Demonstrating the Economic Value of Texas A&M University-Kingsville

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emsi

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Executive Summary

The purpose of this report is to assess the impact of Texas A&M University-Kingsville (TAMUK) on the regional economy and the benefits generated by the university for students, society, and taxpayers. The results of this study show that TAMUK creates a positive net impact on the regional economy and generates a positive return on investment for students, society, and taxpayers.

Economic Impact Analysis

During the analysis year, TAMUK spent **$69.2 million** on payroll and benefits for **1,953** full-time and part-time employees, and spent another **$68.3 million** on goods and services to carry out its day-to-day operations and research. This initial round of spending creates more spending across other businesses throughout the regional economy, resulting in the commonly referred to multiplier effects. This analysis estimates the net economic impact of TAMUK that directly takes into account the fact that state and local dollars spent on TAMUK could have been spent elsewhere in the region if not directed towards TAMUK and would have created impacts regardless. We account for this by estimating the impacts that would have been created from the alternative spending and subtracting the alternative impacts from the spending impacts of TAMUK.

This analysis shows that in FY13, payroll and operations spending of TAMUK, together with the spending of its students, visitors, and human capital creation, generated **$491.9 million** in added income to the TAMUK Service Region economy. Although we use the terminology *added regional income* to refer to the economic impacts, it is helpful to realize that regional income in this context is equivalent to the commonly referred to measure of gross regional product (GRP). The added regional income, or additional GRP, of **$491.9 million** created by TAMUK is equal to approximately **2.1%** of the total GRP of the TAMUK Service Region, and is equivalent to creating **8,844** new jobs. These economic impacts break down as follows:

Operations spending impact

Payroll and benefits to support day-to-day operations (less research) of TAMUK amounted to $61.4 million. The net impact of operations spending toward the university in the TAMUK Service Region during the analysis year was approximately **$91.5 million** in added regional income, which is equivalent to creating **2,147** new jobs.

Research spending impact

Research activities of TAMUK impact the regional economy by employing people and making purchases for equipment, supplies, and services. They also facilitate new knowledge creation throughout the TAMUK Service Region through inventions, patent applications, and licenses. In FY13, TAMUK spent **$7.8 million** on payroll to support research activities.

Research spending of TAMUK generates **$13.3 million** in added regional income for the TAMUK Service Region economy, which is equivalent to creating **334** new jobs.

Student spending impact

Around **57%** of graduate and undergraduate students attending TAMUK originated from outside the region. Some of these students relocated to the TAMUK Service Region and spent money on groceries, transportation, rent, and so on at regional businesses.

The expenditures of students who relocated to the region during the analysis year added approximately **$25.6 million** in regional income for the TAMUK Service Region economy, which is equivalent to creating **457** new jobs.

Visitor spending impact

Out-of-region visitors attracted to the TAMUK Service Region for activities at TAMUK brought new dollars to the economy through their spending at hotels, restaurants, gas stations, and other regional businesses.

Visitor spending added approximately **$998,300** in regional income for the TAMUK Service Region economy, which is equivalent to creating **25** new jobs.

Human capital impact

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

The accumulated contribution of former students currently employed in the TAMUK Service Region workforce amounted to **$360.5 million** in regional income added to the TAMUK Service Region economy, which is equivalent to creating **5,881** new jobs.

Note of Importance

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

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

Student perspective

Students invest their own money and time in their education. Students enrolled at TAMUK paid an estimated total of **$42.2 million** to cover the cost of tuition, fees, books, and supplies at TAMUK in FY13. While some students were employed while attending the university, overall students forwent an estimated **$99.8** million in earnings that they would have generated had they been in full employment instead of learning. In return, students will receive a present value of **$521 million** in increased earnings over their working lives. This translates to a return of **$3.70** in higher future income for every $1 that students pay for their education at TAMUK. The corresponding annual rate of return is **14.7%**.

Societal perspective

Texas as a whole spent an estimated **$244.8 million** on educations at TAMUK in FY13. This includes **$137.5 million** in expenses by TAMUK, **$7.5 million** in student expenses, and **$99.8 million** in student opportunity costs. In return, the state of Texas will receive an estimated present value of **$2.3 billion** in added state income over the course of the students' working lives. Texas will also benefit from an estimated **$307.5 million** in present value social savings related to reduced crime, lower welfare and unemployment, and increased health and well-being across the state. For every dollar society invests in an education from TAMUK, an average of **$10.50** in benefits will accrue to Texas over the course of the students' careers.

Taxpayer perspective

Taxpayers provided **$44.6 million** of state funding to TAMUK in FY13. In return, taxpayers will receive an estimated present value of **$151.3 million** in added tax revenue stemming from the students' higher lifetime incomes and the increased output of businesses. Savings to the public sector add another estimated **$50.2 million** in benefits due to a reduced demand for government-funded social services in Texas. For every tax dollar spent on educating students attending TAMUK, taxpayers will receive an average of **$4.50** in return over the course of the students' working lives. In other words, taxpayers enjoy an annual rate of return of **14.4%**.

Introduction

This study considers the economic impact of Texas A&M University-Kingsville (TAMUK). The university naturally helps students achieve their individual potential and develop the knowledge, skills, and abilities they need in order to have fulfilling and prosperous careers. However, the impact of TAMUK consists of more than influencing the lives of students. The university's program offerings supply employers with workers to make their businesses more productive. The spending of the university and its employees, students, and visitors supports the regional economy through the output and employment generated by vendors in the region. The benefits created by the university 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 TAMUK on the regional economy and the benefits generated by the university for students, society, and taxpayers. The approach is twofold. We begin with an economic impact analysis that measures the impacts generated by the university on the TAMUK Service Region economy. To derive results, we rely on a specialized Social Accounting Matrix (SAM) model to calculate the additional income and jobs created in the TAMUK Service Region 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 **operations spending**
2) Impact of **spending on research and development**
3) Impact of **student spending**
4) Impact of **visitor spending**
5) Impact of **human capital** from former students employed in the TAMUK Service Region workforce.

The second component of the study measures the benefits generated by TAMUK 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 university 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. For society, the study assesses how the students' higher incomes and improved quality of life create benefits throughout Texas as a whole, including to students and taxpayers.

A wide array of data are used in the study based on several sources, including the FY13 academic and financial reports from TAMUK and the Texas Higher Education Coordinating Board

(THECB), industry and employment data from the U.S. Bureau of Labor Statistics and U.S. Census Bureau, outputs of EMSI's education impact model, outputs of EMSI's SAM model, and a variety of published materials relating education to social behavior.

1 Texas A&M University-Kingsville and the Economy

The study uses two general types of information: 1) data collected from the university and the Texas Higher Education Coordination Board (THECB), and 2) regional economic data obtained from various public sources and EMSI's proprietary data modeling tools.[1] This section presents the basic underlying institutional information used in this analysis and provides an overview of the TAMUK Service Region economy.

