DEMONSTRATING THE COLLECTIVE ECONOMIC VALUE OF

NORTH CAROLINA
INDEPENDENT
COLLEGES & UNIVERSITIES

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CONTENTS

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EXECUTIVE SUMMARY

The purpose of this report is to assess the collective impact of the 36 North Carolina independent colleges and universities (NCICU) on the state economy and the benefits generated by the institutions for students, society, and taxpayers. The results of this study show that NCICU's institutions create a positive net impact on the state economy and generate significant benefits for students, society, and taxpayers.

ECONOMIC IMPACT ANALYSIS

In FY 2012-13, payroll and operations spending of the NCICU campuses, together with the spending of their students, visitors, start-up companies, and alumni, created $14.2 billion in added state income to the North Carolina economy. Although we use the term "added state income" to refer to the economic impacts, it is helpful to realize that state income in this context is equivalent to the commonly referred to measure of Gross State Product. The added state income, or additional Gross State Product, of **$14.2 billion** created by NCICU's institutions is equal to approximately **3.2%** of the total Gross State Product of North Carolina, and is equivalent to creating **219,590** new jobs.

To create these economic impacts, North Carolina's independent colleges and universities spent **$4 billion** on payroll and benefits for **66,309** full-time and part-time employees, and spent another **$6.8 billion** on goods and services to carry out their day-to-day operations, research, and clinical activities. This initial round of spending creates more spending across other businesses throughout the state economy, resulting in the commonly referred to multiplier effects. This analysis estimates the net economic impact of NCICU's institutions that directly takes into account the fact that state and local dollars spent on the institutions could have been spent elsewhere in the state if not directed towards the institutions and would have created impacts regardless. We account for this by estimating the impacts that would have been created from the alternative spending and subtracting the alternative impacts from the spending impacts of the NCICU campuses.

The economic impacts of the NCICU institutions break down as follows:

Operations spending impact

Payroll to support day-to-day operations (less research and clinical activities) of NCICU's campuses amounted to **$1.9 billion**. The net impact of the institutions' operations spending in North Carolina during the analysis year was approximately **$3 billion** in added state income, which is equivalent to creating **44,945** new jobs.

Research spending impact

Research activities of NCICU's institutions impact the state economy by employing people and making purchases for equipment, supplies, and services. They also facilitate new

knowledge creation throughout North Carolina through inventions, patent applications, and licenses. In FY 2012-13, the institutions spent **$418.8 million** on payroll to support research activities.

Research spending of NCICU's institutions generated **$1.1 billion** in added state income for the North Carolina economy, which is equivalent to creating **17,334** new jobs.

Clinical spending impact

In FY 2012-13, the NCICU campuses spent **$1.7 billion** on clinical and hospital employees. The total net impact of the operations of the clinics and hospitals associated with NCICU's campuses was **$4.5 billion** in added state income, which is equivalent to creating **62,757** new jobs.

Construction spending impact

NCICU's institutions spent millions of dollars on building or renovating their facilities during the analysis year, generating a short-term infusion of income and jobs in the state economy. The net impact of the institutions' construction spending in FY 2012-13 was **$166.3 million** in added income, equivalent to **5,256** new jobs.

Student spending impact

Around **42%** of graduate and undergraduate students attending the NCICU campuses originated from outside the state. Some of these students relocated to North Carolina and spent money on groceries, transportation, rent, and so on at state businesses.

The expenditures of students who relocated to the state during the analysis year added approximately **$242.7 million** in state income for the North Carolina economy, which is equivalent to creating **4,433** new jobs.

Visitor spending impact

Out-of-state visitors attracted to North Carolina for activities at NCICU's institutions brought new dollars to the economy through their spending at hotels, restaurants, gas stations, and other state businesses. This spending added approximately **$119 million** in state income for the North Carolina economy, which is equivalent to creating **3,041** new jobs.

Business start-up impact

The NCICU campuses create an exceptional environment that fosters innovation and entrepreneurship, evidenced by the number of start-up companies created by the institutions in the state. In FY 2012-13, start-up companies related to NCICU's institutions created **$78.8 million** in added state income for the North Carolina economy, which is equivalent to creating **477** jobs.

NOTE OF IMPORTANCE

There is an important point to consider when reviewing the impacts estimated in this study. Impacts are reported in the form of income rather than output. Output includes all the intermediary costs associated with producing goods and services. Income, on the other hand, is a net measure that excludes these intermediary costs and is synonymous with Gross State Product. For this reason, it is a more meaningful measure of new economic activity than output.

Alumni impact

Over the years, students gained new skills, making them more productive workers, by studying at NCICU's institutions. Today, hundreds of thousands of these former students are employed in North Carolina.

The accumulated contribution of former students currently employed in the North Carolina workforce amounted to **$4.9 billion** in state income added to the North Carolina economy, which is equivalent to creating **81,348** new jobs.

INVESTMENT ANALYSIS

Investment analysis is the practice of comparing the costs and benefits of an investment to determine whether or not it is profitable. This study considers the return on investment generated by North Carolina's private colleges and universities for students and society, and it presents the benefits that accrue to state and local taxpayers in the form of added tax revenue and avoided costs.

Student perspective

Students invest their own money and time in their education. Students enrolled at NCICU's institutions paid a total of **$1.6 billion** to cover the cost of tuition, fees, books, and supplies in FY 2012-13. They also forwent another **$1.6 billion** in earnings that they would have generated had they been working instead of learning. In return, students will receive a present value of **$7.2 billion** in increased earnings over their working lives. This translates to a return of **$2.30** in higher future income for every $1 that students pay for their education at the institutions. The corresponding annual rate of return is **10.3%**.

Societal perspective

As a whole, **$8.9 billion** was spent on education at NCICU campuses in FY 2012-13. This includes **$7.2 billion** in expenses by the institutions, **$94 million** in student expenses, and **$1.6 billion** in student opportunity costs. In return, the state of North Carolina will receive a present value of **$28.8 billion** in added state income over the course of the students' working lives. North Carolina will also benefit from **$3.4 billion** in present value social savings related to reduced crime, lower welfare and unemployment, and increased health and well-being across the state. For every dollar society invests in an education from the NCICU institutions, an average of **$3.60** in benefits will accrue to North Carolina over the course of the students' careers.

Taxpayer perspective

Taxpayers will receive a present value of **$2.8 billion** in added tax revenue stemming from the students' higher lifetime incomes and the increased output of businesses. Savings to the public sector add another **$595.7 million** in benefits due to a reduced demand for government-funded social services in North Carolina.

INTRODUCTION

North Carolina Independent Colleges and Universities (NCICU) supports the individual missions of the state's 36 private non-profit colleges and universities. All of NCICU's campuses have an important impact on the students they serve, helping them achieve their individual potential and develop the skills they need in order to have a fulfilling and prosperous career. However, the impact of the NCICU campuses consists of more than influencing the lives of students. The institutions' program offerings supply employers with workers to make their businesses more productive. The spending of the institutions and their employees, students, and visitors support the state economy through the output and employment generated by state vendors. The benefits created by the institutions extend as far as the state treasury in terms of the increased tax receipts and decreased public sector costs generated by students across the state.

The purpose of this report is to assess the collective impact of North Carolina's independent colleges and universities on the state economy and the benefits generated by the institutions for students, society, and taxpayers. The approach is twofold. We begin with an economic impact analysis that measures the impacts generated by the NCICU institutions on the North Carolina economy. To derive results, we rely on a specialized Social Accounting Matrix (SAM) model to calculate the additional income and jobs created in the North Carolina economy as a result of increased consumer spending, the founding of new companies, and the added knowledge, skills, and abilities of alumni. Results of the economic impact analysis are broken out according to the following impacts:

1. Impact of **operations spending**
2. Impact of **spending on research and development**
3. Impact of **spending on clinical services**
4. Impact of **spending on construction**
5. Impact of **student spending**
6. Impact of **visitor spending**
7. Impact of **start-up companies** (with an additional assessment of spin-off companies)
8. Impact of **alumni** employed in the North Carolina workforce.

The second component of the study measures the benefits generated by NCICU's campuses for the following three groups: students, taxpayers, and society. For students, we perform an investment analysis to determine how the money spent by students on their education performs as an investment over time. The students' investment in this case consists of their out-of-pocket expenses and the opportunity cost of attending the institutions as opposed

to working. In return for these investments, students receive a lifetime of higher incomes. For society, the study assesses how the students' higher incomes and improved quality of life translate to an enlarged economy and a reduced demand for social services across the state. Finally, the study measures the benefits to state and local taxpayers in the form of increased tax revenues and public sector savings.

A wide array of data is used in the study based on several sources, including the 2012-13 IPEDS academic and financial reports from the NCICU institutions, industry and employment data from the U.S. Bureau of Labor Statistics and U.S. Census Bureau, outputs of EMSI's education impact model, outputs of EMSI's SAM model, and a variety of published materials relating education to social behavior.

1 PROFILE OF NORTH CAROLINA'S INDEPENDENT COLLEGES AND UNIVERSITIES AND THE STATE ECONOMY

The study uses two general types of information: 1) employee, finance, and student data collected from NCICU's institutions, and 2) state economic data obtained from various public sources and EMSI's proprietary data modeling tools.[1] This section presents the basic underlying information provided by the institutions for the analysis and presents an overview of the North Carolina economy.

1.1 EMPLOYEE, FINANCE, AND STUDENT DATA FOR THE NCICU INSTITUTIONS

1.1.1 Employee data

Data provided by the NCICU campuses include information on employee counts by place of work and by place of residence. These data appear in Table 1.1. As shown, the institutions employed 57,222 full-time and 9,087 part-time employees in FY 2012-13, including faculty, staff, and graduate assistants working at NCICU's campuses, plus clinical employees working for the Wake Forest Baptist Medical Center and the Duke University Health System. Of all the employees listed in Table 1.1, 99% worked in the state and 98% lived in the state. These data are used to isolate the portion of the employees' payroll and household expenses that remains in the state economy.

TABLE 1.1: EMPLOYEE DATA, FY 2012-13

Full-time faculty and staff	57,222
Part-time faculty and staff	9,087
Total faculty and staff	66,309
% of employees that work in state	99%
% of employees that live in state	98%

Source: Data supplied by the NCICU institutions.

1.1.2 Revenues

Table 1.2 on the next page shows the annual revenues of North Carolina's private colleges and universities by funding source – totaling $12.8 billion in FY 2012-13. These include revenues for general activities as well as for research, development, and clinical operations. As indicated, tuition and fees comprised 11% of total revenue, and revenue from local, state, and federal government comprised another 8%, most of which was in the form of student financial aid. All other revenue comprised the remaining 81%, including revenue from private gifts, grants, and contracts; investment returns; sales and services from educational activities and auxiliary enterprises; and revenue from independent operations. These data are critical

1 Appendix 3 provides a list and description of the primary data sources used in EMSI's modeling tools.

in identifying the annual costs of educating the student population of NCICU's campuses.

1.1.3 Expenses

The combined payroll of NCICU's campuses – including the clinical operations of Duke University and Wake Forest University – amounted to $4 billion. This equaled 37% of the institutions' total expenses in FY 2012-13. Other expenses, including capital depreciation and purchases of supplies and services, made up $6.8 billion. The costs of ongoing construction projects that have not yet been capitalized appear in the institutions' statement of cash flows and are thus not shown in Table 1.3.

1.1.4 Students

In the 2012-13 analysis year, North Carolina's private colleges and universities served 100,962 students taking courses for credit and 964 non-degree seeking students. The breakdown of the credit-bearing student population by gender was 41% male and 59% female; and the breakdown by ethnicity was 55% white, 37% people of color, and 8% unknown. The students' overall average age was 25.[2] An estimated 60% of students remained in North Carolina after finishing their studies at the NCICU institutions, and the remaining 40% settled outside the state.[3]

Table 1.4 on the next page summarizes the breakdown of the student population and their corresponding awards and credits by education level. In FY 2012-13, NCICU's institutions served 1,873 PhD or professional graduates, 4,890 master's degree graduates, 13,718 bachelor's degree graduates, 669 associate's degree graduates, and 170 certificate graduates. Another 79,195 students enrolled in courses for credit but did not complete a degree during the reporting year. Dual credit students (i.e., students dually enrolled in courses for both high school and college credit) comprised another 447 students over the course of the year. The institutions also served 606 personal enrichment students – these students enrolled for purposes of leisure and not necessarily to enhance their careers. Students not allocated to the other categories, including non-degree seeking workforce students, comprised the remaining 358 students.

Credit hour equivalents (CHEs) are used track the educational workload of the students and are equal in value to one credit,

2 The 12-month enrollment, gender, ethnicity, and age data were provided by the NCICU campuses.

3 Student settlement data were provided by the NCICU campuses. In the event that data were unavailable, EMSI used estimates based on student origin.

TABLE 1.2: REVENUE BY SOURCE, FY 2012-13

FUNDING SOURCE	TOTAL	% OF TOTAL
Tuition and fees	$1,458,491,708	11%
Local government	$5,000	<1%
State government	$250,667,554	2%
Federal government	$762,215,969	6%
All other revenue	$10,311,577,707	81%
Total revenues	$12,782,957,938	100%

Source: Data supplied by the NCICU institutions.

TABLE 1.3: EXPENSES BY TYPE OF COST, FY 2012-13

EXPENSE ITEM	TOTAL	%
Salaries, wages, and benefits	$4,018,965,565	37%
Capital depreciation	$1,211,595,341	11%
All other expenses	$5,605,179,094	52%
Total expenses	$10,835,740,000	100%

Source: Data supplied by the NCICU institutions.

TABLE 1.4: BREAKDOWN OF STUDENT HEADCOUNT AND CHE PRODUCTION BY EDUCATION LEVEL, FY 2012-13

CATEGORY	HEADCOUNT	TOTAL CHES	AVERAGE CHES
DEGREE-SEEKING STUDENTS			
PhD or professional graduates	1,873	38,626	20.6
Master's degree graduates	4,890	81,713	16.7
Bachelor's degree graduates	13,718	334,481	24.4
Associate's degree graduates	669	12,764	19.1
Certificate graduates	170	2,306	13.6
Credit-bearing students not yet graduated	79,195	1,804,211	22.8
Dual credit students	447	6,761	15.1
Total, degree-seeking students	100,962	2,280,862	22.6
NON-DEGREE SEEKING STUDENTS			
Personal enrichment students	606	305	0.5
Workforce and all other students	358	466	1.3
Total, non-degree seeking students	**964**	**771**	**0.8**
TOTAL, ALL STUDENTS	101,926	2,281,633	22.4
TOTAL, LESS PERSONAL ENRICHMENT STUDENTS	101,320	2,281,328	22.5

Source: Data supplied by the NCICU institutions.

or 15 contact hours of classroom instruction per semester. Altogether, students at North Carolina's private colleges and universities completed 2.3 million CHEs in FY 2012-13 (this value excludes the CHE production of personal enrichment students because their educational activities do not translate to higher earnings in the workplace). The average number of CHEs per student excluding personal enrichment students was 22.5.

1.2 THE NORTH CAROLINA ECONOMY

Table 1.5 on the following page summarizes the breakdown of the state economy by major industrial sector, with details on labor and non-labor income. Labor income refers to wages, salaries, and proprietors' income. Non-labor income refers to profits, rents, and other forms of investment income. Together, labor and non-labor income comprise the state's total Gross State Product (GSP).

As shown in Table 1.5, total income in North Carolina is approximately $436.4 billion, equal to the sum of labor income ($243.4 billion) and non-labor income ($193 billion). In Section 2, we use total income as the backdrop against which we measure the relative impacts of the institutions on the state economy.

Table 1.6 provides the breakdown of jobs by industry in North Carolina. Among the state's non-government industry sectors, the Retail Trade sector is the largest employer, supporting 547,329 jobs or 10.2% of total employment in the state. The second largest employer is the Health Care and Social Assistance sector, sup-

TABLE 1.5: LABOR AND NON-LABOR INCOME BY MAJOR INDUSTRY SECTOR IN NORTH CAROLINA, 2014*†

INDUSTRY SECTOR	LABOR INCOME (MILLIONS)	+	NON-LABOR INCOME (MILLIONS)	=	TOTAL INCOME (MILLIONS)	OR	% OF TOTAL
Agriculture, Forestry, Fishing, and Hunting	$2,362		$1,550		$3,912		0.9%
Mining	$336		$657		$993		0.2%
Utilities	$1,415		$5,135		$6,551		1.5%
Construction	$11,680		$1,057		$12,738		2.9%
Manufacturing	$29,965		$38,734		$68,699		15.7%
Wholesale Trade	$13,161		$12,106		$25,268		5.8%
Retail Trade	$14,987		$10,633		$25,620		5.9%
Transportation and Warehousing	$6,539		$3,343		$9,882		2.3%
Information	$6,081		$9,836		$15,917		3.6%
Finance and Insurance	$17,197		$21,193		$38,389		8.8%
Real Estate and Rental and Leasing	$5,992		$22,764		$28,756		6.6%
Professional and Technical Services	$18,954		$5,948		$24,902		5.7%
Management of Companies and Enterprises	$8,915		$2,014		$10,928		2.5%
Administrative and Waste Services	$10,958		$2,506		$13,464		3.1%
Educational Services	$4,410		$585		$4,995		1.1%
Health Care and Social Assistance	$25,610		$3,018		$28,629		6.6%
Arts, Entertainment, & Recreation	$2,825		$1,394		$4,219		1.0%
Accommodation and Food Services	$6,846		$4,658		$11,504		2.6%
Other Services (except Public Administration)	$6,793		$971		$7,764		1.8%
Public Administration	$48,353		$14,073		$62,426		14.3%
Other Non-industries	$0		$30,834		$30,834		7.1%
Total	$243,381		$193,010		$436,391		100.0%

** Data reflect the most recent year for which data are available. EMSI data are updated quarterly.*
† Numbers may not add due to rounding.
Source: EMSI.

TABLE 1.6: JOBS BY MAJOR INDUSTRY SECTOR IN NORTH CAROLINA, 2013*†

INDUSTRY SECTOR	TOTAL JOBS	% OF TOTAL
Agriculture, Forestry, Fishing, and Hunting	86,247	1.6%
Mining	7,356	0.1%
Utilities	12,970	0.2%
Construction	291,463	5.4%
Manufacturing	459,970	8.6%
Wholesale Trade	189,273	3.5%
Retail Trade	547,329	10.2%
Transportation and Warehousing	144,722	2.7%
Information	86,106	1.6%
Finance and Insurance	248,656	4.6%
Real Estate and Rental and Leasing	229,992	4.3%
Professional and Technical Services	306,383	5.7%
Management of Companies and Enterprises	83,229	1.6%
Administrative and Waste Services	367,979	6.9%
Educational Services	118,726	2.2%
Health Care and Social Assistance	537,510	10.0%
Arts, Entertainment, and Recreation	112,271	2.1%
Accommodation and Food Services	380,939	7.1%
Other Services (except Public Administration)	301,605	5.6%
Public Administration	852,696	15.9%
Total	5,365,424	100.0%

** Data reflect the most recent year for which data are available. EMSI data are updated quarterly.*
† Numbers may not add due to rounding.
Source: EMSI complete employment data.

porting 537,510 jobs or 10.0% of the state's total employment. Altogether, the state supports 5.4 million jobs.[4]

Table 1.7 presents the mean income by education level in North Carolina at the midpoint of the average-aged worker's career. These numbers are derived from EMSI's complete employment data on average income per worker in the state.[5] As shown, students have the potential to earn more as they achieve higher levels of education compared to maintaining a high school diploma. Students who achieve a bachelor's degree can expect $54,200 in income per year, approximately $25,700 more than someone with a high school diploma.

4 Job numbers reflect EMSI's complete employment data, which includes the following four job classes: 1) employees that are counted in the Bureau of Labor Statistics' Quarterly Census of Employment and Wages (QCEW), 2) employees that are not covered by the federal or state unemployment insurance (UI) system and are thus excluded from QCEW, 3) self-employed workers, and 4) extended proprietors.

