Demonstrating the Economic Value of South Texas College

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emsi

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Executive Summary

The purpose of this report is to assess the impact of South Texas College (STC) as a whole on the regional economy and the benefits generated by the college for students, society, and taxpayers. The results of this study show that STC creates a positive net impact on the regional economy and generates benefits for students, society, and taxpayers.

Economic Impact Analysis

This study reports the impacts of STC in terms of value added and jobs. Impacts reported in this section equal the sum of the initial and multiplier effects – where the initial effect is the shock to the economy caused by STC and the multiplier effects are the subsequent economic activity occurring in the region.

- In FY 2012-13, STC enrolled **40,009** students in courses for credit, spent **$88.5 million** in payroll that employed **1,280** full-time and **858** part-time employees, and spent another **$65.2 million** on goods and services.
- The net impact of STC operational expenditures was approximately **$121.6 million** in added value, equivalent to **2,771 jobs**, in the STC Service Area.
- Around **3%** of STC students originated from outside the STC Service Area. The spending of these out-of-region students for living and personal expenses created approximately **$595,600** in added value for the STC Service Area, equivalent to **27 jobs**.
- An estimated **97%** of STC alumni stay in the STC Service Area after leaving the college. The accumulated impact of alumni who were employed in the regional workforce in FY 2012-13 amounted to **$325.4 million** in added value in the STC Service Area, equivalent to **7,194 jobs**.
- The total impact of STC on the regional economy in FY 2012-13 was **$447.6 million** in added value, or the same amount that **9,991 jobs** would generate for the STC Service Area. This is approximately equal to **2.7**% of the STC Service Area's gross regional product.

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 STC as an investment from the perspectives of students, society, and taxpayers.

- Students invest their own money and time in their education. Students enrolled at STC paid a total of **$43.1 million** to cover the cost of tuition, fees, books, and supplies at STC in FY 2012-13. They also forwent **$101.3 million** in earnings that they would have generated had they been working instead of learning. In return, students will receive a present value of **$1.2 billion** in increased earnings over their working lives. This translates to a return of **$8.30** in higher future income for every $1 that students pay for their education at STC. The corresponding annual rate of return is **23.9%**.

- Texas as a whole spent **$277.1 million** on STC educations in FY 2012-13. This includes **$153.8 million** in STC expenditures, **$22.1 million** in student expenditures, and **$101.3 million** in student opportunity costs. In return, the state of Texas will receive a present value of **$7.3 billion** in added state income over the course of the students' working lives. Texas will also benefit from **$169.8 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 STC student's education, an average of **$27.10** in benefits will accrue to Texas over the course of the student's career.

- Taxpayers provided **$89.8 million** of state and local funding to STC in FY 2012-13. In return, taxpayers will receive a present value of **$487.9 million** in added tax revenue stemming from the students' higher lifetime incomes and the increased output of businesses amounts. Savings to the public sector add another **$52.4 million** in benefits due to a reduced demand for government-funded social services in Texas. For every taxpayer dollar spent on STC educations, taxpayers will receive an average of **$6.00** in return over the course of the students' working lives. In other words, taxpayers enjoy an annual rate of return of **13.7%**.

Notes of Importance

There are two points to consider when reviewing the findings of this study:

- If state and local dollars were not spent on STC, they would have been spent elsewhere in the region and would have created impacts regardless. This study accounts for that counterfactual scenario. The impacts of the counterfactual spending are estimated and then subtracted from the STC spending impacts.

- Impacts are reported in the form of income and value added rather than output. Output includes all the intermediary costs associated with producing goods and services. Income and value added, on the other hand, are net measures that exclude these intermediary costs and are synonymous with gross regional product. For this reason, they are more meaningful measures of new economic activity than output.

Introduction

This study considers the economic impact of South Texas College (STC). The college naturally helps students achieve their individual potential and develop the knowledge, skills, and abilities they need to have a fulfilling and prosperous career, but the impact of STC 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 and its employees and students support the regional economy through the output and employment generated by regional 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.

The purpose of this report is to assess the impact of STC as a whole on the regional economy and the benefits generated by the college for students, society, and taxpayers. The approach is twofold. We begin with an economic impact analysis of the college on the STC Service Area economy. To derive results, we rely on a specialized Social Accounting Matrix (SAM) model to calculate the additional income created in the STC 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 student spending, and 3) impact of alumni who are still employed in the STC Service Area workforce.

The second component of the study measures the benefits generated by STC for the following stakeholder groups: students, taxpayers, and society. For students, we perform an investment analysis to determine how the money spent by students on their education performs as an investment over time. The students' investment in this case consists of their out-of-pocket expenses and the opportunity cost of attending the college as opposed to working. In return for these investments, students receive a lifetime of higher incomes. For taxpayers, the study measures the benefits to state 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 incomes and improved quality of life create benefits throughout Texas as a whole.

The study uses a wide array of data that are based on several sources, including the 2012-13 academic and financial reports from STC and the Texas Higher Education Coordinating Board; industry and employment data from the U.S. Bureau of Labor Statistics and U.S. Census Bureau; outputs of EMSI's college impact model and SAM model; and a variety of published materials relating education to social behavior.

1 Profile of South Texas College and the Economy

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 STC information used in this analysis and provides an overview of the STC Service Area economy.

1.1 STC employee and finance data

1.1.1 Employee data

Data provided by STC include information on faculty and staff by place of work and by place of residence. These data appear in Table 1.1. As shown, STC employed 1,280 full-time and 858 part-time faculty and staff, including student workers, in FY 2012-13. Of these, 100% worked in the region and 95% 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 2012-13

Full-time faculty and staff	1,280
Part-time faculty and staff	858
Total faculty and staff	**2,138**
% of employees that work in region	100%
% of employees that live in region	95%

Source: Data supplied by STC.

1.1.2 Revenues

Table 1.2 shows the college's annual revenues by funding source – a total of $179 million in FY 2012-13. As indicated, tuition and fees comprised 12% of total revenue, and revenue from local, state, and federal government sources comprised another 85%. All other revenue (i.e., auxiliary revenue, sales and services, interest, and donations) comprised the remaining 4%. These data are critical in identifying the annual costs of educating the student body from the perspectives of students, society, and taxpayers.

[1]See Appendix 2 for a detailed description of the data sources used in the EMSI modeling tools.

Table 1.2: Revenue by source, FY 2012-13

Funding source	Total	% of total
Tuition and fees	$21,051,377	12%
Local government	$45,703,971	26%
State government	$44,138,533	25%
Federal government	$61,781,609	35%
All other revenue	$6,286,826	4%
Total revenues	**$178,962,316**	**100%**

Source: Data supplied by STC.

1.1.3 Expenditures

The combined payroll at STC, including student salaries and wages, amounted to $88.5 million. This was equal to 58% of the college's total expenses for FY 2012-13. Other expenditures, including capital and purchases of supplies and services, made up $65.2 million. These budget data appear in Table 1.3.

Table 1.3: Expenses by function, FY 2012-13

Expense item	Total	%
Employee salaries, wages, and benefits	$88,546,869	58%
Capital depreciation	$8,103,977	5%
All other expenditures	$57,099,957	37%
Total expenses	**$153,750,803**	**100%**

Source: Data supplied by STC.

1.1.4 Students

STC served 40,009 students taking courses for credit and 4,474 students taking courses but not for credit towards a degree in the 2012-13 reporting year. These numbers represent unduplicated student headcounts. The breakdown of the student body by gender was 44% male and 56% female. The breakdown by ethnicity was 3% white, 88% minority, and 9% unknown. The students' overall average age was 22.[2] An estimated 97% of students remain in the STC Service Area after finishing their time at STC, another 1% settle outside the region but in the state, and the remaining 2% settle outside the state.[3]

Table 1.4 summarizes the breakdown of the student population and their corresponding awards and credits by education level. In the 2012-13 reporting year, STC served 120 bachelor's degree graduates, 2,258 associate's degree graduates, and 1,392 certificate graduates. Another 22,735 students enrolled in courses for credit but did not complete a degree during the reporting year. The college also offered dual credit courses to high schools, serving a total of 13,315 students over the

[2] Unduplicated headcount, gender, ethnicity, and age data provided by STC.

[3] Settlement data provided by STC. In the event that the data was unavailable, EMSI used estimates based on student origin.

course of the year. The college also served 3,069 basic education students and 189 personal enrichment students enrolled in non-credit courses. Students not allocated to the other categories – including non-degree-seeking workforce students – comprised the remaining 1,405 students.

We use semester credit hours (SCHs) to track the educational workload of the students. One SCH is equal to 15 contact hours of classroom instruction per semester. In the analysis, we exclude the SCH production of personal enrichment students under the assumption that they do not attain knowledge, skills, and abilities that will increase their earnings. The average number of SCHs per student (excluding personal enrichment students) was 12.5.

Table 1.4: Breakdown of student headcount and SCH production by education level, FY 2012-13

Category	Headcount	Total SCHs	Average SCHs
Bachelor's degree graduates	120	2,543	21.2
Associate's degree graduates	2,258	43,494	19.3
Certificate graduates	1,392	30,033	21.6
Continuing students	22,735	266,046	11.7
Dual credit students	13,315	139,844	10.5
Basic education students	3,069	61,400	20.0
Personal enrichment students	189	1,438	7.6
Workforce and all other students	1,405	9,591	6.8
Total, all students	**44,483**	**554,389**	**12.5**
Total, less personal enrichment students	**44,294**	**552,951**	**12.5**

Source: Data supplied by STC.

1.2 The STC Service Area economy

STC serves a region referred to as the STC Service Area, made up of several counties in Texas[4]. Since the college was first established, it has been serving the STC 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 gross regional product (GRP).

As shown in Table 1.5, the GRP of STC Service Area is approximately $16.6 billion, equal to the sum of labor income ($11.2 billion) and non-labor income ($5.4 billion). In Section 2, we use GRP as the backdrop against which we measure the relative impacts of the college on the regional economy.

[4] The service region includes the following counties: Hidalgo and Starr.

Table 1.5: Labor and non-labor income by major industry sector in the STC Service Area, 2013

Industry sector	Labor income (millions)	+	Non-labor income (millions)	=	Value added (millions)	OR	% of Total
Agriculture, Forestry, Fishing, and Hunting	$190		$48		$238		1.4%
Mining	$291		$242		$533		3.2%
Utilities	$56		$154		$210		1.3%
Construction	$442		$33		$474		2.9%
Manufacturing	$336		$174		$510		3.1%
Wholesale Trade	$390		$301		$691		4.2%
Retail Trade	$1,203		$724		$1,927		11.6%
Transportation and Warehousing	$465		$155		$619		3.7%
Information	$109		$160		$269		1.6%
Finance and Insurance	$479		$513		$992		6.0%
Real Estate and Rental and Leasing	$227		$629		$856		5.2%
Professional and Technical Services	$303		$99		$402		2.4%
Management of Companies and Enterprises	$30		$5		$35		0.2%
Administrative and Waste Services	$412		$89		$500		3.0%
Educational Services	$119		$13		$132		0.8%
Health Care and Social Assistance	$2,170		$208		$2,378		14.3%
Arts, Entertainment, and Recreation	$40		$17		$58		0.3%
Accommodation and Food Services	$380		$209		$589		3.6%
Other Services (except Public Administration)	$317		$41		$358		2.2%
Public Administration	$3,216		$316		$3,533		21.3%
Other Non-industries	$0		$1,293		$1,293		7.8%
Total	**$11,173**		**$5,422**		**$16,595**		**100.0%**

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

† Numbers may not add due to rounding.

