding sources for research and development activities: industry, federal government, state and local government, academia, and non-profit institutions. Once research and development expenditures are received, the funds are reported as R&D performance.

Industry is by far the largest R&D performing sector conducting more than half of the applied research in the U.S. and most of the development. Considering all funding sources, industry also garners the majority of R&D expenditures. The federal government is the primary funding facilitator of basic research in the United States; its role as a major R&D performer is intentionally minimized through its establishment and support of federally funded research and development centers (FFRDCs) administered by industry, universities and colleges, or non-profit organizations. Federal-financing goes directly to non-federal R&D performers not operating as FFRDCs.

Academia's strongest work percentage contribution to the national R&D effort is in the area of basic research. From 1996 to 2002, two-thirds of federal funds to academia for R&D concentrated on one field of science – life science; the funding was concentrated at only a relatively few research universities. Two federal agencies dominate as funding sources for academic R&D - the Department of Health and Human Services (HHS), followed by the National Science Foundation (NSF). The top 20 institutions, in terms of total research and development expenditures, accounted for

nearly a third (30%) of total academic R&D spending of the 640 institutions surveyed in FY 2005. The top 100 research performers accounted for 80% of all R&D dollars in FY 2005.

As academic R&D performance is highly concentrated, so is total R&D performance - by geographic location. For example, in 1998, the 20 highest ranking states in research and development expenditures accounted for 85% of the national total, and the lowest ranking 20 states had only 4% of the total. Most of the states that lead the nation in total R&D performance are also the top ranked leaders in academic and industrial performance.

The concept of a national system of innovation is based on the competitive prowess of America's firms and the technological capabilities rooted in national resources and national action. Firms, universities, and governmental entities represent the three central and indispensable components that interact in systematic patterns to promote innovation associated with economic performance. Some scholars refer to this system as the "U.S. technology infrastructure" – defined as the combination of industry, the public sector, and increasingly by joint public-private operations, with academia providing scientific and technical expertise.

The university's more contemporary purpose is to reflect the challenges and opportunities brought about by the realities of economic globalization and the hyper-competitive global environment. This has given birth to the notion of the "entrepreneurial university" paradigm which has become a contemporary development model for American colleges and universities.

Federal funding of HBCUs, like that for all of academia, has benefited

from a pattern of current-dollar increase until 2006. The research and development funding disparities between HBCUs and non-HBCUs, overall and among top-universities, is reflective of the R&D performance levels and institutional capacity disparities that exist between HBCUs and non-HBCUs.

Table 2-1. U.S. R&D Expenditures, by Character of Work, Performing Sector, & Source of funds: 2006

Performing sector and character of work	Total in Million $	Industry	Federal government	U&C	Other Non-profits	Total Exp. (percentage)
R&D	312,068	199,025	93.384	11.095	8.565	100.0
Industry	219.226	195,691	23,535	NA	NA	70.2
Industry-administered FFRDCs	2.584	NA	2.584	NA	NA	0.8
Federal government	24.742	NA	24.742	NA	NA	7.9
U&C	42.431	2,135	26.115	5	3.087	13.6
U&C-administered FFRDCs	7.500	NA	7.500	NA	NA	2.4
Other nonprofit institutions	12.750	1.199	6.072	NA	5.478	4.1
Nonprofit-administered FFRDCs	2.834	NA	2.834	NA	NA	0.9
Percent distribution by source	100.0	63.8	29.9	3.6	2.7	NA
Basic research	58.356	9,551	36.075	7.579	5.150	100.0
Industry	9.278	1.427	1.851	NA	NA	15.9
Industry-administered FFRDCs	706	NA	706	NA	NA	1.2
Federal government	4.887	NA	4.887	NA	NA	8.4
U&C	31.735	1.458	20.589	7.579	2.109	54.4
U&C-administered FFRDCs	3.917	NA	3.917	NA	NA	6.7
Other nonprofit institutions	6.651	666	2.944	NA	3.042	11.4
Nonprofit-administered FFRDCs	1.181	NA	1.181	NA	NA	2.0
Percent distribution by source	100.0	16.4	61.8	13.0	8.8	NA
Applied research	66.364	35.975	25.315	2.883	2.190	100.0
Industry	41.009	35.117	5.892	NA	NA	61.8
Industry-administered FFRDCs	1.268	NA	1,268	NA	NA	1.9
Federal government	8.407	NA	8.407	NA	NA	12.7
U&C	9.223	555	4.983	2.883	802	13.9
U&C-administered FFRDCs	1.806	NA	1.806	NA	NA	2.7
Other nonprofit institutions	4.287	304	2.595	NA	1.388	6.5
Nonprofit-administered FFRDCs	365	NA	365	NA	NA	0.5
Percent distribution by source	100.0	54.2	38.1	4.3	3.3	NA
Development	187.349	153.498	31.993	633	1.224	100.0
Industry	168.939	153.147	15.792	NA	NA	90.2
Industry-administered FFRDCs	610	NA	610	NA	NA	0.3
Federal government	11.447	NA	11.447	NA	NA	6.1
U&C	1.474	122	543	633	176	0.8
U&C-administered FFRDCs	1.778	NA	1.778	NA	NA	0.9
Other nonprofit institutions	1.812	229	534	NA	1.048	1.0
Nonprofit-administered FFRDCs	1.288	NA	1.288	NA	NA	0.7
Percent distribution by source	100.0	81.9	17.1	0.3	0.7	NA

NA = not available. Notes: State & local government support to industry included in industry support for industry performance. State and local government support to U&C ($2.890 million in total R&D) included in U&C support for U&C performance. Source: National Science Foundation. Div. of Science Resources Statistics. National Patterns of R&D Resources (annual series).

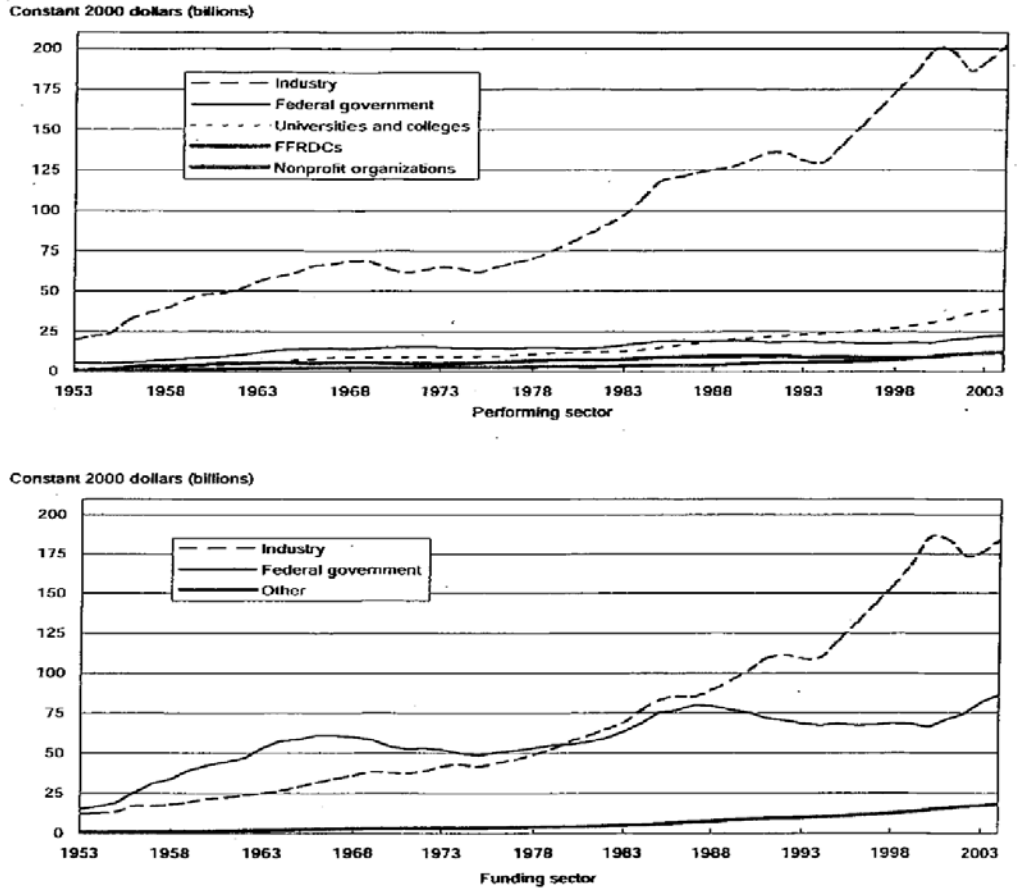


Figure 2-1. U.S. R&D, by Performing and Funding Sector – 1953 – 2004

FFRDC = Federally Funded Research and Development Center. Note: Data for FY 2004 are projections. Source: National Science Foundation, Division of Statistics, National Patterns of R&D Resources (annual series).

Table 2-2. R&D Expenditures at Universities and Colleges, by Science and Engineering Field: FY 2004-05 (millions of current dollars)

Field	FY 2004	FY 2005	% change 2004-05
All R&D Expenditures	43,229	45,750	5.8
Computer sciences	1,404	1,406	0.1
Environmental sciences	2,353	2,546	8.2
Atmospheric sciences	414	457	10.3
Earth sciences	828	916	10.6
Oceanography	778	812	4.3
Environmental sciences nec	332	362	8.9
Life sciences	25,944	27,603	6.4
Agricultural sciences	2,696	2,657	-1.4
Biological sciences	8,148	8,846	8.6
Medical sciences	14,037	14,874	6.0
Life sciences nec	1,063	1,226	15.3
Mathematical sciences	449	495	10.2
Physical sciences	3,545	3,704	4.5
Astronomy	420	454	8.0
Chemistry	1,317	1,364	3.6
Physics	1,522	1,607	5.6
Physical sciences nec	286	280	-2.3
Psychology	782	826	5.6
Social sciences	1,667	1,675	0.5
Economics	317	324	2.4
Political sciences	301	315	4.7
Sociology	355	371	4.5
Social sciences nec	694	665	-4.1
Sciences nec	775	767	-1.0
Engineering	6,310	6,728	6.6
Aero & astronautical / engineering	432	441	1.9
Bioengineering / medical engineering	370	420	13.4
Chemical engineering	493	503	2.1
Civil engineering	189	788	-0.1
Electrical engineering	1,437	1,579	9.9
Mechanical engineering	875	935	6.8
Metallurgical / materials engineering	565	611	8.1
Engineering nec.	1,348	1,451	7.6

nec = not elsewhere classified. Source: National Science Foundation / Division of Science Resources Statistics, Survey of Research and Development Expenditures at Universities and Colleges, FY 2005.

Table 2-3. Federally Financed R&D Expenditures at Universities and Colleges, by Source of Funds, and Science & Engineering Field: FY 2005 (millions of current dollars)

Field	Fed Exp.	DOD	DOE	HHS	NASA	NSF	USDA	OTHER*
All science and engineering	29,167	2,165	1,055	15,869	1,130	3,533	814	3,327
Computer Science	1,023	302	29	36	28	427	2	129
Environmental Sciences	1,725	141	96	60	218	590	54	522
Life Sciences	17,691	428	153	14,197	114	568	673	1,421
Agricultural	845	11	19	52	15	100	453	188
Biological	6,194	139	68	4,913	46	407	180	385
Medical	9,898	258	57	8,622	49	44	27	773
Life	753	20	9	609	4	17	13	76
Math Sciences	346	41	10	62	4	174	4	25
Physical Sciences	2,674	319	379	452	353	779	7	244
Psychology	611	25	1	451	12	51	0	61
Social Sciences	691	25	19	256	12	98	35	229
Engineering	4,116	1,278	354	291	380	772	35	599

* Includes all other agencies reported. Nec = not elsewhere classified. DOD = Department of Defense; DOE = Department of Education; HHS = Department of Health and Human Services; NASA = National Aeronautics and Space Administration; NSF = National Science Foundation; USDA = Department of Agriculture. Notes: Not all fields are reported in this table. Also, agency detail may not add to total because some institutions did not break out their expenditures by agency. Source: National Science Foundation, Div. of Science Resources Statistics, Survey of Federal Science & Engineering Support to Universities, Colleges, and Nonprofit Institutions. FY 2005.

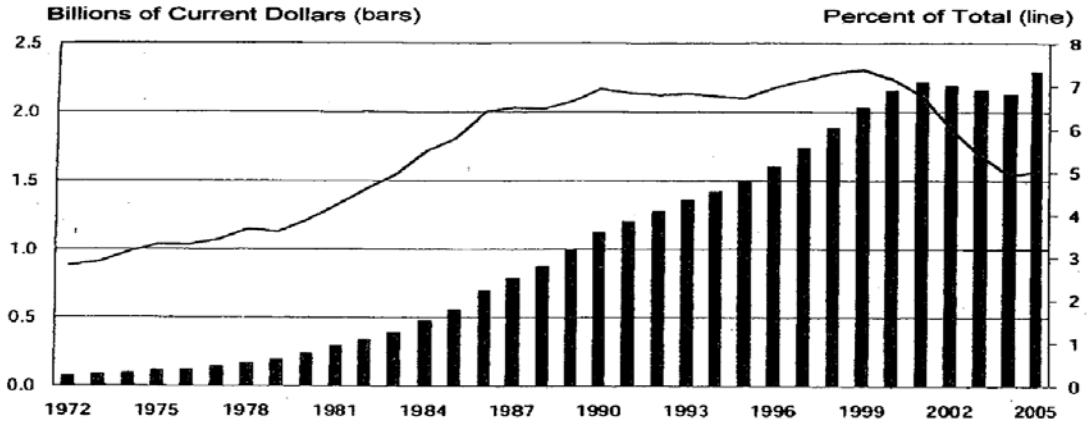


Figure 2-2. Industry Financed R&D Expenditures at Universities and Colleges: FY 1972 – 2005

Source: National Science Foundation / Division of Science Resources Statistics, Survey of Research and Development Expenditures at Universities and Colleges, FY 2005.

Note: Detail may not add to total because some respondents reporting did not break out total and federal funds by non-S&E fields. Source: National Science Foundation / Division of Science Resources Statistics, Survey of Research and Development Expenditures at Universities and Colleges, FY 2005.

Table 2-4. Science and Engineering Expenditures at Universities and Colleges: FY 2000-2005 (millions of current dollars)

Source of funds and character of work	2000	2001	2002	2003	2004	2005
All R&D expenditures	30,070	32,805	36,385	40,075	43,229	45,750
Source of funds						
Federal government	17,536	19,229	21,857	24,750	27,620	29,167
State & local government	2,200	2,320	2,505	2,645	2,877	2,940
Industry	2,156	2,218	2,191	2,162	2,129	2,292
Institutional funds	5,924	6,613	7,131	7,661	7,751	8,258
All other sources	2,254	2,425	2,700	2,857	2,852	3,093
Character of work						
Basic research	22,454	24,382	27,304	29,986	32,515	34,384
Applied research and development	7,616	8,423	9,081	10,088	10,714	11,367

Note: Because of rounding, detail may not add to total. Source: National Science Foundation / Division of Science Resource Statistics, Survey of Research and Development Expenditures at Universities and Colleges, FY 2005.

Table 2-5. Research and Development Expenditures in Non-science and Engineering Fields at Universities and Colleges: FY 2005 (millions of current dollars)

Field	All non-S&E R&D expenditures	Federal non-S&E R&D expenditures
All non-S&E fields	1,750	764
Business and management	220	52
Communications, Journalism, and Library Science	75	26
Education	761	426
Humanities	194	58
Law	62	27
Social Work	87	26
Visual and Performing Arts	42	4
Other non-S&E fields	309	145

Note: Detail may not add to total because some respondents reporting did not break out total and federal funds by non-S&E fields. Source: National Science Foundation / Division of Science Resources Statistics, Survey of Research and Development Expenditures at Universities and Colleges, FY 2005.

Table 2-6. Twenty Institutions Reporting the Largest FY 2006 Academic R&D Expenditures in Science and Engineering Fields: FY 2005-06 (millions of current dollars)

Rank	Institution	2005	2006
	All R&D Expenditures [a]	45,777	47,760
	Leading 20 Institutions	13,685	14,194
1	John Hopkins University [b]	1,444	1,500
2	University of Wisconsin – Madison	798	832
3	University of California – Los Angeles	786	811
4	University of Michigan (all campuses)	809	800
5	University of California – San Francisco	754	796
6	University of Washington	708	778
7	University of California – San Diego	721	755
8	Stanford University	715	679
9	University of Pennsylvania	655	676
10	Duke University	631	657
11	Ohio State University (all campuses)	609	652
12	Cornell University (all campuses)	607	649
13	Pennsylvania State Univ. (all campuses)	626	644
14	Massachusetts Institute of Technology	581	601
15	University of Minnesota (all campuses)	549	595
16	University of California – Davis	547	573
17	University of Florida	531	565
18	Washington University (Saint Louis)	532	548
19	University of California – Berkeley	555	546
20	University of Arizona	530	536
	All other surveyed institutions	32,092	33,566

[a] Excludes R&D performed by university-administered federally funded R&D centers.
[b] Includes the Applied Physics Laboratory total R&D expenditures for which were $678 in FY 2005
and $709 million in FY 2006. Note: Because of rounding, detail may not add to total.
Source: National Science Foundation, Division of Science Resources Statistics, Survey of Research Development Expenditures at Universities and Colleges, FY 2006.

Table 2-7. Federal Academic S&E Support to the 20 Leading Universities in Order of Total Order of Total S&E Obligations, by Agency: FY 2006 (millions of dollars)

Institutions	All Oblig.	DOD	DOE	HSS	NASA	NSF	USDA	Other*
All Institutions	28,657.8	2,904.1	901.8	17,184.5	975.3	4,098.7	1,262.7	1,294.6
John Hopkins*	1,341.7	530.8	3.4	617.0	135.3	28.9	0.2	26.1
U.WA	676.6	43.7	13.4	466.1	8.9	94.7	2.7	47.1
U. MI	558.0	44.4	12.1	402.7	13.7	69.2	1.4	14.4
U.PA	532.8	28.4	9.8	460.0	2.1	27.4	1.0	4.0
UCLA	505.9	20.5	21.7	396.3	14.0	53.2	0.0	0.3
Columbia	503.3	9.1	9.9	374.0	11.0	72.1	0.4	27.0
Duke U.	496.5	24.6	9.7	422.8	1.0	31.9	1.1	5.4
Stanford	491.6	47.8	15.8	317.0	54.2	53.8	0.0	3.0
U.WI-Madison	473.6	22.3	26.6	259.5	6.4	119.5	34.7	4.7
U.CA-San Francisco	466.4	9.3	0.5	455.3	0.6	0.7	0.0	0.0
Harvard	450.9	13.8	9.5	378.2	10.0	29.2	0.1	10.1
U.CA - San Diego	445.5	16.8	14.2	306.9	5.8	101.0	0.1	0.8
U. Pitts.	444.0	22.4	2.7	396.3	1.2	18.5	0.0	2.8
WA U.	434.0	7.7	2.6	380.7	8.8	31.8	0.1	0.8
MIT	423.9	99.9	56.6	183.1	16.7	55.8	2.6	9.2
Yale U.	390.2	7.3	10.2	341.4	1.3	27.8	1.1	1.1
UNC - Chapel Hill	374.5	14.2	3.8	317.5	0.6	24.0	0.1	14.3
Colorado	371.9	17.5	6.4	232.8	40.6	44.4	1.4	28.8
Minnesota	370.3	13.1	7.2	241.7	4.0	53.4	32.3	18.6
Vanderbilt	334.3	21.7	2.2	278.5	1.6	18.2	0.0	12.0
Top 20 schools	10,085.8	1,015.4	238.4	7,227.6	338.0	955.5	79.1	231.8

DOD= Department of Defense; DOE=Department of Education; HHS=Department of Health and Human Services; NASA=National Aeronautics & Space Administration; NSF=National Science Foundation; USDA=Department of Agriculture. * Includes data for the Departments of Commerce, Education, Homeland Security, Housing and Urban Development, the Interior, Labor and Transportation; Agency for International Development; Environmental Protection Agency; Appalachian Regional Commission; Nuclear Regulatory Commission, Office of Justice Programs (part of Justice Department); and Social Security Administration. ** Includes funding for Applied Physics Laboratory. Source: National Science Foundation, Division of Science Resources Statistics, Survey of Federal Science and Engineering Support to Universities, Colleges, and Nonprofit Institutions. FY 2006.

TABLE 2-8. Leading states in total R&D performance, R&D sector, and R&D as percentage of gross state product: 2000

Top 10 states in Total R&D Performance [a]			Top States in Size of R&D, by Type of Performer			Top 10 States in R&D Intensity (states with the highest R&D/GSP ratio)		
Rank	State	Total R&D (in millions)	Industry [b]	Universities & Colleges [c]	Federal Government	State	R&D/GSP (percent)	GSP (in billions)
1	California	55,093	California	California	Maryland	Michigan	5.81	325.4
2	Michigan	18,892	Michigan	New York	Dist. of Colombia	New Mexico	5.68	54.4
3	New York	13,556	New Jersey	Texas	California	Washington	4.78	219.9
4	New Jersey	13,133	Illinois	Massachusetts	Virginia	Maryland	4.64	186.1
5	Massachusetts	13,004	New York	Pennsylvania	Alabama	Massachusetts	4.56	284.9
6	Illinois	12,767	Massachusetts	Maryland	Ohio	Delaware	4.22	36.3
7	Texas	11,552	Washington	Illinois	Florida	Rhode Island	4.12	36.5
8	Washington	10,516	Texas	North Carolina	Texas	California	4.10	1,344.6
9	Pennsylvania	9,842	Pennsylvania	Michigan	New Jersey	Idaho	3.87	37.0
10	Maryland	8,634	Ohio	Georgia	New Mexico	Dist. of Colombia	3.87	59.4

a Includes in-state total R&D performance of industry, universities, Federal agencies, FFRDCs, and federally financed nonprofit R&D.
b Includes R&D activities of industry-administered FFRDCs located within these states. c Excludes R&D activities of university-administered FFRDCs located within these states. 4 Includes costs associated with the administration of intramural and extramural programs by Federal personnel as well as actual intramural performance. Key: R&D = research and development; GSP = gross state product; FFRDC = federally funded research and development center. Notes: Reliability of the estimates of industry R&D varies by state because the sample allocation was not based on geography. Rankings do not take into account the margin of error of estimates from sample surveys. Source: National Science Foundation/Division of Science Resources Statistics, National Patterns of R&D Resources, annual series; GSP data are from the U.S. Bureau of Economic Analysis.

