The Economic Impact of the UNC System on the State of North Carolina

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SECTION 1

Introduction

The University of North Carolina (UNC) generally ranks as one of the best public university systems in the nation. The system grants about 23,000 baccalaureates, 6,200 masters, and 800 doctorates every year, and, by 1999, had created about 43,000 jobs. The UNC system has helped prepare many North Carolinians for the 21st century workforce. Moreover, the rewards of the UNC system reach well beyond its students and employees. The presence of such a large university system has a significant impact, both direct and indirect, on the state economy. University spending constitutes a major part of the direct impact, which can be measured within the context of input-output linkages. Simply put, universities spend money, and that stimulates local economies. The indirect impact is much harder to measure, but nonetheless has been discussed extensively by many researchers.

First, researchers have emphasized that universities make workers more productive through education, and accordingly, this increases their wage levels. Becker (1975) and Hanoch (1967) applied human capital theory to estimate a 10-to-20 percent average rate of return to schooling. These studies drew on the human capital tradition and addressed the issue of human capital development through education. Second, Griliches (1984, 1986), Jaffe (1986, 1989), and Tratjenberg *et al*. (1992) underscored the role of universities as loci of research and development (R&D) activities. The discussion of most research of this kind is closely related to and supported by the rapidly growing literature of new growth theory. According to that theory, R&D activities create increasing returns to scale through externalities and spillovers and therefore make economic growth sustainable. That argument is particularly important in the discussion of the role of universities because universities are increasingly involved in technology development and transfer, which is crucial to the sustainable economic growth of a region.

Many previous studies aimed to measure the impacts of universities on the regional economy by focusing mainly on direct impacts based on input-output linkages and the multiplier effect of university spending. This study seeks to measure not only the direct, but also the indirect impacts of the UNC system on the state of North Carolina by utilizing the REMI[1] simulation model and by collecting quantitative and qualitative information through surveys and interviews. This is the first attempt to measure the impact of the UNC system as a whole. Several individual campuses have done their

[1] Regional Economic Models, Inc.

own impact analyses, but we hope to demonstrate that the whole is greater than the sum of the parts. We hope, also, to use this and subsequent periodic reports of the system's impact to improve all campuses' methodology for measuring the importance of what they do.

Section two gives a brief background of the UNC system, while section three provides a detailed discussion about the economic impacts of a university system. The final two sections present the methodology and the results of our analysis. Lastly, the appendix includes a profile of each campus, a description of the data required for this study, and an overview of the analytical models we have used.

SECTION 2

The University of North Carolina System

All public education institutions that grant baccalaureate degrees in North Carolina are part of the University of North Carolina system.[2] The University of North Carolina was founded in 1789 as the first public university in the United States; currently the system consists of sixteen constituent institutions. The first class was admitted at Chapel Hill in 1795, and for the next 136 years, the Chapel Hill campus was the only member of the University of North Carolina.

In 1931, the N.C. General Assembly redefined the University of North Carolina to include three state-funded higher education institutions, now known as the University of North Carolina at Chapel Hill, North Carolina State University at Raleigh, and the University of North Carolina at Greensboro, which at that time was a women's college. Three additional institutions—the University of North Carolina at Charlotte, the University of North Carolina at Asheville, and the University of North Carolina at Wilmington—had joined the system by 1969. The current system was completed in 1971 by bringing into the University of North Carolina the ten remaining public higher education institutions in the state. Five of them—Elizabeth City State University, Fayetteville State University, North Carolina Agricultural & Technical State University, North Carolina Central University, and Winston-Salem State University—are historically black institutions, and the University of North Carolina at Pembroke was originally created for Native Americans. The North Carolina School of the Arts, which trains performing artists, was the first public institution of this kind in the nation. The rest of the constituent institutions—Appalachian State University, East Carolina University, and Western Carolina University—were training schools for teachers. Figure 2.1 shows the sixteen constituent institutions of the University of North Carolina and their locations. A brief profile of each campus is given in the appendix.

Administrative Structure

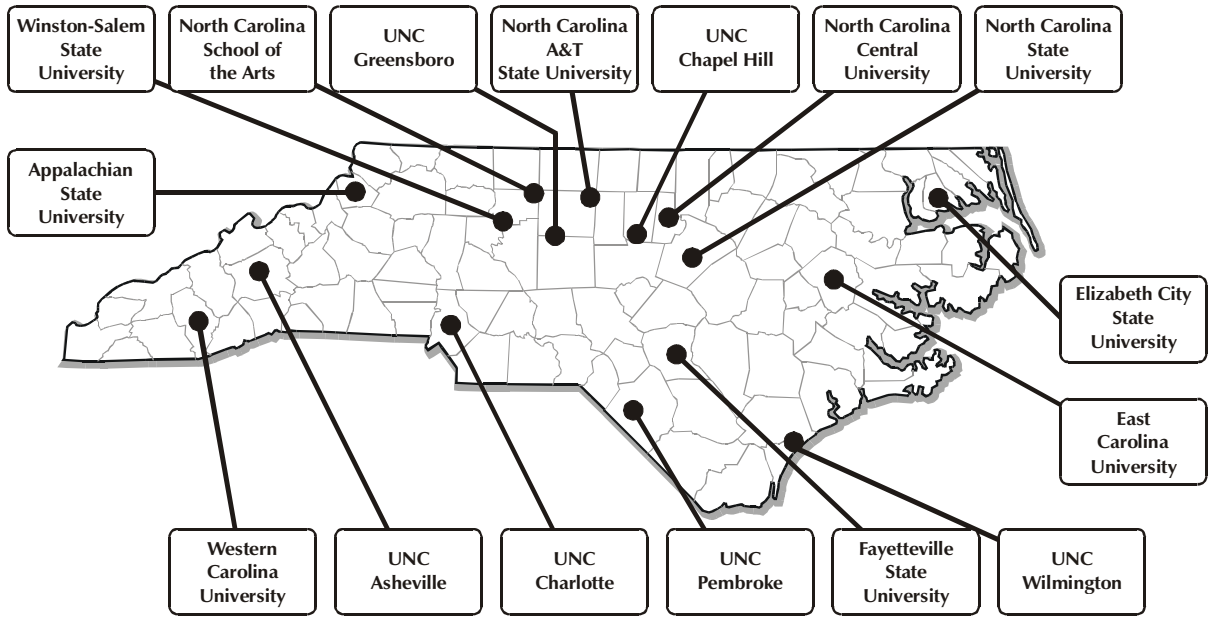
The UNC Board of Governors is the legal policy-making body responsible for the general determination, control, supervision, management, and governance of all affairs of

[2] More detailed information is available from the Office of the President's Web site: www.northcarolina.edu.

the constituent institutions. The General Assembly elects 32 voting members of the Board for four-year terms. The board also has non-voting members, including former board chairmen, former board members, and the president of the UNC Association of Student Governments. The president of the UNC system is elected by voting members of the Board.

Each constituent institution is led by a chancellor, who is appointed by the Board of Governors on the president's nomination. Each institution also has a board of trustees, which holds extensive power and is deeply involved in academic and other operational decisions. Each board of trustees is composed of eight members elected by the Board of Governors, four members appointed by the governor, and the president of the student body as an *ex officio*.

Figure 2.1
Sixteen Constituent Institutions



SECTION 3

Economic Impacts of a Public University System

A major public university system plays a critical role in the long-term economic growth and development of the state in many ways. Through teaching, it provides highly productive skilled workers to local businesses; therefore, it helps those businesses become more competitive in the local and global marketplaces. Some universities are responsible for attracting qualified students from outside the region or state, who end up staying nearby after graduation, or they may prevent qualified students from having to leave to pursue their studies. Through spending, a public university system stimulates the local economy and contributes millions of dollars in earned income to North Carolina workers and their families. A university also can attract businesses to the region which either seek to trade with the university or have close access to its students and faculty, or simply, enjoy the academic milieu. In addition, a university is a visitor destination, certainly for students' families and friends, but also for those wanting to use libraries, museums, sports venues, and other facilities a university operates. This section briefly describes the various aspects and mechanisms through which universities convey economic impacts on a region's economy.

Mechanism of University Impacts

The economic impacts of universities are largely produced by spending multipliers and productivity gains. Dollars directly or indirectly spent by universities stimulate economic activities through multiplier effects. A high-skill labor force trained at universities increases the productivity level of a region and makes regional economic growth more sustainable. In addition, the regional milieu created by universities often stimulates entrepreneurial activities and attracts high-skill workers into the region. The following discussion focuses on the major mechanisms through which universities deliver impacts on regional economies and how they can be measured.

Attraction of financial resources: A large university system can be a magnet attracting money into the region where it is located. Millions of dollars are dispensed to universities for research, day-to-day operations, and employee payroll from various sources. A significant portion of that money would not have been in the region if the universities were not present. In addition, good universities attract students and visitors from outside of the region, and they normally bring in money to spend locally.

UNC is a typical example of a large university system that creates major impacts on the state in many ways. One of them is the attraction of financial resources and the stimulation of the regional economy through spending. Particularly when dollars are attracted from out-of-state sources, the gross impact equals the net impact because there are no "opportunity costs" for that money.[3] Measuring the influx of research dollars from outside is straightforward because most universities maintain detailed revenue information. However, measuring the financial resources that out-of-state students and visitors bring in is problematic. We estimated students' and visitors' spending by employing a student survey (see the methodology section for a more detailed description of that instrument), which asked students where they are from, whether or not they would stay in North Carolina if the UNC campuses did not exist, how much they spent on goods and services monthly, and how many visitors they have per semester and for how many days.

Creation of jobs: A major university system directly creates tens of thousands of jobs, many of which are filled by local residents. Universities—especially those with a national reputation—also attract scholars from other regions to fill research and faculty positions. UNC campuses provide about 43,000 jobs with a combined payroll of $1.5 billion. Dollars paid from universities to their employees stimulate the regional economy because most money is spent locally. Through multiplier effects, a dollar spent usually begets much more in economic activity. How many UNC employees would stay within the state without the presence of UNC campuses is not clear. Many faculty members and researchers would leave the state unless other private universities in the state increased their capacity and hired more faculty and researchers. Non-faculty staff would be more likely to stay, switching to private-sector jobs.

Attraction of students and visitors: Out-of-state students and visitors can also stimulate the state economy through both the multiplier effect and productivity increases.[4] In 1999, there were a total of 154,991 students enrolled at UNC campuses, and they spent millions of dollars on various commodities, from housing and food to books and clothes. Note that many of them would not stay within the state if the UNC system did not exist. In addition, out-of-state students generally have stronger academic credentials as a group (especially those at UNC-CH and NCSU) than do in-state students because the process for admitting out-of-state students is much more competitive (only up to 18 percent of the freshman class can be non-residents, pursuant to the Board of Governors' policy). According to our survey, many out-of-state students at UNC-CH chose Chapel Hill over other prestigious private institutions such as the University of Chicago, the University of Pennsylvania, Brown University, and Northwestern University.

Direct purchases of goods and services: Large universities spend billions of dollars purchasing goods and services, which stimulates the regional economy through multiplier effects. Considering the magnitude of its spending, a major university can act as an economic engine in the development of a small town. How much impact universi-

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[3] That is why the source of financial resources is important to consider in any impact study.

[4] Productivity increase applies only to students, not visitors.

ties can have on the state economy through spending actually depends upon how much of their purchases are made locally: the more universities purchase locally, the higher their impact on the state economy. UNC campuses spend a total of $1.1 billion dollars every year on goods and services, including construction. How much of these goods and services are actually purchased locally is not clear, since many campuses do not have vendor location information for small purchases. Regional purchasing coefficients incorporated in the REMI model were used to estimate the percentage of local purchases and the consequent economic impact on the state. (See the methodology section for a more detailed description of the model.)