Source: EMSI.

Table 1.6 provides the breakdown of jobs by industry in the STC Service Area. Among the region's non-government industry sectors, the Health Care and Social Assistance sector is the largest employer, supporting 70,094 jobs or 20.2% of total employment in the region. The second largest employer is the Retail Trade sector, supporting 47,824 jobs or 13.8% of the region's total employment. Altogether, the region supports 347,624 jobs.[5]

[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.

Table 1.6: Jobs by major industry sector in the STC Service Area, 2013

Industry sector	Total jobs	% of Total
Agriculture, Forestry, Fishing, and Hunting	8,820	2.5%
Mining	3,718	1.1%
Utilities	959	0.3%
Construction	20,375	5.9%
Manufacturing	8,438	2.4%
Wholesale Trade	9,447	2.7%
Retail Trade	47,824	13.8%
Transportation and Warehousing	13,117	3.8%
Information	2,592	0.7%
Finance and Insurance	11,919	3.4%
Real Estate and Rental and Leasing	8,825	2.5%
Professional and Technical Services	9,347	2.7%
Management of Companies and Enterprises	667	0.2%
Administrative and Waste Services	21,404	6.2%
Educational Services	4,204	1.2%
Health Care and Social Assistance	70,094	20.2%
Arts, Entertainment, and Recreation	3,034	0.9%
Accommodation and Food Services	23,939	6.9%
Other Services (except Public Administration)	17,630	5.1%
Public Administration	61,271	17.6%
Total	**347,624**	**100.0%**

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

† Numbers may not add due to rounding.

Source: EMSI complete employment data.

Table 1.7 presents the mean income by education level in the STC Service Area at the midpoint of the average-aged worker's career. These numbers are derived from EMSI's complete employment data on average income per worker in the region.[6] 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's degree can expect $28,700 in income per year, approximately $7,500 more than someone with a high school diploma.

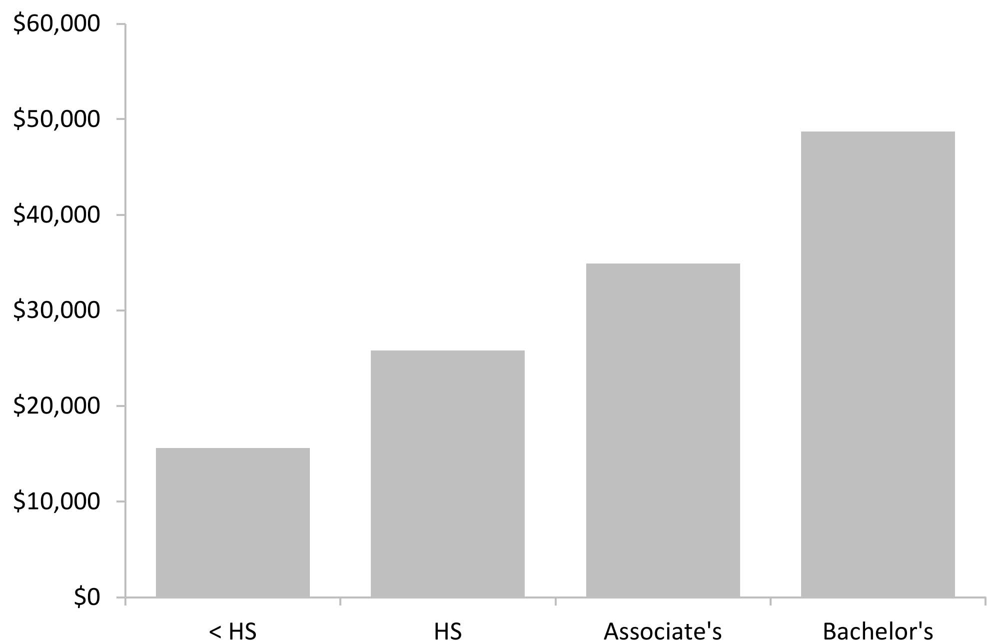
[6] Wage rates in the EMSI SAM model combine state and federal sources to provide earnings that reflect complete employment in the region, including proprietors, self-employed workers, and others not typically included in state data, as well as benefits and all forms of employer contributions. As such,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

Table 1.7: Expected income in the STC Service Area at the midpoint of an individual's working career by education level

Education level	Income	Difference from next lowest degree
Less than high school	$12,800	n/a
High school or equivalent	$21,200	$8,400
Associate’s degree	$28,700	$7,500
Bachelor’s degree	$40,100	$11,400

Source: EMSI complete employment data.

Figure 1.1: Expected income by education level at career midpoint



2 Economic Impacts on the STC Service Area Economy

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

In this section we estimate the economic impacts of STC: 1) the operations spending impact; 2) the student spending impact; and 3) the alumni impact, measuring the added income created in the region as former students expand the economy's stock of human capital.

To calculate the multiplier effects, we use a Social Accounting Matrix (SAM) input-output model that captures the interconnection of industries, government, and households in the region. The EMSI SAM model contains approximately 1,100 industry sectors at the highest level of detail available in the North American Industry Classification System (NAICS), and it supplies the industry-specific multipliers required to determine the impacts associated with economic activity within the region. The EMSI SAM model used in this analysis reflects 2013 data. For more information on the EMSI SAM model and its data sources, see Appendix 2.

Different terminology is often used to identify types of economic impacts. Throughout the analysis, we will maintain the terminology and definitions described as follows:

> ***Initial*** effect is the first round of spending by the college that generates the subsequent multiplier effects. For example, STC spends money on supplies and services necessary for its day-to-day operation, it employs faculty and staff, and its students spend money on amenities. The multiplier effects describe the additional economic activity created as the initial spending ripples throughout the regional economy. The multiplier effects are categorized according to the three effects defined below.
>
> ***Direct*** effects refer to the economic activity created by the industries affected by the initial effect. Think of it as the impact that the initial effect has on the businesses in the supply chain served by the college. Thus, direct effects occur in all industries where STC has operational expenditures.
>
> ***Indirect*** effects occur as the supply chain for the industries impacted by direct effects creates even more economic activity in the region. It is an inter-industry effect, stemming from businesses purchasing from other businesses. Think of it as the impact on the businesses in the supply chains of the direct effect. This also includes the inter-industry supply chain effects of all subsequent rounds of spending.

Induced effects refer to the economic activity created by the increased spending of the household sector as a result of the direct and indirect effects. The businesses affected in the direct and indirect effects employ people. These people are consumers of goods and services as well. When these people spend their earnings, another round of spending is sent through the regional economy.

These definitions differ from other commonly used input-output models. For example, IMPLAN refers to our initial effect as a direct effect and combines our direct and indirect effects into a single effect they refer to as the indirect effect. The total effects are analogous.

EMSI	*Initial*	*Direct*	*Indirect*	*Induced*
IMPLAN	*Direct*	*Indirect*		*Induced*

Economic impacts are also reported using a variety of measures. In this report we will present the economic impacts in terms of the following measures:

Labor income: This is the additional (new) employee compensation that is created and received as a result of labor (i.e., wages).

Non-labor income: This measure represents the new income received by business owners and self-proprietors, as well as the returns on capital from investments such as rent, interest, and dividends.

Value added (or gross regional product, GRP): This measure is equal to employee compensation, gross operating surplus, and taxes on production and imports, less subsidies. By definition, value added or GRP is also equal to the sum of labor and non-labor income.

Job Equivalents: This measure is another way to state the value added and it represents full- and part-time jobs that would not have occurred in the region without the college. They are calculated by jobs to sales ratios specific to each industry.

2.1 Operations spending impact

Faculty and staff payroll is part of the region's overall income, 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 STC Service Area. These expenditures create a ripple effect that generates still more jobs and income 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 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 95% of the people working at STC live in the STC Service Area (see Table 1.1), and therefore we consider 95% of the salaries, wages, and benefits. For the other two expenditure categories (i.e., capital depreciation and all other expenditures), we assume the college's spending patterns approximately match national averages and apply the national spending coefficients for NAICS 611310 (Colleges, Universities, and Professional Schools). Capital depreciation is mapped to the construction sectors of NAICS 611310 and the college's remaining expenditures to the non-construction sectors of NAICS 611310.

Table 2.1: Expenses by function, FY 2012-13

Expense category	Total expenditures	In-region expenditures	Out-of-region expenditures
Employee salaries, wages, and benefits	$88,547	$34,998	$53,549
Capital depreciation	$8,104	$4,346	$3,758
All other expenditures	$57,100	$20,506	$36,594
Total	**$153,751**	**$59,850**	**$93,901**

Source: Data supplied by STC and the EMSI impact model.

We now have three vectors of expenditures for STC: 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 the 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 SAM model.[7] 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 SAM model's multiplier matrix, which in turn provides an estimate of the associated multiplier effects on regional labor income, non-labor income, value added, and jobs.

Table 2.2 presents the economic impact from spending toward college operations. The people employed by STC 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, value added, and jobs equivalents. 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 $121.9 million in labor income and $28.8 million in non-labor income. This comes to a total impact of $150.7 million

[7] See Appendix 2 for a description of EMSI's SAM model.

in value added, equivalent to 3,357 jobs, associated with the spending of the college and its employees in the region.

Table 2.2: Impact of STC spending operations

	Labor income (thousands)	+	Non-labor income (thousands)	=	Value added (thousands)	OR	Job equivalents
Initial effect	**$88,547**		**$0**		**$88,547**		**2,138**
Multiplier effect							
Direct effect	$7,516		$8,608		$16,124		308
Indirect effect	$1,191		$1,058		$2,249		50
Induced effect	$24,677		$19,091		$43,769		861
Total multiplier effect	**$33,385**		**$28,756**		**$62,141**		**1,219**
Gross impact (initial + multiplier)	**$121,932**		**$28,756**		**$150,688**		**3,357**
Less alternative uses of funds	-$17,267		-$11,793		-$29,060		-587
Net impact	**$104,665**		**$16,963**		**$121,628**		**2,771**

Source: EMSI impact model.