Table 2-9. Federal Academic S&E Support to the 20 Leading HBCUs, Ranked by total amount received by agency: FY 2006 (thousands of dollars)

Institution	All Oblig.	DOD	DOE	HHS	NASA	NSF	USDA	Other *
All HBCUs	444,193	40,069	22,303	148,279	25,820	71,123	117,617	18,982
Howard U.	34,406	1,748	147	24,170	472	7,138	0	0
Morehouse (Medicine)	29,884	0	962	28,922	0	0	0	0
Meharry Medical C.	27,387	437	0	26,950	0	0	0	0
Hampton U.	23,205	1,486	1,070	1,824	12,289	6,106	0	430
JacksonState	20,437	6,629	1,925	5,965	0	4,989	285	644
Tuskegee	18,344	595	199	7,962	204	3,384	6,000	0
FL A&M U.	18,602	2,636	353	4,226	39	5,695	4,641	472
NC A&T State	17,751	2,378	178	1,492	522	5,029	8,152	0
AL A&M U.	16,812	4,497	106	130	1,613	283	10,183	0
TN State U.	13,894	2,135	0	1,957	607	502	8,693	0
Morgan State	13,120	1,774	862	3,829	4,016	1,517	0	1,122
Prairie View A&M U.	10,661	952	592	133	25	543	8,416	0
Alcorn State	10,122	2,352	0	499	0	528	6,509	234
Southern U.	9,390	479	0	831	1,914	1,118	4,424	624
Clark Atlanta	8,770	957	168	3,293	431	3,163	0	758
SC State U.	8,689	0	1,000	524	252	1,521	4,220	1,172
Lincoln U. (MO)	8,442	2,071	0	0	0	0	6,351	0
DE State U.	7,780	1,414	990	356	0	1,295	3,700	25
KY State	7,618	0	0	0	0	150	7,468	0
U.Maryland East. Shore	311,901	32,842	8,552	114,336	22,384	43,758	83,718	6,312

DOD = Department of Defense; DOE = Department of Energy; HHS = Department of Health and Human Services; NASA = National Aeronautics and Space Administration; NSF = National Science Foundation; USDA = Department of Agriculture. * Includes data for the Departments of Commerce, Education, Interior, Labor, and Transportation, Environmental Protection Agency, Office of Justice Programs (part of Department of Justice). Source: National Science Foundation, Division of Science Resources Statistics, Survey of Federal Science and Engineering Support to Universities, Colleges, and Nonprofit Institutions: FY 2006

Table 2-10. Top 50 HBCUs and Non-HBCUs Provided Federal R&D Funds: FY 2002

Historically Black Colleges and Universities			Non-Historically Black Colleges & Universities		
Average or All HBCUs Receiving Federal R&D Funds		5,200,875	Average of all Non-HBCUs Receiving Federal R&D Funds		28,320,186
Average of All HBCUs		3,596,350	Average of All Non-HBCUs		12,083,713
Rank	Institution	Total Fed. R&D Funds Received	Rank	Institution	Total Fed. R&D Funds Received
1	Howard University	39,489,251	1	John Hopkins University	969,346,779
2	Meharry Medical College	39,293,507	2	Univ. of Wash., Seattle	518,105,691
3	Morehouse College	36,374,771	3	Univ. of Pennsylvania	458,468,017
4	Tuskegee University	26,255,994	4	Univ. of Mich., Ann Arbor	428,841,708
5	Charles R. Drew University of Medicine and Science	19,990,406	5	UCLA	412,554,554
6	Florida A & M University	17,532,604	6	Univ. of Cal., San Diego	405,563,825
7	Xavier University of Louisiana	14,555,679	7	Stanford University	386,003,275
8	N. Carolina A&T State University	10,201,949	8	MIT	380,832,879
9	Hampton University	10,128,090	9	Univ. of Wisc., Madison	364,986,252
10	Jackson State University	9,889,789	10	Washington Univ., STL.	360,440,828
11	Tennessee State University	9,885,108	11	Univ. of Cal., San Fran.	356,743,364
12	Clark Atlanta University	7,999,473	12	University of Pittsburgh	336,901,314
13	Morgan State University	7,904,435	13	Columbia University	334,901,399
14	Prairie View University	7,887,608	14	Harvard University	332,530,435
15	Alabama A& M University	6,767,007	15	Duke University	327,315,626
16	N. Carolina Central University	5,518,094	16	Yale University	312,309,557
17	Spellman College	4,481,609	17	Univ. of Minnesota	309,877,336
18	Bowie State University	3,996,143	18	Univ. of North Carolina	307,967,854
19	South Carolina State University	3,918,911	19	Baylor College of Med.	273,931,037
20	Southern Univ., Baton Rouge	3,559,364	20	U. of Ala., Birmingham	260,792,305
21	Alcorn State University	3,275,827	21	Cornell University	258,544,760
22	Norfolk State University	3,127,852	22	U. of Southern Cal.	223,851,269
23	Univ. of Arkansas, Pine Bluff	2,981,653	23	Univ. of Cal., Berkley	223,779,543
24	Lincoln University	2,872,219	24	Vanderbilt University	223,742,350
25	Kentucky State University	2,826,843	25	Pennsylvania State Univ.	221,313,180

Table 2-10. Continued.

Rank	Institution	Total Fed. R&D Funds Received	Rank	Institution	Total Fed. R&D Funds Received
26	Virginia State University	2,774,001	26	Univ. of Illinois, Urbana	206,263,136
27	Fort Valley State University	2,623,199	27	Case Western Reserve U.	195,106,497
28	Texas Southern University	2,561,198	28	University of Rochester	189,376,514
29	Langston University	1,973,117	29	Univ. of Cal., Davis	189,264,822
30	Winston-Salem State Univ.	1,924,488	30	Emory University	189,186,474
31	Univ. of Maryland, East. Shore	1,914,127	31	University of Arizona	184,787,624
32	Chicago State University	1,907,774	32	University of Iowa	176,503,090
33	Shaw University	1,868,871	33	Boston University	175,652,126
34	Fisk University	1,830,284	34	Ohio State U., Columbus	173,332,020
35	Delaware State University	1,815,646	35	University of Chicago	172,652,126
36	Tougaloo College	1,703,210	36	Univ. of Colorado System Health Sciences Center	171,217,091
37	West Virginia State College	1,672,041	37	U. of Virginia, Char.	167,559,784
38	Univ. of the District of Colombia	1,343,829	38	Oregon Health & Science U.	166,774,546
39	Savannah State University	1,294,378	39	University of Florida	165,041,811
40	Mississippi Valley State	1,054,974	40	University of Texas, SW Medical Center at Dallas	162,647,874
41	Benedict College	972,394	41	Northwestern University	161,234,045
42	Bethune-Cookman University	928,908	42	University of Colorado	156,690,828
43	Lincoln Univ. of Pennsylvania	862,764	43	University of Utah	154,795,096
44	Elizabeth City State University	792,779	44	Mt. Sinai School of Med.	150,446,538
45	Grambling State University	778,111	45	Mayo Medical School	148,057,109
46	Johnson C. Smith University	700,710	46	New York University	143,198,057
47	Oakwood College	567,477	47	Univ. of Chicago, Illinois	142,885,797
48	Fayetteville State University	557,989	48	Univ. of Texas, Austin	140,822,610
49	Alabama State University	546,672	49	Yeshiva University	138,929,910
50	City University of New York, Medgar Evers College	487,926	50	University of Texas, MD Anderson Cancer Center	137,474,907

Source: Fossum and et al. 2004; Tables C-21 and C-22

CHAPTER 3
HISTORICALLY BLACK COLLEGES AND UNIVERSITIES

While there are many definitions of what makes a black college or university historic, in 1965 the U.S. Congress formally designated as Historically Black Colleges and Universities (HBCUs) those institutions that were founded before 1964 whose principal mission was the education of Black Americans. Most of these schools were founded immediately before the Civil War or in the decades afterwards by Christian churches, many of them funded through the Freedman's Bureau and private philanthropy.

Today, according to the Department of Education, there are 104 federally designated HBCUs, which are eligible to receive federal money through Title III of the Higher Education Act. This group includes 40 public 4-year institutions, 10 public 2-year institutions, 49 private 4-year institutions, and five private 2-year institutions located in eight south Atlantic states, eight central southern states, two mid-western states, one northeastern state, and the District of Columbia and the Virgin Islands. Tables 3-1 and 3-2, respectively, provide a list of the HBCUs in this study with their locations and the sample population, denoted by control of institution. Appendix B is a compilation of the variable data that reveals more about HBCUs, in relation to the geographic, economic and institutional factors explored in this study.

Historically Black Colleges and Universities and the Relevance Question

Despite commitments to HBCUs from levels as high as the U.S. presidency, the question is still asked in this country: Are HBCUs still needed? HBCUs came into being during a time when blacks were denied access to institutions of higher learning in the United States, and their collective purpose has been to provide black students with

opportunities for scholarship and professional training. However, the 1992 U.S. Supreme Court decision (U.S. v. Fordice) required states to "educationally justify or eliminate" all vestiges of segregation in higher education. Public HBCUs have been categorized as one of these vestiges. Therefore, some have called for a more compelling educational justification for HBCU's existence.

A number of justifications have been presented in defense of these institutions. Three of the most salient are the following: 1) HBCUs provide a more socially cohesive environment for minority students; 2) they are remarkably successful at preparing students for leadership roles in their community and the greater society; and 3) they successfully prepare students for the job market, particularly in the fields of the hard sciences and engineering (Wenglinsky 1997). There have been relatively few empirical studies to test these justifications, or to determine if HBCUs offer educational benefits that do not exist at mainstream institutions. Studies that have been done provide us with some empirical evidence for the continued justification of HBCUs.

Thomas (1987, 1991) and Trent (1991) found that black students attending HBCUs were most likely to major in business, engineering, or the sciences. This is an important finding because of the support provided to the national labor force in these critical fields. From the vantage point of the graduates and the black economic community, the income potential and ultimate income contribution from these fields is higher than that of the liberal arts and fine arts fields.

Nettles (1991) studied the characteristics of post-secondary students and their institutions that were associated with student achievement (as measured by GPA), and student progression (as measured by the number of credits taken per semester).

There was found to be no relationship between GPA and the racial composition of the institution, but he did find that black students had lower progression rates at institutions where they were the minority compared to those rates of black students where they were the majority.

More recently, a study by Astin, Tsui, and Avalos (1996) suggested that black students attending HBCUs are more likely than black students attending mainstream educational institutions to complete their degrees. When a number of factors are taken into account, including prior student achievement (as measured by high school grades and SAT scores), institutional size, and institutional selectivity, black students at HBCUs were found to be 17% more likely than their counterparts at mainstream schools to earn their degrees.

There are divergent opinions on the central collective mission of HBCUs dating back as far the debates between the black leaders W.E.B. DuBois and Booker T. Washington (Jencks and Riesman 1968; Roebuck and Murty 1993). W.E.B. DuBois highlighted the ability of black educational institutions to produce community leaders. Booker T. Washington, on the other hand, emphasized the ability of the schools to groom blacks to be more economically competitive in the job market.
Today's advocates of Washington's position would point to the ability of HBCUs to produce scientists, technicians, and engineers disproportionate to their numbers and resources. The views of DuBois and Washington have probably been over-dichotomized over the decades because HBCUs have been very successful as wellsprings of aspiration for the community and talent for the labor force.

The Evolution of Historically Black Colleges and Universities

In the late 19th century, colleges for black students were started in boxcars and church basements as over 90% of the South's adult black population was illiterate in 1960 (Foner 1988,196). Mary McLeod Bethune, one of the nation's foremost black educators opened a college in the year 1904 with only $1.50 and five students. The history of HBCUs has been one of trials, tribulations, perseverance and victory. From hardship to success, to still finding purpose in today's society, the life of HBCUs may be best understood within a broad historical context. This history can be divided into five periods of growth: the Antebellum Period, the Post-bellum Period, the "Separate but Equal" Period, the Desegregation Period, and lastly, the Modern Period (Roebuck and Murty 1993).

The Antebellum Period began with the end to the Revolutionary War. Free blacks began to establish churches, schools, and organizations in northern and southern cities where they could worship, educate their children, and protect themselves freely. Blacks yearned for an education with hopes of making their mark in society. With little support from the white community, free blacks held fundraisers, bazaars, plays, etc. to obtain money to build schools where many self-taught freeman taught other freeman to read and write (Quarles 1985; Berlin 1974, 70-78).

These schools provided a sense of identity, as well as means of advancement for black youth and adults. Occasionally, a few white institutions allowed black people to attend. However, many of the higher degrees were obtained through apprenticeship training, non-degree courses in colleges and universities, teacher training, university training abroad, and self-education.

The first two HBCUs to open before the Civil War were Lincoln University (PA) and Wilberforce University. Both schools are still in existence and remain in their original locations today. These schools were the first to award baccalaureate degrees, and the first to develop into degree-granting institutions. Only 28 black people received baccalaureate degrees prior to the American Civil War (Bowles and et al. 1971, 20-21). Most whites during this time opposed the education of black people believing them to be intellectually inferior and also fearing that educated blacks might “get out of their place” and inevitably compete with whites in economic, political, and sexual spheres (Goodenow 1989). Nevertheless, the black pursuit of higher formal education continued.

After the end of the Civil War and into the Reconstruction era, five million freed blacks lived in the southern states of the Union (Foner 1988) with a tangible demand for education. This demand signaled the start of the Post-bellum Period. During this period, the Freedman’s Bureau, along with the American Missionary Association (AMA) and other northern missionary societies, helped to draft formal educational schools for blacks to train and learn (Raboteau 1989; Godenow 1989). The AMA was responsible for founding seven black colleges between 1861 and 1870 including Dillard, Fisk, Atlanta, and Morehouse (Law and Clift 1981). By the year 1869, nearly 3,000 schools serving over 150,000 students were in operation, jointly run by missionary societies and blacks themselves. By 1870, it is estimated that black people had expended over one million dollars on their private education (Foner 1988, 144).

The enactment of the civil rights acts in 1866 and 1875 led to the expansion of educational, economic, social, and political opportunities for emancipated blacks during

the Reconstruction Era. Between 1865 and 1890, over 200 black private institutions were founded with the help of missionaries and the northern churches (Foner 1988). Unfortunately, founded with haste, and limited financial backing, many closed by 1900.

Now only 40 private HBCUs remain in existence of those established during the Reconstruction area. However during this period, private HBCUs turned out a total of 1,100 college graduates by 1895, many of which became prominent and assumed black leadership roles during the early decades of the twentieth century (Bowles and et al. 1971, 33-34).

All but two public HBCUs were originally listed as normal or industrial schools, and none of them initially conferred baccalaureate degrees. Seventeen public HBCUs, all of which are still in existence, were established under the second Morrill Act of August 30, 1890. The first Morrill Act of 1862 was originally authorized to establish land grant institutions in each state to educate citizens. However, it excluded southern blacks due to the South's "separate but equal" rules. The second Morrill Act was to rectify this exclusion by including historically black institutions. Many of the black normal schools, founded before the second act, were incorporated into this system along with new schools being formed. These colleges and universities became known as "the 1890 institutions." To this day these land-grant HBCUs have had a collective group impact on black education and its advancement that is probably unequaled by any other group of HBCUs. A list of the land-grant HBCUs are found at the end of this chapter (Table 3-3).

The third period that describes the growth of HBCUs is considered the "Separate but Equal" Period lasting from 1896 to 1953. Over two-thirds of the U.S. black

population still resided in the South during this time living under the “separate but equal” 1896 federal court decision in Plessy vs. Ferguson. Black people were still granted their educational rights but were not allowed to learn with whites (Franklin 1975). In educational environments, revised state constitutions and enacted state laws legally prevented black and white students from attending the same institutions (Roebuck and Murty 1993, 29).

This separation was tantamount to segregation and the under-funding of both private and public HBCUs. Many public schools were under the financial control of whites who believed blacks were inferior (Goodenow 1989). The laws of segregation demanded each to stay with its own, regardless of the imbalance in resources (Jencks and Reisman 1968; Roebuck and Murty 1993). Legalized segregation led to an increased pattern of under-funding for black education. Unlike the private HBCUs, public HBCUs were dependent on state governments for support. This coincided with the vast upgrading of white public school facilities and programs in the South spawned by white populist politicians. Black public HBCUs received inadequate and unequal funding from state treasuries, from federal land-grant provisions, and other federal sources.

Be that as it may, HBCUs emerged as the principal employment source for black teachers. HBCUs produced ministers as well as teachers because prior to the Civil Rights Era, the most widely accepted professional occupations for black people were teaching and preaching. Black high schools in southern urban areas proliferated during this period. The availability of teaching positions supported by state education budgets drew more black students into HBCUs to qualify college graduates for teaching

positions. The interdependence between public high schools and HBCUs ensured a functioning educational system that survived despite the inequities in funding and resources. In the segregated South, the rate of expenditure per black pupil amounted to approximately one-fourth of the rate of expenditure per white pupil (Bowles and et al. 1971, 37).

With the dissolution of the Freedmen's Bureau in 1870, northern missionary organizations took on the responsibility to continue to raise funds for HBCUs. After 1900, the secular philanthropic agencies began to contribute as well. Some of these agencies included the General Education Board of the Rockefeller Foundation, the Southern Education Board, the Julius Rosenwall Fund, the Phelps-Stokes Fund, and the Carnegie Foundation. Their funds went to private schools to help expand vocational and industrial training (Moss 1989).

By 1930, the majority of HBCUs had developed into full-fledged colleges. They had dropped non-academic courses, and many required incoming students to have high school diplomas in hand. In addition, by 1931, thirty-one colleges had received approval from the American Medical Association to offer premedical courses, and the Southern Association of Colleges and Schools (SACS) agreed to establish procedures for the accreditation of HBCUs (Quarles 1989). Yet with the Great Depression in the 1930's and American involvement in World War II, financial support to HBCUs diminished and in the early 1940's private HBCUs faced a financial crisis (Roebuck and Murty 1993, 33). Dr. Frederick Patterson, the third president of Tuskegee Institute, urged black colleges to pool their resources and make a united appeal for assistance to the nation.

This resulted in the establishment of The United Negro College Fund (UNCF). In 1944, the UNCF started its first annual campaign and with twenty-seven colleges in participation, raising $765,000. Students and alumni of the UNCF institutions were among the top leaders of the civil rights movement enhancing the efforts of the Fund greatly. Since its foundation, the UNCF has played a major support role in the financial stabilization of most private HBCUs. The money UNCF raises has always come from a variety of sources: private groups and individuals, corporations, small and medium-sized businesses, churches and HBCU alumni.

Unfortunately, public HBCUs continued to struggle with more than their share of poorly trained teachers and administrators and operated with the most inadequate of resources. However, the period Desegregation, the fourth period of this history, would provide some much needed relief to black institutions of higher learning.

In 1954, the judicial ruling on the landmark case of Brown vs. the Board of Education of Topeka, Kansas declared the principle of “separate but equal” unconstitutional. Significant desegregation in American society did not occur until the passage of the Civil Rights Act of 1964. This act empowered the U.S. Attorney General to bring lawsuits on behalf of black plaintiffs and prohibited, under Title VI, the spending of federal funds (appropriated under the Elementary and Secondary Education Act of 1965 and the Higher Education Act of 1965) in segregated schools and colleges.

In Alexander vs. Holmes County Board of Education (1969) the federal court ordered that all school segregation be ended immediately. This brought to a close the legal battles over the desegregation of southern schools that had lasted for half a century, from the years 1930-1980 (Synnott 1989).

The Higher Education Act of 1965 made basic education opportunity grants (BEOGs) and a variety of other financial aid programs available to disadvantaged students, which greatly increased the number of minority enrollment in American colleges and universities. This legislation included Title III – Strengthening Developing Institutions – which was interpreted as a direct intercession favoring HBCUs and as a federal commitment to the survival and enhancement of them. The term "developing institutions" was incorporated into the legislation in an apparent effort to avoid designating HBCUs as the primary recipients of the federal assistance available in the funding.

The areas eligible for government subsidies under this act were faculty and student exchanges, faculty improvement programs, curriculum improvement, student services, a visiting scholars program, and administrative improvements. The Higher Education Act of 1965 also identified the fundable improvement techniques that institutions could utilize – for example, cooperative arrangements with established universities and membership in consortium agreements (Thomas and McPartland 1984; Roebuck and Murty 1993, 44).

Several factors in combination brought about widespread educational desegregation in the South: Federal courts' civil rights rulings, black demonstrations, protests, and marches, federal troop presence, threats to withdraw federal grants for education to white southern institutions, and the tying of federal funding to nondiscriminatory practices – both grant and loan programs. As it was with the second Morrill Act of 1890, federal law in combination with federal dollars produced results.

Because the proportion of black students enrolled at non-HBCUs was, and still

is, higher than the proportion of white students enrolled at Historically Black Colleges and Universities, desegregation for the most part has had a great impact on the racial makeup of student bodies at non-HBCUs. It should be noted that during much of the desegregation era HBCUs, as a group, coped with declines in enrollment (Roebuck and Murty 1993, 41). And in the eyes of some this appeared to diminish the original purpose of HBCUs. Nevertheless, HBCUs have continued to hold their collective importance to black Americans and still struggle for social, economic and political advancement.

From the landmark Brown vs. the Board of Education ruling, historically black colleges and universities did gain some benefits, like funding for infrastructure improvements and increased financial aid for students. Also during this period, the federal government and private philanthropic organizations commissioned fact-finding studies to gain more knowledge about black colleges with regards to physical plants and infrastructure, curricula, student and faculty compositions, and their financial frameworks. These studies were undertaken to develop recommendations for strengthening these colleges. The findings of these studies dramatized HBCUs institutional challenges and outlined and validated the government support needed. These findings served as a basis for governmental funding in the late sixties and early seventies (Thompson 1973).

The goals in the period were to remove the racially identifiable symbols in order to encourage integration and to stimulate the assimilation of black students into predominately white schools. The logical conclusion of this policy is the possible extinction of HBCUs - through lack of need. This was a possibility not considered by

many, yet it did draw the attention of some (Myers 1987). Efforts to enroll larger numbers of white students in HBCUs during the desegregation period were unsuccessful. Though white students were admitted into HBCUs many did not feel welcomed there (Hacker 1992, 157-58). HBCUs have always accepted white students, yet they do not actively recruit them. Nevertheless there are a handful of HBCUs with substantial, if not majority populations composed of white students (Bowles and et al. 1971; Hacker 1992).

A number of events took place in the late 1970's and 1980's that represented a shift in American educational policy from the strict integration of colleges and universities to the encouragement of racially identifiable black institutions as a dimension of pluralistic system of higher education (Roebuck and Murty 1993). HBCUs were preserved and strengthened by the U.S. District Court for the District of Columbia when it directed the Office for Civil Rights to develop guidelines for states that prevented the burden of desegregation from disproportionately falling on black institutions. The persistent under representation of black Americans in most policy-making, managerial, and professional realms (which required a college degree) coupled with the fact that HBCUs are (and had been) graduating professionals at disproportional rate to their numbers made a strong case for the need to enhance all HBCUs.

Also on mainstream campuses across the country during the 19 70s and 1980s black students were facing increasing difficulties, many of which were cultural (Hacker 1992). The result was an increase in enrollments at HBCUs. The federal government, through all three branches, reinforced HBCU acceptability and viability. The Supreme Court ruled unconstitutional the use of race-specific solutions to address the historical

effects of segregation. This fundamentally clarified as constitutional – special assistance to historically black colleges and universities (Roebuck and Murty 1993). The Modern Period begins from 1975 to the present. At the end of segregation, HBCUs faced serious dilemmas. Declining enrollments, potential mergers, and financial losses have hurt the usage of HBCUs.

However, enrollments at HBCUs increased by 25% between 1986 and 1994, but black colleges still face numerous challenges. They receive far less funding from both the private and public sector than their white counterparts. For example, in 1960, the combined endowment of HBCUs was less than the endowment of Northwestern University alone. Also, Howard University, one of the four black organizations (educational or otherwise) that receive the most charitable donations, only has an endowment of $152 million, a piddling amount compared to Harvard University's $7.02 billion. In addition, in Texas, the state government gives predominantly white public institutions $14,000 per student, while HBCUs get only $11,000.