1.1 Employee, finance, and student data for TAMUK

1.1.1 Employee data

Data provided by TAMUK include information on faculty and staff by place of work and by place of residence. These data appear in Table 1.1. As shown, TAMUK employed 874 full-time and 1,079 part-time faculty and staff in FY13. These headcounts include student workers as well as faculty and staff involved in research operations. Of these, 96% worked in the region and 82% 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, FY13

Full-time faculty and staff	874
Part-time faculty and staff	1,079
Total faculty and staff	**1,953**
% of employees that work in region	96%
% of employees that live in region	82%

Source: Data supplied by TAMUK.

1.1.2 Revenues

Table 1.2 shows the university's annual revenues by funding source – totaling $138.7 million in FY13. These include revenues for general activities as well as for research activities. As indicated, tuition and fees comprised 25% of total revenue, and revenues from state and federal government sources comprised another 53%. All other revenue (i.e., auxiliary revenue, sales and services, interest, and donations) comprised the remaining 22%. These data are critical in identifying the annual costs of educating the student body from the perspectives of students, society, and taxpayers.

[1] Appendix 2 provides a list and description of the primary data sources used in the EMSI modeling tools.

Table 1.2: Revenue by source, FY13

Funding source	Total	% of total
Tuition and fees	$34,636,829	25%
State government	$44,568,144	32%
Federal government	$29,245,566	21%
All other revenue	$30,238,279	22%
Total revenues	**$138,688,818**	**100%**

Source: Data supplied by TAMUK and THECB.

1.1.3 Expenses

The combined payroll and benefits at TAMUK, including student salaries and wages as well as research activities, amounted to $69.2 million. This was equal to 50% of the university's total expenses for FY13. Other expenses, including capital and purchases of supplies and services, made up $68.3 million. These budget data appear in Table 1.3.

Table 1.3: Expenses by type of cost, FY13

Expense item	Total	%
Salaries, wages, and benefits	$69,221,577	50%
Capital expenditures (amortized) and/or depreciation	$9,285,879	7%
All other expenses	$59,002,809	43%
Total expenses	**$137,510,265**	**100%**

Source: Data supplied by TAMUK and IPEDS.

1.1.4 Students

In Fall 2012, TAMUK enrolled 7,234 for-credit students.[2] Throughout this analysis, we also include students enrolled in Spring 2013 and Summer 2013, as well as non-degree seeking students, so we can capture the benefits created by the entire student population. Using the full year, in FY13 TAMUK served 7,914 students (unduplicated) taking courses for credit towards a degree. The university also served 991 students for courses not for credit towards a degree. The breakdown of the credit-bearing student body by gender was 51% male and 49% female. The breakdown by ethnicity was 21% white, 77% minority, and 2% unknown. The students' overall average age was 24 years old.[3] An estimated 59% of students remained in the TAMUK Service Region after finishing their time at TAMUK, another 8% settled outside the region but in the state, and the remaining 33% settled outside the state.[4]

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[2] Fall headcount data provided by THECB.

[3] Unduplicated headcount, gender, ethnicity, and age data provided by TAMUK and THECB.

[4] Settlement data provided by THECB and EMSI estimates based on student origin data. When using THECB data for an institution, data reflects bachelor's degree completers who enrolled in an in-state higher education institution or who were found in Texas employment records.

Table 1.4 summarizes the breakdown of the student population and their corresponding semester credit hours by education level. In FY13, TAMUK served 34 PhD or professional graduates, 423 master's degree graduates, and 980 bachelor's degree graduates. Another 6,041 students enrolled in courses for credit but did not complete a degree during the reporting year. The university offered dual credit courses to high school students, serving a total of 436 students over the course of the year. The university also served 776 personal enrichment students in non-credit courses for leisure. Students not allocated to the other categories – including non-degree-seeking workforce students – comprised the remaining 215 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 21.8.

Table 1.4: Breakdown of student headcount and SCH production by education level, FY13

Category	Headcount	Total SCHs	Average SCHs
Degree-seeking students			
PhD or professional graduates	34	291	8.6
Master's degree graduates	423	5,129	12.1
Bachelor's degree graduates	980	22,655	23.1
Credit-bearing students not yet graduated	6,041	142,618	23.6
Dual credit students	436	3,634	8.3
Total, degree-seeking students	**7,914**	**174,327**	**22.0**
Non-degree seeking students			
Personal enrichment students	776	622	0.8
Workforce and all other students	215	2,688	12.5
Total, non-degree-seeking students	**991**	**3,310**	**3.3**
Total, all students	**8,905**	**177,637**	**19.9**
Total, less personal enrichment students	**8,129**	**177,015**	**21.8**

Source: Data supplied by TAMUK and THECB.

1.2 The TAMUK Service Region economy

Figure 1.1 displays the counties included in the TAMUK Service Region economy[5] and 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).

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[5] The service region was defined by TAMUK. The following are the counties included in the TAMUK Service Region: Kleberg, Nueces, San Patricio, Jim Wells, Brooks, and Kenedy.

Figure 1.1: Definition of the TAMUK Service Region

As shown in Table 1.5, the GRP of the TAMUK Service Region is approximately $23.8 billion, equal to the sum of labor income ($13.4 billion) and non-labor income ($10.4 billion). In Section 2, we use GRP as the backdrop against which we measure the relative impacts of the university on the regional economy. The income of TAMUK fits within the Public Administration industry sector.

Table 1.5: Labor and non-labor income by major industry sector in the TAMUK Service Region, 2014

Industry sector	Labor income (millions)	+	Non-labor income (millions)	=	Total income (millions)	OR	% of Total
Agriculture, Forestry, Fishing, and Hunting	$149		$88		$237		1.0%
Mining	$1,616		$1,501		$3,116		13.1%
Utilities	$102		$303		$404		1.7%
Construction	$1,266		$94		$1,360		5.7%
Manufacturing	$1,025		$3,265		$4,289		18.0%
Wholesale Trade	$529		$410		$939		3.9%
Retail Trade	$786		$473		$1,259		5.3%
Transportation and Warehousing	$487		$200		$686		2.9%
Information	$136		$219		$355		1.5%
Finance and Insurance	$586		$431		$1,017		4.3%
Real Estate and Rental and Leasing	$361		$802		$1,163		4.9%
Professional and Technical Services	$618		$190		$808		3.4%
Management of Companies and Enterprises	$86		$16		$102		0.4%
Administrative and Waste Services	$437		$117		$554		2.3%
Educational Services	$70		$10		$81		0.3%
Health Care and Social Assistance	$1,630		$154		$1,784		7.5%
Arts, Entertainment, and Recreation	$61		$30		$91		0.4%
Accommodation and Food Services	$437		$254		$691		2.9%
Other Services (except Public Administration)	$376		$48		$424		1.8%
Public Administration	$2,626		$564		$3,190		13.4%
Other Non-industries	$0		$1,283		$1,283		5.4%
Total	**$13,383**		**$10,450**		**$23,833**		**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 TAMUK Service Region. Among the region's non-government industry sectors, the Health Care and Social Assistance sector is the largest employer, supporting 38,920 jobs or 13.6% of total employment in the region. The second largest employer is the Retail Trade sector, supporting 26,879 jobs or 9.4% of the region's total employment. Altogether, the TAMUK Service Region supports 286,977 jobs.[6]