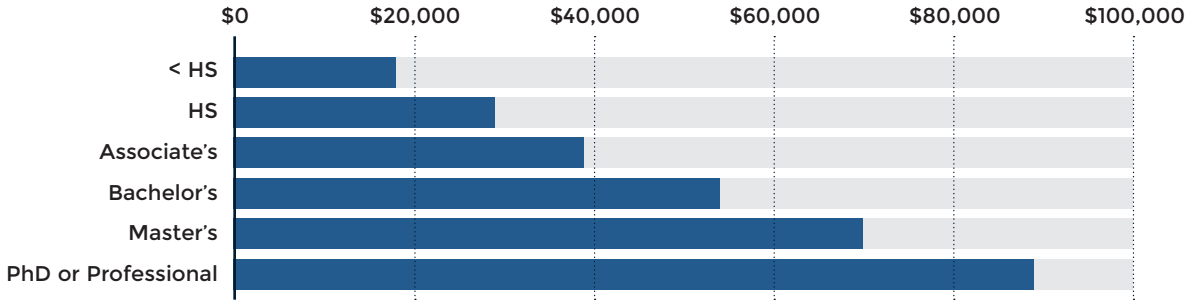
5 Wage rates in the EMSI SAM model combine state and federal sources to provide earnings that reflect complete employment in the state, including proprietors, self-employed workers, and others not typically included in state data, as well as benefits and all forms of employer contributions. As such, EMSI industry earnings-per-worker numbers are generally higher than those reported by other sources.

TABLE 1.7: EXPECTED INCOME IN NORTH CAROLINA AT THE MIDPOINT OF AN INDIVIDUAL'S WORKING CAREER BY EDUCATION LEVEL

EDUCATION LEVEL	INCOME	DIFFERENCE FROM NEXT LOWEST DEGREE	DIFFERENCE FROM HIGH SCHOOL DIPLOMA
Less than high school	$17,900	n/a	n/a
High school or equivalent	$28,500	$10,600	n/a
Associate's degree	$39,300	$10,800	$10,800
Bachelor's degree	$54,200	$14,900	$25,700
Master's degree	$70,300	$16,100	$41,800
PhD or Professional	$88,800	$18,500	$60,300

Source: EMSI complete employment data.

FIGURE 1.1: EXPECTED INCOME BY EDUCATION LEVEL AT CAREER MIDPOINT



2 ECONOMIC IMPACTS ON THE NORTH CAROLINA ECONOMY

The North Carolina economy is impacted by the NCICU institutions in a variety of ways. The institutions are employers and buyers of goods and services. They attract monies that would not otherwise have entered the state economy through their day-to-day operations, their research and clinical activities, and the expenditures of their out-of-state students and visitors. Further, they foster the development of new start-up companies and provide students with the knowledge, skills, and abilities they need to become productive citizens and contribute to the overall output of the state.

This section presents the total economic impact of North Carolina's private colleges and universities broken out according to the following categories:

1. Impact of **operations spending**
2. Impact of **spending on research and development**
3. Impact of **spending on clinical services**
4. Impact of **spending on construction**
5. Impact of **student spending**
6. Impact of **visitor spending**
7. Impact of **start-up companies** (with an additional assessment of spin-off companies)
8. Impact of **alumni** employed in the North Carolina workforce.

Economic impact analyses use different types of impact measures when reporting results. Frequently used is the sales impact, which comprises the change in business sales revenue in the economy as a result of increased economic activity. However, much of this sales revenue leaves the economy and overstates actual impacts. A more conservative measure – and the one employed in this study – is the income impact, which assesses the change in Gross State Product, or GSP. Income may be further broken out into the labor income impact, which assesses the change in employee compensation; and the non-labor income impact, which assesses the change in business profits. Another way to state the income impact is job equivalents, a measure of the number of full- and part-time jobs that would be required to support the change in income. All of these measures – job equivalents and income with labor and non-labor income detail – are used to estimate the economic impact results presented in this section.

The analysis breaks out the impact measures into different components, each based on the economic effect that caused the impact. The following is a list of each type of effect presented in this analysis:

1. The **initial effect** is the economic event caused by the initial spending of money, whether to pay for salaries and wages, purchase goods or services, or cover operating expenses.

2. The initial round of spending creates more spending in the economy, resulting in what is commonly known as the **multiplier effect**. The multiplier effect comprises the additional activity that occurs across all industries in the economy and may be further decomposed into the following three types of effects:

    - The **direct effect** refers to the additional economic activity that occurs as the industries affected by the initial effect spend money to purchase goods and services from their supply chain industries.

    - The **indirect effect** occurs as the supply chain of the initial industries creates even more activity in the economy through their own inter-industry spending.

    - The **induced effect** refers to the economic activity created by the household sector as the businesses affected by the initial, direct, and indirect effects raise salaries or hire more people.

The terminology used to describe the economic effects listed above differs slightly from that of other commonly used input-output models, such as IMPLAN. For example, the initial effect in this study is called the "direct effect" by IMPLAN, as shown in the table below. Further, the term "indirect effect" as used by IMPLAN refers to the combined direct and indirect effects defined in this study. To avoid confusion, readers are encouraged to interpret the results presented in this section in the context of the terms and definitions listed above. Note that, regardless of the effects used to break down the results, the total impact measures are analogous.

EMSI	Initial	Direct	Indirect	Induced
IMPLAN	Direct	Indirect		Induced

Multiplier effects in this analysis are derived using EMSI's Social Accounting Matrix (SAM) input-output model that captures the interconnection of industries, government, and households in the state. The EMSI SAM contains approximately 1,100 industry sectors at the highest level of detail available in the North American Industry Classification System (NAICS) and supplies the industry-specific multipliers required to determine the impacts associated with increased activity within a given economy. For more information on the EMSI SAM model and its data sources, see Appendix 3.

2.1 OPERATIONS SPENDING IMPACT

Faculty and staff payroll is part of the state's overall income, and the spending of employees for groceries, apparel, and other household spending helps support state businesses. The institutions themselves purchase supplies and services, and many of their vendors are located in North Carolina. These expenses create a ripple effect that generates still more jobs and income throughout the economy.

Table 2.1 on the following page presents the expenses of NCICU's institutions in FY 2012-13 by type of cost, less expenses for research

TABLE 2.1: EXPENSES BY TYPE OF COST OF NCICU'S INSTITUTIONS (LESS RESEARCH AND CLINICAL ACTIVITIES), FY 2012-13

TYPE OF COST	TOTAL EXPENSES (THOUSANDS)	IN-STATE EXPENSES (THOUSANDS)	OUT-OF-STATE EXPENSES (THOUSANDS)
Salaries, wages, and benefits	$1,892,330	$870,214	$1,022,116
Capital depreciation	$1,017,482	$727,679	$289,804
All other expenses	$3,089,578	$1,734,718	$1,354,861
Total	$5,999,391	$3,332,611	$2,666,781

Source: Data supplied the NCICU institutions and the EMSI impact model.

and clinical activities (the impacts of these expenses are described and assessed separately in the following subsections). Three main categories appear in the table: 1) salaries, wages, and benefits, 2) capital depreciation, and 3) all other expenses, including purchases for supplies and services.

The first step in estimating the impact of the expenses shown in Table 2.1 is to map them to the approximately 1,100 industries of the EMSI SAM model. Assuming that the spending patterns of the institutions' personnel approximately match those of the average consumer, we map salaries, wages, and benefits to spending on industry outputs using national household expenditure coefficients supplied by EMSI's national SAM. Approximately 98% of the people working at NCICU's campuses live in North Carolina (see Table 1.1), and therefore we consider only 98% of the salaries, wages, and benefits. For the other two expense categories (i.e., capital depreciation and all other expenses), we assume the institutions' spending patterns approximately match national averages and apply the national spending coefficients for NAICS 611310 (Colleges, Universities, and Professional Schools). Capital depreciation is mapped to the construction sectors of NAICS 611310 and the institutions' remaining expenses to the non-construction sectors of NAICS 611310.

We now have three expense vectors for NCICU's institutions: one for salaries, wages, and benefits; another for capital depreciation; and a third for the institutions' purchases of supplies and services. The next step is to estimate the portion of these expenses that occurs inside the state (those that occur outside the state are known as leakages). We estimate in-state expenses using regional purchase coefficients (RPCs), a measure of the overall demand for the commodities produced by each industry sector that is satisfied by state suppliers, for each of the approximately 1,100 industries in the SAM model.[6] For example, if 40% of the demand for NAICS 541211 (Offices of Certified Public Accountants) is satisfied by state suppliers, the RPC for that industry is 40%. The remaining 60% of the demand for NAICS 541211 is provided by suppliers located outside the state. The three vectors of expenses are multiplied, industry by industry, by the corresponding RPC to arrive at the in-state expenses associated with the institutions (see the column labeled "In-state expenses" in Table 2.1). Finally, in-state spending is entered, indus-

6 See Appendix 3 for a description of EMSI's SAM model.

TABLE 2.2: IMPACT OF THE OPERATIONS SPENDING OF NCICU'S INSTITUTIONS, FY 2012-13

	LABOR INCOME (THOUSANDS)	+	NON-LABOR INCOME (THOUSANDS)	=	TOTAL ADDED INCOME (THOUSANDS)	OR	JOB EQUIVALENTS
INITIAL EFFECT	$1,866,652		$0		$1,866,652		32,654
MULTIPLIER EFFECT							
Direct effect	$805,069		$849,200		$1,654,269		21,070
Indirect effect	$204,003		$161,985		$365,987		5,210
Induced effect	$1,069,169		$1,102,914		$2,172,083		28,864
Total multiplier effect	$2,078,241		$2,114,099		$4,192,340		55,145
GROSS IMPACT (INITIAL + MULTIPLIER)	**$3,944,892**		**$2,114,099**		**$6,058,991**		**87,799**
Less alternative uses of funds	-$1,533,194		-$1,509,480		-$3,042,674		-42,854
NET IMPACT	**$2,411,699**		**$604,619**		**$3,016,317**		**44,945**

Source: EMSI impact model.

try by industry, into the SAM model's multiplier matrix, which in turn provides an estimate of the associated multiplier effects on state labor income, non-labor income, total income, and job equivalents.

Table 2.2 presents the economic impact of the NCICU institutions' operations. The people employed by the institutions and their salaries, wages, and benefits (excluding research and clinical activities) comprise the initial effect, shown in the top row in terms of labor income, non-labor income, total income, and job equivalents. Note that these values do not include the income and jobs impact of people employed outside the state. Additional impacts created by the initial effect appear in the next four rows under the heading "Multiplier effect." Summing initial and multiplier effects, the gross impacts are $3.9 billion in labor income and $2.1 billion in non-labor income. This comes to a total impact of $6.1 billion, equivalent to 87,799 jobs, associated with the spending of the institutions and their employees in the state.

The $6.1 billion in total gross income is often reported by other researchers as an impact. We go a step further to arrive at a net impact by applying a counterfactual scenario; i.e., what has not happened but what would have happened if a given event – in this case, the expenditure of in-state funds on the NCICU campuses – had not occurred. The institutions received an estimated 60.2% of their funding from sources within North Carolina. These monies came from the tuition and fees paid by resident students, from the auxiliary revenue and donations from private sources located within the state, and from the financial aid issued to students by state and local government. We must account for the opportunity cost of this in-state funding. Had other industries received these monies rather than the NCICU campuses, income impacts would have still been created in the economy. In economic analysis, impacts that occur under counterfactual conditions are used to offset the impacts that actually occur in order to derive the true impact of the event under analysis.

We estimate this counterfactual by simulat-

TABLE 2.3: RESEARCH EXPENSES BY TYPE OF COST OF NCICU'S INSTITUTIONS, FY 2009-10 TO 2012-13

FISCAL YEAR	PAYROLL (THOUSANDS)	EQUIPMENT (THOUSANDS)	CONSTRUCTION (THOUSANDS)	OTHER (THOUSANDS)	TOTAL (THOUSANDS)
2012-13	$418,770	$11,218	$209,772	$581,022	$1,220,782
2011-12	$429,854	$18,923	$212,363	$576,799	$1,237,939
2010-11	$386,974	$16,626	$191,702	$587,074	$1,182,375
2009-10	$337	$117	$0	$374	$827

Source: Data supplied by the NCICU institutions.

ing a scenario where in-state monies spent on the institutions are instead spent on consumer goods and savings. This simulates the in-state monies being returned to students, donors, and taxpayers and being spent instead by the household sector. Our approach is to establish the total amount spent by in-state funding sources on the NCICU institutions, map this to the detailed industries of the SAM model using national household expenditure coefficients, use the industry RPCs to estimate in-state spending, and run the in-state spending through the SAM model's multiplier matrix to derive multiplier effects. The results of this exercise are shown as negative values in the row labeled "Less alternative uses of funds" in Table 2.2.

The total net impacts of the institutions' operations are equal to the total gross impacts less the impact of the alternative uses of funds – the opportunity cost of the state and local money. As shown in the last row of Table 2.2, the net impact is approximately $2.4 billion in labor income and $604.6 million in non-labor income. This totals $3 billion and is equivalent to 44,945 jobs. These impacts represent new economic activity created in the state economy solely attributable to the operations of North Carolina's private colleges and universities.

2.2 RESEARCH SPENDING IMPACT

Similar to the day-to-day operations of the NCICU campuses, research activities impact the economy by employing people and requiring the purchase of equipment and other supplies and services. Table 2.3 shows the research expenses of NCICU's campuses by type of cost – payroll, equipment, construction, and other – for the last four fiscal years. In FY 2012-13, the campuses spent over $1.2 billion on research and development activities. These expenses would not have been possible without funding from outside the state. The campuses received around 63% of their research funding from federal sources in FY 2012-13, monies that would not otherwise have entered the state economy but for the research activities of the institutions.

The methodology employed to calculate impacts is similar to the one used to estimate the impacts of operational expenses. We begin by mapping total research expenses to the industries of the SAM model, removing the spending that occurs outside the state, and then running the in-state expenses through the multiplier matrix. As with the operations spending impact, we also adjust the gross impacts to account for the opportunity cost

TABLE 2.4: IMPACT OF THE RESEARCH ACTIVITIES OF NCICU'S INSTITUTIONS, FY 2012-13

	LABOR INCOME (THOUSANDS)	+	NON-LABOR INCOME (THOUSANDS)	=	TOTAL ADDED INCOME (THOUSANDS)	OR	JOB EQUIVALENTS
INITIAL EFFECT	$413,087		$0		$413,087		7,227
MULTIPLIER EFFECT							
Direct effect	$188,254		$144,963		$333,217		4,796
Indirect effect	$45,194		$34,511		$79,706		1,118
Induced effect	$261,166		$216,200		$477,366		6,842
Total multiplier effect	$494,614		$395,674		$890,288		12,757
GROSS IMPACT (INITIAL + MULTIPLIER)	$907,701		$395,674		$1,303,375		19,984
Less alternative uses of funds	-$94,805		-$93,338		-$188,143		-2,650
NET IMPACT	$812,896		$302,336		$1,115,232		17,334

Source: EMSI impact model.

of monies withdrawn from the state and local economy to support the research of the NCICU institutions, whether through state-sponsored research awards or through private donations. Again, we refer to this adjustment as the alternative use of funds.

Mapping the research expenses by category to the industries of the SAM model – the only difference from our previous methodology – requires some exposition. The National Science Foundation's Higher Education Research and Development Survey (HERD) is completed annually by universities that spend in excess of $150,000 on research and development. Table 67 in the 2012 HERD lists each institution's research expenses by field of study.[7] We map these fields of study to their respective industries in the SAM model. This implicitly assumes researchers at NCICU's campuses have similar spending patterns to private sector researchers in similar fields. The result is a distribution of research expenses to the various 1,100 industries following a weighted average of the fields of study reported in the HERD survey. This assumption serves as our best estimate of the distribution of research expenses across the various industries without individually surveying researchers at the campuses.

Initial, direct, indirect, and induced effects of the NCICU campuses' research expenses appear in Table 2.4. As with the operations spending impact, the initial effect consists of the 7,227 jobs supported by the institutions' research activities and the associated salaries, wages, and benefits of those jobs (less any jobs and payroll that occur outside the state). The institutions' research expenses have a total gross impact of $907.7 million in labor income and $395.7 million in non-labor income. This totals $1.3 billion in overall income, equivalent to 19,984 jobs. Taking into account the impact of the alternative uses of funds, the net

7 The fields include environmental sciences, life sciences, math and computer sciences, physical sciences, psychology, social sciences, sciences not elsewhere classified, engineering, and all non-science and engineering fields.

TABLE 2.5: INVENTION DISCLOSURES, PATENT APPLICATIONS, LICENSES, AND LICENSE INCOME OF NCICU'S INSTITUTIONS

FISCAL YEAR	INVENTION DISCLOSURES RECEIVED	PATENT APPLICATIONS FILED	LICENSES AND OPTIONS EXECUTED	LICENSE INCOME RECEIVED
2012-13	102	36	22	$2,206,265
2011-12	68	44	23	$363,949
2010-11	70	51	25	$45,733,291
2009-10	72	40	16	$85,991,743
Total	312	171	86	$134,295,248

Source: Data supplied by the NCICU institutions.

research spending impacts of NCICU's institutions are $812.9 million in labor income and $302.3 million in non-labor income, totaling $1.1 billion and equivalent to 17,334 jobs.

Research and innovation play an important role in driving the North Carolina economy. Some indicators of innovation are the number of invention disclosures, patent applications, and licenses and options executed by the campuses as a result of their research activities. Over the last four years, North Carolina's private colleges and universities collectively received 312 invention disclosures, filed 171 new US patent applications, and produced 86 licenses (see Table 2.5). Total license income also appears in the table and amounted to $2.2 million in FY 2012-13. Without the research activities of NCICU's campuses, this level of innovation and sustained economic growth would not have been possible.

2.3 CLINICAL SPENDING IMPACT

In this section we estimate the economic impact of the clinical operations affiliated with two of NCICU's largest campuses, Wake Forest University and Duke University. Wake Forest Baptist Medical Center (including Wake Forest's affiliated hospitals North Carolina Baptist Hospital, Lexington Memorial Hospital, and Davie Medical Center) is Wake Forest's clinical enterprise and employs more than 13,000 people. Duke University's health care system includes three hospitals – Duke University Hospital, Duke Regional Hospital, and Duke Raleigh Hospital – as well as primary care and home hospice care. In FY 2012-13, Wake Forest University and Duke University spent $3.6 billion to support the operations of their hospitals and care centers (see Table 2.6 on the next page).

The methodology used here is similar to that used when estimating the impact of operations spending. Salaries, wages, and benefits are mapped to industries using national household expenditure coefficients. Assuming the hospitals and care centers affiliated with Wake Forest University and Duke University have a spending pattern similar to that of average general and surgical hospitals in North Carolina, we map their capital depreciation and other expenses to the industries of the SAM model using general and surgical hospital spending coefficients. Next, we remove the spending that occurs outside the state and run the in-state expenses through the multiplier matrix. Note

TABLE 2.6: CLINICAL EXPENSES BY TYPE OF COST OF NCICU'S INSTITUTIONS, FY 2012-13

TYPE OF COST	TOTAL EXPENSES (THOUSANDS)	IN-STATE EXPENSES (THOUSANDS)	OUT-OF-STATE EXPENSES (THOUSANDS)
Salaries, wages and benefits	$1,707,865	$793,578	$914,288
Capital depreciation	$194,113	$142,181	$51,932
All other expenses	$1,713,589	$1,186,479	$527,109
Total	$3,615,567	$2,122,238	$1,493,329

Source: Data supplied by the NCICU institutions.