According to NAFEO, white enrollment at black HBCUs has climbed significantly. From 1990 to 1998, the overall number of whites at historically black colleges increased by 16%, and at 12 black colleges, white students now comprise between 19% and 49% of the student body. African Americans are now minorities at three historically black colleges - Bluefield State College, West Virginia State College, and Lincoln University in Missouri.

Today's African-American students can attend college anywhere that their grades, talents, and interests will take them. Increasingly, they are looking at HBCUs because they want the unique experience that only such institutions offer. In fact, the

last few years have seen resurgence in HBCU enrollment. Many incoming students consider HBCUs not so much because of racial issues, but because they want to share in their cultural heritage with students like themselves. Some students come from families where several generations are HBCU graduates, which is often a big incentive for young people who want to experience and HBCU for themselves. Another primary motivation for students is the environmental access to people of their own culture who were successful in their fields. On a more personal level, students like the family closeness that HBCUs give. In addition, the connection that students make with their professors is part of the extensive mentoring facilitated by HBCUs. This is a factor in the high percentage of HBCU graduates who go on for their doctorates. Students see role models all around them and know that faculty members will assist them to get internships and prepare them for careers (Jencks and Riesman 1968; Jones 1993; Hoffman and et al. 1992; Roebuck and Murty 1993).

Federal Policies

In the 1973, the federal government established the Research Infrastructure Grant for American Colleges and Universities. However, HBCUs were not included among the classes of institutions given funding access. To compensate for the omission, President Nixon mandated the first executive order granting a preferential status in the federal sector to some classes of those omitted. There have been a number of important federal policies that have affected HBCUs since Nixon's mandate. In Executive Order 12320, President Reagan focused on specifically focused HBCUs.

This presidential action basically reauthorized the Higher Education Act of 1986. U.S. Congress passed the Historically Black College Act as Part B of Title III. This act

authorizes $100 million exclusively for HBCUs. Congress approved $50.7 million in the 1987 fiscal year, with at least $350,000 allocated to each eligible institution.
April 28 1989, President George H. Bush, in Executive Order 12677 called for the establishment within the Department of Education an advisory commission (the President's Board of Advisors on HBCUs) to oversee the annual development of a national program designed to increase the participation of HBCUs in federally sponsored initiatives and provide advice on how to increase private sector participation in strengthening black colleges and universities. Special emphasis was to be made on providing technical, strategic, and development advice to black institutions, with the goal of ensuring the long-term viability (Federal Register 1989; Roebuck and Murty 1993).

Critics have pointed out that under both Reagan and Bush administrations federal agencies, like the National Science Foundation, the Department of Defense, and the Department Of Health and Human Services could have offered more substantial assistance (Blumenstyle 1989). Seemingly in response to such criticism, the Bush administration altered its approach by categorizing HBCUs according to their missions and programs (Foxworth 1995). The goal here was to help federal agencies better identify schools with interests and resources compatible to their own, thus strengthening and building relationships.

Private foundations were also expected to benefit from such a classification system. However, HBCU officials at some institutions were quite unhappy with the system, believing it would further distance richer HBCUs from their poorer counterparts (Jaschik 1991).

Significantly, President Clinton gave his executive order some teeth by requesting its oversight by the Office of Management and Budget. A utilization plan has been developed by each federal agency that features a percentage of its budget allocated to HBCU funding related to science and technology issues. Each plan operates under a goal-based system in which compliance is rewarded. This preferential status in the federal sector has increased HBCUs attractiveness in the private sector (Foxworth 1995).

The More Recent Initiatives

On February 12, 2002 President George W. Bush signed Executive order 13256 establishing his White House Initiative on HBCUs and with it an appointed board of advisors, housed in the Department of Education's Office of the Secretary.
This initiative provides staff and support for the advisory board and assists the secretary as the liaison between the executive branch and the HBCUs. His initiative also works with some 20 federal agencies to increase the ability of black colleges and universities to compete successfully for federal grants, contracts and federally sponsored programs. President Bush's FY 2004 budget for the U.S. Department of Education included more than $224 million for HBCUs. This is an increase in funding for $10.7 million – a five per cent increase over 2003 funding levels. This would result in an estimated average award of more than $2 million each for almost 100 eligible HBCUs. This will help the schools strengthen infrastructure and improve financial stability, supporting activities such as construction, student services and community relations (NSF 2007, 07-326).

Competition and Perceptions Related to Research and HBCUs

The National Association for Equal Opportunity in Higher Education has recognized 109 educational institutions to be historically black colleges and universities. Eighty-nine of them are four-year institutions. This is 4% of the 2,241 four-year colleges and universities in the country. Among the four-year HBCUs, 61 of them have been identified as research-performing institutions (NSF 1998c). Most of these schools are relatively small institutions, with considerably fewer faculty members and less research space than at most mainstream institutions. Like their counterparts, however, black institutions are most likely to have S&E research space committed to activities concentrating in the fields of life and physical sciences (NSF 1994a).

Grants for and projects involving high-profile or highly sensitive scientific research are rarely awarded to black institutions because of the belief that black institutions lack the expertise to perform the critical research. Historically black colleges and universities are often in a situation where the desired outcome is unattainable because a predetermined body of beliefs prevents the outcome (Journal of Blacks in Higher Education 1997). Seemingly caught in a catch 22, what does qualify as a research institution?

Among the 2,241 four-year colleges and universities in the United States only 126 of these are classified as Research I or Research II institutions by the Carnegie Foundation for the Advancement of Teaching. Carnegie has developed a classification or typology system, not a ranking. In the minds of many, it may be that the Carnegie system serves as a ranking of the quality, potential, or worth of academic institutions.

If this becomes, or already is, the prevailing belief, HBCUs are possibly fighting a no-win situation, considering there is only one black university classified as a research institution – Howard University. Found in Tables B-10 and B-11 in the Appendix are the current classification the HBCUs this study, as well as and their classifications in 2000. Given the technological imperative that is part of the global economy requiring nations for economic survival and growth to harness the full range of their own resources and utilize human capital wherever it can be found, the question of what qualifies as a research institution is a valid one. The presence of "cultural distance" between individuals and groups can be a significant factor in the inability of different parties to achieve successful collaboration or technology transfer (Gertler 1995). It is also evident that an appreciation of "technical culture" is present when and where collaborative efforts are successful. We have recent empirical evidence of successful collaborative efforts in foreign-affiliated R&D labs here in the U.S. (Florida 1997).

A "technical culture" is believed to exist in places where technology-oriented educational systems have produced a shared value system between interacting parties (Sweeney 1991). With such a culture, a common language exists between the users and producers of technology, which aids in the transmission of information, capabilities and operations (Lundvall 1988). Not all research-performing HBCUs can reflect sufficient aspects of technical culture to realistically enter into collaborations and funding competition with established mainstream universities. However, there are some, never considered, who can.

The undergraduate origins of recent S&E doctorate recipients reveal that there is a nurturing environment within HBCUs valuable to the S&T enterprise. In the late

1970s over 40% of black S&E doctorate recipients received their baccalaureate degrees from HBCUs. This percentage fell to 25% in the first part of the 1990s before increasing to about 33% in 2006. During the same period (1977-2006), the share of blacks receiving bachelor's degrees from HBCUs fell from 36% to 21% (NSF 2008, 08-319).

Of the 1,855 African-Americans who earned Ph.D.s in the sciences and engineering (S&E) between the years 1991 and 1995, 27% were graduates of HBCUs. Science and engineering bachelors degrees are awarded by 81 HBCUs, most of which are classified as master's or baccalaureate institutions. This figure of 27% is roughly equivalent to all black college graduates who earn their degrees at HBCUs, which enroll only 17% of all black college students nationwide, but awarded 44% of all bachelor's degrees in the sciences that went to black students in 1990 (NSF 2001).

Non-HBCU (of all types) and HBCUs are been the baccalaureate-origin institutions of black S&E doctorate degree recipients. The yield ratios of all of these types of institutions generally increased between 1986 and the late 1990s, reaching their peak in 1999 or 2000, and have generally declined since then (NSF 2008, 08-319).

Chapter Summary

In 1965 the U.S. Congress formally designated as Historically Black Colleges and Universities (HBCUs) those institutions that were founded before 1964 whose principal mission was the education of Black Americans. Most of these schools were founded immediately before the Civil War or in the decades afterwards by Christian churches, many of them funded through the Freedman's Bureau and private philanthropy.

Today, according to the Department of Education, there are 104 federally designated HBCUs, which are eligible to receive federal money through Title III of the Higher Education Act. A number of justifications have been echoed in defense of HBCUs. Three of the most salient are the following: 1) HBCUs provide a more socially cohesive environment for minority students; 2) they are remarkably successful at preparing students for leadership roles in their community and the greater society; and 3) they successfully prepare students for the job market, particularly in the fields of the hard sciences and engineering.

The history of HBCUs has been one of trials, tribulations, perseverance and victory. From hardship to success, to still finding its purpose in today's society, the life of HBCUs may be best understood within a broad historical context. It can be divided into five periods of growth: the Antebellum Period, the Post-bellum Period, the "Separate but Equal" Period, the Desegregation Period, and lastly, the Modern Period.

The third period that describes the growth of HBCUs is considered the "Separate but Equal" Period lasting from 1896 to 1953. Over two-thirds of the U.S. black population still resided in the South during this time living under the "separate but equal" 1896 federal court decision in Plessy vs. Ferguson. This separation was tantamount to segregation and the under-funding of both private and public HBCUs. Many public schools were under the financial control of whites who believed blacks were inferior (Goodenow 1989). The laws of segregation demanded each to stay with its own, regardless of the imbalance in resources (Jencks and Reisman 1968; Roebuck and Murty 1993). Legalized segregation led to an increased pattern of under-funding for

black education. Unlike the private HBCUs, public HBCUs were dependent on state governments for support.

This coincided with the vast upgrading of white public school facilities and programs in the South spawned by white populist politicians. Black public HBCUs received inadequate and unequal funding from state treasuries, from federal land-grant provisions, and other federal sources. However, the period Desegregation, the fourth period of this history, would provide some much needed relief to black institutions of higher learning.

Several factors in combination brought about widespread educational desegregation in the South: Federal courts' civil rights rulings, black protests, demonstrations, and marches, federal troop presence, threats to withdraw federal grants for education to white southern institutions, and the tying of federal funding to nondiscriminatory practices – both grant and loan programs. As it was with the second Morrill Act of 1890, federal law in combination with federal dollars produced significant results (Thomas and McPartland 1984; Roebuck and Murty 1993). A number of events took place in the late 1970's and 1980's that represented a shift in American educational policy from the strict integration of universities and colleges to the encouragement of racially identifiable black institutions as a dimension of pluralistic system of higher education.

The Modern Period begins from 1975 to the present. At the end of segregation, HBCUs faced serious dilemmas. Declining enrollments, potential mergers, and financial losses have hurt the usage of HBCUs; nevertheless enrollment at HBCUs did increase by 25% between 1986 and 1994, but black colleges still face numerous challenges.

The undergraduate origins of recent S&E doctorate recipients reveal that there is a nurturing environment within HBCUs valuable to the S&T enterprise.

In the late 1970's over 40% of black S&E doctorate recipients received their baccalaureate degrees from HBCUs. This percentage fell to 25% in the first part of the 1990s before increasing to about 33% in 2006. During the same period (1977-2006), the share of blacks receiving bachelor's degrees from HBCUs fell from 36% to 21%.

A series of presidential executive orders starting with President Nixon in 1973 have been implemented by the federal government to compensate for the omission of HBCUs in the Research Infrastructure Grant for American colleges and universities. These executive orders grant preferential status and incentives in the federal sector to agencies that initiate science and technology partnerships and development programs with and through HBCUs.

Table 3-1. Sample Population of HBCUs and Their Home Locations

Alabama A&M University Huntsville, AL	Fisk University *Nashville, TN
Alabama State University *Montgomery, AL	Florida A&M University *Tallahassee, FL
Albany State College Albany, GA	Fort Valley State University Fort Valley, GA
Alcorn State University Lorman, MS	Grambling State University Grambling, LA
Bennett College Greensboro, NC	Hampton University Hampton, VA
Benedict College *Columbia, SC	Howard University *Washington, DC
Bethune-Cookman University Daytona Beach, FL	Jackson State University *Jackson, MS
Bowie State University Bowie, MD	Jarvis Christian College Hawkins, TX
Central State University Wilberforce, OH	Johnson C. Smith University Charlotte, NC
Clafin College Orangeburg, SC	Kentucky State University *Frankfort, KY
Clark Atlanta University *Atlanta, GA	Langston University Langston, OK
Coppin State College Baltimore, MD	Lincoln University *Jefferson City, MO
Delaware State University *Dover, DE	Lincoln University Lincoln University, PA
Dillard University New Orleans, LA	Meharry Medical College *Nashville, TN
Elizabeth City State University Elizabeth City, NC	Mississippi Valley State Univ. Itta Bena, MS
Fayetteville State University Fayetteville, NC	

* denotes a state or federal capital city

Table 3-1. Continued.

Morehouse College
*Atlanta, GA

Morehouse School of Medicine
*Atlanta, GA

Morgan State University
Baltimore, MD

Morris Brown College
*Atlanta, GA

Norfolk State University
Norfolk, VA

North Carolina A&T State University
Greensboro, NC

North Carolina Central University
Durham, NC

Oakwood College
Huntsville, AL

Philander Smith College
*Little Rock, AR

Prairie View A&M University
Prairie View, TX

Savannah State College
Savannah, GA

South Carolina State University
Orangeburg, SC

Southern University and A&M College
*Baton Rogue, LA

Spelman College
*Atlanta, GA

Tennessee State University
*Nashville, TN

Texas Southern University
Houston, TX

Tougaloo College
Tougaloo, MS

Tuskegee University
Tuskegee, AL

Univ. of Arkansas – Pine Bluff
Pine Bluff, AR

Univ. of Maryland – Eastern Shore
Princess Anne, MD

Univ. of the District of Columbia
*Washington, DC

Virginia State University
Petersburg, VA

West Virginia State University
Institute, WV

Winston-Salem State University
Winston-Salem, NC

Wilberforce University
Wilberforce, OH

Xavier University (of Louisiana)
New Orleans, LA

* denotes a state or federal capital city

Table 3-2. Historically Black Colleges and Universities, by Control of Institution

Public Institutions		
Alabama A&M University	Alabama State University	Albany State College
Alcorn State University	Bowie State University	Central State University
Coppin State University	Delaware State University	Elizabeth City State Univ.
Fayetteville State Univ.	Florida A&M University	Fort Valley State Univ.
Grambling State Univ.	Jackson State University	Kentucky State University
Langston University	Lincoln University (MO)	Mississippi Valley State U.
Morgan State University	Norfolk State University	N. Carolina A&T State U.
North Carolina Central U.	Prairie View A&M Univ.	Savannah State College
S. Carolina State Univ.	Southern University	Tennessee State Univ.
Texas Southern Univ.	Tuskegee University	Univ. of Arkansas Pine Bluff
U. of Maryland Eastern Shore	U. of the District of Columbia	Virginia State University
West Virginia State Univ.	Winston-Salem State Univ.	

Private Institutions		
Bennett College	Benedict College	Bethune-Cookman Univ.
Clafin College	Clark Atlanta University	Dillard University
Fisk University	Hampton University	Howard University
Jarvis Christian College	Johnson C. Smith Univ.	Lincoln University (PA)
Meharry Medical College	Morris Brown College	Morehouse College
Morehouse Sch. of Med.	Oakwood College	Philander Smith College
Spelman College	Tougaloo College	Wilberforce University
Xavier University		

Table 3-3. Historically Black Colleges and Universities with Land-Grant Status

Name	Year Founded
Alabama Agricultural &Mechanical University	1875
Alcorn State University	1871
Delaware State University	1891
Florida Agricultural & Mechanical University	1887
Fort Valley State University	1939
Kentucky State University	1886
Langston University	1897
Lincoln University (MO)	1866
North Carolina Agricultural & Technical State University	1887
Prairie View Agricultural & Mechanical University	1876
South Carolina State University	1896
Southern University and Agricultural & Mechanical College	1885
Tennessee State University	1912
Tuskegee University	1881
University of Arkansas – Pine Bluff	1873
University of the District of Columbia	1955
University of Maryland – Eastern Shore	1886
University of the Virgin Islands	1963
Virginia State University	1882

Note: The University of the Virgin Islands is not included in this study due to data unavailability.

CHAPTER 4
RESEARCH DESIGN

The Restated Purpose & Goals of this Study

The primary purpose of this study is to identify some of the most critical factors that influence science and technology (S&T) funding of HBCUs. A secondary purpose is to determine how these factors impact and shape relationships that affect S&T funding of HBCUs. It is hoped that the findings of this study can be presented as useful recommendations to support policies and initiatives for the enhancement of S&T capabilities at HBCUs and will support realistic expectations between funders and their recipients, which should lead to better relations between academic institutions and funding sources.

Choice of Method and Variables

This study is an investigation of relationships among factors. Multiple regression analysis has been chosen for this study because it provides a straightforward means of dealing with multiple relationships simultaneously while providing the expected statistical efficiency. It is statistically expressed as: $Y1 = X1 + X2 + X3 + \ldots + Xn$, where Y represents the dependent variable and X represents the independent variables. Multivariate techniques have been employed and multivariate analysis is used for hypotheses testing. This method has the ability to assess the relationships explored in this study.

Area of Study, Sample Size, and Time Frame of Study

This study looks at 57 black colleges and universities all are located in the mainland of the United States. The sample population of 57 is drawn from a group of 493

colleges and universities providing data to a National Science Foundation (NSF) parent survey regarding their research activities. This group of 493 includes HBCUs and non-HBCUs of all types – each performing R&D activities and receiving R&D funding from outside sources. Only those HBCUs offering bachelor degrees or higher, and providing enough relevant information in the NSF parent survey were selected. Ultimately, this offered a sample size of 60 academic institutions, from a possible total of sixty-five black schools that responded to the survey.

To highlight the role of baccalaureate and post–baccalaureate degree granting institutions, the sample population excludes all Associate of Arts colleges engaged in research activities. Because a sufficient amount of data was unavailable for the University of the Virgin Islands, Selma College, and Rust College, these institutions were dropped from the study, reducing the original sample size of 60 institutions to 57. A point needs to be made here about Southern University. NSF data reporting counts Southern University and A&M College (at Baton Rouge) as "all campuses." Therefore Southern University - New Orleans and Southern University –Shreveport are not counted as separate HBCUs in this study.

The time period of FY 2000 is important as the focus of this study because it represent the start of an important shift in research performance roles between academia and industry. By 2000, there was a decline in the percentage of basic research being performed by academia and a rise in industry's percentage of basic research performance.

Also in FY 2000 two federal agencies, the National Institutes of Health (NIH) and the National Aeronautics and Space Administration (NASA), made character of work

reclassifications that affected funding flows in academia. The National Institutes of Health classified all of its development activities as research. NASA reclassified and transferred funding for space station research and space research from R&D to R&D plant.

HBCUs, non-HBCU doctorate granting institutions, and non-HBCU master's institutions all produced their highest yields of black science and engineering doctorate recipients – as baccalaureate - origin institutions, in the years 1999 and 2000. Since those peak years these three types of institutions have seen a general decline (NSF 2008, 08-319). Whatever strengths and /or weaknesses HBCUs represent can be studied at a period when research and development funding was relatively more stable than now as all American colleges and universities find themselves in an era of ever-escalating competition for research dollars – within academia and with industry.

Variables in this Study

There is one dependent variable: total R&D Expenditures from outside sources. For the sake of brevity, this variable is referred to, at times, as RDEXP. Research and development expenditures are all funds spent for activities specially organized to produce research outcomes and commissioned by an agency external to the institution. As stated above, expenditure totals are derived from combining separately budgeted expenditures from four categories. The category of 'institutional funds' (internally generated) are intentionally omitted to emphasize this study's focus on external funding.

There are 16 independent variables employed in this study, each was suspected of having some effect on research expenditures from outside sources to historically black colleges and universities. They can be grouped into three categories: geographic

variables, economic variables, and institutional variables. The raw data of each of these variables has been made available in tables in Appendix B.

There are four geographic variables. Metropolitan Statistical Area Size (MSA) is used to provide a demographic picture of the size of where HBCUs are located. MSA size provides a means to compare and contrast location, place, region, and factors of geographic movement. Population sizes where HBCUs are located provide a context to help explain what is likely or possible due to the advantages of location, place, and the mobility of people and ideas.

Capital City Home Location of an HBCU can be an advantage that provides greater access that reinforces political and economic ties critical to academic institutions. Physical proximity is believed to do more than decrease distance. It is believed to increase access to resources and decision makers. Exposure through physical proximity could also be a factor in the formation of new connections with influential institutions and individuals.

The question of quantity of academic institution in a given city or state being an influencing factor on funding has been addressed with the selection of these last two geographic indicators. Others were tested but with the help of the economic indicators used in this study, the following two where determined to be the best.

Total # of HBCUs in the State is employed to determine if the number of HBCUs in a region, in this case the state, affect funding amounts to a HBCU individually.

Total # of Research Class Non-HBCUs in the same MSA as HBCUs is an indicator used to help determine the effects of physical proximity, greater exposure, resource concentration, size and the sharing of ideas and people that connections and

easier mobility make possible. I believe that these four geographic variables in a broad sense work well together to help us examine funding relationships.

There are four economic variables, all reflecting state level economic conditions. Legislative activity, governmental funding, policy decisions, and data collection often reflects fiscal decisions through the administrative boundaries of the state, therefore economic variables on the state level seems most appropriate for use.

Personal Income (per capita) is a standard means to compare and contrast relative economic health and wealth of regions. The effects of urbanization, local and regional development, and economic activity – scientific, technological, and otherwise can be reflected partially through this indicator.

State Higher Education Current Fund Expenditures – total is a more specific indicator of the economic investment the state makes to colleges and universities, and hopefully to be a very telling one, considering it is expenditure, as is our dependent variable. HBCU current fund expenditures were originally considered as an independent variable candidate. However it was eliminated as due to its effect on the other variables in this study.

State R&D Concentration captures the influence of total state R&D performance and gross state product**.** This indicator is one of two variables tied directly to the work of research and development activities.

State Academic R&D Performance is the other indicator. This indicator reflects the influence of research & development performance in the specific sphere we have selected our sample population.

Eight of the indicators in this study are categorized as institutional variables.

The decision to include more variables in this category than the other groups is based on the belief that institutional factors are perhaps some of the most important influencers in the acquisition of R&D funding.

Control of Institution. Whether an HBCU is administratively controlled publicly or privately could be an important factor. Considering our sample population is comprised of schools that are a mix of small, very small, medium-sized, and relatively large institutions. It includes comparatively well run and not-so-well run institutions, land-grant universities, small liberal-arts colleges, two medical colleges and one research extensive university, the Control of Institution could be an insightful indicator.

Total Enrollment. The size of the HBCU tell us something about what is expected, required, and demanded in the way of resources, and of course, what may be expected in the way of output. Therefore, Total Enrollment was a logical choice as an institutional variable. It is the supply side of an equation that has demand and expectations on the other side - the expectation of education that leads to successful matriculation.