[6] 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 TAMUK Service Region, 2014

Industry sector	Total jobs	% of Total
Agriculture, Forestry, Fishing, and Hunting	5,328	1.9%
Mining	18,051	6.3%
Utilities	1,013	0.4%
Construction	23,836	8.3%
Manufacturing	11,931	4.2%
Wholesale Trade	8,090	2.8%
Retail Trade	26,879	9.4%
Transportation and Warehousing	8,819	3.1%
Information	2,721	0.9%
Finance and Insurance	11,651	4.1%
Real Estate and Rental and Leasing	11,522	4.0%
Professional and Technical Services	11,432	4.0%
Management of Companies and Enterprises	808	0.3%
Administrative and Waste Services	14,841	5.2%
Educational Services	2,886	1.0%
Health Care and Social Assistance	38,920	13.6%
Arts, Entertainment, and Recreation	3,809	1.3%
Accommodation and Food Services	24,547	8.6%
Other Services (except Public Administration)	14,634	5.1%
Public Administration	45,258	15.8%
Total	**286,977**	**100.0%**

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

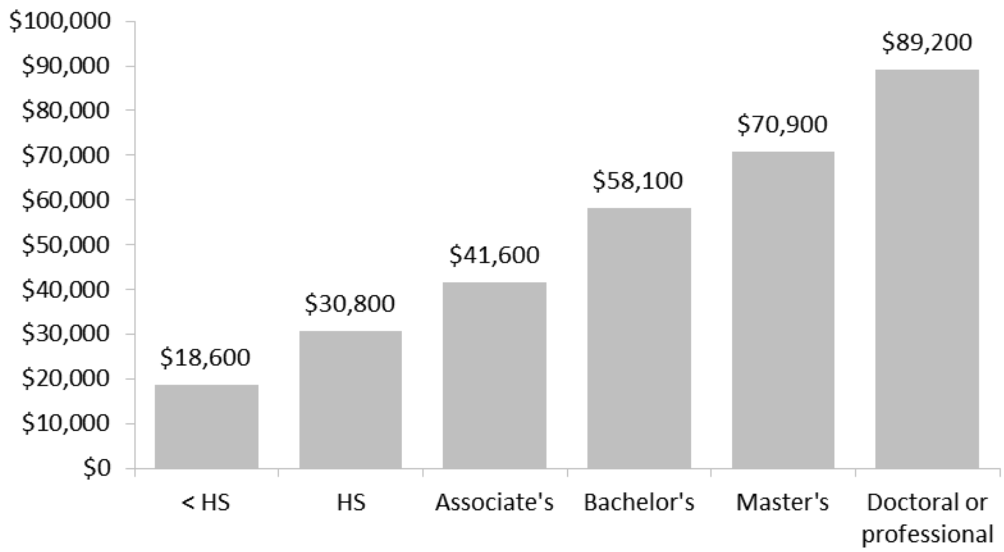
† Numbers may not add due to rounding.

Source: EMSI complete employment data.

Figure 1.2 presents the mean income by education level in the TAMUK Service Region 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.[7] As shown, students have the potential to earn more as they achieve higher levels of education compared to maintaining a high school diploma. Students who achieve a bachelor's degree can expect $58,100 in income per year, approximately $27,300 more than someone with a high school diploma.

[7] 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.

Figure 1.2: Expected income in the TAMUK Service Region at the midpoint of an individual's working career by education level



Source: EMSI complete employment data.

2 Economic Impacts on the TAMUK Service Region Economy

The TAMUK Service Region economy is impacted by TAMUK in a variety of ways. The university 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, research activities, and the expenditures of its out-of-region students and visitors. 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.

This section presents the total economic impact of TAMUK broken out according to the following categories:

1) Impact of **operations spending**
2) Impact of **spending on research and development**
3) Impact of **student spending**
4) Impact of **visitor spending**
5) Impact of **human capital** from former students employed in the TAMUK Service Region workforce.

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

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

- The **initial effect** is the exogenous shock to the economy caused by the initial spending of money, whether to pay for salaries and wages, purchase goods or services, or cover operating expenses.
- The initial round of spending creates more spending in the economy, resulting is what is commonly known as the **multiplier effect**. The multiplier effect comprises the additional

activity that occurs across all industries in the economy and may be further decomposed into the following three types of effects:

- The **direct effect** refers to the additional economic activity that occurs as the industries affected by the initial effect spend money to purchase goods and services from their supply chain industries.
- The **indirect effect** occurs as the supply chain of the initial industries creates even more activity in the economy through their own inter-industry spending.
- The **induced effect** refers to the economic activity created by the household sector as the businesses affected by the initial, direct, and indirect effects raise salaries or hire more people.

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

<table>
<tr><td>EMSI</td><td>Initial</td><td>Direct</td><td>Indirect</td><td>Induced</td></tr>
<tr><td>IMPLAN</td><td>Direct</td><td colspan="2">Indirect</td><td>Induced</td></tr>
</table>

Multiplier effects in this analysis are derived using EMSI's Social Accounting Matrix (SAM) input-output model that captures the interconnection of industries, government, and households in the state. The EMSI SAM contains approximately 1,100 industry sectors at the highest level of detail available in the North American Industry Classification System (NAICS) and supplies the industry-specific multipliers required to determine the impacts associated with increased activity within a given economy. For more information on the EMSI SAM model and its data sources, see Appendix 2.

2.1 Operations spending impact

Faculty and staff payroll and benefits are part of the region's overall income, and the spending of employees for groceries, apparel, and other household spending helps support businesses in the regional economy. The university purchases supplies and services, and many of its vendors are located in the TAMUK Service Region. These expenses create a ripple effect that generates still more jobs and income throughout the economy.

Table 2.1 presents the total expenses of the university in FY13 by type of cost, less expenses for research activities (the impacts of these expenses are described and assessed separately in the following subsection). Three main categories appear in the table: 1) salaries, wages, and benefits, 2) capital depreciation, and 3) all other expenses, including purchases for supplies and services. These total expenditures are then broken out as discussed below to account for those that occurred in-region and out-of-region.

Table 2.1: Expenses by type of cost of TAMUK (less research activities), FY13

Type of cost	Total expenses (thousands)	In-region expenses (thousands)	Out-of-region expenses (thousands)
Salaries, wages, and benefits	$61,408	$20,099	$41,309
Capital expenditures (amortized) and/or depreciation	$9,286	$5,699	$3,587
All other expenses	$50,072	$20,413	$29,659
Total	**$120,766**	**$46,211**	**$74,555**

Source: Data supplied by TAMUK, IPEDS, and the EMSI impact model.