TABLE 2.7: IMPACT OF THE CLINICAL EXPENSES OF NCICU'S INSTITUTIONS, FY 2012-13

	LABOR INCOME (THOUSANDS)	+	NON-LABOR INCOME (THOUSANDS)	=	TOTAL ADDED INCOME (THOUSANDS)	OR	JOB EQUIVALENTS
INITIAL EFFECT	$1,707,865		$0		$1,707,865		25,880
MULTIPLIER EFFECT							
Direct effect	$461,623		$458,146		$919,769		11,861
Indirect effect	$117,612		$100,143		$217,755		2,862
Induced effect	$822,823		$798,209		$1,621,032		22,155
Total multiplier effect	$1,402,058		$1,356,498		$2,758,556		36,877
TOTAL IMPACT (INITIAL + MULTIPLIER)	$3,109,924		$1,356,498		$4,466,422		62,757

Source: EMSI impact model.

that, to avoid double counting, the impact of medical research expenses are not reported here but rather in the research spending impact discussed in the previous subsection. All impacts of clinical spending were excluded from the operations spending impact.

Table 2.7 presents the impacts. The payroll and number of people employed by the clinics and hospitals affiliated with Wake Forest University and Duke University comprise the initial effect. The total impacts of clinical expenses (the sum of the initial and multiplier effects) are $3.1 billion in added labor income and $1.4 billion in non-labor income, totaling $4.5 billion or 62,757 job equivalents. These impacts, while substantial, do not reflect the broader health-related impacts of the healthcare provided through the hospitals and care centers, most notably the added productivity in the workforce related to reduced mortality and improved health. These impacts are beyond the scope of this analysis and are thus not included.

2.4 CONSTRUCTION SPENDING IMPACT

During the analysis year, NCICU's campuses spent $483.4 million on various construction projects, whether to build new structures or to make permanent improvements or renovations to their existing facilities. Due to the one-time nature of construction projects, the costs associated with ongoing construction vary widely from year to year and are typically reported on the institutions' statement of cash flows rather than on their expense form. For this reason, construction spending is excluded from the expense data reported in Table 1.3, and the jobs and income generated by the institutions' construction spending are not reflected in the impact measures presented in the previous sections.

To calculate the impact of construction, the model distributes the $483.4 million spent by the institutions across the construction sectors of the national spending vector for NAICS 611310 (Colleges, Universities, and Professional Schools), the same spending vector used in distributing the institutions' other non-payroll spending across the detailed industries of the SAM model. The assumption in this case is that the institutions' construction spending approximately matches the spending patterns of other colleges and universities across the nation. Once the institutions' construction spending has been allocated to the industries of the SAM model, we use the RPCs to remove the portion that occurs outside the state. We then run the in-state spending through the SAM's multiplier matrix to estimate the multiplier effects and convert all values from sales to income and jobs using the ratios provided by the SAM. Note that, in converting initial and multiplier effects from sales to income and jobs, the initial effect becomes zero, under the assumption that no new income or jobs are created at the institutions themselves during the construction phase of their ongoing projects; all new jobs and income are assumed to occur under the multiplier effect, in the industries affected by the spending of the institutions' contractors

TABLE 2.8: IMPACT OF CONSTRUCTION SPENDING OF NCICU'S INSTITUTIONS, FY 2012-13

	LABOR INCOME (THOUSANDS)	+	NON-LABOR INCOME (THOUSANDS)	=	TOTAL ADDED INCOME (THOUSANDS)	OR	JOB EQUIVALENTS
INITIAL EFFECT	$0		$0		$0		0
MULTIPLIER EFFECT							
Direct effect	$163,397		$14,795		$178,192		4,064
Indirect effect	$44,250		$4,007		$48,256		1,095
Induced effect	$99,660		$9,024		$108,684		2,475
GROSS IMPACT (INITIAL + MULTIPLIER)	$307,306		$27,826		$335,132		7,634
Less alternative uses of funds	-$85,076		-$83,760		-$168,835		-2,378
NET IMPACT	$222,230		-$55,934		$166,296		5,256

Source: EMSI impact model.

and their suppliers. The sum of all initial and multiplier effects appears in Table 2.8, in the row labeled "Gross impact."

The final step of the process calls for further discussion. As with the impact of operations and research spending, the impact of alternative fund uses is removed in order to determine the net impact that occurs above and beyond what would have been generated in the economy anyway. This step is done by simulating a scenario where the in-state monies spent on construction are spent instead on consumer goods and services. What sets this step apart from the other impact measures is that the non-labor income impact generated by the alternative fund uses is actually greater than the non-labor income impact generated by the construction spending, resulting in a non-labor income impact of -$55.9 million. This phenomenon, while counterintuitive, is readily explained by the fact that the construction industry is highly labor-intensive and tends to generate lower amounts of non-labor income than other industries do. In the counterfactual scenario where the amount spent on construction is spent instead on industries that generate higher amounts of non-labor income, the estimated non-labor income impact generated under the counterfactual scenario is higher than the non-labor impact of the construction, leading to a negative non-labor income impact overall.

Despite the negative non-labor income impact, the total net impact is still positive, as shown in the bottom row of Table 2.8. Total added income comes to $166.3 million, the equivalent of creating 5,256 new jobs in the state. These impacts are considered short-term because the institutions' ongoing construction projects are short-term as well and unlikely to continue beyond a few years. In contrast, the impact measures presented in the previous sections are likely to persist year over year, as long as the institutions maintain their operations, research, and clinical activities at a level comparable to where they were during the analysis year.

2.5 STUDENT SPENDING IMPACT

An estimated 16,583 students attending NCICU's institutions in FY 2012-13 came from outside the state and lived off campus. These students spent money at state businesses for housing, food, clothing, entertainment, transportation, and so on. Another estimated 24,943 students came from outside the state and lived on campus. These students spent money at state businesses as well, although to a lesser degree because a portion of their expenditures for housing and food went directly to the NCICU campuses. Collectively, the off-campus expenditures of out-of-state students supported jobs and created new income in the state economy.[8]

The average off-campus costs of out-of-state students appear in the first section of Table 2.9 on the next page, equal to $10,637 per student. Note that this figure excludes expenses for books and supplies, since many of these monies are already reflected in the operations impact discussed in the previous section. We multiply the $10,637 in annual costs by the number of students who lived in the state but off-campus while attending (16,583 students) to estimate their total spending. For students living on campus, we multiply the per-student cost of personal expenses, transportation, and off-campus food purchases (assumed to be equal

8 Online students and students who commuted to North Carolina from outside the state are not considered in this calculation because their living expenses predominantly occurred in the state where they resided during the analysis year.

to 25% of room and board) by the number of students who lived in the state but on-campus while attending (24,943 students). Altogether, off-campus student spending generated gross sales of $295.2 million. This figure, once net of the monies paid to student workers, yields net off-campus sales of $282.6 million, as shown in the bottom row of the Table 2.9.

Estimating the impacts generated by the $282.6 million in student spending follows a procedure similar to that of the operations impact described above. We distribute the $282.6 million in sales to the industry sectors of the SAM model, apply RPCs to reflect in-state spending only, and run the net sales figures through the SAM model to derive multiplier effects.

Table 2.10 presents the results. As with the construction spending impact, the initial effect is purely sales-oriented and there is no change in labor or non-labor income. The impact of out-of-state student spending thus falls entirely under the multiplier effect. The total impact of out-of-state student spending is $114.3 million in labor income and $128.5

TABLE 2.9: AVERAGE STUDENT COSTS AND TOTAL SALES GENERATED BY OUT-OF-STATE STUDENTS IN NORTH CAROLINA, FY 2012-13

Room and board	$7,831
Personal expenses	$1,743
Transportation	$1,063
Total expenses per student	$10,637
Number of students who lived in the state off-campus	16,583
Number of students who lived in the state on-campus	24,943
Gross sales	$295,202,782
Wages and salaries paid to student workers*	$12,593,863
Net off-campus sales	$282,608,919

** This figure reflects only the portion of payroll that was used to cover the living expenses of non-resident student workers who lived in the state.*

Source: Student costs supplied by the NCICU institutions. The number of out-of-state students who lived in the state while attending is derived from the student origin data and in-term residence data supplied by the institutions. The data are based on all students.

TABLE 2.10: IMPACT OF THE SPENDING OF OUT-OF-STATE STUDENTS ATTENDING NCICU'S INSTITUTIONS, FY 2012-13

	LABOR INCOME (THOUSANDS)	+	NON-LABOR INCOME (THOUSANDS)	=	TOTAL ADDED INCOME (THOUSANDS)	OR	JOB EQUIVALENTS
INITIAL EFFECT	$0		$0		$0		0
MULTIPLIER EFFECT							
Direct effect	$60,134		$68,434		$128,568		2,385
Indirect effect	$14,042		$14,318		$28,360		546
Induced effect	$40,085		$45,723		$85,808		1,502
TOTAL MULTIPLIER EFFECT	$114,261		$128,475		$242,736		4,433
TOTAL IMPACT (INITIAL + MULTIPLIER)	$114,261		$128,475		$242,736		4,433

Source: EMSI impact model.

million in non-labor income, equal to $242.7 million in total income, or 4,433 jobs. These values represent the direct effects created at the businesses patronized by the students, the indirect effects created by the supply chain of those businesses, and the effects of the increased spending of the household sector throughout the state economy as a result of the direct and indirect effects.

It is important to note that students from the state also spend money while attending the NCICU institutions. However, had they chosen not to attend, they would have spent a similar amount of money on their living expenses anyway. For that reason, their expenditures do not introduce new monies into the North Carolina economy and are thus not considered here. We make no inference regarding the number of students that would have left the state had they not attended one of NCICU's institutions. Had the impact of these students been included, the results presented in Table 2.10 would have been much greater.

2.6 VISITOR SPENDING IMPACT

In addition to out-of-state students, thousands of visitors came to the NCICU campuses to participate in various activities, including commencement, sports events, and orientation. While some of the campuses were able to provide the number of out-of-state visitors, others were not. For those unable to provide out-of-state visitor information, we made the conservative assumption that each out-of-state student received two visitors throughout FY 2012-13. Combining the information provided by the institutions with our estimates, approximately 491,651 out-of-state visitors attended events hosted by the NCICU campuses in FY 2012-13.

TABLE 2.11: AVERAGE COSTS PER VISITOR AND SALES GENERATED BY OUT-OF-STATE VISITORS IN NORTH CAROLINA, FY 2012-13

Accommodation	$67
Food	$126
Entertainment and shopping	$74
Transportation	$116
Total expenses per visitor	$383
Number of out-of-state visitors	491,651
Gross sales	$188,232,061
On-campus sales (excluding textbooks)	$33,244,966
Net off-campus sales	$154,987,095

Source: Based on data supplied by TNS Travels America and the US Travel Association, "Fast Facts: 2013 Impact of Visitor Spending," 2014 and North Carolina Department of Commerce, "2013 North Carolina Visitor Profile," North Carolina Division of Tourism, Film and Sports Development, June 2014. Sales calculations by EMSI estimated based on data provided by the NCICU institutions.

Table 2.11 presents the average expenditures per visitor for accommodation, food, transportation, and other personal expenses. These figures were reported in a 2013 study conducted for the North Carolina Department of Commerce. Based on these figures, the gross spending of out-of-state visitors totaled $188.2 million in FY 2012-13. However, some of this spending includes monies spent on campus for non-textbook items such as event tickets, food, and souvenirs. These expenditures have already been accounted for in the impact of operations and should thus be removed to avoid double-counting. We estimate that on-campus sales generated by out-of-state visitors totaled $33.2 million, based on the estimated portion of expenditures for food, entertainment, and shopping that occurred on campus. The net off-campus sales from out-of-state visitors in FY 2012-13 thus come to $155 million.

TABLE 2.12: IMPACT OF THE SPENDING OF OUT-OF-STATE VISITORS OF NCICU'S INSTITUTIONS, FY 2012-13

	LABOR INCOME (THOUSANDS)	+	NON-LABOR INCOME (THOUSANDS)	=	TOTAL ADDED INCOME (THOUSANDS)	OR	JOB EQUIVALENTS
INITIAL EFFECT	$0		$0		$0		0
MULTIPLIER EFFECT							
Direct effect	$38,385		$23,518		$61,903		1,577
Indirect effect	$7,766		$5,576		$13,341		353
Induced effect	$27,572		$16,191		$43,763		1,111
TOTAL MULTIPLIER EFFECT	$73,723		$45,284		$119,007		3,041
TOTAL IMPACT (INITIAL + MULTIPLIER)	$73,723		$45,284		$119,007		3,041

Source: EMSI impact model.

Calculating the increase in state income as a result of visitor spending again requires use of the SAM model. The analysis begins by discounting the off-campus sales generated by out-of-state visitors to account for leakage in the trade sector, and then bridging the net figures to the detailed sectors of the SAM model. The model runs the net sales figures through the multiplier matrix to arrive at the multiplier effects. As shown in Table 2.12, the net impact of visitor spending in FY 2012-13 comes to $73.7 million in labor income and $45.3 million in non-labor income. This totals $119 million in income impacts and is equivalent to 3,041 jobs.

2.7 BUSINESS START-UP IMPACT

While North Carolina's independent colleges and universities create an economic impact through their spending and the spending of their students and visitors, their greatest economic impact stems from the added productivity they bring to the workforce, whether through the transfer of new knowledge and technologies to state businesses or through the added knowledge, skills, and abilities found in their alumni. This subsection presents the economic impact of new companies that were established as a result of their affiliation with NCICU's institutions, and the following subsection focuses on the institutions' alumni.

The founding of the new companies by NCICU's institutions creates an exceptional environment that fosters innovation and entrepreneurship in the state. These are companies that contribute to the state's overall output and that would not have existed in North Carolina but for the presence of the institutions. To estimate the impacts of these companies, we categorize them according to the following types:

- **Start-up companies:** Companies created specifically to license and commercialize technology or knowledge of the NCICU campuses.
- **Spin-off companies:** Companies created and fostered through institutional programs that support entrepreneurial

business development, or companies that were created by faculty, students, or alumni as a result of their experience at the institutions.

We vary our methodology from the previous sections in order to estimate the impacts of start-up and spin-off companies. Ideally, we would use detailed financial information for all start-up and spin-off companies to estimate their impacts. However, collecting that information is not feasible and would raise a number of privacy concerns. As an alternative, we use the number of people employed by each start-up and spin-off company, as collected and reported by the institutions. Table 2.13 presents the number of employees for all start-up and spin-off companies that were related to NCICU's institutions and that were active in North Carolina during the analysis year.

First, we match each start-up and spin-off company with the closest NAICS industry. Next, we assume the companies have earnings and spending patterns – or production functions – similar to their respective industry averages. Given the number of employees reported for each company, we use industry-specific jobs-to-earnings and earnings-to-sales ratios to estimate the sales of each business. As an alternative, we use the number of people employed by each start-up and spin-off company, as collected and reported by the institutions.

Table 2.14 presents the impacts of the start-up companies. The initial effect is the 244 jobs, equal to the number of employees at all start-up companies in the state (from Table

TABLE 2.13: START-UP AND SPIN-OFF COMPANIES THAT WERE ACTIVE IN NORTH CAROLINA IN FY 2012-13

	NUMBER OF COMPANIES	NUMBER OF EMPLOYEES
Start-up companies	43	244
Spin-off companies	2	2

Source: Data supplied by the NCICU institutions.

TABLE 2.14: IMPACT OF START-UP COMPANIES RELATED TO NCICU'S INSTITUTIONS, FY 2012-13

	LABOR INCOME (THOUSANDS)	+	NON-LABOR INCOME (THOUSANDS)	=	TOTAL ADDED INCOME (THOUSANDS)	OR	JOB EQUIVALENTS
INITIAL EFFECT	$23,472		$17,929		$41,401		244
MULTIPLIER EFFECT							
Direct effect	$5,747		$4,016		$9,762		58
Indirect effect	$1,628		$1,232		$2,861		16
Induced effect	$15,182		$9,639		$24,821		158
TOTAL MULTIPLIER EFFECT	$22,557		$14,887		$37,444		233
TOTAL IMPACT (INITIAL + MULTIPLIER)	$46,029		$32,816		$78,845		477

Source: EMSI impact model.

TABLE 2.15: IMPACT OF SPIN-OFF COMPANIES RELATED TO NCICU'S INSTITUTIONS, FY 2012-13

	LABOR INCOME (THOUSANDS)	+	NON-LABOR INCOME (THOUSANDS)	=	TOTAL ADDED INCOME (THOUSANDS)	OR	JOB EQUIVALENTS
INITIAL EFFECT	$203		$24		$228		2
MULTIPLIER EFFECT							
Direct effect	$49		$6		$55		<1
Indirect effect	$13		$2		$15		<1
Induced effect	$156		$18		$174		2
TOTAL MULTIPLIER EFFECT	$218		$26		$244		2
TOTAL IMPACT (INITIAL + MULTIPLIER)	$421		$51		$472		4

Source: EMSI impact model.

2.13). The corresponding initial effect on labor income is $23.5 million. The total impacts (the sum of the initial, direct, indirect, and induced effects) are $46 million in added labor income and $32.8 million in non-labor income, totaling $78.8 million, the equivalent of 477 jobs.

Start-up companies have a strong and clearly defined link to the NCICU campuses. The link between the campuses and the existence of their spin-off companies, however, is less direct and is thus viewed as more subjective. Also, not all of the campuses were able to provide data for their spin-off companies, so much of the information needed to perform a complete analysis of the companies' impact was unavailable. For these reasons, the impacts of spin-off companies are estimated separately from the start-up companies and excluded from the grand total impact presented later in this report.[9]

9 There are many ways to measure linkages between spin-off companies and the educational institutions where they originated, in this case, the NCICU institutions. At the very least, the impacts of the spin-off businesses provide important context for the broader effects of the institutions.

As shown in Table 2.15, the impacts of spin-off companies related to NCICU's campuses are $420.8 thousand in added labor income and $50.8 thousand in non-labor income, totaling $471.5 thousand in overall income – the equivalent of 4 jobs. As noted previously, these impacts reflect only the companies for which data were available. Had the impacts of all spin-off companies related to the institutions been reflected in the analysis, the total job and income impacts would have been much greater.

2.8 ALUMNI IMPACT

Further to sharing of knowledge and technologies through the development of start-up and spin-off companies, North Carolina's private colleges and universities create an even larger economic impact through the added human capital – the intelligence, creativity, and entrepreneurship – found in their alumni. While attending one of NCICU's campuses, students receive education and training, providing them with the knowledge, skills, and abilities

they need to increase their productivity and command a higher wage once they enter the workforce. But the reward of increased productivity does not stop there. Talented professionals make capital more productive too (e.g., buildings, production facilities, equipment, and everything else). The employers of the NCICU institutions' alumni enjoy the fruits of this increased productivity in the form of additional non-labor income (i.e., higher profits).

In this section we estimate the economic impacts stemming from the higher labor income of alumni in combination with their employers' higher non-labor income. Before continuing, it is helpful to understand that the term "alumni" in this context refers to all former students of NCICU's campuses, those that achieved a degree as well as those that did not finish a degree or that did not take courses for credit. The methodology for calculating alumni impacts differs from the previous impacts in one fundamental way. Whereas the other impacts depend on an annually-renewed injection of sales in the state economy, the alumni impact is the result of years of past instruction and the associated accumulation of human capital in the workforce. This is an important distinction that sets the alumni impact apart from the other impacts presented in this report.

The initial effect of alumni comprises two main components. The first and largest of these is the added labor income of the NCICU institutions' alumni, and the second comprises the added non-labor income of the businesses where the alumni are employed. To derive the initial effect, we estimate the portion of alumni that are employed in the workforce using the following sets of data or assumptions: 1) settling-in factors to determine how long it takes the average student to settle into a career;[10] 2) death, retirement, and unemployment rates from the National Center for Health Statistics, the Social Security Administration, and the Bureau of Labor Statistics; and 3) state migration data from the U.S. Census Bureau. Applying these factors to the institutions' historical 12-month enrollment data yields the estimated number of alumni that were still actively employed in the state as of FY 2012-13.

