OZARKS TECHNICAL COMMUNITY COLLEGE

Analysis of the Return on Investment and Economic Impact of Education

THE ECONOMIC VALUE OF
OZARKS TECHNICAL COMMUNITY COLLEGE

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MAIN REPORT

Emsi

Contents

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Executive Summary

This report assesses the impact of Ozarks Technical Community College (OTC) on the regional economy and the benefits generated by the college for students, taxpayers, and society. The results of this study show that OTC creates a positive net impact on the regional economy and generates a positive return on investment for students, taxpayers, and society.

ECONOMIC IMPACT ANALYSIS

During the analysis year, OTC spent **$47 million** on payroll and benefits for **2,021** full-time and part-time employees, and spent another **$35.5 million** on goods and services to carry out its day-to-day operations. This initial round of spending creates more spending across other businesses throughout the regional economy, resulting in the commonly referred to multiplier effects. This analysis estimates the net economic impact of OTC that directly takes into account the fact that state and local dollars spent on OTC could have been spent elsewhere in the region if not directed towards OTC 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 OTC.

This analysis shows that in Fiscal Year (FY) 2015-16, operations spending and construction spending of OTC, together with the spending from its students and alumni, generated **$234 million** in added income to the OTC Service Area economy. The additional income of $234 million created by OTC is equal to approximately **1.0%** of the total gross regional product (GRP) of the OTC Service Area, and is equivalent to supporting **5,579** jobs. For perspective, this impact from the college is nearly as large as the entire Arts, Entertainment, & Recreation industry in the region. These economic impacts break down as follows:

Operations spending impact

Payroll and benefits to support day-to-day operations of OTC amounted to **$47 million**. The net impact of operations spending toward the college in the OTC Service Area during the analysis year was approximately **$63 million** in added income, which is equivalent to supporting **2,383** jobs.

Construction spending impact

OTC spends millions of dollars on construction each year to maintain its facilities, create additional capacities, and meet its growing educational demands. While the amount varies from year to year, these quick infusions of earnings and jobs have a substantial impact on the regional economy. In FY 2015-16, the construction spending of OTC created **$1.9 million** in income, which is equivalent to creating **46** new jobs.

Student spending impact

Around 16% of students attending OTC originated from outside the region. Some of these students relocated to the OTC Service Area to attend OTC. In addition, some

IMPORTANT NOTE

When reviewing the impacts estimated in this study, it's important to note that it reports impacts in the form of added income rather than sales. Sales includes all of 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 regional product (GRP) and value added. For this reason, it is a more meaningful measure of new economic activity than sales.

students are residents of the OTC Service Area who would have left the region if not for the existence of OTC. The money that these students spent toward living expenses in the OTC Service Area is attributable to OTC.

The expenditures of relocated and retained students in the region during the analysis year added approximately **$17.1 million** in income for the OTC Service Area economy, which is equivalent to supporting **367** jobs.

Alumni impact

Over the years, students gained new skills, making them more productive workers, by studying at OTC. Today, thousands of these former students are employed in the OTC Service Area.

The accumulated impact of former students currently employed in the OTC Service Area workforce amounted to **$152 million** in added income to the OTC Service Area economy, which is equivalent to supporting **2,782** 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 OTC as an investment from the perspectives of students, taxpayers, and society.

Student perspective

Students invest their own money and time in their education to pay for tuition, books, and supplies. Many take out student loans to attend the college, which they pay back over time. While some students were employed while attending the college, students will overall forego earnings that they would have generated had they been in full employment instead of learning. Summing these direct outlays, opportunity costs, and future student loan costs yields a total of **$67.9 million** in student costs.

In return, students will receive a present value of **$357 million** in increased earnings over their working lives. This translates to a return of **$5.30** in higher future earnings for every $1 that students pay for their education at OTC. The corresponding annual rate of return is **18.5%**.

Local taxpayer perspective

Local taxpayers provided **$10.1 million** of local funding to OTC in FY 2015-16. In return, local taxpayers will receive an estimated present value of **$46.9 million** in added tax revenue stemming from the students' higher lifetime earnings, increased output of businesses, and savings to the public sector. For every local tax dollar spent on educating students attending OTC, local taxpayers will receive an average of **$4.70** in return over the course of the students' working lives. In other words, local taxpayers enjoy an annual rate of return of **13.4%**.

State and local taxpayer perspective

State and local taxpayers provided **$26.6 million** of funding to OTC in FY 2015-16. In return, state and local taxpayers will receive an estimated present value of **$161.1 million** in added tax revenue and **$11.2 million** in benefits due to a reduced demand for government-funded social services in Missouri. For every dollar state and local taxpayers spent on educating students attending OTC, they will receive an average of **$6.50** in return over the course of the students' working lives. That is to say, state and local taxpayers will receive a **15.8%** annual rate of return.

Social perspective

Missouri as a whole spent an estimated **$145.4 million** on educations obtained at OTC in FY 2015-16. This includes expenses by OTC, student expenses for direct outlays and student loans, and student opportunity costs. In return, the state of Missouri will receive an estimated present value of **$1.8 billion** in added state revenue over the course of the students' working lives. Missouri will also benefit from an estimated **$50 million** 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 OTC, an average of **$12.50** in benefits will accrue to Missouri over the course of the students' careers.

Introduction

Ozarks Technical Community College (OTC), established in 1990, has today grown to serve 18,589 credit and 1,579 non-credit students. The college is led by Dr. Hal Higdon. The college's service region, for the purpose of this report, consists of Polk, Dallas, Laclede, Pulaski, Greene, Webster, Wright, Christian, Douglas, Stone, Taney, and Ozark Counties.

While OTC affects its region in a variety of ways, many of them difficult to quantify, this study is concerned with considering its economic benefits. The college naturally helps students achieve their individual potential and develop the knowledge, skills, and abilities they need to have fulfilling and prosperous careers. However, the value of OTC consists of more than simply influencing the lives of students. The college's program offerings supply employers with workers to make their businesses more productive. The expenditures of the college, its employees, and students support the regional economy through the output and employment generated by region vendors. The benefits created by the college 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.

This report assesses the impact of OTC as a whole on the regional economy and the benefits generated by the college for students, taxpayers, and society. The approach is twofold. We begin with an economic impact analysis of the college on the OTC Service Area economy. To derive results, we rely on a specialized Multi-Regional Social Accounting Matrix (MR-SAM) model to calculate the added income created in the OTC Service Area economy as a result of increased consumer spending and the added knowledge, skills, and abilities of students. Results of the economic impact analysis are broken out according to the following impacts: 1) impact of the college's day-to-day operations, 2) impact of construction spending, 3) impact of student spending, and 4) impact of alumni who are still employed in the OTC Service Area workforce.

The second component of the study measures the benefits generated by OTC for the following stakeholder groups: students, local taxpayers, state and local 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, the cost of interest incurred on student loans, and the opportunity cost of attending the college as opposed to working. In return for these investments, students receive a lifetime of higher earnings. For taxpayers, the study measures the benefits to state and local taxpayers in the form of increased tax revenues and public sector savings stemming from a reduced demand for social services. Finally, for society, the study assesses how the students' higher earnings and improved quality of life create benefits throughout Missouri as a whole.

The study uses a wide array of data that are based on several sources, including the FY 2015-16 academic and financial reports from OTC; industry and employment data from the Bureau of Labor Statistics and Census Bureau; outputs of Emsi's impact model and MR-SAM model; and a variety of published materials relating education to social behavior.

CHAPTER 1:

Profile of Ozarks Technical Community College and the Economy

Ozarks Technical Community College (OTC) is a community technical college serving southwest Missouri, based in Springfield. OTC has grown to three campuses and two centers across southwest Missouri.

OTC offered its first classes in 1991 with 1,198 students. In its 27 years of operation, its scope has expanded significantly, as has its physical footprint and its program offerings. Notable facilities at OTC include the:

- OTC Springfield Campus
- OTC Richwood Valley Campus
- OTC Table Rock Campus
- OTC Lebanon Center
- OTC Waynesville Center

In FY 2015-16, OTC served a total of 20,168 students. OTC was founded as a two-year community college focused on technical education and to this day has a mission of job-skill training and college transfer preparation.

OTC EMPLOYEE AND FINANCE DATA

The study uses two general types of information: 1) data collected from the college and 2) regional economic data obtained from various public sources and Emsi's proprietary data modeling tools.[1] This section presents the basic underlying information from OTC used in this analysis and provides an overview of the OTC Service Area economy.

1 See Appendix 4 for a detailed description of the data sources used in the Emsi modeling tools.

Employee data

Data provided by OTC include information on faculty and staff by place of work and by place of residence. These data appear in Table 1.1. As shown, OTC employed 566 full-time and 1,455 part-time faculty and staff, including student workers, in FY 2015-16. Of these, 100% worked in the region and 92% lived in the region. These data are used to isolate the portion of the employees' payroll and household expenses that remains in the regional economy.

TABLE 1.1: Employee data, FY 2015-16

Full-time faculty and staff	566
Part-time faculty and staff	1,455
Total faculty and staff	**2,021**
% of employees that work in the region	100%
% of employees that live in the region	92%

Source: Data supplied by OTC.

Revenues

Table 1.2, on the next page, shows the college's annual revenues by funding source – a total of $86.9 million in FY 2015-16. As indicated, tuition and fees comprised 21% of total revenue, and revenues from local, state, and federal government sources comprised another 67%. All other revenue (i.e., auxiliary revenue, sales and services, interest, and donations) comprised the remaining 12%. These data

TABLE 1.2: Revenue by source, FY 2015-16

FUNDING SOURCE	TOTAL	%
Tuition and fees	$18,096,088	21%
Local government	$10,056,458	12%
State government	$16,516,597	19%
Federal government	$31,751,935	37%
All other revenue	$10,489,937	12%
Total revenues	**$86,911,015**	**100%**

Source: Data supplied by OTC.

TABLE 1.3: Expenses by function, FY 2015-16

EXPENSE ITEM	TOTAL	% OF TOTAL
Employee salaries, wages, and benefits	$46,961,326	52%
Capital depreciation	$1,352,510	1%
All other expenditures	$35,545,449	39%
Construction expenditures	$6,617,367	7%
Total expenses	**$90,476,652**	**100%**

Source: Data supplied by OTC.

are critical in identifying the annual costs of educating the student body from the perspectives of students, taxpayers, and society.

Expenditures

The combined payroll at OTC, including student salaries and wages, amounted to $47 million. This was equal to 108% of the college's total expenses for FY 2015-16. Other expenditures, including capital and purchases of supplies and services, made up $35.5 million. These budget data appear in Table 1.3.

Students

OTC served 18,589 students taking courses for credit and 1,579 non-credit students in FY 2015-16. These numbers represent unduplicated student headcounts. The breakdown of the student body by gender was 41% male and 59% female. The breakdown by ethnicity was 84% white, 15% minority, and 2% unknown. The students' overall average age was 21 years old.[2] An estimated 91% of students remain in the OTC Service Area after finishing their time at OTC, another 4% settle outside the region but in the state, and the remaining 5% settle outside the state.[3]

TABLE 1.4: Breakdown of student headcount and CHE production by education level, FY 2015-16

CATEGORY	HEADCOUNT	TOTAL CHES	AVERAGE CHES
Associate degree graduates	1,710	30,124	17.6
Certificate graduates	612	11,237	18.4
Continuing students	14,558	149,121	10.2
Dual credit students	1,709	15,741	9.2
Workforce and all other students	1,579	1,141	0.7
Total, all students	**20,168**	**207,364**	**10.3**

Source: Data supplied by OTC.

Table 1.4 summarizes the breakdown of the student population and their corresponding awards and credits by education level. In FY 2015-16, OTC served 1,710 associate degree graduates and 612 certificate graduates. Another 14,558 students enrolled in courses for credit but did not complete a degree during the reporting year. The college offered dual credit courses to high schools, serving a total of 1,709 students over the course of the year. Students not allocated to the other categories – including non-degree-seeking workforce students – comprised the remaining 1,579 students.

We use credit hour equivalents (CHEs) to track the educational workload of the students. One CHE is equal to 15 contact hours of classroom instruction per semester. The average number of CHEs per student was 10.3.

THE OTC SERVICE AREA ECONOMY

OTC serves a region referred to as the OTC Service Area in Missouri.[4] Since the college was first established, it has

2 Unduplicated headcount, gender, ethnicity, and age data provided by OTC.
3 Settlement data provided by OTC.
4 The following counties comprise the OTC Service Area: Polk, Dallas, Laclede, Pulaski, Greene, Webster, Wright, Christian, Douglas, Stone, Taney, and Ozark.

been serving the OTC Service Area by enhancing the workforce, providing local residents with easy access to higher education opportunities, and preparing students for highly-skilled, technical professions. Table 1.5 summarizes the breakdown of the regional 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 region's total income, which can also be considered as the region's gross regional product (GRP).

As shown in Table 1.5, the total income, or GRP, of the OTC Service Area is approximately $22.9 billion, equal to the sum of labor income ($15.4 billion) and non-labor income ($7.5 billion). In Chapter 2, we use the total added income as the measure of the relative impacts of the college on the regional economy.

Table 1.6, on the next page, provides the breakdown of jobs by industry in the OTC Service Area. Among the region's non-government industry sectors, the Retail Trade sector is the largest employer, supporting 46,553 jobs or 12.0% of total employment in the region. The second largest employer

TABLE 1.5: Labor and non-labor income by major industry sector in the OTC Service Area, 2016*

INDUSTRY SECTOR	LABOR INCOME (MILLIONS)	NON-LABOR INCOME (MILLIONS)	TOTAL INCOME (MILLIONS)†	% OF TOTAL INCOME	SALES (MILLIONS)
Agriculture, Forestry, Fishing, & Hunting	$288	$186	$474	2.1%	$1,416
Mining	$19	$27	$46	0.2%	$81
Utilities	$75	$143	$218	1.0%	$326
Construction	$763	$190	$953	4.2%	$1,903
Manufacturing	$1,192	$480	$1,672	7.3%	$6,254
Wholesale Trade	$813	$619	$1,432	6.2%	$2,136
Retail Trade	$1,327	$481	$1,808	7.9%	$3,080
Transportation & Warehousing	$787	$158	$945	4.1%	$2,172
Information	$272	$297	$569	2.5%	$1,369
Finance & Insurance	$852	$540	$1,392	6.1%	$2,467
Real Estate & Rental & Leasing	$394	$290	$685	3.0%	$1,696
Professional & Technical Services	$779	$104	$883	3.9%	$1,349
Management of Companies & Enterprises	$351	$38	$389	1.7%	$701
Administrative & Waste Services	$638	$114	$752	3.3%	$1,400
Educational Services, Private	$158	$11	$169	0.7%	$282
Health Care & Social Assistance	$2,309	$114	$2,423	10.6%	$4,294
Arts, Entertainment, & Recreation	$192	$69	$261	1.1%	$490
Accommodation & Food Services	$683	$266	$949	4.1%	$1,932
Other Services (except Public Administration)	$508	$2,386	$2,894	12.6%	$4,173
Government, Non-Education	$1,943	$987	$2,930	12.8%	$14,800
Government, Education	$1,038	$34	$1,072	4.7%	$1,222
Total	**$15,382**	**$7,535**	**$22,917**	**100.0%**	**$53,543**

* 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.

is the Health Care & Social Assistance sector, supporting 44,229 jobs or 11.4% of the region's total employment. Altogether, the region supports 388,675 jobs.[5]

Table 1.7 and Figure 1.1, on the next page, present the mean earnings by education level in the OTC Service Area and the state of Missouri at the midpoint of the average-aged worker's career. These numbers are derived from Emsi's complete employment data on average earnings per worker in the region and the state.[6] The numbers are then weighted by the college's demographic profile. 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 an associate degree from OTC can expect approximate wages of $26,400 per year within the OTC Service Area, approximately $3,200 more than someone with a high school diploma.