The first step in estimating the impact of the expenses shown in Table 2.1 is to map them to the approximately 1,100 industries of the EMSI SAM model. Assuming that the spending patterns of the university's 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 82% of the people working at TAMUK live in the TAMUK Service Region (see Table 1.1), and therefore we consider only 82% of the salaries, wages, and benefits. For the other two expense categories (i.e., capital depreciation and all other expenses), we assume the university's spending patterns approximately match national averages and apply the national spending coefficients for NAICS[8] 611310 (Colleges, Universities, and Professional Schools). Capital depreciation is mapped to the construction sectors of NAICS 611310 and the university's remaining expenses to the non-construction sectors of NAICS 611310.

We now have three expense vectors for TAMUK: one for salaries, wages, and benefits; another for capital depreciation; and a third for the university's purchases of supplies and services. The next step is to estimate the portion of these expenses that occurs inside the region. Those that occur outside the region are known as leakages. We estimate in-region expenses using regional purchase coefficients (RPCs), a measure of the overall demand for the commodities produced by each industry sector that is satisfied by regional suppliers, for each of the approximately 1,100 industries in the SAM model.[9] For example, if 40% of the demand for NAICS 541211 (Offices of Certified Public Accountants) is satisfied by regional suppliers, the RPC for that industry is 40%. The remaining 60% of the demand for NAICS 541211 is provided by suppliers located outside the region. The three vectors of expenses are multiplied, industry by industry, by the corresponding RPC to arrive at the in-region expenses associated with the university (see the column labeled "In-region expenses" in Table 2.1). Finally, in-region spending is entered, industry by industry, into the

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[8] NAICS stands for North American Industry Classification System (http://www.census.gov/eos/www/naics/). It is a product of Census and classifies each industry according to its primary activities.

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

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

Table 2.2 presents the economic impact of the university's operations. The people employed by TAMUK and their salaries, wages, and benefits comprise the initial effect, shown in the top row in terms of labor income, non-labor income, total income, and job equivalents. The additional impacts created by the initial effect appear in the next four rows under the heading "Multiplier effect." Summing initial and multiplier effects, the gross impacts are $81.1 million in labor income and $20.8 million in non-labor income. This comes to a total impact of $101.9 million, equivalent to 2,322 jobs, associated with the spending of the university and its employees in the region.

Table 2.2: Impact of the operations spending of TAMUK, FY13

	Labor income (thousands)	Non-labor income (thousands)	Total income (thousands)	Sales	Job equivalents
Initial effect	**$58,644**	**$0**	**$58,644**	**$120,766**	**1,655**
Multiplier effect					
Direct effect	$7,824	$8,382	$16,206	$26,112	230
Indirect effect	$1,399	$1,123	$2,522	$4,361	42
Induced effect	$13,258	$11,283	$24,541	$40,646	394
Total multiplier effect	**$22,481**	**$20,787**	**$43,269**	**$71,119**	**667**
Gross impact (initial + multiplier)	**$81,126**	**$20,787**	**$101,913**	**$191,885**	**2,322**
Less alternative uses of funds	-$5,885	-$4,543	-$10,428	-$17,721	-175
Net impact	**$75,240**	**$16,244**	**$91,485**	**$174,164**	**2,147**

Source: EMSI impact model.

The $101.9 million in total gross income is often reported by other researchers as an impact. We go a step further to arrive at a net impact by applying a counterfactual scenario; i.e., what has not happened but what would have happened if a given event – in this case, the expenditure of in-region funds on TAMUK – had not occurred. The university received an estimated 22.6% of its funding from sources within the TAMUK Service Region. These monies came from the portion of tuition and fees paid by resident students, from the auxiliary revenue and donations from private sources located within the region, from state taxpayer funding, and from the financial aid issued to students by state government. We must account for the opportunity cost of this in-region funding. Had other industries received these monies rather than TAMUK, income impacts would have still been created in the economy. In economic analysis, impacts that occur under counterfactual conditions are used to offset the impacts that actually occur in order to derive the true impact of the event under analysis.

We estimate this counterfactual by simulating a scenario where in-region monies spent on the university are instead spent on consumer goods and savings. This simulates the in-region monies being returned to the students, donors, and taxpayers and being spent instead by the household sector. Our approach is to establish the total amount spent by in-region funding sources on

TAMUK, 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 university's operations are equal to the total gross impacts less the impact of the alternative use of funds – the opportunity cost of the state money. As shown in the last row of Table 2.2, the total net impact is approximately $75.2 million in labor income and $16.2 million in non-labor income. This totals $91.5 million in income and is equivalent to 2,147 jobs. These impacts represent new economic activity created in the regional economy solely attributable to the operations of TAMUK.

2.2 Research spending impact

Similar to the day-to-day operations of TAMUK, research activities impact the economy by employing people and requiring the purchase of equipment and other supplies and services. Table 2.3 shows TAMUK's research expenses by function – payroll, equipment, and other – for the last four fiscal years. In FY13, TAMUK spent over $16.7 million on research and development activities. These expenses would not have been possible without funding from outside the region – TAMUK received around 38% of its research funding from federal sources.

Table 2.3: Research expenses by type of cost of TAMUK, FY13

Fiscal Year	Payroll (thousands)	Equipment (thousands)	Other (thousands)	Total (thousands)
FY13	$7,814	$379	$8,552	$16,745
FY12	$7,605	$451	$8,153	$16,209
FY11	$7,534	$388	$8,224	$16,146
FY10	$7,194	$576	$8,529	$16,299

Source: Data supplied by TAMUK.

We employ a methodology similar to the one used to estimate the impacts of operational expenses. We begin by mapping total research expenses to the industries of the SAM model, removing the spending that occurs outside the region, and then running the in-region expenses through the multiplier matrix. As with the operations spending impact, we also adjust the gross impacts to account for the opportunity cost of monies withdrawn from the state economy to support the research of TAMUK, whether through state-sponsored research awards or through private donations. Again, we refer to this adjustment as the alternative use of funds.

Mapping the research expenses by category to the industries of the SAM model – the only difference from our previous methodology – requires some exposition. The National Science Foundation's Higher Education Research and Development Survey (HERD) is completed annually by universities that spend in excess of $150,000 on research and development. Table 67 in the 2012 HERD lists each institution's research expenses by field of study.[10] We map these fields of study to their respective industries in the SAM model. This implicitly assumes researchers at TAMUK will have similar spending patterns to private sector researchers in similar fields. The result is a distribution of research expenses to the various 1,100 industries that follows a weighted average of the fields of study reported in the HERD survey. This assumption serves as our best estimate of the distribution of research expenses across the various industries without individually surveying researchers at TAMUK.