The next step is to quantify the skills that alumni acquired from the institutions, using the students' production of credit hour equivalents (CHEs) as a proxy for skills. To do this, we multiply the number of alumni still employed in the workforce by the 22.5 average CHEs per student (see Table 1.4)[11] to generate an estimate of approximately 25.6 million CHEs active in the workforce. Note that alumni who enrolled at the institutions more than one year are counted at least twice – if not more – in the calculations. However, CHEs remain distinct regardless of when and by whom they were earned, so there is no duplication in the CHE counts.

Next, we estimate the value of the CHEs. This is done using the incremental added labor income stemming from the students' higher wages. The incremental labor income is the difference between the wages earned by alumni and the alternative wage they would have earned had they not attended an NCICU campus. Using the CHEs earned by students and the associated wage differentials between education levels, we estimate the average value per

10 Settling-in factors are used to delay the onset of the benefits to students in order to allow time for them to find employment and settle into their careers. In the absence of hard data, we assume a range between one and three years for students who graduate with a certificate or a degree, and between one and five years for returning students.

11 This assumes the average CHE production and level of study from past years is equal to the CHE production and level of study of students during the analysis year.

CHE to be equal to $178. This value represents the average incremental increase in wages that the NCICU institutions' alumni received during the analysis year for every CHE they completed. For a more detailed discussion of the calculation of this variable, see Appendix 4.

Because experience leads to increased productivity and higher wages, the value per CHE varies depending on the length of time that alumni have been in the workforce, with the highest value applied to the CHEs of alumni that were employed the longest by FY 2012-13, and the lowest value per CHE applied to alumni just entering the workforce. In determining the amount of added labor income attributable to alumni, we multiply the CHEs of former students in each year of the historical time horizon by the corresponding average value per CHE for that year, and then sum the products together. This calculation yields approximately $4.6 billion in gross labor income in increased wages received by alumni in FY 2012-13 (as shown in Table 2.16).

The next two rows in Table 2.16 show two adjustments used to account for counterfactual outcomes. As discussed above, counterfactual outcomes in economic impact analysis represent what would have happened if a given event had not occurred. The event in question is the education and training provided by North Carolina's private colleges and universities and the subsequent influx of skilled labor into the state economy. The first counterfactual scenario that we address is the adjustment for alternative education opportunities. In the counterfactual scenario where NCICU's institutions did not exist, we assume that a portion of their alumni could have received a comparable education elsewhere – whether in state or out of state – and found employment in North Carolina anyway after completing their educational goals. The incremental labor income that accrues to those students cannot be counted towards the added labor income attributable to the alumni of the NCICU institutions. The adjustment for alternative education opportunities amounts to a 15% reduction of the $4.6 billion in added labor income.[12] This means that an estimated 15% of the added labor income attributable to the NCICU institutions' alumni would have been generated in the state anyway, even if the institutions did not exist. For more information on the alternative education adjustment, see Appendix 5.

The other adjustment in Table 2.16 accounts for the importation of labor. Suppose North Carolina's private colleges and universities did not exist and in consequence there were fewer skilled workers in the state. Businesses could still satisfy some of their need for skilled labor by recruiting from outside North Carolina. We refer to this as the labor import effect. Lacking information on its possible magnitude,

TABLE 2.16: NUMBER OF CHEs IN WORKFORCE AND INITIAL LABOR INCOME CREATED IN NORTH CAROLINA, FY 2012-13

Number of CHEs in workforce	25,629,101
Average value per CHE	$178
Initial labor income, gross	$4,556,854,840
COUNTERFACTUALS	
Percent reduction for alternative education opportunities	15%
Percent reduction for adjustment for labor import effects	50%
Initial labor income, net	$1,936,663,307

Source: EMSI impact model.

12 For a sensitivity analysis of the alternative education opportunities variable, see Section 4.

TABLE 2.17: IMPACT OF ALUMNI OF NCICU'S INSTITUTIONS, FY 2012-13

	LABOR INCOME (THOUSANDS)	+	NON-LABOR INCOME (THOUSANDS)	=	TOTAL ADDED INCOME (THOUSANDS)	OR	JOB EQUIVALENTS
INITIAL EFFECT	$1,936,663		$588,370		$2,525,033		41,044
MULTIPLIER EFFECT							
Direct effect	$298,754		$107,639		$406,393		6,488
Indirect effect	$80,416		$30,708		$111,124		1,765
Induced effect	$1,510,367		$393,450		$1,903,818		32,051
TOTAL MULTIPLIER EFFECT	$1,889,537		$531,797		$2,421,334		40,304
TOTAL IMPACT (INITIAL + MULTIPLIER)	$3,826,200		$1,120,167		$4,946,367		81,348

Source: EMSI impact model.

we assume 50% of the jobs that students fill at state businesses could have been filled by workers recruited from outside the state if the institutions did not exist.[13] We conduct a sensitivity analysis for this assumption in Section 4. With the 50% adjustment, the net labor income added to the economy comes to $1.9 billion, as shown in Table 2.16.

The $1.9 billion in added labor income appears under the initial effect in the labor income column of Table 2.17. To this we add an estimate for initial non-labor income. As discussed earlier in this section, businesses that employ former students of North Carolina's private colleges and universities see higher profits as a result of the increased productivity of their capital assets. To estimate this additional income, we allocate the initial increase in labor income ($1.9 billion) to the six-digit NAICS industry sectors where students are most likely to be employed. This allocation entails a process that maps completers in the state to the detailed occupations for which those completers have been trained, and then maps the detailed occupations to the six-digit industry sectors in the SAM model.[14] Using a crosswalk created by National Center for Education Statistics (NCES) and the Bureau of Labor Statistics (BLS), we map the breakdown of the state's completers to the approximately 700 detailed occupations in the Standard Occupational Classification (SOC) system. Finally, we apply a matrix of wages by industry and by occupation from the SAM model to map the occupational distribution of the $1.9 billion in initial labor income effects to the detailed industry sectors in the SAM model.[15]

Once these allocations are complete, we apply the ratio of non-labor to labor income

13 A similar assumption is used by Walden (2014) in his analysis of the Cooperating Raleigh Colleges.

14 Completer data comes from the Integrated Postsecondary Education Data System (IPEDS), which organizes program completions according to the Classification of Instructional Programs (CIP) developed by the National Center for Education Statistics (NCES).

15 For example, if the SAM model indicates that 20% of wages paid to workers in SOC 51-4121 (Welders) occur in NAICS 332313 (Plate Work Manufacturing), then we allocate 20% of the initial labor income effect under SOC 51-4121 to NAICS 332313.

provided by the SAM model for each sector to our estimate of initial labor income. This computation yields an estimated $588.4 million in non-labor income that can be attributable to alumni of NCICU's campuses. Summing initial labor and non-labor income together provides the total initial effect of alumni on the North Carolina economy, equal to approximately $2.5 billion.

Multiplier effects occur as alumni generate an increased demand for consumer goods and services through the expenditure of their higher wages. Further, as the industries where alumni are employed increase their output, there is a corresponding increase in the demand for input from the industries in the employers' supply chain. Together, the incomes generated by the expansions in business input purchases and household spending constitute the multiplier effect of the increased productivity of the NCICU institutions' alumni. To estimate these effects, we convert the industry-specific income figures generated through the initial effect to sales using sales-to-income ratios from the SAM model. We then run the values through the SAM's multiplier matrix. The final results are $1.9 billion in labor income and $531.8 million in non-labor income, for an overall total of $2.4 billion in multiplier effects (see the row labeled "Total multiplier effect" in Table 2.17). The grand total impact of alumni thus comes to $4.9 billion in income, the sum of all initial and multiplier labor and non-labor income impacts. This is equivalent to 81,348 jobs.

2.9 TOTAL IMPACT

The total economic impact of North Carolina's private colleges and universities can be generalized into two broad types of impacts. First, on an annual basis, NCICU's campuses generate a flow of spending that has a significant impact on the North Carolina economy. The impacts of

TABLE 2.18: TOTAL IMPACT OF NCICU'S INSTITUTIONS (WITHOUT SPIN-OFF COMPANIES), FY 2012-13

	LABOR INCOME (THOUSANDS)	+	NON-LABOR INCOME (THOUSANDS)	=	TOTAL ADDED INCOME (THOUSANDS)	OR	JOB EQUIVALENTS
Operations spending	$2,411,699		$604,619		$3,016,317		44,945
Research spending	$812,896		$302,336		$1,115,232		17,334
Clinical spending	$3,109,924		$1,356,498		$4,466,422		62,757
Construction spending	$222,230		-$55,934		$166,296		5,256
Student spending	$114,261		$128,475		$242,736		4,433
Visitor spending	$73,723		$45,284		$119,007		3,041
Start-up companies	$46,029		$32,816		$78,845		477
Alumni	$3,826,200		$1,120,167		$4,946,367		81,348
Total impact	$10,616,962		$3,534,260		$14,151,223		219,590
% OF NORTH CAROLINA ECONOMY	4.4%		1.8%		3.2%		4.1%

Source: EMSI impact model.

this spending are captured by the operations, research, clinical, construction, student, and visitor spending impacts. While not insignificant, these measures don't capture the true impact of the institutions. The basic purpose of NCICU's campuses is to transfer knowledge and provide education. These purposes are realized through the innovation and entrepreneurship fostered by the institutions' start-up companies, and through the knowledge, skills, and abilities that the institutions' alumni directly apply to their jobs in the workplace. The alumni impact is especially significant, evidenced by the fact that it is the largest of all the impacts measured and is the only impact that is sustained by a cohort of newly-trained alumni that add to the stock of human capital in North Carolina each year.

Table 2.18 displays the grand total impacts of North Carolina's independent colleges and universities on the state economy in FY 2012-13 – including the impacts from operations spending, research spending, clinical spending, construction spending, student spending, visitor spending, start-up companies, and alumni. For context, the percentage of the North Carolina economy that is explained by each type of impact is also presented.

3 BENEFITS TO STUDENTS, SOCIETY, AND TAXPAYERS

The benefits generated by North Carolina's private colleges and universities affect the lives of many people. The most obvious beneficiaries are the institutions' students; they give up time and money to attend an NCICU campus in return for a lifetime of higher income and improved quality of life. But the benefits do not stop there. As students earn more, communities and citizens throughout North Carolina benefit from an enlarged economy and a reduced demand for social services. The benefits of education extend as far as the state and local government, in the form of increased tax revenues and public sector savings.

In this chapter, we consider the benefits generated by NCICU's campuses from the perspectives of their main beneficiary groups – students, society, taxpayers. For students and society, the approach is a standard benefit-cost analysis where benefits are weighed against costs to determine if it makes economic sense for students and society to invest in education. Taxpayers, on the other hand, do not directly invest in private colleges or universities, except to the extent that they contribute student financial aid; for this reason, the analysis only assesses taxpayer benefits without taking costs into account.

3.1 STUDENT PERSPECTIVE

To attend an NCICU institution, students pay money for tuition and forgo monies that they would have otherwise earned had they chosen to work instead of learn. From the perspective of students, education is the same as an investment; i.e., they incur a cost, or put up a certain amount of money, with the expectation of receiving benefits in return. The total costs consist of the monies that students pay in the form of tuition and fees and the opportunity costs of forgone time and money. The benefits are the higher earnings that students receive as a result of their education.

3.1.1 Calculating student costs

Student costs consist of two main items: direct outlays and opportunity costs. Direct outlays include tuition and fees, equal to $1.5 billion from Table 1.2. Direct outlays also include the cost of books and supplies. On average, full-time students spent $1,242 each on books and supplies during the reporting year.[16] Multiplying this figure times the number of full-time equivalents (FTEs) produced by NCICU's institutions in FY 2012-13[17] generates a total cost of $94.1 million for books and supplies.

Opportunity cost is the most difficult com-

16 Based on the data supplied by the NCICU institutions.

17 A single FTE is equal to 30 CHEs, so there were 76,044 FTEs produced by students in FY 2012-13, equal to 2.3 million CHEs divided by 30 (excluding the CHE production of personal enrichment students).

ponent of student costs to estimate. It measures the value of time and earnings forgone by students who attend an NCICU campus rather than work. To calculate it, we need to know the difference between the students' full earning potential and what they actually earn while attending the institutions.

We derive the students' full earning potential by weighting the average annual income levels in Table 1.7 according to the education level breakdown of the student population when they first enrolled.[18] However, the income levels in Table 1.7 reflect what average workers earn at the midpoint of their careers, not while attending the institutions. Because of this, we adjust the income levels to the average age of the student population (25) to better reflect their wages at their current age.[19] This calculation yields an average full earning potential of $25,532 per student.

In determining how much students earn while enrolled, an important factor to consider is the time that they actually spend on their education, since this is the only time that they are required to give up a portion of their earnings. We use the students' CHE production as a proxy for time, under the assumption that the more CHEs students earn, the less time they have to work, and, consequently, the greater their forgone earnings. Overall, students attending NCICU's campuses earned an average of 22.5 CHEs per student (excluding personal enrichment students), which is approximately equal to 75% of a full academic year.[20] We thus include no more than $19,162 (or 75%) of the students' full earning potential in the opportunity cost calculations.

Another factor to consider is the students' employment status. Based on data supplied by the institutions, approximately 56% of students are employed while attending.[21] For the 44% that are not working, we assume that they are either seeking work or planning to seek work once they complete their educational goals (with the exception of personal enrichment students, who are not included in this calculation). By choosing to enroll, therefore, non-working students give up everything that they can potentially earn during the academic year (i.e., the $19,162). The total value of their forgone income thus comes to $910.3 million.

Working students are able to maintain all or part of their income while enrolled. However, many of them hold jobs that pay less than statistical averages, usually because those are the only jobs they can find that accommodate their course schedule. These jobs tend to be at entry level, such as restaurant servers or cashiers. To account for this, we assume that working students hold jobs that pay 58% of what they would have earned had they chosen to work full-time rather than attend an NCICU campus.[22] The remaining 42% comprises the percent of their full earning potential that they forgo. Obviously this assumption varies by person; some students forgo more and others less. Since we don't know the actual jobs held by students while attending, the 42% in forgone earnings serves as a reasonable average.

Working students also give up a portion

18 This is based on the number of students who reported their entry level of education to the NCICU institutions. EMSI provided estimates in the event that the data were not available from the institutions.

19 Further discussion on this adjustment appears in Appendix 4.

20 Equal to 22.5 CHEs divided by 30, the assumed number of CHEs in a full-time academic year.

21 EMSI provided an estimate of the percentage of students employed in the case the institutions were unable to collect the data.

22 The 58% assumption is based on the average hourly wage of the jobs most commonly held by working students divided by the national average hourly wage. Occupational wage estimates are published by the Bureau of Labor Statistics (see http://www.bls.gov/oes/current/oes_nat.htm).

of their leisure time. According to the Bureau of Labor Statistics American Time Use Survey, students forgo up to 1.4 hours of leisure time per day.[23] Assuming that an hour of leisure is equal in value to an hour of work, we derive the total cost of leisure by multiplying the number of leisure hours forgone during the academic year by the average hourly pay of the students' full earning potential. For working students, therefore, their total opportunity cost comes to $734 million, equal to the sum of their forgone income ($522.3 million) and forgone leisure time ($211.7 million).

The steps leading up to the calculation of student costs appear in Table 3.1. Direct outlays amount to $1.6 billion, the sum of tuition and fees ($1.5 billion) and books and supplies ($94.1 million), less $98,650 in direct outlays for personal enrichment students (these students are excluded from the cost calculations). Opportunity costs for working and non-working students amount to $1.6 billion, excluding $64.2 million in offsetting residual aid that is paid directly to students.[24] Summing direct outlays and opportunity costs together yields a total of $3.1 billion in student costs.

TABLE 3.1: STUDENT COSTS, FY 2012-13 (THOUSANDS)

DIRECT OUTLAYS	
Tuition and fees	$1,458,492
Books and supplies	$94,083
Less direct outlays of personal enrichment students	-$99
Total direct outlays	$1,552,476
OPPORTUNITY COSTS	
Earnings forgone by non-working students	$910,300
Earnings forgone by working students	$522,259
Value of leisure time forgone by working students	$211,710
Less residual aid	-$64,173
Total opportunity costs	$1,580,097
TOTAL STUDENT COSTS	$3,132,572

Source: Based on data supplied by the NCICU institutions and outputs of the EMSI education impact model.

3.1.2 Linking education to earnings

Having estimated the costs of education to students, we weigh these costs against the benefits that students receive in return. The relationship between education and earnings is well documented and forms the basis for determining student benefits. As shown in Table 1.7, mean income levels at the midpoint of the average-aged worker's career increase as people achieve higher levels of education. The differences between income levels define the incremental benefits of moving from one education level to the next.

A key component in determining the students' return on investment is the value of their future benefits stream; i.e., what they can expect to earn in return for the investment they make in education. We calculate the future benefits stream to the institutions' 2012-13 students first by determining their average annual increase in income, equal to $496.8 million. This value represents the higher income that accrues to students at the midpoint of their careers and is calculated based on the marginal wage increases of the CHEs that students complete while attending the institutions. For a full description of the methodology used to derive the $496.8 million, see Appendix 4.

The second step is to project the $496.8 million annual increase in income into the

23 "Charts by Topic: Leisure and sports activities," Bureau of Labor Statistics American Time Use Survey, last modified November 2012, accessed July 2013, http://www.bls.gov/TUS/CHARTS/LEISURE.HTM.

24 Residual aid is the remaining portion of scholarship or grant aid distributed directly to students after the institutions apply tuition and fees.

future, for as long as students remain in the workforce. We do this using the Mincer function to predict the change in earnings at each point in an individual's working career.[25] The Mincer function originated from Mincer's seminal work on human capital (1958) and is used to estimate earnings using an individual's years of education and post-schooling experience. While some have criticized Mincer's earnings function, it is still upheld in recent data and has served as the foundation for a variety of research pertaining to labor economics. Card (1999 and 2001) addresses a number of these criticisms using U.S. based research over the last three decades and concludes that any upward bias in the Mincer parameters is on the order of 10% or less. For the purpose of this analysis, we use United States-based Mincer coefficients estimated by Polachek (2003) and account for any upward bias by incorporating a 10% reduction in our projected earnings. With the $496.8 million representing the students' higher earnings at the midpoint of their careers, we apply scalars from the Mincer function to yield a stream of projected future benefits that gradually increase from the time students enter the workforce, peak shortly after the career midpoint, and then dampen slightly as students approach retirement at age 67. This earnings stream appears in Column 2 of Table 3.2 on the next page.

As shown in Table 3.2, the $496.8 million in gross added income occurs around Year 16, which is the approximate midpoint of the students' future working careers given the average age of the student population and an assumed retirement age of 67. In accordance with the Mincer function, the gross added income that accrues to students in the years leading up to the midpoint is less than $496.8 million and the gross added income in the years after the midpoint is greater than $496.8 million.

The final step in calculating the students' future benefits stream is to net out the potential benefits generated by students who are either not yet active in the workforce or who leave the workforce over time. This adjustment appears in Column 3 of Table 3.2 and represents the percentage of the 2012-13 student population that will be employed in the workforce in a given year. Note that the percentages in the first five years of the time horizon are relatively lower than those in subsequent years. This is because many students delay their entry into the workforce, either because they are still enrolled at the institutions or because they are unable to find a job immediately upon graduation. Accordingly, we apply a set of "settling-in" factors to account for the time needed by students to find employment and settle into their careers. As discussed in Section 2, settling-in factors delay the onset of the benefits by one to three years for students who graduate with a certificate or a degree and by one to five years for degree-seeking students who do not complete during the analysis year.

Beyond the first five years of the time horizon, students will leave the workforce for any number of reasons, whether because of death, retirement, or unemployment. We estimate the rate of attrition using the same data and assumptions applied in the calculation of the attrition rate in the economic impact analysis of Section 2.[26] The likelihood of leaving the

25 Appendix 4 provides more information on the Mincer function and how it is used to predict future earnings growth.

26 See the discussion of the alumni impact in Section 2. The main sources for deriving the attrition rate are the National Center for Health Statistics, the Social Security Administration, and the Bureau of Labor Statistics. Note that we do not account for migration patterns in the student investment analysis because the higher earnings that students receive as a result of their education will accrue to them regardless of where they find employment.