5 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.

6 Wage rates in the Emsi MR-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 regional or 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 1.6: Jobs by major industry sector in the OTC Service Area, 2016*

INDUSTRY SECTOR	TOTAL JOBS	% OF TOTAL
Agriculture, Forestry, Fishing, & Hunting	13,385	3.4%
Mining	555	0.1%
Utilities	751	0.2%
Construction	20,647	5.3%
Manufacturing	22,762	5.9%
Wholesale Trade	14,420	3.7%
Retail Trade	46,553	12.0%
Transportation & Warehousing	16,685	4.3%
Information	5,895	1.5%
Finance & Insurance	16,507	4.2%
Real Estate & Rental & Leasing	17,667	4.5%
Professional & Technical Services	16,440	4.2%
Management of Companies & Enterprises	4,349	1.1%
Administrative & Waste Services	22,182	5.7%
Educational Services, Private	6,400	1.6%
Health Care & Social Assistance	44,229	11.4%
Arts, Entertainment, & Recreation	9,293	2.4%
Accommodation & Food Services	34,043	8.8%
Other Services (except Public Administration)	22,513	5.8%
Government, Non-Education	32,966	8.5%
Government, Education	20,432	5.3%
Total	**388,675**	**100.0%**

* Data reflect the most recent year for which data are available. Emsi data are updated quarterly.

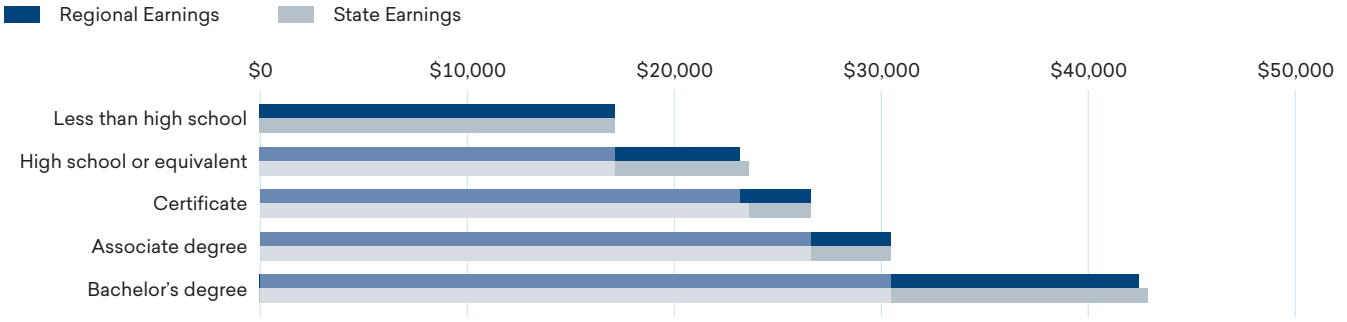
Source: Emsi complete employment data.

TABLE 1.7: Expected earnings by education level at the midpoint of a OTC student's working career

EDUCATION LEVEL	REGIONAL EARNINGS	DIFFERENCE FROM NEXT LOWEST DEGREE	STATE EARNINGS	DIFFERENCE FROM NEXT LOWEST DEGREE
Less than high school	$17,000	n/a	$17,200	n/a
High school or equivalent	$23,200	$6,200	$23,400	$6,200
Certificate	$26,400	$3,200	$26,600	$3,200
Associate degree	$30,100	$3,700	$30,400	$3,800
Bachelor's degree	$42,200	$12,100	$42,600	$12,200

Source: Emsi complete employment data.

FIGURE 1.1: Expected earnings by education level at a OTC student's career midpoint



CHAPTER 2:

Economic Impacts on the OTC Service Area Economy

OTC impacts the OTC Service Area economy in a variety of ways. The college is an employer and buyer of goods and services. It attracts monies that otherwise would not have entered the regional economy through its day-to-day operations, its construction activities, and the expenditures of its students. Further, it provides students with the knowledge, skills, and abilities they need to become productive citizens and add to the overall output of the region.

In this section we estimate the following economic impacts of OTC: 1) the day-to-day operations spending impact; 2) the construction spending impact, 3) the student spending impact; and 4) the alumni impact, measuring the income added in the region as former students expand the regional economy's stock of human capital.

When exploring each of these economic impacts, we consider the following hypothetical question:

How would economic activity change in the OTC Service Area if OTC and all its alumni did not exist in FY 2015-16?

Each of the economic impacts should be interpreted according to this hypothetical question. Another way to think about the question is to realize that we measure net impacts, not gross impacts. Gross impacts represent an upper-bound estimate in terms of capturing all activity stemming from the college; however, net impacts reflect a truer measure since they demonstrate what would not have existed in the regional economy if not for the college.

Economic impact analyses use different types of impacts to estimate the results. The impact focused on in this study assesses the change in income. This measure is similar to the commonly used gross regional product (GRP). Income may be further broken out into the **labor income impact**, also known as earnings, which assesses the change in employee compensation; and the **non-labor income impact**, which assesses the change in business profits. Together, labor income and non-labor income sum to **total income**.

Another way to state the impact is in terms of **jobs**, a measure of the number of full- and part-time jobs that would be required to support the change in income. Finally, a frequently used measure is the **sales** impact, which comprises the change in business sales revenue in the economy as a result of increased economic activity. It is important to bear in mind, however, that much of this sales revenue leaves the regional economy through intermediary transactions and costs.[7] All of these measures – added labor and non-labor income, total income, jobs, and sales – 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:

- The **initial effect** is the exogenous shock to the economy caused by the initial spending of money, whether to pay for salaries and wages, purchase goods or services, or cover operating expenses.
- 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

7 See Appendix 3 for an example of the intermediary costs included in the sales impact but not in the income impact.

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 decompose 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 MR-SAM input-output model that captures the interconnection of industries, government, and households in the region. The Emsi MR-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 MR-SAM model and its data sources, see Appendix 4.

OPERATIONS SPENDING IMPACT

Faculty and staff payroll is part of the region's total earnings, and the spending of employees for groceries, apparel, and other household expenditures helps support regional businesses. The college itself purchases supplies and services, and many of its vendors are located in the OTC Service Area. These expenditures create a ripple effect that generates still more jobs and higher wages throughout the economy.

Table 2.1 presents college expenditures for the following three categories: 1) salaries, wages, and benefits, 2) capital depreciation, and 3) all other expenditures (including purchases for supplies and services). The first step in estimating the multiplier effects of the college's operational expenditures is to map these categories of expenditures to the approximately 1,100 industries of the Emsi MR-SAM model. Assuming that the spending patterns of college 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 92% of the people working at OTC live in the OTC Service Area (see Table 1.1), and therefore we consider 92% of the salaries, wages, and benefits. For the other two expenditure categories (i.e., capital depreciation and all other expenditures),

TABLE 2.1: OTC expenses by function, FY 2015-16

EXPENSE CATEGORY	TOTAL EXPENDITURES (THOUSANDS)	IN-REGION EXPENDITURES (THOUSANDS)	OUT-OF-REGION EXPENDITURES (THOUSANDS)
Employee salaries, wages, and benefits	$46,961	$46,961	$0
Capital depreciation	$1,353	$754	$598
All other expenditures	$35,545	$15,009	$20,537
Total	**$83,859**	**$62,724**	**$21,135**

Source: Data supplied by OTC and the Emsi impact model.

we assume the college's spending patterns approximately match national averages and apply the national spending coefficients for NAICS 611210 (Junior Colleges).[8] Capital depreciation is mapped to the construction sectors of NAICS 611210 and the college's remaining expenditures to the non-construction sectors of NAICS 611210.

We now have three vectors of expenditures for OTC: one for salaries, wages, and benefits; another for capital items; and a third for the college's purchases of supplies and services. The next step is to estimate the portion of these expenditures that occur inside the region. The expenditures occurring outside the region are known as leakages. We estimate in-region expenditures using regional purchase coefficients (RPCs), a measure of the overall demand for the commodities produced by each sector that is satisfied by regional suppliers, for each of the approximately 1,100 industries in the MR-SAM model.[9] For example, if 40% of the demand for NAICS 541211 (Offices of Certified Public Accountants) is satisfied by regional suppliers, the RPC for that industry is 40%. The remaining 60% of the demand for NAICS 541211 is provided by suppliers located outside the region. The three vectors of expenditures are multiplied, industry by industry, by the corresponding RPC to arrive at the in-region expenditures associated with the college. See Table 2.1 for a break-out of the expenditures that occur in-region. Finally, in-region spending is entered, industry by industry, into the MR-SAM model's multiplier matrix, which in turn provides an estimate of the associated multiplier effects on regional labor income, non-labor income, total income, sales, and jobs.

Table 2.2 presents the economic impact of college operations spending. The people employed by OTC and their salaries, wages, and benefits comprise the initial effect, shown in the top row of the table in terms of labor income, non-labor income, total added income, sales, and jobs. The additional impacts created by the initial effect appear in the next four rows under the section labeled multiplier effect. Summing the initial and multiplier effects, the gross impacts are $63.1 million in labor income and $12.3 million in non-labor income. This comes to a total impact of $75.4 million in total added income associated with the spending of the college and its employees in the region. This is equivalent to 2,563 jobs.

The $75.4 million in gross impact is often reported by researchers as the total impact. We go a step further to arrive at a net impact by applying a counterfactual scenario, i.e., what would have happened if a given event – in this case, the expenditure of in-region funds on OTC – had not occurred. OTC received an estimated 37.0% of its funding from sources within the OTC Service Area. These monies came from the tuition and fees paid by resident students, from the auxiliary revenue and donations from

8 See Appendix 1 for a definition of NAICS.
9 See Appendix 4 for a description of Emsi's MR-SAM model.

TABLE 2.2: Impact of OTC operations spending, FY 2015-16

	LABOR INCOME (THOUSANDS)	NON-LABOR INCOME (THOUSANDS)	TOTAL INCOME (THOUSANDS)	SALES (THOUSANDS)	JOBS
Initial effect	**$46,961**	**$0**	**$46,961**	**$83,859**	**2,021**
MULTIPLIER EFFECT					
Direct effect	$4,688	$2,272	$6,961	$15,763	177
Indirect effect	$1,333	$666	$2,000	$4,880	54
Induced effect	$10,068	$9,362	$19,431	$32,831	311
Total multiplier effect	**$16,090**	**$12,300**	**$28,391**	**$53,474**	**542**
Gross impact (initial + multiplier)	**$63,052**	**$12,300**	**$75,352**	**$137,333**	**2,563**
Less alternative uses of funds	-$6,107	-$6,211	-$12,318	-$19,881	-180
Net impact	**$56,945**	**$6,089**	**$63,034**	**$117,452**	**2,383**

Source: Emsi impact model.

private sources located within the region, from state and local taxes, and from the financial aid issued to students by state and local government. We must account for the opportunity cost of this in-region funding. Had other industries received these monies rather than OTC, 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 simulating a scenario where in-region monies spent on the college are instead spent on consumer goods and savings. This simulates the in-region monies being returned to the taxpayers and being spent by the household sector. Our approach is to establish the total amount spent by in-region students and taxpayers on OTC, map this to the detailed industries of the MR-SAM model using national household expenditure coefficients, use the industry RPCs to estimate in-region spending, and run the in-region spending through the MR-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 college's operations are equal to the gross impacts less the impacts of the alternative use of funds – the opportunity cost of the state and local money. As shown in the last row of Table 2.2, the total net impact is approximately $56.9 million in labor income and $6.1 million in non-labor income. This sums together to $63 million in total added income and is equivalent to 2,383 jobs. These impacts represent new economic activity created in the regional economy solely attributable to the operations of OTC.

CONSTRUCTION SPENDING IMPACT

In this section we estimate the economic impact of the construction spending of OTC. Because construction funding is separate from operations funding in the budgeting process, it is not captured in the operations spending impact estimated earlier. However, like the operations spending, the construction spending creates subsequent rounds of spending and multiplier effects that generate still more jobs and higher wages throughout the region. During FY 2015-16, OTC spent a total of $6.6 million on various construction projects.

The methodology used here is similar to that used when estimating the impact of capital spending under the operations spending impact. Assuming OTC construction spending approximately matches the average construction spending patter of NAICS 611210 (Junior Colleges), we map OTC construction spending to the construction industries of the EMSI SAM model. Next, we use the RPCs to estimate the portion of this spending that occurs in-region. Finally, the in-region spending is run through the multiplier matrix to estimate the direct, indirect and induced effects. Because

TABLE 2.3: Impact of construction spending of OTC, FY 2015-16

	LABOR INCOME (THOUSANDS)	NON-LABOR INCOME (THOUSANDS)	TOTAL INCOME (THOUSANDS)	SALES (THOUSANDS)	JOBS
Initial effect	**$0**	**$0**	**$0**	**$6,617**	**0**
MULTIPLIER EFFECT					
Direct effect	$1,480	$368	$1,848	$3,690	39
Indirect effect	$302	$75	$376	$752	8
Induced effect	$477	$118	$595	$1,189	13
Gross impact	**$2,259**	**$561**	**$2,820**	**$12,247**	**60**
Less alternative uses of funds	-$465	-$473	-$938	-$1,514	-14
Net impact	**$1,794**	**$88**	**$1,882**	**$10,734**	**46**

Source: Emsi impact model.

construction is so labor intensive, the non-labor income impact is relatively small.

To account for the opportunity cost of any in-region construction money, we estimate the impacts of a similar alternative uses of funds as found in the operations spending impacts. This is done by simulating a scenario where in-region monies spent on construction are instead spent on consumer goods. These impacts are then subtracted from the gross construction spending impacts.

Table 2.3 presents the impacts of OTC construction spending during FY 2015-16. Note the initial effect is purely a sales effect, so there is no initial change in labor or non-labor income. The FY 2015-16 OTC construction spending creates a net total short-run impact of $1.8 million in labor income and $88.1 thousand in non-labor income. This is equal to $1.9 million in total added income – the equivalent of creating 46 new jobs.

STUDENT SPENDING IMPACT

Both in-region and out-of-region students contribute to the student spending impact of OTC; however, not all of these students can be counted towards the impact. Of the in-region students, only those students who were retained, or who would have left the region to seek education elsewhere had they not attended OTC, are measured. Students who would have stayed in the region anyway are not counted towards the impact since their monies would have been added to the OTC Service Area economy regardless of OTC. In addition, only the out-of-region students who relocated to the OTC Service Area to attend OTC are measured. Students who commute from outside the region or take courses online are not counted towards the student spending impact because they are not adding money from living expenses to the region.