Initial, direct, indirect, and induced effects of TAMUK's research expenses appear in Table 2.4. As with the operations spending impact, the initial effect consists of the 210 jobs and their associated salaries, wages, and benefits. The university's research expenses have a total gross impact of $12.2 million in labor income and $2.1 million in non-labor income. This equals $14.3 million in total income, equivalent to 351 jobs. Taking into account the impact of the alternative uses of funds, net research expenditure impacts of TAMUK are $11.6 million in labor income and $1.7 million in non-labor income, totaling $13.3 million and equivalent to 334 jobs.

Table 2.4: Impact of the research activities of TAMUK, FY13

	Labor income (thousands)	Non-labor income (thousands)	Total income (thousands)	Sales	Job equivalents
Initial effect	**$7,462**	**$0**	**$7,462**	**$16,745**	**210**
Multiplier effect					
Direct effect	$2,110	$696	$2,806	$4,431	63
Indirect effect	$409	$135	$544	$909	14
Induced effect	$2,170	$1,284	$3,454	$5,683	64
Total multiplier effect	**$4,690**	**$2,115**	**$6,804**	$11,024	**140**
Gross impact (initial + multiplier)	**$12,152**	**$2,115**	**$14,266**	$27,768	**351**
Less alternative uses of funds	-$543	-$419	-$962	-$1,635	-16
Net impact	**$11,609**	**$1,695**	**$13,304**	**$26,133**	**334**

Source: EMSI impact model.

2.3 Student spending impact

An estimated 2,636 students[11] came from outside the region and lived off campus while attending the university in FY13. These students spent money at businesses in the region for groceries,

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

[11] EMSI calculation based on multiplying the percentage of students originating from outside the region by the percentage of those students living in the region off-campus by the student headcount. These data items were provided by TAMUK.

accommodation, transportation, and so on. Another estimated 1,647 out-of-region students[12] lived on campus while attending TAMUK. These students also spent money while attending, although we exclude most of their spending for room and board since these expenditures are already reflected in the impact of the university's operations. Collectively, the off-campus expenditures of out-of-region students supported jobs and created new income in the regional economy.[13]

The average off-campus costs of out-of-region students appear in the first section of Table 2.5, equal to $12,257 per student. Note that this figure excludes expenses for books and supplies, since many of these monies are already reflected in the operations impact discussed in the previous section. We multiply the $12,257 in annual costs by the number of students who lived in the region but off-campus while attending (2,636 students) to estimate their total spending. For students living on campus, we multiply the per-student cost of personal expenses, transportation, and off-campus food purchases (assumed to be equal to 25% of room and board) by the number of students who lived in the region but on-campus while attending (1,647 students). Altogether, off-campus student spending generated gross sales of $43.7 million. This figure, once net of the monies paid to student workers, yields net off-campus sales of $40.4 million, as shown in the bottom row of Table 2.5.

Table 2.5: Average student costs and total sales generated by out-of-region students in the TAMUK Service Region, FY13

Room and board	$7,086
Personal expenses	$3,213
Transportation	$1,958
Total expenses per student	**$12,257**
Number of students who lived in the region off-campus	2,636
Number of students who lived in the region on-campus	1,647
Gross sales	$43,743,811
Wages and salaries paid to student workers*	$3,297,270
Net off-campus sales	**$40,446,541**

* This figure estimated by EMSI reflects only the portion of payroll that was used to cover the living expenses of non-resident student workers who lived in the region. Original data of salaries and wages paid to all student workers provided by TAMUK.

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

Estimating the impacts generated by the $40.4 million in student spending follows a procedure similar to that of the operations impact described above. We distribute the $40.4 million in sales to

12 EMSI calculation based on multiplying the percentage of students originating from outside the region by the percentage of those students living in the region on-campus by the student headcount. These data items were provided by TAMUK.

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

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 2.6 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 impact of out-of-region student spending is $14.1 million in labor income and $11.5 million in non-labor income, totaling $25.6 million, or 457 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 2.6: Impact of the spending of out-of-region students attending TAMUK, FY13

	Labor income (thousands)	Non-labor income (thousands)	Total income (thousands)	Sales	Job equivalents
Initial effect	**$0**	**$0**	**$0**	**$40,447**	**0**
Multiplier effect					
Direct effect	$9,139	$7,461	$16,601	$28,075	298
Indirect effect	$1,502	$1,131	$2,633	$4,537	48
Induced effect	$3,504	$2,896	$6,400	$10,492	111
Total multiplier effect	**$14,145**	**$11,488**	**$25,633**	**$43,103**	**457**
Total impact (initial + multiplier)	**$14,145**	**$11,488**	**$25,633**	**$83,550**	**457**

Source: EMSI impact model.

It is important to note that students from the region also spend money while attending TAMUK. However, had they lived in the region without attending TAMUK, they would have spent a similar amount of money on their living expenses. We make no inference regarding the number of students that would have left the region had they not attended TAMUK. Had the impact of these students been included, the results presented in Table 2.6 would have been much greater.

2.4 Visitor spending impact

In addition to out-of-region students, thousands of visitors came to TAMUK to participate in various activities, including commencement, sports events, and orientation. An estimated 9,250 out-of-region visitors attended events hosted by TAMUK in FY13. Table 2.7 presents the average expenditures per visitor for accommodation, food, transportation, and other personal expenses (including shopping and entertainment). These figures were reported in a 2013 study conducted for the Office of the Governor, Texas Economic Development and Tourism. By multiplying these figures by the number of out-of-region visitors, the gross spending of out-of-region visitors totaled $2.3 million in FY13. However, some of this spending includes monies paid to the university through non-textbook items (e.g., event tickets, food, etc.). These have already been accounted for in the impact of operations and should thus be removed to avoid double-counting. We estimate that on-campus sales generated by out-of-region visitors totaled $371,040. The net sales from out-of-region visitors in FY13 thus come to $2 million.

Table 2.7: Average visitor costs and sales generated by out-of-region visitors in Texas, FY13

Accommodation	$44
Food	$63
Entertainment and shopping	$61
Transportation	$84
Total expenses per visitor	**$253**
Number of out-of-region visitors	9,250
Gross sales	$2,338,249
On-campus sales (excluding textbooks)	$371,040
Net off-campus sales	**$1,967,210**

Source: *The Economic Impact of Travel on Texas,* prepared for the Office of the Governor, Texas Economic Development and Tourism (2014). The number of out-of-region visitors estimated by EMSI based on student origin data and the assumption that each out-of-region student would receive 2 visitors.

Calculating the increase in regional income as a result of visitor spending again requires use of the SAM model. The analysis begins by discounting the off-campus sales generated by out-of-region visitors to account for leakage in the trade sector, and then bridging the net figures to the detailed sectors of the SAM model. The model runs the net sales figures through the multiplier matrix to arrive at the multiplier effects. As shown in Table 2.8, the net impact of visitor spending in FY13 comes to $638,900 in labor income and $359,500 in non-labor income. This equals $998,300 in total income and is equivalent to 25 jobs.