TABLE 3.2: PROJECTED BENEFITS AND COSTS, STUDENT PERSPECTIVE

1	2	3	4	5	6
YEAR	GROSS ADDED INCOME TO STUDENTS (MILLIONS)	LESS ADJUSTMENTS (MILLIONS)*	NET ADDED INCOME TO STUDENTS (MILLIONS)	STUDENT COSTS (MILLIONS)	NET CASH FLOW (MILLIONS)
0	$300	10%	$31	$3,133	-$3,102
1	$313	18%	$56	$0	$56
2	$326	28%	$90	$0	$90
3	$339	44%	$149	$0	$149
4	$352	67%	$236	$0	$236
5	$365	95%	$345	$0	$345
6	$378	95%	$358	$0	$358
7	$391	95%	$370	$0	$370
8	$404	95%	$383	$0	$383
9	$416	95%	$395	$0	$395
10	$429	95%	$407	$0	$407
11	$441	95%	$419	$0	$419
12	$453	95%	$430	$0	$430
13	$464	95%	$441	$0	$441
14	$476	95%	$451	$0	$451
15	$486	95%	$461	$0	$461
16	$497	95%	$471	$0	$471
17	$507	95%	$479	$0	$479
18	$516	94%	$488	$0	$488
19	$525	94%	$495	$0	$495
20	$533	94%	$502	$0	$502
21	$541	94%	$508	$0	$508
22	$548	94%	$513	$0	$513
23	$554	93%	$517	$0	$517
24	$559	93%	$521	$0	$521
25	$564	93%	$523	$0	$523
26	$568	92%	$525	$0	$525
27	$571	92%	$526	$0	$526
28	$574	92%	$526	$0	$526
29	$575	91%	$525	$0	$525
30	$576	91%	$522	$0	$522
31	$576	90%	$519	$0	$519
32	$576	89%	$515	$0	$515
33	$574	84%	$482	$0	$482
34	$572	81%	$464	$0	$464
35	$569	79%	$450	$0	$450
36	$515	85%	$440	$0	$440
37	$506	85%	$432	$0	$432
38	$495	81%	$403	$0	$403
39	$487	75%	$363	$0	$363
40	$481	56%	$268	$0	$268
41	$439	50%	$219	$0	$219
42	$379	46%	$174	$0	$174
43	$250	44%	$110	$0	$110
44	$221	37%	$81	$0	$81
45	$176	17%	$31	$0	$31
PRESENT VALUE			$7,221	$3,133	$4,089
Internal rate of return					10.3%
Benefit-cost ratio					2.3
Payback period (no. of years)					11.7

** Includes the "settling-in" factors and attrition. Percentages reflect aggregate values for all institutions and are subject to fluctuations due to the institutions' varying time horizons.*

Source: EMSI impact model.

workforce increases as students age, so the attrition rate is more aggressive near the end of the time horizon than in the beginning. Column 4 of Table 3.2 shows the net added income to students after accounting for both the settling-in patterns and attrition.

3.1.3 Return on investment to students

Having estimated the students' costs and their future benefits stream, the next step is to discount the results to the present to reflect the time value of money. This process is called "discounting to present value" and makes use of an assumed rate of interest called the discount rate (see the "Discounting to Present Value" box). For the student perspective we assume a discount rate of 4.5%. Because students tend to rely upon debt to pay for their educations – i.e., they are negative savers – the discount rate used to convert future sums of money to their present values is based upon student loan interest rates.[27] In Section 4, we conduct a sensitivity analysis of this discount rate. The present value of the benefits is then compared to student costs to derive the investment analysis results, expressed in terms of a benefit-cost ratio, rate of return, and payback period. The investment is feasible if returns match or exceed the minimum threshold values; i.e., a benefit-cost ratio that is greater than 1, a rate of return that exceeds the discount rate, and a reasonably short payback period.

In Table 3.2, the net added income of students yields a cumulative discounted sum of approximately $7.2 billion, the present value of all of the future income increments (see the bottom section of Column 4). This may also be interpreted as the gross capital asset value of the students' higher income stream. In effect, the aggregate 2012-13 student body is rewarded for its investment in NCICU's institutions with a capital asset valued at $7.2 billion.

The students' cost of attending the institutions is shown in Column 5 of Table 3.2, equal to a present value of $3.1 billion. Note that costs occur only in the single analysis year and are thus already in current year dollars. Comparing the cost with the present value of benefits yields a student benefit-cost ratio of

DISCOUNTING TO PRESENT VALUE

Discounting to present value is the process by which future costs and benefits are converted to their present values using an assumed rate of interest, or "discount rate." For example, $1,000 in higher earnings realized 30 years in the future is worth much less than $1,000 in the present. All future values must therefore be expressed in present value terms in order to compare them with investments (i.e., costs) made today. The selection of an appropriate discount rate, however, can become an arbitrary and controversial undertaking. As suggested in economic theory, the discount rate should reflect the investor's opportunity cost of capital; i.e., the rate of return one could reasonably expect to obtain from alternative investment schemes. In this study we assume a 4.5% discount rate from the student perspective and a 1.1% discount rate from the perspective of society and taxpayers.

27 The rate used to discount future student benefits to their present value is derived from the baseline forecasts for the 10-year zero coupon bond discount rate published by the Congressional Budget Office. See the Congressional Budget Office, Student Loan and Pell Grant Programs - March 2012 Baseline, Congressional Budget Office Publications, last modified March 13, 2012, accessed July 2013, http://www.cbo.gov/sites/default/files/cbofiles/attachments/ 43054_StudentLoanPellGrantPrograms.pdf.

2.3 (equal to $7.2 billion in benefits divided by $3.1 billion in costs).

Another way to compare the same benefits stream and associated cost is to compute the rate of return. The rate of return indicates the interest rate that a bank would have to pay a depositor to yield an equally attractive stream of future payments.[28] Table 3.2 shows students of the NCICU campuses earning average returns of 10.3% on their investment of time and money. This is a favorable return compared, for example, to approximately 1% on a standard bank savings account, or 7% on stocks and bonds (30-year average return).

Note that returns reported in this study are real returns, not nominal. When a bank promises to pay a certain rate of interest on a savings account, it employs an implicitly nominal rate. Bonds operate in a similar manner. If it turns out that the inflation rate is higher than the stated rate of return, then money is lost in real terms. In contrast, a real rate of return is on top of inflation. For example, if inflation is running at 3% and a nominal percentage of 5% is paid, then the real rate of return on the investment is only 2%. In Table 3.2, the 10.3% student rate of return is a real rate. With an inflation rate of 2.5% (the average rate reported over the past 20 years as per the U.S. Department of Commerce, Consumer Price Index), the corresponding nominal rate of return is 12.8%, higher than what is reported in Table 3.2.

The payback period is defined as the length of time it takes to entirely recoup the initial investment.[29] Beyond that point, returns are what economists would call pure costless rent. As indicated in Table 3.2, students of North Carolina's private colleges and universities see, on average, a payback period of 11.7 years on their forgone earnings and out-of-pocket costs.

3.2 SOCIETAL PERSPECTIVE

North Carolina benefits from the education that NCICU's campuses provide through the income that students create in the state and through the savings that they generate through their improved lifestyles. To receive these benefits, however, members of society must put up monies and forgo services that they would have otherwise enjoyed if the campuses did not exist. Society's investment in the NCICU campuses stretches across a number of groups, from students to donors to employers. We weigh the benefits that accrue to North Carolina against the total societal costs of generating those benefits. Total societal costs include all expenses of the NCICU campuses (excluding clinical expenses), all student expenses less tuition and fees, and all student opportunity costs, totaling $8.9 billion ($7.2 billion in institutional expenses, $94 million in student expenses, and $1.6 billion in student opportunity costs).

On the benefits side, any benefits that accrue to North Carolina as a whole – including students, employers, taxpayers, and anyone else who stands to benefit from the activities of

28 Rates of return are computed using the familiar internal rate-of-return calculation. Note that, with a bank deposit or stock market investment, the depositor puts up a principal, receives in return a stream of periodic payments, and then recovers the principal at the end. Someone who invests in education, on the other hand, receives a stream of periodic payments that include the recovery of the principal as part of the periodic payments, but there is no principal recovery at the end. These differences notwithstanding, comparable cash flows for both bank and education investors yield the same internal rate of return.

29 Payback analysis is generally used by the business community to rank alternative investments when safety of investments is an issue. Its greatest drawback is that it takes no account of the time value of money. The payback period is calculated by dividing the cost of the investment by the net return per period. In this study, the cost of the investment includes tuition and fees plus the opportunity cost of time; it does not take into account student living expenses or interest on loans.

North Carolina's private colleges and universities – are counted as benefits under the societal perspective. We group these benefits under the following broad headings: 1) increased income in the state, and 2) social externalities stemming from improved health, reduced crime, and reduced unemployment in the state (see the "Beekeeper Analogy" box for a discussion of externalities). Both of these benefits components are described more fully in the following sections.

3.2.1 Income growth in the state

In the process of absorbing the newly-acquired skills of students that attend NCICU's campuses, not only does the productivity of North Carolina's workforce increase, but also does the productivity of its physical capital and assorted infrastructure. Students earn more because of the skills they learned while attending the institutions, and businesses earn more because student skills make capital more productive (buildings, machinery, and everything else). This in turn raises profits and other business property income. Together, increases in labor and non-labor (i.e., capital) income are considered the effect of a skilled workforce.

Estimating the effect of NCICU's institutions on income growth in the state begins with the present value of the students' future income stream, which is displayed in Column 4 of Table 3.2. To this we apply a multiplier derived from EMSI's SAM model to estimate the added labor income created in the state as students and businesses spend their higher incomes.[30] As labor income increases, so does non-labor income, which consists of monies gained through investments. To calculate the growth in non-labor income, we multiply the increase in labor income by a ratio of the North Carolina Gross State Product to total labor income in the state. We also include the spending impacts discussed in Section 2 that were created in 2012-13 by the operations of the institutions and their research activities, student spending, and visitor spending.

The sum of the students' higher incomes, multiplier effect, increase in non-labor income,

30 For a full description of the EMSI SAM model, see Appendix 3.

BEEKEEPER ANALOGY

Beekeepers provide a classic example of positive externalities (sometimes called "neighborhood effects"). The beekeeper's intention is to make money selling honey. Like any other business, receipts must at least cover operating costs. If they don't, the business shuts down.

But from society's standpoint there is more. Flowers provide the nectar that bees need for honey production, and smart beekeepers locate near flowering sources such as orchards. Nearby orchard owners, in turn, benefit as the bees spread the pollen necessary for orchard growth and fruit production. This is an uncompensated external benefit of beekeeping, and economists have long recognized that society might actually do well to subsidize positive externalities such as beekeeping.

Educational institutions are like beekeepers. While their principal aim is to provide education, in the process an array of external benefits are created. Students' health and lifestyles are improved, and society indirectly benefits just as orchard owners indirectly benefit from beekeepers. Aiming at a more complete accounting of the benefits generated by education, the model tracks and accounts for many of these external social benefits.

and spending impacts comprises the gross added income that accrues to communities and citizens throughout the state of North Carolina. Not all of this income may be counted as benefits to the state, however. Some students leave the state during the course of their careers, and the higher income they receive as a result of their education leaves the state with them. To account for this dynamic, we combine student settlement data from the institutions with data on migration patterns from the U.S. Census Bureau to estimate the number of students who will leave the state workforce over time.

We apply another reduction factor to account for the students' alternative education opportunities. This is the same adjustment that we use in the calculation of the alumni impact in Section 2 and is designed to account for the counterfactual scenario where the NCICU institutions do not exist. The assumption in this case is that any benefits generated by students who could have received an education even without the institutions cannot be counted as new benefits to society. For this analysis, we assume an alternative education variable of 15%, meaning that 15% of the student population at the institutions would have generated benefits anyway even without the institutions. For more information on the alternative education variable, see Appendix 5.

After adjusting for attrition and alternative education opportunities, we calculate the present value of the future added income that occurs in the state, equal to $28.8 billion (this value appears again later in Table 3.3). Recall from the discussion of the student return on investment that the present value represents the sum of the future benefits that accrue each year over the course of the time horizon, discounted to current year dollars to account for the time value of money. Given that the stakeholder in this case is society, we use the discount rate of 1.1%, the real treasury interest rate recommended by the Office for Management and Budget (OMB) for 30-year investments.[31] In Section 4, we conduct a sensitivity analysis of this discount rate.

3.2.2 Social externalities

In addition to the creation of higher income in the state, education is statistically associated with a variety of lifestyle changes that generate social savings, also known as external or incidental benefits of education. These represent the avoided costs that would have otherwise been drawn from private and public resources absent the education provided by North Carolina's private colleges and universities. Social benefits appear in Table 3.3 on the next page and break down into three main categories: 1) health savings, 2) crime savings, and 3) welfare and unemployment savings. Health savings include avoided medical costs, lost productivity, and other effects associated with smoking, alcoholism, obesity, mental illness, and drug abuse. Crime savings consist of avoided costs to the justice system (i.e., police protection, judicial and legal, and corrections), avoided victim costs, and benefits stemming from the added productivity of individuals who would have otherwise been incarcerated. Welfare and unemployment benefits comprise avoided costs due to the reduced number of social assistance and unemployment insurance claims.

The model quantifies social savings by calculating the probability at each education level that individuals will have poor health, commit crimes, or claim welfare and unemployment benefits. Deriving the probabilities involves assembling data from a variety of studies and surveys analyzing the correlation between education and health, crime, welfare,

31 See the Office of Management and Budget, Real Treasury Interest Rates in "Table of Past Years Discount Rates" from Appendix C of OMB Circular No. A-94 (revised December 2012).

TABLE 3.3: PRESENT VALUE OF THE FUTURE ADDED INCOME AND SOCIAL SAVINGS IN THE STATE (THOUSANDS)

ADDED INCOME	$28,842,707
SOCIAL SAVINGS	
Health	
Smoking	$1,660,012
Alcoholism	$53,670
Obesity	$1,119,636
Mental illness	$426,513
Drug abuse	$102,225
Total health savings	$3,362,056
Crime	
Criminal Justice System savings	$33,409
Crime victim savings	$2,970
Added productivity	$10,974
Total crime savings	**$47,353**
Welfare/unemployment	
Welfare savings	$1,065
Unemployment savings	$1,898
Total welfare/unemployment savings	**$2,963**
Total social savings	**$3,412,373**
TOTAL, ADDED INCOME + SOCIAL SAVINGS	$32,255,080

Source: EMSI impact model.

and unemployment at the national and state level. We spread the probabilities across the education ladder and multiply the marginal differences by the number of students who achieved CHEs at each step. The sum of these marginal differences counts as the upper bound measure of the number of students who, due to the education they received at the institutions, will not have poor health, commit crimes, or claim welfare and unemployment benefits. We dampen these results by the 10% adjustment discussed earlier in this section and in Appendix 4 to account for factors (besides education) that influence individual behavior. We then multiply the marginal effects of education times the associated costs of health, crime, welfare, and unemployment.[32] Finally, we apply the same adjustments for attrition and alternative education to derive the net savings to society.

Table 3.3 displays the results of the analysis. The first row shows the added income created in the state, equal to $28.8 billion, from students' higher incomes and their multiplier effect, increase in non-labor income, and spending impacts. Social savings appear next, beginning with a breakdown of savings related to health. These savings amount to a present value of $3.4 billion, including savings due to a reduced demand for medical treatment and social services, improved worker productivity and reduced absenteeism, and a reduced number of vehicle crashes and fires induced by alcohol or smoking-related incidents. Crime savings amount to $47.4 million, including savings associated with a reduced number of crime victims, added worker productivity, and reduced expenditures for police and law enforcement, courts and administration of justice, and corrective services. Finally, the present value of the savings related to welfare and unemployment amount to $3 million, stemming from a reduced number of persons in need of income assistance. All told, social savings amounted to $3.4 billion in benefits to communities and citizens in North Carolina.

The sum of the social savings and the added income in the state is $32.3 billion, as shown in the bottom row of Table 3.3. These savings accrue in the future as long as the 2012-13 student population of North Carolina's private

32 For a full list of the data sources used to calculate the social externalities, see the "Resources and References" section. See also Appendix 7 for a more in-depth description of the methodology.

TABLE 3.4: PROJECTED BENEFITS AND COSTS, SOCIETAL PERSPECTIVE

1	2	3	4
YEAR	BENEFITS TO SOCIETY (MILLIONS)	SOCIETAL COSTS (MILLIONS)	NET CASH FLOW (MILLIONS)
0	$7,378	$8,894	-$1,516
1	$113	$0	$113
2	$182	$0	$182
3	$304	$0	$304
4	$481	$0	$481
5	$701	$0	$701
6	$718	$0	$718
7	$736	$0	$736
8	$753	$0	$753
9	$770	$0	$770
10	$786	$0	$786
11	$801	$0	$801
12	$816	$0	$816
13	$831	$0	$831
14	$844	$0	$844
15	$857	$0	$857
16	$869	$0	$869
17	$881	$0	$881
18	$891	$0	$891
19	$900	$0	$900
20	$908	$0	$908
21	$915	$0	$915
22	$921	$0	$921
23	$925	$0	$925
24	$929	$0	$929
25	$931	$0	$931
26	$931	$0	$931
27	$931	$0	$931
28	$929	$0	$929
29	$925	$0	$925
30	$920	$0	$920
31	$914	$0	$914
32	$906	$0	$906
33	$811	$0	$811
34	$768	$0	$768
35	$737	$0	$737
36	$716	$0	$716
37	$702	$0	$702
38	$639	$0	$639
39	$543	$0	$543
40	$423	$0	$423
41	$341	$0	$341
42	$251	$0	$251
43	$160	$0	$160
44	$117	$0	$117
45	$49	$0	$49
PRESENT VALUE	$32,255	$8,894	$23,361
Benefit-cost ratio			3.6
Payback period (no. of years)			5.6

Source: EMSI impact model.

colleges and universities remains in the workforce.

3.2.3 Return on investment to society

Table 3.4 on the previous page presents the stream of benefits accruing to North Carolina society and the total societal costs of generating those benefits. Comparing the present value of the benefits and the societal costs, we have a benefit-cost ratio of 3.6. This means that for every dollar invested in the education provided by NCICU's institutions – whether that money is spent by the institutions on day-to-day operations or by students on tuition, fees, and forgone time and money – an average of $3.60 in benefits will accrue to society in North Carolina.[33]

3.3 TAXPAYER PERSPECTIVE

From the taxpayer perspective, the pivotal step here is to limit the overall public benefits shown in Tables 3.3 and 3.4 to those that specifically accrue to state and local government. For example, benefits resulting from income growth are limited to increased state and local tax payments. Similarly, savings related to improved health, reduced crime, and fewer welfare and unemployment claims are limited to those received strictly by state and local government. In all instances, benefits to private residents, local businesses, or the federal government are excluded.

Table 3.5 presents the added tax revenue and government savings that accrue to taxpayers. Added tax revenue is derived by multiplying the income growth figures from Table 3.3 by the prevailing state and local government tax rates. For the social externalities, we claim only the benefits that reduce the demand for government-supported social services, or the benefits resulting from improved productivity among government employees. The present value of future tax revenues and government savings thus comes to approximately $3.4 billion.

TABLE 3.5: PRESENT VALUE OF ADDED TAX REVENUE AND GOVERNMENT SAVINGS (THOUSANDS)

ADDED TAX REVENUE	
Added tax revenue	$2,786,584
GOVERNMENT SAVINGS	
Health-related savings	$557,893
Crime-related savings	$34,882
Welfare/unemployment-related savings	$2,963
Total government savings	$595,738
TOTAL TAXPAYER BENEFITS	$3,382,321

Source: EMSI impact model.