While there were 17,107 students attending OTC who originated from the OTC Service Area,[10] not all of them would have remained in the region if not for the existence of OTC. We apply a conservative assumption that 10% of these retained students would have left the OTC Service Area for other education opportunities if OTC did not exist.[11] Therefore, we recognize that the in-region spending of 1,711 students retained in the region is attributable to OTC. These students spent money at businesses in the region for groceries, accommodation, transportation, and so on.

TABLE 2.4: Average student costs and total sales generated by relocated and retained students in the OTC Service Area, FY 2015-16

Room and board	$5,929
Personal expenses	$3,181
Transportation	$1,939
Total expenses per student	**$11,049**
Number of students that were retained	1,711
Number of students that relocated	980
Gross retained student sales	$18,901,524
Gross relocated student sales	$10,822,716
Total gross off-campus sales	**$29,724,241**
Wages and salaries paid to student workers*	$60,219
Net off-campus sales	**$29,664,022**

* This figure reflects only the portion of payroll that was used to cover the living expenses of resident and non-resident student workers who lived in the region.
Source: Student costs and wages supplied by OTC. The number of relocated and retained students who lived in the region off-campus while attending is derived by Emsi from the student origin data and in-term residence data supplied by OTC. The data is based on credit students.

An estimated 980 students came from outside the region and lived off campus while attending OTC in FY 2015-16. The off-campus expenditures of out-of-region students supported jobs and created new income in the regional economy.[12]

The average costs of students appear in the first section of Table 2.4, equal to $11,049 per student. Note that this table 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 $11,049 in

10 Note that if the college was unable to provide origin data for their non-credit students, we make the assumption that all non-credit students originated from within the region.

11 See Section 4.5 for a sensitivity analysis of the retained student variable.

12 Online students and students who commuted to the OTC Service Area from outside the region are not considered in this calculation because it is assumed their living expenses predominantly occurred in the region where they resided during the analysis year. We recognize that not all online students live outside the region, but keep the assumption given data limitations.

annual costs by the 2,690 students who either were retained or relocated to the region because of OTC and lived in-region but off-campus. This provides us with an estimate of their total spending. Altogether, off-campus spending of relocated and retained students generated gross sales of $29.7 million. This figure, once net of the monies paid to student workers, yields net off-campus sales of $29.7 million, as shown in the bottom row of Table 2.4.

Estimating the impacts generated by the $29.7 million in student spending follows a procedure similar to that of the operations impact described above. We distribute the $29.7 million in sales to the industry sectors of the MR-SAM model, apply RPCs to reflect in-region spending, and run the net sales figures through the MR-SAM model to derive multiplier effects.

Table 2.5 presents the results. Unlike the previous subsections, the initial effect is purely sales-oriented and there is no change in labor or non-labor income. The impact of relocated and retained student spending thus falls entirely under the multiplier effect. The total impact of student spending is $11.8 million in labor income and $5.3 million in non-labor income. This sums together to $17.1 million in total added income and is equivalent to 367 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 regional economy as a result of the direct and indirect effects.

ALUMNI IMPACT

In this section we estimate the economic impacts stemming from the added labor income of alumni in combination with their employers' added non-labor income. This impact is based on the number of students who have attended OTC throughout its history. We then use this total number to consider the impact of those students in the single FY 2015-16. Former students who achieved a degree as well as those who may not have finished their degree or did not take courses for credit are considered alumni.

While OTC creates an economic impact through its operations and student spending, the greatest economic impact of OTC stems from the added human capital – the knowledge, creativity, imagination, and entrepreneurship – found in its alumni. While attending OTC, students receive experience, education, and the knowledge, skills, and abilities that increase their productivity and allow them to 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). The employers of OTC alumni enjoy the fruits of this increased productivity in the form of additional non-labor income (i.e., higher profits).

The methodology here differs from the previous impacts in one fundamental way. Whereas the previous spending impacts depend on an annually renewed injection of new sales into the regional economy, the alumni impact is the result of years of past instruction and the associated accumulation of human capital. The initial effect of alumni is

TABLE 2.5: Student spending impact, FY 2015-16

	LABOR INCOME (THOUSANDS)	NON-LABOR INCOME (THOUSANDS)	TOTAL INCOME (THOUSANDS)	SALES (THOUSANDS)	JOBS
Initial effect	**$0**	**$0**	**$0**	**$29,664**	**0**
MULTIPLIER EFFECT					
Direct effect	$7,479	$3,339	$10,818	$19,744	233
Indirect effect	$1,504	$647	$2,151	$3,967	46
Induced effect	$2,811	$1,282	$4,093	$7,402	88
Total multiplier effect	**$11,794**	**$5,267**	**$17,062**	**$31,113**	**367**
Total impact (initial + multiplier)	**$11,794**	**$5,267**	**$17,062**	**$60,777**	**367**

Source: Emsi impact model.

comprised of two main components. The first and largest of these is the added labor income of OTC's former students. The second component of the initial effect is comprised of the added non-labor income of the businesses that employ former students of OTC.

We begin by estimating the portion of alumni who are employed in the workforce. To estimate the historical employment patterns of alumni in the region, we use 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;[13] 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 Census Bureau. The result is the estimated portion of alumni from each previous year who were still actively employed in the region as of FY 2015-16.

The next step is to quantify the skills and human capital that alumni acquired from the college. We use the students' production of CHEs as a proxy for accumulated human capital. The average number of CHEs completed per student in FY 2015-16 was 10.3. To estimate the number of CHEs present in the workforce during the analysis year, we use the college's historical student headcount over the past 26 years, from FY 1990-91 to FY 2015-16.[14] We multiply the 10.3 average CHEs per student by the headcounts that we estimate are still actively employed from each of the previous years.[15] Students who enroll at the college more than one year are counted at least twice in the historical enrollment data. However, CHEs remain distinct regardless of when and by whom they were earned, so there is no duplication in the CHE counts. We estimate there are approximately 2.2 million CHEs from alumni active in the workforce.

Next, we estimate the value of the CHEs, or the skills and human capital acquired by OTC alumni. This is done using the incremental added labor income stemming from the students' higher wages. The incremental added labor income is the difference between the wage earned by OTC alumni and the alternative wage they would have earned had they not attended OTC. Using the regional incremental earnings, credits required, and distribution of credits at each level of study, we estimate the average value per CHE to equal $87. This value represents the regional average incremental increase in wages that alumni of OTC received during the analysis year for every CHE they completed.

TABLE 2.6: Number of CHEs in workforce and initial labor income created in the OTC Service Area, FY 2015-16

Number of CHEs in workforce	2,227,385
Average value per CHE	$87
Initial labor income, gross	**$192,854,347**
COUNTERFACTUALS	
Percent reduction for alternative education opportunities	15%
Percent reduction for adjustment for labor import effects	50%
Initial labor income, net	**$81,963,098**

Source: Emsi impact model.

Because workforce experience leads to increased productivity and higher wages, the value per CHE varies depending on the students' workforce experience, with the highest value applied to the CHEs of students who had been employed the longest by FY 2015-16, and the lowest value per CHE applied to students who were just entering the workforce. More information on the theory and calculations behind the value per CHE appears in Appendix 5. 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 $192.9 million in gross labor income from increased wages received by former students in FY 2015-16 (as shown in Table 2.6).

The next two rows in Table 2.6 show two adjustments used to account for counterfactual outcomes. As discussed above, counterfactual outcomes in economic analysis represent what would have happened if a given event had not occurred. The event in question is the education and training provided by OTC and subsequent influx of skilled labor into the regional economy. The first counterfactual

13 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.

14 The 26-year time horizon is equal to the number of years that OTC was in operation since it was established in 1990-91 to the 2015-16 analysis year.

15 This assumes the average credit load and level of study from past years is equal to the credit load and level of study of students today.

scenario that we address is the adjustment for alternative education opportunities. In the counterfactual scenario where OTC does not exist, we assume a portion of OTC alumni would have received a comparable education elsewhere in the region or would have left the region and received a comparable education and then returned to the region. The incremental added labor income that accrues to those students cannot be counted towards the added labor income from OTC alumni. The adjustment for alternative education opportunities amounts to a 15% reduction of the $192.9 million in added labor income.[16] This means that 15% of the added labor income from OTC alumni would have been generated in the region anyway, even if the college did not exist. For more information on the alternative education adjustment, see Appendix 6.

The other adjustment in Table 2.6 accounts for the importation of labor. Suppose OTC did not exist and in consequence there were fewer skilled workers in the region. Businesses could still satisfy some of their need for skilled labor by recruiting from outside the OTC Service Area. We refer to this as the labor import effect. Lacking information on its possible magnitude, we assume 50% of the jobs that students fill at regional businesses could have been filled by workers recruited from outside the region if the college did not exist.[17] Consequently, the gross labor income must be adjusted to account for the importation of this labor, since it would have happened regardless of the presence of the college. We conduct a sensitivity analysis for this assumption in Section 4. With the 50% adjustment, the net added labor income added to the economy comes to $82 million, as shown in Table 2.6.

The $82 million in added labor income appears under the initial effect in the labor income column of Table 2.7. To this we add an estimate for initial non-labor income. As discussed earlier in this section, businesses that employ former students of OTC 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 ($82 million) 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 region 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 MR-SAM model.[18] Using a crosswalk created by National Center for Education Statistics (NCES) and the Bureau of Labor Statistics, we map the breakdown of the region'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 MR-SAM model to map the occupational distribution of the $82 million in initial labor income effects to the detailed

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

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

18 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).

TABLE 2.7: Alumni impact, FY 2015-16

	LABOR INCOME (THOUSANDS)	NON-LABOR INCOME (THOUSANDS)	TOTAL INCOME (THOUSANDS)	SALES (THOUSANDS)	JOBS
Initial effect	**$81,963**	**$16,327**	**$98,291**	**$262,181**	**1,784**
MULTIPLIER EFFECT					
Direct effect	$13,042	$2,574	$15,616	$33,312	283
Indirect effect	$3,451	$669	$4,120	$8,715	76
Induced effect	$28,389	$5,604	$33,993	$69,196	639
Total multiplier effect	**$44,882**	**$8,847**	**$53,729**	**$111,222**	**998**
Total impact (initial + multiplier)	**$126,845**	**$25,174**	**$152,019**	**$373,404**	**2,782**

Source: Emsi impact model.

industry sectors in the MR-SAM model.[19]

Once these allocations are complete, we apply the ratio of non-labor to labor income provided by the MR-SAM model for each sector to our estimate of initial labor income. This computation yields an estimated $16.3 million in added non-labor income attributable to the college's alumni. Summing initial labor and non-labor income together provides the total initial effect of alumni productivity in the OTC Service Area economy, equal to approximately $98.3 million. To estimate multiplier effects, we convert the industry-specific income figures generated through the initial effect to sales using sales-to-income ratios from the MR-SAM model. We then run the values through the MR-SAM's multiplier matrix.

Table 2.7 shows the multiplier effects of alumni. 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 college's alumni. The final results are $44.9 million in added labor income and $8.8 million in added non-labor income, for an overall total of $53.7 million in multiplier effects. The grand total of the alumni impact thus comes to $152 million in total added income, the sum of all initial and multiplier labor and non-labor income effects. This is equivalent to 2,782 jobs.

19 For example, if the MR-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.

TOTAL IMPACT OF OTC

The total economic impact of OTC on the OTC Service Area can be generalized into two broad types of impacts. First, on an annual basis, OTC generates a flow of spending that has a significant impact on the OTC Service Area economy. The impacts of this spending are captured by the operations, construction, and student spending impacts. While not insignificant, these impacts do not capture the true purpose of OTC. The basic mission of OTC is to foster human capital. Every year, a new cohort of OTC former students adds to the stock of human capital in the OTC Service Area, and a portion of alumni continues to add to the OTC Service Area economy. Table 2.8 displays the grand total impacts of OTC on the OTC Service Area economy in FY 2015-16. For context, the percentages of OTC compared to the total labor income, total non-labor income, combined total income, sales, and jobs in the OTC Service Area, as presented in Table 1.5 and Table 1.6, are included. The total added value of OTC is equivalent to 1.0% of the GRP of the OTC Service Area. By comparison, this contribution that the college provides on its own is nearly as large as the entire Arts, Entertainment, & Recreation industry in the region.

These impacts, stemming from spending related to the college and its students, spread throughout the regional economy and affect individual industry sectors. Table 2.9, on the next page, displays the total impact of OTC on

TABLE 2.8: Total impact of OTC, FY 2015-16

	LABOR INCOME (THOUSANDS)	NON-LABOR INCOME (THOUSANDS)	TOTAL INCOME (THOUSANDS)	SALES (THOUSANDS)	JOBS
Operations spending	$56,945	$6,089	$63,034	$117,452	2,383
Construction Spending	$1,794	$88	$1,882	$10,734	46
Student spending	$11,794	$5,267	$17,062	$60,777	367
Alumni	$126,845	$25,174	$152,019	$373,404	2,782
Total impact	**$197,378**	**$36,619**	**$233,997**	**$562,366**	**5,579**
% of the OTC Service Area economy	1.3%	0.5%	1.0%	1.1%	1.4%

industry sectors based on their two–digit NAICS code. The table shows the total impact of operations, students, and alumni as shown in Table 2.8, broken down by industry sector using processes outlined earlier in this chapter. By showing the impact on individual industry sectors, it is possible to see in finer detail where OTC has the greatest impact. For example, OTC's impact for the Health Care & Social Assistance industry sector was 882 jobs in FY 2015-16.

TABLE 2.9: Total impact of OTC by industry, FY 2015-16

INDUSTRY SECTOR	LABOR INCOME (THOUSANDS)	NON-LABOR INCOME (THOUSANDS)	TOTAL INCOME (THOUSANDS)	SALES (THOUSANDS)	JOBS
Agriculture, Forestry, Fishing, & Hunting	$24	$6	$31	$202	1
Mining	$32	$53	$86	$155	1
Utilities	$735	$1,298	$2,033	$3,448	10
Construction	$4,888	$858	$5,746	$18,446	121
Manufacturing	$10,777	$4,120	$14,897	$56,414	213
Wholesale Trade	$4,100	$3,125	$7,225	$10,774	70
Retail Trade	$6,678	$2,613	$9,291	$19,907	198
Transportation & Warehousing	$1,292	$340	$1,632	$4,735	27
Information	$3,666	$3,536	$7,203	$16,967	79
Finance & Insurance	$1,831	$1,579	$3,410	$5,864	35
Real Estate & Rental & Leasing	$3,893	$2,713	$6,606	$17,065	184
Professional & Technical Services	$13,939	$2,275	$16,214	$24,854	418
Management of Companies & Enterprises	$18,171	$1,956	$20,128	$36,282	225
Administrative & Waste Services	$2,454	$424	$2,878	$5,364	85
Educational Services, Private	$956	$65	$1,021	$2,051	40
Health Care & Social Assistance	$42,775	$2,224	$45,000	$86,361	882
Arts, Entertainment, & Recreation	$843	$296	$1,139	$2,582	40
Accommodation & Food Services	$10,040	$5,015	$15,056	$44,945	413
Other Services (except Public Administration)	$5,264	$2,074	$7,337	$13,301	220
Government, Non-Education	$10,788	$1,806	$12,594	$100,268	158
Government, Education	$54,229	$242	$54,471	$92,381	2,161
Total impact	**$197,378**	**$36,619**	**$233,997**	**$562,366**	**5,579**

Source: Emsi impact model.