Table 2.8: Impact of the spending of out-of-region visitors of TAMUK, FY13

	Labor income (thousands)	Non-labor income (thousands)	Total income (thousands)	Sales	Job equivalents
Initial effect	**$0**	**$0**	**$0**	**$1,967**	**0**
Multiplier effect					
Direct effect	$405	$227	$631	$1,095	16
Indirect effect	$69	$44	$112	$208	3
Induced effect	$165	$89	$254	$429	6
Total multiplier effect	**$639**	**$359**	**$998**	**$1,732**	**25**
Total impact (initial + multiplier)	**$639**	**$359**	**$998**	**$3,700**	**25**

Source: EMSI impact model.

2.5 Human capital impact

While TAMUK creates an economic impact through its spending and the spending of its students and visitors, the greatest economic impact of TAMUK stems from the added human capital – the knowledge, creativity, imagination, and entrepreneurship – found in its alumni. While attending TAMUK, 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 (e.g., buildings, production facilities, equipment) more productive by efficiently adding value to their operational capacity. The employers of TAMUK's alumni enjoy the fruits of this increased productivity in the form of additional non-labor income (i.e., higher profits).

In this section we estimate the economic impacts stemming from the higher labor income of alumni in combination with their employers' higher non-labor income. Former students who achieved a degree as well as those who may not have finished a degree or who did not take courses for credit are considered alumni. The methodology here differs from the previous impacts in one fundamental way. Whereas the other impacts depend on an annually renewed injection of new sales in the regional economy, the human capital impact is the result of years of past instruction and the associated accumulation of human capital. This is an important distinction that sets the human capital impact apart from the other impacts presented in this report.

The initial effect of human capital comprises two main components. The first and largest of these is the added labor income of the university's alumni, and the second comprises the added non-labor income of the businesses where the alumni are employed. To derive the initial effect, we estimate the portion of alumni that are employed in the workforce using the following sets of data or assumptions: 1) settling-in factors to determine how long it takes the average student to settle into a career;[14] 2) death, retirement, and unemployment rates from the National Center for Health Statistics, the Social Security Administration, and the Bureau of Labor Statistics; and 3) state migration data from the U.S. Census Bureau. Applying these factors to the university's historical student 12-month enrollments yields the estimated number of alumni that were still actively employed in the region as of FY13.

The next step is to quantify the skills that alumni acquired from the university, using the students' production of semester credit hours (SCHs) as a proxy for skills. To do this, we multiply the number of alumni still employed in the workforce by the 21.8 average SCHs per student (see Table 1.4)[15] to generate an estimate of approximately 2.2 million SCHs active in the workforce. Note that alumni who enrolled at the university more than one year are counted at least twice – if not more – in the calculations. However, SCHs remain distinct regardless of when and by whom they were earned, so there is no duplication in the SCH counts.

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[14] 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 students who have not yet completed their certificate or degree.

[15] This assumes the average SCH production and level of study from past years is equal to the SCH production and level of study of students during the analysis year.

Next, we estimate the value of the SCHs. This is done using the incremental added labor income stemming from the students' higher wages. The incremental labor income is the difference between the wages earned by alumni and the alternative wage they would have earned had they not attended college. Using the SCHs earned by students and the associated wage differentials between education levels, we estimate the average value per SCH to be equal to $177. This value represents the average incremental increase in wages that alumni of TAMUK received during the analysis year for every SCH they completed. For a more detailed discussion of the calculation of this variable, see Appendix 3.

Because experience leads to increased productivity and higher wages, the value per SCH varies depending on how long alumni have been in the workforce, with the highest value applied to the SCHs of students who had been employed the longest by FY13, and the lowest value per SCH applied to students who were just entering the workforce. In determining the amount of added labor income attributable to human capital, we multiply the estimated 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 an estimate of approximately $380.9 million in gross labor income in increased wages received by former students in FY13 (as shown in Table 2.9).

Table 2.9: Number of SCHs in workforce and initial labor income created in the TAMUK Service Region, FY13

Number of SCHs in workforce	2,153,069
Average value per SCH	$177
Initial labor income, gross	**$380,885,940**
Counterfactuals	
Percent reduction for alternative education opportunities	15%
Percent reduction for adjustment for labor import effects	50%
Initial labor income, net	**$161,876,524**

Source: EMSI impact model. Figures are EMSI estimates.

The next two rows in Table 2.9 show two adjustments used to account for counterfactual outcomes. As discussed above, counterfactual outcomes in economic impact analysis represent what would have happened if a given event had not occurred. The event in question is the education and training provided by TAMUK 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 TAMUK did not exist, we assume a portion of TAMUK's 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 alumni of TAMUK. The adjustment for alternative education opportunities amounts to a 15% reduction of the $380.9 million in added labor income. This means that 15% of the added labor income from alumni of TAMUK would have been generated in the region anyway, even if the university did not exist. See Section 4 for a sensitivity analysis of this variable, and Appendix 4 for more information on the alternative education adjustment.

The other adjustment in Table 2.9 accounts for the importation of labor. Suppose TAMUK 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 TAMUK Service Region. 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 TAMUK Service Region businesses could have been filled by workers recruited from outside the region if the university did not exist.[16] We conduct a sensitivity analysis for this assumption in Section 4. With the 50% adjustment, the net labor income added to the economy comes to $161.9 million, as shown in Table 2.9.

The $161.9 million in added labor income appears under the initial effect in the labor income column of Table 2.10. To this we add an estimate for initial non-labor income. As discussed earlier in this section, businesses that employ former students of TAMUK 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 ($161.9 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.[17] 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 $161.9 million in initial labor income effects to the detailed industry sectors in the SAM model.[18]

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 $74.5 million in non-labor income that can be attributable to the human capital creation of the university. Summing initial labor and non-labor income together provides the total initial effect of human capital creation on the TAMUK Service Region economy, equal to approximately $236.4 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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16 A similar assumption is used by Walden (2014) in his analysis of the Cooperating Raleigh Colleges.

17 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).

18 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 2.10: Impact of human capital of TAMUK, FY13

	Labor income (thousands)	Non-labor income (thousands)	Total income (thousands)	Sales	Job equivalents
Initial effect	**$161,877**	**$74,542**	**$236,418**	**$505,548**	**3,723**
Multiplier effect					
Direct effect	$16,335	$9,896	$26,231	$54,693	394
Indirect effect	$3,181	$1,743	$4,924	$9,991	78
Induced effect	$70,688	$22,258	$92,946	$157,112	1,686
Total multiplier effect	**$90,205**	**$33,897**	**$124,101**	**$221,796**	**2,158**
Total impact (initial + multiplier)	**$252,081**	**$108,439**	**$360,520**	**$727,344**	**5,881**

Source: EMSI impact model.