The $150.7 million in total gross value added is often reported by researchers as an impact. We go a step further to arrive at a net impact by applying a counterfactural scenario, i.e., what has not happened but what would have happened if a given event – in this case, the expenditure of in-region funds on STC – had not occurred. STC received an estimated 39.5% of its funding from sources within the STC Service Area. These monies came from the tuition and fees paid by resident students, from the auxiliary revenue and donations from 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 STC, income effects 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 STC, map this to the detailed industries of the SAM model using national household expenditure coefficients, use the industry RPCs to estimate in-region spending, and run the in-region spending through the SAM model's multiplier matrix to derive multiplier effects. The results of this exercise are shown as negative values in the row labeled *less alternative uses of funds* in Table 2.2.

The total net impacts of the college's operations are equal to the total 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 effect is approximately $104.7 million in labor income and $17 million in non-labor income. This totals $121.6 million in value added and is equivalent to 2,771 jobs. These effects represent new economic activity created in the regional economy solely attributable to the operations of STC.

2.2 Student spending impact

In-region students spend money while attending STC. However, had they lived in the region without attending STC, they would have spent a similar amount of money on living expenses. We make no inference regarding the number of students who would have left the region had they not attended STC. Therefore, it is important to note that total student spending impacts – including the spending of in-region students who would have left the region but for STC – are greater than the out-of-region student impact estimated here.

An estimated 186 out-of-region students lived in the region but off campus while attending the college in FY 2012-13. These students spent money at regional businesses for groceries, accommodation, transportation, and so on. The off-campus expenditures of out-of-region students supported jobs and created new income in the regional economy.[8]

The average off-campus costs of out-of-region students appear in the first section of Table 2.3, equal to $6,054 per student. Note that this figure excludes expenses for books and supplies, since many of these monies are already reflected in the operations impact discussed in the previous section. Multiplying the $6,054 in annual costs by the number of students who lived in the region but off-campus while attending (186 students) generates gross sales of $1.1 million. This figure, once net of the monies paid to student workers, yields net off-campus sales of $1.1 million, as shown in the bottom row of the Table 2.3.

Table 2.3: Average student costs and total sales generated by out-of-region students in the STC Service Area, 2012-13

Room and board	$4,854
Personal expenses	$746
Transportation	$454
Total expenses per student	**$6,054**
Number of students who lived in the region off-campus	186
Gross sales	$1,126,044
Wages and salaries paid to student workers*	$8,845
Net off-campus sales	**$1,117,199**

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

Source: Student costs supplied by STC. The number of students who lived in the region and off-campus while attending is derived from the student origin data and in-term residence data supplied by STC. The data is based on all students.

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[8] Online students and students who commuted to the STC Service Area from outside the region are not considered in this calculation because their living expenses predominantly occurred in the region where they resided during the analysis year.

Estimating the impacts generated by the $1.1 million in student spending follows a procedure similar to that of the operations impact described above. We distribute the $1.1 million in sales to the industry sectors of the SAM model, apply RPCs to reflect in-region spending only, and run the net sales figures through the SAM model to derive multiplier effects.

Table 2.4 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 out-of-region student spending thus falls entirely under the multiplier effect. The total effect of out-of-region student spending is $280,566 in labor income and $315,031 in non-labor income. This totals $595,600 in value added and is equivalent to 27 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.

Table 2.4: Student spending impact

	Labor income (thousands)	+	Non-labor income (thousands)	=	Value added (thousands)	OR	Job equivalents
Initial effect	**$0**		**$0**		**$0**		**0**
Multiplier effect							
Direct effect	$172		$188		$360		17
Indirect effect	$27		$27		$54		3
Induced effect	$82		$100		$181		7
Total multiplier effect	**$281**		**$315**		**$596**		**27**
Total impact (initial + multiplier)	**$281**		**$315**		**$596**		**27**

Source: EMSI impact model.

2.3 Alumni impact

In this section we estimate the economic impacts stemming from the higher labor income of alumni in combination with their employers' higher non-labor income. 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 STC creates an economic impact through its operations and student spending, the greatest economic impact of STC stems from the added human capital – the knowledge, creativity, imagination, and entrepreneurship – found in its alumni. While attending STC, 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 STC 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 effects in one fundamental way. Whereas the operations and student spending impacts depend on an annually renewed injection of new sales in 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 comprises two main components. The first and largest of these is the added labor income of the college's former students. The second component of the initial effect thus comprises the added non-labor income of the businesses that employ former students of STC.

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;[9] 2) death, retirement, and unemployment rates from the National Center for Health Statistics, the Social Security Administration, and the Bureau of Labor Statistics; and 3) state migration data from the U.S. Census Bureau. The result is the estimated portion of alumni from each previous year who were still actively employed in the region as of FY 2012-13.

The next step is to quantify the skills and human capital that alumni acquired from the college. We use the students' production of semester credit hours (SCHs) as a proxy for accumulated human capital. The average number of SCHs completed per student in 2012-13 was 12.5. To estimate the number of SCHs present in the workforce during the analysis year, we use the college's historical student headcount over the past 21 years, from 1992-93 to 2012-13.[10] We multiply the 12.5 average SCHs per student by the headcounts that we estimate are still actively employed from each of the previous years.[11] Students who enroll at the college more than one year were counted at least twice in the historical enrollment data. However, SCHs remain distinct regardless of when and by whom they were earned, so there is no duplication in the SCH counts. We estimate there are approximately 3.1 million SCHs from alumni active in the workforce.

Next, we estimate the value of the SCHs or the skills and human capital acquired by the STC alumni. This is done using the *incremental* added labor income stemming from the students' higher wages. The incremental labor income is the difference between the wage earned by STC alumni and the alternative wage they would have earned had they not attended STC. Using the incremental earnings, credits required, and distribution of credits at each level of study, we estimate the average value per SCH to equal $113. This value represents the average incremental increase in wages that alumni of STC received during the analysis year for every SCH they completed.

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[9] 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.

[10] The 21-year time horizon is equal to the number of years that STC was in operation since it was established in 1992-93 to the 2012-13 analysis year.

[11] 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.

Because workforce experience leads to increased productivity and higher wages, the value per SCH varies depending on the students' workforce experience, with the highest value applied to the SCHs of students who had been employed the longest by FY 2012-13, and the lowest value per SCH applied to students who were just entering the workforce. More information on the theory and calculations behind the value per SCH appears in Appendix 3. In determining the amount of added labor income attributable to alumni, we multiply the SCHs of former students in each year of the historical time horizon by the corresponding average value per SCH for that year, and then sum the products together. This calculation yields approximately $356.3 million in gross labor income in increased wages received by former students in FY 2012-13 (as shown in Table 2.5).

Table 2.5: Number of SCHs in workforce and initial labor income created in the STC Service Area

Number of SCHs in workforce	3,145,458
Average value per SCH	$113
Initial labor income, gross	**$356,329,814**
Counterfactuals	
Percent reduction for alternative education opportunities	15%
Percent reduction for adjustment for labor import effects	50%
Initial labor income, net	**$151,440,171**

Source: EMSI impact model.

The next two rows in Table 2.5 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 STC and subsequent influx of skilled labor into the regional economy. The first counterfactual scenario that we address is the adjustment for alternative education opportunities. In the counterfactual scenario where STC did not exist, we assume a portion of STC 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 labor income that accrues to those students cannot be counted towards the added labor income from STC alumni. The adjustment for alternative education opportunities amounts to a 15% reduction of the $356.3 million in added labor income.[12] This means that 15% of the added labor income from STC 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 4.

The other adjustment in Table 2.5 accounts for the importation of labor. Suppose STC 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 STC 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

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

outside the region if the college did not exist.[13] With the 50% adjustment, the net labor income added to the economy comes to $151.4 million, as shown in Table 2.5.

The $151.4 million in added labor income appears under the initial effect in the labor income column of Table 2.6. To this we add an estimate for initial non-labor income. As discussed earlier in this section, businesses that employ former students of STC 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 ($151.4 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 SAM model.[14] Using a crosswalk created by National Center for Education Statistics (NCES) and the Bureau of Labor Statistics (BLS), we map the breakdown of the 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 SAM model to map the occupational distribution of the $151.4 million in initial labor income effects to the detailed industry sectors in the SAM model.[15]

Once these allocations are complete, we apply the ratio of non-labor to labor income provided by the SAM model for each sector to our estimate of initial labor income. This computation yields an estimated $46.1 million in 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 STC Service Area economy, equal to approximately $197.6 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 SAM model. We then run the values through the SAM's multiplier matrix.

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[13] For a sensitivity analysis of the labor import effect variable, see Section 5.

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

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

Table 2.6: Alumni impact

	Labor income (thousands)	+	Non-labor income (thousands)	=	Value added (thousands)	OR	Jobs equivalents
Initial effect	**$151,440**		**$46,123**		**$197,563**		**4,333**
Multiplier effect							
Direct effect	$15,869		$5,183		$21,051		502
Indirect effect	$2,854		$924		$3,778		91
Induced effect	$80,443		$22,559		$103,002		2,268
Total multiplier effect	**$99,165**		**$28,666**		**$127,831**		**2,860**
Total impact (initial + multiplier)	**$250,606**		**$74,789**		**$325,394**		**7,194**

Source: EMSI impact model.

Table 2.6 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 $99.2 million in labor income and $28.7 million in non-labor income, for an overall total of $127.8 million in multiplier effects. The grand total effect of the alumni effect thus comes to $325.4 million in value added, the sum of all initial and multiplier labor and non-labor income effects. This is equivalent to 7,194 jobs.

2.4 Total impact of STC

The total economic impact of STC on the STC Service Area can be generalized into two broad types of effects. First, on an annual basis, STC generates a flow of spending that has a significant impact on the STC Service Area economy. The impacts of this spending are captured by the operations and student spending impacts. While not insignificant, these impacts don't capture the true effect or purpose of STC. The basic purpose of STC is to foster human capital. Every year a new cohort of STC alumni and students add to the stock of human capital in the STC Service Area, and a portion of alumni continue to contribute to the STC Service Area economy. Table 2.7 displays the grand total effects of STC on the STC Service Area economy in 2012-13.

Table 2.7: Total impact of STC, 2012-13

	Labor income (thousands)	+	Non-labor income (thousands)	=	Value added (thousands)	OR	Jobs equivalents
Operations spending	$104,665		$16,963		$121,628		2,771
Student spending	$281		$315		$596		27
Alumni	$250,606		$74,789		$325,394		7,194
Total impact	**$355,551**		**$92,067**		**$447,618**		**9,991**
% of STC Service Area economy	**3.2%**		**1.7%**		**2.7%**		**2.9%**

Source: EMSI impact model.

3 Investment Analysis

The benefits generated by STC 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 income and improved quality of life. But the benefits do not stop there. As students earn more, communities and citizens throughout Texas 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 STC as a worthwhile investment from the perspectives of students, society, and taxpayers.

3.1 Student perspective

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

3.1.1 Calculating student costs

Student costs consist of two main items: direct outlays and opportunity costs. Direct outlays include tuition and fees, equal to $21.1 million from Table 1.2. Direct outlays also include the cost of books and supplies. On average, full-time students spent $1,200 each on books and supplies during the reporting year.[16] Multiplying this figure times the number of full-time equivalents (FTEs) produced by STC in 2012-13[17] generates a total cost of $22.1 million for books and supplies.