3.4 CONCLUSION

This section has shown that the education provided by North Carolina's independent colleges and universities is an attractive investment to students with rates of return that exceed alternative investment opportunities. At the same time, the presence of the institutions expands the state economy and creates a wide range of positive social benefits that accrue to citizens and communities in North Carolina.

33 The rate of return is not reported for the societal perspective because the beneficiaries of the investment are not necessarily the same as the original investors.

4 SENSITIVITY ANALYSIS

Sensitivity analysis is the process by which researchers determine how sensitive the outputs of the model are to variations in the background data and assumptions, especially if there is any uncertainty in the variables. Sensitivity analysis is also useful for identifying a plausible range wherein the results will fall should any of the variables deviate from expectations. In this section we test the sensitivity of the model to the following input factors: 1) the alternative education variable, 2) the labor import effect variable, 3) the student employment variables, and 4) the rate of interest used to discount future monies to their present value (i.e., the discount rate).

4.1 ALTERNATIVE EDUCATION VARIABLE

The alternative education variable (15%) accounts for the counterfactual scenario where students would have to seek a similar education elsewhere absent the NCICU institutions. Given the difficulty in accurately specifying the alternative education variable, we test the sensitivity of the societal and taxpayer perspective results to its magnitude. Variations in the alternative education assumption are calculated around base case results listed in the middle column of Table 4.1. Next, the model brackets the base case assumption on either side with a plus or minus 10%, 25%, and 50% variation in assumptions. Analyses are then redone introducing one change at a time, holding all other variables constant. For example, an increase of 10% in the alternative education assumption (from 15% to 17%) reduces the taxpayer benefits from $3.4 billion to $3.3 billion. Likewise, a decrease of 10% (from 15% to 14%) in the assumption increases the rate of return from just under $3.4 billion to over $3.4 billion.

Based on this sensitivity analysis, the conclusion can be drawn that results from the

TABLE 4.1: SENSITIVITY ANALYSIS OF ALTERNATIVE EDUCATION VARIABLE, TAXPAYER AND SOCIETAL PERSPECTIVE

% VARIATION IN ASSUMPTION	-50%	-25%	-10%	BASE CASE	10%	25%	50%
Alternative education variable	8%	11%	14%	15%	17%	19%	23%
Benefits to society (millions)	$33,515	$32,156	$31,341	$32,255	$30,254	$29,438	$28,080
Benefits to taxpayers (millions)	$3,681	$3,532	$3,442	$3,382	$3,323	$3,233	$3,084

TABLE 4.2: SENSITIVITY ANALYSIS OF LABOR IMPORT EFFECT VARIABLE

% VARIATION IN ASSUMPTION	-50%	-25%	-10%	BASE CASE	10%	25%	50%
Labor import effect variable	25%	38%	45%	50%	55%	63%	75%
Alumni impact (millions)	$2,473	$3,710	$4,452	$4,946	$5,441	$6,183	$7,420

taxpayer and societal perspectives are not very sensitive to relatively large variations in the alternative education variable. As indicated, results are still strongly positive, even when the alternative education assumption is increased by as much as 50% (from 15% to 23%). The conclusion is that although the assumption is difficult to specify, its impact on the overall results for the societal and taxpayer perspectives is not very sensitive.

4.2 LABOR IMPORT EFFECT VARIABLE

The labor import effect variable only affects the alumni impact calculation in Table 2.17. In the model we assume a labor import effect variable of 50%, which means that we claim only 50% of the initial labor income generated by increased alumni productivity. The other 50% we assume would have been created in the state anyway – even without the NCICU institutions – since the businesses that hired the institutions' students could have substituted some of these workers with equally-qualified people from outside the state had there been no students from the NCICU institutions to hire.

Table 4.2 presents the results of the sensitivity analysis for the labor import effect variable. As above, the assumption increases and decreases relative to the base case of 50% by the increments indicated in the table. Alumni impacts attributable to NCICU's institutions, for example, range from a low of $2.5 billion at a -50% variation to a high of $7.4 billion at a +50% variation from the base case assumption. This means that if the labor import effect variable increases, the impact that we claim as attributable to alumni increases as well. The impact stemming from the alumni still remains a sizeable factor in the North Carolina economy, even under the most conservative assumptions.

4.3 STUDENT EMPLOYMENT VARIABLES

Student employment variables are difficult to estimate because many students do not report their employment status or because higher education institutions generally do not collect this kind of information. Employment variables include the following: 1) the percentage of students that are employed while attending the institutions, and 2) the percentage of earnings that working students receive relative to the income they would have received had they not chosen to attend an NCICU campus. Both employment variables affect the investment analysis results from the student perspective.

Students incur substantial expense by attending the NCICU campuses because of the time they spend not gainfully employed. Some of that cost is recaptured if students remain partially (or fully) employed while attending. It is estimated that 56% of students who reported

their employment status are employed, based on data provided by the institutions.[34] This variable is tested in the sensitivity analysis by changing it first to 100% and then to 0%.

The second student employment variable is more difficult to estimate. In this study we estimate that students that are working while attending earn only 58%, on average, of the income that they would have statistically received if not attending. This suggests that many students hold part-time jobs that accommodate their attendance at the institutions, though it is at an additional cost in terms of receiving a wage that is less than what they might otherwise make. The 58% variable is an estimation based on the average hourly wages of the most common jobs held by post-secondary students relative to the average hourly wages of all occupations in the U.S. The model captures this difference in wages and counts it as part of the opportunity cost of time. As above, the 58% estimate is tested in the sensitivity analysis by changing it to 100% and then to 0%.

The changes generate results summarized in Table 4.3, with "A" defined as the percent of students employed and "B" defined as the percent that students earn relative to their full earning potential. Base case results appear in the shaded row; here the assumptions remain unchanged, with A equal to 56% and B equal to 58%. Sensitivity analysis results are shown in non-shaded rows. Scenario 1 increases A to 100% while holding B constant, Scenario 2 increases B to 100% while holding A constant, Scenario 3 increases both A and B to 100%, and Scenario 4 decreases both A and B to 0%.

- **Scenario 1:** Increasing the percentage of students employed (A) from 56% to 100%, the net present value, internal rate of return, and benefit-cost ratio improve to $4.5 billion, 11.4%, and 2.6, respectively, relative to base case results. Improved results are attributable to a lower opportunity cost of time; all students are employed in this case.
- **Scenario 2:** Increasing earnings relative to statistical averages (B) from 58% to 100%, the net present value, internal rate of return, and benefit-cost ratio results improve to $4.6 billion, 12.0%, and 2.8, respectively, relative to base case results; a strong improvement, again attributable to a lower opportunity cost of time.

34 EMSI provided an estimate of the percentage of students employed in the event that the institutions were unable to collect the data.

TABLE 4.3: SENSITIVITY ANALYSIS OF STUDENT EMPLOYMENT VARIABLES

VARIATIONS IN ASSUMPTIONS	NET PRESENT VALUE (MILLIONS)	INTERNAL RATE OF RETURN	BENEFIT-COST RATIO
Base case: A = 56%, B = 58%	**$4,088.6**	**10.3%**	**2.3**
Scenario 1: A = 100%, B = 58%	$4,456.4	11.4%	2.6
Scenario 2: A = 56%, B = 100%	$4,610.8	12.0%	2.8
Scenario 3: A = 100%, B = 100%	$5,364.7	15.5%	3.9
Scenario 4: A = 0%, B = 0%	$3,590.8	9.1%	2.0

Note: A = percent of students employed; B = percent earned relative to statistical averages

- **Scenario 3:** Increasing both assumptions A and B to 100% simultaneously, the net present value, internal rate of return, and benefit-cost ratio improve yet further to $5.4 billion, 15.5%, and 3.9, respectively, relative to base case results. This scenario assumes that all students are fully employed and earning full salaries (equal to statistical averages) while attending classes.
- **Scenario 4:** Finally, decreasing both A and B to 0% reduces the net present value, internal rate of return, and benefit-cost ratio to $3.6 billion, 9.1%, and 2.0, respectively, relative to base case results. These results are reflective of an increased opportunity cost; none of the students are employed in this case.[35]

It is strongly emphasized in this section that base case results are very attractive in that results are all above their threshold levels. As is clearly demonstrated here, results of the first three alternative scenarios appear much more attractive, although they overstate benefits. Results presented in Section 3 are realistic, indicating that investments in North Carolina's private colleges and universities generate excellent returns, well above the long-term average percent rates of return in stock and bond markets.

4.4 DISCOUNT TO PRESENT VALUE

In order to convert future monies to their present value, a rate of interest known as the discount rate must be applied. This process is called "discounting to present value." In investment analysis, the application of a discount rate to future sums of money accounts for two fundamental principles: 1) the time value of money, and 2) the level of risk that an investor is willing to accept. Time value of money refers to the value of money after interest or inflation has accrued over a given length of time. An investor must be willing to forgo the use of his money in the present if he wishes to receive compensation for it in the future. Discounting to present value also addresses the investors' risk preferences by serving as a proxy for the minimum rate of return that the proposed risky asset must be expected to yield before the investors will be persuaded to invest in it. Typically this minimum rate of return is determined by the known returns of less risky assets where the investors might alternatively consider placing their money.

In this study, we assume a 4.5% discount rate for students and a 1.1% discount rate for society.[36] Similar to the sensitivity analysis of the alternative education variable, we vary the base case discount rates for students and society on either side by increasing the discount rate by 10%, 25%, and 50%, and then reducing it by 10%, 25%, and 50%. Note that, because the rate of return and the payback period are both based on the undiscounted cash flows, they are unaffected by changes in the discount rate. As such, only variations in the net present value and the benefit-cost ratio are shown for students and society in Table 4.4.

35 Note that reducing the percentage of students employed to 0% automatically negates the percentage they earn relative to full earning potential, since none of the students receive any earnings in this case.

36 These values are based on the baseline forecasts for the 10-year zero coupon bond discount rate published by the Congressional Budget Office, and the real treasury interest rates recommended by the Office for Management and Budget (OMB) for 30-year investments. See the Congressional Budget Office, Student Loan and Pell Grant Programs - March 2012 Baseline, and the Office of Management and Budget, Circular A-94 Appendix C, last modified December 2012.

TABLE 4.4: SENSITIVITY ANALYSIS OF DISCOUNT RATE

% VARIATION IN ASSUMPTION	-50%	-25%	-10%	BASE CASE	10%	25%	50%
STUDENT PERSPECTIVE							
Discount rate	2.2%	3.4%	4.0%	4.5%	4.9%	5.6%	6.7%
Benefits (millions)	$10,923	$8,814	$7,807	$7,221	$6,695	$6,001	$5,053
Benefit-cost ratio	3.5	2.8	2.5	2.3	2.1	1.9	1.8
SOCIETAL PERSPECTIVE							
Discount rate	0.6%	0.8%	1.0%	1.1%	1.2%	1.4%	1.7%
Benefits (millions)	$35,304	$33,722	$32,829	$32,255	$31,698	$30,893	$29,627
Benefit-cost ratio	4.0	3.8	3.7	3.6	3.6	3.5	3.3

As demonstrated in the table, an increase in the discount rate leads to a corresponding decrease in the expected returns, and vice versa. For example, increasing the student discount rate by 50% (from 4.5% to 6.7%) reduces the students' benefit-cost ratio from 2.3 to 1.8. Conversely, reducing the discount rate for students by 50% (from 4.5% to 2.2%) increases the benefit-cost ratio from 2.3 to 3.5. The sensitivity analysis results for society show the same inverse relationship between the discount rate and the benefit-cost ratio, going from a 4.0 benefit-cost ratio at a -50% variation from the base case, to a 3.3 benefit-cost ratio at a 50% variation from the base case.

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APPENDIX 1: NORTH CAROLINA'S INDEPENDENT COLLEGES AND UNIVERSITIES

Barton College	Livingstone College
Belmont Abbey College	Louisburg College
Bennett College	Mars Hill University
Brevard College	Meredith College
Cabarrus College of Health Sciences	Methodist University
Campbell University	Montreat College
Catawba College	N. C. Wesleyan College
Chowan University	Pfeiffer University
Davidson College	Queens University of Charlotte
Duke University	St. Andrews University
Elon University	Saint Augustine's University
Gardner-Webb University	Salem College
Greensboro College	Shaw University
Guilford College	University of Mount Olive
High Point University	Wake Forest University
Johnson C. Smith University	Warren Wilson College
Lees-McRae College	William Peace University
Lenoir-Rhyne University	Wingate University

APPENDIX 2: GLOSSARY OF TERMS

Alternative education A "with" and "without" measure of the percent of students who would still be able to avail themselves of education if the institutions under analysis did not exist. An estimate of 10%, for example, means that 10% of students do not depend directly on the existence of the institutions in order to obtain their education.

Alternative use of funds A measure of how monies that are currently used to fund the institutions might have otherwise been used if the institutions did not exist.

Asset value Capitalized value of a stream of future returns. Asset value measures what someone would have to pay today for an instrument that provides the same stream of future revenues.

Attrition rate Rate at which students leave the workforce due to out-migration, unemployment, retirement, or death.

Benefit-cost ratio Present value of benefits divided by present value of costs. If the benefit-cost ratio is greater than 1, then benefits exceed costs, and the investment is feasible.

Credit hour equivalent A credit hour equivalent, or CHE, is defined as 15 contact hours of education if on a semester system, and 10 contact hours if on a quarter system. In general, it requires 450 contact hours to complete one full-time equivalent, or FTE.

Demand Relationship between the market price of education and the volume of education demanded (expressed in terms of enrollment). The law of the downward-sloping demand curve is related to the fact that enrollment increases only if the price (tuition and fees) is lowered, or conversely, enrollment decreases if price increases.

Discount rate Rate of interest used to convert future revenues and costs to their present values.

Economics Study of the allocation of scarce resources among alternative and competing ends. Economics is not normative (what ought to be done), but positive (describes what is, or how people are likely to behave in response to economic changes).

Elasticity of demand Degree of responsiveness of the quantity of education demanded (enrollment) to changes in market prices (tuition and fees). If a decrease in fees increases total revenues, demand is elastic. If it decreases total revenues, demand is inelastic. If total revenues remain the same, elasticity of demand is unitary.

Externalities Impacts (positive and negative) for which there is no compensation. Positive externalities of education include improved social behaviors such as lower crime, reduced welfare and unemployment, and improved health. Educational institutions do not receive compensation for these benefits, but benefits still occur because education is statistically proven to lead to improved social behaviors.

Gross State Product Measure of the final value of all goods and services produced in a

state after netting out the cost of goods used in production. Alternatively, Gross State Product (GSP) equals the combined incomes of all factors of production, i.e., labor, land and capital. These include wages, salaries, proprietors' incomes, profits, rents, and other. Gross State Product is equal to the state's total income and is also sometimes called value added.

Initial effect Income generated by the initial injection of monies into the economy through the payroll of the institutions and the higher earnings of their students.

Input-output analysis Relationship between a given set of demands for final goods and services and the implied amounts of manufactured inputs, raw materials, and labor that this requires. In an educational setting, when institutions pay wages and salaries and spend money for supplies in the state, they also generate earnings in all sectors of the economy, thereby increasing the demand for goods and services and jobs. Moreover, as students enter or rejoin the workforce with higher skills, they earn higher salaries and wages. In turn, this generates more consumption and spending in other sectors of the economy.

Internal rate of return Rate of interest that, when used to discount cash flows associated with investing in education, reduces its net present value to zero (i.e., where the present value of revenues accruing from the investment are just equal to the present value of costs incurred). This, in effect, is the breakeven rate of return on investment since it shows the highest rate of interest at which the investment makes neither a profit nor a loss.

Labor income Income that is received as a result of labor (i.e., wages).

Multiplier effect Additional income created in the economy as the institutions and their students spend money in the state. It consists of the income created by the supply chain of the industries initially affected by the spending of the institutions and their students (i.e., the direct effect), income created by the supply chain of the initial supply chain (i.e., the indirect effect), and the income created by the increased spending of the household sector (i.e., the induced effect).

Net cash flow Benefits minus costs; i.e., the sum of revenues accruing from an investment minus costs incurred.

Net present value Net cash flow discounted to the present. All future cash flows are collapsed into one number, which, if positive, indicates feasibility. The result is expressed as a monetary measure.

Non-labor income Income received from investments, such as rent, interest, and dividends.

Opportunity cost Benefits forgone from alternative B once a decision is made to allocate resources to alternative A. Or, if individuals choose to attend college, they forgo earnings that they would have received had they chosen instead to work full-time. Forgone earnings, therefore, are the "price tag" of choosing to attend college.

Payback period Length of time required to recover an investment. The shorter the period, the more attractive the investment. The formula for computing payback period is:

Payback period =
cost of investment/net return per period

APPENDIX 3: EMSI MR-SAM

EMSI's Multi-Regional Social Accounting Matrix (MR-SAM) represents the flow of all economic transactions in a given region. It replaces EMSI's previous input-output (IO) model, which operated with some 1,100 industries, four layers of government, a single household consumption sector, and an investment sector. The old IO model was used to simulate the ripple effects (i.e., multipliers) in the regional economy as a result of industries entering or exiting the region. The SAM model performs the same tasks as the old IO model, but it also does much more. Along with the same 1,100 industries, government, household and investment sectors embedded in the old IO tool, the SAM exhibits much more functionality, a greater amount of data, and a higher level of detail on the demographic and occupational components of jobs (16 demographic cohorts and about 750 occupations are characterized).

This appendix presents a high-level overview of the MR-SAM. Additional documentation on the technical aspects of the model is available upon request.

A3.1 DATA SOURCES FOR THE MODEL

The EMSI MR-SAM model relies on a number of internal and external data sources, mostly compiled by the federal government. What follows is a listing and short explanation of our sources. The use of these data will be covered in more detail later in this appendix.

- **EMSI Data** are produced from many data sources to produce detailed industry, occupation, and demographic jobs and earnings data at the local level. This information (especially sales-to-jobs ratios derived from jobs and earnings-to-sales ratios) is used to help regionalize the national matrices as well as to disaggregate them into more detailed industries than are normally available.
- **BEA Make and Use Tables** (MUT) are the basis for input-output models in the U.S. The make table is a matrix that describes the amount of each commodity made by each industry in a given year. Industries are placed in the rows and commodities in the columns. The use table is a matrix that describes the amount of each commodity used by each industry in a given year. In the use table, commodities are placed in the rows and industries in the columns. The BEA produces two different sets of MUTs, the benchmark and the summary. The benchmark set contains about 500 sectors and is released every five years, with a five-year lag time (e.g., 2002 benchmark MUTs were released in 2007). The summary set contains about 80 sectors and is released every year, with a two-year lag (e.g., 2010 summary MUTs were released in late 2011/early 2012). The MUTs are used in the EMSI SAM model to produce an industry-by-industry matrix describing all industry purchases from all industries.

- **BEA Gross Domestic Product by State** (GSP) describes gross domestic product from the value added perspective. Value added is equal to employee compensation, gross operating surplus, and taxes on production and imports, less subsidies. Each of these components is reported for each state and an aggregate group of industries. This dataset is updated once per year, with a one-year lag. The EMSI SAM model makes use of this data as a control and pegs certain pieces of the model to values from this dataset.

- **BEA National Income and Product Accounts** (NIPA) cover a wide variety of economic measures for the nation, including gross domestic product (GDP), sources of output, and distribution of income. This dataset is updated periodically throughout the year and can be between a month and several years old depending on the specific account. NIPA data are used in many of the EMSI MR-SAM processes as both controls and seeds.

- **BEA Local Area Income** (LPI) encapsulates multiple tables with geographies down to the county level. The following two tables are specifically used: CA05 (Personal income and earnings by industry) and CA91 (Gross flow of earnings). CA91 is used when creating the commuting submodel and CA05 is used in several processes to help with place-of-work and place-of-residence differences, as well as to calculate personal income, transfers, dividends, interest, and rent.