CHAPTER 3:

Investment Analysis

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

Investment analysis is the process of evaluating total costs and measuring these against total benefits to determine whether or not a proposed venture will be profitable. If benefits outweigh costs, then the investment is worthwhile. If costs outweigh benefits, then the investment will lose money and is thus considered infeasible. In this section, we consider OTC as a worthwhile investment from the perspectives of students, local taxpayers, state and local taxpayers, and society.

STUDENT PERSPECTIVE

To enroll in postsecondary education, students pay money for tuition and forego monies that otherwise they would have 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 foregone time and money. The benefits are the higher earnings that students receive as a result of their education.

Calculating student costs

Student costs consist of three main items: direct outlays, opportunity costs, and future principal and interest costs incurred from student loans. Direct outlays include tuition and fees, equal to $18.1 million from Table 1.2. Direct outlays also include the cost of books and supplies. On average, full-time students spent $800 each on books and supplies during the reporting year.[20] Multiplying this figure times the number of full-time equivalents (FTEs) produced by OTC in FY 2015-16[21] generates a total cost of $5.5 million for books and supplies.

In order to pay the cost of tuition, many students had to take out loans. These students not only incur the cost of tuition from the college but also incur the interest cost of taking out a loan. In FY 2015-16, students received a total of $25.7 million in federal loans to attend OTC.[22] Students pay back these loans along with interest over the span of several years in the future. Since students pay off these loans over time, they receive no initial cost during the analysis year. Hence, the $25.7 million in federal loans is subtracted from the $18.1 million in tuition and fees incurred by students during the analysis year. This avoids double counting and results in students receiving more in loans than spending directly on tuition, meaning they likely use the amount leftover to help pay for living expenses while at the college.

In addition to the cost of tuition, books, and supplies, stu-

20 Based on the data supplied by OTC.

21 A single FTE is equal to 30 CHEs, so there were 6,912 FTEs produced by students in FY 2015-16, equal to 207,364 CHEs divided by 30.

22 Due to data limitations, only federal loans are considered in this analysis. The interest incurred from private and other types of loans is excluded from this analysis.

dents also experience an opportunity cost of attending college during the analysis year. Opportunity cost is the most difficult component of student costs to estimate. It measures the value of time and earnings foregone by students who go to the college 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 college.

We derive the students' full earning potential by weighting the average annual earnings levels in Table 1.7 according to the education level breakdown of the student population when they first enrolled.[23] However, the earnings levels in Table 1.7 reflect what average workers earn at the midpoint of their careers, not while attending the college. Because of this, we adjust the earnings levels to the average age of the student population (21) to better reflect their wages at their current age.[24] This calculation yields an average full earning potential of $11,536 per student.

In determining how much students earn while enrolled in postsecondary education, an important factor to consider is the time that they actually spend on postsecondary 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 foregone earnings. Overall, students attending OTC earned an average of 10.3 CHEs per student, which is approximately equal to 34% of a full academic year.[25] We thus include no more than $3,954 (or 34%) of the students' full earning potential in the opportunity cost calculations.

Another factor to consider is the students' employment status while enrolled in postsecondary education. Based on data supplied by the college, approximately 78% of students are employed. For the 22% that are not working, we assume that they are either seeking work or planning to seek work once they complete their educational goals. By choosing to enroll, therefore, non-working students give up everything that they can potentially earn during the academic year (i.e., the $3,954). The total value of their foregone earnings thus comes to $17.5 million.

Working students are able to maintain all or part of their earnings 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 go to college.[26] The remaining 42% comprises the percent of their full earning potential that they forego. Obviously this assumption varies by person; some students forego more and others less. Since we do not know the actual jobs that students hold while attending, the 42% in foregone earnings serves as a reasonable average.

Working students also give up a portion of their leisure time in order to attend higher education institutions. According to the Bureau of Labor Statistics American Time Use Survey, students forego up to 0.5 hours of leisure time per day.[27] 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 foregone 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 $30.5 million, equal to the sum of their foregone earnings ($26.4 million) and foregone leisure time ($4.1 million).

Thus far we have talked about student costs during the analysis year. However, recall that students are taking out student loans to attend the college during the year, which they will have to pay back over time. The amount they will be paying in the future must be a part of their decision to attend the college today. Students who take out a loan are not only required to pay back the principal of the loan, but to also pay back a certain amount in interest. The first step in calculating students' loan interest cost is to determine the

23 This is based on the number of students who reported their entry level of education to OTC. Emsi provided estimates in the event that the data was not available from the college.

24 Further discussion on this adjustment appears in Appendix 5.

25 Equal to 10.3 CHEs divided by 30, the assumed number of CHEs in a full-time academic year.

26 The 58% assumption is based on the average hourly wage of jobs 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).

27 Bureau of Labor Statistics. "Charts by Topic: Leisure and Sports Activities." *American Time Use Survey.* Last modified December 2016. Accessed January 2017. http://www.bls.gov/TUS/CHARTS/LEISURE.HTM.

payback time for the loans. The $25.7 million in loans was awarded to 8,276 students, averaging $3,103 per student in the analysis year. However, this figure represents only one year of loans. Because loan payback time is determined by total indebtedness, we make an assumption that since OTC is a two-year college, students will be indebted twice that amount, or $6,207 on average. According to the U.S. Department of Education, this level of indebtedness will take 10 years to pay back under the standard repayment plan.[28]

This indebtedness calculation is used solely to estimate the loan payback period. Students will be paying back the principal amount of $25.7 million in student loans over time. After taking into consideration the time value of money (discussed in Section 3.2.3), this means that students will pay off a discounted present value of $20.2 million in principal over the ten years. In order to calculate interest, we only consider interest on the federal loans awarded to students in FY 2015-16. Using the student discount rate of 4.3%[29] as our interest rate, we calculate that students will pay a total discounted present value of $5.1 million in interest on student loans throughout the first 10 years of their working lifetime. The stream of these future interest costs together with the stream of loan payments is included in the costs in Column 5 of Table 3.2.

The steps leading up to the calculation of student costs appear in Table 3.1. Direct outlays amount to -$2.1 million, the sum of tuition and fees ($18.1 million) and books and supplies ($5.5 million), less federal loans ($25.7 million). Opportunity costs for working and non-working students amount to $44.6 million, excluding $3.4 million in offsetting residual grant aid that is paid directly to students.[30] Finally, we have the present value of future student loan costs, amounting to $25.3 million between principal and interest. Summing direct outlays, opportunity costs, and future student loan costs yields a total of $67.9 million in student costs.

TABLE 3.1: Present value of student costs, FY 2015-16 (thousands)

DIRECT OUTLAYS IN FY 2015-16	
Tuition and fees	$18,096
Less federal loans received	-$25,683
Books and supplies	$5,530
Total direct outlays	**-$2,057**
OPPORTUNITY COSTS IN FY 2015-16	
Earnings foregone by non-working students	$17,543
Earnings foregone by working students	$26,372
Value of leisure time foregone by working students	$4,089
Less residual grant aid	-$3,382
Total opportunity costs	**$44,621**
FUTURE STUDENT LOAN COSTS	
Student loan principal	$20,232
Student loan interest	$5,057
Total student loan costs	**$25,288**
Total present value student costs	**$67,852**

Source: Based on data supplied by OTC and outputs of the Emsi impact model.

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, state mean earnings levels at the midpoint of the average-aged worker's career increase as people achieve higher levels of education. The differences between state earnings 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 college's FY 2015-16 students first by determining their average annual increase in earnings, equal to $27.5 million. This value represents the higher wages that

28 Repayment period based on total education loan indebtedness, U.S. Department of Education, 2017. Accessed February 2017. https://studentaid.ed.gov/sa/repay-loans/understand/plans/standard.

29 The student discount rate is derived from the baseline forecasts for the 10-year 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.

30 Residual grant aid is the remaining portion of scholarship or grant aid distributed directly to a student after the college applies tuition and fees.

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 college. Using the state of Missouri earnings, the marginal wage increase per CHE is $133. For a full description of the methodology used to derive the $27.5 million, see Appendix 5.

The second step is to project the $27.5 million annual increase in earnings into the 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.[31] The Mincer function originated from Mincer's seminal work on human capital (1958). The function estimates 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. We use state-specific and education-level-specific Mincer coefficients. To account for any upward bias, we incorporate a 10% reduction in our projected earnings, otherwise known as the ability bias. With the $27.5 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 $27.5 million in gross higher earnings occurs around Year 22, 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 higher earnings that accrues to students in the years leading up to the midpoint is less than $27.5 million and the gross higher earnings in the years after the midpoint is greater than $27.5 million.

31 Appendix 5 provides more information on the Mincer function and how it is used to predict future earnings growth.

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 FY 2015-16 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 college 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 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.[32] The likelihood of leaving the 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 higher earnings to students after accounting for both the settling-in patterns and attrition.

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. For the student perspective we assume a discount rate of 4.3% (see below). Because students tend to rely upon debt to pay for their

32 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

YEAR	GROSS HIGHER EARNINGS TO STUDENTS (MILLIONS)	% ACTIVE IN WORKFORCE*	NET HIGHER EARNINGS TO STUDENTS (MILLIONS)	STUDENT COSTS (MILLIONS)	NET CASH FLOW (MILLIONS)
0	$9.6	11%	$1.0	$42.6	-$41.5
1	$10.3	17%	$1.8	$3.2	-$1.4
2	$11.1	25%	$2.8	$3.2	-$0.4
3	$11.8	39%	$4.6	$3.2	$1.5
4	$12.6	60%	$7.6	$3.2	$4.4
5	$13.4	93%	$12.4	$3.2	$9.3
6	$14.2	93%	$13.2	$3.2	$10.0
7	$15.0	93%	$14.0	$3.2	$10.8
8	$15.9	93%	$14.8	$3.2	$11.6
9	$16.7	93%	$15.6	$3.2	$12.4
10	$17.6	93%	$16.4	$3.2	$13.2
11	$18.5	93%	$17.2	$0.0	$17.2
12	$19.4	93%	$18.0	$0.0	$18.0
13	$20.2	93%	$18.8	$0.0	$18.8
14	$21.1	93%	$19.6	$0.0	$19.6
15	$22.0	93%	$20.4	$0.0	$20.4
16	$22.8	93%	$21.2	$0.0	$21.2
17	$23.7	93%	$22.0	$0.0	$22.0
18	$24.5	93%	$22.7	$0.0	$22.7
19	$25.3	93%	$23.4	$0.0	$23.4
20	$26.1	92%	$24.1	$0.0	$24.1
21	$26.8	92%	$24.7	$0.0	$24.7
22	$27.5	92%	$25.3	$0.0	$25.3
23	$28.2	92%	$25.9	$0.0	$25.9
24	$28.8	92%	$26.4	$0.0	$26.4
25	$29.3	91%	$26.8	$0.0	$26.8
26	$29.9	91%	$27.2	$0.0	$27.2
27	$30.3	91%	$27.6	$0.0	$27.6
28	$30.7	91%	$27.9	$0.0	$27.9
29	$31.1	90%	$28.1	$0.0	$28.1
30	$31.4	90%	$28.2	$0.0	$28.2
31	$31.6	89%	$28.3	$0.0	$28.3
32	$31.8	89%	$28.3	$0.0	$28.3
33	$31.9	89%	$28.2	$0.0	$28.2
34	$31.9	88%	$28.1	$0.0	$28.1
35	$31.9	87%	$27.9	$0.0	$27.9
36	$31.8	87%	$27.6	$0.0	$27.6
37	$31.6	86%	$27.3	$0.0	$27.3
38	$31.4	86%	$26.9	$0.0	$26.9
39	$31.1	85%	$26.4	$0.0	$26.4
40	$30.8	84%	$25.8	$0.0	$25.8
41	$30.4	83%	$25.2	$0.0	$25.2
42	$29.9	82%	$24.6	$0.0	$24.6
43	$29.4	81%	$23.9	$0.0	$23.9
44	$28.9	51%	$14.7	$0.0	$14.7
45	$28.2	32%	$9.0	$0.0	$9.0
Present value			**$357.0**	**$67.9**	**$289.2**
Internal rate of return					18.5%
Benefit-cost ratio					5.3
Payback period (no. of years)					8.6

* Includes the "settling-in" factors and attrition.

Source: Emsi college impact model.

DISCOUNT RATE

The discount rate is a rate of interest that converts future costs and benefits to present values. 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 1.4% discount rate from the perspective of taxpayers and society.

educations – i.e. they are negative savers – their discount rate is based upon student loan interest rates.[33] 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 greater than 1, a rate of return that exceeds the discount rate, and a reasonably short payback period.

In Table 3.2, the net higher earnings of students yield a cumulative discounted sum of approximately $357 million, the present value of all of the future earnings increments (see the bottom section of Column 4). This may also be interpreted as the gross capital asset value of the students' higher earnings stream. In effect, the aggregate FY 2015-16 student body is rewarded for its investment in OTC with a capital asset valued at $357 million.

The students' cost of attending the college is shown in Column 5 of Table 3.2, equal to a present value of $67.9 million. 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 5.3 (equal to $357 million in benefits divided by $67.9 million 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.[34] Table 3.2 shows students of OTC earning average returns of 18.5% 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 18.5% student rate of return is a real rate. With an inflation rate of 2.3% (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 20.8%, 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.[35] Beyond that point,

33 The student discount rate is derived from the baseline forecasts for the 10-year Treasury rate published by the Congressional Budget Office. See the Congressional Budget Office, "Table 4. Projection of Borrower Interest Rates: CBO's January 2017 Baseline," *Congressional Budget Office Publications, CBO's January 2017 Baseline Projections for the Student Loan Program*, last modified January 25, 2017, accessed February 2017, https://www.cbo.gov/sites/default/files/recurringdata/ 51310-2017-01-studentloan.pdf.

34 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.

35 Payback analysis is generally used by the business community to rank alternative investments when safety of investments is an issue. Its greatest drawback is it does not take into 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.

returns are what economists would call pure costless rent. As indicated in Table 3.2, students at OTC see, on average, a payback period of 8.6 years on their foregone earnings and out-of-pocket costs.

LOCAL TAXPAYER PERSPECTIVE

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

Growth in local tax revenues

As a result of their time at OTC, students earn more because of the skills they learned while attending the college, 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. These in turn increase tax revenues since as students earn more, they pay more in taxes towards the local government.

Estimating the effect of OTC on increased tax revenues begins with the present value of the students' future earnings stream. This is similar to Column 4 of Table 3.2, however it is calculated based off of regional earnings. To this we apply a multiplier derived from Emsi's MR-SAM model to estimate the added labor income created in the region as students and businesses spend their higher earnings.[36] 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 OTC Service Region's gross regional product to total labor income in the region. We also include the spending impacts discussed in Section 2 that were created in FY 2015-16 by the operations of the college, construction, and student spending. To each of these, we capture only the tax revenues attributable to local government from this additional revenue.