Total # of Degrees Conferred and Total # of Doctorate Degrees Conferred. As discussed in chapter 3, HBCUs have done remarkable job through out the history of American education in providing baccalaureate opportunities to students of color and been sources of baccalaureate-origin for blacks earning doctorate degrees in science and engineering fields. Because the ultimate production measure of institution of higher learning is the awarding of degrees, the variables of Total # of Degrees Conferred and Total # of Doctorate Degrees Conferred are had to be a part of the institutional picture of each HBCU, and the schools as a group.

Graduation Ratio follows as a reasonable measure linking input to output, enrollment to successful matriculation.

Library Holdings and Faculty / Student Ratio are two indicators that reflect any academic institutions need to rely on key support resources – human and material to fulfill its mission and meet its goals.

Land-Grant Status for university or college embodies and symbolizes a set of political and economic ties and a set of responsibilities that possibly have an effect on R&D funding to that institution. Because of this, and the fact that several of the more prominent HBCUs in this study hold this designation, Land-Grant Status has included among the group of institutional indicators.

Data Collection Method & Sources

The National Science Foundation's Survey of Scientific and Engineering Expenditures at Universities and Colleges (R&D Expenditures) is the primary data source for the dependent variable. Developed and administered as an instrument to assess trends in R&D expenditures, this survey is completed by institutional representatives at each college and university. To increase measurement accuracy, the survey requests institutions to include industry R&D funding received in the form of grants and contracts from profit-making entities. Survey data did not provide information on funding for research from corporate foundations, endowments or fellowships, and through unrestricted accounts (NSF 1995, 29-31).

The data source of the dependent variable was the National Science Foundation's report on Academic R&D expenditures FY 2000. Data collection for the dependent variable involved recording the totals of separately budgeted R&D expenditures from

four categories each representing outside funding source, and adding the totals from the relevant categories. The categories are: federal government, state and local government, industry, and “all other sources” which are largely awards for non-profit foundations and voluntary health agencies. The omitted expenditure category of course was “institutional funds”. A National Science Foundation description of each category is found in Appendix C.

Data sources for the independent variables data are gathered largely from secondary sources - federal and state agency documents and reports available to the public. Most of the data for the variables was collected from bound print publications and the rest from the internet. When figures were not available federal and state agency published documents and reports, were sought primary sources. The schools were contacted directly - usually by phone. In a few instances no data, not even estimates, were available.

Of the independent variables, the economic ones, were gathered as follows: Science and Engineering State Profiles: 2002, an NSF publication, is the source of statewide number of science and engineering (S&E) doctorate degrees awarded, state total R&D performance, statewide academic R&D performance, statewide industry R&D performance, state higher education current fund expenditures, gross state product and personal income per capita on the state level. State R&D concentration data was collected from the NSF/SRS publication, National Patterns of R&D Resources 2002. An added source for income data (per capita) was the State and Metropolitan Data Book 2002-03: A Statistical Abstract Supplement.

The data sources for the institutional variables are as follows. Student figures required to calculate graduation ratios and to determine enrollment size, and the number of degrees conferred – both doctorate and total - were taken from the U.S. Department of Education's Digest of Education Statistics, 2001. HBCU current fund expenditures data also comes from the same Digest of Education Statistics, 2001. Another source for the figures citing degree production are special reports published in Black Issues in Higher Education (July 10th 2002 and 2002a). Library holdings for each HBCU are sourced from the U.S. Department of Education IPEDS Academic Library Survey, 2001. Library category totals were aggregated for each educational institution. Graduation ratios were self-calculated from total student enrollment figures and graduate totals. The formula is (total number of students graduating over the total number of students enrolled.)

To create faculty/student ratios, faculty totals per institution were collected from several sources: the College and University Personnel Association, the American Association of University Professors, and the College Handbook 2002 – 39th edition, published by the College Entrance Board Examination. Faculty/student ratios were self-calculated from student enrollment figures and faculty totals.

The College Handbook is also the data source for the institutional control status, as is the Classification Index of Colleges and Universities, developed and published by the Carnegie Foundation for the Advancement of Teaching. Carnegie classification for institutional type also is drawn from the index. Land-grant status was determined through reviewing the historic background pages on websites of the public HBCUs.

The sources for the geographic and demographic variables are as follows: Metropolitan statistical area (MSA) was determined for population estimates by the Population Estimates Program, Population Division of the U.S. Bureau of Census, internet release date: December 2002. A variety of maps provided the location, place, and regional information needed to determine the measurement of the other four geographic variables.

Operationalizing the Variables

Here, a restatement of the dependent and independent variables and how they are defined is provided. The dependent variable is measured in U.S. dollars. It is defined again as follows: TOTAL R&D EXPENDITURES. Dollars received (from external sources) for the purpose of research and development.

Thirteen of the sixteen independent variables are measured quantitatively. There are three qualitative variables in the study: Capital City Home Location, Control of Institution, and Land-Grant Status. These three qualitative measures are 'coded' using quantitative numbers to be put into the regression analysis as dummy variables. Measurement codes are provided with their variables.

METROPOLITAN STATISTICAL AREA SIZE. The official population estimate determined by the United States Census Bureau.

CAPITAL CITY HOME LOCATION. An HBCU located in its state capital. (no = 0, yes =1)

THE NUMBER OF OTHER HBCUS IN STATE RECEIVING FEDERAL R&D FUNDS.

TOTAL # OF RESEARCH CLASS NON-HBCUS WITHIN THE SAME MSA AS HBCUS

PERSONAL INCOME (PER CAPITA). State income total divided by state population. This figure was calculated by the data source.

STATE HIGHER EDUCATION CURRENT FUND EXPENDITURES. Money spent to meet current operating costs for state higher education, including salaries, wages, utilities, student

services, public services, research libraries, scholarships & fellowships, auxiliary enterprises, hospitals, and independent operations. Loans, capital expenditures, and investments are excluded.

STATE R&D CONCENTRATION. The R&D performance as a proportion of the gross state product. R&D performance is calculated in dollar amounts.

STATE ACADEMIC R&D PERFORMANCE. R&D carried out by colleges and universities in the state. Performance is calculated in dollar amounts.

CONTROL OF INSTITUTION. The nature of an academic institution's administrative control. (1 = private, 2 = public) Private institutions are designated "1" because the only research extensive HBCU in this study and the medical schools in this study are under private control.

TOTAL ENROLLMENT. Total number of students registered in school in the academic year – the beginning of fall semester 2000 to the end of summer semester 2001.

TOTAL # OF DEGREES CONFERRED. Number at the bachelor's and master's level within the specified academic year.

TOTAL # OF DOCTORATE DEGREES CONFERRED.

GRADUATION RATIO. The total number of students enrolled divided by the total number of graduated students.

LIBRARY HOLDINGS. An aggregate index of all of the volumes held in book and media collections. This includes the number of book volumes, periodical subscriptions, and volumes bound.

STUDENT / FACULTY RATIO. Number of students per one faculty member. Faculty includes full-time, part-time, and adjunct faculty, but not teaching assistants.

LAND-GRANT STATUS. Status granted by U. S. Congressional legislation with the 2nd Morrill Act of 1890. (0 = no, 1 = yes)

The Chosen Statistical Techniques and their Goals

Multiple regression analysis was used to test the effects of various geographic, demographic, economic, and institutional factors (i.e.), independent variables on R&D expenditures (the dependent variable). As mutli-collinear relations are suspected amongst the independent variables, a stepwise procedure was employed to sidestep the problem of statistical inefficiency in the testing of regression coefficients.

Stepwise regression allowed for the inclusion of statistically relevant variables that explained the greatest share of variation in the dependent variable, and excluded variables that were insignificant or collinear. The models formed by the stepwise procedures allow for the identification of the best predictors of the dependent variable, with variables added (incrementally) as long as their coefficients are shown to possess statistical significance. Variables may be dropped from the model should their predictive power fall to a non-significant level as other variables are added.

Regression Analysis Presentation of Model Formation

The establishment of a fitted model by way of regression analysis will start with a full model containing all 16 predictors.

$$Y_i = B_0 + B_1 X_{i1} + B_2X_{i2} + B_3X_{i3} + B_4X_{i4} + B_5X_{i5} + B_6X_{i6} + B_7X_{i7} + B_8X_{i8} + B_9X_{i9} + B_{10}X_{i10} + B_{11}X_{i11} + B_{12}X_{i12} + B_{13}X_{i13} + B_{14}X_{i14} + B_{15}X_{i15} + B_{16}X_{i16} + e$$

where:

Y_i = R&D Expenditures for the ith HBCU

B_0 = intercept (value of Y_i given that all predictors = 0)

B_1, B_2, B_3, B_4, B_5… B_{16} = represents the influence of the predictors

X_{i1} = Metropolitan Statistical Area (MSA) population estimate

X_{i2} = Capital City Home Presence

X_{i3} = # of other HBCUs in State Receiving Federal R&D Funds

X_{i4} = # of Research Class Non-HBCUs within the same MSA

X_{i5} = Personal Income (per capita)

X_{i6} = State R&D Concentration

X_{i7} = State Higher Ed. Current Fund Expenditures

X_{i8} = State Academic R&D Performance

X_{i9} = Control of Institution

X_{i10} = Total Enrollment

X_{i11} = Total # of Degrees Conferred

X_{i12} = # of Doctorate Degrees Conferred

X_{i13} = Library Holdings

X_{i14} = Student / Faculty Ratio

X_{i15} = Land-Grant Status

X_{i16} = Graduation Ratio

e = errors with the assumption of normal distribution (w/mean = 0 and variance = ^{2} I)

Regression Diagnostics of the Fitted Model

The diagnostics of a regression generated fitted model relies heavily on an interpretation of the coefficient of determination or R^2. The R^2 is the proportion of variability in the data set that is accounted for by the model. It is offered to measure the proportion of the variance of the dependent variable about its mean explained by the predictor variables. The modified measure of the coefficient of determination (adjusted R^2) takes into account the number of independent variables included in the regression equation and the sample size. With sixteen independent variables and a sample size of fifty-seven, this statistic is not very relevant here because we do not need to make a comparison between equations with different numbers of independent variables or different sample sizes.

Chapter Summary

The purpose of this study is to identify some of the critical factors that influence science and technology (S&T) funding of HBCUs in fiscal year 2000. A second purpose is to determine how said factors impact and shape relationships that affect S&T funding of HBCUs. Schools were drawn from a group of 493 institutions providing data to the National Science Foundation regarding their research activities.

Fifty-seven HBCUs for this study were identified and data collected from a major secondary source. Data sources for the dependent and independent variables was gathered largely from secondary sources - federal and state agency documents and reports available to the general public.

For this study to investigate the relationships between and within types of variables, regression analysis has been chosen. Regression analysis provides a straightforward means of dealing with multiple relationships simultaneously while providing the expected statistical efficiency. The dependent variable is Total R&D Expenditures (from outside sources) a reflection of all funds spent for activities specially organized to produce research outcomes and commissioned by an agency external to the HBCU. Sixteen independent variables are employed. Thirteen of them are quantitative in nature and will be measured as such. The three qualitative independent variables are coded as dummy variables and will also be measured qualitatively.

All variables in this study have been operationalized and prepared for data analysis. Data will be run in its raw form. Both linear and stepwise regression analysis will be performed in this study. These processes will include all variables in order to devise a model (or models) were the least and most relevant variables are accounted for.

CHAPTER FIVE
RESEARCH ANALYSIS

Research Question and Test Hypotheses Restated

The purpose of this research is to examine the relationships that exist between suggested factors that affect acquisition of research and development funding from outside sources to historically black colleges and universities. The research question explored in this study is: What are the main factors that influence external funding received by HBCUs?

Sixteen test hypotheses were employed. H_o1: Metropolitan statistical area size (MSA) has no effect on funding. H_a1: Metropolitan statistical area (MSA) size affects funding. H_o2: State (or federal) capital home location has no effect on HBCU funding. H_a2: State (or federal) capital home location affects funding. H_o3: The number of other HBCUs in state receiving federal R&D funds has no effect on funding. H_a3: The number of other HBCUs in state receiving federal R&D funds affects funding. H_o4: The number of research non-HBCUs in the same (MSA) with HBCU has no effect on funding. H_a4: The number of research non-HBCUs in the same (MSA) with HBCU affects funding.

H_o5: Personal income level (per capita) has no effect on funding. H_a5: Personal income level (per capita) affects funding. H_o6: State R&D concentration has no effect on funding. H_a6: State R&D concentration affects funding. H_o7: State higher education current fund expenditures have no effect on funding. H_a7: State higher education current fund expenditures affect funding. H_o8: State academic R&D performance has no effect funding. H_a8: State academic R&D performance affects funding.

H_o9: Control of institution has no effect on funding. H_a9: Control of institution affects funding. H_o10: The size of student enrollment has no effect on funding. H_a10: The size of student enrollment affects funding. H_o11: The total number of degrees conferred has no effect on funding. H_a11: The total number of degrees conferred affects funding. H_o12: The number of doctorate degrees conferred by a HBCU has no effect on funding. H_a12: The number of doctorate degrees conferred by a HBCU affects funding. H_o13: HBCU graduation ratios have no effect on funding. H_a13: HBCU graduation ratios affect funding. H_o14: The size of HBCU library holdings has no effect on its funding. H_a14: The size of HBCU library holdings affects funding. H_o15: HBCU student / faculty ratio have no effect on funding. H_a15: HBCU student / faculty ratio affects funding. H_o16: Land-grant status held by a HBCU has no effect on funding. H_a16: Land-grant status held by a HBCU affects funding.

A stepwise regression model was used to explain variation in R&D expenditures, and the model with the highest coefficient of determination (R^2) and F values was chosen. That model yielded an R^2 of .66 and an F-statistic of 34.5, with three explanatory variables: (a) total number of degrees conferred; (b) number of doctorate degrees conferred; and (c) number of research non-HBCUs in the metropolitan statistical area. These three explanatory variables account for 66% of the variations in R&D expenditures, with each being significant at the 95% confidence level (based on the results of the t-tests on their associated coefficients).

Discussion of the Final Model

As discussed above in the research design, stepwise estimation is a selection process for finding the most influential parameters - parameters are statistically

expressed above as: B_0, B_1, B_2, B_3, B_4, B_5, B_6, …B_{16}. The important determination of which independent variables highly correlate with the dependent variable yet to a low degree with other independent variables is realized thru the stepwise process.
The sought incremental explanatory power of the predictor variables was found in the results from stepwise estimation.

The fitted model provides the highest coefficient of determination (R^2) possible, while containing the greatest number of predictor variables possible. R square represents the measure of the proportion of the variance of the dependent variable about its mean that is explained by its predictor variables. With a properly applied and estimated model, it is assumed that the higher the numerical value of R^2, the greater the explanatory power of the regression equation. Thus, the better will be the prediction of the dependent variable.

Here is the interpretation of the fitted model: $Y_i = B_0 + B_{18} X_{i18} + B_{19} X_{i19} + B_5 X_{i5}$

$Yi = - 1149.667 + 7.143 X_{i18} + 84.430 X_{i19} + 574.831 X_{i5}$

where: Y_i = R&D Expenditures for the ith HBCU X_{i18} = Total # of Degrees Conferred X_{i19} = # of Doctorate Degrees Conferred X_{i5} = # of Research non-HBCUs in the MSA.

We can now consider the above variables together in a way that possibly reveals their collective influence on R&D expenditures from outside sources. The beta coefficient for Xi_{18} and Xi_{19} suggest that for every degree conferred an additional $7.1 goes to R&D expenditures and for every additional doctorate degree conferred $84.4 is contributed to R&D expenditures. This implies that a doctoral degree conformation is 12 times as influential in terms of producing research and development expenditures in comparison to degree conformation (at the baccalaureate and master's levels).

The results suggest that degree-producing areas or programs tend to have the greatest ability to secure research and development funding.

The beta coefficient for Xi_5 suggests that for every MSA non-HBCU there is an additional 574.8 dollars contributed to R&D expenditures, once we take into account the number of degrees conferred. This is believed to be the result of urban agglomeration and /or synergistic effects tied to geographic location. Academic institutions tend to be numerous and cluster in vibrant and / or dense urban corridors.

Unanticipated Findings and Directions for Future Research

There were some unanticipated findings in this study. Most unexpectedly, there were only three variables selected by the stepwise regression process. My assumption was that there as a sufficient number (16) and type of variables (3) to generate a model with more elements. I anticipated a model somewhere in the range of five or six elements. In hindsight, the small number of statistically significant variables from the linear regression runs was evidence that the stepwise regression model would probably not contain many variables.

The less than robust results of the regression analysis should be noted. There is a clearly observed low level of explained variance among the coefficients and a general lack of statistical significance to report from the findings. Perhaps given the number of independent variables in the study and the expectation that more variables would have stronger influence regression results should be considered quite satisfactory.

In further research on this topic, I believe that a study of this nature would benefit from a research design that includes a component that creates indicators that would measure social networking factors from the funding sources side of the dynamic.

The focus would be primarily on decision-making rationale by leading federal agencies that fund research and development in the academic sphere. It may also possible to create a collaboration indicator that captures the degree and length of interaction between HBCUs and research non-HBCUs performing joint research and development activities.

In future research on this topic, a greater effort will be made to directly test other forms of proximity other than physical proximity. Science and technology collaboration is encouraged thru network proximity and hierarchical proximity. The use of frequency counts and accessibility indices could possibly create successful measurement instruments to determine the impact of network and proximity based on hierarchy.

It was anticipated at the outset of this study that institutional factors would have some recognizable role in influencing R&D expenditures. After correlation analysis, the ability of total number of degrees conferred and doctorate degrees to make through to the final model stage was not surprising, and with total degrees conferred – it was expected. There was the expectation that perhaps one additional institutional factor, such as library holdings (with a correlation of .600) would find their way its way into the model. Yet upon further consideration I can see how the effect of degrees conferred can possibly outweigh many, if not most, of the institutional variables considering what it represents - the culmination of the educational process itself, with all the inputs taken into consideration.

Only after correlation analysis reflected the basically weak representation of the economic variables, did I consider the likelihood that state-wide economic indicators are probably too broad in nature to effective tease out any direct economic influences tied to

R&D funding for HBCUs. The absence of economic variables in the model results thus was somewhat expected.

A study of this type with sixteen independent variables may be less damaging than omission of variables. Yet the inclusion of irrelevant variables does produce a form of specification errors. The inclusion of irrelevant variables does not lead to bias in the estimation of the regression coefficients for the relevant variables in the equation, but it may adversely affect the significance test of the coefficients of relevant variables (Pedhazur and Schmelkin 1991).

There were variables considered not selected for this study. I had no impulse to include variables as an added means of security or to satisfy to my curiosity. However, in hindsight, the formulation and testing of some interactive variables would have provided a better picture of the nature of the interactions between variables. Interactive variables would allow of slope and intercept shifting. Polynomials or combinations thereof could have been used to the analysis. The scatter-plots of the variables (Appendix A) hint that there may be a curvilinear relationship between some of the variables. The model used in this study lacks a control group. A comparison with non-HBCUs would have offered a useful means to enrich this study. Future research on this topic of HBCUs and R&D funding will include these additions and suggestions to the research design.

All variables in this study support my initial theory and ideas about the factors that effect higher levels of R&D funding to HBCUs. With random measurement errors carefully avoided, an overestimation or underestimation of regression coefficients should be free of measurement error bias.

The statistically significant correlation of capital city home location (.366) with the dependent variable was somewhat expected to play a role in the development of the model. If only to perhaps to reflect some of the advantage that proximity and closer access to economic and political decision-makers provide academic institutions. It is possible that some of this advantage is indeed best reflected in the geographic variable selected for the model. The power of place is seen in the uniqueness of environments that attract, retain and development human resources. These are the places where we find the institutions and structures that are generally better at meeting contemporary human needs and wants.

The Results of the Tested Hypotheses

Based on our sample population, the following can be said about our tested hypotheses.

I accept the null hypothesis.
H_o1: Metropolitan statistical area size (MSA) has no effect on HBCU funding.

I accept the null hypothesis.
H_o2: State (or federal) capital home location has no effect on HBCU funding.

I accept the null hypothesis.
H_o3: The number of HBCUs within a state has no effect on HBCU funding.

I reject the null hypothesis.
H_o4: The number of non-HBCUs in the same (MSA) with HBCU has no effect on funding.

I accept the null hypothesis.
H_o5: Personal income level (per capita) has no effect on HBCU funding.

I accept the null hypothesis.
H_o6: State R&D concentration has no effect on HBCU funding.

I accept the null hypothesis.
H_o7: State higher education current fund expenditures have no effect on HBCU funding.

I accept the null hypothesis.
H_o8: State academic R&D performance has no effect HBCU funding.

I accept the null hypothesis.
H_o9: Control of institution has no effect on HBCU funding.

I accept the null hypothesis.
H_o10: The size of student enrollment has no effect on HBCU funding.

I reject the null hypothesis.
H_o11: The total number of degrees conferred has no effect on HBCU funding.

I reject the null hypothesis.
H_o12: The number of doctorate degrees conferred by a HBCU has no effect on its funding.

I accept the null hypothesis.
H_o13: The size of HBCUs library holdings has no effect on its funding.

I reject the null hypothesis.
H_o14: A HBCU's student / faculty ratio has no effect on its funding.

I accept the null hypothesis.
H_o15: Land-grant status held by a HBCU has no effect on funding.

I accept the null hypothesis.
H_o16: A HBCU's graduation ratio has no effect on its funding.

The two research questions were explored in this study. The first question is: What are some of the key factors that influence R&D funding received by HBCUs from outside sources? This study finds that the combination of number of degrees conferred, number of doctorate degrees conferred, and number of research non-HBCUs in the same metro area are the best predictors of influence on R&D expenditures to historically black colleges and universities.

These factors combined have great credibility. Largely because they seem embody relationships that are able to maximize the educational experience and take it to its farthest ends (i.e.), degrees conferred and degrees earned. Relationships that seem to have the greatest credibility are those relationships that are able to take advantage of environments comparatively high levels of capacity, usually but not in all

cases, large highly urbanized areas were there is strong resource concentration economic, political, and intellectual levels. In short, access and proximity to resource-rich places enhance institutional outcomes for HBCUs.

Chapter Summary

A stepwise regression model was used to explain variation in R&D expenditures, and the model with the highest coefficient of determination (R^2) and F values was chosen. That model yielded an R^2 of .66 and an F-statistic of 34.5, with three explanatory variables: (a) total number of degrees conferred; (b) number of doctorate degrees conferred; and (c) number of research non-HBCUs in the metropolitan statistical area. These three explanatory variables account for 66% of the variations in research and development expenditures, with each being significant at the 95% confidence level (based on the results of the t-tests on their associated coefficients).

The beta coefficients for Xi_{18} and Xi_{19} suggest that for every degree conferred an additional $7.1 goes to R&D expenditures and for every additional doctorate degree conferred $84.4 is contributed to R&D expenditures.

This implies that a doctoral degree conformation is 12 times as influential in terms of producing research and development expenditures in comparison to degree conformation (at the baccalaureate and master's levels). The results suggest that degree-producing areas or programs tend to have the greatest ability to secure research and development funding.