Table 2.10 shows the multiplier effects of human capital creation. 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 university's alumni. The final results are $90.2 million in labor income and $33.9 million in non-labor income, for an overall total of $124.1 million in multiplier effects. The grand total impact of human capital creation thus comes to $360.5 million, the sum of all initial and multiplier labor and non-labor income impacts. This is equivalent to 5,881 jobs.

2.6 Total impact of TAMUK

The total economic impact of TAMUK on the TAMUK Service Region can be generalized into two broad types of impacts. First, on an annual basis, TAMUK generates a flow of spending that has a significant impact on the TAMUK Service Region economy. The impacts of this spending are captured by the operations, research, student, and visitor spending impacts. While not insignificant, these impacts do not capture the true impact or purpose of TAMUK. The basic purpose of TAMUK is to foster human capital. Every year a new cohort of TAMUK's alumni adds to the stock of human capital in the TAMUK Service Region, and a portion of alumni continue to contribute to the TAMUK Service Region economy.

Table 2.11 displays the grand total impacts of TAMUK on the TAMUK Service Region economy in FY13 – including the impacts from operations spending, research spending, student spending, visitor spending, and human capital. For context, the percentage of the total TAMUK Service Region economy (as presented in Table 1.5) that each type of impact comprises is also presented.

Table 2.11: Total impact of TAMUK, FY13

	Labor income (thousands)	Non-labor income (thousands)	Total income (thousands)	Sales	Job equivalents
Operations spending	$75,240	$16,244	$91,485	$174,164	2,147
Research spending	$11,609	$1,695	$13,304	$26,133	334
Student spending	$14,145	$11,488	$25,633	$83,550	457
Visitor spending	$639	$359	$998	$3,700	25
Human capital	$252,081	$108,439	$360,520	$727,344	5,881
Total impact	**$353,714**	**$138,226**	**$491,940**	**$1,014,891**	**8,844**
% of TAMUK Service Region economy	**2.6%**	**1.3%**	**2.1%**	**0.5%**	**3.1%**

Source: EMSI impact model.

3 Investment Analysis

The benefits generated by TAMUK affect the lives of many people. The most obvious beneficiaries are the university's students; they give up time and money to go to the university 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. A portion of these benefits of education extend specifically to the state government in the form of increased tax revenues and public sector savings.

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 TAMUK 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 be in full employment instead of learning. 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 $34.6 million from Table 1.2. Direct outlays also include the cost of books and supplies. On average, full-time students spent $1,300 each on books and supplies during the reporting year.[19] Multiplying this figure times the number of full-time equivalents (FTEs) produced by TAMUK in FY13[20] generates a total cost of $7.7 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 university 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 university.

[19] Based on the data supplied by TAMUK.

[20] A single FTE is equal to 30 SCHs, so there were 5,901 FTEs produced by students in FY13, equal to 177,015 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 Figure 1.2 according to the education level breakdown of the student population when they first enrolled.[21] However, the income levels in Figure 1.2 reflect what average workers earn at the midpoint of their careers, not while attending the university. Because of this, we adjust the income levels to the average age of the student population (24) to better reflect their wages at their current age.[22] This calculation yields an average full earning potential of $25,516 per student.

In determining how much students earn while enrolled, an important factor to consider is the time that they actually spend on their education, since this is the only time that they are required to give up a portion of their earnings. We use the students' 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 TAMUK earned an average of 21.8 SCHs per student (excluding personal enrichment students), which is approximately equal to 73% of a full academic year.[23] We thus include no more than $18,521 (or 73%) of the students' full earning potential in the opportunity cost calculations.

Another factor to consider is the students' employment status. Based on data supplied by TAMUK, approximately 73% of students are employed. For the 28% 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 $18,521). The total value of their forgone income thus comes to $41.4 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 university.[24] 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 do not know the actual jobs held by students while attending, the 42% in forgone earnings serves as a reasonable average.

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21 This is based on the number of students who reported their entry level of education to TAMUK.

22 Further discussion on this adjustment appears in Appendix 4.

23 Equal to 21.8 SCHs divided by 30, the assumed number of SCHs in a full-time academic year.

24 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).

Working students also give up a portion of their leisure time in order to attend a higher education institution. According to the Bureau of Labor Statistics American Time Use Survey, students forgo up to 1.4 hours of leisure time per day.[25] Assuming that an hour of leisure is equal in value to an hour of work, we derive the total cost of leisure by multiplying the number of leisure hours forgone during the academic year by the average hourly pay of the students' full earning potential. For working students, therefore, their total opportunity cost comes to $65 million, equal to the sum of their forgone income ($46.3 million) and forgone leisure time ($18.8 million).

The steps leading up to the calculation of student costs appear in Table 3.1. Direct outlays amount to $42.2 million, the sum of tuition and fees ($34.6 million) and books and supplies ($7.7 million), less $121,290 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 $99.8 million, excluding $6.7 million in offsetting residual aid that is paid directly to students.[26] Summing direct outlays and opportunity costs together yields a total of $142 million in student costs.

Table 3.1: Student costs, FY13 (thousands)

Direct outlays	
Tuition and fees	$34,637
Books and supplies	$7,671
Less direct outlays of personal enrichment students	-$121
Total direct outlays	**$42,186**
Opportunity costs	
Earnings forgone by non-working students	$41,403
Earnings forgone by working students	$46,281
Value of leisure time forgone by working students	$18,761
Less residual aid	-$6,671
Total opportunity costs	**$99,773**
Total student costs	**$141,959**

Source: Based on data supplied by TAMUK and THECB, 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 Figure 1.2, mean income levels at the midpoint of the average-aged worker's career increase as people achieve higher levels of education. The differences between income levels define the incremental benefits of moving from one education level to the next.

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[25] "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.

[26] Residual aid is the remaining portion of scholarship or grant aid distributed directly to a student after the university apply tuition and fees.

A key component in determining the students' return on investment is the value of their future benefits stream, that is, what they can expect to earn in return for the investment they make in education. We calculate the future benefits stream to the university's FY13 students first by determining their average annual increase in income, equal to $35.8 million. This value represents the higher income that accrues to students at the midpoint of their careers and is calculated based on the marginal wage increases of the SCHs that students complete while attending the university. For a full description of the methodology used to derive the $35.8 million, see Appendix 3.

The second step is to project the $35.8 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.[27] The Mincer function originated from Mincer's seminal work on human capital (1958) and 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. For the purpose of this analysis, we use United States-based Mincer coefficients estimated by Polachek (2003) and account for any upward bias by incorporating a 10% reduction in our projected earnings. With the $35.8 million representing the students' higher earnings at the midpoint of their careers, we apply scalars from the Mincer function to yield a stream of projected future benefits that gradually increase from the time students enter the workforce, peak shortly after the career midpoint, and then dampen slightly as students approach retirement at age 67. This earnings stream appears in Column 2 of Table 3.2.