Not all of these tax revenues may be counted as benefits to the region, however. Some students leave the region during the course of their careers, and the higher earnings they receive as a result of their education leaves the region with them. To account for this dynamic, we combine student settlement data from the college with data on migration patterns from the Census Bureau to estimate the number of students who will leave the regional 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 OTC does not exist. The assumption in this case is that any benefits generated by students who could have received an education even without the college 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 college would have generated benefits anyway even without the college. For more information on the alternative education variable, see Appendix 6.

We apply a final adjustment factor to account for the "shutdown point" that nets out benefits that are not directly linked to the local government costs of supporting the college. As with the alternative education variable discussed under the alumni impact, the purpose of this adjustment is to account for counterfactual scenarios. In this case, the counterfactual scenario is where local government funding for OTC did not exist and OTC had to derive the revenue elsewhere. To estimate this shutdown point, we apply a sub-model that simulates the students' demand curve for education by reducing local support to zero and progressively increasing student tuition and fees. As student tuition and fees increase, enrollment declines. For OTC, the shutdown point adjustment is 44%, meaning that the added tax revenue results are discounted by 44% to account for the benefits that the college could still potentially generate even without local taxpayer support. For more information on the theory and methodology behind the estimation of the shutdown point, see Appendix 8.

36 For a full description of the Emsi MR-SAM model, see Appendix 4.

After adjusting for attrition, alternative education opportunities, and the shutdown point, we calculate the present value of the future added tax revenues that occur in the region, equal to $36.6 million. 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 the public sector, we use the discount rate of 0.7%. This is the real treasury interest rate recommended by the Office of Management and Budget (OMB) for 30-year investments, and in Section 4, we conduct a sensitivity analysis of this discount rate.[37]

Local Government savings

In addition to the creation of higher tax revenues to the local government, 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 to the local government that otherwise would have been drawn from public resources absent the education provided by OTC. Local government savings appear in Table 3.3 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 that would have otherwise been covered by local government. Crime savings consist of avoided costs to the justice system (i.e., police protection, judicial and legal, and corrections). Welfare and unemployment benefits comprise avoided costs due to the reduced number of social assistance and unemployment insurance claims.

The model quantifies government 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, 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 college, will not have poor health, commit crimes, or claim welfare and unemployment benefits. We dampen these results by the ability bias adjustment discussed earlier in the student perspective section and in Appendix 5 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.[38] Finally, we apply the same adjustments for attrition and alternative education to derive the net savings to the local government.

TABLE 3.3: Present value of added tax revenue and government savings (thousands)

Added tax revenue	**$36,648**
GOVERNMENT SAVINGS	
Health-related savings	$6,961
Crime-related savings	$3,115
Welfare/unemployment-related savings	$134
Total government savings	**$10,210**
Total taxpayer benefits	**$46,858**

Source: Emsi impact model.

Table 3.3 displays all benefits to taxpayers. The first row shows the added tax revenues created in the state, equal to $36.6 million, from students' higher earnings, increases in non-labor income, and spending impacts. A breakdown in local government savings by health, crime, and welfare/unemployment-related savings appears next. These total to $10.2 million. The sum of the social savings and the added income in the region is $46.9 million. These benefits continue to accrue in the future as long as the FY 2015-16 student population of OTC remains in the regional workforce.

Return on investment to local taxpayers

Taxpayer costs are reported in Table 3.4, on the next page, and come to $10.1 million, equal to the contribution of local government to OTC. In return for their public support, taxpayers are rewarded with an investment benefit-cost ratio

37 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).

38 For a full list of the data sources used to calculate the social externalities, see the References and Resource section. See also Appendix 4 for a more in-depth description of the methodology.

TABLE 3.4: Projected benefits and costs, taxpayer perspective

YEAR	BENEFITS TO TAXPAYERS (MILLIONS)	STATE AND LOCAL GOV'T COSTS (MILLIONS)	NET CASH FLOW (MILLIONS)
0	$4.6	$10.1	-$5.4
1	$0.1	$0.0	$0.1
2	$0.2	$0.0	$0.2
3	$0.3	$0.0	$0.3
4	$0.5	$0.0	$0.5
5	$0.8	$0.0	$0.8
6	$0.9	$0.0	$0.9
7	$0.9	$0.0	$0.9
8	$0.9	$0.0	$0.9
9	$1.0	$0.0	$1.0
10	$1.0	$0.0	$1.0
11	$1.0	$0.0	$1.0
12	$1.1	$0.0	$1.1
13	$1.1	$0.0	$1.1
14	$1.1	$0.0	$1.1
15	$1.1	$0.0	$1.1
16	$1.2	$0.0	$1.2
17	$1.2	$0.0	$1.2
18	$1.2	$0.0	$1.2
19	$1.2	$0.0	$1.2
20	$1.3	$0.0	$1.3
21	$1.3	$0.0	$1.3
22	$1.3	$0.0	$1.3
23	$1.3	$0.0	$1.3
24	$1.3	$0.0	$1.3
25	$1.4	$0.0	$1.4
26	$1.4	$0.0	$1.4
27	$1.4	$0.0	$1.4
28	$1.4	$0.0	$1.4
29	$1.4	$0.0	$1.4
30	$1.4	$0.0	$1.4
31	$1.4	$0.0	$1.4
32	$1.4	$0.0	$1.4
33	$1.4	$0.0	$1.4
34	$1.4	$0.0	$1.4
35	$1.4	$0.0	$1.4
36	$1.4	$0.0	$1.4
37	$1.3	$0.0	$1.3
38	$1.3	$0.0	$1.3
39	$1.3	$0.0	$1.3
40	$1.3	$0.0	$1.3
41	$1.2	$0.0	$1.2
42	$1.2	$0.0	$1.2
43	$1.2	$0.0	$1.2
44	$0.7	$0.0	$0.7
45	$0.4	$0.0	$0.4
Present value	**$46.9**	**$10.1**	**$36.8**
Internal rate of return			13.4%
Benefit-cost ratio			4.7
Payback period (no. of years)			3.7

Source: Emsi impact model.

of 4.4 (= $46.9 million ÷ $10.1 million), indicating a profitable investment.

At 13.4%, the rate of return to local taxpayers is favorable. Given that the stakeholder in this case is the public sector, we use the discount rate of 0.7%, the real treasury interest rate recommended by the Office of Management and Budget for 30-year investments.[39] This is the return governments are assumed to be able to earn on generally safe investments of unused funds, or alternatively, the interest rate for which governments, as relatively safe borrowers, can obtain funds. A rate of return of 0.7% would mean that the college just pays its own way. In principle, the local government could borrow monies used to support OTC and repay the loans out of the resulting added taxes and reduced government expenditures. A rate of return of 13.4%, on the other hand, means that OTC not only pays its own way, but also generates a surplus that the local government can use to fund other programs. It is unlikely that other government programs could make such a claim.

STATE AND LOCAL TAXPAYER PERSPECTIVE

The state and local taxpayer perspective is very similar to the local taxpayer perspective except for it hones in on the public benefits that accrue to the state and local government. This includes savings that are related to earnings growth as well as social savings received by the state and local government. In all instances, benefits to private residents, local businesses, or the federal government are excluded.

Growth in state and local tax revenues

As described above, because OTC students are more skilled as a result of their college attendance, they earn more in wages and make businesses more productive and therefore profitable. This, in turn, leads to an increase in tax revenues for the state and local government.

The methodology to estimate the effect of OTC on increased state and local tax revenues is almost identical to the methodology described in the local taxpayer section above. One notable difference is that we use state level earnings to calculate the present value of the students' future earnings stream, which is displayed in Column 4 of Table 3.2. Similar to above, we then apply a multiplier derived from Emsi's MR-SAM model to estimate the added labor income created in the state as students and businesses spend their higher earnings. Another notable difference is that we now calculate the increase in non-labor income by multiplying the increase in labor income by a ratio of the Missouri gross state product to total labor income in the state. Once again, we include the spending impacts created by the operations and construction of the college and student spending; however, we grow these impacts to the state level rather than using the regional impacts. To each of these, we capture not only the tax revenues attributable to the local government but to the state government as well from this additional revenue.

Again, not all of these tax revenues may be counted as benefits to the state and local government, so we apply similar reduction factors as listed in the local taxpayer perspective. We account for students that leave the state and therefore take their earnings with them by combining student state settlement data from the college with data on migration patterns from the Census Bureau. 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 the local taxpayer perspective above. Finally, we also account for the "shutdown point" that nets out benefits that are not directly linked to the state and local government costs of supporting the college. At the state level, the shutdown point adjustment is 0%, meaning that the college could not operate without taxpayer support. As such, no reduction applies.

After adjusting for these reduction factors, we discount the future added tax revenues that occur in the state to the present value, equal to $161.1 million. Similar to the local taxpayer above, we use a discount rate of 0.7% and in Section 4, we conduct a sensitivity analysis of this discount rate.[40]

39 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).

40 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).

State and local government savings

The local government isn't the only government that benefits from social savings – the state government experiences these benefits as well. State and local government savings appear in Table 3.5.

The state government savings are calculated the same way as the local government savings were calculated above. The difference lies in the number of students that stay in the state versus the number of students that stay in the region. There are more students that settle in the state than in the region, resulting in greater government savings. We again adjust for ability bias, state attrition factors, and alternative education.

The first row of Table 3.5 shows the added tax revenues created in the state, equal to $161.1 million, from students' higher earnings, increases in non-labor income, and spending impacts. The government savings broken down by category appears next. These total to $11.2 million. The sum of the social savings and the added income in the state is $172.4 million. These savings continue to accrue in the future as long as the FY 2015-16 student population of OTC remains in the state workforce.

Return on investment to state and local taxpayers

State and local taxpayer costs are reported in Table 3.6, on the next page, and come to $26.6 million, equal to the contribution of state and local government to OTC. In return for their public support, state and local taxpayers are rewarded with an investment benefit-cost ratio of 6.5 (= $172.4 million ÷ $26.6 million), indicating a profitable investment.

A rate of return of 15.8% is favorable for state and local taxpayers. Recall that a rate of return of 0.7% would mean that the college pays its own way. Governments could borrow monies used to support OTC and repay the loans out of the resulting added taxes and reduced government expenditures. A rate of return of 15.8%, on the other hand, means that OTC not only pays its own way, but also generates a surplus that the state and local government can use to fund other programs. It is unlikely that other government programs could make such a claim.

TABLE 3.5: Present value of added tax revenue and government savings (thousands)

Added tax revenue	**$161,116**
GOVERNMENT SAVINGS	
Health-related savings	$7,667
Crime-related savings	$3,431
Welfare/unemployment-related savings	$148
Total government savings	**$11,246**
Total taxpayer benefits	**$172,362**

Source: Emsi impact model.

SOCIAL PERSPECTIVE

Missouri benefits from the education that OTC provides through the earnings 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 pay money and forego services that they otherwise would have enjoyed if OTC did not exist. Society's investment in OTC stretches across a number of investor groups, from students to employers to taxpayers. We weigh the benefits generated by OTC to these investor groups against the total social costs of generating those benefits. The total social costs include all OTC expenditures, all student expenditures (including principal and interest on student loans) less tuition and fees, and all student opportunity costs, totaling $114.9 million.

On the benefits side, any benefits that accrue to Missouri as a whole – including students, employers, taxpayers, and anyone else who stands to benefit from the activities of OTC – are counted as benefits under the social perspective. We group these benefits under the following broad headings: 1) increased earnings 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.

TABLE 3.6: Projected benefits and costs, state and local taxpayer perspective

YEAR	BENEFITS TO TAXPAYERS (MILLIONS)	STATE AND LOCAL GOV'T COSTS (MILLIONS)	NET CASH FLOW (MILLIONS)
0	$11.8	$26.6	-$14.8
1	$0.4	$0.0	$0.4
2	$0.6	$0.0	$0.6
3	$1.0	$0.0	$1.0
4	$1.6	$0.0	$1.6
5	$2.7	$0.0	$2.7
6	$2.8	$0.0	$2.8
7	$3.0	$0.0	$3.0
8	$3.1	$0.0	$3.1
9	$3.3	$0.0	$3.3
10	$3.4	$0.0	$3.4
11	$3.6	$0.0	$3.6
12	$3.7	$0.0	$3.7
13	$3.9	$0.0	$3.9
14	$4.1	$0.0	$4.1
15	$4.2	$0.0	$4.2
16	$4.3	$0.0	$4.3
17	$4.5	$0.0	$4.5
18	$4.6	$0.0	$4.6
19	$4.8	$0.0	$4.8
20	$4.9	$0.0	$4.9
21	$5.0	$0.0	$5.0
22	$5.1	$0.0	$5.1
23	$5.2	$0.0	$5.2
24	$5.3	$0.0	$5.3
25	$5.4	$0.0	$5.4
26	$5.4	$0.0	$5.4
27	$5.5	$0.0	$5.5
28	$5.5	$0.0	$5.5
29	$5.6	$0.0	$5.6
30	$5.6	$0.0	$5.6
31	$5.6	$0.0	$5.6
32	$5.6	$0.0	$5.6
33	$5.6	$0.0	$5.6
34	$5.6	$0.0	$5.6
35	$5.5	$0.0	$5.5
36	$5.5	$0.0	$5.5
37	$5.4	$0.0	$5.4
38	$5.3	$0.0	$5.3
39	$5.2	$0.0	$5.2
40	$5.1	$0.0	$5.1
41	$5.0	$0.0	$5.0
42	$4.9	$0.0	$4.9
43	$4.7	$0.0	$4.7
44	$2.9	$0.0	$2.9
45	$1.8	$0.0	$1.8
Present value	**$172.4**	**$26.6**	**$145.8**
Internal rate of return			15.8%
Benefit-cost ratio			6.5
Payback period (no. of years)			8.9

Source: Emsi impact model.

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 and raise people's earnings, 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.

Growth in state economic base

In the process of absorbing the newly-acquired skills of students that attend OTC, not only does the productivity of Missouri's workforce increase, but so does the productivity of its physical capital and assorted infrastructure. Students earn more because of the skills they learned while attending the college, 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 OTC on the state's economic base follows the same process used when calculating increased tax revenues in the taxpayer perspective. However, instead of looking at just the tax revenue portion, we include all of the added earnings and business output. We again factor in student attrition and alternative education opportunities. The shutdown point does not apply to the growth of the economic base because the social perspective captures not only the state and local taxpayer support to the college, but also the support from the students and other non-governmental sources.

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 $1.8 billion. Recall from the discussion of the student and taxpayer 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. As stated in the taxpayer perspective, given that the stakeholder in this case is the public sector, we use the discount rate of 0.7%.

Social savings

Similar to the government savings discussed above, society as a whole sees savings due to external or incidental benefits of education. These represent the avoided costs that otherwise would have been drawn from private and public resources absent the education provided by OTC. Social benefits appear in Table 3.7, on the next page, and break down into three main categories: 1) health savings, 2) crime savings, and 3) welfare and unemployment savings. These are similar to the categories from the taxpayer perspective above, although health savings now also include lost productivity and other effects associated with smoking, alcoholism, obesity, mental illness, and drug abuse. In addition to avoided costs to the justice system, crime savings also consist of avoided victim costs and benefits stemming from the added productivity of individuals who otherwise would have been incarcerated. Welfare and unemployment benefits comprise avoided costs due to the reduced number of social assistance and unemployment insurance claims.