- **BLS Consumer Expenditure Survey** (CEX) reports on the buying habits of consumers along with some information as to their income, consumer unit, and demographics. EMSI utilizes this data heavily in the creation of the national demographic by income type consumption on industries.

- **Census of Government's** (CoG) state and local government finance dataset is used specifically to aid breaking out state and local data that is reported in the MUTs. This allows EMSI to have unique production functions for each of its state and local government sectors.

- **Census' OnTheMap** (OTM) is a collection of three datasets for the census block level for multiple years. **Origin-Destination** (OD) offers job totals associated with both home census blocks and a work census block. **Residence Area Characteristics** (RAC) offers jobs totaled by home census block. **Workplace Area Characteristics** (WAC) offers jobs totaled by work census block. All three of these are used in the commuting submodel to gain better estimates of earnings by industry that may be counted as commuting. This dataset has holes for specific years and regions. These holes are filled with Census' Journey-to-Work described later.

- **Census' Current Population Survey** (CPS) is used as the basis for the demographic breakout data of the MR-SAM model. This set is used to estimate the ratios of demographic cohorts and their income for the three different income categories (i.e., wages, property income, and transfers).

- **Census' Journey-to-Work** (JtW) is part of the 2000 Census and describes the amount of commuting jobs between counties. This set is used to fill in the areas where OTM does not have data.

- **Census' American Community Survey** (ACS) Public Use Microdata Sample (PUMS) is the replacement for Census' long form and is used by EMSI to fill the holes in the CPS data.
- **Oak Ridge National Lab (ORNL) County-to-County Distance Matrix** (Skim Tree) contains a matrix of distances and network impedances between each county via various modes of transportation such as highway, railroad, water, and combined highway-rail. Also included in this set are minimum impedances utilizing the best combination of paths. The ORNL distance matrix is used in EMSI's gravitational flows model that estimates the amount of trade between counties in the country.

A3.2 OVERVIEW OF THE MR-SAM MODEL

EMSI's MR-SAM modeling system is a comparative static model in the same general class as RIMS II (Bureau of Economic Analysis) and IMPLAN (Minnesota Implan Group). The MR-SAM model is thus not an econometric model, the primary example of which is PolicyInsight by REMI. It relies on a matrix representation of industry-to-industry purchasing patterns originally based on national data which are regionalized with the use of local data and mathematical manipulation (i.e., non-survey methods). Models of this type estimate the ripple effects of changes in jobs, earnings, or sales in one or more industries upon other industries in a region.

The EMSI SAM model shows final equilibrium impacts – that is, the user enters a change that perturbs the economy and the model shows the changes required to establish a new equilibrium. As such, it is not a dynamic model that shows year-by-year changes over time (as REMI's does).

A3.2.1 National SAM

Following standard practice, the SAM model appears as a square matrix, with each row sum exactly equaling the corresponding column sum. Reflecting its kinship with the standard Leontief input-output framework, individual SAM elements show accounting flows between row and column sectors during a chosen base year. Read across rows, SAM entries show the flow of funds into column accounts (also known as receipts or the appropriation of funds by those column accounts). Read down columns, SAM entries show the flow of funds into row accounts (also known as expenditures or the dispersal of funds to those row accounts).

The SAM may be broken into three different aggregation layers: broad accounts, sub-accounts, and detailed accounts. The broad layer is the most aggregate and will be covered first. Broad accounts cover between one and four sub-accounts, which in turn cover many detailed accounts. This appendix will not discuss detailed accounts directly because of their number. For example, in the industry broad account, there are two sub-accounts and over 1,100 detailed accounts.

A3.2.2 Multi-regional aspect of the SAM

Multi-regional (MR) describes a non-survey model that has the ability to analyze the transactions and ripple effects (i.e., multipliers) of not just a single region, but multiple regions interacting with each other. Regions in this case are made up of a collection of counties.

EMSI's multi-regional model is built off of gravitational flows, assuming that the larger a county's economy, the more influence it will have on the surrounding counties' purchases

and sales. The equation behind this model is essentially the same that Isaac Newton used to calculate the gravitational pull between planets and stars. In Newton's equation, the masses of both objects are multiplied, then divided by the distance separating them and multiplied by a constant. In EMSI's model, the masses are replaced with the supply of a sector for one county and the demand for that same sector from another county. The distance is replaced with an impedance value that takes into account the distance, type of roads, rail lines, and other modes of transportation. Once this is calculated for every county-to-county pair, a set of mathematical operations is performed to make sure all counties absorb the correct amount of supply from every county and the correct amount of demand from every county. These operations produce more than 200 million data points.

A3.3 COMPONENTS OF THE EMSI MR-SAM MODEL

The EMSI MR-SAM is built from a number of different components that are gathered together to display information whenever a user selects a region. What follows is a description of each of these components and how each is created. EMSI's internally created data are used to a great extent throughout the processes described below, but its creation is not described in this appendix.

A3.3.1 County earnings distribution matrix

The county earnings distribution matrices describe the earnings spent by every industry on every occupation for a year (i.e., earnings by occupation). The matrices are built utilizing EMSI's industry earnings, occupational average earnings, and staffing patterns.

Each matrix starts with a region's staffing pattern matrix which is multiplied by the industry jobs vector. This produces the number of occupational jobs in each industry for the region. Next, the occupational average hourly earnings per job is multiplied by 2,080 hours, which converts the average hourly earnings into a yearly estimate. Then the matrix of occupational jobs is multiplied by the occupational annual earnings per job, converting it into earnings values. Last, all earnings are adjusted to match the known industry totals. This is a fairly simple process, but one that is very important. These matrices describe the place-of-work earnings used by the MR-SAM.

A3.3.2 Commuting model

The commuting sub-model is an integral part of EMSI's MR-SAM model. It allows the regional and multi-regional models to know what amount of the earnings can be attributed to place-of-residence vs. place-of-work. The commuting data describe the flow of earnings from any county to any other county (including within the counties themselves). For this situation, the commuted earnings are not just a single value describing total earnings flows over a complete year, but are broken out by occupation and demographic. Breaking out the earnings allows for analysis of place-of-residence and place-of-work earnings. These data are created using BLS' OnTheMap dataset, Census' Journey-to-Work, BEA's LPI CA91 and CA05 tables, and some of EMSI's data. The process incorporates the cleanup and disaggregation of the OnTheMap data, the estimation of a closed system of county inflows and outflows of earnings, and the creation of finalized commuting data.

A3.3.3 National SAM

The national SAM as described above is made

up of several different components. Many of the elements discussed are filled in with values from the national Z matrix – or industry-to-industry transaction matrix. This matrix is built from BEA data that describe which industries make and use what commodities at the national level. These data are manipulated with some industry standard equations to produce the national Z matrix. The data in the Z matrix act as the basis for the majority of the data in the national SAM. The rest of the values are filled in with data from the county earnings distribution matrices, the commuting data, and the BEA's National Income and Product Accounts.

One of the major issues that affect any SAM project is the combination of data from multiple sources that may not be consistent with one another. Matrix balancing is the broad name for the techniques used to correct this problem. EMSI uses a modification of the "diagonal similarity scaling" algorithm to balance the national SAM.

A3.3.4 Gravitational flows model

The most important piece of the EMSI MR-SAM model is the gravitational flows model that produces county-by-county regional purchasing coefficients (RPCs). RPCs estimate how much an industry purchases from other industries inside and outside of the defined region. This information is critical for calculating all IO models.

Gravity modeling starts with the creation of an impedance matrix that values the difficulty of moving a product from county to county. For each sector, an impedance matrix is created based on a set of distance impedance methods for that sector. A distance impedance method is one of the measurements reported in the Oak Ridge National Laboratory's County-to-County Distance Matrix. In this matrix, every county-to-county relationship is accounted for in six measures: great-circle distance, highway impedance, rail miles, rail impedance, water impedance, and highway-rail-highway impedance. Next, using the impedance information, the trade flows for each industry in every county are solved for. The result is an estimate of multi-regional flows from every county to every county. These flows are divided by each respective county's demand to produce multi-regional RPCs.

APPENDIX 4: VALUE PER CREDIT HOUR EQUIVALENT AND THE MINCER FUNCTION

Two key components in the analysis are 1) the value of the students' educational achievements, and 2) the change in that value over the students' working careers. Both of these components are described in detail in this appendix.

A4.1 VALUE PER CHE

Typically the educational achievements of students are marked by the credentials they earn. However, not all students who attended the NCICU campuses in the 2012-13 analysis year obtained a degree or certificate. Some returned the following year to complete their education goals, while others took a few courses and entered the workforce without graduating. As such, the only way to measure the value of the students' achievement is through their credit hour equivalents, or CHEs. This approach allows us to see the benefits to all students who attended the institutions, not just those who earned a credential.

To calculate the value per CHE, we first determine how many CHEs are required to complete each education level. For example, assuming that there are 30 CHEs in an academic year, a student generally completes 60 CHEs in order to move from a high school diploma to an associate's degree, another 60 CHEs to move from an associate's degree to a bachelor's degree, and so on. This progression of CHEs generates an education ladder beginning at the less than high school level and ending with the completion of a doctoral degree, with each level of education representing a separate stage in the progression.

The second step is to assign a unique value to the CHEs in the education ladder based on the wage differentials presented in Table 1.7. For example, the difference in earnings between a high school diploma and an associate's degree is $10,800. We spread this $10,800 wage differential across the 60 CHEs that occur between the high school diploma and the associate's degree, applying a ceremonial "boost" to the last CHE in the stage to mark the achievement of the degree.[37] We repeat this process for each education level in the ladder.

Next we map the CHE production of the 2012-13 student population to the education ladder. Table 1.4 on the next page provides information on the CHE production of students attending NCICU's campuses, broken out by educational achievement. In total, students completed 2.3 million CHEs during the analysis year, excluding the CHE production of personal enrichment students. We map each of these CHEs to the education ladder depending on

37 Economic theory holds that workers that acquire education credentials send a signal to employers about their ability level. This phenomenon is commonly known as the sheepskin effect or signaling effect. The ceremonial boosts applied to the achievement of degrees in the EMSI college impact model are derived from Jaeger and Page (1996).

TABLE A4.1: AGGREGATE ANNUAL INCREASE IN INCOME OF STUDENTS AND VALUE PER CHE

Aggregate annual increase in income	$496,839,164
Total credit hour equivalents (CHEs) in FY 2012-13*	2,281,328
Value per CHE	$218

** Excludes the CHE production of personal enrichment students.*
Source: EMSI impact model.

the students' education level and the average number of CHEs they completed during the year. For example, bachelor's degree graduates are allocated to the stage between the associate's degree and the bachelor's degree, and the average number of CHEs they completed informs the shape of the distribution curve used to spread out their total CHE production within that stage of the progression.

The sum product of the CHEs earned at each step within the education ladder and their corresponding value yields the students' aggregate annual increase in income (ΔE), as shown in the following equation:

$$\Delta E = \sum_{i=1}^{n} e_i h_i \quad \text{where } i \in 1, 2, \ldots n$$

and n is the number of steps in the education ladder, e_i is the marginal earnings gain at step i, and h_i is the number of CHEs completed at step i.

Table A4.1 displays the result for the students' aggregate annual increase in income (ΔE), a total of $496.8 million. By dividing this value by the students' total production of 2.3 million CHEs during the analysis year, we derive an overall value of $218 per CHE.

A4.2 MINCER FUNCTION

The $218 value per CHE in Table A4.1 only tells part of the story, however. Human capital theory holds that earnings levels do not remain constant; rather, they start relatively low and gradually increase as the worker gains more experience. Research also shows that the earnings increment between educated and non-educated workers grows through time. These basic patterns in earnings over time were originally identified by Jacob Mincer, who viewed the lifecycle earnings distribution as a function with the key elements being earnings, years of education, and work experience, with age serving as a proxy for experience.[38] While some have criticized Mincer's earnings function, it is still upheld in recent data and has served as the foundation for a variety of research pertaining to labor economics. Those critical of the Mincer function point to several unobserved factors such as ability, socioeconomic status, and family background that also help explain higher earnings. Failure to account for these factors results in what is known as an "ability bias." Research by Card (1999 and 2001) suggests that the benefits estimated using Mincer's function are biased upwards by 10% or less. As such, we reduce the estimated benefits by 10%. We also use United States-based Mincer coefficients estimated by Polachek (2003).

Figure A4.1 illustrates several important points about the Mincer function. First, as demonstrated by the shape of the curves, an individual's earnings initially increase at an increasing rate, then increase at a decreasing rate, reach a maximum somewhere well after the midpoint of the working career, and then decline in later years. Second, individuals with higher levels of education reach their

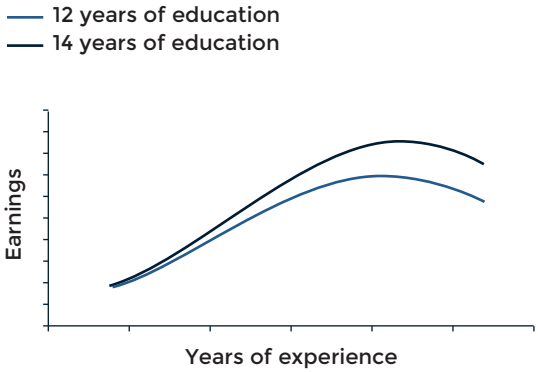
38 See Mincer (1958 and 1974).

maximum earnings at an older age compared to individuals with lower levels of education (recall that age serves as a proxy for years of experience). And third, the benefits of education, as measured by the difference in earnings between education levels, increase with age.

In calculating the alumni impact in Section 2, we use the slope of the curve in Mincer's earnings function to condition the $218 value per CHE to the students' age and work experience. To the students just starting their career during the analysis year, we apply a lower value per CHE; to the students in the latter half or approaching the end of their careers we apply a higher value per CHE. The original $218 value per CHE applies only to the CHE production of students precisely at the midpoint of their careers during the analysis year.

In Section 3 we again apply the Mincer function, this time to project the benefits stream of the 2012-13 student population into the future.

FIGURE A4.1: LIFECYCLE CHANGE IN EARNINGS, 12 YEARS VERSUS 14 YEARS OF EDUCATION



Here too the value per CHE is lower for students at the start of their career and higher near the end of it, in accordance with the scalars derived from the slope of the Mincer curve illustrated in Figure A4.1.

APPENDIX 5: ALTERNATIVE EDUCATION VARIABLE

In a scenario where North Carolina's independent colleges and universities do not exist, some of their students would still be able to avail themselves of an alternative comparable education. These students create benefits in the state even in the absence of the institutions. The alternative education variable accounts for these students and is used to discount the benefits presented in the analysis.

Recall this analysis considers only relevant economic information regarding NCICU's campuses. Considering the existence of various other academic institutions surrounding the NCICU campuses, we have to assume that a portion of the students could find alternative educations and either remain in or return to North Carolina. For example, some students may participate in online programs while remaining in the state. Others may attend an out-of-state institution and return to North Carolina upon completing their studies. For these students (i.e., those who would have found an alternative education and produced benefits in North Carolina regardless of the presence of the NCICU campuses), we discount the benefits attributed to the campuses. An important distinction must be made here: the benefits from students who would have found alternative educations outside the state and would not have returned to North Carolina are not discounted. Because these benefits would not have occurred in the state without the presence of NCICU's campuses, they must be included in the analysis.

In the absence of North Carolina's private colleges and universities, we assume 15% of students attending the institutions would have been able to find alternative education opportunities and either remain in or return to North Carolina. We account for this by discounting the alumni impact, the benefits to society, and the benefits to taxpayers in Sections 2 and 3 by 15%. In other words, we assume that 15% of the benefits created by students attending the institutions would have occurred anyway in the counterfactual scenario where the institutions do not exist. A sensitivity analysis of this adjustment is presented in Section 4.

APPENDIX 6: OVERVIEW OF INVESTMENT ANALYSIS MEASURES

The purpose of this appendix is to provide context to the investment analysis results using the simple hypothetical example summarized in Table A6.1 below. The table shows the projected benefits and costs for a single student over time and associated investment analysis results.[39]

Assumptions are as follows:

- Benefits and costs are projected out ten years into the future (Column 1).
- The student attends one of the institutions for one year, and the cost of tuition is $1,500 (Column 2).
- Earnings forgone while attending one of the institutions for one year (opportunity cost) come to $20,000 (Column 3).
- Together, tuition and earnings forgone cost sum to $21,500. This represents the out-of-pocket investment made by the student (Column 4).
- In return, the student earns $5,000 more per year than he would have otherwise

39 Note that this is a hypothetical example. The numbers used are not based on data collected from an existing institution.

TABLE A6.1: EXAMPLE OF THE BENEFITS AND COSTS OF EDUCATION FOR A SINGLE STUDENT

1	2	3	4	5	6
YEAR	TUITION	OPPORTUNITY COST	TOTAL COST	HIGHER EARNINGS	NET CASH FLOW
1	$1,500	$20,000	$21,500	$0	-$21,500
2	$0	$0	$0	$5,000	$5,000
3	$0	$0	$0	$5,000	$5,000
4	$0	$0	$0	$5,000	$5,000
5	$0	$0	$0	$5,000	$5,000
6	$0	$0	$0	$5,000	$5,000
7	$0	$0	$0	$5,000	$5,000
8	$0	$0	$0	$5,000	$5,000
9	$0	$0	$0	$5,000	$5,000
10	$0	$0	$0	$5,000	$5,000
NET PRESENT VALUE			$21,500	$35,753	$14,253
Internal rate of return					**18.0%**
Benefit-cost ratio					**1.7**
Payback period					**4.2 years**

earned without the education (Column 5).

- The net cash flow (NCF) in Column 6 shows higher earnings (Column 5) less the total cost (Column 4).
- The assumed going rate of interest is 4%, the rate of return from alternative investment schemes for the use of the $21,500.

Results are expressed in standard investment analysis terms, which are as follows: the net present value, the internal rate of return, the benefit-cost ratio, and the payback period. Each of these is briefly explained below in the context of the cash flow numbers presented in Table A6.1.

A6.1 NET PRESENT VALUE

The student in Table A6.1 can choose either to attend one of the institutions or to forgo post-secondary education and maintain his present employment. If he decides to enroll, certain economic implications unfold. Tuition and fees must be paid, and earnings will cease for one year. In exchange, the student calculates that with post-secondary education, his income will increase by at least the $5,000 per year, as indicated in the table.

The question is simple: Will the prospective student be economically better off by choosing to enroll? If he adds up higher earnings of $5,000 per year for the remaining nine years in Table A6.1, the total will be $45,000. Compared to a total investment of $21,500, this appears to be a very solid investment. The reality, however, is different. Benefits are far lower than $45,000 because future money is worth less than present money. Costs (tuition plus earnings forgone) are felt immediately because they are incurred today, in the present. Benefits, on the other hand, occur in the future. They are not yet available. All future benefits must be discounted by the going rate of interest (referred to as the discount rate) to be able to express them in present value terms.[40]

Let us take a brief example. At 4%, the present value of $5,000 to be received one year from today is $4,807. If the $5,000 were to be received in year 10, the present value would reduce to $3,377. Put another way, $4,807 deposited in the bank today earning 4% interest will grow to $5,000 in one year; and $3,377 deposited today would grow to $5,000 in ten years. An "economically rational" person would, therefore, be equally satisfied receiving $3,377 today or $5,000 ten years from today given the going rate of interest of 4%. The process of discounting – finding the present value of future higher earnings – allows the model to express values on an equal basis in future or present value terms.

The goal is to express all future higher earnings in present value terms so that they can be compared to investments incurred today (in this example, tuition plus earnings forgone). As indicated in Table A6.1, the cumulative present value of $5,000 worth of higher earnings between years 2 and 10 is $35,753 given the 4% interest rate, far lower than the undiscounted $45,000 discussed above.