Opportunity cost is the most difficult component of student costs to estimate. It measures the value of time and earnings forgone 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.

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[16] Based on the data supplied by STC.

[17] A single FTE is equal to 30 SCHs, so there were 18,432 FTEs produced by students in 2012-13, equal to 552,951 SCHs divided by 30 (excluding the SCH production of personal enrichment students).

We derive the students' full earning potential by weighting the average annual income levels in Table 1.7 according to the education level breakdown of the student population when they first enrolled.[18] However, the income levels in Table 1.7 reflect what average workers earn at the midpoint of their careers, not while attending the college. Because of this, we adjust the income levels to the average age of the student population (22) to better reflect their wages at their current age.[19] This calculation yields an average full earning potential of $10,180 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' SCH production as a proxy for time, under the assumption that the more SCHs students earn, the less time they have to work, and, consequently, the greater their forgone earnings. Overall, students attending STC earned an average of 12.5 SCHs per student (excluding personal enrichment students), which is approximately equal to 42% of a full academic year.[20] We thus include no more than $4,236 (or 42%) 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 75% of students are employed.[21] For the 25% that are not working, we assume that they are either seeking work or planning to seek work once they complete their educational goals (with the exception of personal enrichment students, who are not included in this calculation). By choosing to enroll, therefore, non-working students give up everything that they can potentially earn during the academic year (i.e., the $4,236). The total value of their forgone income thus comes to $46.9 million.

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

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[18] This is based on the number of students who reported their entry level of education to STC. EMSI provided estimates in the event that the data was not available from the college.

[19] Further discussion on this adjustment appears in Appendix 3.

[20] Equal to 12.5 SCHs divided by 30, the assumed number of SCHs in a full-time academic year.

[21] EMSI provided an estimate of the percentage of students employed in the case the college was unable to collect the data.

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

actual jobs that students hold while attending, the 42% in forgone 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 forgo up to 1.4 hours of leisure time per day.[23] Assuming that an hour of leisure is equal in value to an hour of work, we derive the total cost of leisure by multiplying the number of leisure hours 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 $83.9 million, equal to the sum of their foregone income ($59.7 million) and forgone leisure time ($24.2 million).

The steps leading up to the calculation of student costs appear in Table 3.1. Direct outlays amount to $43.1 million, the sum of tuition and fees ($21.1 million) and books and supplies ($22.1 million), less $54,600 in direct outlays for personal enrichment students (these students are excluded from the cost calculations). Opportunity costs for working and non-working students amount to $101.3 million, excluding $29.5 million in offsetting residual aid that is paid directly to students.[24] Summing direct outlays and opportunity costs together yields a total of $144.4 million in student costs.

Table 3.1: Student costs, FY 2012-13 (thousands)

Direct outlays	
Tuition and fees	$21,051
Books and supplies	$22,118
Less direct outlays of personal enrichment students	-$55
Total direct outlays	**$43,115**
Opportunity costs	
Earnings forgone by non-working students	$46,910
Earnings forgone by working students	$59,669
Value of leisure time forgone by working students	$24,188
Less residual aid	-$29,514
Total opportunity costs	**$101,253**
Total student costs	**$144,368**

Source: Based on data supplied by STC and outputs of the EMSI college impact model.

3.1.2 Linking education to earnings

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

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

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

The differences between income levels define the incremental benefits of moving from one education level to the next.

A key component in determining the students' return on investment is the value of their future benefits stream; i.e., what they can expect to earn in return for the investment they make in education. We calculate the future benefits stream to the college's 2012-13 students first by determining their average annual increase in income, equal to $85.9 million. This value represents the higher income that accrues to students at the midpoint of their careers and is calculated based on the marginal wage increases of the SCHs that students complete while attending the college. For a full description of the methodology used to derive the $85.9 million, see Appendix 3.

The second step is to project the $85.9 million annual increase in income 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.[25] 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 US 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.[26] We use United States based Mincer coefficients estimated by Polachek (2003). To account for any upward bias, we incorporate a 10% reduction in our projected earnings. With the $85.9 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.

Table 3.2: Projected benefits and costs, student perspective

1	2	3	4	5	6
Year	Gross added income to students (millions)	Less adjustments (millions)*	Net added income to students (millions)	Student costs (millions)	Net cash flow (millions)
0	$47	5%	$2	$144	-$142
1	$50	13%	$6	$0	$6
2	$52	20%	$11	$0	$11
3	$54	32%	$17	$0	$17
4	$56	47%	$26	$0	$26
5	$59	92%	$54	$0	$54
6	$61	92%	$56	$0	$56

[25] Appendix 3 provides more information on the Mincer function and how it is used to predict future earnings growth.

Table 3.2: Projected benefits and costs, student perspective

1 Year	2 Gross added income to students (millions)	3 Less adjustments (millions)*	4 Net added income to students (millions)	5 Student costs (millions)	6 Net cash flow (millions)
7	$63	92%	$58	$0	$58
8	$65	92%	$60	$0	$60
9	$68	92%	$62	$0	$62
10	$70	93%	$65	$0	$65
11	$72	93%	$67	$0	$67
12	$74	93%	$69	$0	$69
13	$76	93%	$71	$0	$71
14	$78	93%	$73	$0	$73
15	$80	93%	$75	$0	$75
16	$82	93%	$76	$0	$76
17	$84	93%	$78	$0	$78
18	$86	93%	$80	$0	$80
19	$88	93%	$81	$0	$81
20	$89	93%	$83	$0	$83
21	$91	93%	$84	$0	$84
22	$92	93%	$85	$0	$85
23	$93	93%	$86	$0	$86
24	$95	92%	$87	$0	$87
25	$96	92%	$88	$0	$88
26	$97	92%	$89	$0	$89
27	$97	92%	$89	$0	$89
28	$98	91%	$90	$0	$90
29	$99	91%	$90	$0	$90
30	$99	91%	$90	$0	$90
31	$99	90%	$90	$0	$90
32	$100	90%	$89	$0	$89
33	$100	89%	$89	$0	$89
34	$99	89%	$88	$0	$88
35	$99	88%	$87	$0	$87
36	$99	88%	$86	$0	$86
37	$98	87%	$85	$0	$85
38	$98	86%	$84	$0	$84
39	$97	85%	$83	$0	$83
40	$96	84%	$81	$0	$81
41	$95	84%	$79	$0	$79
42	$94	83%	$77	$0	$77
43	$92	26%	$24	$0	$24
44	$91	7%	$6	$0	$6
Present value			**$1,194**	**$144**	**$1,050**
Internal rate of return					**23.9%**

Table 3.2: Projected benefits and costs, student perspective

1	2	3	4	5	6
Year	Gross added income to students (millions)	Less adjustments (millions)*	Net added income to students (millions)	Student costs (millions)	Net cash flow (millions)
Benefit-cost ratio					**8.3**
Payback period (no. of years)					**6.5**

* Includes the "settling-in" factors and attrition.
Source: EMSI impact model.

As shown in Table 3.2, the $85.9 million in gross added income occurs around Year 18, which is the approximate midpoint of the students' future working careers given the average age of the student population and an assumed retirement age of 67. In accordance with the Mincer function, the gross added income that accrues to students in the years leading up to the midpoint is less than $85.9 million, and the gross added income in the years after the midpoint is greater than $85.9 million.

The final step in calculating the students' future benefits stream is to net out the potential benefits generated by students who are either not yet active in the workforce or who leave the workforce over time. This adjustment appears in Column 3 of Table 3.2 and represents the percentage of the 2012-13 student population that will be employed in the workforce in a given year. Note that the percentages in the first five years of the time horizon are relatively lower than those in subsequent years. This is because many students delay their entry into the workforce, either because they are still enrolled at the 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.[27] 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 added income to students after accounting for both the settling-in patterns and attrition.

[27] 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.

3.1.3 Return on investment to students

Having estimated the students' costs and their future benefits stream, the next step is to discount the results to the present to reflect the time value of money. For the student perspective we assume a discount rate of 4.5% (see below).[28] 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.

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 1.1% discount rate from the perspective of society and taxpayers. The discount rate for students is higher because they are a smaller investor group and can therefore only spread their risks over a smaller and less diverse investment portfolio than the public sector can.

In Table 3.2, the net added income of students yields a cumulative discounted sum of approximately $1.2 billion, the present value of all of the future income increments (see the bottom section of Column 4). This may also be interpreted as the gross capital asset value of the students' higher income stream. In effect, the aggregate 2012-13 student body is rewarded for its investment in STC with a capital asset valued at $1.2 billion.

The students' cost of attending the college is shown in Column 5 of Table 3.2, equal to a present value of $144.4 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 8.3 (equal to $1.2 billion in benefits divided by $144.4 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

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

yield an equally attractive stream of future payments.[29] Table 3.2 shows students of STC earning average returns of 23.9% 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 23.9% student rate of return is a real rate. With an inflation rate of 2.5% (the average rate reported over the past 20 years as per the U.S. Department of Commerce, Consumer Price Index), the corresponding nominal rate of return is 26.4%, 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.[30] Beyond that point, returns are what economists would call pure costless rent. As indicated in Table 3.2, students at STC see, on average, a payback period of 6.5 years on their forgone earnings and out-of-pocket costs.

3.2 Social perspective

Texas benefits from the education that STC provides through the income that students create in the state and through the savings that they generate through their improved lifestyles. To receive these benefits, however, members of society must pay money and forgo services that they would have otherwise enjoyed if STC did not exist. Society's investment in STC stretches across a number of investor groups, from students to employers to taxpayers. We weigh the benefits generated by STC to these investor groups against the total social costs of generating those benefits. The total social costs include all STC expenditures, all student expenditures less tuition and fees, and all student opportunity costs, totaling $277.1 million ($153.8 million in STC expenditures, $22.1 million in student expenditures, and $101.3 million in student opportunity costs).

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[29] 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.

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

On the benefits side, any benefits that accrue to Texas as a whole – including students, employers, taxpayers, and anyone else who stands to benefit from the activities of STC – are counted as benefits under the social perspective. We group these benefits under the following broad headings: 1) increased income in the state, and 2) social externalities stemming from improved health, reduced crime, and reduced unemployment in the state (see the Beekeeper Analogy box for a discussion of externalities). Both of these benefits components are described more fully in the following sections.

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 incomes, 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.

3.2.1 Income growth in the state

In the process of absorbing the newly-acquired skills of students that attend STC, not only does the productivity of Texas' 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 STC on income growth in the state begins with the present value of the students' future income stream, which is displayed in Column 4 of Table 3.2. To this we apply a multiplier derived from EMSI's SAM model to estimate the added labor income created in the state as students and businesses spend their higher incomes.[31] 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 Texas gross state

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[31] For a full description of the EMSI SAM model, see Appendix 2.

product to total labor income in the state. We also include the spending impacts discussed in Section 2 that were created in 2012-13 by the operations of the college and its student spending.