The beta coefficient for Xi_5 suggests that for every MSA non-HBCU there is an additional 574.8 dollars contributed to R&D expenditures, once we take into account the number of degrees conferred. This is believed to be the result of urban agglomeration

and/or synergistic effects tied to geographic location. Academic institutions tend to be numerous and cluster in vibrant and/or dense urban corridors.

Table 5-1. Descriptive Statistics: Stepwise Regression

Model	Coefficients Unstandard. Beta	Standard Error	t	Significance Level
1 (constant)	-717.842	945.275	-.759	.451
RDEXP	8.814	1.268	6.952	.000
2 (constant)	-663.018	793.699	-.835	.407
# of Degrees Conferred	7.386	1.104	6.689	.000
# of Doctorate Degrees	90.743	18.675	4.859	.000
3 (constant)	-1149.667	797.407	-1.442	.155
# of Degrees Conferred	7.143	1.072	6.665	.000
# of Doctorate Degrees	84.430	18.255	4.625	.000
# of MSA Non-HBCUs	574.831	260.663	2.205	.032

Model 3: R^2 = .666 Adj. R^2 = .647 Sig. F Change .032 ANOVA Sig. .000

Collinearity Tolerances: Total #of Degrees Conferred .919
# of Doctorate Degrees Conferred .906
# of Research Non- HBCUs in MSA.954

CHAPTER SIX
CONCLUSIONS AND IMPLICATIONS

Further Discussion of Research Findings and Conclusions

As discussed in earlier chapters, HBCUs have had notable and continued success in the granting of degrees of higher learning. Successful matriculation is part of their collective mission and collective function. In academia and to the world at large, arguably the most important and tangible measure of a college or university's performance is the number of degrees conferred. Therefore it stands to reason that R&D funding sources, particularly the federal government and its agencies, are well aware of the collective and individual performance record of HBCUs over the years and have responded in some measure with funding to these institutions.

This contention is supported by the variables in our fitted model which account for 66% of the variations in R&D expenditures, with each being significant at the 95% confidence level. For every degree conferred an additional $7.1 goes to research and development expenditures and for every additional doctorate degree conferred $84.4 is contributed to research and development expenditures. The results suggest that degree-producing areas or programs tend to have the greatest ability to secure research and development funding.

For every research non-HBCU in the same metropolitan area as a HBCU there is an additional 574.8 dollars contributed to R&D expenditures, once we take into account the number of degrees conferred. This is believed to be the result of urban agglomeration and/or synergistic effects tied to location. Academic institutions tend to be numerous and cluster in vibrant and/or dense urban corridors.

This is supportive evidence that R&D funding sources recognize the role HBCUs play in the pipeline that feeds America's national science and technology workforce and contributes to the research and development activities encouraged to achieve a range of goals. As discussed in Chapters 2 and 3, the proportion of black doctorate degree earners who claim an HBCU as their baccalaureate-origin institution has been impressive. Like total number of degrees conferred at .690, the number of doctorate degrees conferred by HBCUs correlates with R&D expenditures at .573 – the statistically significant value at the .01 level. All doctorate granting institutions, regardless of their designations, by function and mission play an integral role in the development and advancement of national scientific and technological prowess the United States relies on for economic growth and development when they produce advanced degree graduates. The economic and possible entrepreneurial value of colleges and universities is enhanced by the production of new knowledge creators from the most demanding academic programs. Academia's ability to do so is directly attributable in part to R&D funding from outside sources.

HBCUs as a group, including the ones in this study, have a limited number doctorate degree granting institutions among their ranks. Doctorate degree programs exist at Master levels I & II institutions, but they are not as commonly found, or as varied, as in mainstream academic institutions. Howard University, Clark Atlanta University, Meharry Medical College, and Morehouse School of Medicine would have been exceptions to the general rule. Less than one fourth of the HBCUs in our sample population granted doctorate degrees in 2000 and most HBCUs today maintain a

primary focus on undergraduate education, and a growing number of master's degree program options. Table B-10 is the Carnegie classification listings of HBCUs for 2000.

With the third predictor in our model have a number of new and interesting things to consider. Counting the number of institutions and locations related to the details of this variable, fundamentally we are exploring an interaction that takes place between 22 HBCUs in our sample population and 23 research non-HBCUs located in 14 metropolitan areas (Table 6-1). There is a noticeable concentration of more than one HBCU and more than one research non-HBCUs as neighbors in several of the largest of the cities found in Table 6.1. Many of the HBCUs that grant most the degrees (on the doctorate level and in total number) are found in locations where they have non-HBCUs as metro neighbors.

Even when we consider institutions not in major urban areas, like Florida A&M University in Tallahassee, Florida with only one research non-HBCU in the MSA (Florida State) it is one of the HBCUs that granted the highest number of degrees in the year 2000. Florida A&M University granted 1,944 degrees in total – 8 of them doctorates; this is second only to Howard University, located in Washington D.C., granting a total of 2,172 degrees – 121 of them doctorates. Note that Howard University has four non-HBCUs as metro neighbors. The six of top eight HBCU producers of graduates (Howard, FAMU, Tennessee State, Southern, North Carolina Central, and Prairie View) are universities in metro areas with research non-HBCUs.

Nine of the fifteen black academic institutions granting doctorate degrees in 2000 are located in metropolitan areas shared with research non-HBCUs. These schools generated the lion's share (295) of the 349 doctorates granted in 2000. When we

consider the fact that Howard University (121 doctorates) in Washington, DC, Clark Atlanta University (28 doctorates) in Atlanta, and Morehouse School of Medicine (48 doctorates) in Atlanta, are HBCUs that have as metro neighbors four research non-HBCUs, we can see the pervasive influence the combination our three predictors could have on explaining the presence of R&D funding.

According to the research findings we can report that having a non-HBCU as an advantage is neighbor. Consider Meharry Medical School in Nashville, Tennessee. It has one research non-HBCU as a metro neighbor (Vanderbilt University), but Meharry Medical School granted 150 doctorates in 2000 and it also has fellow HBCU Tennessee State (conferring 1,468 degrees – 33 of them doctorates) as a metro neighbor.

This discussion has attempted to show academic institutions highlighted by our predictor variables in their relationships with each other and their general performance explain the validity of the predictor variables in our model. A reasonable start towards an explanation of research and development funding received by HBCUs in this study has begun with this research.

Implications and Recommendations

The implications of the findings of this study could support the body of theoretical literature related to agglomeration, resource concentration, and the multiplier effects that spring from a critical mass of institutions, infrastructure, and human talent. The findings reported also have implications for further research studies. Studies with a small scale focus on the outcomes of institutional strategy approaches taken by a single HBCU or a small group of HBCUs seeking greater levels of sponsored research could benefit from a broad study of this type. The implications for professional practice and

decision making are quite straight forward. The inputs and support mechanisms that enhance the matriculation process must be maintain the highest priority.

The development of marketable undergraduate degree programs, leading to advanced degree programs at HBCUs and elsewhere, must be maintained as the highest of priorities. Existing HBCU doctorate programs and graduate programs deserve the fullest support and development.

As mentioned in the introduction and again in this chapter, my contention is that factors of agglomeration, such as size, scope, access, proximity, resource concentration, urbanization, formal political and economic relationships, and regional development are relevant in answering the research questions examined here. The findings of this study do support the economic attractiveness (some may say "economic imperative") of very large urban areas, despite an acceptance of the null hypotheses for my first variable – metropolitan statistical area size.

As it relates to historically black colleges and universities, their options are naturally limited by the reality of having to function, for the most part, from their given fixed locations. Black academic institutions in the cities of Atlanta, Georgia, Washington, DC, or Houston Texas have access, proximity advantages, and close collaboration opportunities that Mississippi State University in Itta Bena, Mississippi do not have, and can only dream of. Black academic institutions like Florida Agricultural & Mechanical University and Tennessee State University located in capital cities coupled with their land-grant status have access, proximity advantages, and close collaboration options and opportunities West Virginia State University most likely will never see.

Recommendations can be made to HBCUs seeking to attract R&D funding in this times when academic institutions are expected to evolve in entrepreneurial universities.

For those HBCUs that do not have the benefits of fixed location in larger more dynamic urban areas (and this is a good number of the HBCUs in our sample population), the recommendations are to develop as many outreach initiatives as possible – on the state, regional, national and international levels. Devote more resources to these initiatives while maintaining priority commitments to high quality degree programs. In some cases, shared programs and facilities could be the solution to resource shortages. Isolating behaviors and insular practices will doom HBCUs located in geographically distant and small urban and semi-rural areas.

For those HBCUs that are the locations were connectivity or the potential for connectivity is high. The above recommendations apply along with organizational and administrative commitment to implement state-of-the-art best practices, support and attract superior faculty and staff. Be willing to eliminate bureaucratic malaise and stagnation. Aggressively capitalize the unique qualities and academic programs at your institution that are high degree producers. These things are very important in an urban competitive environment whether people have access to other viable choices than your institution.

Chapter Summary

The findings of this study support the contention that proximity (and subsequent access) to resource rich centers such as research non-HBCUs directly and indirectly positively affect HBCUs that are high in degree production. Some of these HBCUs have active doctorate degree programs – further enhancing the attraction of these

institutions. This combination of factors explains 66% of the influencing factors on research and development expenditures received by the HBCUs in this study.

Through the testing of these hypotheses we also have an opportunity to discover more about the role geographic themes in how they manifest a decentralized system of multiple institutions and agencies, multiple needs and expectations, interdependencies and economic pressures.

The geographic themes of location, place, and region are particularly relevant to this study. The theme of location is significant because it conceptualizes the power that fixed sites have to draw (or not draw) specific human activities, and the opportunities and growth that may ultimately result. Proximity and access to multiple centers of knowledge creation and collaboration are of great benefit to HBCU communities.

The theme of place clearly reflects in the ability of some locations to develop a critical mass of talent, ideas, specializations, capital, institutions, infrastructure, and government support that reinforces much of the concentration of wealth and opportunity people seek. Unique human environments alone are not enough to attract research and development funding. Uniqueness coupled with dynamic activity can create synergy. Synergy can make geographic locations magnetic. Places where a technical culture is found, appreciated, expected, and supported will be a place where the right type of academic institution will be enhanced and collaboration is probably more likely.

Considering the stratified and concentrated patterns in R&D funding and R&D performance, the fact that few HBCUs are located in the top R&D performing states or high-tech regional belts offers us an opportunity to explore the role of region as a geographic theme. The challenges of regional economic development on a cross-state

and intra-state level have had there effect on HBCUs. The southern states, mid-western states and rural to semi-rural areas in the U.S. (where you find most HBCUs) have been in the economic shadows of the more urbanized and tech-savvy north-eastern and western regions of the country. Because of the realities of fixed location, HBCUs will have to be vital players in the best regional economic development strategies at work in their home areas.

With this in mind, HBCUs would do well to commit to and keep at the forefront curriculum, programs, policies, and practices that attract students, faculty, and resources, making in-migration and pull factors at the core of all they do. These aspects of the geographic theme of movement historically black colleges and universities would be pleased to reflect.

Table 6-1. Research Non-HBCUs in Metro Areas with HBCUs, by Location

South Atlantic Region

Metropolitan Statistical Area: Petersburg / Richmond, Virginia
1 Research Non HBCU – Virginia Commonwealth University
1 HBCU – Virginia State University

Metropolitan Statistical Area: Washington, District of Columbia
4 Research Non-HBCUs – Georgetown University John Hopkins Univ. George Washington UniversityUniversity of Maryland – College Park
1 HBCU – Howard University

Metropolitan Statistical Area: Baltimore, Maryland
4 Research Non-HBCUs – Georgetown University John Hopkins Univ. George Washington UniversityUniversity of Maryland – College Park
2 HBCUs – Coppin State CollegeMorgan State University

Metropolitan Statistical Area: Columbia, South Carolina
1 Research Non-HBCU – University of South Carolina
1 HBCU – Benedict College

Metropolitan Statistical Area: Raleigh / Durham, North Carolina
3 Research Non-HBCUs – North Carolina State University Duke UniversityUniversity of North Carolina – Chapel Hill
1 HBCU – North Carolina Central University

Metropolitan Statistical Area: Atlanta, Georgia
4 Research Non-HCUs – Georgia Institute of Technology Emory Univ. Georgia State UniversityInstitute of Paper of Science & Technology
5 HBCUs – Clark Atlanta University Morehouse School of Medicine Morehouse College Morris Brown College Spelman College

Metropolitan Statistical Area: Tallahassee, Florida
1 Research Non-HBCU – Florida State University
1 HBCU – Florida A&M University

West South Central Region

Metropolitan Statistical Area: Little Rock, Arkansas
1 Research Non-HBCU – University of Arkansas – Little Rock
1 HBCU – Philander Smith College

Metropolitan Statistical Area: Houston, Texas
2 Research Non-HBCUs – University of HoustonRice University
2 HBCUs – Prairie View A&M University Texas Southern University

Metropolitan Statistical Area: New Orleans, Louisiana
1 Research Non-HBCU – Tulane University
1 HBCU – Dillard University

Table 6-1. Continued.

West South Central Region

Metropolitan Statistical Area: Baton Rogue, Louisiana
1 Research Non-HBCU – Louisiana State University
2 HBCUs – Southern University Xavier University

Northeast Region

Metropolitan Statistical Area: Philadelphia, Pennsylvania
3 Research Non-HBCUs – Temple University University of Delaware University of Pennsylvania
1 HBCU – Lincoln University (PA)

APPENDIX A

Statistical Data Tables

Histograms and Plots

Table A-1. Descriptive Statistics: Linear Regression

Variable	N	Mean	Standard Deviation	Significance Level
RDEXP	56	4553.2321	5762.02390	.886
Metro. Stat. Area Size	56	165107.7	2140258.6340	.492
Capital City Location	56	.3571	.48349	.393
# of other HBCUs in State with Fed. R&D $	56	5.9821	3.77788	.560
# of Research Non-HBCUs In the MSA	56	1.1964	1.81328	.110
Personal Income (per capita)	56	27787.179	4239.76822	.355
State R&D Concentration	56	1.4291	.91336	.500
State Higher Ed. Current Fund Exp.	56	2930.0179	1972.19474	.391
State Academic R&D Expenditures	56	3792.1250	3292.84853	.377
Control of Institution	56	.6607	.47775	.094
Student Enrollment	56	3845.4643	2542.63185	.281
Total # of Degrees Conferred	56	598.0536	449.28547	.021*
# of Doctorate Degrees Conferred	56	8.8036	26.56479	.024*
Library Holdings	56	314531.71	358806.81088	.458
Student/Faculty Ratio	56	16.0714	5.29788	.109
Land-Grant Status	56	.3214	.47125	.053*
Graduation Ratio	56	15.4613	3.85092	.839

p * > .05 Note: Mean & standard deviation results in stepwise run (raw data) are the same as the above results.

Table A-2. Descriptive Statistics: Linear Regression

Model: R^2 = .587 Adj. R^2 = .563 Sig. F Change .042 ANOVA Sig. .000

Collinearity Tolerances:	
Metropolitan Statistical Area Size	.399
Capital City Home Location	.554
# of other HBCUs Receiving Fed. R&D $	.711
# of non-HBCUs in the MSA	.598
Personal Income (per capita)	.284
State R&D Concentration	.446
State Higher Ed. Current Fund Exp.	.173
State Academic R&D Expenditures	.118
Control of Institution	.467
Student Enrollment	.036
Total # of Degrees Conferred	.028
# of Doctorate Degrees Conferred	.467
Library Holdings	.261
Student / Faculty Ratio	.458
Land-Grant Status	.538
Graduation Ratio	.276

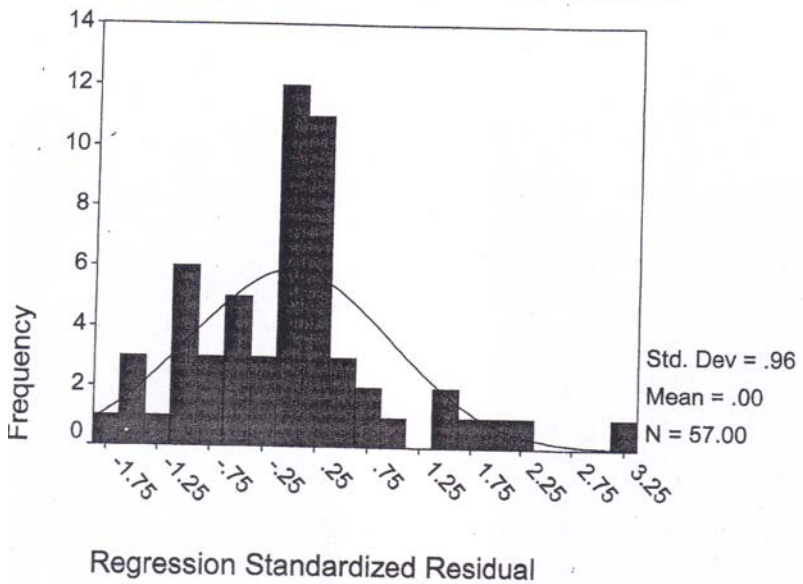
Table A-3. Correlation Results of Predictor Variables on the RDEXP

Predictor Variable	Correlation
Metropolitan Statistical Area Size	.209
Capital City Home Location	.366**
# of Other HBCUs in State Receiving Federal R&D Funds	- .014
# of Non-HBCUs in the MSA	.342*
Personal Income (per capita)	.216
State R&D Concentration	.197
State Higher Education Current Fund Expenditures	-.036
State Academic R&D Performance	-.081
Control of Institution	.118
Student Enrollment	.578**
Total # of Degrees Conferred	.690**
# of Doctorate Degrees Conferred	.573**
Library Holdings	.600**
Student / Faculty Ratio	-.359*
Land-Grant Status	.256
Graduation Ratio	.451**

** Significant at the 0.01 level (2-tailed test). * Significant at the 0.05 level (2-tailed test).

Histogram

Dependent Variable: VAR00025



Normal P-P Plot of Regression Sta

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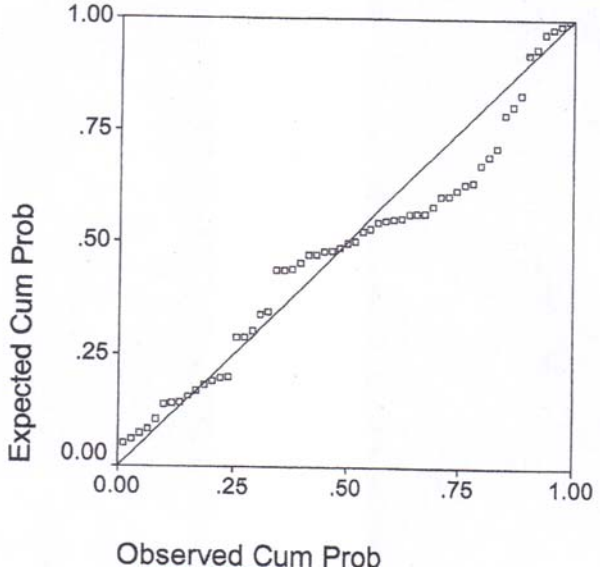
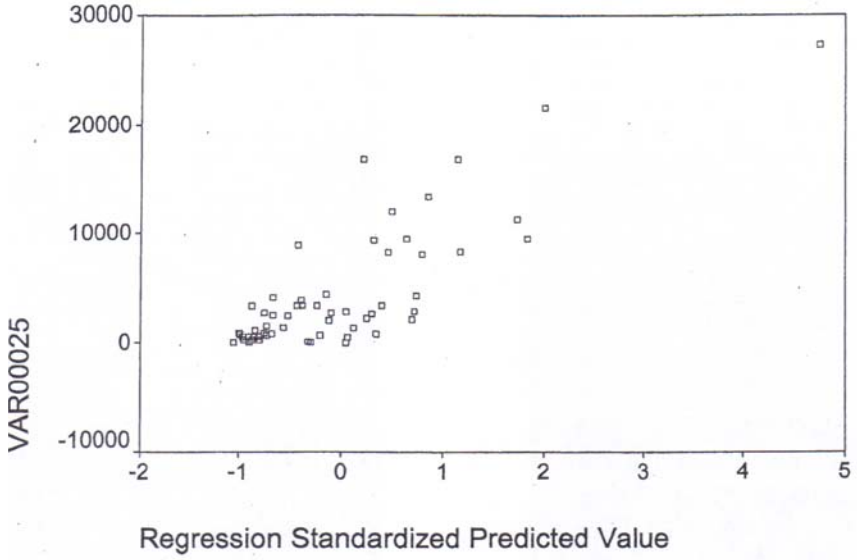


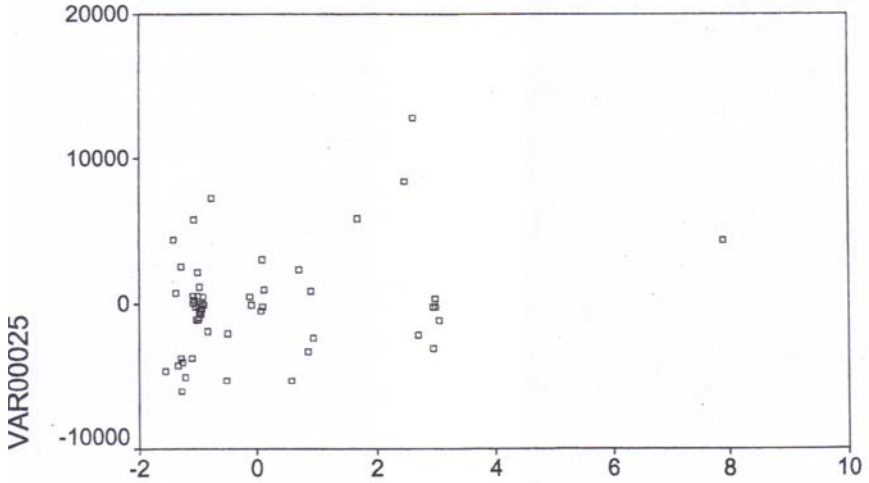
Scatterplot

Dependent Variable: VAR00025



Partial Regression Plot

Dependent Variable: VAR00025



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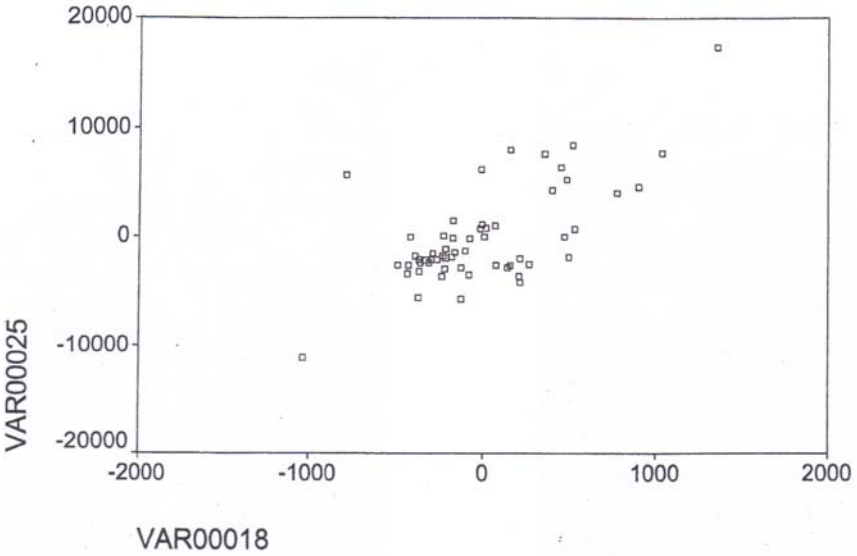