Table 3.7 displays the results of the analysis. The first row shows the increased economic base in the state, equal to $1.8 billion, from students' higher earnings and their multiplier effects, increases 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 $45.3 million, 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 $4.6 million, including savings associated with a

TABLE 3.7: Present value of the future increased economic base and social savings in the state (thousands)

Increased economic base	**$1,773,493**
SOCIAL SAVINGS	
Health	
Smoking	$24,250
Alcoholism	$1,860
Obesity	$16,271
Mental illness	$1,595
Drug abuse	$1,321
Total health savings	**$45,296**
Crime	
Criminal Justice System savings	$3,331
Crime victim savings	$389
Added productivity	$867
Total crime savings	**$4,587**
Welfare/unemployment	
Welfare savings	$97
Unemployment savings	$50
Total welfare/unemployment savings	**$148**
Total social savings	**$50,031**
Total, increased economic base + social savings	**$1,823,523**

Source: Emsi impact model.

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 $147,657, stemming from a reduced number of persons in need of earnings assistance. All told, social savings amounted to $50 million in benefits to communities and citizens in Missouri.

The sum of the social savings and the increased state economic base is $1.8 billion, as shown in the bottom row of Table 3.5. These savings accrue in the future as long as the FY 2015-16 student population of OTC remains in the workforce.

Return on investment to society

Table 3.6, on the next page, presents the stream of benefits accruing to the Missouri society and the total social costs of generating those benefits. Comparing the present value of the benefits and the social costs, we have a benefit-cost ratio of 12.5. This means that for every dollar invested in an education from OTC, whether it is the money spent on day-to-day operations of the college or money spent by students on tuition and fees, an average of $12.50 in benefits will accrue to society in Missouri.[41]

With and without social savings

Earlier in this chapter, social benefits attributable to education (reduced crime, lower welfare, lower unemployment, and improved health) were defined as externalities that are incidental to the operations of OTC. Some would question the legitimacy of including these benefits in the calculation

TABLE 3.9: Taxpayer and social perspectives with and without social savings

	INCLUDING SOCIAL SAVINGS	EXCLUDING SOCIAL SAVINGS
LOCAL TAXPAYER PERSPECTIVE		
Net present value (thousands)	**$36,802**	**$26,592**
Benefit-cost ratio	4.7	3.6
Internal rate of return	13.4%	10.2%
Payback period (no. of years)	9.7	12.7
STATE AND LOCAL TAXPAYER PERSPECTIVE		
Net present value (thousands)	**$145,789**	**$134,543**
Benefit-cost ratio	6.5	6.1
Internal rate of return	15.8%	14.7%
Payback period (no. of years)	8.9	9.5
SOCIAL PERSPECTIVE		
Net present value (thousands)	**$1,678,133**	**$1,628,102**
Benefit-cost ratio	12.5	12.2

Source: Emsi impact model.

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

TABLE 3.8: Projected benefits and costs, social perspective

YEAR	BENEFITS TO SOCIETY (MILLIONS)	SOCIAL COSTS (MILLIONS)	NET CASH FLOW (MILLIONS)
0	$147.6	$114.9	$32.7
1	$4.3	$3.2	$1.1
2	$6.5	$3.2	$3.4
3	$10.9	$3.2	$7.8
4	$17.8	$3.2	$14.6
5	$29.0	$3.2	$25.8
6	$30.4	$3.2	$27.3
7	$32.0	$3.2	$28.8
8	$33.5	$3.2	$30.3
9	$35.0	$3.2	$31.9
10	$36.6	$3.2	$33.4
11	$38.1	$0.0	$38.1
12	$39.6	$0.0	$39.6
13	$41.1	$0.0	$41.1
14	$42.6	$0.0	$42.6
15	$44.1	$0.0	$44.1
16	$45.5	$0.0	$45.5
17	$46.9	$0.0	$46.9
18	$48.3	$0.0	$48.3
19	$49.6	$0.0	$49.6
20	$50.8	$0.0	$50.8
21	$51.9	$0.0	$51.9
22	$53.0	$0.0	$53.0
23	$53.9	$0.0	$53.9
24	$54.8	$0.0	$54.8
25	$55.6	$0.0	$55.6
26	$56.3	$0.0	$56.3
27	$56.8	$0.0	$56.8
28	$57.3	$0.0	$57.3
29	$57.6	$0.0	$57.6
30	$57.8	$0.0	$57.8
31	$57.9	$0.0	$57.9
32	$57.8	$0.0	$57.8
33	$57.7	$0.0	$57.7
34	$57.3	$0.0	$57.3
35	$56.9	$0.0	$56.9
36	$56.3	$0.0	$56.3
37	$55.7	$0.0	$55.7
38	$54.8	$0.0	$54.8
39	$53.9	$0.0	$53.9
40	$52.8	$0.0	$52.8
41	$51.6	$0.0	$51.6
42	$50.2	$0.0	$50.2
43	$48.8	$0.0	$48.8
44	$30.1	$0.0	$30.1
45	$18.4	$0.0	$18.4
Present value	**$1,823.5**	**$145.4**	**$1,678.1**
Benefit-cost ratio			12.5
Payback period (no. of years)			N/A

Source: Emsi college impact model.

of rates of return to education, arguing that only the tangible benefits (higher earnings) should be counted. Table 3.4 and Table 3.6 are inclusive of social benefits reported as attributable to OTC. Recognizing the other point of view, Table 3.7 shows rates of return for both the taxpayer and social perspectives exclusive of social benefits. As indicated, returns are still above threshold values (a benefit-cost ratio greater than 1.0 and a rate of return greater than 0.7%), confirming that taxpayers receive value from investing in OTC.

CONCLUSION

This section has shown that the education provided by OTC is an attractive investment to students with rates of return that exceed alternative investment opportunities. At the same time, the presence of the college expands the state economy and creates a wide range of positive social benefits that accrue to taxpayers and society in general within Missouri.

CHAPTER 4:

Sensitivity Analysis

Sensitivity analysis measures the extent to which a model's outputs are affected by hypothetical changes in the background data and assumptions. This is especially important when those variables are inherently uncertain. This analysis allows us to identify a plausible range of potential results that would occur if the value of any of the variables is in fact different from what was expected. In this chapter 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, 4) the discount rate, and 5) the retained student variable.

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 publicly-funded college in the region. Given the difficulty in accurately specifying the alternative education variable, we test the sensitivity of the taxpayer and social investment analysis 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 perspective rate of return from 6.9% to 6.8%. Likewise, a decrease of 10% (from

TABLE 4.1: Sensitivity analysis of alternative education variable, taxpayer and social perspective

% VARIATION IN ASSUMPTION	-50%	-25%	-10%	BASE CASE	10%	25%	50%
Alternative education variable	8%	11%	14%	**15%**	17%	19%	23%
LOCAL TAXPAYER PERSPECTIVE							
Net present value (millions)	$44	$41	$38	**$37**	$35	$33	$29
Rate of return	16.7%	15.0%	14.0%	**13.4%**	12.9%	12.0%	10.7%
Benefit-cost ratio	5.4	5.0	4.8	**4.7**	4.5	4.3	3.9
STATE AND LOCAL TAXPAYER PERSPECTIVE							
Net present value (millions)	$161	$153	$149	**$146**	$143	$138	$131
Rate of return	17.5%	16.6%	16.1%	**15.8%**	15.5%	15.0%	14.2%
Benefit-cost ratio	7.1	6.8	6.6	**6.5**	6.4	6.2	5.9
SOCIAL PERSPECTIVE							
Net present value (millions)	$1,869	$1,789	$1,741	**$1,678.1**	$1,676	$1,628	$1,548
Benefit-cost ratio	13.6	13.1	12.8	**12.5**	12.3	12.0	11.4

15% to 14%) in the assumption increases the rate of return from 6.9% to 7.0%.

Based on this sensitivity analysis, the conclusion can be drawn that OTC investment analysis results from the taxpayer and social perspectives are not very sensitive to relatively large variations in the alternative education variable. As indicated, results are still above their threshold levels (net present value greater than 0, benefit-cost ratio greater than 1, and rate of return greater than the discount rate of 0.7%), 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 overall investment analysis results for the taxpayer and social perspective is not very sensitive.

LABOR IMPORT EFFECT VARIABLE

The labor import effect variable only affects the alumni impact calculation in Table 2.6. In the model we assume a labor import effect variable of 50%, which means that 50% of the region's labor demands would have been satisfied without the presence of OTC. In other words, businesses that hired OTC students could have substituted some of these workers with equally-qualified people from outside the region had there been no OTC students to hire. Therefore, we attribute only the remaining 50% of the initial labor income generated by increased alumni productivity to the college.

Table 4.2 presents the results of the sensitivity analysis for the labor import effect variable. As explained earlier, the assumption increases and decreases relative to the base case of 50% by the increments indicated in the table. Alumni productivity impacts attributable to OTC, for example, range from a high of $228 million at a -50% variation to a low of $76 million 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 decreases. Even under the most conservative assumptions, the alumni impact on the OTC Service Area economy still remains sizeable.

STUDENT EMPLOYMENT VARIABLES

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

Students incur substantial expense by attending OTC 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 78% of students who reported their employment status are employed, based on data provided by OTC. 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 the college earn only 58%, on average, of the earnings that they statistically would have received if not attending OTC. This suggests that many students hold part-time jobs that accommodate their OTC attendance, though it is at an additional cost in terms of receiving a wage that is less than what they otherwise might make. The 58% variable is an estimation based on

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)	$228	$190	$167	**$152**	$137	$114	$76

the average hourly wages of the most common jobs held by students while attending college 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 78% 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 78% to 100%, the net present value, internal rate of return, and benefit-cost ratio improve to $297.7 million, 17.9%, and 6.0, 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 $315.2 million, 22.4%, and 8.5, respectively, relative to base case results; a strong improvement, again attributable to a lower opportunity cost of time.
- **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 $331.6 million, 30.7%, and 14.0, 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 $257.1 million, 12.6%, and 3.6, respectively, relative to base case results. These results are reflective of an increased opportunity cost; none of the students are employed in this case.[42]

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 Chapter 3 are realistic, indicating that investments in OTC generate excellent returns, well above the long-term average percent rates of return in stock and bond markets.

DISCOUNT RATE

The discount rate is a rate of interest that converts future monies to their present value. In investment analysis, the discount rate 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

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

TABLE 4.3: Sensitivity analysis of student employment variables

% VARIATION IN ASSUMPTION	NET PRESENT VALUE (MILLIONS)	INTERNAL RATE OF RETURN	BENEFIT-COST RATIO
Base case: A = 78%, B = 58%	**$289.2**	**18.5%**	**5.3**
Scenario 1: A = 100%, B = 58%	$297.7	17.9%	6.0
Scenario 2: A = 78%, B = 100%	$315.2	22.4%	8.5
Scenario 3: A = 100%, B = 100%	$331.6	30.7%	14.0
Scenario 4: A = 0%, B = 0%	$257.1	12.6%	3.6

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

TABLE 4.4: Sensitivity analysis of discount rate

% VARIATION IN ASSUMPTION	-50%	-25%	-10%	BASE CASE	10%	25%	50%
STUDENT PERSPECTIVE							
Discount rate	2.1%	3.2%	3.9%	4.3%	4.7%	5.4%	6.4%
Net present value (millions)	$493	$376	$321	$289	$261	$224	$216
Benefit-cost ratio	8.3	6.5	5.7	5.3	4.8	4.3	4.2
LOCAL TAXPAYER PERSPECTIVE							
Discount rate	0.4%	0.5%	0.6%	0.7%	0.8%	0.9%	1.1%
Net present value (millions)	$41	$39	$38	$37	$36	$35	$33
Benefit-cost ratio	5.0	4.8	4.7	4.7	4.6	4.5	4.3
STATE AND LOCAL TAXPAYER PERSPECTIVE							
Discount rate	0.4%	0.5%	0.6%	0.7%	0.8%	0.9%	1.1%
Net present value (millions)	$160	$153	$149	$146	$143	$139	$133
Benefit-cost ratio	7.0	6.8	6.6	6.5	6.4	6.2	6.0
SOCIAL PERSPECTIVE							
Discount rate	0.4%	0.5%	0.6%	0.7%	0.8%	0.9%	1.1%
Net present value (millions)	$1,830	$1,752	$1,707	$1,678	$1,650	$1,608	$1,542
Benefit-cost ratio	13.6	13.1	12.7	12.5	12.3	12.1	11.6

length of time. An investor must be willing to forego the use of money in the present to receive compensation for it in the future. The discount rate 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 4.3% discount rate for students and a 0.7% discount rate for society and taxpayers.[43] Similar to the sensitivity analysis of the alternative education variable, we vary the base case discount rates for students, taxpayers, 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, taxpayers, and society in Table 4.4.

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 4.3% to 6.4%) reduces the students' benefit-cost ratio from 5.3 to 4.2. Conversely, reducing the discount rate for students by 50% (from 4.3% to 2.1%) increases the benefit-cost ratio from 5.3 to 8.3. The sensitivity analysis results for society and taxpayers show the same inverse relationship between the discount rate and the benefit-cost ratio, with the variance in results being the greatest under the social perspective (from a 13.6 benefit-cost ratio at a -50% variation from the base case, to a 11.6 benefit-cost ratio at a 50% variation from the base case).

RETAINED STUDENT VARIABLE

The retained student variable only affects the student spending impact calculation in Table 4.5, on the next page. For this analysis, we assume a retained student variable of 10%, which means that 10% of OTC's students who

43 These values are based on the baseline forecasts for the 10-year Treasury rate published by the Congressional Budget Office and the real treasury interest rates recommended by the Office of Management and Budget for 30-year investments. See the Congressional Budget Office "Table 4. Projection of Borrower Interest Rates: CBO's January 2017 Baseline" and the Office of Management and Budget "Circular A-94 Appendix C."

originated from the OTC Service Area would have left the region for other opportunities, whether that be education or employment, if OTC did not exist. The money these retained students spent in the region for accommodation and other personal and household expenses is attributable to OTC.

Table 4.5 presents the results of the sensitivity analysis for the retained student variable. The assumption increases and decreases relative to the base case of 10% by the increments indicated in the table. The student spending impact is recalculated at each value of the assumption, holding all else constant. Student spending impacts attributable to OTC range from a high of $22.5 million when the retained student variable is 15% to a low of $11.6 million when the retained student variable is 5%. This means as the retained student variable decreases, the student spending attributable to OTC decreases. Even under the most conservative assumptions, the student spending impact on the OTC Service Area economy remains substantial.

TABLE 4.5: Sensitivity analysis of retained student variable

% VARIATION IN ASSUMPTION	-50%	-25%	-10%	BASE CASE	10%	25%	50%
Retained student variable	5%	8%	9%	**10%**	11%	13%	15%
Student spending impact (thousands)	$11,637	$14,349	$15,977	**$17,062**	$18,147	$19,774	$22,486

CHAPTER 5:

Conclusion

While OTC's value to the OTC Service Area is larger than simply its economic impact, understanding the dollars and cents value is an important asset to understanding the college's value as a whole. In order to fully assess OTC's value to the regional economy, this report has evaluated the college from the perspectives of economic impact analysis and investment analysis.