Formation of human capital: Universities educate people and produce more productive workers. The importance of labor quality for regional growth is well documented: availability of a high-skill labor force is often considered the number one reason for firms to locate in a specific region. This is especially the case when it comes to high-tech firms. Many high-tech regions such as Silicon Valley, Route 128 and Austin have been developed around cities where major research universities are located. Economists have shown that the development of high-quality human capital and the consequent high level of productivity is a key element for sustainable economic growth. UNC campuses produce approximately 23,000 baccalaureates, 6,200 masters, and 800 doctorates every year, many of whom stay within North Carolina and contribute to the state's productivity level. Considering that more than 70 percent of North Carolina's professional labor force (e.g., engineers, scientists, lawyers, and teachers) is produced by UNC campuses, the impact that the UNC system makes on the state economy is substantial. To estimate the net loss of human capital without the presence of UNC campuses, we asked students whether or not they would stay in North Carolina if the UNC campuses did not exist. In addition, we also tracked prior UNC graduates to see what percentage of them actually stayed within the state after graduation.

Another important aspect of human capital formation is a university's ability to attract and retain professionally trained students. This idea is commonly referred to as *brain draw* or *brain drain*. A university that attracts students to programs that train some of the aforementioned professionals and retains them in the region after they graduate generates significantly greater economic gains than the university that does not retain the same talent after graduation. The ideas of brain draw and brain drain are important elements in the discussion of economic impacts and are quantified in this study through an examination of the student survey.

Development of new technologies: Universities have long played a leading role in the development of basic research. In general, individual firms seriously underinvest in basic research because they find it difficult to convert that activity into profitable applications. This lack of investment in basic research is addressed by the government through the funding of research at universities. Major research universities administer millions of dollars' worth of research projects throughout the campus, and the results of that research are often brought to market and commercialized. Some of them are adapted to many fields of industry and make significant contributions to productivity gains. Historically, universities have played a crucial role in developing new technologies and in making significant scientific breakthroughs. For example, the current computer and

information technology revolution started on college campuses. The first computer, ENIAC, was developed by researchers at the University of Pennsylvania, and the first experiment with electronic file transfer was conducted on the UCLA campus. Universities also have been hotbeds of development for many leading technology firms. The development of the computer industry along Boston's Route 128 corridor is a case in point: MIT is situated at the center of the new industrial development in the region, and many of the Route 128 firms emerged from MIT, including industry leaders such as Digital Equipment Corporation. During the 1960s, 175 new firms were initiated by MIT researchers and faculty members. We used three indicators to measure the UNC system's contribution to technology development: the number of patents issued, royalty income, and start-up companies initiated from UNC campuses.

Creation of a regional milieu: One final area that must be mentioned is the regional milieu. This term refers to the "feel" or "culture" of an area, including its dynamism and overall quality of life. Certainly, universities contribute to this milieu through their provision of academic and cultural opportunities. By attracting "footloose" businesses and skilled personnel, universities further contribute to regional growth (see Florida, 2000).

Figure 3.1 illustrates the relationships among variables and the mechanism through which these variables affect the regional economy. Not included in the figure is the market adjustment process, which operates in the background. Each variable in the model is linked to a market either directly or indirectly where it is traded. The operation of the market as it responds to any change in these variables can also affect the regional economy. For example, a large college-educated labor force means there is a sufficient supply of quality workers that can satisfy businesses needs; therefore, employers can find workers they need at a reasonable cost. However, if the pool of college graduates were to shrink significantly in a region, the labor market would tighten, and wage levels would increase. Accordingly, businesses in the region would have to pay higher wages to attract the workers they need, and the increased cost may affect their competitive edge.

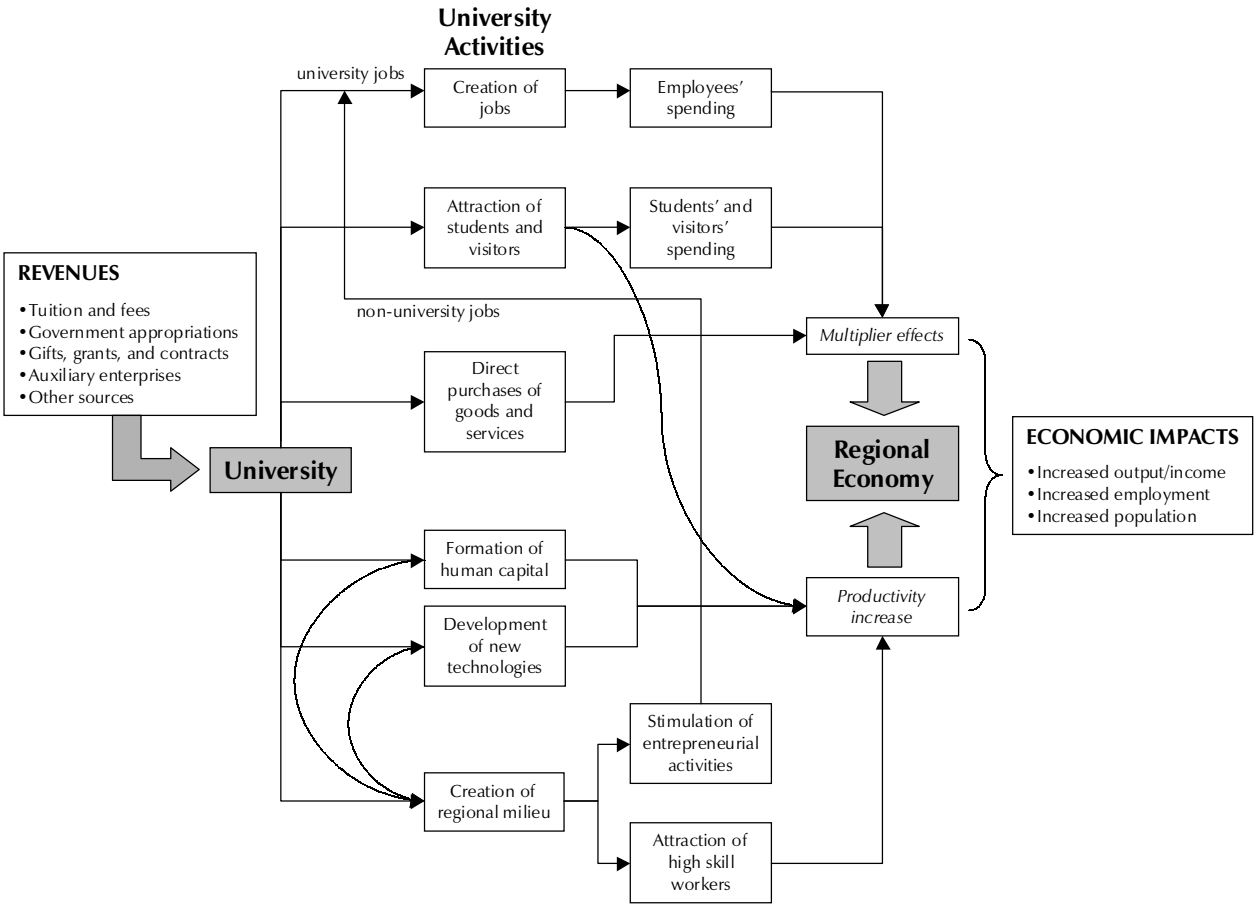
Measurement of University Impacts

The previous section illustrates the mechanism through which universities influence the regional economy. How can such influences be measured? A number of economic effects are commonly measured in the case of universities and other large public works projects. The traditional indicators of economic impacts include the increase in local jobs, economic activities, and populations. They are intended to measure the impacts of universities delivered through both channels (i.e., multiplier effects and productivity gains). However, the specification of productivity measures is more difficult than it is for multiplier effects. For example, the quality of the local labor force and local business environment are important factors for assessing the regional economy, but they are hard to measure. In this study, we included only the impacts which are delivered through multiplier effects and the background market adjustment process. For example, the impact of college graduates on the labor market is taken into account, but their impact on productivity is not. Tangible, commonly measured economic impacts are estimated

by the REMI model with data from the student survey. We used three indicators, employment, output, and population, to measure such impacts. On the other hand, for those variables that affect the regional economy through productivity gains (i.e., formation of human capital and technology development/transfer), we described the expected change of the variables themselves due to universities, rather than their impact on the state economy. Because of this, it is important to note that our results may underestimate the real impact of UNC campuses. The following discussion describes the expected effects on major economic indicator variables due to the existence of the UNC system.

An additional issue involved in measuring the impact of universities is determining how to distinguish between gross and net impacts. The gross impacts are influences that universities have on the regional economy without taking into account what would be left in the state even without the presence of universities. For example, some portion of the $4.2-billion UNC budget would be spent within the state regardless of the presence of the UNC system. Some UNC students would stay in North Carolina even if UNC campuses were not present. These residuals are not taken into account when measuring gross impacts. On the other hand, net impacts subtract such residual impacts to esti-

Figure 3.1
University Impact Mechanism



mate a more realistic influence of universities on the regional economy. This study aims to estimate the net impacts of the UNC system.

Effects on the quality and the amount of employment: The UNC system served over 150,000 student clients in 1998. These students required a number of services, from teaching (provided by professors and other instructors hired by the universities) to construction (provided by workers hired to build the buildings on campus). Economic theory would indicate that these students provide a quantitatively direct and indirect impact on the number of jobs available in the state. There would be a direct effect in the form of the professors hired to teach the students, the administrators hired to run schools, and all the campus support personnel (for example, librarians, groundskeepers, and security personnel).

In addition to the direct employment provided by the campuses to serve the students, there is also an indirect positive impact, in the form of other university-hired employees (research assistants, business professionals, and administrators of public service units of the universities). Finally, there are the various service industries that spring up around universities which are not run by the schools, but still appear to serve the needs of the students (and the university employees as well). This is what is referred to as the job chain effect, where a mass of people (in this case students) locate and concentrate in a specific area attracting multiple industries to provide services. Restaurants and entertainment industries are examples of service industries that typically appear around universities. In addition, other less concentrated but more specialized services may appear (insurance, banking, and medical services, for instance) to serve the needs of the students.

Aside from these general positive job chain effects, there are specific industries that benefit (in the sense of increased employment opportunities) in the presence of universities. As the data collected from the Office of the President show, the university system is a tremendous source of construction expenditures within the state. The construction industry theoretically benefits from the presence of the system, because annual construction expenditures provide a steady source of employment in the industry every year. Other specialized industries also benefit on a fairly regular basis from annual expenditures by the university system, in the form of more jobs than would otherwise be present. This increased employment provides a general pattern of economic growth which draws a larger number of better quality jobs.

Effects on output and income: Another important indicator that reflects the importance of universities is output. UNC campuses create a huge final demand in various industries from computer equipment to construction. The effects of increased demand in those sectors stimulate demand increases in other sectors related to the original industries. Such chain reactions occur through input-output linkages. University employees, students and visitors also cause changes in final demand and trigger the same kind of chain reactions.

The UNC system also contributes to better-paying jobs and an increased number of higher-skilled jobs than would otherwise be present. These higher-paid workers contribute more tax dollars, in turn, to the state. They also contribute to a "wage rollout" whereby the wages of all professional workers are driven up. The more higher-paid

professionals come to an area, the more higher-valued services are demanded, and there is an upward economic spiral. In addition, with the labor pool available here in North Carolina, there is a predictable influx of firms into the area to take advantage of the strong labor supply. The research facilities in the state present evidence of this trend, as do the numbers of certain jobs attributable to the UNC system that the REMI model reveals.

Effects on population: The university system theoretically contributes to greater population growth than would occur if the system were not present. Without the UNC system, North Carolina's students would still attend college, either private universities within the state or institutions outside the state. It is possible that without the UNC system greater numbers of North Carolinians would leave the state to attend college; this potential migration would lower the student population from its current level. The university system also has an assumed effect on the influx of students from other states, because students come to North Carolina to attend the universities for a variety of reasons. Without the university system, presumably there would be fewer students entering the state for college. The same is true with university employees: many of them might leave the state if UNC campuses were not present.