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

We apply another reduction factor to account for the students' alternative education opportunities. This is the same adjustment that we use in the calculation of the alumni impact in Section 2 and is designed to account for the counterfactual scenario where STC do 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 calculation of the alternative education variable, see Appendix 4.

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 $7.3 billion (this value appears again later in Table 3.3). Recall from the discussion of the student return on investment that the present value represents the sum of the future benefits that accrue each year over the course of the time horizon, discounted to current year dollars to account for the time value of money. Given that the stakeholder in this case is the public sector, we use the discount rate of 1.1%, the real treasury interest rate recommended by the Office for Management and Budget (OMB) for 30-year investments.[32] In Section 4, we conduct a sensitivity analysis of this discount rate.

3.2.2 Social savings

In addition to the creation of higher income in the state, education is statistically associated with a variety of lifestyle changes that generate social savings, also known as external or incidental benefits of education. These represent the avoided costs that would have otherwise been drawn from private and public resources absent the education provided by STC. Social benefits 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, lost productivity, and other effects associated with smoking, alcoholism, obesity, mental illness, and drug abuse. Crime savings consist of avoided costs to the justice system (i.e., police protection, judicial and legal, and

[32] 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).

corrections), avoided victim costs, and benefits stemming from the added productivity of individuals who would have otherwise been incarcerated. Welfare and unemployment benefits comprise avoided costs due to the reduced number of social assistance and unemployment insurance claims.

The model quantifies social savings by calculating the probability at each education level that individuals will have poor health, commit crimes, or claim welfare and unemployment benefits. Deriving the probabilities involves assembling data from a variety of studies and surveys analyzing the correlation between education and health, crime, welfare, 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 SCHs 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 this section and in Appendix 3 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.[33] Finally, we apply the same adjustments for attrition and alternative education to derive the net savings to society.

Table 3.3: Present value of the future added income and social savings in the state (thousands)

Added Income	**$7,334,743**
Social Savings	
Health	
Smoking	$75,244
Alcoholism	$4,270
Obesity	$26,805
Mental illness	$15,644
Drug abuse	$4,920
Total health savings	**$126,883**
Crime	
Criminal Justice System savings	$31,378
Crime victim savings	$4,146
Added productivity	$6,565
Total crime savings	**$42,089**
Welfare/unemployment	
Welfare savings	$548
Unemployment savings	$271
Total welfare/unemployment savings	**$819**
Total social savings	**$169,791**
Total, added income + social savings	**$7,504,533**

Source: EMSI impact model.

33 For a full list of the data sources used to calculate the social externalities, see the References and Resource section. See also Appendix 8 for a more in-depth description of the methodology.

Table 3.3 above displays the results of the analysis. The first row shows the added income created in the state, equal to $7.3 billion, from students' higher incomes and their multiplier effect, increase in non-labor income, and spending impacts. Social savings appear next, beginning with a breakdown of savings related to health. These savings amount to a present value of $126.9 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 $42.1 million, including savings associated with a reduced number of crime victims, added worker productivity, and reduced expenditures for police and law enforcement, courts and administration of justice, and corrective services. Finally, the present value of the savings related to welfare and unemployment amount to $819,340, stemming from a reduced number of persons in need of income assistance. All told, social savings amounted to $169.8 million in benefits to communities and citizens in Texas.

The sum of the social savings and the added income in the state is $7.5 billion, as shown in the bottom row of Table 3.3. These savings accrue in the future as long as the 2012-13 student population of STC remains in the workforce.

3.2.3 Return on investment to society

Table 3.4 presents the stream of benefits accruing to Texas 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 27.1. This means that for every dollar invested in a STC education, 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 $27.10 in benefits will accrue to society in Texas.[34]

Table 3.4: Projected benefits and costs, social perspective

1	2	3	4
Year	Benefits to society (millions)	Social costs (millions)	Net cash flow (millions)
0	$205	$277	-$72
1	$21	$0	$21
2	$35	$0	$35
3	$56	$0	$56
4	$85	$0	$85
5	$174	$0	$174
6	$180	$0	$180
7	$186	$0	$186
8	$192	$0	$192
9	$198	$0	$198

[34] 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 3.4: Projected benefits and costs, social perspective

1	2	3	4
Year	**Benefits to society (millions)**	**Social costs (millions)**	**Net cash flow (millions)**
10	$204	$0	$204
11	$210	$0	$210
12	$215	$0	$215
13	$221	$0	$221
14	$226	$0	$226
15	$231	$0	$231
16	$236	$0	$236
17	$240	$0	$240
18	$245	$0	$245
19	$249	$0	$249
20	$252	$0	$252
21	$256	$0	$256
22	$259	$0	$259
23	$261	$0	$261
24	$264	$0	$264
25	$266	$0	$266
26	$267	$0	$267
27	$268	$0	$268
28	$269	$0	$269
29	$269	$0	$269
30	$269	$0	$269
31	$268	$0	$268
32	$267	$0	$267
33	$265	$0	$265
34	$263	$0	$263
35	$261	$0	$261
36	$258	$0	$258
37	$255	$0	$255
38	$251	$0	$251
39	$247	$0	$247
40	$242	$0	$242
41	$237	$0	$237
42	$231	$0	$231
43	$71	$0	$71
44	$19	$0	$19
Present value	**$7,505**	**$277**	**$7,227**
Benefit-cost ratio			**27.1**
Payback period (no. of years)			**3.3**

Source: EMSI impact model.

3.3 Taxpayer perspective

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

3.3.1 Benefits to taxpayers

Table 3.5 presents the total added income from the college and the present value of the benefits to taxpayers. Added tax revenue is derived by multiplying the income growth figures from Table 3.3 by the prevailing state and local government tax rates. For the social externalities, we claim only the benefits that reduce the demand for government-supported social services, or the benefits resulting from improved productivity among government employees. The present value of future tax revenues and government savings thus comes to approximately $540.2 million.

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

Added income from STC	
Added tax revenue	**$487,852**
Government savings	
Health-related savings	$19,449
Crime-related savings	$32,083
Welfare/unemployment-related savings	$819
Total government savings	$52,351
Total taxpayer benefits	**$540,203**

Source: EMSI impact model.

3.3.2 Return on investment to taxpayers

Taxpayer costs are reported in Table 3.6 and come to $89.8 million, equal to the contribution of state and local government to STC. In return for their public support, taxpayers are rewarded with an investment benefit-cost ratio of 6.0 (= $540.2 million ÷ $89.8 million), indicating a profitable investment.

Table 3.6: Projected benefits and costs, taxpayer perspective

1 Year	2 Benefits to taxpayers (millions)	3 State and local gov't costs (millions)	4 Net cash flow (millions)
0	$14	$90	-$76
1	$2	$0	$2
2	$3	$0	$3
3	$4	$0	$4

Table 3.6: Projected benefits and costs, taxpayer perspective

1 Year	2 Benefits to taxpayers (millions)	3 State and local gov't costs (millions)	4 Net cash flow (millions)
4	$6	$0	$6
5	$13	$0	$13
6	$13	$0	$13
7	$14	$0	$14
8	$14	$0	$14
9	$15	$0	$15
10	$15	$0	$15
11	$15	$0	$15
12	$16	$0	$16
13	$16	$0	$16
14	$16	$0	$16
15	$17	$0	$17
16	$17	$0	$17
17	$17	$0	$17
18	$18	$0	$18
19	$18	$0	$18
20	$18	$0	$18
21	$18	$0	$18
22	$19	$0	$19
23	$19	$0	$19
24	$19	$0	$19
25	$19	$0	$19
26	$19	$0	$19
27	$19	$0	$19
28	$19	$0	$19
29	$19	$0	$19
30	$19	$0	$19
31	$19	$0	$19
32	$19	$0	$19
33	$19	$0	$19
34	$19	$0	$19
35	$19	$0	$19
36	$18	$0	$18
37	$18	$0	$18
38	$18	$0	$18
39	$18	$0	$18
40	$17	$0	$17
41	$17	$0	$17
42	$17	$0	$17
43	$5	$0	$5
44	$1	$0	$1

Table 3.6: Projected benefits and costs, taxpayer perspective

1 Year	2 Benefits to taxpayers (millions)	3 State and local gov't costs (millions)	4 Net cash flow (millions)
Present value	**$540**	**$90**	**$450**
Internal rate of return			**13.7%**
Benefit-cost ratio			**6.0**
Payback period (no. of years)			**9.5**

Source: EMSI impact model.

At 13.7%, the rate of return to state and local taxpayers is also favorable. As above, we assume a 1.1% discount rate when dealing with government investments and public finance issues.[35] 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 1.1% would mean that the college just pays its own way. In principle, governments could borrow monies used to support STC and repay the loans out of the resulting added taxes and reduced government expenditures. A rate of return of 13.7%, on the other hand, means that STC not only pays its own way, but also generates a surplus that state and local government can use to fund other programs. It is unlikely that other government programs could make such a claim.

3.3.3 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 STC. Some would question the legitimacy of including these benefits in the calculation of rates of return to education, arguing that only the tangible benefits (higher income) should be counted. Tables 3.4 and 3.6 are inclusive of social benefits reported as attributable to STC. Recognizing the other point of view, Table 3.7 shows rates of return for both the social and taxpayer 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 1.1%), confirming that taxpayers receive value from investing in STC.

[35] See Section 4 for a sensitivity analysis of this discount rate.

Table 3.7: Social and taxpayer perspectives with and without social savings

	Including social savings	Excluding social savings
Social perspective		
Net present value	$7,227,466	$6,860,304
Benefit-cost ratio	27.1	25.8
Taxpayer perspective		
Net present value	$450,361	$398,009
Benefit-cost ratio	6.0	5.4
Internal rate of return	13.7%	12.5%
Payback period (no. of years)	9.5	10.3

Source: EMSI impact model.

3.4 Conclusion

This section has shown that the education provided by STC 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 communities in Texas.

4 Sensitivity Analysis

Sensitivity analysis is the process by which researchers determine how sensitive the outputs of the model are to variations in the background data and assumptions, especially if there is any uncertainty in the variables. Sensitivity analysis is also useful for identifying a plausible range wherein the results will fall should any of the variables deviate from expectations. In this 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, and 4) the discount rate.

4.1 Alternative education variable

The alternative education variable (15%) accounts for the counterfactual scenario where students would have to seek a similar education elsewhere absent the 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 13.7% to 13.5%. Likewise, a decrease of 10% (from 15% to 14%) in the assumption increases the rate of return from 13.7% to 13.9%.

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%
Social perspective							
Net present value (millions)	$7,890	$7,559	$7,360	$7,227	$7,095	$6,896	$6,565
Benefit-cost ratio	29.5	28.3	27.6	27.1	26.6	25.9	24.7
Taxpayer perspective							
Net present value (millions)	$498	$474	$460	$450	$441	$427	$403
Rate of return	14.8%	14.2%	13.9%	13.7%	13.5%	13.2%	12.7%
Benefit-cost ratio	6.5	6.3	6.1	6.0	5.9	5.7	5.5

Based on this sensitivity analysis, the conclusion can be drawn that STC 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 1.1%), 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.