The net present value of the investment is $14,253. This is simply the present value of the benefits less the present value of the costs, or $35,753 - $21,500 = $14,253. In other words, the present value of benefits exceeds the present value of costs by as much as $14,253. The criterion for an economically worthwhile

40 Technically, the interest rate is applied to compounding – the process of looking at deposits today and determining how much they will be worth in the future. The same interest rate is called a discount rate when the process is reversed – determining the present value of future earnings.

investment is that the net present value is equal to or greater than zero. Given this result, it can be concluded that, in this case, and given these assumptions, this particular investment in education is very strong.

A6.2 INTERNAL RATE OF RETURN

The internal rate of return is another way of measuring the worth of investing in education using the same cash flows shown in Table A6.1. In technical terms, the internal rate of return is a measure of the average earning power of money used over the life of the investment. It is simply the interest rate that makes the net present value equal to zero. In the discussion of the net present value above, the model applies the going rate of interest of 4% and computes a positive net present value of $14,253. The question now is what the interest rate would have to be in order to reduce the net present value to zero. Obviously it would have to be higher – 18.0% in fact, as indicated in Table A6.1. Or, if a discount rate of 18.0% were applied to the net present value calculations instead of the 4%, then the net present value would reduce to zero.

What does this mean? The internal rate of return of 18.0% defines a breakeven solution – the point where the present value of benefits just equals the present value of costs, or where the net present value equals zero. Or, at 18.0%, higher incomes of $5,000 per year for the next nine years will earn back all investments of $21,500 made plus pay 18.0% for the use of that money ($21,500) in the meantime. Is this a good return? Indeed it is. If it is compared to the 4% going rate of interest applied to the net present value calculations, 18.0% is far higher than 4%. It may be concluded, therefore, that the investment in this case is solid. Alternatively, comparing the 18.0% rate of return to the long-term 7% rate or so obtained from investments in stocks and bonds also indicates that the investment in education is strong relative to the stock market returns (on average).

A6.3 BENEFIT-COST RATIO

The benefit-cost ratio is simply the present value of benefits divided by present value of costs, or $35,753 ÷ $21,500 = 1.7 (based on the 4% discount rate). Of course, any change in the discount rate would also change the benefit-cost ratio. Applying the 18.0% internal rate of return discussed above would reduce the benefit-cost ratio to 1.0, the breakeven solution where benefits just equal costs. Applying a discount rate higher than the 18.0% would reduce the ratio to lower than 1.0, and the investment would not be feasible. The 1.7 ratio means that a dollar invested today will return a cumulative $1.70 over the ten-year time period.

A6.4 PAYBACK PERIOD

This is the length of time from the beginning of the investment (consisting of tuition and earnings forgone) until higher future earnings give a return on the investment made. For the student in Table A6.1, it will take roughly 4.2 years of $5,000 worth of higher earnings to recapture his investment of $1,500 in tuition and the $20,000 in earnings forgone while attending the institutions. Higher earnings that occur beyond 4.2 years are the returns that make the investment in education in this example economically worthwhile. The payback period is a fairly rough, albeit common, means of choosing between investments. The shorter the payback period, the stronger the investment.

APPENDIX 7: SOCIAL EXTERNALITIES

Education has a predictable and positive effect on a diverse array of social benefits. These, when quantified in dollar terms, represent significant social savings that directly benefit communities and citizens throughout North Carolina, including taxpayers. In this appendix we discuss the following three main benefit categories: 1) improved health, 2) reductions in crime, and 3) reductions in welfare and unemployment.

It is important to note that the data and estimates presented here should not be viewed as exact, but rather as indicative of the positive impacts of education on an individual's quality of life. The process of quantifying these impacts requires a number of assumptions to be made, creating a level of uncertainty that should be borne in mind when reviewing the results.

A7.1 HEALTH

Statistics clearly show the correlation between increases in education and improved health. The manifestations of this are found in five health-related variables: smoking, alcoholism, obesity, mental illness, and drug abuse. There are other health-related areas that link to educational attainment, but these are omitted from the analysis until we can invoke adequate (and mutually exclusive) databases and are able to fully develop the functional relationships between them.

A7.1.1 Smoking

Despite a marked decline over the last several decades in the percentage of U.S. residents that smoke, a sizeable percentage of the U.S. population still uses tobacco. The negative health effects of smoking are well documented in the literature, which identifies smoking as one of the most serious health issues in the U.S.

Figure A7.1 shows the prevalence of cigarette smoking among adults aged 25 years and over, based on data provided by the National Health Interview Survey.[41] As indicated, the percent of persons who smoke begins to decline beyond the level of high school education.

The Centers for Disease Control and Preven-

41 Centers for Disease Control and Prevention, "Table 61. Age-adjusted prevalence of current cigarette smoking among adults aged 25 and over, by sex, race, and education level: United States, selected years 1974-2011," National Health Interview Survey, 2011.

FIGURE A7.1: PREVALENCE OF SMOKING AMONG U.S. ADULTS BY EDUCATION LEVEL

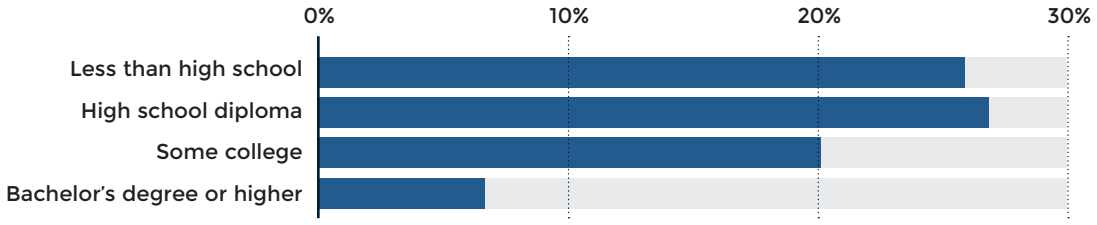
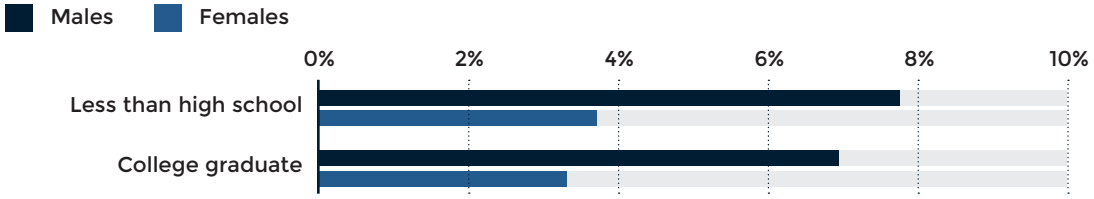


FIGURE A7.2: PREVALENCE OF ALCOHOL DEPENDENCE OR ABUSE BY SEX AND EDUCATION LEVEL



tion (CDC) reports the percentage of adults who are current smokers by state.[42] We use this information to create an index value by which we adjust the national prevalence data on smoking to each state. For example, 21.8% of North Carolina' adults were smokers in 2011, relative to 21.2% for the nation. We thus apply a scalar of 1.0 to the national probabilities of smoking in order to adjust them to the state of North Carolina.

A7.1.2 Alcohol abuse

Alcoholism is difficult to measure and define. There are many patterns of drinking, ranging from abstinence to heavy drinking. Alcohol abuse is riddled with social costs, including healthcare expenditures for treatment, prevention, and support; workplace losses due to reduced worker productivity; and other effects.

Figure A7.2 compares the percent of males and females aged 26 and older that abuse or depend on alcohol at the less than high school level to the prevalence rate of alcoholism among college graduates, based on data supplied by the Substance Abuse and Mental Health Services Administration (SAMHSA).[43] These statistics give an indication of the correlation between education and the reduced probability of alcoholism. As indicated, alcohol dependence or abuse falls from a 7.7% prevalence rate among males with less than a high school diploma to a 6.9% prevalence rate among males with a college degree. Similarly, alcohol dependence or abuse among females ranges from a 3.7% prevalence rate at the less than high school level to a 3.3% prevalence rate at the college graduate level.

A7.1.3 Obesity

The rise in obesity and diet-related chronic diseases has led to increased attention on how expenditures relating to obesity have increased in recent years. The average cost of obesity-related medical conditions is calculated using information from the Journal of Occupational and Environmental Medicine, which reports incremental medical expenditures and productivity losses due to excess weight.[44] The CDC also reports the prevalence of obesity among adults by state.[45]

Data for Figure A7.3 was provided by the

42 Centers for Disease Control and Prevention, "Adults who are current smokers" in "Tobacco Use – 2011," Behavioral Risk Factor Surveillance System Prevalence and Trends Data, accessed August 2013, http://apps.nccd.cdc.gov/brfss/list.asp?cat=TU&yr=2011&qkey=8161&state=All.

43 Substance Abuse and Mental Health Services Administration, "Table 5.7B - Substance Dependence or Abuse in the Past Year among Persons Aged 26 or Older, by Demographic Characteristics: Percentages, 2010 and 2011," Center for Behavioral Health Statistics and Quality, National Survey on Drug Use and Health, 2010 and 2011.

44 Eric A. Finkelstein, Marco da Costa DiBonaventura, Somali M. Burgess, and Brent C. Hale, "The Costs of Obesity in the Workplace," *Journal of Occupational and Environmental Medicine* 52, no. 10 (October 2010): 971-976.

45 Centers for Disease Control and Prevention, "Adult Obesity Facts," Overweight and Obesity, accessed August 2013, http://www.cdc.gov/obesity/data/adult.html#Prevalence.

FIGURE A7.3: PREVALENCE OF OBESITY BY EDUCATION LEVEL

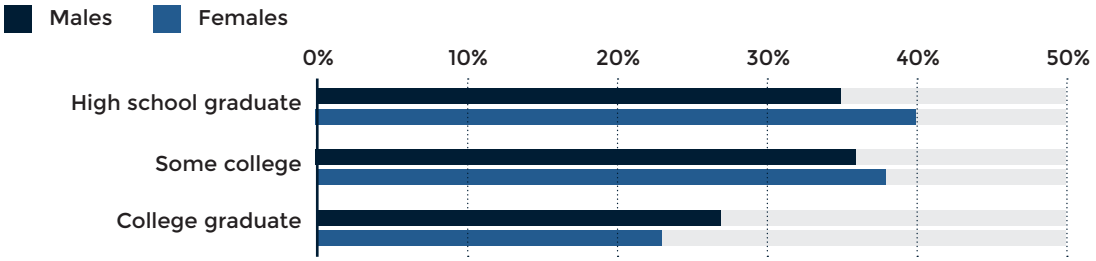
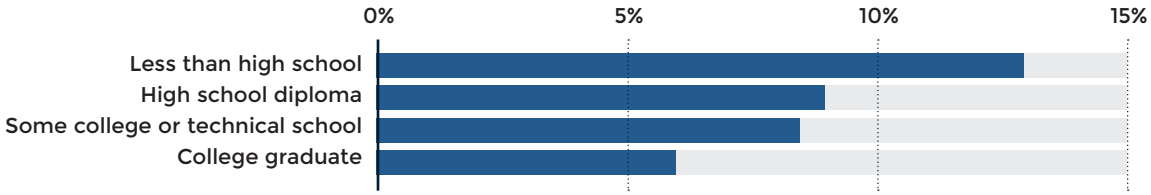


FIGURE A7.4: PREVALENCE OF FREQUENT MENTAL DISTRESS BY EDUCATION LEVEL



National Center for Health Statistics which shows the prevalence of obesity among adults aged 20 years and over by education and sex.[46] As indicated, college graduates are less likely to be obese than individuals with a high school diploma. However, the prevalence of obesity among males with some college is actually greater than males with no more than a high school diploma. In general, though, obesity tends to decline with increasing levels of education.

A7.1.4 Mental illness

Capturing the full economic cost of mental disorders is problematic because many of the costs are hidden or difficult to detach from others externalities, such as drug abuse or alcoholism. For this reason, this study only examines the costs of absenteeism caused by depression in the workplace. Figure A7.4 summarizes the prevalence of self-reported frequent mental distress among adults by education level, based on data supplied by the CDC.[47] As shown, people with higher levels of education are less likely to suffer from mental illness, with the prevalence of mental illness being the highest among people with less than a high school diploma.

A7.1.5 Drug abuse

The burden and cost of illicit drug abuse is enormous in our society, but little is known about potential costs and effects at a population level. What is known is that the rate of people abusing drugs is inversely proportional to their education level. The higher the education level, the less likely a person is to abuse or depend on illicit drugs. The probability that a person with less than a high school diploma

46 Cynthia L. Ogden, Molly M. Lamb, Margaret D. Carroll, and Katherine M. Flegal, "Figure 3. Prevalence of obesity among adults aged 20 years and over, by education, sex, and race and ethnicity: United States 2005-2008" in "Obesity and Socioeconomic Status in Adults: United States 2005-2008," NCHS data brief no. 50, Hyattsville, MD: National Center for Health Statistics, 2010.

47 Centers for Disease Control and Prevention, "Table 1. Number of respondents to a question about mental health and percentage who self-reported frequent mental distress (FMD), by demographic characteristics -- United States, Behavioral Risk Factor Surveillance System, 1993-1996" in "Self-Reported Frequent Mental Distress Among Adults -- United States, 1993-1996." *Morbidity and Mortality Weekly Report* 47, no. 16 (May 1998): 325-331.

FIGURE A7.5: PREVALENCE OF ILLICIT DRUG DEPENDENCE OR ABUSE BY EDUCATION LEVEL

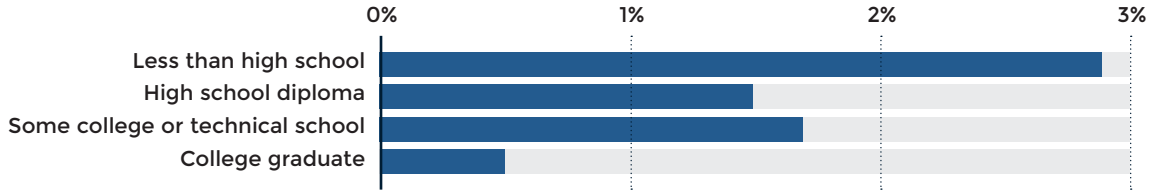
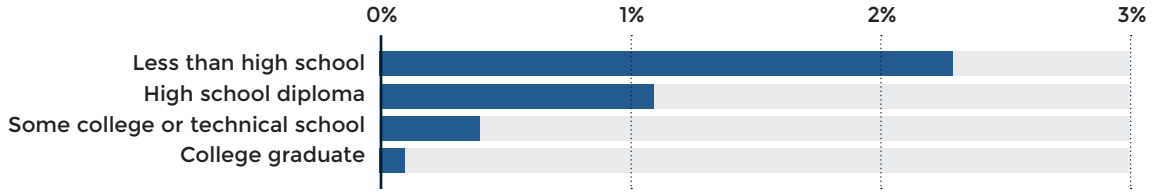


FIGURE A7.6: INCARCERATION RATES BY EDUCATION LEVEL



will abuse drugs is 2.9%, nearly six times greater than the probability of drug abuse for college graduates (0.5%). This relationship is presented in Figure A7.5 based on data supplied by SAMHSA.[48] Health costs associated with illegal drug use are also available from SAMSHA, with costs to state and local government representing 48% of the total cost related to illegal drug use.[49]

A7.2 CRIME

As people achieve higher education levels, they are statistically less likely to commit crimes. The analysis identifies the following three types of crime-related expenses: 1) criminal justice expenditures, including police protection, judicial and legal, and corrections, 2) victim costs, and 3) productivity lost as a result of time spent in jail or prison rather than working.

Figure A7.6 displays the probability that an individual will be incarcerated by education level. Data are derived from the breakdown of the inmate population by education level in federal, state, and local prisons as provided by the Bureau of Justice Statistics,[50] divided by the total adult population. As indicated, incarceration drops on a sliding scale as education levels rise.

Victim costs comprise material, medical, physical, and emotional losses suffered by crime victims. Some of these costs are hidden, while others are available in various databases. Estimates of victim costs vary widely, attributable to differences in how the costs are measured. The lower end of the scale includes only

48 Substance Abuse and Mental Health Services Administration, National Survey on Drug Use and Health, 2010 and 2011.

49 Substance Abuse and Mental Health Services Administration. "Table A.2. Spending by Payer: Levels and Percent Distribution for Mental Health and Substance Abuse (MHSA), Mental Health (MH), Substance Abuse (SA), Alcohol Abuse (AA), Drug Abuse (DA), and All-Health, 2005" in National Expenditures for Mental Health Services & Substance Abuse Treatment, 1986 – 2005. DHHS Publication No. (SMA) 10-4612. Rockville, MD: Center for Mental Health Services and Center for Substance Abuse Treatment, Substance Abuse and Mental Health Services Administration, 2010.

50 Caroline Wolf Harlow. "Table 1. Educational attainment for State and Federal prison inmates, 1997 and 1991, local jail inmates, 1996 and 1989, probationers, 1995, and the general population, 1997" in "Education and Correctional Populations." Bureau of Justice Statistics Special Report, January 2003, NCJ 195670. Accessed August 2013. http://bjs.ojp.usdoj.gov/index.cfm?ty=pbdetail&iid=814.

tangible out-of-pocket costs, while the higher end includes intangible costs related to pain and suffering (McCollister et al, 2010).

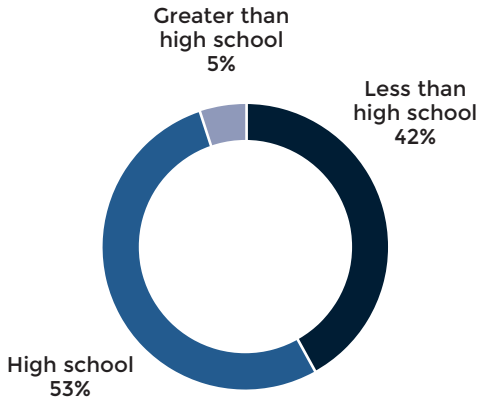
Yet another measurable benefit is the added economic productivity of people who are gainfully employed, all else being equal, and not incarcerated. The measurable productivity benefit is simply the number of additional people employed multiplied by the average income of their corresponding education levels.

A7.3 WELFARE AND UNEMPLOYMENT

Statistics show that as education levels increase, the number of welfare and unemployment applicants declines. Welfare and unemployment claimants can receive assistance from a variety of different sources, including Temporary Assistance for Needy Families (TANF), Supplemental Nutrition Assistance Program (SNAP), Medicaid, Supplemental Security Income (SSI), and unemployment insurance.[51]

Figure A7.7 relates the breakdown of TANF recipients by education level, derived from data supplied by the U.S. Department of Health and Human Services.[52] As shown, the demographic characteristics of TANF recipients are weighted heavily towards the less than high school and high school categories, with a much smaller representation of individuals with greater than a high school education.

FIGURE A7.7: BREAKDOWN OF TANF RECIPIENTS BY EDUCATION LEVEL



Unemployment rates also decline with increasing levels of education, as illustrated in Figure A7.8. These data are supplied by the Bureau of Labor Statistics.[53] As shown, unemployment rates range from 12.4% for those with less than a high school diploma to 4.0% for those at the bachelor's degree level or higher.

51 Medicaid is not considered in the analysis for welfare because it overlaps with the medical expenses in the analyses for smoking, alcoholism, obesity, mental illness, and drug abuse. We also exclude any welfare benefits associated with disability and age.

52 U.S. Department of Health and Human Services, Office of Family Assistance, "Table 10:26 - Temporary Assistance for Needy Families - Active Cases: Percent Distribution of TANF Adult Recipients by Educational Level, FY 2009" in Temporary Assistance for Needy Families Program Ninth Report to Congress, 2012.

53 Bureau of Labor Statistics, "Table 7. Employment status of the civilian noninstitutional population 25 years and over by educational attainment, sex, race, and Hispanic or Latino ethnicity." Current Population Survey, Labor Force Statistics. Accessed August 2013. http://www.bls.gov/cps/cpsaat07.pdf.

FIGURE A7.8: UNEMPLOYMENT BY EDUCATION LEVEL