In addition to the impact on student and employee population, the UNC system attracts special populations to enter the state. There is a greater construction population in North Carolina due to the large amounts universities spend annually on construction projects. Universities' extensive spending on various goods and services also contributes to a population increase because such spending stimulates economic activities, which creates more jobs. Finally, the population of small business start-ups and spin-offs would be greater with the universities than without them, an increase attributable in large part to the various UNC business schools. With the UNC campuses currently placing an emphasis on minority enrollments, there is an additional positive effect on the minority population in the state. The UNC system also encourages a more skilled professional class to locate within the state. This class includes professionals who move here from other states to work at UNC campuses or attendant institutions, and professionals who would otherwise leave the state for broader opportunities. This brain drain prevention is a simple population change effect, meaning that UNC has kept North Carolina's population larger than would be expected without the universities.

SECTION 4

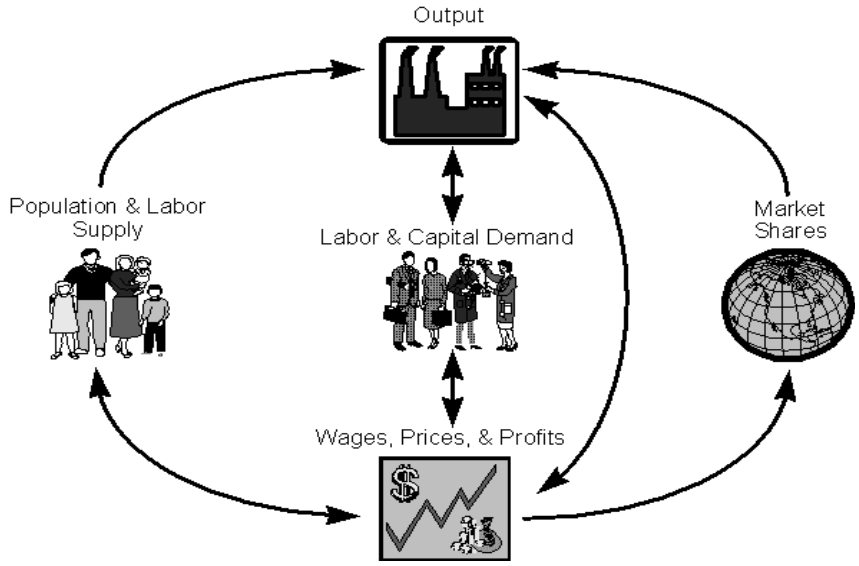
Methodology

This section describes the methodology adopted for the study. To estimate the impact of the UNC system, a dynamic computer simulation model, REMI, was used in conjunction with student surveys. First, we introduce the basic structure of the REMI model and the input-output multiplier. Then, we describe the student survey methodology and report a brief summary of results. Lastly, we describe the data incorporated into the REMI model.

The REMI Model

Structure of REMI: REMI is a dynamic simulation model designed to calibrate the impact of policy initiatives or external events on a local economy and demography. It is a structural model including various cause-and-effect relationships based on actual historical data and economic theory. The model consists of five components. First, the output component shows how much each industry sells to other sectors and industries. This component incorporates the input-output model. Second, the labor and capital demand component shows how labor and capital requirements are related to output and relative factor prices. Third, the population and labor supply component shows how demographic changes can affect output demand and factor prices. Fourth, the wage, price, and profit component shows the dynamics of supply and demand, which determine factor prices. Fifth, once prices and profits are established, the market-share component shows, along with the components of demand, how output is determined. Figure 4.1 represents the basic structure of the model.

Figure 4.1
Basic Structure of the REMI Model



Source: Regional Economic Models, Inc.

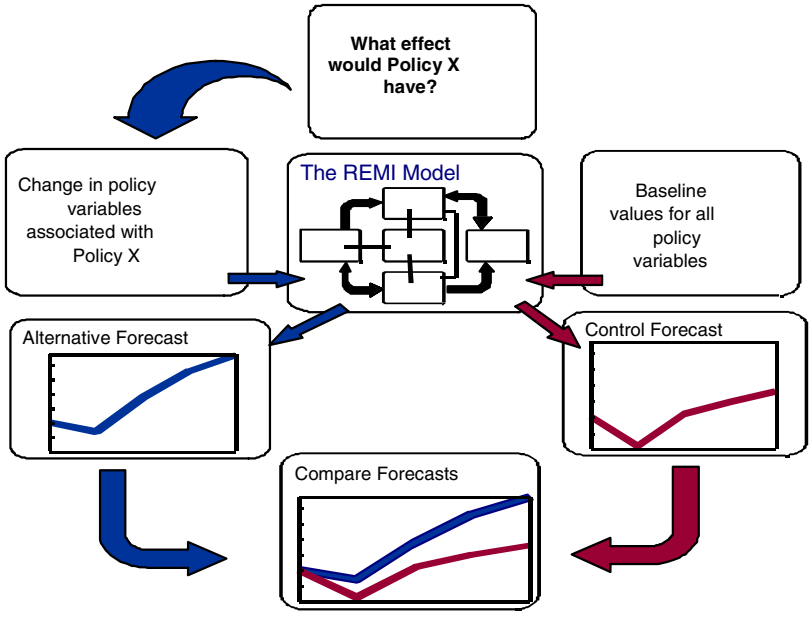
The REMI model brings all these elements together to calibrate the movement of each variable in the model for each year. The model includes all the industry linkages, which are a part of the input-output model (described below) in the output block. However, the REMI model extends well beyond the input-output model by incorporating the dynamics of all the other blocks in Figure 4.1. To estimate the impact of a hypothetical policy initiative "X," the model calibrates an alternative forecast incorporating changes in policy variables then compares the result with a control forecast which assumes no changes in all policy variables. Figure 4.2 illustrates this process.

Input-Output Model and Multiplier: The economic impact of the university on the state due to its purchasing of supplies, equipment, services, utilities, and labor is estimated within an I-O model. An I-O model takes into account inter-industry trade relationships, or linkages, among industries within a given geographic area. In general, businesses are mutually dependent upon one another for purchasing what is needed for their own production; therefore when a business in one industry increases its production because of an increase in demand for its product, businesses in related industries will also have an increase in demand for their products. This is an example of the "multiplier effect."

An I-O model estimates the magnitude of this multiplier effect. The magnitude depends upon the extent to which businesses purchase their inputs from other businesses located in the same region, rather than from businesses located outside of the region. Multipliers vary among industries and among regions. Industries in which businesses are linked to other regional industries will have larger multipliers than industries in which, say, almost all of the non-labor inputs are purchased from outside the region. Also, regions that are larger and more economically diverse will tend to have larger industry multipliers, on average, because there will be a greater likelihood that an industry's necessary inputs will be produced within the region. In this study, industry multipliers were obtained from a REMI simulation model. REMI can generate regional input-output models from national inter-industry trade data, adjusted for regional economic structure. It can generate a set of multipliers for any state, county, or county aggregates.

A multiplier is a number that relates the magnitude of a direct economic impact to a to-

Figure 4.2
REMI Simulation Procedure



Source: Regional Economic Models, Inc.

tal economic impact that includes both direct and indirect impacts. As mentioned above, there are three types of multipliers available: output, personal income, and employment. An output multiplier is defined as the change in regional total output for every dollar of change in final demand for what is produced in a given regional industry. Thus if the value of an industry's output multiplier is 1.8, for example, it means that for every dollar increase in production in that industry that is delivered to final demand, total production in the region increases by $1.80. Of the $1.80, $1.00 is the direct result of the increase in final demand for the particular industry's product, and $0.80 is the indirect increase in production in the region as the result of related industries increasing their production to meet the expanded production requirements of the first industry. Personal income and employment multipliers are interpreted similarly. For the former, it is the change in personal income (the sum of employee compensation and proprietor income) for every dollar change in final demand for what is produced in a given regional industry. For employment multipliers, it is the change in number of employees in the region for every million-dollar change in final demand for what is produced in the given industry.

Student Survey

Sample campuses and classes: We surveyed a sample of 1,222 UNC students from six campuses to collect information about their origins, budgets, and spending patterns. To obtain a representative sample of the entire UNC student population, we categorized the 16 campuses into six groups based on size, location, and characteristics of the student body. Then, we strategically selected one campus from each group to respond to the student survey: ECSU, ECU, UNCC, UNC-CH, WCU, and WSSU. To obtain a higher response rate, survey administrators visited selected classrooms and asked students to fill out a questionnaire. Classes were carefully chosen to reflect the student body of each campus. Half of the classes were freshman and sophomore requirement classes. The other half of the classes were divided among the natural science, social science, and humanities classes for juniors and seniors. The same rule was applied to all six campuses.

Brief Summary Statistics: A total of 1,222 students answered our survey. Respondents were fairly evenly distributed, from freshmen to seniors. About half of them, 46.3 percent, were social science majors, natural science majors accounted for about 38.6 percent, and humanities majors represented 13.5 percent. Most respondents were in-state students (82.2 percent). Out-of-state students were about 10.1 percent of all respondents. Table 4.2 shows a summary of statistics on student distribution.

Calculation of Student Spending: One of the major challenges we faced was to calculate students' monthly budget from their

Table 4.1
Survey Distribution among Campuses

Survey Campus	Represented Campuses	No. of Cases	Percent of Total
ECU	UNCA, UNCW	120	9.82
ECSU	UNCP	323	26.43
UNCC		214	17.51
UNC-CH	NCSU, UNCG, NCSA	200	16.37
WSSU	NCA&T, FSU, NCCU	176	14.40
WCU	ASU	189	15.47
TOTAL		**1,222**	**100.00**

answers to spending pattern questions. Students were asked to state how much they usually spend a month on certain items. A problem arose when it came to essential living costs such as food, housing, utilities, and clothing. Many students did not answer or put zero for those categories, probably because they do not consider it their spending when their parents pay for some of their essential living expenses. To compensate for such a response, a mean value for each category was calculated campus by campus (note that living expenses can vary significantly according to the location of a campus). Assuming that students who wrote "$0" on essential spending categories would spend about the same amount that other students spend on those items, we replaced $0 in each essential living expense category with the average value of the appropriate category. After the adjustment, the total monthly budget was calculated by adding up expenses in all categories. Finally, average total monthly spending was compared among campuses. As expected, UNCC students spend significantly more than students at other campuses. On average, UNCC students spend about $1,241 a month, whereas students at the other five campuses spend about $851 a month. There were some differences in monthly student spending among the five campuses other than UNCC, but they were statistically insignificant. The survey questionnaire is attached in the appendix.

Table 4.2
Distribution of Student Respondents

	Students	
	Number	Percent
Expected year of graduation		
2000	201	17.4%
2001	289	25.0%
2002	263	22.8%
2003	304	26.3%
2004	66	5.7%
No response	32	2.8%
Major		
Humanities	158	13.5%
Social sciences	537	46.3%
Natural sciences	450	38.6%
Undecided	20	1.6%
Residency		
In-state	1,005	82.2%
Out-of-state	123	10.1%
No response	94	7.7%

Data for REMI

We estimated the impact of the UNC system using a baseline assumption that UNC campuses were not present. The REMI model we employ requires data in the following variables.

Employment: As illustrated in the impact mechanism model (Figure 3.1), through jobs created by the UNC system, school employees' spending stimulates the regional economy. The employment variable takes into account such induced spending, investment, and wage changes.

Consumer spending: This variable takes into account spending by students and visitors and consequent final demand changes in industry sectors through multiplier effects. Student spending patterns and visitor data were collected from the student survey. To estimate the net impact, only 63 percent of out-of-state students' and 33 percent of in-state students' spending and their guests were entered in the model (equivalent to the percentage of students that answered they were not likely to attend another college in North Carolina).

Industry demand: UNC campuses spend $1.1 billion a year on various goods and services, which increases final demand of related industries inasmuch as the goods and

services are produced locally. The rate of local purchases for each sector is already embedded in the REMI model as Regional Purchasing Coefficients (RPCs). The change in demand in one sector induces subsequent effects on other sectors through input-output linkages. We did not attempt to measure net change in industry demand because the increase in government spending cancels the effects of industry demand decrease, and therefore automatically adjusts the magnitude of university spending effects.

Government spending: Since UNC campuses are public institutions, they receive a significant amount of support from the state government. If the public university system did not exist, the money appropriated for higher education would be used in other sectors if the state government maintained the same tax rate. Therefore, the amount of the appropriation was reentered into the model as increased general state and local government spending.