From an economic impact perspective, we calculated that OTC generates a total economic impact of $234 million in total added income for the regional economy. This represents the sum of several different impacts, including the college's operations spending impact ($63 million), construction spending impact ($1.9 million), student spending impact ($17.1 million), and alumni impact ($152 million). This impact means that OTC is responsible for 5,579 jobs in the OTC Service Area.

Since OTC's activity represents an investment by various parties, including students, state and local taxpayers, and society as a whole, we also considered the college as an investment to see the value it provides to these investors. For each dollar invested by students, local taxpayers, state and local taxpayers, and society, OTC offers a benefit of $5.30, $4.70, $6.50, and $12.50, respectively.

Modeling the impact of the college is subject to many factors, the variability of which we considered in our sensitivity analysis. With this variability accounted for, we present the findings of this study as a robust picture of the economic value of OTC.

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Appendix 1: 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 college 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 college in order to obtain their education.

Alternative use of funds A measure of how monies that are currently used to fund the college might otherwise have been used if the college 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 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.

Discounting Expressing future revenues and costs in present value terms.

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 regional product Measure of the final value of all goods and services produced in a region after netting out the cost of goods used in production. Alternatively, gross regional product (GRP) 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 regional product is also sometimes called value added or added income.

Initial effect Income generated by the initial injection of monies into the economy through the payroll of the college and the higher earnings of its 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. When educational institutions pay wages and salaries and spend money for supplies in the region, 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.

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

Multiplier effect Additional income created in the economy as the college and its students spend money in the region. It consists of the income created by the supply chain of the industries initially affected by the spending of the college and its 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).

NAICS The North American Industry Classification System (NAICS) classifies North American business establishment in order to better collect, analyze, and publish statistical data related to the business economy.

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 foregone from alternative B once a decision is made to allocate resources to alternative A. Or, if individuals choose to attend college, they forego earnings that they would have received had they chose instead to work full-time. Foregone 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 2: Frequently Asked Questions (FAQs)

This appendix provides answers to some frequently asked questions about the results.

What is economic impact analysis?

Economic impact analysis quantifies the impact from a given economic event – in this case, the presence of a college – on the economy of a specified region.

What is investment analysis?

Investment analysis is a standard method for determining whether or not an existing or proposed investment is economically viable. This methodology is appropriate in situations where a stakeholder puts up a certain amount of money with the expectation of receiving benefits in return, where the benefits that the stakeholder receives are distributed over time, and where a discount rate must be applied in order to account for the time value of money.

Do the results differ by region, and if so, why?

Yes. Regional economic data are drawn from Emsi's proprietary MR-SAM model, the Census Bureau, and other sources to reflect the specific earnings levels, jobs numbers, unemployment rates, population demographics, and other key characteristics of the region served by the college. Therefore, model results for the college are specific to the given region.

Are the funds transferred to the college increasing in value, or simply being re-directed?

Emsi's approach is not a simple "rearranging of the furniture" where the impact of operations spending is essentially a restatement of the level of funding received by the college. Rather, it is an impact assessment of the additional income created in the region as a result of the college spending on payroll and other non-pay expenditures, net of any impacts that would have occurred anyway if the college did not exist.

How does my college's rates of return compare to that of other institutions?

In general, Emsi discourages comparisons between institutions since many factors, such as regional economic conditions, institutional differences, and student demographics are outside of the college's control. It is best to compare the rate of return to the discount rates of 4.5% (for students) and 1.1% (for society and taxpayers), which can also be seen as the opportunity cost of the investment (since these stakeholder groups could be spending their time and money in other investment schemes besides education). If the rate of return is higher than the discount rate, the stakeholder groups can expect to receive a positive return on their educational investment.

Emsi recognizes that some institutions may want to make comparisons. As a word of caution, if comparing to an institution that had a study commissioned by a firm other than Emsi, then differences in methodology will create an "apples to oranges" comparison and will therefore be difficult. The study results should be seen as unique to each institution.

Net Present Value (NPV): How do I communicate this in laymen's terms?

Which would you rather have: a dollar right now or a dollar 30 years from now? That most people will choose a dollar now is the crux of net present value. The preference for a dollar today means today's dollar is therefore worth more than it would be in the future (in most people's opinion). Because the dollar today is worth more than a dollar in 30 years, the dollar 30 years from now needs to be adjusted to express its worth today. Adjusting the values for "this time value of money" is called discounting and the result of adding them all up after discounting each value is called net present value.

Internal Rate of Return (IRR): How do I communicate this in laymen's terms?

Using the bank as an example, an individual needs to decide between spending all of their paycheck today and putting it into savings. If they spend it today, they know what it is worth: $1 = $1. If they put it into savings, they need to know that there will be some sort of return to them for spending those dollars in the future rather than now. This is why banks offer interest rates and deposit interest earnings. This makes it so an individual can expect, for example, a 3% return in the future for money that they put into savings now.

Total Economic Impact: How do I communicate this in laymen's terms?

Big numbers are great, but putting it into perspective can be a challenge. To add perspective, find an industry with roughly the same "% of GRP" as your college (Table 1.5). This percentage represents its portion of the total gross regional product in the region (similar to the nationally recognized gross domestic product but at a regional level). This allows the college to say that their single brick and mortar campus does just as much for the OTC Service Area as the entire utility industry, for example. This powerful statement can help put the large total impact number into perspective.

Appendix 3: Example of Sales versus Income

Emsi's economic impact study differs from many other studies because we prefer to report the impacts in terms of income rather than sales (or output). Income is synonymous with value added or gross regional product (GRP). Sales include all the intermediary costs associated with producing goods and services. Income is a net measure that excludes these intermediary costs:

Income = Sales – Intermediary Costs

For this reason, income is a more meaningful measure of new economic activity than reporting sales. This is evidenced by the use of gross domestic product (GDP) – a measure of income – by economists when considering the economic growth or size of a country. The difference is GRP reflects a region and GDP a country.

To demonstrate the difference between income and sales, let us consider an example of a baker's production of a loaf of bread. The baker buys the ingredients such as eggs, flour, and yeast for $2.00. He uses capital such as a mixer to combine the ingredients and an oven to bake the bread and convert it into a final product. Overhead costs for these steps are $1.00. Total intermediary costs are $3.00. The baker then sells the loaf of bread for $5.00.

The sales amount of the loaf of bread is $5.00. The income from the loaf of bread is equal to the sales amount less the intermediary costs:

Income = $5.00 – $3.00 = $2.00

In our analysis, we provide context behind the income figures by also reporting the associated number of jobs. The impacts are also reported in sales and earnings terms for reference.

Appendix 4: Emsi MR-SAM

Emsi's 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 MR-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 MR-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.

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 MR-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 (also known as added income) 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 MR-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- 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.

Bureau of Labor Statistics 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.

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 MR-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).

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.

Multi-regional aspect of the MR-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.

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.

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 are 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.

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 Bureau of Labor Statistics' 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.

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.

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 5: 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.

VALUE PER CHE

Typically, the educational achievements of students are marked by the credentials they earn. However, not all students who attended OTC in the 2015-16 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 college, 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 degree, another 60 CHEs to move from an associate 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.[44] For example, the difference in regional earnings between a high school diploma and an associate degree is $3,200. We spread this $3,200 wage differential across the 60 CHEs that occur between a high school diploma and an associate degree, applying a ceremonial "boost" to the last CHE in the stage to mark the achievement of the degree.[45] We repeat this process for each education level in the ladder.

Next we map the CHE production of the FY 2015-16 student population to the education ladder. Table 1.4 provides information on the CHE production of students attending OTC, broken out by educational achievement. In total, students completed 207,364 CHEs during the analysis year. We map each of these CHEs to the education ladder depending on 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 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.

44 The value per CHE is different between the economic impact analysis and the investment analysis. The economic impact analysis uses the region as its background and, therefore, uses regional earnings to calculate value per CHE while the investment analysis uses the state as its backdrop and, therefore, uses state earnings. The methodology outlined in this appendix will use regional earnings; however, the same methodology is followed for the investment analysis when state earnings are used.

45 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 impact model are derived from Jaeger and Page (1996).

Table A5.1 displays the result for the students' aggregate annual increase in income (ΔE), a total of $27.2 million. By dividing this value by the students' total production of 207,364 CHEs during the analysis year, we derive an overall value of $131 per CHE.

TABLE A5.1: Aggregate annual increase in income of students and value per CHE

Aggregate annual increase in income	$27,240,631
Total credit hour equivalents (CHEs) in FY 2015-16	207,364
Value per CHE	**$131**

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

MINCER FUNCTION

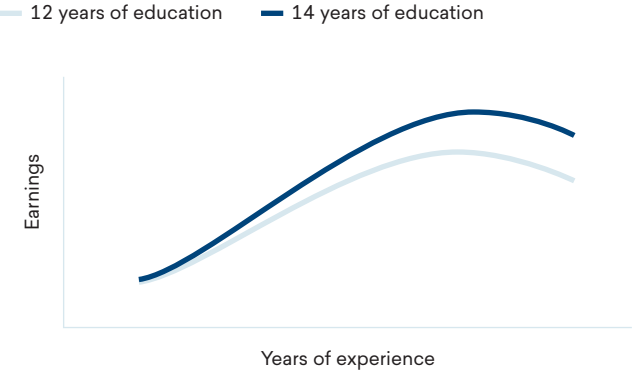
The $131 value per CHE in Table A5.1 only tells part of the story, however. Human capital theory holds that earnings levels do not remain constant; rather, they start relatively low and gradually increase as the worker gains more experience. Research also shows that the earnings increment between educated 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.[46] 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 use state-specific and education-level-specific Mincer coefficients.

Figure A5.1 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 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 $131 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 $131 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 FY 2015-16 student population into the future. 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 A5.1.

FIGURE A5.1: Lifecycle change in earnings, 12 years versus 14 years of education



46 See Mincer (1958 and 1974).

Appendix 6: Alternative Education Variable

In a scenario where the college did not exist, some of its students would still be able to avail themselves of an alternative comparable education. These students create benefits in the region even in the absence of the college. The alternative education variable accounts for these students and is used to discount the benefits we attribute to the college.

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

In the absence of the college, we assume 15% of the college's students would find alternative education opportunities and remain in or return to the region. We account for this by discounting the alumni impact, the benefits to taxpayers, and the benefits to society in the region in sections 2 and 3 by 15%. In other words, we assume 15% of the benefits created by the college's students would have occurred anyways in the counterfactual scenario where the college did not exist. A sensitivity analysis of this adjustment is presented in chapter 4.

Appendix 7: Overview of Investment Analysis Measures

The appendix provides context to the investment analysis results using the simple hypothetical example summarized in Table A7.1 below. The table shows the projected benefits and costs for a single student over time and associated investment analysis results.[47]

Assumptions are as follows:

- Benefits and costs are projected out 10 years into the future (Column 1).
- The student attends the college for one year, and the cost of tuition is $1,500 (Column 2).
- Earnings foregone while attending the college for one year (opportunity cost) come to $20,000 (Column 3).
- Together, tuition and earnings foregone 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 otherwise would have 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 A7.1.

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

TABLE A7.1: 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%
Benefit-cost ratio					1.7
Payback period					4.2 years

NET PRESENT VALUE

The student in Table A7.1 can choose either to attend college or to forego 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 earnings 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 A7.1, 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 foregone) 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.[48]

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 10 years. An "economically rational" person would, therefore, be equally satisfied receiving $3,377 today or $5,000 10 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 foregone). As indicated in Table A7.1 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 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.

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 A7.1. 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 A7.1. 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 earnings 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

48 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 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).

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.

PAYBACK PERIOD

This is the length of time from the beginning of the investment (consisting of tuition and earnings foregone) until higher future earnings give a return on the investment made. For the student in Table A7.1, 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 foregone while attending the college. 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 8: Shutdown Point

The investment analysis in Chapter 3 weighs the benefits generated by the college against the state and local taxpayer funding that the college receives to support its operations. An important part of this analysis is factoring out the benefits that the college would have been able to generate anyway, even without state and local taxpayer support. This adjustment is used to establish a direct link between what taxpayers pay and what they receive in return. If the college is able to generate benefits without taxpayer support, then it would not be a true investment.[49]

The overall approach includes a sub-model that simulates the effect on student enrollment if the college loses its state and local funding and has to raise student tuition and fees in order to stay open. If the college can still operate without state and local support, then any benefits it generates at that level are discounted from total benefit estimates. If the simulation indicates that the college cannot stay open, however, then benefits are directly linked to costs, and no discounting applies. This appendix documents the underlying theory behind these adjustments.

STATE AND LOCAL GOVERNMENT SUPPORT VERSUS STUDENT DEMAND FOR EDUCATION

Figure A8.1 presents a simple model of student demand and state and local government support. The right side of the graph is a standard demand curve (D) showing student enrollment as a function of student tuition and fees. Enrollment is measured in terms of total credit hour equivalents (CHEs) and expressed as a percentage of the college's current CHE production. Current student tuition and fees are represented by p', and state and local government support covers C% of all costs. At this point in the analysis, it is assumed that the college has only two sources of revenues: 1) student tuition and fees and 2) state and local government support.

FIGURE A8.1: Student demand and government funding by tuition and fees

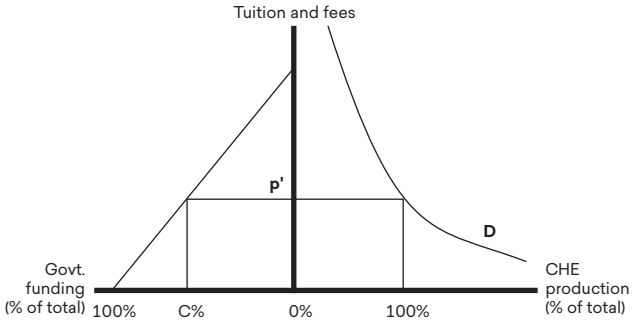


FIGURE A8.2: CHE production and government funding by tuition and fees

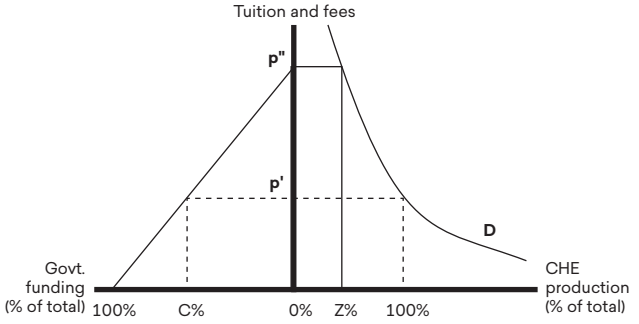


Figure A8.2 shows another important reference point in the model – where state and local government support is 0%, student tuition and fees are increased to p", and CHE production is at Z% (less than 100%). The reduction in CHEs reflects the price elasticity of the students' demand for education, i.e., the extent to which the students' decision to attend the college is affected by the change in tuition and fees. Ignoring for the moment those issues concerning the college's minimum operating scale (considered below in the section called "Shutdown Point"), the implication for the investment analysis is that benefits to state and local

49 Of course, as a public training provider, the college would not be permitted to continue without public funding, so the situation in which it would lose all state support is entirely hypothetical. The purpose of the adjustment factor is to examine the college in standard investment analysis terms by netting out any benefits it may be able to generate that are not directly linked to the costs of supporting it.

government must be adjusted to net out the benefits that the college can provide absent state and local government support, represented as Z% of the college's current CHE production in Figure A8.2.