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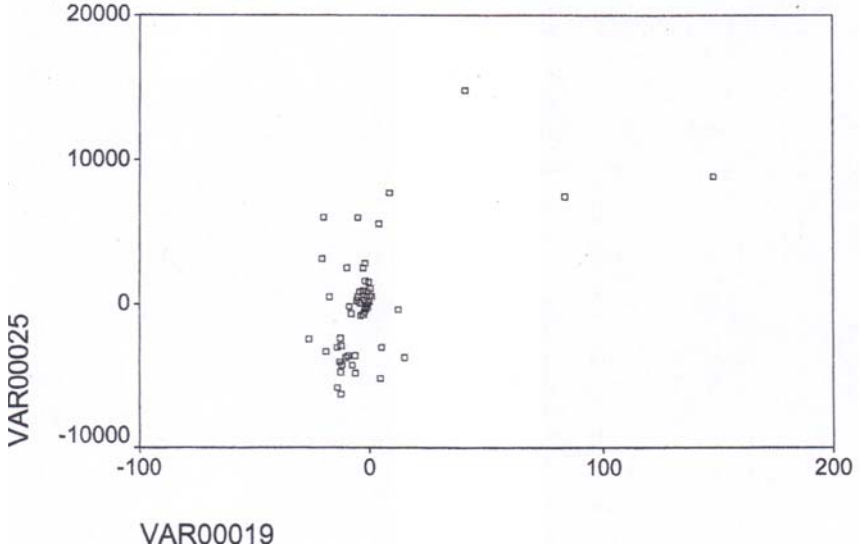

Histogram

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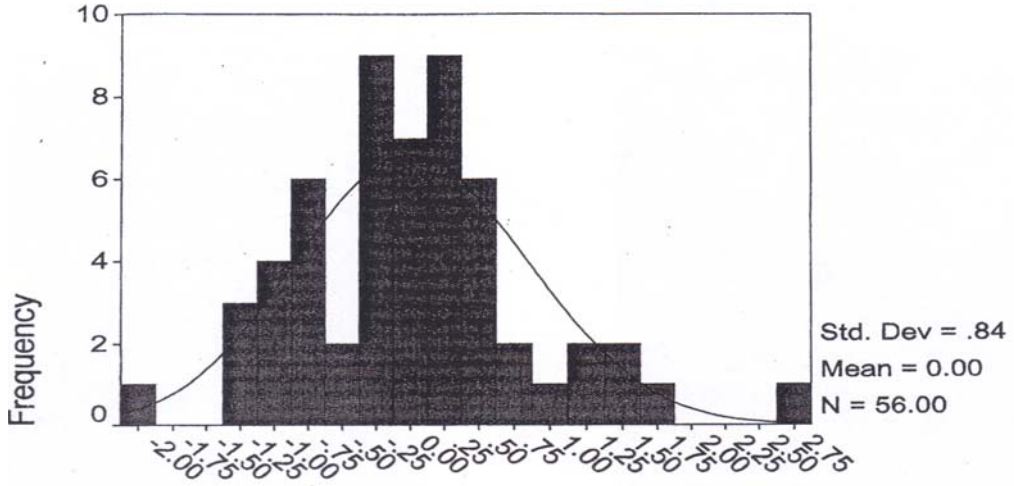

Normal P-P Plot of Regression Sta

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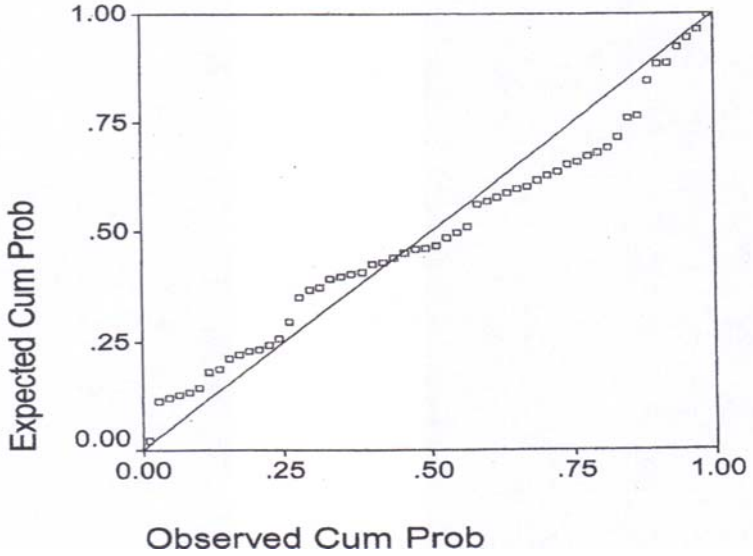

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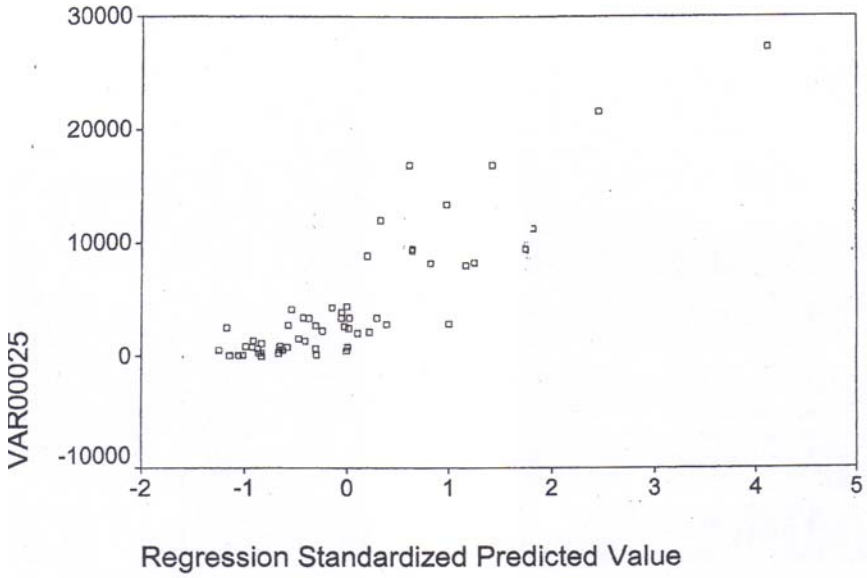

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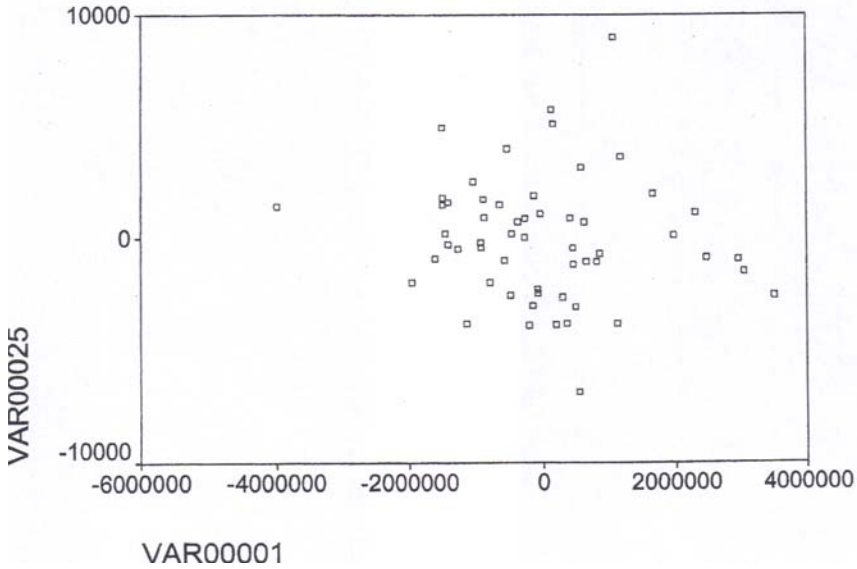

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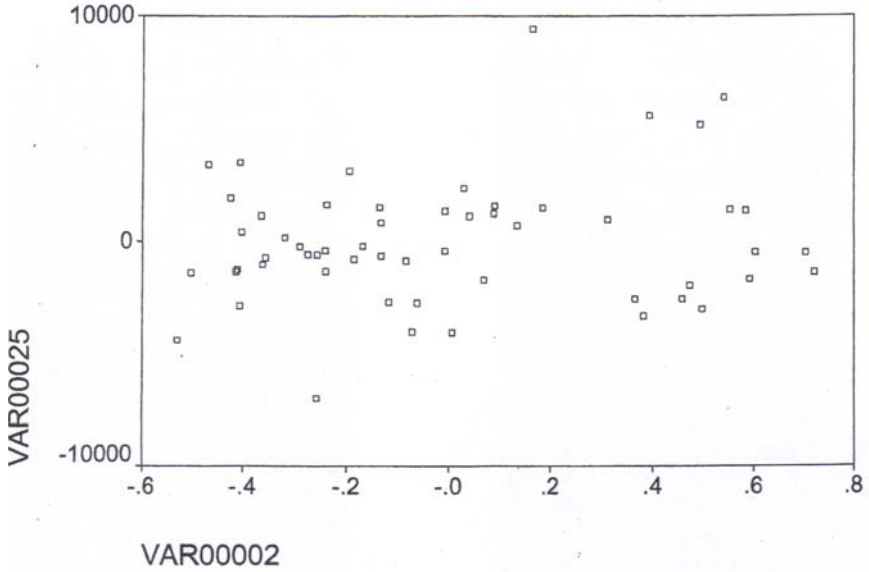

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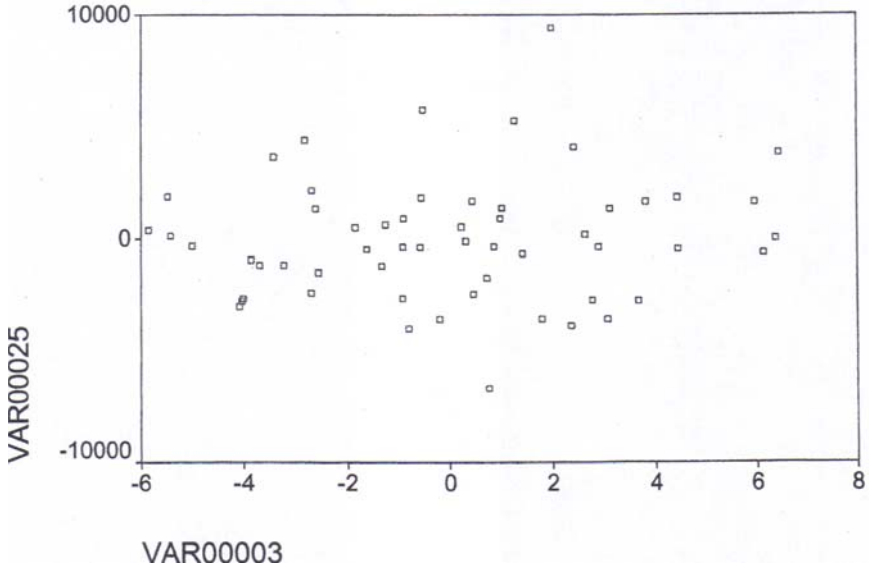
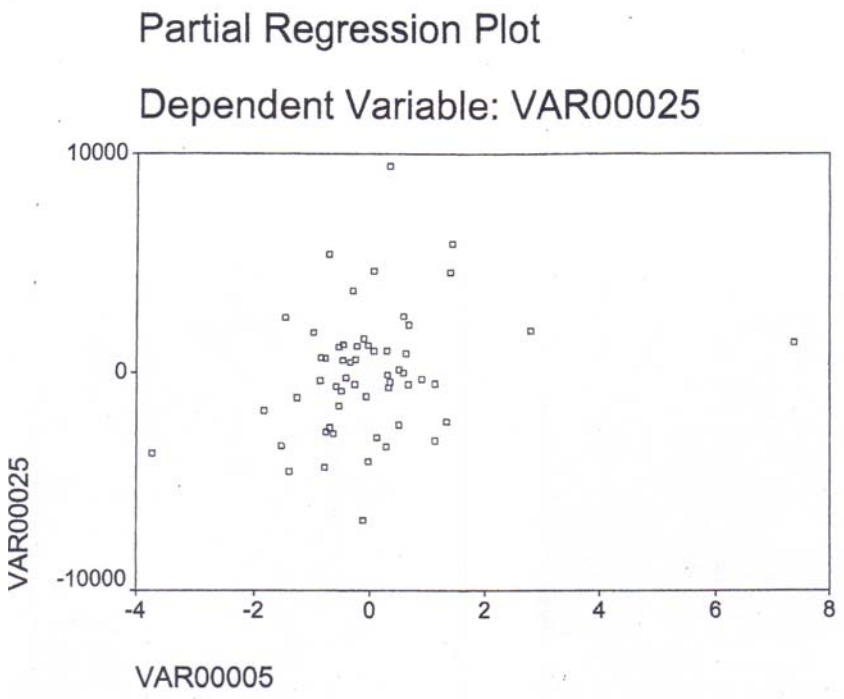
Dependent Variable: VAR00025

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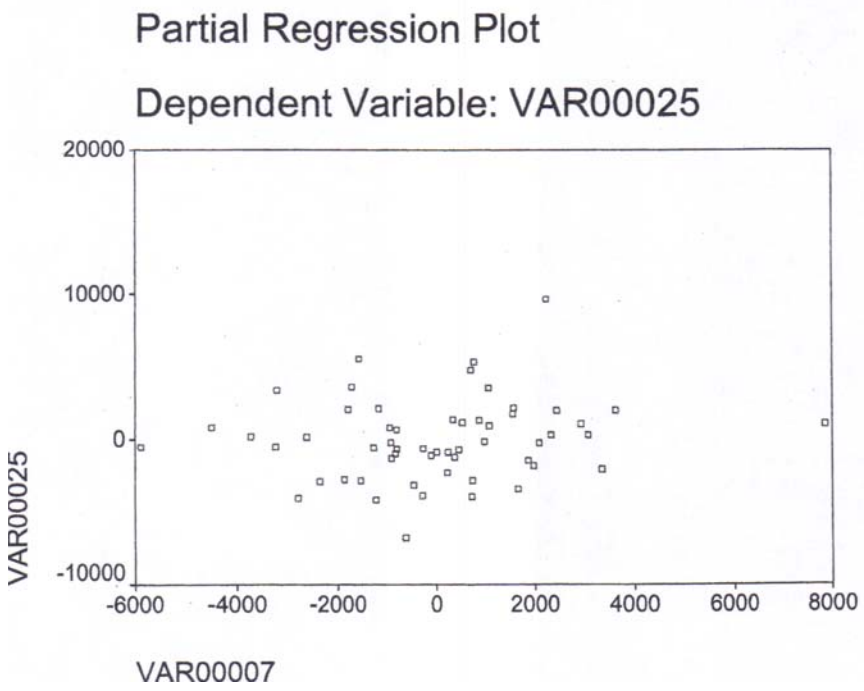
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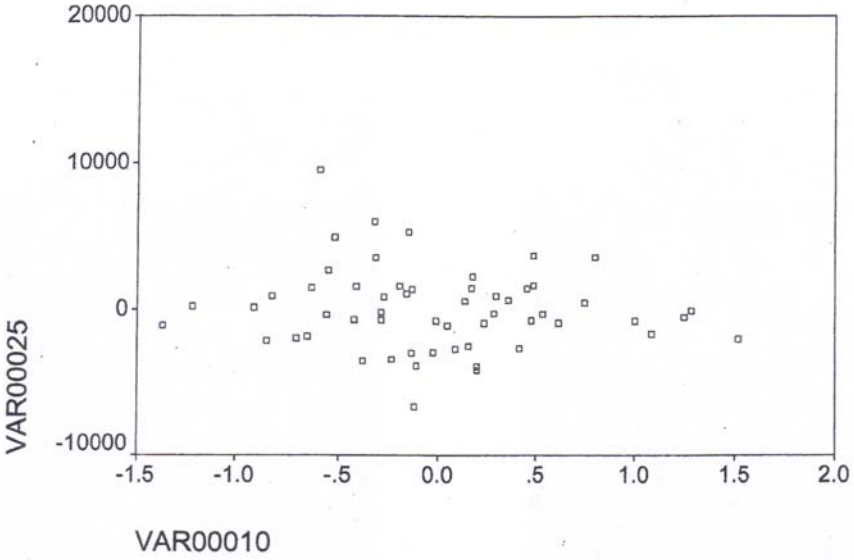
Dependent Variable: VAR00025



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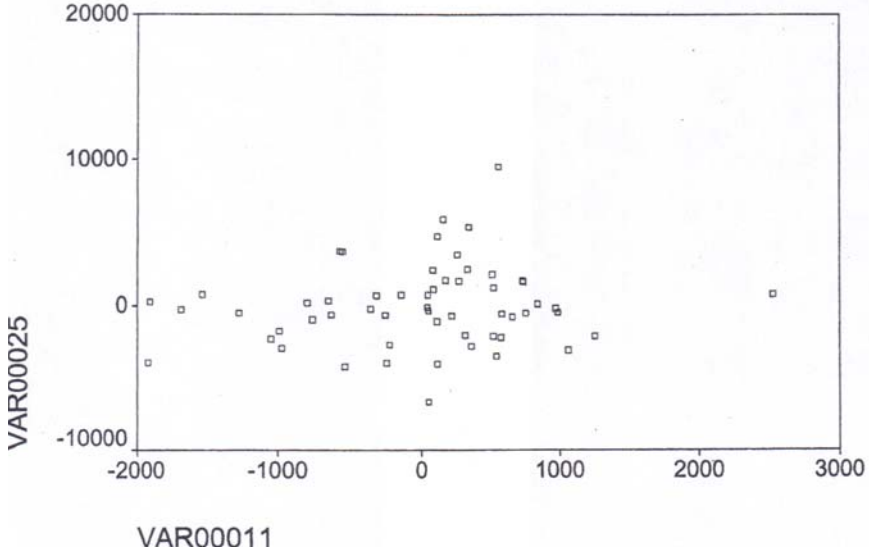

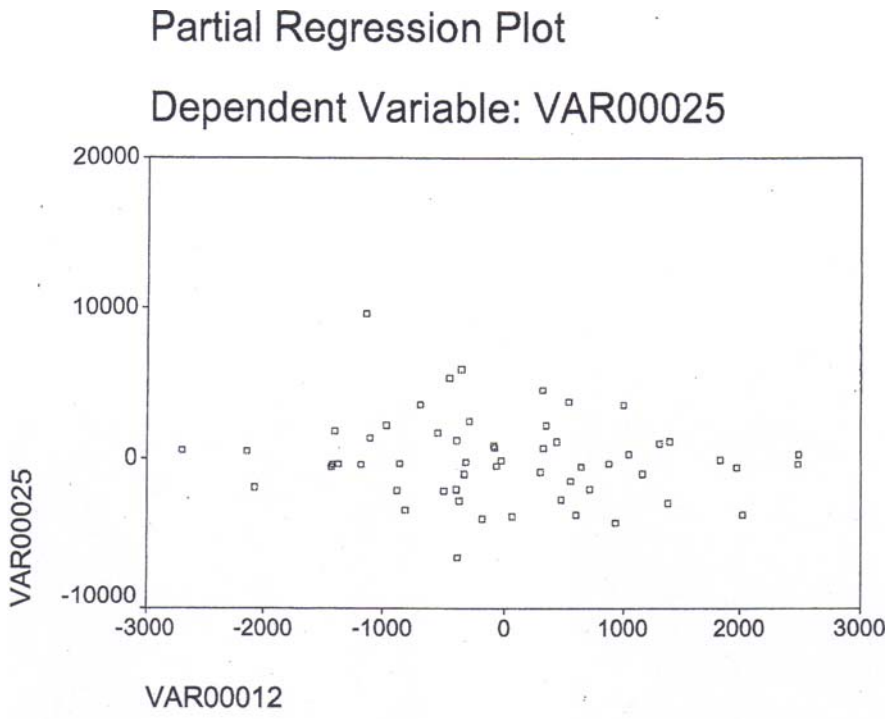
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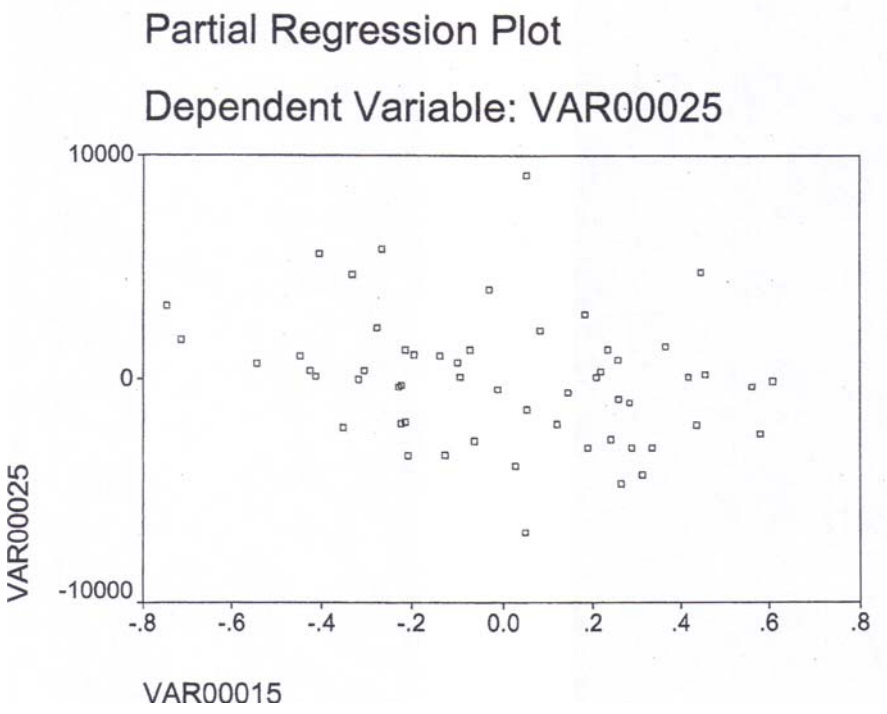
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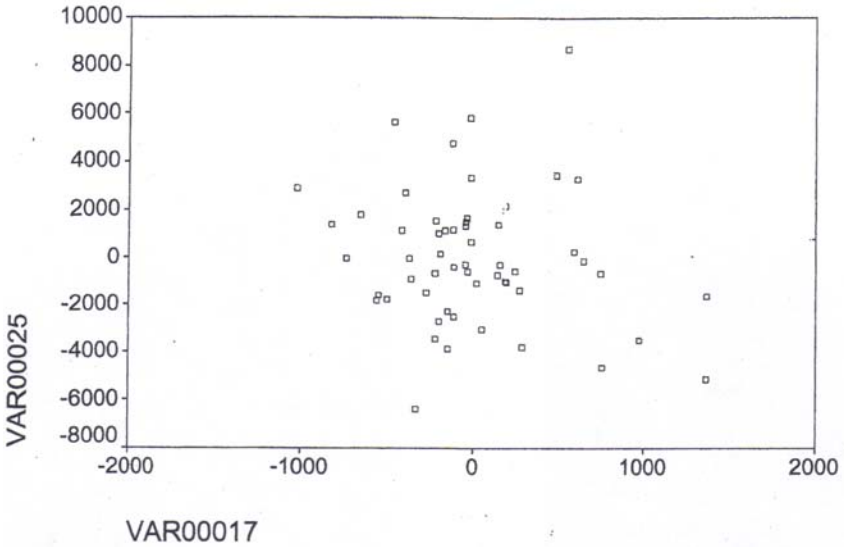