College population: The number of college students is an important demographic factor in labor force estimation. Since college students do not participate fully in the labor market, they do not greatly influence the overall wage level. In addition, they may leave the state after graduation, so it is not appropriate to treat them the same as the population groups that remain. To estimate the net college population change, we entered only the number of in- and out-of-state students after taking into account students' responses as to whether or not they would attend another college in North Carolina when UNC campuses were not present.

Occupational supply: UNC campuses produce approximately 23,000 baccalaureates, 6,200 masters, and 800 doctorates every year. Many of them stay within the state and affect the local labor market. Without the UNC system, the professional labor supply would decrease. Considering the fact that over 70 percent of many professional degrees such as science/engineering, law, and computer science/mathematics are produced by UNC campuses, the influence of the UNC system on the supply of professionals for the local labor market is substantial. Any changes in the labor supply lead to a wage rate change in the labor market, which also affects the migration rate. To measure the net change in occupational supply, the results of the student survey and student flow analysis were incorporated. Only the estimated number of students who would still attend a college in North Carolina and would stay within the state was entered in the model.

SECTION 5

Results

This section presents the results of our analysis. First, we discuss the attraction of financial resources. Next, we report the results of the REMI simulation model. The final two sections discuss our analysis of human resources and technology developments, which are also important factors for regional economies.

Analysis of Financial Resources

Table 5.1 summarizes the UNC system's total revenue by sources. The annual revenue of the system is over three billion dollars. Government appropriation accounts for the largest portion of this revenue, followed by auxiliary revenue, public gifts, grants, contracts, and tuition and fees. About 28 percent of the total revenue is raised from out-of-state sources. It is hard to estimate accurately how much out-of-state funding would actually be lost by the state if the UNC system did not exist (i.e., by going to other universities or to research institutions in other states). However, we can reasonably infer that a significant percentage of out-of-state funds would not flow into North Carolina due to the following reasons.

Table 5.1
UNC Revenue by Sources (1999)

Tuition and fees	**413,607,245**
From in-state students	218,409,043
From out-of-state students	195,198,202
Government appropriation	**1,651,197,605**
From federal government	24,396,562
From state or local governments	1,626,801,043
Public gifts, grants, and contracts	**569,967,036**
From federal organizations	478,475,737
From state and local organizations	91,491,299
Private gifts, grants, and contracts	**221,084,327**
From in-state donators and contractors	53,884,370
From out-of-state donators and contractors	167,199,957
Auxiliary	**750,476,961**
From in-state sources	627,597,919
From out-of-state sources	122,879,042
Other sources	**579,886,679**
Total Revenue	**4,186,219,853**

Source: NCHED and IPED Report

First, according to our survey, 63 percent of out-of-state students answered that they would not have come to North Carolina if the UNC system did not exist. That means the same percentage of tuition and fees from out-of-state sources would not have flowed into North Carolina. Second, the largest source of out-of-state funding is private and public gifts, grants, and contracts. If the UNC campuses did not exist, there would be few other educational institutions to which donors interested in higher education could contribute (some reallocations would occur to Duke, Davidson, Elon, Guilford, Wake Forest, and other private institutions). Accordingly, a large proportion of these resources would go to institutions out-of-state. Even some portion of private in-state funding is likely to be reallocated to universities in other states. Third, the same

is true with auxiliary revenue, which comes mostly from sports, concerts, exhibits, meals, and student store sales. That is, without the presence of the UNC system, a significant portion of revenue from these activities would be lost because approximately 33 percent of in-state students would leave North Carolina, and 63 percent of out-of-state students would never come.

Another factor, perhaps less important but certainly not negligible, is the attraction of students and visitors from other states. According to our survey, UNCC students spend significantly more than students at other campuses. (We expected the average spending of UNC-CH student would also be higher than that of students at most other campuses, but the difference was not statistically significant.) Accordingly, $1,242 was assigned to UNCC students as average monthly spending, and $853 was assigned to students at the other 15 campuses as average monthly spending. The total potential loss to the state can be calculated thus: ((number of in-state students)(0.33)(average monthly spending)) + ((number of out-of-state students)(0.63)(average monthly spending)). The final estimated loss from student spending is about $462 million.

REMI Simulation Model

The following discussion focuses on several quantified economic impacts of the UNC system. As described briefly in the previous sections, the major economic impacts of UNC campuses are delivered through six main channels. First, the UNC system provides about 43,000 jobs to North Carolinians with a combined annual payroll of $1.5 billion, and its employees spend much of their earnings locally. Second, UNC campuses spend about $1.1 billion dollars every year purchasing goods and services (including construction), thereby stimulating the local economy. Third, UNC campuses attract students and visitors, and they spend money locally while they are staying in town. Fourth, UNC campuses produce more than 30,000 bachelors, masters, and doctorates every year, and a significant number of them stay in North Carolina. Fifth, UNC campuses spend $600 million for research and development every year, and many discoveries are patented and are often delivered to the marketplace by start-ups initiated from universities or by the private sector via license agreements. Lastly, UNC campuses create a highly favorable environment that can attract quality labor and stimulate entrepreneurial activities.

The REMI model takes into account the first four channels in its estimation process. The impact delivered through the first three channels—employment, spending on goods and services, and spending by students and visitors—is mostly based on spending multiplier effects. In other words, money spent within the state stimulates the regional economy. On the other hand, the impact delivered through the fourth channel—university graduates—draws upon the labor market adjustment process. A large pool of skilled, college-educated labor is an important factor that boosts productivity levels and can attract firms to locate in the region. The model takes into account the availability of college graduates and their impact on labor market, but not productivity changes.

The five-year and ten-year-out impacts were estimated for seven economic development regions of North Carolina and for the entire state. The results show the differ-

ence between the forecast of the state economy calibrated *without* the UNC system and the forecast of the state economy calibrated *with* the UNC system. These differences estimate the UNC system's economic impact on the state economy.

Regionwide Impact: To evaluate the economic impact of each campus on the region where it is located, we ran 16 regional models. Table 5.2 shows the estimated regional

Table 5.2
Regionwide Impact of UNC Campuses

		2003					
		Employment		GRP		Population	
Campus	Region	(thousands)	(%)	(millions)	(%)	(thousands)	(%)
ASU	Advantage West	2.92	0.53	73.74	0.32	14.92	1.55
UNCA	Advantage West	0.61	0.11	14.95	0.06	3.86	0.40
WCU	Advantage West	1.90	0.35	42.97	0.19	8.42	0.87
UNCC	Charlotte	3.94	0.34	148.58	0.22	20.47	1.16
ECU	Global Transpark	6.53	1.12	152.05	0.62	24.35	2.57
ECSU	Northeast	0.51	0.30	10.74	0.16	2.74	0.79
NCSA	Piedmont Triad	0.40	0.04	9.54	0.02	1.32	0.09
NCA&T	Piedmont Triad	1.94	0.21	59.41	0.11	9.41	0.67
UNCG	Piedmont Triad	3.13	0.34	91.56	0.17	14.86	1.06
WSSU	Piedmont Triad	0.63	0.07	17.10	0.03	3.37	0.24
NCCU	Research Triangle	1.53	0.16	54.03	0.10	7.93	0.53
NCSU	Research Triangle	10.69	1.09	344.41	0.64	36.88	2.44
UNC-CH	Research Triangle	18.91	1.94	609.52	1.13	45.00	2.98
FSU	Southeast	0.96	0.19	25.83	0.11	5.55	0.57
UNCP	Southeast	0.64	0.12	17.52	0.08	3.94	0.40
UNCW	Southeast	2.30	0.45	65.93	0.29	12.58	1.29

		2008					
		Employment		GRP		Population	
Campus	Region	(thousands)	(%)	(millions)	(%)	(thousands)	(%)
ASU	Advantage West	3.19	0.57	89.42	0.35	17.71	1.81
UNCA	Advantage West	0.71	0.13	21.50	0.08	5.34	0.55
WCU	Advantage West	2.51	0.45	63.97	0.25	12.93	1.32
UNCC	Charlotte	5.56	0.47	232.92	0.31	21.64	1.18
ECU	Global Transpark	7.61	1.37	178.53	0.68	24.99	2.56
ECSU	Northeast	0.74	0.43	17.64	0.25	4.58	1.31
NCSA	Piedmont Triad	0.48	0.05	13.82	0.02	1.85	0.13
NCA&T	Piedmont Triad	2.65	0.28	104.24	0.18	13.20	0.93
UNCG	Piedmont Triad	3.69	0.39	129.17	0.23	16.58	1.16
WSSU	Piedmont Triad	0.92	0.10	31.43	0.06	5.07	0.36
NCCU	Research Triangle	2.15	0.21	83.85	0.14	12.32	0.78
NCSU	Research Triangle	11.77	1.15	409.53	0.69	38.42	2.43
UNC-CH	Research Triangle	19.24	1.88	639.21	1.07	50.12	3.18
FSU	Southeast	1.42	0.27	42.20	0.17	8.93	0.88
UNCP	Southeast	0.93	0.18	28.55	0.11	6.17	0.61
UNCW	Southeast	3.04	0.57	94.64	0.38	18.25	1.79

The impact of the UNC system was estimated with the assumption that UNC campuses were not present, therefore the input data prepared for the model were negative. Since any difference between the two forecasts shows the impact of the UNC system on the state economy, they are presented here as positive numbers.

contributions to employment, gross regional product (GRP), and population made by the UNC system.

The magnitude of the impacts of UNC-CH, NCSU, and ECU are relatively larger than those of other campuses. In particular, UNC-CH is expected to contribute 1.88 percent of the region's employment growth, 1.07 percent of the growth in GRP, and 3.18 percent of the region's population growth by 2008. Relatively small campuses such as NCSA, WSSU, and UNCP have much smaller impacts on their respective regional economies.

To see the effects of UNC campuses on regions, we need to aggregate the impact of each campus by region. Then, all seven regions of North Carolina can be seen to benefit from the presence of the UNC system. Employment, GRP, and population will all be significantly higher over the next decade because of the campuses. The Research Triangle Region captures the largest effect. By 2008, employment and population in the region would be expected to be about 33,000 and 93,000 higher respectively; the GRP would be projected to grow by $1.1 billion because of the three UNC campuses (NCCU, NCSU, and UNC-CH)—that is almost 2 percent of GRP and over 3 percent of total employment in the region. The impact on other regions would not be as great as that on the Research Triangle. However, other regions would also register a gain of over 5,000 jobs and an increase of $160,000 in the GRP by 2008, except in the Northeast region, where only one small UNC campus is located (ECSU). Table 5.3 shows the aggregated economic impact of UNC campuses on North Carolina's seven Economic Development Partnership Regions. Figures 5.1 and 5.2 illustrate the magnitude of such impact over time. All calculations were done using the REMI model.

Statewide Impact: The statewide impact of UNC campuses was estimated separately because the sum of the regional impacts is not equal to the statewide impact due to the residual effects of each campus on other regions. For example, while UNC-CH mainly influences the Research Triangle region's economy, it also creates minor impacts on the other six regions. Table 5.4 shows the impact on employment, gross state product (GSP), and population that UNC campuses make on North Carolina's economy. In total, the presence of UNC campuses con-

Table 5.3
Aggregated Regional Impact of UNC Campuses

	2003					
	Employment		GRP		Population	
Region	(thousands)	(%)	(millions)	(%)	(thousands)	(%)
Advantage West	5.43	0.99	131.67	0.57	27.20	2.82
Charlotte	3.94	0.34	148.58	0.22	20.47	1.16
Global Transpark	6.53	1.21	152.05	0.62	24.35	2.57
Northeast	0.51	0.30	10.74	0.16	2.74	0.79
Piedmont Triad	6.10	0.65	177.61	0.34	28.97	2.07
Research Triangle	31.13	3.19	1,007.96	1.88	89.81	5.94
Southeast	3.90	0.76	109.27	0.48	22.07	2.26

	2008					
	Employment		GRP		Population	
Region	(thousands)	(%)	(millions)	(%)	(thousands)	(%)
Advantage West	6.41	1.15	174.89	0.69	35.98	3.68
Charlotte	5.56	0.47	232.92	0.31	21.64	1.18
Global Transpark	7.61	1.37	178.53	0.68	24.99	2.56
Northeast	0.74	0.43	17.64	0.25	4.58	1.31
Piedmont Triad	7.74	0.81	278.66	0.49	36.70	2.58
Research Triangle	33.24	3.25	1,051.80	1.90	93.24	5.91
Southeast	5.39	1.01	165.39	0.66	33.35	3.28

tributes 1.4 percent of the state's total jobs (68,000) and 0.8 percent of total economic activity ($2.2 billion) by 2008. The UNC system also contributes 263,000 to the state's population during the same period.