To clarify the argument, it is useful to consider the role of enrollment in the larger benefit-cost model. Let B equal the benefits attributable to state and local government support. The analysis derives all benefits as a function of student enrollment, measured in terms of CHEs produced. For consistency with the graphs in this appendix, B is expressed as a function of the percent of the college's current CHE production. Equation 1 is thus as follows:

1) B = B (100%)

This reflects the total benefits generated by enrollments at their current levels.

Consider benefits now with reference to Z. The point at which state and local government support is zero nonetheless provides for Z% (less than 100%) of the current enrollment, and benefits are symbolically indicated by the following equation:

2) B = B (Z%)

Inasmuch as the benefits in equation 2 occur with or without state and local government support, the benefits appropriately attributed to state and local government support are given by equation 3 as follows:

3) B = B (100%) – B (Z%)

CALCULATING BENEFITS AT THE SHUTDOWN POINT

Colleges and universities cease to operate when the revenue they receive from the quantity of education demanded is insufficient to justify their continued operations. This is commonly known in economics as the shutdown point.[50] The shutdown point is introduced graphically in Figure A8.3 as S%. The location of point S% indicates that the college

50 In the traditional sense, the shutdown point applies to firms seeking to maximize profits and minimize losses. Although profit maximization is not the primary aim of colleges and universities, the principle remains the same, *i.e., that there is a minimum scale of operation required in order for colleges and universities to stay open.*

FIGURE A8.3: Shutdown Point after Zero Government Funding

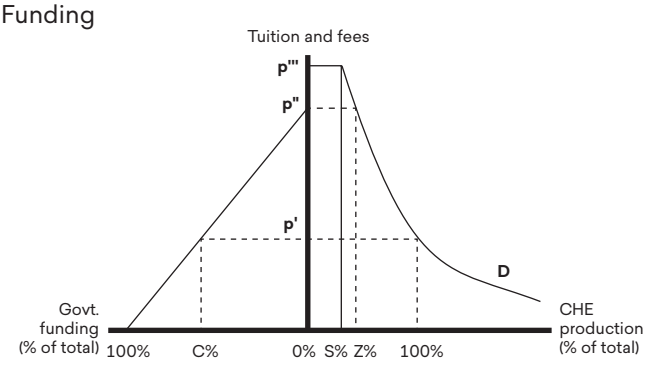
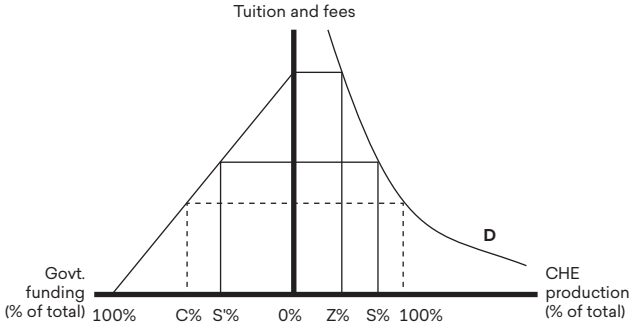


FIGURE A8.4: Shutdown Point before Zero Government Funding



can operate at an even lower enrollment level than Z% (the point at which the college receives zero state and local government funding). State and local government support at point S% is still zero, and student tuition and fees have been raised to p'''. State and local government support is thus credited with the benefits given by equation 3, or B = B (100%) – B (Z%). With student tuition and fees still higher than p''', the college would no longer be able to attract enough students to keep the doors open, and it would shut down.

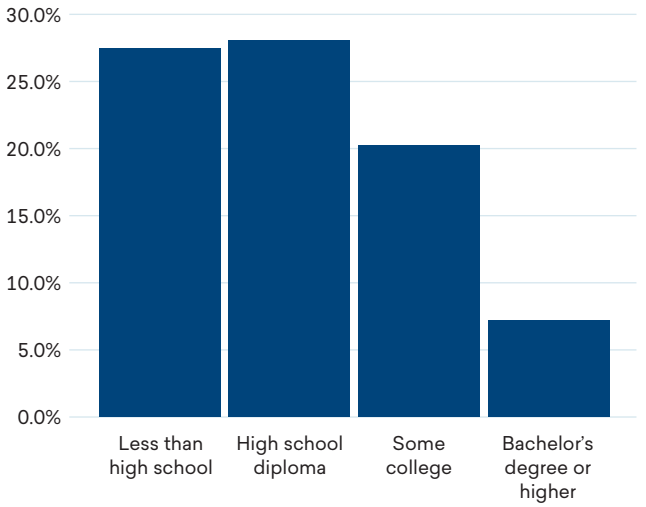
Figure A8.4 illustrates yet another scenario. Here the shutdown point occurs at a level of CHE production greater than Z% (the level of zero state and local government support), meaning some minimum level of state and local government support is needed for the college to operate at all. This minimum portion of overall funding is indicated by S'% on the left side of the chart, and as before, the shutdown point is indicated by S% on the right side of chart. In this case, state and local government support is appropriately credited with all the benefits generated by the college's CHE production, or B = B (100%).

Appendix 9: 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 society communities and citizens throughout the region, 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.

FIGURE A9.1: Prevalence of smoking among U.S. adults by education level



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.

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 A9.1 shows the prevalence of cigarette smoking among adults aged 25 years and over, based on data provided by the National Health Interview Survey.[51] As indicated, the percent of persons who smoke begins to decline beyond the level of high school education.

The Centers for Disease Control and Prevention (CDC) reports the percentage of adults who are current smokers by state.[52] We use this information to create an index value by which we adjust the national prevalence data on smoking to each state. For example, 25.0% of Missouri' adults were smokers in 2011, relative to 21.2% for the nation. We thus apply a scalar of 1.2 to the national probabilities of smoking in order to adjust them to the state of Missouri.

51 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.

52 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.

FIGURE A9.2: Prevalence of alcohol dependence or abuse by sex and education level

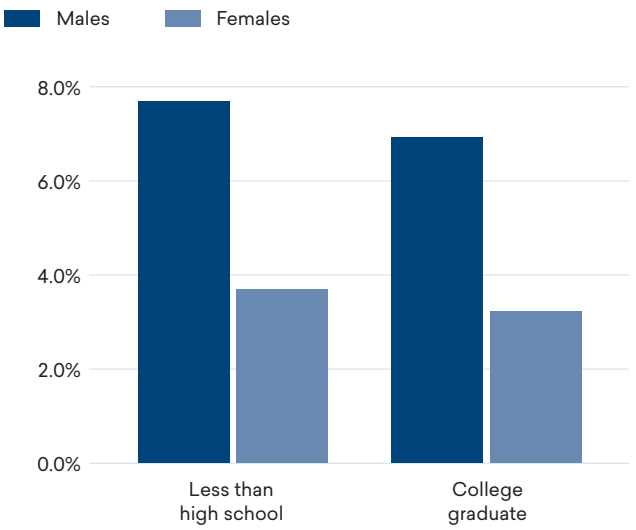
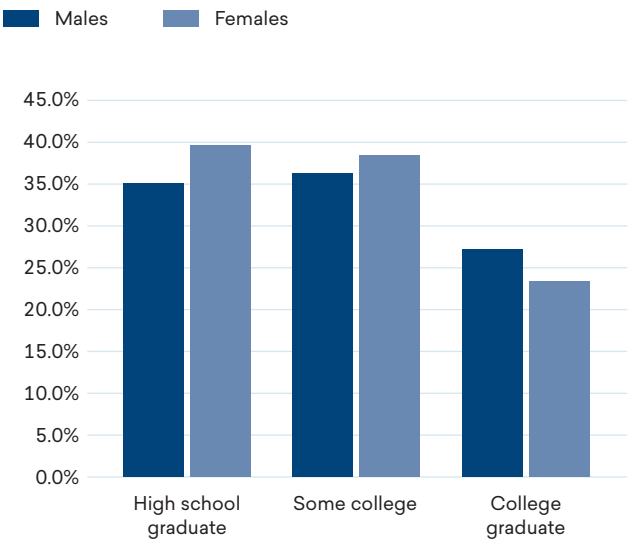


FIGURE A9.3: Prevalence of obesity by education level



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 A9.2 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).[53] 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.

53 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.

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.[54] The CDC also reports the prevalence of obesity among adults by state.[55]

Data for Figure A9.3 was provided by the National Center for Health Statistics which shows the prevalence of obesity among adults aged 20 years and over by education and sex.[56] 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

54 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.

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

56 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.

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.

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 A9.4 summarizes the prevalence of self-reported frequent mental distress among adults by education level, based on data supplied by the CDC.[57] 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.

57 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.

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 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 A9.5 based on data supplied by SAMHSA.[58] 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.[59]

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

59 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.

FIGURE A9.4: Prevalence of frequent mental distress by education level

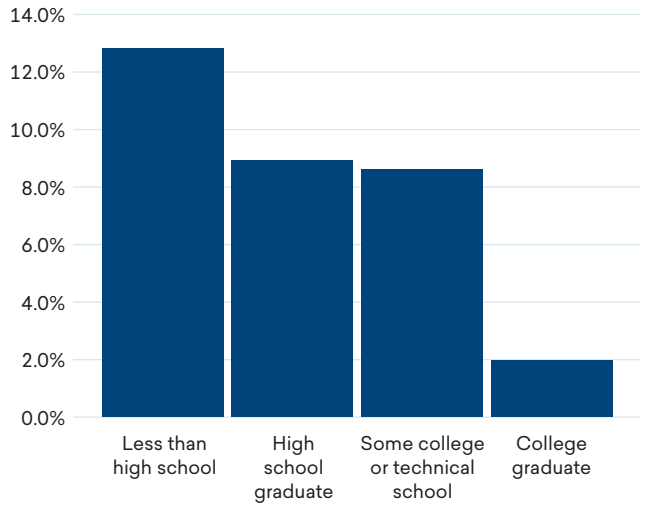
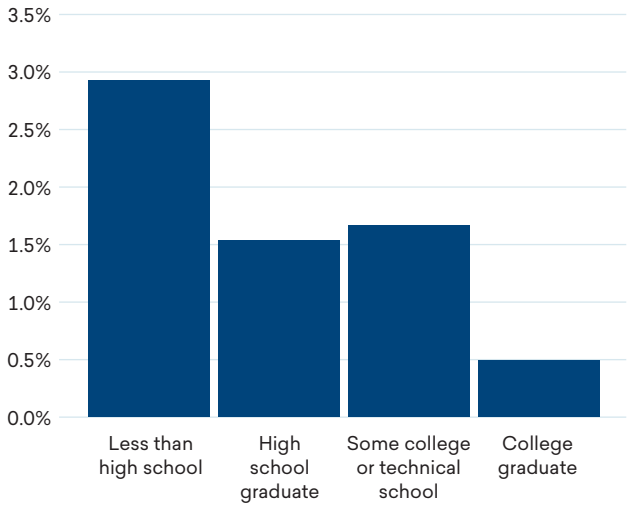


FIGURE A9.5: Prevalence of illicit drug dependence or abuse by education level



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 A9.6 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,[60] 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 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.

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.[61]

Figure A9.7 relates the breakdown of TANF recipients by education level, derived from data supplied by the U.S.

60 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.

61 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.

FIGURE A9.6: Incarceration rates by education level

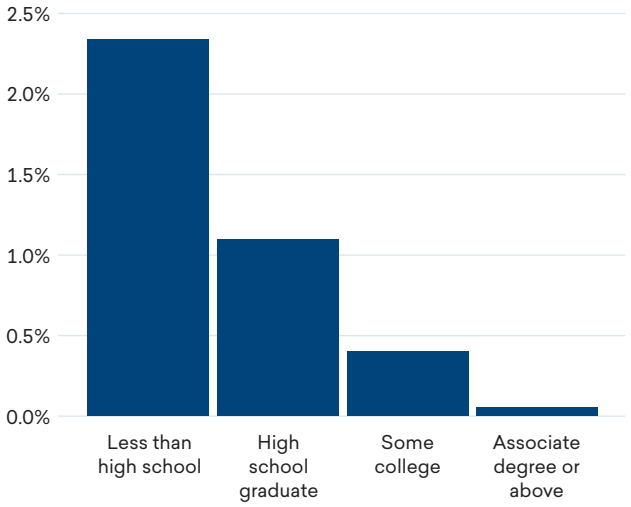
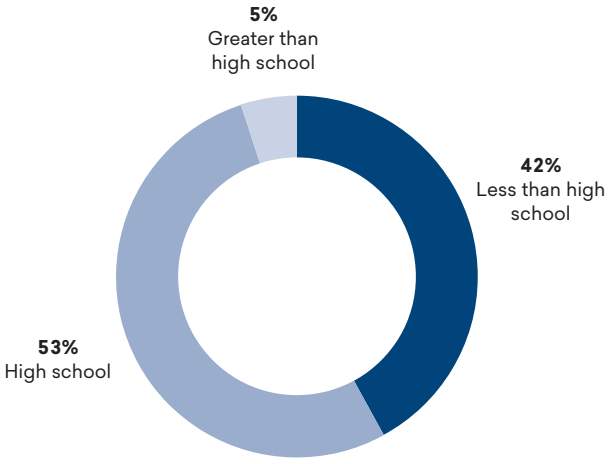


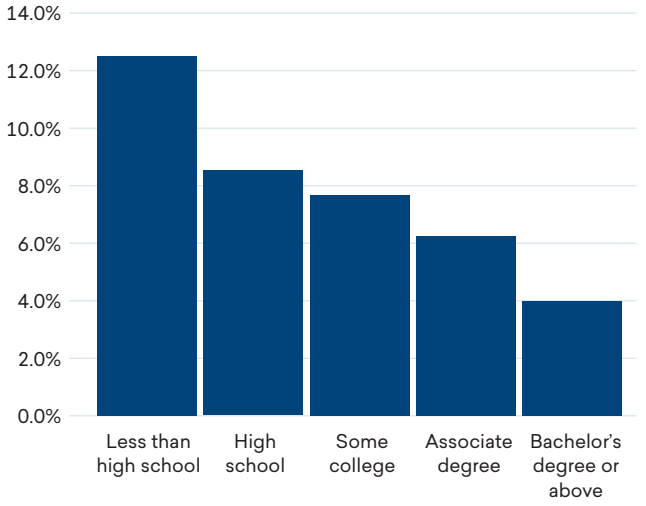
FIGURE A9.7: Breakdown of TANF recipients by education level



Department of Health and Human Services.[62] 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.

Unemployment rates also decline with increasing levels of education, as illustrated in Figure A9.8. These data are supplied by the Bureau of Labor Statistics.[63] 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.

FIGURE A9.8: Unemployment by education level



62 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.

63 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.