4.2 Labor import effect variable

The labor import effect variable only affects the alumni effect calculation in Table 2.6. In the model we assume a labor import effect variable of 50%, which means that we claim only 50% of the initial labor income generated by increased alumni productivity. The other 50% we assume would have been created in the region anyway – even without STC – since the businesses that hired STC students could have substituted some of these workers with equally-qualified people from outside the region had there been no STC students to hire.

Table 4.2 presents the results of the sensitivity analysis for the labor import effect variable. As above, the assumption increases and decreases relative to the base case of 50% by the increments indicated in the table. Alumni productivity effects attributable to STC, for example, range from a low of $162.7 million at a -50% variation to a high of $488.1 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 productivity increases as well. The effect stemming from the alumni still remains a sizeable factor in the STC Service Area economy, even under the most conservative assumptions.

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)	$163	$244	$293	$325	$358	$407	$488

4.3 Student employment variables

Student employment variables are difficult to estimate because many students do not report their employment status or because universities 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 income 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 STC 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 75% of students who reported their employment status are employed, based on data provided by STC.[36] This variable is tested in the sensitivity analysis by changing it first to 100% and then to 0%.

[36] EMSI provided an estimate of the percentage of students employed in the event that the college was unable to collect the data.

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 income that they would have statistically received if not attending STC. This suggests that many students hold part-time jobs that accommodate their STC attendance, though it is at an additional cost in terms of receiving a wage that is less than what they might otherwise make. The 58% variable is an estimation based on the average hourly wages of the most common jobs held by students while attending the 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 75% 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%.

Table 4.3: Sensitivity analysis of student employment variables

Variations in assumptions	Net present value (millions)	Internal rate of return	Benefit-cost ratio
Base case: A = 75%, B = 58%	$1,049.8	23.9%	8.3
Scenario 1: A = 100%, B = 58%	$1,068.8	26.2%	9.5
Scenario 2: A = 75%, B = 100%	$1,109.5	33.5%	14.1
Scenario 3: A = 100%, B = 100%	$1,148.3	48.9%	26.0
Scenario 4: A = 0%, B = 0%	$992.9	19.3%	5.9

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

1. Scenario 1: Increasing the percentage of students employed (A) from 75% to 100%, the net present value, internal rate of return, and benefit-cost ratio improve to $1.1 billion, 26.2%, and 9.5, respectively, relative to base case results. Improved results are attributable to a lower opportunity cost of time; all students are employed in this case.
2. 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 $1.1 billion, 33.5%, and 14.1, respectively, relative to base case results; a strong improvement, again attributable to a lower opportunity cost of time.
3. 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 $1.1 billion, 48.9%, and 26.0, 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.
4. Scenario 4: Finally, decreasing both A and B to 0% reduces the net present value, internal rate of return, and benefit-cost ratio to $992.9 million, 19.3%, and 5.9, respectively, relative

to base case results. These results are reflective of an increased opportunity cost; none of the students are employed in this case.[37]

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 STC generate excellent returns, well above the long-term average percent rates of return in stock and bond markets.

4.4 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 length of time. An investor must be willing to forgo the use of his money in the present if he wishes to receive compensation for it in the future. 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 4.5% discount rate for students and a 1.1% discount rate for society and taxpayers.[38] Similar to the sensitivity analysis of the alternative education variable, we vary the base case discount rates for students, society, and taxpayers 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, society, and taxpayers in Table 4.4.

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[37] 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.

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

Table 4.4: Sensitivity analysis of discount rate

% variation in assumption	-50%	-25%	-10%	Base Case	10%	25%	50%
Student perspective							
Discount rate	2.2%	3.4%	4.0%	4.5%	4.9%	5.6%	6.7%
Net present value (millions)	$1,715	$1,334	$1,154	$1,050	$957	$835	$803
Benefit-cost ratio	12.9	10.2	9.0	8.3	7.6	6.8	6.6
Social perspective							
Discount rate	0.6%	0.8%	1.0%	1.1%	1.2%	1.4%	1.7%
Net present value (millions)	$8,210	$7,699	$7,412	$7,227	$7,049	$6,792	$6,389
Benefit-cost ratio	30.6	28.8	27.8	27.1	26.4	25.5	24.1
Taxpayer perspective							
Discount rate	0.6%	0.8%	1.0%	1.1%	1.2%	1.4%	1.7%
Net present value (millions)	$521	$484	$464	$450	$438	$419	$390
Benefit-cost ratio	6.8	6.4	6.2	6.0	5.9	5.7	5.3

As demonstrated in the table, an increase in the discount rate leads to a corresponding decrease in the expected returns, and vice versa. For example, increasing the student discount rate by 50% (from 4.5% to 6.7%) reduces the students' benefit-cost ratio from 8.3 to 6.6. Conversely, reducing the discount rate for students by 50% (from 4.5% to 2.2%) increases the benefit-cost ratio from 8.3 to 12.9. 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 30.6 benefit-cost ratio at a -50% variation from the base case, to a 24.1 benefit-cost ratio at a 50% variation from the base case).

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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 have otherwise 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.
Semester credit hour	Semester credit hour, or SCH, 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 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. In an educational setting, when 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.

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).
Net cash flow	Benefits minus costs, i.e., the sum of revenues accruing from an investment minus costs incurred.
Net present value	Net cash flow discounted to the present. All future cash flows are collapsed into one number, which, if positive, indicates feasibility. The result is expressed as a monetary measure.
Non-labor income	Income received from investments, such as rent, interest, and dividends.
Opportunity cost	Benefits forgone from alternative B once a decision is made to allocate resources to alternative A. Or, if individuals choose to attend college, they forgo earnings that they would have received had they chosen instead to work full-time. Forgone earnings, therefore, are the "price tag" of choosing to attend college.
Payback period	Length of time required to recover an investment. The shorter the period, the more attractive the investment. The formula for computing payback period is: Payback period = cost of investment/net return per period

Appendix 2: EMSI MR-SAM

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

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

A2.1 Data sources for the model

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

EMSI Data are produced from many data sources to produce detailed industry, occupation, and demographic jobs and earnings data at the local level. This information (especially sales-to-jobs ratios derived from jobs and earnings-to-sales ratios) is used to help regionalize the national matrices as well as to disaggregate them into more detailed industries than are normally available.

BEA Make and Use Tables (MUT) are the basis for input-output models in the U.S. The *make* table is a matrix that describes the amount of each commodity made by each industry in a given year. Industries are placed in the rows and commodities in the columns. The *use* table is a matrix that describes the amount of each commodity used by each industry in a given year. In the use table, commodities are placed in the rows and industries in the columns. The BEA produces two different sets of MUTs, the benchmark and the summary. The benchmark set contains about 500 sectors and is released every five years, with a five-year lag time (e.g., 2002 benchmark MUTs were released in 2007). The summary set contains about 80 sectors and is released every year, with a two-year lag (e.g., 2010 summary MUTs were released in late 2011/early 2012). The MUTs are used in the EMSI SAM model to produce an industry-by-industry matrix describing all industry purchases from all industries.

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

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

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

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

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

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

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

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

Census' American Community Survey (ACS) **Public Use Microdata Sample** (PUMS) is the replacement for Census' long form and is used by EMSI to fill the holes in the CPS data.

Oak Ridge National Lab (ORNL) County-to-County Distance Matrix (Skim Tree) contains a matrix of distances and network impedances between each county via various modes of transportation such as highway, railroad, water, and combined highway-rail. Also included in this set are minimum impedances utilizing the best combination of paths. The ORNL distance matrix is used in EMSI's gravitational flows model that estimates the amount of trade between counties in the country.

A2.2 Overview of the MR-SAM model

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

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

A2.2.1 National SAM

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

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

A2.2.2 Multi-regional aspect of the SAM

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

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

A2.3 Components of the EMSI MR-SAM model

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

A2.3.1 County earnings distribution matrix

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

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

A2.3.2 Commuting model

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

A2.3.3 National SAM

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

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

A2.3.4 Gravitational flows model

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

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

Appendix 3: Value per Semester Credit Hour 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.

A3.1 Value per SCH

Typically the educational achievements of students are marked by the credentials they earn. However, not all students who attended STC in the 2012-13 analysis year obtained a degree or certificate. Some returned the following year to complete their education goals, while others took a few courses and entered the workforce without graduating. As such, the only way to measure the value of the students' achievement is through their semester credit hours, or SCHs. 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 SCH, we first determine how many SCHs are required to complete each education level. For example, assuming that there are 30 SCHs in an academic year, a student generally completes 60 SCHs in order to move from a high school diploma to an associate's degree, another 60 SCHs to move from an associate's degree to a bachelor's degree, and so on. This progression of SCHs 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 SCHs in the education ladder based on the wage differentials presented in Table 1.7. For example, the difference in earnings between a high school diploma and an associate's degree is $7,500. We spread this $7,500 wage differential across the 60 SCHs that occur between the high school diploma and the associate's degree, applying a ceremonial "boost" to the last SCH in the stage to mark the achievement of the degree.[39] We repeat this process for each education level in the ladder.

Next we map the SCH production of the 2012-13 student population to the education ladder. Table 1.4 provides information on the SCH production of students attending STC, broken out by educational achievement. In total, students completed 552,951 SCHs during the analysis year, excluding the SCH production of personal enrichment students. We map each of these SCHs to the education ladder depending on the students' education level and the average number of SCHs they

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

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

The sum product of the SCHs 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:

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

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 SCHs completed at step i.

Table A3.1 displays the result for the students' aggregate annual increase in income (ΔE), a total of $85.9 million. By dividing this value by the students' total production of 552,951 SCHs during the analysis year, we derive an overall value of $155 per SCH.

Table A3.1: Aggregate annual increase in income of students and value per SCH

Aggregate annual increase in income	$85,863,255
Total semester credit hours (SCHs) in FY 2012-13*	552,951
Value per SCH	$155

* Excludes the SCH production of personal enrichment students.

Source: EMSI impact model.