As expected, the impacts of UNC-CH and NCSU outweigh that of other campuses. They account for almost half of the projected statewide employment and GSP gain and over a third of the population increase. Midsize campuses such as UNCC, UNCG and ECU also contribute a significant economic impact: a quarter of the projected difference in employment, GSP, and population is represented by these three campuses.

Figure 5.1
Aggregated Impact on GRP without UNC System

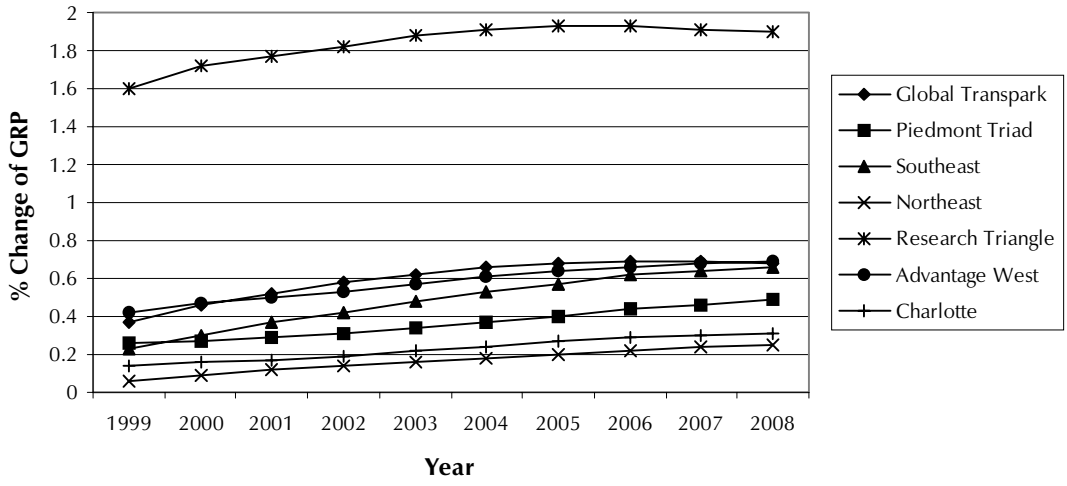
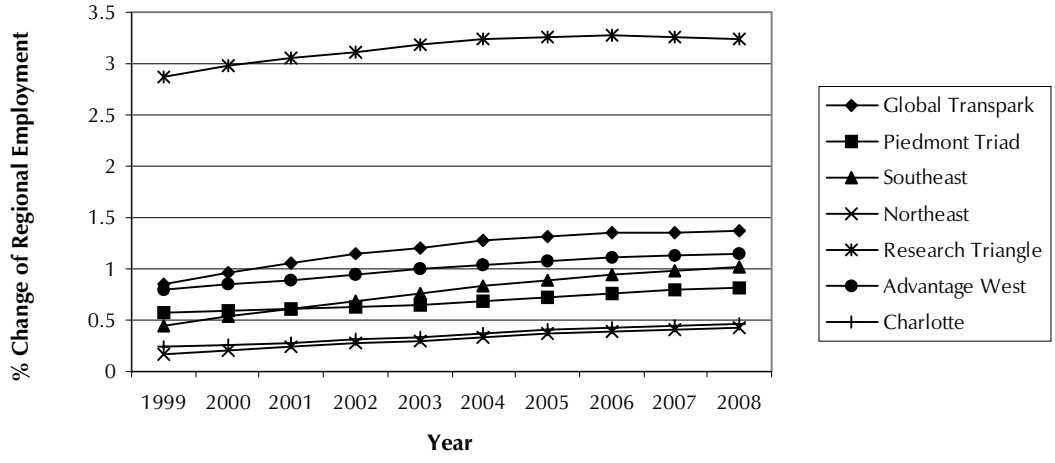


Figure 5.2
Aggregated Impact on Regional Employment



All in all, UNC campuses carry a substantial economic impact on the regional and state economies. The presence of UNC system contributes about 1.4 percent of the total state employment and 0.8 percent of GSP. At the regional level, however, some large campuses play a relatively more important role in their local economy. In addition, the economic impacts estimated in this section do not account for qualitative factors such as human resource and technology development. UNC campuses produce a significant number of high-skill workers each year and create many technological innovations whose contributions to the state economy are not easily measurable.

Table 5.4
Statewide Impact of UNC Campuses

	2003					
	Employment		GRP		Population	
Campus	(thousands)	(%)	(millions)	(%)	(thousands)	(%)
ASU	3.08	0.06	90.32	0.04	15.20	0.19
ECSU	0.55	0.01	14.26	0.01	2.78	0.04
ECU	7.12	0.15	194.39	0.08	25.11	0.32
FSU	1.02	0.02	30.87	0.01	5.63	0.07
NCA&T	1.95	0.04	59.56	0.02	9.49	0.12
NCSA	0.42	0.01	10.32	0.00	1.36	0.02
NCCU	1.53	0.03	50.92	0.02	7.97	0.10
NCSU	11.10	0.23	345.65	0.14	37.68	0.48
UNCA	0.63	0.01	17.09	0.01	3.90	0.05
UNCC	4.00	0.08	141.55	0.06	20.61	0.26
UNC-CH	20.61	0.43	655.22	0.26	47.55	0.60
UNCG	3.15	0.07	92.06	0.04	15.01	0.19
UNCP	0.69	0.01	21.15	0.01	4.00	0.05
UNCW	2.46	0.05	78.93	0.03	12.78	0.16
WCU	2.02	0.04	52.46	0.02	8.58	0.11
WSSU	0.63	0.01	16.90	0.01	3.39	0.04
TOTAL	**60.96**	**1.27**	**1,871.65**	**0.75**	**221.04**	**2.79**

	2008					
	Employment		GRP		Population	
Campus	(thousands)	(%)	(millions)	(%)	(thousands)	(%)
ASU	3.20	0.06	100.01	0.04	17.86	0.22
ECSU	0.75	0.02	21.02	0.01	4.63	0.06
ECU	8.04	0.16	217.39	0.08	25.81	0.32
FSU	1.43	0.03	46.39	0.02	9.00	0.11
NCA&T	2.58	0.05	100.72	0.04	13.17	0.16
NCSA	0.48	0.01	13.87	0.01	1.88	0.02
NCCU	2.05	0.04	74.10	0.03	12.26	0.15
NCSU	11.97	0.24	397.86	0.14	39.07	0.48
UNCA	0.68	0.01	21.76	0.01	5.33	0.07
UNCC	5.60	0.11	220.76	0.08	21.68	0.27
UNC-CH	20.45	0.41	662.82	0.24	52.78	0.65
UNCG	3.61	0.07	124.57	0.05	16.56	0.20
UNCP	0.94	0.02	31.28	0.01	6.21	0.08
UNCW	3.06	0.06	104.16	0.04	18.40	0.23
WCU	2.54	0.05	71.52	0.03	13.05	0.16
WSSU	0.89	0.02	29.26	0.01	5.04	0.06
TOTAL	**68.27**	**1.37**	**2,237.50**	**0.81**	**262.72**	**3.22**

Analysis of Human Resources

Student Flow: The goal of the public university system is to educate and train residents of the state and create a skilled workforce to support the state economy. This attraction and retention of bright students is an important part of what the University of North Carolina does. As a part of the UNC system impact study, we examined and quantified the concepts of *brain draw* and *brain drain*. The goal is to determine how successful the public universities in North Carolina are at attracting and retaining bright students and also at keeping the top students from North Carolina from leaving the state for other universities. This is important because evidence indicates that those who leave the state for education are less likely than in-state students who stay within the state to choose their home state as a long-term place to live after they graduate.

For many North Carolinians who support a quality public university system, a major concern would be whether or not students would stay within the state after

graduation. Many people believe that the state spends money in educating students only to lose them to other states. This brain drain concept was examined using two primary methods. The first is a cohort study of alumni of each of the 16 campuses. The cohorts used were the classes of 1988 and 1994, and information was obtained as to their location in 1998. This information helped determine the percentage of students who stay in the state after graduation. The other method used to determine brain drain was to see how talented the students are relative to other North Carolinians and to examine other educational institution choices students would make if the UNC system did not exist. This was discerned via Office of the President data on incoming students and student surveys, which determined the student's rank, how likely they were to stay in-state if the UNC system did not exist, and also how important the student's current school was in keeping them in-state.

The cohort study was not available for all the universities due to the lack of alumni records at some of the campuses. Table 5.5 shows the origin of two cohorts (1988 and 1994) and their location in 1998 for both undergraduates and graduate/professional students.

The student flow information is helpful for determining the pattern of students' relocations after graduation. As seen in the table, only nine campuses were included in this analysis. Some campuses either do not keep track of alumni location or do not have information accurate enough to be included in the study. The results show that, even though there is a sign of minor brain drain, a large proportion of students still stay in North Carolina after they graduate. In small regional campuses, the percentage of students who remain in North Carolina after graduation is about the same as the percentage of in-state students at the outset. This demonstrates that any fear of losing students whom the state educates to other states is not well-founded. However, it is noticeable that the larger research universities (e.g., UNC-CH and NCSU) have a lower rate of retention in North Carolina than the smaller universities. This is because these cam-

Table 5.5
1989 and 1994 Cohorts from Selected Campuses and Their Location as of 1998

	Origin upon Entry (1989 or 1994)				Location as of 1998			
Campus	Number of Students*	In-State (%)	Out-of-State (%)	Unknown (%)	Number of Students**	In-State (%)	Out-of-State (%)	Unknown (%)
ECU	14,633	81	19		2,863	79	21	
ECSU	1,903	70	18	12	0	N/A	N/A	
FSU	3,168	86	14		775	97	3	
NCA&T	6,367	81	19		987	60	40	
NCSU	21,345	51	14	35	5,530	32	13	55
UNC-CH	15,234	59	41		6,520	36	64	
UNCC	14,083	80	20		2,587	79	21	
UNCG	10,049	79	21		2,651	71	29	
UNCW	2,592	90	10		2,592	60	21	19
TOTAL	86,782	68	23	9	21,913	53	33	14

* Total identified 1988 and 1994 cohorts; ** total identified 1988 and 1994 cohorts as of 1998. Source: Alumni Office of each campus.

puses have a larger out-of-state student population (we can see from the table that the large research universities attract a larger number of students from outside the state). A recent report by Southern Growth Policies Board (Tornatzky *et al.* 2000) shows that college graduates with science and engineering degrees are about 10 times more likely to stay in-state after graduation if they also attended high school there. All told, the student flow data suggest a minor brain drain, but a significant number of UNC graduates still choose to stay. At the outset, a total of 68 percent of UNC students were North Carolina residents. Years later, about 53 percent of graduates still reside within the state.

An important element in determining the effects of brain drain is to determine how well the UNC system keeps talented students in North Carolina. Approximately 1,222 UNC students were surveyed to determine the likelihood of a student still attending a university in North Carolina if the UNC system or the student's individual school did not exist. The question asked was: "If you had not been accepted to this university, how likely is it that you would have attended another college in North Carolina?" The students were given a scale of one through five, with one being highly unlikely to attend school in North Carolina and five being highly likely to attend school in North Carolina. The results showed that 63.4 percent of out-of-state students would be unlikely or highly unlikely to come to North Carolina, while in-state students would be 32.8 percent unlikely or highly unlikely to stay in North Carolina. In other words, about one-third of in-state students stay in North Carolina, and about two-thirds of out-of-state students come to North Carolina because of the UNC system. These are significant numbers and demonstrate the universities' ability to retain talented students. Combined with student flow data, this information provides a strong rationale for the state's public university system. It attracts and educates quality students from in- and out-of-state. More importantly, a substantial number of these students stay within North Carolina after graduation.