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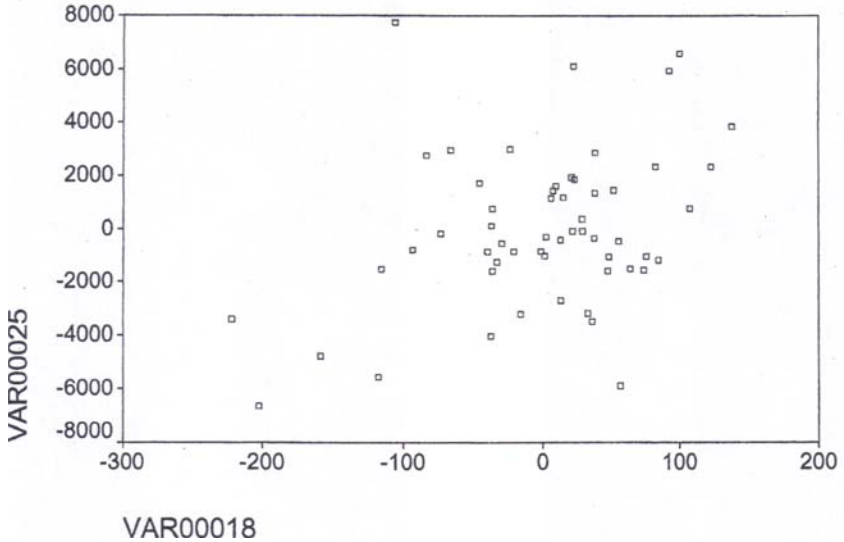

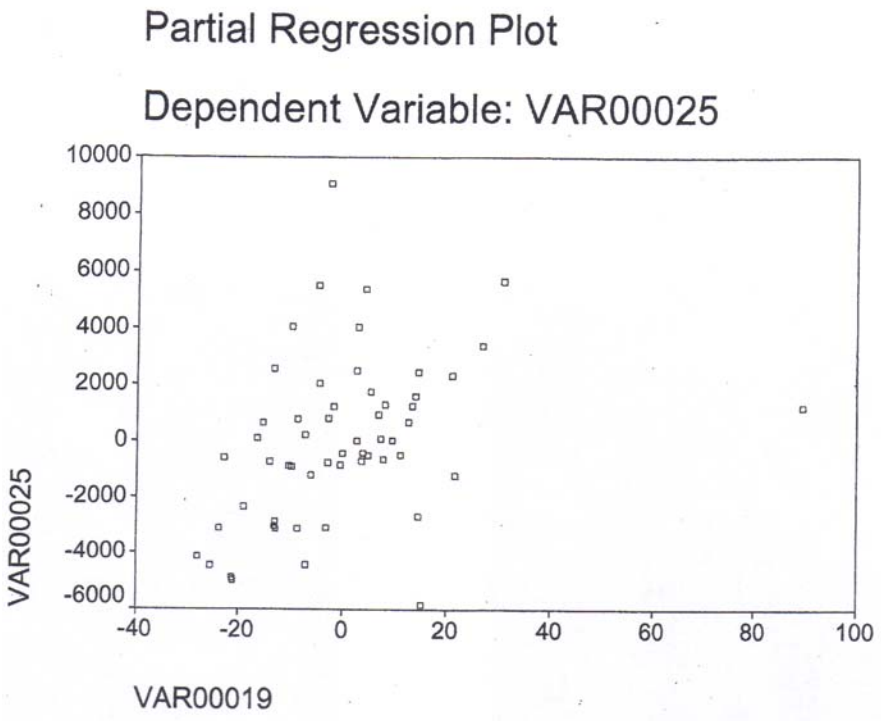
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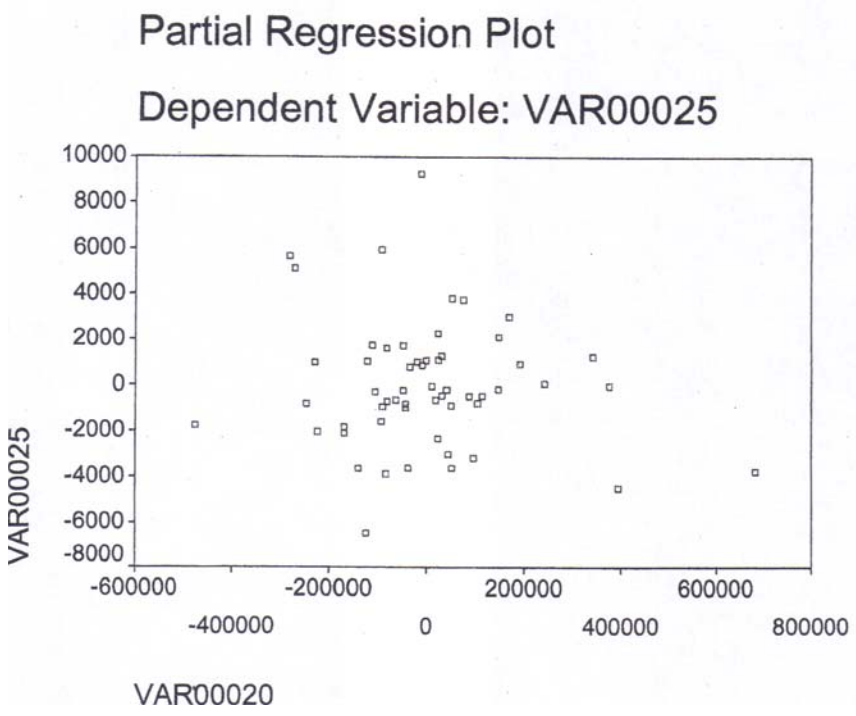
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800000
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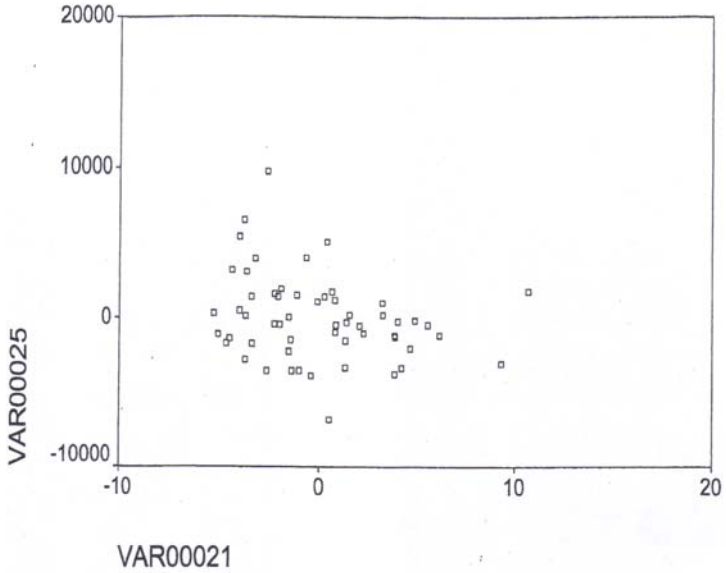

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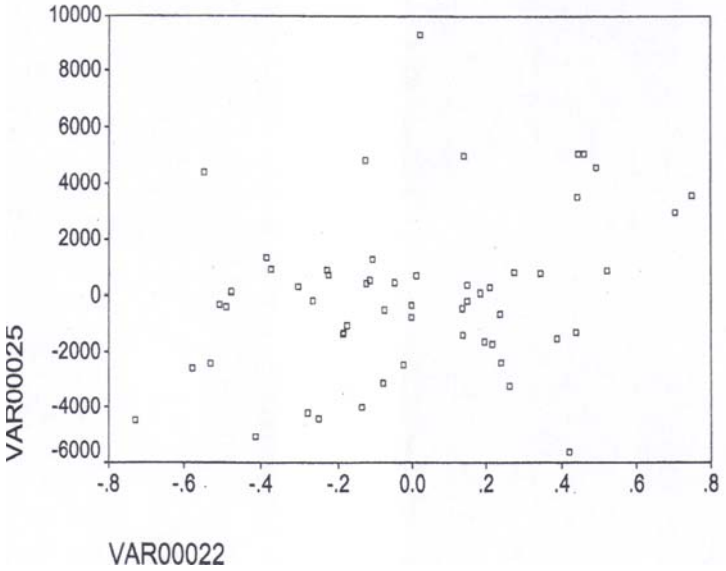

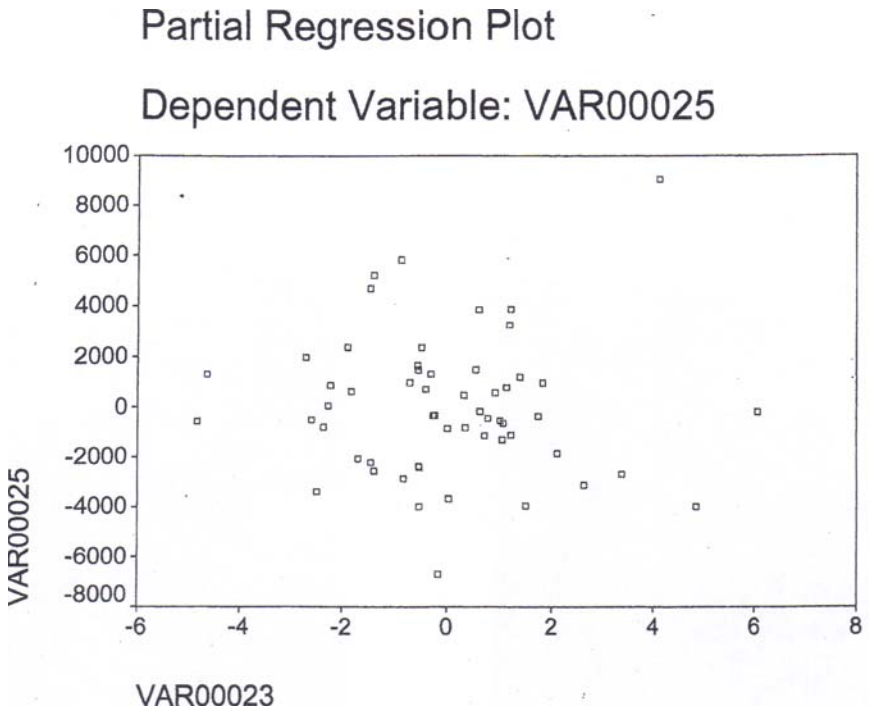
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VAR00023

APPENDIX B

Table B-1. Number of Other HBCUs in State Receiving Federal R&D Funds, by State & Region: FY 2000

Region and State	Total Number of HBCUs
South	
South Atlantic	
Delaware	0
Maryland	3
District of Columbia	1
Virginia	2
West Virginia	0
North Carolina	6
South Carolina	2
Georgia	7
Florida	1
East South Central	
Kentucky	0
Tennessee	2
Alabama	3
Mississippi	3
West South Central	
Arkansas	1
Louisiana	3
Oklahoma	0
Texas	2
Midwest	
East North Central	
Ohio	1
West North Central	
Missouri	0
Northeast	
Middle Atlantic	
Pennsylvania	0

Table B-2. Historically Black Colleges and Universities, Location by State

Alabama
- Alabama A&M University
- Alabama State University
- Oakwood College
- Tuskegee University

Arkansas
- Philander Smith College
- University of Arkansas – Pine Bluff

Delaware
- Delaware State University

District of Columbia
- Howard University
- Univ. of the District of Columbia

Florida
- Bethune-Cookman University
- Florida A&M University

Georgia
- Albany State University
- Clark Atlanta University
- Fort Valley State University
- Morehouse College
- Morehouse School of Medicine
- Morris Brown College
- Savannah State University
- Spelman College

Kentucky
- Kentucky State University

Louisiana
- Dillard University
- Grambling State University
- Southern University
- Xavier University

Maryland
- Bowie State University
- Coppin State University
- Morgan State University
- University of Maryland- Eastern Shore

Mississippi
- Alcorn State University
- Jackson State University
- Mississippi Valley State University
- Tougaloo College

Missouri
- Lincoln University

North Carolina
- Bennett College
- Elizabeth City State University
- Fayetteville State University
- Johnson C. Smith University
- North Carolina A&T University
- North Carolina Central University
- Winston-Salem State University

Ohio
- Central State University
- Wilberforce University

Oklahoma
- Langston University

Pennsylvania
- Lincoln University

South Carolina
- Benedict College
- Clafin College
- South Carolina State University

Tennessee
- Fisk University
- Meharry Medical College
- Tennessee State University

Texas
- Jarvis Christian College
- Prairie View A&M University
- Texas Southern University

Virginia
- Hampton University
- Norfolk State University
- Virginia State University

West Virginia
- West Virginia State University

Table B-3. Capital City Home Presence of HBCUs 0 = no 1 = yes

Alabama A&M University	0	Meharry Medical College	1
Alabama State University	1	Mississippi Valley State Univ.	0
Albany State College	0	Morehouse College	1
Alcorn State University	0	Morehouse School of Medicine	1
Bennett College	0	Morgan State University	0
Benedict College	1	Morris Brown College	1
Bethune-Cookman University	0	Norfolk State University	0
Bowie State University	0	North Carolina A&T State Univ.	0
Central State University	0	North Carolina Central University	0
Clafin College	0	Oakwood College	0
Clark Atlanta University	1	Philander Smith College	1
Coppin State College	0	Prairie View A&M Univ.	0
Delaware State University	1	Savannah State College	0
Dillard University	0	South Carolina State University	0
Elizabeth City State Univ.	0	Southern University	1
Fayetteville State University	0	Spelman College	1
Fisk University	1	Tennessee State University	1
Florida A&M University	1	Texas Southern University	0
Fort Valley State University	0	Tougaloo College	0
Grambling State University	0	Tuskegee University	0
Hampton University	0	U. of Arkansas – Pine Bluff	0
Howard University	1	U. of Maryland – Eastern Shore	0
Jackson State University	1	Univ. of the District of Columbia	1
Jarvis Christian College	0	Virginia State University	0
Johnson C. Smith Univ.	0	West Virginia State College	0
Kentucky State University	1	Wilberforce University	0
Langston University	0	Winston-Salem State Univ.	0
Lincoln University (MO)	1	Xavier Univ. (of Louisiana)	0
Lincoln University (PA)	0		

Table B-4. Metropolitan Statistical Area Size: 2000

HBCU	City / State	Population Estimate
Alabama A&M University	Huntsville, AL	343,418
Alabama State University	Montgomery, AL	322,441
Albany State College	Albany, GA	117,421
Alcorn State University	Lorman, MS Madison / Hines Cty MSA	432,647
Bennett College	Greensboro, NC	1,179,384
Benedict College	Columbia, SC	516,251
Bethune-Cookman University	Daytona Beach, FL	474,711
Bowie State University	Bowie, MD	7,359,044
Central State University	Wilberforce, OH Dayton MSA	958,698
Clafin College	Orangeburg, SC Columbia MSA	516,251
Clark Atlanta University	Atlanta, GA	3,857,097
Coppin State College	Baltimore, MD / Wash., DC	7,359,044
Delaware State University	Dover, DE	126,048
Dillard University	New Orleans, LA	1,305,479
Elizabeth City State Univ.	Elizabeth City, NC	17,188
Fayetteville State University	Fayetteville, NC	283,650
Fisk University	Nashville, TN	1,171,755
Florida A&M University	Tallahassee, FL	260,003
Fort Valley State University	Fort Valley, GA Peach County MSA	24,996
Grambling State University	Grambling, LA Monroe MSA	146,672
Hampton University	Norfolk / Virginia Beach, VA	1,562,635
Howard University	Washington, DC	7,359,044
Jackson State University	Jackson, MS	432,647
Jarvis Christian College	Hawkins, TX Longview-Marshall MSA	209,493
Johnson C. Smith University	Charlotte, NC	1,417,217
Kentucky State University	Frankfort, KY Franklin County MSA	43,781
Langston University	Langston, OK	1,761
Lincoln University (MO)	Jefferson City, MO	53,714
Lincoln University (PA)	Lincoln Univ., PA Philadelphia MSA	5,999,034

Table B-4. Continued.

HBCU	City / State	Population Estimate
Meharry Medical College	Nashville, TN	1,171,755
Mississippi Valley State Univ.	Itta Bena, MS	2,208
Morehouse College	Atlanta, GA	3,857,097
Morehouse School of Medicine	Atlanta, GA	3,857,097
Morgan State University	Baltimore, MD / Wash., DC	7,359,044
Morris Brown College	Atlanta, GA	3,857,097
Norfolk State University	Norfolk / Virginia Beach, VA	1,562,635
North Carolina A&T State U.	Greensboro, NC	1,179,384
North Carolina Central Univ.	Raleigh / Durham, NC	1,105,535
Oakwood College	Huntsville, AL	343,418
Philander Smith College	Little Rock, AR	559,074
Prairie View A&M University	Houston / Galveston, TX	4,493,741
Savannah State University	Savannah, GA	288,426
South Carolina State College	Orangeburg, SC Columbia MSA	516,251
Southern University	Baton Rouge, LA	578,946
Spelman College	Atlanta, GA	3,857,097
Tennessee State University	Nashville, TN	1,171,755
Texas Southern University	Houston / Galveston, TX	4,493,741
Tougaloo College	Tougaloo, MS Jackson MSA	432,647
Tuskegee University	Tuskegee, AL Auburn-Opelika MSA	102,164
U. of Arkansas – Pine Bluff	Pine Bluff, AR	80,785
U. of Maryland – Eastern Shore	Princess Anne, MD Somerset Cty MSA	24,747
U. of the District of Columbia	Washington, DC	7,359,044
Virginia State University	Petersburg, VA Petersburg Cty MSA	34,398
West Virginia State College	Institute, WV Kanawha County MSA	199,263
Wilberforce University	Wilberforce, OH Dayton MSA	958,698
Winston-Salem State Univ.	Winston-Salem, NC	1,179,384
Xavier Univ. (of Louisiana)	New Orleans, LA	1,305,479

Table B-5. Number of Doctorate Degrees Conferred by HBCUs: FY 2000

Alabama A&M University	11	Meharry Medical College	150
Alabama State University	0	Mississippi Valley State Univ.	0
Albany State College	0	Morehouse College	0
Alcorn State University	0	Morehouse School of Medicine	48
Bennett College	0	Morgan State University	11
Benedict College	0	Morris Brown College	0
Bethune-Cookman University	0	Norfolk State University	0
Bowie State University	0	North Carolina A&T State Univ.	0
Central State University	0	North Carolina Central Univ.	0
Clafin College	0	Oakwood College	0
Clark Atlanta University	28	Philander Smith College	0
Coppin State College	0	Prairie View A&M University	0
Delaware State University	0	Savannah State College	0
Dillard University	0	South Carolina State University	0
Elizabeth City State University	0	Southern University	27
Fayetteville State University	3	Spelman College	0
Fisk University	0	Tennessee State University	33
Florida A&M University	8	Texas Southern University	19
Fort Valley State University	0	Tougaloo College	0
Grambling State University	14	Tuskegee University	0
Hampton University	2	U. of Arkansas – Pine Bluff	0
Howard University	121	U. of Maryland – Eastern Shore	1
Jackson State University	15	Univ. of the District of Columbia	0
Jarvis Christian College	0	Virginia State University	0
Johnson C. Smith University	0	West Virginia State College	0
Kentucky State University	0	Wilberforce University	0
Langston University	0	Winston-Salem State University	0
Lincoln University (MO)	0	Xavier Univ. (of Louisiana)	0
Lincoln University (PA)	0		

Table B-6. HBCUs - Student Enrollment, Total Number of Degrees Conferred, and Graduation Ratios: 1999-2000

	Student Enrollment	# of Degrees Conferred	Graduation Ratio
Alabama A&M University	5,497	967	17.6
Alabama State University	5,664	715	12.6
Albany State College	3,356	427	12.7
Alcorn State University	2,901	595	20.5
Bennett College	640	68	10.6
Benedict College	2,750	244	8.9
Bethune-Cookman University	2,558	268	10.5
Bowie State University	4,770	993	20.8
Central State University	1,130	164	14.5
Clafin College	1,120	203	18.1
Clark Atlanta University	4,963	899	18.1
Coppin State College	3,844	505	13.1
Delaware State University	3,159	514	16.3
Dillard University	1,698	192	11.3
Elizabeth City State Univ.	1,966	318	16.2
Fayetteville State University	4,875	801	16.4
Fisk University	886	142	16.0
Florida A&M University	12,082	1,944	16.1
Fort Valley State University	2,658	305	7.1
Grambling State University	4,671	795	17.0
Hampton University	5,783	981	17.0
Howard University	9,108	2,172	23.8
Jackson State University	6,354	942	14.8
Jarvis Christian College	519	105	20.0
Johnson C. Smith University	1,546	172	11.0
Kentucky State University	2,393	316	13.2
Langston University	3,501	359	10.3

Table B-6. Continued.