A3.2 Mincer Function

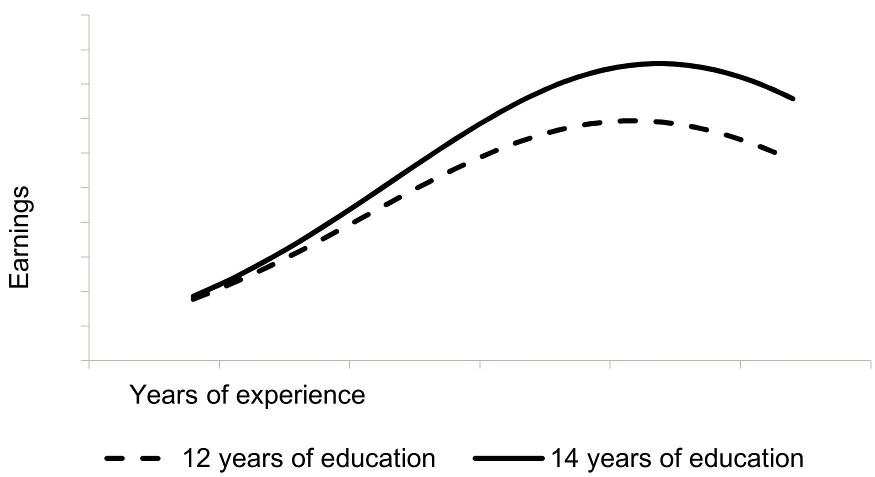
The $155 value per SCH in Table A3.1 only tells part of the story, however. Human capital theory holds that earnings levels do not remain constant; rather, they start relatively low and gradually increase as the worker gains more experience. Research also shows that the earnings increment between educated 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.[40] 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%

[40] See Mincer (1958 and 1974).

or less. As such, we reduce the estimated benefits by 10%. We use United States based Mincer coefficients estimated by Polachek (2003).

Figure A3.1 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.

Figure A3.1: Lifecycle change in earnings, 12 years versus 14 years of education



In calculating the alumni effect in Section 2, we use the slope of the curve in Mincer's earnings function to condition the $155 value per SCH to the students' age and work experience. To the students just starting their career during the analysis year, we apply a lower value per SCH; to the students in the latter half or approaching the end of their careers we apply a higher value per SCH. The original $155 value per SCH applies only to the SCH production of students precisely at the midpoint of their careers during the analysis year.

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

Appendix 4: Alternative Education Variable

In a scenario where STC 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 STC.

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

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

Appendix 5: Overview of Investment Analysis Measures

The purpose of this appendix is to provide context to the investment analysis results using the simple hypothetical example summarized in Table A5.1 below. The table shows the projected benefits and costs for a single student over time and associated investment analysis results.[41]

Table A5.1: Example of the benefits and costs of education for a single student

Year	Tuition	Opportunity cost	Total cost	Higher earnings	Net cash flow
1	**2**	**3**	**4**	**5**	**6**
1	$1,500	$20,000	$21,500	$0	-$21,500
2	$0	$0	$0	$5,000	$5,000
3	$0	$0	$0	$5,000	$5,000
4	$0	$0	$0	$5,000	$5,000
5	$0	$0	$0	$5,000	$5,000
6	$0	$0	$0	$5,000	$5,000
7	$0	$0	$0	$5,000	$5,000
8	$0	$0	$0	$5,000	$5,000
9	$0	$0	$0	$5,000	$5,000
10	$0	$0	$0	$5,000	$5,000
Net present value			**$21,500**	**$35,753**	**$14,253**
Internal rate of return					**18.0%**
Benefit-cost ratio					**1.7**
Payback period					**4.2 years**

Assumptions are as follows:

1. Benefits and costs are projected out 10 years into the future (Column 1).
2. The student attends the college for one year, and the cost of tuition is $1,500 (Column 2).
3. Earnings forgone while attending the college for one year (opportunity cost) come to $20,000 (Column 3).
4. Together, tuition and earnings forgone cost sum to $21,500. This represents the out-of-pocket investment made by the student (Column 4).
5. In return, the student earns $5,000 more per year than he would have otherwise earned without the education (Column 5).
6. The net cash flow (NCF) in Column 6 shows higher earnings (Column 5) less the total cost (Column 4).

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

7. 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 A5.1.

A5.1 Net present value

The student in Table A5.1 can choose either to attend the college or to forgo post-secondary education and maintain his present employment. If he decides to enroll, certain economic implications unfold. Tuition and fees must be paid, and earnings will cease for one year. In exchange, the student calculates that with post-secondary education, his income will increase by at least the $5,000 per year, as indicated in the table.

The question is simple: Will the prospective student be economically better off by choosing to enroll? If he adds up higher earnings of $5,000 per year for the remaining nine years in Table A5.1, the total will be $45,000. Compared to a total investment of $21,500, this appears to be a very solid investment. The reality, however, is different. Benefits are far lower than $45,000 because future money is worth less than present money. Costs (tuition plus earnings forgone) are felt immediately because they are incurred today, in the present. Benefits, on the other hand, occur in the future. They are not yet available. All future benefits must be discounted by the going rate of interest (referred to as the discount rate) to be able to express them in present value terms.[42]

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 forgone). As indicated in Table A5.1, 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

[42] 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.

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.

A5.2 Internal rate of return

The internal rate of return is another way of measuring the worth of investing in education using the same cash flows shown in Table A5.1. 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 A5.1. Or, if a discount rate of 18.0% were applied to the net present value calculations instead of the 4%, then the net present value would reduce to zero.

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

A5.3 Benefit-cost ratio

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

A5.4 Payback period

This is the length of time from the beginning of the investment (consisting of tuition and earnings forgone) until higher future earnings give a return on the investment made. For the student in Table A5.1, it will take roughly 4.2 years of $5,000 worth of higher earnings to recapture his investment of

$1,500 in tuition and the $20,000 in earnings forgone while attending the 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 6: 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 Texas, 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.

A6.1 Health

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

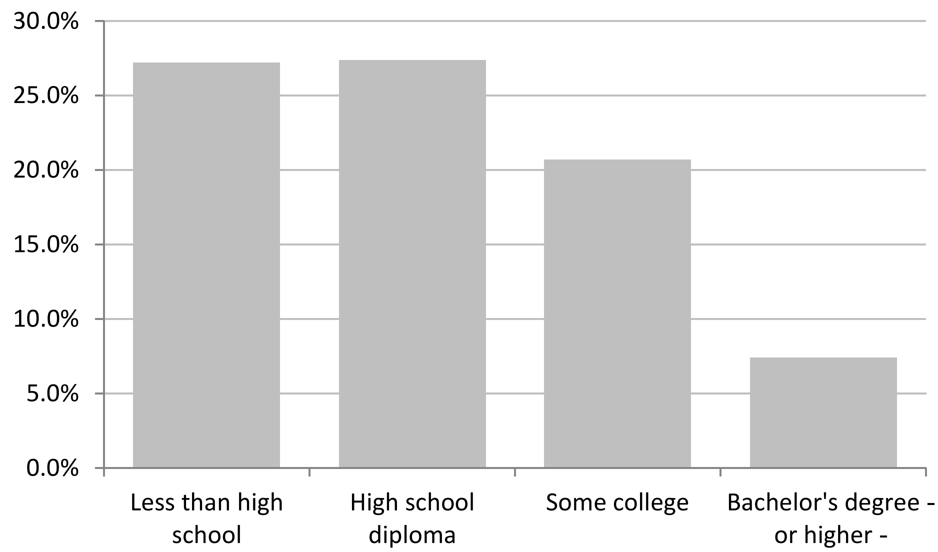
A6.1.1 Smoking

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

Figure A6.1 shows the prevalence of cigarette smoking among adults aged 25 years and over, based on data provided by the National Health Interview Survey.[43] As indicated, the percent of persons who smoke begins to decline beyond the level of high school education.

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

Figure A6.1: Prevalence of smoking among U.S. adults by education level



The Centers for Disease Control and Prevention (CDC) reports the percentage of adults who are current smokers by state.[44] We use this information to create an index value by which we adjust the national prevalence data on smoking to each state. For example, 19.2% of Texas' adults were smokers in 2011, relative to 21.2% for the nation. We thus apply a scalar of 0.9 to the national probabilities of smoking in order to adjust them to the state of Texas.

A6.1.2 Alcohol abuse

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

Figure A6.2 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).[45] 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

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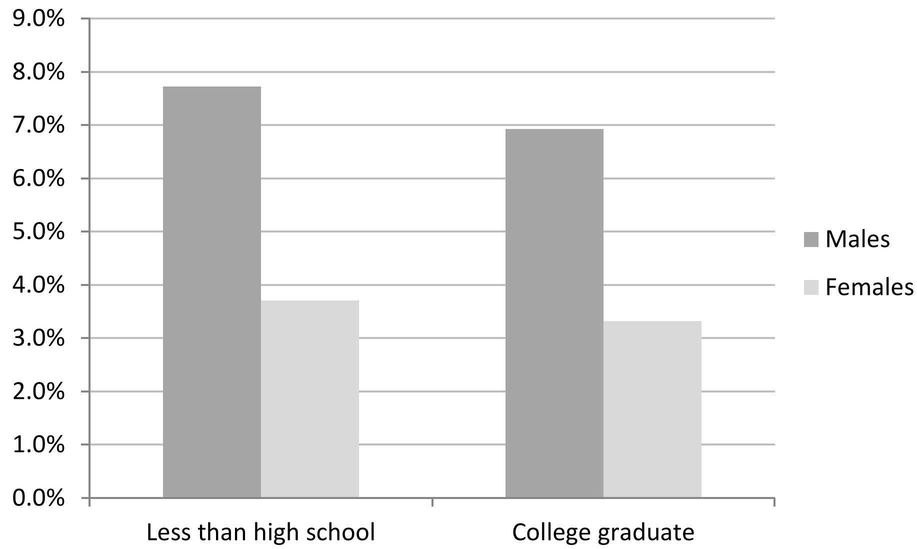
[44] Centers for Disease Control and Prevention, "Adults who are current smokers" in "Tobacco Use – 2011," Behavioral Risk Factor Surveillance System Prevalence and Trends Data, accessed August 2013, http://apps.nccd.cdc.gov/brfss/list.asp?cat=TU&yr=2011&qkey=8161&state=All.

[45] 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.

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.

Figure A6.2: Prevalence of alcohol dependence or abuse by sex and education level



A6.1.3 Obesity

The rise in obesity and diet-related chronic diseases has led to increased attention on how expenditures relating to obesity have increased in recent years. The average cost of obesity-related medical conditions is calculated using information from the *Journal of Occupational and Environmental Medicine*, which reports incremental medical expenditures and productivity losses due to excess weight.[46] The CDC also reports the prevalence of obesity among adults by state.[47]

Data for Figure A6.3 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.[48] As indicated, college graduates are less likely to be obese than individuals with a high school diploma. However, the prevalence of obesity among males with some college is actually greater than males with no more

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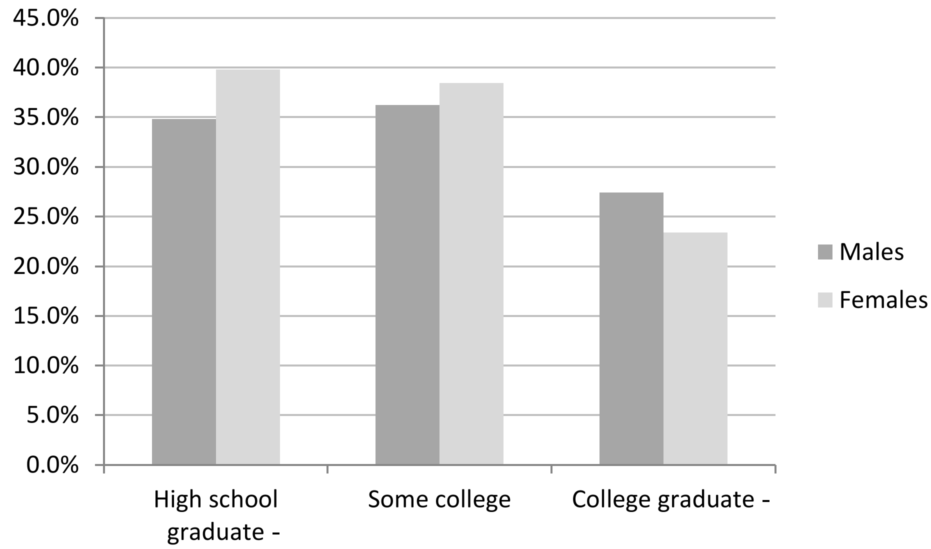
[46] Eric A. Finkelstein, Marco da Costa DiBonaventura, Somali M. Burgess, and Brent C. Hale, "The Costs of Obesity in the Workplace," *Journal of Occupational and Environmental Medicine* 52, no. 10 (October 2010): 971-976.