In terms of brain draw, we found the difference between the quality of in- and out-of-state students to be statistically insignificant among the campuses surveyed in the UNC system, but according to student surveys and UNC Office of the President (OP) statistics, out-of-state students in the UNC system had higher class rankings and SAT averages than the in-state students. The student survey on UNC campuses shows the average high school class rank for the UNC system is 2.26 for in-state students compared to 2.19 for out-of-state students. The scale given to the students was one for the top 10 percent of their class, two for the top 25 percent of their class, three for the top 50 percent of their class, four for the top 75 percent of their class, and five for the bottom 25 percent of their class. In 1998, the average SAT scores for incoming out-of-state was 1,106; for in-state students it was 1,057. This is not a large difference, but it still shows that quality students are coming into North Carolina to attend UNC. The bigger, higher profile universities like UNC-CH, NCSU, UNCA, and NCSA brought in the best-ranked out-of-state students. This supports the claim that larger research universities tend to attract the most talented out-of-state students to North Carolina. Reputation, resources, and quality education go a long way in building the overall quality of students at an educational institution. The retention and attraction of quality students to North Carolina is important for creating and maintaining top educational institutions in the state and also for training highly skilled workers for the North Carolina economy.

Human Capital Formation: It is now common knowledge among researchers and practitioners that the most important element for a region to stay competitive is whether or not the region has an appropriate workforce. Many firms make location decisions based on labor force availability in candidate regions. Since it is a major role of universities to train people, the importance of universities in maintaining and strengthening the competitiveness of a region is greater than ever.

UNC campuses have played a critical role in producing professionals and providing a quality work force for businesses in the state. Eighty-eight percent of the total number of engineers produced in North Carolina are educated at one of the UNC campuses. Seventy percent of North Carolina's life scientists, 72 percent of computer/math analysts, and 77 percent of teachers and librarians are produced by the UNC system. Table 5.6 shows that UNC is a powerhouse in producing professionals. The importance of the UNC system may be underestimated if only quantifiable economic impacts drawn from an input-output model are considered.

One major element to emphasize is the UNC system's role in minority education. As shown in Table 5.6, UNC campuses have produced a large share of the state's minority professionals. For African-American professionals, the role of UNC campuses is critical. Ninety-eight percent of African-American engineers, 93 percent of African-American health professionals, and 69 percent of African-American lawyers in North Carolina are produced by the UNC system. Considering the fact that the proportion of minority professionals that UNC campuses produce is higher than the share of total UNC graduate professionals, the importance of the UNC system in minority education cannot be overemphasized.

Table 5.6
UNC's Share of Professional Education, 1998

Professional Education	No. of Degrees Conferred	Percent of NC Total
Engineers	**2,257**	**88.4**
Black	429	98.2
Women	478	88.4
Architects	**318**	**100.0**
Black	20	100.0
Women	127	100.0
Life Scientists	**2,401**	**70.0**
Black	334	75.6
Women	1,293	66.4
Computer, Math Analysts	**1,155**	**72.7**
Black	224	68.7
Women	380	62.5
Physical Scientists	**824**	**76.7**
Black	81	82.3
Women	325	76.7
Social Scientists	**11,759**	**61.6**
Black	2,128	63.1
Women	6,279	62.4
Lawyers	**316**	**37.5**
Black	72	69.2
Women	158	42.7
Teachers, Librarians, and Counselors	**6,054**	**76.9**
Black	1,015	78.4
Women	4,448	76.3
Health Professionals	**2,992**	**79.6**
Black	387	93.3
Women	2,312	81.5
Writer, Artists	**1,263**	**69.7**
Black	148	75.9
Women	746	66.4
Other Professionals	**1,916**	**55.6**
Black	231	55.4
Women	1,188	60.0

Source: Statistical Abstract of Higher Education in North Carolina

Another important aspect of UNC's contribution to the formation of human capital is the extension degree program (continuing education) provided by most campuses. Over 4,000 people in North Carolina are retrained annually at UNC campuses. They make up about half of the total students enrolled in the extension credit programs offered by all of the higher education institutions (both public and private) in North Carolina. The importance of such programs will grow in the next century, as the speed of technological change accelerates and firms want employees' skills updated to keep up with such changes.

Analysis of Technology Development

As discussed earlier, technological progress lies at the center of the discussion about sustainable economic development. It is the quintessence of the so-called "New Economy." Universities have played a crucial role in technology development due to their abundant human and financial resources available for research and development. They have a larger pool of researchers than any other type of organization and receive a substantial amount of research funding from various private and public sources. The outcomes of university research activities are often patented and transferred to the marketplace for commercialization. We measured the UNC system's efforts toward and contribution to technology development with three indicators: number of patents issued to universities, amount of license (royalty) income, and start-up and spin-off companies initiated from UNC campuses. Unfortunately, the limitation of data availability kept us from conducting a more comprehensive analysis of technology developments for all UNC campuses; therefore, we used only two major research universities (UNC-CH and NCSU) in our analysis. This analysis needs to be expanded in future reports.

In 1999, UNC campuses attracted about $600 million in external grants for research and other sponsored programs. UNC-CH and NCSU account for the lion's share of these external grants ($490 million out of $600 million). Research areas varied from biomedicals to textiles. The results of the research are often patented. In 1999, 41 and 30 new U.S. patents were issued to UNC-CH and NCSU, respectively. Together, they earned almost $6 million in license and royalty income.

Many researchers at UNC-CH and NCSU bring their ideas to the market and establish their own companies. In most cases, these start-up companies are very innovative and technologically advanced. The Research Triangle has served as a hotbed for such entrepreneurial activities. For example, SAS Institute, founded by a NCSU graduate in 1972, is now a leading software company employing over 3,000 workers. Quintiles Transnational, founded by a UNC-CH faculty member in 1982, is now a major player in pharmaceutical development and testing. Such role models send a positive signal to their followers, and many other researchers at these two institutions have started their own businesses. Table 5.7 lists companies initiated from UNC-CH and NCSU recently. Although the list is far from complete due to a lack of data availability, it shows that a significant level of entrepreneurial activities utilizing new technologies is present on both campuses.

Table 5.7
Start-ups initiated from UNC-CH and NCSU

UNC-CH Spin-Off Companies

Name	Product	Year Founded
Mycosearch, Inc.	Pharmaceuticals	1979
SunTechnologies Group, Inc.	Computer	1980
Numerical Design Limited	Computer Graphics	1982
Quintiles Transnational Corp.	Pharmaceuticals	1982
Triangle Laboratories, Inc.	Chemicals	1984
ICAgen	Pharmaceuticals	1992
Virtual Reality Games	Computer Game	1994
Inspire Pharmaceuticals	Pharmaceuticals	1995
Lari Software	Computer Graphics	1995
MiCell Technologies, Inc.	Chemicals	1996
Xanthon, Inc.	Pharmaceuticals	1996
Novalon Pharmaceutical	Pharmaceuticals	1996
AlphaVax	Pharmaceuticals	1998
Renaissance Cell Technologies	Pharmaceuticals	1998
LeukoMed, Inc.	Pharmaceuticals	2000
deltaSphere, Inc.	Computer Graphics	2000
HiBall Tracker, Inc.	Computer Graphics	2000
nanoManipulator, Inc.	Computer Graphics	2000

NCSU Spin-Off Companies

Name	Product	Year Founded
SAS Institute	Software	1972
Embrex	Pharmaceuticals	1985
Cree Research	Semiconductors	1987
Probiologics	Biotechnology	1987
Gentra System		1988
Pathogene Biologics	Biotechnology	1989
LipoMed	Medical	1994
ID Technologies	Infotech	1994
Zymotech Inc.	Biotechnology	1996
3Tex., Inc.	Textile	1996
Xanthon	Biotechnology	1996
Pilot Therapeutics	Pharmaceuticals	1998
HowStuffWorks	Infotech	1998
Nitronex	Chemicals	1999
Giant Semiconductor, Inc.	Semiconductors	1999
SentriSystems, Inc.	Infotech	1999
Db Tag, Inc.	Electronics	
Silicon Wireless	Electronics	
Mi-Corporation	Infotech	
ZisZas	Infotech	
Biolex, Inc.	Biotechnology	

Source: Office of Technology Development, UNC-CH and Centennial Venture Partners, NCSU

Conclusion — The Significance of the UNC System

Our analysis shows that the presence of the UNC system is crucial to the state's economy in many ways. The state's investment in UNC campuses creates more jobs, produces more wealth, and attracts more people to the state. It also makes the state's labor force more productive and the state's economy more technology intensive. The following list summarizes the importance of the UNC system to the state economy.

First, UNC campuses attract over one billion dollars from out-of-state sources.[5] This is almost equivalent to the total output of apparel and other textile products (SIC 23), which is one of the major traditional industries in North Carolina.

Second, UNC campuses are projected to create 68,000 new jobs by 2008. Note that this number is net job creation after taking into account increased government spending redirected from education to other fields. This number is almost equivalent to the total employment in industrial machinery and equipment (SIC 35) in North Carolina.

Third, UNC campuses are projected to create, directly and indirectly, about $2.2 billion worth of economic activity (0.8 percent of the GSP) by 2008. This is almost equivalent to the total output of motor vehicles and equipment (SIC 371), which is one of the major strategic industries in North Carolina.

Fourth, UNC campuses are projected to attract about 263,000 persons to the state by 2008. This is almost 3.2 percent of the total state population as of 1998.

Fifth, UNC campuses produce about 23,000 baccalaureates, 6,200 masters, and 800 doctorates every year. This is about 68 percent of the total number of bachelors, 75 percent of the total number of masters, and 72 percent of the total number of doctorates produced in North Carolina.

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[5] This is the gross amount. We did not estimate the net amount of money attracted by UNC campuses.

APPENDIX 1

Campus Profiles[6]

Appalachian State University: Founded in 1899, Appalachian State University (ASU) was known as Watauga Academy until 1903. After it became a statutory institution, it was designated Appalachian Training School for Teachers. The name changed to Appalachian State Teachers College in 1929. It was designated Appalachian State University in 1967, and it became part of the University of North Carolina system in 1972. Appalachian State University offers 95 undergraduate and 81 graduate majors through four colleges (College of Arts & Sciences, Education, Business, and Fine & Applied Arts) and one professional school (School of Music). Since the University mainly serves undergraduate students, Appalachian's primary mission is instruction. The University is integrated with the Appalachian region in various respects and seeks to contribute to the understanding and preservation of its culture. The University covers 340 acres and is located in Boone, which is in the northwestern part of the state in the heart of the Blue Ridge Mountains. The city has a population of 14,500.

East Carolina University: East Carolina University (ECU) was founded in 1907 as East Carolina Teachers Training School. The name changed to East Carolina Teachers College in 1921 and to East Carolina College in 1951. It was designated East Carolina University in 1967, and was merged into the University of North Carolina system in 1972. The University's academic program consists of 14 colleges and professional schools, which offer baccalaureate, masters, first professional, and doctoral degrees. The University has earned a national reputation in health science education, particularly focusing on primary care and responsive regional service. It is well integrated with the community and serves as a cultural and educational center of the region. The University covers 484 acres and is located in Greenville, which is a business, medical, and trade center in the coastal plain region. Greenville has a population of 57,405.

Elizabeth City State University: Elizabeth City State University (ECSU) was established as the State Colored Normal School in 1891. It is one of five campuses whose ethnic majority has historically been African-American. The name changed to Elizabeth City State Teachers College in 1939 and to Elizabeth City State College in 1963. It was designated a regional University in 1969 and was merged into the University of North Carolina system in 1972. The university offers comprehensive majors at the baccalaureate level through 13 academic departments under two academic divisions (Division of

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[6] This section is based on "2000-2001 University of North Carolina Institutional Profiles," published by the Office of the President.