	Student Enrollment	# of Degrees Conferred	Graduation Ratio
Lincoln University (MO)	3,347	454	13.6
Lincoln University (PA)	2,008	501	16.7
Meharry Medical College	900	150	25.0
Mississippi Valley State U.	2,509	352	14.0
Morehouse College	3,012	504	16.7
Morehouse School of Medicine	196	48	24.5
Morgan State University	6,172	828	13.4
Morris Brown College	2,013	261	13.0
Norfolk State University	6,987	1,056	15.1
North Carolina A&T State U.	7,603	1,117	14.7
North Carolina Central Univ.	5,595	1,020	18.2
Oakwood College	1,736	237	13.7
Philander Smith College	932	125	13.4
Prairie View A&M University	6,271	1,055	16.8
Savannah State College	2,153	302	14.0
South Carolina State University	4,623	868	18.3
Southern University	9,345	1,465	15.7
Spelman College	2,065	397	19.2
Tennessee State University	8,836	1,468	16.6
Texas Southern University	6,522	865	13.3
Tougaloo College	967	143	14.8
Tuskegee University	3,009	517	17.0
U. of Arkansas – Pine Bluff	3,040	360	11.8
U. of Maryland – Eastern Shore	3,000	529	17.6
U. of the District of Columbia	5,181	412	8.0
Virginia State University	4,303	621	14.4
West Virginia State College	4,794	602	12.6
Wilberforce University	964	223	23.0
Winston-Salem State Univ.	2,788	546	19.6
Xavier Univ. (of Louisiana)	3,820	562	14.7

Table B-7. HBCUs - Student / Faculty Ratios: 1999- 2000

Alabama A&M University	18:1	Meharry Medical College	2:1
Alabama State University	26:1	Mississippi Valley State U.	16:1
Albany State College	17:1	Morehouse College	16:1
Alcorn State University	12:1	Morehouse School of Med.	7:1
Bennett College	11:1	Morgan State University	21:1
Benedict College	25:1	Morris Brown College	22:1
Bethune-Cookman University	18:1	Norfolk State University	14:1
Bowie State University	16:1	North Carolina A&T State U.	13:1
Central State University	11:1	North Carolina Central Univ.	11:1
Clafin College	n/a	Oakwood College	16:1
Clark Atlanta University	16:1	Philander Smith College	24:1
Coppin State College	20:1	Prairie View A&M Univ.	18:1
Delaware State University	12:1	Savannah State University	20:1
Dillard University	19:1	South Carolina State College	16:1
Elizabeth City State Univ.	16:1	Southern University	17:1
Fayetteville State University	12:1	Spelman College	14:1
Fisk University	13:1	Tennessee State University	19:1
Florida A&M University	16:1	Texas Southern University	11:1
Fort Valley State University	16:1	Tougaloo College	13:1
Grambling State University	24:1	Tuskegee University	11:1
Hampton University	15:1	U. of Arkansas – Pine Bluff	15:1
Howard University	5:1	U. of Maryland – East. Shore	29:1
Jackson State University	13:1	Univ. of the Dist. of Columbia	10:1
Jarvis Christian College	13:1	Virginia State University	19:1
Johnson C. Smith Univ.	17:1	West Virginia State College	21:1
Kentucky State University	15:1	Wilberforce University	17:1
Langston University	31:1	Winston-Salem State Univ.	13:1
Lincoln University (MO)	14:1	Xavier Univ. (of Louisiana)	18:1
Lincoln University (PA)	16:1		

Table B-8. HBCUs Library Holdings: 2000-01

	Book Volumes	Periodicals & Subscriptions	Total
Alabama A&M University	240,233	1,285	241,518
Alabama State University	265,150	1,287	266,437
Albany State College	16,500	964	17,464
Alcorn State University	189,364	1,046	190,410
Bennett College	98,000	365	98,365
Benedict College	112,821	279	113,100
Bethune-Cookman University	160,000	n/a	160,000
Bowie State University	290,000	860	290,860
Central State University	174,768	800	175,568
Clafin College	147,000	325	147,325
Clark Atlanta University	361,503	2,290	393,793
Coppin State College	129,605	652	130,257
Delaware State University	234,000	n/a	234,000
Dillard University	103,000	491	103,491
Elizabeth City State Univ.	174,566	1,835	176,401
Fayetteville State University	250,000	2,100	252,100
Fisk University	203,000	380	203,380
Florida A&M University	673,842	5,685	679,527
Fort Valley State University	182,882	805	183,687
Grambling State University	302,501	920	303,421
Hampton University	341,359	1,300	342,659
Howard University	2,372,000	14,202	2,386,202
Jackson State University	435,552	1,589	437,141
Jarvis Christian College	78,347	297	78,644
Johnson C. Smith University	114,146	280	114,426
Kentucky State University	334,954	1,023	335,977
Langston University	110,248	1,507	111,755
Lincoln University (MO)	170,398	614	171,012
Lincoln University (PA)	175,481	652	176,133

Table B-8. Continued.

	Book Volumes	Periodicals & Subscriptions	Total
Meharry Medical College	99,273	1,045	100,318
Mississippi Valley State U.	130,918	599	131,517
Morehouse College	361,503	2,290	363,793
Morehouse School of Medicine	52,498	1,250	53,648
Morgan State University	508,475	3,113	511,588
Morris Brown College	361,503	2,290	363,793
Norfolk State University	n/a	1,426	1,426
North Carolina A&T State U.	457,326	3,988	461,314
North Carolina Central Univ.	635,550	2,002	637,552
Oakwood College	12,776	605	128,371
Philander Smith College	62,000	280	620,280
Prairie View A&M University	310,481	617	311,098
Savannah State College	151,812	808	152,610
South Carolina State University	284,190	1,267	285,457
Southern University	1,396,602	1,967	1,397,569
Spelman College	391,503	2,290	363,793
Tennessee State University	580,653	1,446	582,099
Texas Southern University	507,171	1,597	508,768
Tougaloo College	139,000	389	139,389
Tuskegee University	310,000	1,500	311,500
U. of Arkansas – Pine Bluff	257,007	1,068	258,075
U. of Maryland – Eastern Shore	172,719	937	173,656
U. of the District of Columbia	536,776	530	537,306
Virginia State University	280,200	1,198	281,398
West Virginia State College	204,801	792	205,593
Wilberforce University	62,834	350	63,184
Winston-Salem State Univ.	193,023	1,697	194,720
Xavier Univ. (of Louisiana)	134,370	1,868	136,238

Table B-9. HBCUS, by Carnegie Classification: 2000

Research I University
- Howard University

Doctoral I University
- Clark Atlanta University

Doctoral II Universities
- Tennessee State University
- Texas Southern University

Masters Colleges & Universities I
- Alabama A&M University
- Alabama State University
- Albany State University
- Alcorn State University
- Bowie State University
- Coppin State University
- Delaware State University
- Fayetteville State University
- Florida A&M University
- Fort Valley State University
- Grambling State University
- Hampton University
- Jackson State University
- Morgan State University
- Norfolk State University
- North Carolina A&T State Univ.
- North Carolina Central University
- Prairie View A&M University
- South Carolina State University
- Southern Univ. and A&M College
- Tuskegee University
- Univ. of the District of Columbia
- Virginia State University
- Xavier University (of Louisiana)

Masters Colleges & Universities II
- Kentucky State University
- Lincoln University (MO)
- Lincoln University (PA)
- Univ. of Maryland – East. Shore

Baccalaureate (Liberal Arts) Colleges
- Dillard University
- Morehouse College
- Spelman College

Baccalaureate (Liberal Arts) Colleges II
- Benedict College
- Bennett College
- Bethune-Cookman University
- Central State University
- Clafin College
- Elizabeth City State Univ.
- Fisk University
- Jarvis Christian College
- Johnson C. Smith University
- Langston University
- Mississippi Valley State Univ.
- Morris Brown College
- Oakwood College
- Philander Smith College
- Savannah State University
- Tougaloo College
- U. of Arkansas – Pine Bluff
- West Virginia State University
- Wilberforce University
- Winston-Salem State Univ.

Medical Colleges
- Meharry Medical College
- Morehouse School of Medicine

source: www.carnegiefoundation.org

Table B-10. HBCUS, by Carnegie Classification: 2009

Doctoral / Research Extensive
- Howard University

Doctoral / Research Intensive
- Alabama A&M University
- Clark Atlanta University
- Jackson State University
- South Carolina State University
- Tennessee State University
- Texas Southern University

Masters Colleges & Universities I
- Alabama State University
- Albany State University
- Alcorn State University
- Bowie State University
- Coppin State University
- Delaware State University
- Fayetteville State University
- Florida A&M University
- Fort Valley State University
- Grambling State University
- Hampton University
- Lincoln University (MO)
- Lincoln University (PA)
- Morgan State University
- North Carolina A&T State Univ.
- North Carolina Central Univ.
- Norfolk State University
- Prairie View A&M University
- Southern Univ. and A&M College
- Tuskegee University
- Univ. of the District of Columbia
- Univ. of Maryland – Eastern Shore
- Virginia State University
- Xavier University (of Louisiana)

Masters Colleges & Universities II
- Kentucky State University
- Savannah State University

Baccal. Colleges Liberal Arts
- Bennett College
- Fisk University
- Morehouse College
- Spelman College
- Tougaloo College

Baccalaureate Colleges General
- Benedict College
- Bethune-Cookman Univ.
- Central State University
- Dillard University
- Elizabeth City State Univ.
- Jarvis Christian College
- Johnson C. Smith University
- Langston University
- Mississippi Valley State Univ.
- Morris Brown College
- Oakwood College
- Philander Smith College
- U. of Arkansas – Pine Bluff
- West Virginia State Univ.
- Wilberforce University
- Winston-Salem State Univ.

Medical Schools
- Meharry Medical School
- Morehouse Sch. of Medicine

source: www.carnegiefoundation.org

Table B-11. Personal Income, R&D Concentration, Higher Ed. Current Fund Expenditures, & Academic R&D Performance by State: FY 2000

State	Personal Income (per capita)	R&D Concentration (percentage)	Higher Ed. Cur. Fund Exp. (in millions)	Academic R&D Perf. (in millions)
Alabama	24,426	1.53	2,841	1,761
Arkansas	22,912	0.58	378	216
Delaware	32,121	3.84	510	1,343
Dist. of Columbia	40,498	4.48	1,070	2,510
Florida	28,493	0.96	3,968	4,265
Georgia	28,438	1.07	2,760	2,960
Kentucky	24,057	0.85	1,995	968
Louisiana	24,084	0.46	2,060	626
Maryland	34,950	0.46	2,353	8,087
Mississippi	21,643	0.74	1,490	476
Missouri	28,029	1.18	2,117	2,009
North Carolina	27,418	2.03	3,791	5,268
Ohio	28,619	2.23	4,880	8,082
Oklahoma	24,787	0.70	1,453	664
Pennsylvania	30,617	2.79	4,941	10,695
South Carolina	24,594	0.91	2,021	979
Tennessee	26,758	1.34	2,128	2,290
Texas	28,486	1.80	8,758	12,429
Virginia	32,295	2.11	3,805	5,100
West Virginia	22,725	1.07	743	439

Table B-12. HBCU Research & Development Expenditures: FY 2000 (in thousands)

Alabama A&M University	8,238	Meharry Medical College	9,460
Alabama State University	1,365	Mississippi Valley State Univ.	834
Albany State College	1,393	Morehouse College	2,853
Alcorn State University	8,034	Morehouse Sch. of Medicine	16,889
Bennett College	811	Morgan State University	4,371
Benedict College	1,143	Morris Brown College	116
Bethune-Cookman University	586	Norfolk State University	3,408
Bowie State University	2,675	North Carolina A&T State U.	13,400
Central State University	560	North Carolina Central Univ.	808
Clafin College	555	Oakwood College	567
Clark Atlanta University	16,891	Philander Smith College	72
Coppin State College	11	Prairie View A&M Univ.	9,464
Delaware State University	3,415	Savannah State College	905
Dillard University	264	South Carolina State Univ.	2,915
Elizabeth City State Univ.	1,558	Southern University	8,302
Fayetteville State University	507	Spelman College	2,082
Fisk University	3,401	Tennessee State University	11,285
Florida A&M University	21,612	Texas Southern University	2,182
Fort Valley State University	2,768	Tougaloo College	895
Grambling State University	2,264	Tuskegee University	8,893
Hampton University	9,323	U. of Arkansas – Pine Bluff	4,151
Howard University	27,254	U. of Maryland – East. Shore	3,895
Jackson State University	12,027	Univ. of the Dist. of Columbia	2,737
Jarvis Christian College	55	Virginia State University	4,422
Johnson C. Smith Univ.	287	West Virginia State College	55
Kentucky State University	345*	Wilberforce University	280
Langston University	2,553	Winston-Salem State Univ.	3,450
Lincoln University (MO)	2,502	Xavier Univ. (of Louisiana)	3,425
Lincoln University (PA)	709		

* fiscal year -1999

APPENDIX C

A NSF Detailed Description of Separately Budgeted R&D Expenditures

Separately budgeted research and development (R&D) expenditures includes all funds expended for activities specifically organized to produce research outcomes and commissioned by an agency either external to the institution or separately budgeted by an organizational unit within the institution. Include research equipment purchased under research projects awards from "current fund" accounts. Also include research funds for which an outside organization, educational or other, is sub-recipient. Exclude training grants, demonstration projects, clinical trials, and departmental research expenditures that are not separately budgeted. Also, exclude any R&D expenditures in the fields of education, law, humanities, music, the arts, physical education, library science, as well as all other non-science fields. Allocate funding to the original sources whenever possible, as specified below. If this information is unknown, report the proximate funding source.

a. Federal Government. Report awards for R&D (including direct and reimbursed indirect costs) by all agencies of the Federal Government.

b. State and local government. Include funds for R&D (including direct and reimbursed indirect costs) for State, county, and municipal, or other local governments and their agencies. Include here State funds that support R&D at agricultural and other experiment stations.

c. Industry. Include all awards for R&D (including direct and reimbursed indirect costs) from profit-making organizations, whether engaged in research, production, distribution, or service. Do not include awards from non-profit foundations financed by industry: these should be reported under "All other sources."

d. Institutional funds. Report funds, including related indirect costs, that your institution spent for R&D activities from the following unrestricted sources: general purpose State or local government appropriations; general-purpose awards from industry, foundations, or other outside sources; tuition and fees; endowment income; gifts; and other institutional funds.

e. All other sources. Include awards for R&D (including direct and reimbursed costs) from nonprofit foundations and voluntary health agencies as well as from all other sources not elsewhere classified. Funds from foundations that are affiliated with, or granted solely to your institution, should be included under "institutional funds." Funds for R&D received from a health agency that is a unit of a State or local government should be reported under "State and local governments." Also include gifts from individuals that are restricted by the donor to research.

Source: Academic Research & Development Expenditures FY 2000 (NSF 02-308).
www.nsf.gov/statistics/rdexpenditures/

Key Terms and Definitions

Agency - A department or instrumentality of the U.S. government (see 31 USC 101). The federal agencies include the Department of Defense (DOD), the Department of Health and Human Services (HHS), the Department of Energy (DOE), the Department of Agriculture (USDA), the National Aeronautics and Space Administration (NASA), and the National Science Foundation (NSF), which collectively controlled 95 percent of all federal funds devoted to the conduct of R&D in FY 2002.

Applied Research - Systematic study to gain knowledge or understanding necessary to determine the means of a recognized and specific need (see OMB Circular A-11, Section 84). See Conduct of Research and Development.

Award - A contract, grant, cooperative agreement, or other legal instrument a federal agency uses to engage the services of a nongovernmental entity to carry out a government responsibility or to achieve some purposes.

Basic Research - Systematic study directed toward fuller knowledge or understanding of the fundamental aspects of phenomena and of observable facts without specific applications toward processes or products in mind (see OMB Circular A-11, Section 84).

Baseline - All funds reported to the Office of Management and Budget (OMB) as being spent on activities that meet the OMB definition of what constitutes R&D, and which therefore fall within the federal R&D portfolio. (National Science Foundation, Division of Science Resources Statistics, “Academic Research and Development Expenditures: Fiscal Year 2001”, Arlington, VA [NSF 03-3161], April 2003).

College – A postsecondary school that offers general or liberal arts education usually leading to an associate, bachelor’s master’s or doctor’s or first professional degree. Although this term usually encompasses junior colleges and community colleges, this study does not include junior colleges, community colleges, technical schools, or schools granting associate degrees (see National Center for Education Statistics, “Digest of Education Statistics, 2002”, June 2003).

Conduct of Research and Development – Systematic creative work undertaken to increase the stock of knowledge, including knowledge of man, culture, and society, and the use of this stock of knowledge to devise new applications. This includes basic research, applied research, and development and the administrative expenses associated with each. This excludes research and development facilities and equipment. Also excludes routine product testing, quality control, mapping, collection of general-purpose statistics, experimental production, routine monitoring and evaluation of an operational program, and the training of scientific and technical personnel (see OMB Circular A-11, section 84). See Basic Research, Applied Research, and Development).

Contract – A legal instrument reflecting a relationship between the U.S. government and a state, local government, or other recipient (1) when the principal purpose of the instrument is to acquire (by purchase, lease, or barter) property or services for the direct benefit or use of the U.S. government or (2) when the agency decides in a specific instance that the use of procurement contract is appropriate (see USC 6303).

Development – The systematic application of knowledge or understanding directed toward the production of useful materials, devices, and systems or methods, including design, creation, and improvement of prototypes and new processes to meet specific requirements.

Enrollment – The total number of students registered in a given school unit at a given time, generally in the fall of a year (see U.S. Department of Education, National Center for Education Statistics, "Digest of Education Statistics, 2002, June 2003).

Expenditure – "A disbursement of funds" (Merriam Webster's Collegiate Dictionary, 10th ed., 1993). NSF defines expenditures as "funds actually spent by an institution during its fiscal year" (National Science Foundation, Division of Science Resources Statistics, "Academic Research and Development Expenditures: Fiscal Year 2001," Arlington, VA [NSF 03-316], April 2003).

Faculty – Members of the instruction and/or research staff who are employed full o part time, as defined by the institution (see U.S. Department of Education, National Center for Educational Statistics, "Digest of Education Statistics, 2002, June 2003).

Federally Funded Research and Development Center (FFRDC) – A FFRDC meets some special long-term R&D need that cannot be met as effectively by existing in-house or contractor resources. FFRDCs enable agencies to use private-sector resources to accomplish tasks that are integral to the mission and operation of the sponsoring agency. Each of the 36 FFRDCs the federal government currently sponsors is administered (i.e. operated) by an industrial firm, university, or nonprofit institution (see Federal Acquisition Regulation [FAR] 35.017).

First Professional Degree Student – A student pursuing an award that upon completion of academic requirements of its program allows them to able to begin practice in that professional degrees may be awarded in the following ten fields: chiropractic (DC or DCM), osteopathic medicine (DO) , dentistry(DDS or DMD), pharmacy (PharmD), law (LLB or JD), podiatry (DPM, DP, or PodD), medicine (DVM), (see U.S. Department of Education, National Center for Education Statistics, Integrated Postsecondary Education Data Systems [IPeDSI], Fall 2000). Note that this category does not include graduate students.

Fiscal Year – The federal government's accounting period, from October 1 to September 30, (see OMB Circular A-11, Section 20).

Graduate Student – A student who holds a bachelor's of first professional degree, or the equivalent, and who is working towards a master's or doctor's degree. (U.S. Department of Education, National Center for Education Statistics, "Digest of Education Statistics, 2002", June 2003). See First Professional Degree Student.

Grant – A legal instrument reflecting a relationship between the U. S. government and a state, local government, or other recipient (1) when the principal purpose of the relationship is to transfer a thing of value to the state or local government or other recipient to carry out a public purpose of support or stimulation authorized by a law of the United States instead of acquiring (by purchase, lease, or barter) property or services for the direct benefit or use of the government and (2) when substantial involvement is not expected between the executive agency and the state, local government, or other recipient when carrying out the activity contemplated in the agreement (see USC 6304).

Historically Black College and University – An accredited institution of higher education established prior to 1964 with the principal mission of educating black Americans. The Higher Education Act of 1965, as amended, defines an HBCU as "any historically black college or university that was established prior to 1964, whose principal mission was, and is, the education of black Americans…" Federal regulations (see 20 USC; 106[(2)] allow certain exceptions to the founding date (U.S. Department, National Center for Education Statistics, "Digest of Education Statistics, 2002", June 2003).

Land-Grant University (includes 1890 Schools) – Schools established by the passage of the first Morrill Act of 1862 which facilitated the establishment of colleges through grants of land or of funds in lieu of land. The Morrill Act was intended to provide a broad segment of the population with a practical education that had direct relevance to their daily lives. A discussion about 1890 Schools is in Chapter 3 (see U.S. Department of Agriculture Cooperative State Research, Education, and Extension Service Acronyms and Commonly Used Terms, 2003).

Medical School – (this term excludes osteopathic, and podiatry schools) – An institution offering a program of medical education leading to the MD degree. In this study, the term medical school, does not encompass hospitals or medical centers, it refers only to the 126 programs in universities and colleges that provide medical education leading to the MD degree.

Private University or College – A university or college that is controlled by an individual or agency other than a state, a subdivision of a state, or the federal government and that is usually supported primarily by other than public funds, and the operations of whose program rests with other than publicly elected or appointed officials. (see U.S. Department of Education, National Center for Education Statistics, "Digest of Education Statistics, 2002", June 2003).

Project Grant – The funding for fixed or known periods of specific projects for the delivery of specific services or products without liability for damages, for failure to perform (see Catalog of Federal Domestic Assistance, GSA, 2002). See Grant.

Public University or College – A university or college controlled and operated by publicly elected or appointed officials and deriving its primary support from public funds (see U. S. Department of Education, National Center for Education Statistics, "Digest of Education Statistics", 2002, June 2003).

Research and Development – Throughout this study, this term refers only to the Conduct of Research and Development, as defined above.

Research and Development Equipment – The acquisition or design and production or major equipment for research and development. This includes expendable or movable equipment (spectrometers, research satellites, and detectors). This excludes routine purchases of ordinary office equipment or furniture and fixtures. (see OMB Circular A-11, Section 84).

R&D Plant – includes all projects whose principal purpose is to provide support for construction, acquisition, renovation, modification, repair, or rental of facilities, land, works, or fixed equipment for use in scientific or engineering research and development. All costs – direct, indirect, and related expenditures – are to be included. (see NSF-Federal Support Survey 1995 Instructions for Academic Institutions).

Science and Engineering – This disciplines in the fields of Engineering, Physical Sciences, Mathematical Science, Computer Sciences, Life Sciences, Psychology, and Social Sciences (see National Science Foundation, Division of Sciences Resources Statistics, "Survey of Graduate Students and Post-doctorates in Science and Engineering : Fall 2000[Methodology Report], Arlington, VA, July 2002).

Undergraduate Student – A student registered at an institution of higher education who is working in a program leading to a baccalaureate degree (B. A. or B. S.) or other formal award below the B.A. or B. S., such as an associate degree (see U.S. Department of Education, National Center for Education Statistics, "Digest of Education Statistics, 2002, June 2003).

University – An institution of higher education consisting of a liberal arts college, a diverse graduate program, and usually two or more professional schools or faculties and empowered to confer degrees in various fields of study (see U.S. Department of Education, National Center for Education Statistics, "Digest of Education Statistics, 2002", June 2003).

Source: Fossum and et al. (2004).

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BIOGRAPHICAL SKETCH

John Warford was born in Saint Louis, Missouri. The oldest of eight children, he lived his childhood and earliest adult years in his hometown, graduating from University City Sr. High School in 1974. John has been formally educated and trained in law, religion, theatre, graphic design and several forms of the martial arts. As an exchange student at the University of Sussex in the UK, he received instruction at the School of Cultural and Community Studies. John earned a BA. in English and Black Studies from Washington University (Saint Louis) in 1980.

Moving to Florida, he completed his master's degree coursework in International Studies at Florida International University in the early '90s, focusing on international relations, environmental issues, and socio-economic development. Florida International University is also where John began his career as a student affairs professional, holding numerous administrative positions at the public and private universities in Florida.

At the University of Florida, John was inspired by then department chairman, Dr. Edward Malecki to consider a switch from the political science department to pursue his interests in geography. Dr. Malecki and the department faculty prepared him for next ten to fifteen years of his work as university professor, teacher and able professional. With his long-standing interests in the areas of resource management, and cultural studies, he was discovered by Sybil C. Mobley, the imminent Dean of the School of Business and Industry (SBI) at Florida A&M University and asked to join the graduate faculty in 1999. There he taught graduate management courses in World Cultures and World Resources to the MBA students preparing for international internships. John has been the recipient of a number of teaching, mentorship, and professional service

awards through the years. He received his Ph.D. from the University of Florida in the fall of 2009.

Currently, John is a Visiting Professor at Florida A&M University in the Department of History, Political Science, Geography, and African-American Studies. He has also been for the past five years an adjunct professor at Tallahassee Community College, and a special projects consultant for the non-profit school and after-care programs of B.L.A.M. – the Black Lotus Academy of the Martial Arts located in Miami, Florida.

John has written three books, produced three spoken word projects, and recently played the lead acting role in a full-length independent film, due to be released in 2010. In the future, John plans to travel more, research, publish in his academic field, and learn a foreign language.