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

[48] 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.

than a high school diploma. In general, though, obesity tends to decline with increasing levels of education.

Figure A6.3: Prevalence of obesity by education level



A6.1.4 Mental illness

Capturing the full economic cost of mental disorders is problematic because many of the costs are hidden or difficult to detach from others externalities, such as drug abuse or alcoholism. For this reason, this study only examines the costs of absenteeism caused by depression in the workplace. Figure A6.4 summarizes the prevalence of self-reported frequent mental distress among adults by education level, based on data supplied by the CDC.[49] 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.

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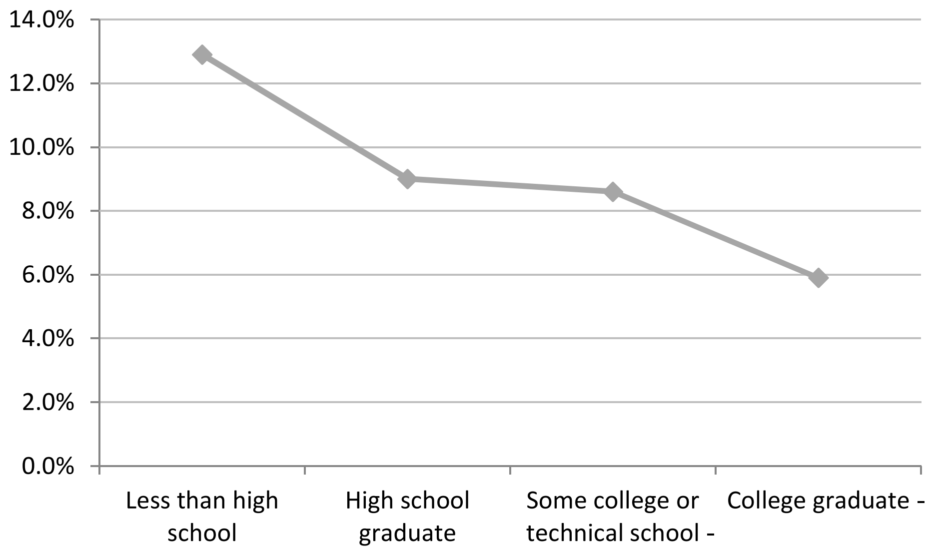
[49] Centers for Disease Control and Prevention, "Table 1. Number of respondents to a question about mental health and percentage who self-reported frequent mental distress (FMD), by demographic characteristics -- United States, Behavioral Risk Factor Surveillance System, 1993-1996" in "Self-Reported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

Figure A6.4: Prevalence of frequent mental distress by education level



A6.1.5 Drug abuse

The burden and cost of illicit drug abuse is enormous in our society, but little is known about potential costs and effects at a population level. What is known is that the rate of people abusing drugs is inversely proportional to their education level. The higher the education level, the less likely a person is to abuse or depend on illicit drugs. The probability that a person with less than a high school diploma 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 A6.5 based on data supplied by SAMHSA.[50] 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.[51]

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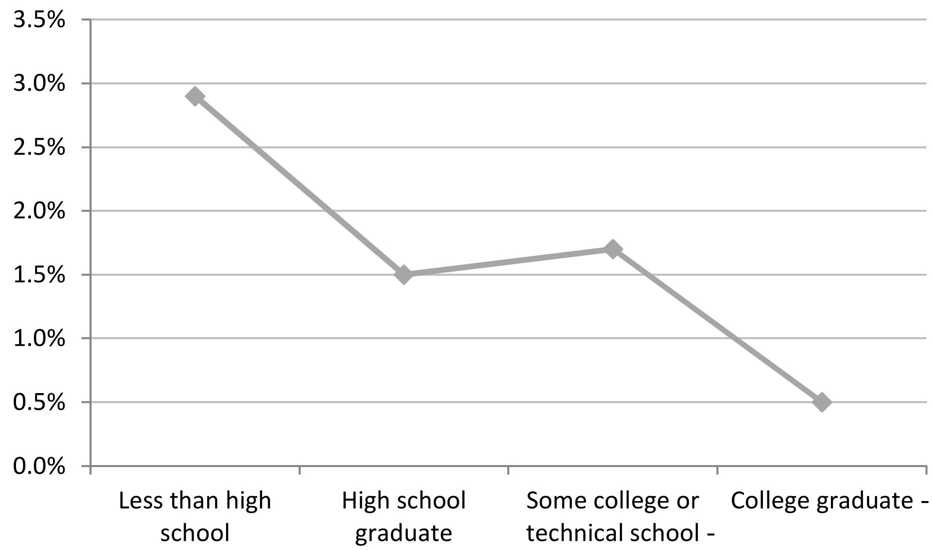
[50] Substance Abuse and Mental Health Services Administration, National Survey on Drug Use and Health, 2010 and 2011.

[51] 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 A6.5: Prevalence of illicit drug dependence or abuse by education level



A6.2 Crime

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

Figure A6.6 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,[52] divided by the total adult population. As indicated, incarceration drops on a sliding scale as education levels rise.

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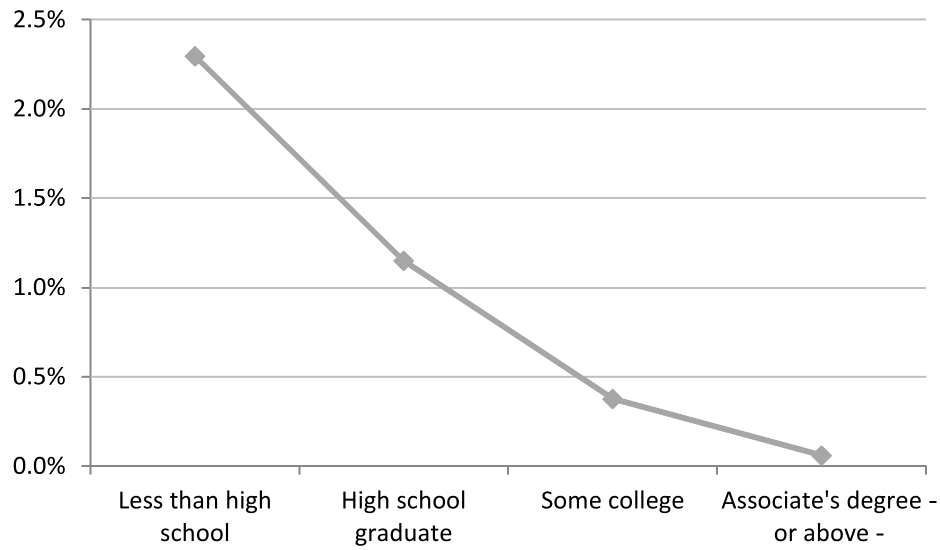
[52] Caroline Wolf Harlow. "Table 1. Educational attainment for State and Federal prison inmates, 1997 and 1991, local jail inmates, 1996 and 1989, probationers, 1995, and the general population, 1997" in "Education and Correctional Populations." Bureau of Justice Statistics Special Report, January 2003,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

Figure A6.6: Incarceration rates by education level



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.

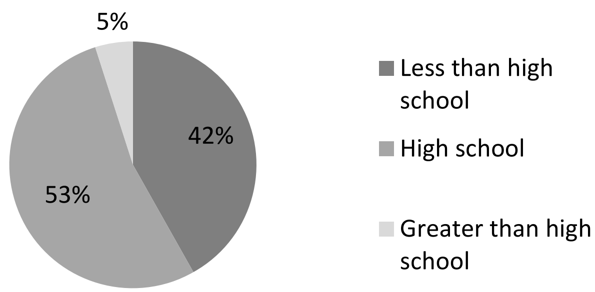
A6.3 Welfare and unemployment

Statistics show that as education levels increase, the number of welfare and unemployment applicants declines. Welfare and unemployment claimants can receive assistance from a variety of different sources, including Temporary Assistance for Needy Families (TANF), Supplemental Nutrition Assistance Program (SNAP), Medicaid, Supplemental Security Income (SSI), and unemployment insurance.[53]

[53] 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.

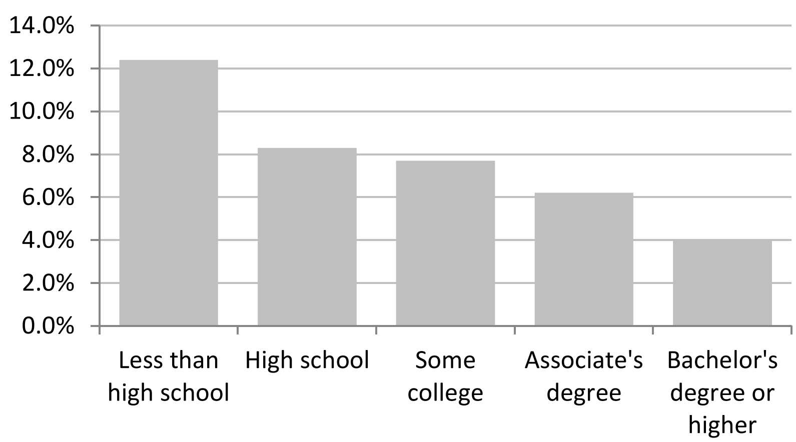
Figure A6.7 relates the breakdown of TANF recipients by education level, derived from data supplied by the U.S. Department of Health and Human Services.[54] As shown, the demographic characteristics of TANF recipients are weighted heavily towards the less than high school and high school categories, with a much smaller representation of individuals with greater than a high school education.

Figure A6.7: Breakdown of TANF recipients by education level



Unemployment rates also decline with increasing levels of education, as illustrated in Figure A6.8. These data are supplied by the Bureau of Labor Statistics.[55] 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 A6.8: Unemployment by education level



[54] 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.

[55] 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.