Education and Division of General Studies). Since the University serves mostly undergraduate students, its primary mission is instruction. The University covers 117 acres and is located in Elizabeth City, which is the center of the historic northeastern region of North Carolina. The city has a population of 45,000.

Fayetteville State University: Fayetteville State University (FSU) was established as Howard School in 1867. It became the State Colored Normal School in 1877 and Normal State School in 1926. The name changed to Fayetteville State Teachers College in 1939, then to Fayetteville State College in 1963, and subsequently to Fayetteville State University in 1969. It was merged into the University of North Carolina system in 1972. The University offers comprehensive degree programs at the baccalaureate, masters, and doctoral levels through the College of Arts and Sciences, the School of Business & Economics, and the School of Education. Since the first alumnus chancellor, Dr. Willis B. McLeod, was elected by the Board of Governors in 1995, the University has been actively involved in new initiatives to enhance educational outcomes and to strengthen community ties. The University covers 156 acres and is located in Cumberland County, including the military bases (Fort Bragg and Pope Air Force Base), and is a trade and business center in the eastern Sandhills area. Fayetteville has a population of 303,000.

NC Agriculture and Technology State University: North Carolina Agriculture and Technical State University (NCA&T) was founded in 1891 as Agricultural and Mechanical College for Negroes. The name changed to Agricultural and Technical College of North Carolina in 1915. It was designated a regional university in 1967 and merged into the University of North Carolina system in 1971. As a land-grant institution, the University offers comprehensive degree programs at the baccalaureate, masters, and doctoral levels. The doctoral program began in 1993. Its programs are organized under the College of Arts and Sciences, College of Engineering, and six professional schools. The University is a leading institution for graduating minorities in science, mathematics, engineering, and technology. It has also been one of the largest producers of minority CPAs. The University covers 759 acres and is located in Greensboro, which is a major city in the west-central Piedmont region. Greensboro serves as a center for business and trade, and has a population of 205,132.

NC Central University: North Carolina Central University (NCCU) was established in 1909 as the National Religious Training School and Chautauqua to train community leaders. Originally a private institution, it became the state-funded Durham Normal School in 1923. It was the first liberal arts college for African-Americans in the nation and has maintained its strong liberal arts tradition. The University's mission statement defines its primary goal as teaching. The University changed its name to North Carolina Central University in 1969 and was merged into the University of North Carolina system in 1972. It offers comprehensive undergraduate and graduate programs through its College of Arts & Sciences, School of Business, School of Education, School of Law, and School of Library & Information Sciences. The University covers 104 acres and is located in Durham, which is one of the three cities that comprise the Research Triangle. Durham has 172,000 residents.

NC School of the Arts: North Carolina School of the Arts (NCSA) was created in 1963 as a residential public institution for training performing artists. The school was the

first state-supported institution of its kind in the nation. In 1972, it was merged into the University of North Carolina system. The institution's primary goal is to train talented students in the performing arts for professional careers. It offers very focused programs at the high school, undergraduate, and graduate levels through five schools: the Schools of Dance, Design & Production, Drama, Filmmaking, and Music. Today, the school is internationally acclaimed for its high quality of training and the outstanding achievements of its alumni. Located in Winston-Salem, a nationally recognized industrial city, the institution covers 57 acres. The city has 161,000 residents.

NC State University: North Carolina State University (NCSU) was established in 1887 as a land-grant college. It was originally designated North Carolina College of Agriculture and Mechanic Arts. The name changed to North Carolina State College of Agriculture and Engineering in 1917. In 1931, it merged with the North Carolina College for Women at Greensboro and the University of North Carolina at Chapel Hill to form the University of North Carolina system and was subsequently renamed North Carolina State University in 1965. The University is a nationally recognized major land-grant institution for research and education in the sciences and technologies, in the humanities and social sciences, and in a wide range of professional programs. Many of its academic programs rank among the best in the nation (e.g., material science, electrical engineering, chemical engineering, etc.). The University offers comprehensive academic programs (125 fields of study) at the baccalaureate, masters, intermediate, first professional, and doctoral levels through one school and nine colleges. The University covers 2,110 acres including the 623-acre main campus and the 1,000-acre Centennial Campus. It is located in Raleigh, the capital of North Carolina. Raleigh has a population of 250,000 — the largest city in the Raleigh-Durham metropolitan area, which includes Research Triangle Park. The population of the metropolitan area tops one million.

UNC Asheville: The University of North Carolina at Asheville (UNCA) was established in 1927 as Buncombe County Junior College. The name was changed to Asheville Biltmore College in 1936, and the institution was given its current name and merged into the statewide university system in 1969. The university is a liberal arts institution focusing on undergraduate education; however, it also offers interdisciplinary graduate degree programs. The institution has earned national recognition for its unique Humanities Program (a four-course sequence required for all UNCA students) and its dedication to undergraduate education and teaching. The University covers a 265-acre wooded area in Asheville, which is an urban center for commerce, culture, and tourism in the western part of North Carolina. Asheville is surrounded by the large forests of the Blue Ridge Mountains and has about 180,000 residents.

UNC Chapel Hill: The University of North Carolina at Chapel Hill (UNC-CH) was founded in 1789 as the first state university in the United States. In 1931, it was merged with the North Carolina College for Women at Greensboro and the North Carolina State College for Agriculture and Engineering at Raleigh to form the University of North Carolina system. As a nationally recognized research university, it offers comprehensive academic programs at the baccalaureate, masters, intermediate, first professional, and doctoral levels. Many of its academic programs rank among the best in the nation (e.g., biostatistics, pharmacology, chemistry, sociology, political science, etc.).

The University has been selected as one of the top 25 universities in the nation by *U.S. News and World Report*. It has two divisions of instructional programs. The division of academic affairs is composed of eight colleges and schools; the division of health affairs consists of five schools. The University also houses 34 centers, institutes, and multidisciplinary programs. The campus covers 720 acres in Chapel Hill, near Research Triangle Park. The city has a population of 38,719.

UNC Charlotte: The University of North Carolina at Charlotte (UNCC) was established in 1946 as the Charlotte Center of the University of North Carolina. It became Charlotte College, a two-year community college, in 1949 and a four-year state-funded university in 1963. The University was merged into the University of North Carolina system in 1965. It offers comprehensive academic programs at the baccalaureate, masters, and doctoral levels through seven schools and colleges: Architecture, Arts and Sciences, Business Administration, Engineering, Education, Nursing & Health Professions, and Information Technology. The University has a 950-acre campus in Charlotte, the largest city in North Carolina. The population within the metropolitan area exceeds 1.1 million.

UNC Greensboro: The University of North Carolina at Greensboro (UNCG) was founded in 1891 as State Normal and Industrial School. In 1896, its name was changed to State Normal and Industrial College in 1896 and then became Women's College of the University of North Carolina in 1931. As an Intensive Doctoral/Research university, it offers comprehensive academic programs at the baccalaureate, masters, intermediate, and doctoral levels through the College of Arts and Sciences and six professional schools (Business and Economics, Education, Health and Human Performance, Human Environmental Science, Music, and Nursing). The University has a 190-acre campus and is located in downtown Greensboro, which is a thriving business, manufacturing, and educational center in the Piedmont region. The city has a population of 208,887.

UNC Pembroke: The University of North Carolina at Pembroke (UNCP) was established in 1887 as a state school for the Native Americans of Robeson County. Originally named Croatan Normal School, it soon changed to Pembroke State College for Indians. The institution earned university status in 1969 and was merged into the University of North Carolina system in 1972. This small University, categorized as Master's Colleges and Universities I, offers various programs at the baccalaureate and masters levels through 19 academic departments. The University covers 126 acres and is located in the town of Pembroke, population 2,640.

UNC Wilmington: The University of North Carolina at Wilmington (UNCW) was founded in 1947 as a two-year institution and was accredited as a junior college in 1952. It became a public four-year institution in 1963 and was merged into the University of North Carolina system in 1969. The University, categorized as Master's Colleges and Universities I, offers comprehensive academic programs at the baccalaureate and masters levels through the College of Arts & Sciences and three professional schools (Business Administration, Education, and Nursing). The University covers 661 acres and is located in the historic port city of Wilmington. The city has a population of 69,500.

Western Carolina University: Western Carolina University (WCU) was established in 1889. It was originally Cullowhee State Normal and Industrial School but became

Western Carolina Teachers College in 1929. It was designated a regional university in 1967 and was merged into the University of North Carolina system in 1972. The University offers comprehensive academic programs at the baccalaureate, masters, and doctoral levels. Its academic programs are organized under four undergraduate colleges (Applied Sciences, Arts and Sciences, Business, and Education and Allied Professions) and a graduate school. The University has 265-acre campus and is located in a small town, Cullowhee, which has a population of 6,500.

Winston-Salem State University: Winston-Salem State University (WSSU) was established in 1892 as the Slater Industrial and State Normal School. The name changed to Winston-Salem Teachers College in 1925. It was the first African-American institution to grant college degrees in elementary teacher education. It became Winston-Salem State University in 1969 and was merged into the statewide university system in 1972. As a Baccalaureate Colleges-General university, it focuses on undergraduate level education and offers only bachelor's degrees. However, it provides master's level study through its graduate center. The University's instructional programs are organized under four academic divisions and continuing education. The University covers 98 acres and is located in Winston-Salem, a city of manufacturing and financial services. The city has about 173,530 residents.

APPENDIX 2

Data

Data for the analysis of financial resources: The analysis of financial resources focuses on the degree to which financial resources are attracted to North Carolina from out-of-state sources due to the existence of UNC campuses. We identified direct and indirect UNC-related flows of financial resources into North Carolina.

First, universities attract financial resources directly from other states. These resources account for a significant portion of university revenue. Revenue flows can be grouped into four large categories: tuition and fees; government appropriations; gifts, grants and contracts; and other sources. For the analysis of financial resources, each category is divided into in-state and out-of-state sources. This is a very important distinction because it allows us to determine the net financial gains for the state of North Carolina due to the existence of the UNC system. The Integrated Postsecondary Education Data (IPED) report and the North Carolina Higher Education Data (NCHED) report, which are readily available from the UNC Office of the President, provided detailed information about tuition and fees, government appropriations and public gifts, grants, and contracts. However, the data about private gifts, grants and contracts by in- and out-of-state sources are not available from the Office of the President, and were therefore obtained from the financial (or controller's) office of each campus. When such data were not available from an individual campus, a sample of private gifts, grants and contracts was drawn for a visual inspection. The percentage of in- and out-of-state sources from the sample was used as a proxy for the population distribution of private gifts, grants and contracts by sources. More detailed data about university spending on tuition and fee support are needed for an adjustment of university revenue flows. Revenue from tuition and fees does not distinguish between the payments made by students themselves and the payments made by the university through financial aid. Accordingly, tuition and fees from out-of-state students are not necessarily a net inflow from out-of-state sources, since they might include financial supports for out-of-state students provided by the university. Therefore, university spending on tuition and fees support was subtracted from the university revenue raised from tuition and fees.

Second, financial resources can also be attracted into the state indirectly through students and visitors in the form of students' living expenses and visitors' travel and entertainment expenses. Some students bring in money from out-of-state sources to cover their education and living costs. Student surveys provide information about the sources of students' financial resources. In order to estimate net impact, only students who would have chosen universities in other states were considered. Support from parents living in other states, loans from banks located in other states, scholarships or

fellowships from out-of-state organizations, and savings deposited in out-of-state banks are examples of indirect financial resource inflow through UNC students. Visitors from other states spend money for a variety of university-related attractions. Such attractions can be categorized into three groups: the arts (museums, galleries, and theaters), sports, and nature and science related attractions (botanical gardens, aquariums, planetariums, and science centers). However, we assume that sporting activities draw more visitors than the others, and provide a spill-over effect to other attractions. For example, people who visit a campus to attend a football game might spend time visiting other attractions as well. Visitors to sports activities and to other attractions are not necessarily different. Likewise, people visiting a campus to see family members or friends can also spend their time and money on such university attractions. Therefore, to avoid double counting, we counted only sports-related visits and family/friend visits. Student spending and family/friend visiting data were collected from the student survey (see technical appendix section 2). Table A.1 summarizes data used for the analysis of financial resources.

Data for I-O analysis: An I-O model aims to measure the impact of spending by universities, university employees, students, and visitors. In an I-O analysis, it is important to note where the money is spent (i.e., within or outside the state). Money "leaked" (spent) outside the state should be excluded from the model. The model requires a careful specification of expenditures by type (e.g., furniture, computer equipment, and food). The spending data for these four groups (i.e., universities, university employees, students, and visitors) are obtained using the following assumptions and procedures.

First, university spending data can be categorized into spending on goods and services and spending on capital improvements.[7] The spending data on goods and services are readily available from the NCHED report. Each UNC campus is required to report its revenue sources and expenditure items by function and type to the Office of the President in a standardized format, called the NCHED report. The problem of using the NCHED report is that it does not have information about vendor locations and some items are aggregated too much. Vendor location is important because it allows researchers to take into account any leakage by dividing university spending into spending within the state and spending outside the state. REMI, which is computer software designed for economic impact analysis (see technical appendix section 3), provides a substitute method. REMI has an embedded function that assigns a percentage of local purchases for each type. The percentage values assigned are called Regional Purchas-

Table A.1
Data for the analysis of financial resources

Data Category	Source
University Revenue	
Tuitions and fees	OP
Government appropriation	OP
Gifts, grants, and contracts	Campus
Other sources	Campus
Students Characteristics	
Number of students	OP
Alternative choice to UNC	Survey
Source of students' spending	Survey
Visitors	
Sports-related activities	Campus
Family and friends	Survey

OP = Office of the President

[7] In an accounting system, every dollar spent on goods and services is captured by current funds, and every dollar spent on capital improvements is captured by plant funds.

ing Coefficients (RPCs), which are developed based on a sophisticated econometric technique. REMI automatically splits the spending within and outside the state based on RPCs without any information about vendor locations. This allows us to use spending data readily available in the NCHED report. General university capital improvement spending data (e.g., total spending) are also readily available from each university's financial statement. RPCs are also used in assigning local purchases for capital improvements.

Among the items in the expenditure on goods and services category, the expenditures on pensions needs to be discussed in more detail. Each university supports its employees' pension payment. The university's financial resources used for this purpose cannot be considered actual spending since it is reserved and not actually spent until the person retires. Therefore, it is necessary to follow today's university support for an employee's pension payment and tomorrow's actual spending after the person retires. However, since this involves complications such as inflation, salary increase, and tracking money flows over time, we assumed that today's university support for pension payment is equivalent to today's actual spending on retirees.

Second, university employee and payroll data were obtained from the NCHED report. The number of employees and the size of the payroll are important for assessing the universities' economic impact because a large university system is a major source of jobs and its employees' spending within the region stimulates local economic activities. Unlike university spending, employee spending need not be categorized. REMI takes into account the impact of employees' spending by assuming that UNC employees' spending pattern follows that of other average university employees. Payroll data are needed to adjust a difference, if any, between the average wage level embedded in the model and that of UNC employees.

Third, data on spending by students were obtained from a student survey. The survey asked students about their origin (in-state, out-of-state), alternative choice to a UNC school, source of funds, and spending patterns. For I-O analysis, only spending made by students who might have chosen universities located in other states as an alternative to a UNC school was used. This procedure aims to measure a net impact that would not have occurred if the UNC system did not exist. These surveys also helped postulate how many university employees would have stayed within North Carolina if the UNC system did not exist and to adjust the size of spending by employees accordingly. Additional information such as tuition and fee payment from students was obtained to adjust student spending. Since students' tuition and fee payments to a university are captured as revenue and spent by the university, they were excluded from student spending to avoid double counting.

Fourth, data on spending by visitors due to university visits were estimated from each campus and student survey. Three groups of university attractions were identified: the arts (museums, galleries, and theaters), sports, and nature and science related attractions (botanical gardens, aquariums, planetariums, and science centers). However, as discussed above, we assumed one attraction (sports activities) would dominate the others. To avoid double counting, we counted only sports-related visits and family/friends visits. Only non-North Carolina resident visitors were included in the estimate of visitor spending. Table A.2 summarizes the data used for I-O analysis.

Data for the analysis of human resources: The issues involved in the analysis of human resources are how much human capital is attracted and retained within North Carolina, how many professionals the UNC system educates, and what university services are available for the public.

The first issue requires data for the origin and destination of students. The origin data should include distribution characteristics (e.g., gender, race, and residential status) of incoming students. These data are readily available from the Statistical Abstract of Higher Education in North Carolina published by the Office of the President. The analysis requires keeping track of student flow and identifying students' current location. Alumni offices at most campuses maintain information on their graduates. We followed the current location of two cohorts: the class of 1988 and the class of 1994. Since the available records of graduates are based on the place of residence rather than the place of work, there exists the possibility for bias. However, given that the size of a commuting zone is limited, we assumed the bias created by this problem would be marginal. The student survey also provides meaningful information. Since students were asked whether or not they would have attended a college within the state if they had not been accepted to UNC, it is possible to infer what percentage of UNC students would be retained without the presence of the UNC system.

The second issue requires data about professional education programs. We selected major professional occupations (i.e., engineers, scientists, lawyers, teachers, and health professionals, etc.). The Office of the President maintains a very detailed database, including enrollment in and degrees conferred by such programs. Much of this information is published annually in the Statistical Abstract of Higher Education in North Carolina. We were particularly interested in how many minority professionals are produced by each UNC campus.

The third issue requires data about university outreach programs such as continuing education and extension services, which provide life-long education programs for people in the community. Information about access to library resources by residents is also necessary. The impact of university outreach in terms of human resources was measured by the number of people trained by each program, the number of hours spent in training programs, the number of library users from outside the university, and the number of university library Web site hits. This information is available only from each program's individual office. Table A.3 summarizes data used for the analysis of human resources.

Data for the analysis of technology development: The analysis of technology development

Table A.2
Data for I-O analysis

Data Category	Source
University Expenditure	
Expenditure on goods and services	OP
Expenditure on construction	Campus
Expenditure on tuition and fee support	Campus
Payroll	
Number of employees	OP
Amount of payroll	OP
Students Characteristics	
Number of students	OP
Alternative choice to UNC	Survey
Source of students' spending	Survey
Tuition and fee payment	Survey
Monthly expenditure on goods and services	Survey
Visitors	
Sports-related activities	Campus
Family and friends	Survey

OP = Office of the President

focuses on the UNC system's role in developing new technologies. We chose three indicators to measure the importance of UNC campuses in technology development: university spin-off companies, patent records, and license and royalty income.

Data about university spin-off companies, patents, and license and royalty incomes are available at the office of technology development or an equivalent office at each campus. Unfortunately, this information is not available from most campuses except the major research universities (i.e., UNC-CH and NCSU). Table A.4 summarizes the data needed for the analysis of technology development.

Table A.3
Data for the analysis of human resources

Data Category	Source
Student Flow	
1988 Cohort	Campus
1994 Cohort	Campus
Cohort (1988, 1994) location in 1998	Campus
Professional Education	
Engineers	OP
Architects	OP
Life Scientists	OP
Computer, Math Analysts	OP
Physical Scientists	OP
Social Scientists	OP
Lawyers	OP
Teachers, Librarians, and Counselors	OP
Health Professionals	OP
Writers, Artists	OP
Other Professionals	OP
University Outreach	
Continuing education	Campus
Extension services	Campus

OP = Office of the President

Table A.4
Data for the analysis of technology development

Technology Development	Source
University spin-offs	Campus
Patents applied for	Campus
Patents received	Campus
License and royalty income	Campus

APPENDIX 3

Student Survey Questionnaire

Part I: Background Information

1. What degree are you currently seeking (*check all that apply*):

   Bachelor's _____
   Master's _____
   Ph.D. _____
   Other; Specify _____ _____

2. Specify ***all*** majors or fields of study ***that apply to you***: _____

3. In what ***month*** and ***year*** do you expect to be awarded the degree(s) indicated above:

   _____

4. What state (or country) is your legal residence?

   North Carolina_____
   Other _____

   IF "***North Carolina***": What ***county*** is your legal home? _____
   IF "***Other***": Specify your legal residence (state or country). _____

5. Was ***North Carolina*** your legal residence before you enrolled for your first semester?
   (Y or N) _____

6. Your high school class rank was

   1 ..... 2 ..... 3 ..... 4 5
   Top 10% Top 25% Top 50% Top75% Bottom 25%

7. Please indicate to what other colleges or universities you applied, where they are located, and which of those accepted you.

Applied to:	State:	Accepted (Y or N)
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

8. If you had ***not*** been accepted to this university, how likely is it that you would have attended another college ***in North Carolina***? (circle the number that best applies)

(a) *Assume that you could go other UNC campuses, but not this one**

1	2	3	4	5
highly unlikely	somewhat unlikely	don't know	somewhat likely	highly likely

(b) *Assume that none of UNC campuses exist*

1	2	3	4	5
highly unlikely	somewhat unlikely	don't know	somewhat likely	highly likely

* UNC system consists of sixteen campuses as follows: UNC-Asheville, UNC-Chapel Hill, UNC-Charlotte, UNC-Greensboro, UNC-Pembroke, UNC-Wilmington, Appalachian State, East Carolina, Elizabeth City State, Fayetteville State, NC Agriculture & Technology State, NC State, NC Central, NC School of the Arts, Western Carolina, Winston-Salem State.

9. How many of the ***last 24 months*** have been spent in the town your college is located?

_____

10. How many of the ***last 24 months*** have been spent in ***North Carolina***? _____

Part II: Sources of Income

(Please do **NOT** include any income spent on tuition in your responses)

10. How much of your yearly income comes from the following sources:

Parents (or relatives)	$_____
Personal savings (including trust funds)	$_____
Loans	$_____
Fellowships/grants	$_____
Employment (including summer works)	$_____
Other; Specify	$_____ _____

If some percent of income in question 10 is from parents answer question 11.

11. In what state do your parents (or relatives) live? _____

If some percent of income in question 10 is from savings answer question 12.

12. What percent of your savings are held in institutions ***outside North Carolina***? _____%

If some percent of income in question 10 is from loans answer question 13.

13. What percent of your loans are from individuals or institutions ***outside North Carolina***? _____%

If some percent of income in question 10 is from fellowships/grants answer question 14.
14. What percent of your fellowships/grants is from institutions ***outside North Carolina***? _____%

If some percent of income in question 10 is from employment answer question 15.
15. What percent of your employment income is from employment ***outside North Carolina***? _____%

If some percent of income in question 10 is from other answer question 16.
16. What percent of your other income is from sources ***outside North Carolina***? _____%

Part III: Spending Patterns

17. Estimate your ***monthly*** expenditures (in dollars) in the following categories. If your spending patterns during academic year and summer are different, please fill out both. If they are the same, you may leave one of them blank.

	Academic Year	Summer
Durables:		
Vehicles and Parts	$_____	$_____
Furniture and Household Equipment	$_____	$_____
Other Durables	$_____	$_____
Non-durables:		
Food and Beverages	$_____	$_____
Clothing and Shoes	$_____	$_____
Gasoline and Oil	$_____	$_____
Other Non-durables	$_____	$_____
Services:		
Housing	$_____	$_____
Utilities (e.g., electricity, gas, and etc)	$_____	$_____
Transportation	$_____	$_____
Medical Care	$_____	$_____
Other Services	$_____	$_____

18. Indicate your ***monthly*** budget. (This total should equal the sum of all items in 17. If not, explain discrepancy.) $_____

Part IV: Other

19. We are interested in the number of "visitor-days" you hosted last semester. That is the number of visitors you hosted (e.g., parents, relatives, and friends) multiplied by the average length of stay.

Visitors from other counties in North Carolina:

Number of nights spent in your place _____

Number of nights spent in a commercial lodging establishment _____

Visitors from other states:

Number of nights spent in your place _____

Number of nights spent in a commercial lodging establishment _____