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	$22	9%	$2	$142	-$140
1	$23	17%	$4	$0	$4
2	$23	26%	$6	$0	$6
3	$24	41%	$10	$0	$10
4	$25	63%	$16	$0	$16
5	$26	94%	$25	$0	$25
6	$27	95%	$26	$0	$26
7	$28	95%	$27	$0	$27
8	$29	95%	$28	$0	$28
9	$30	95%	$28	$0	$28

[27] 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)
10	$31	95%	$29	$0	$29
11	$32	95%	$30	$0	$30
12	$33	95%	$31	$0	$31
13	$33	95%	$32	$0	$32
14	$34	95%	$32	$0	$32
15	$35	95%	$33	$0	$33
16	$36	95%	$34	$0	$34
17	$36	95%	$35	$0	$35
18	$37	94%	$35	$0	$35
19	$38	94%	$36	$0	$36
20	$38	94%	$36	$0	$36
21	$39	94%	$37	$0	$37
22	$39	94%	$37	$0	$37
23	$40	94%	$37	$0	$37
24	$40	93%	$38	$0	$38
25	$41	93%	$38	$0	$38
26	$41	93%	$38	$0	$38
27	$41	92%	$38	$0	$38
28	$41	92%	$38	$0	$38
29	$41	91%	$38	$0	$38
30	$42	91%	$38	$0	$38
31	$42	90%	$38	$0	$38
32	$41	90%	$37	$0	$37
33	$41	89%	$37	$0	$37
34	$41	89%	$36	$0	$36
35	$41	88%	$36	$0	$36
36	$41	87%	$35	$0	$35
37	$40	86%	$35	$0	$35
38	$40	85%	$34	$0	$34
39	$40	84%	$33	$0	$33
40	$39	83%	$33	$0	$33
41	$38	26%	$10	$0	$10
42	$38	7%	$3	$0	$3
Present value			**$521**	**$142**	**$379**
Internal rate of return					**14.7%**
Benefit-cost ratio					**3.7**
Payback period (no. of years)					**9.0**

* Includes the “settling-in” factors and attrition.

Source: EMSI impact model.

As shown in Table 3.2, the $35.8 million in gross added income occurs around Year 16, which is the approximate midpoint of the students' future working careers given the average age of the student population and an assumed retirement age of 67. In accordance with the Mincer function, the gross added income that accrues to students in the years leading up to the midpoint is less than $35.8 million and the gross added income in the years after the midpoint is greater than $35.8 million.

The final step in calculating the students' future benefits stream is to net out the potential benefits generated by students who are either not yet active in the workforce or who leave the workforce over time. This adjustment appears in Column 3 of Table 3.2 and represents the percentage of the FY13 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 university or because they are unable to find a job immediately upon graduation. Accordingly, we apply a set of "settling-in" factors to account for the time needed by students to find employment and settle into their careers. As discussed in Section 2, settling-in factors delay the onset of the benefits by one to three years for students who graduate with a certificate or a degree and by one to five years for degree-seeking students who do not complete during the analysis year.

Beyond the first five years of the time horizon, students will leave the workforce for any number of reasons, whether because of death, retirement, or unemployment. We estimate the rate of attrition using the same data and assumptions applied in the calculation of the attrition rate in the economic impact analysis of Section 2.[28] 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.

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%. Because students tend to rely upon debt to pay for their educations – i.e., they are negative savers – their discount rate is based upon student loan interest rates.[29] In Section 4, we conduct a sensitivity analysis of this discount rate. The present value of the benefits is then

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[28] 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.

[29] 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.

compared to student costs to derive the investment analysis results, expressed in terms of a benefit-cost ratio, rate of return, and payback period. The investment is feasible if returns match or exceed the minimum threshold values; i.e., a benefit-cost ratio that is greater than 1, a rate of return that exceeds the discount rate, and a reasonably short payback period.

In Table 3.2, the net added income of students yields a cumulative discounted sum of approximately $521 million, 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 FY13 student body is rewarded for its investment in TAMUK with a capital asset valued at $521 million.

The students' cost of attending the university is shown in Column 5 of Table 3.2, equal to a present value of $142 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 3.7 (equal to $521 million in benefits divided by $142 million in costs).

Another way to compare the same benefits stream and associated cost is to compute the rate of return. The rate of return indicates the interest rate that a bank would have to pay a depositor to yield an equally attractive stream of future payments.[30] Table 3.2 shows students of TAMUK earning average returns of 14.7% 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 14.7% 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 17.2%, higher than what is reported in Table 3.2.

[30] 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.

The payback period is defined as the length of time it takes to entirely recoup the initial investment.[31] Beyond that point, returns are what economists would call pure costless rent. As indicated in Table 3.2, students at TAMUK see, on average, a payback period of 9.0 years on their forgone earnings and out-of-pocket costs.

3.2 Societal perspective

Texas benefits from the education that TAMUK 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 TAMUK did not exist. Society's investment in TAMUK stretches across a number of investor groups, from students to employers to taxpayers. We weigh the benefits generated by TAMUK to these investor groups against the total societal costs of generating those benefits. The total societal costs include all expenses of TAMUK, all student expenses less tuition and fees, and all student opportunity costs, totaling $244.8 million ($137.5 million in expenses of TAMUK, $7.5 million in student expenses, and $99.8 million in student opportunity costs).

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

[31] 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.

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 do not, 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 TAMUK, not only does the productivity of Texas's workforce increase, but also does the productivity of its physical capital and assorted infrastructure. Students earn more because of the skills they learned while attending the university, 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 TAMUK 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.[32] 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 GRP to total labor income in the state. We also include the spending impacts discussed in Section 2 that were created in FY13 by the operations of the university and its research activities, student spending, and visitor 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,

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

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 university 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 human capital impact in Section 2 and is designed to account for the counterfactual scenario where TAMUK does not exist. The assumption in this case is that any benefits generated by students who could have received an education even without the university 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 university would have generated benefits anyway even without the university. For more information on 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 $2.3 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 society, we use the discount rate of 1.1%, the real treasury interest rate recommended by the Office for Management and Budget (OMB) for 30-year investments.[33] 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 TAMUK. 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 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.

[33] 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).

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 university, will not have poor health, commit crimes, or claim welfare and unemployment benefits. We dampen these results by the 10% adjustment discussed earlier in this section and in Appendix 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.[34] 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	**$2,274,319**
Social Savings	
Health	
Smoking	$145,677
Alcoholism	$4,737
Obesity	$74,911
Mental illness	$62,359
Drug abuse	$9,526
Total health savings	**$297,211**
Crime	
Criminal Justice System savings	$6,295
Crime victim savings	$832
Added productivity	$2,897
Total crime savings	**$10,023**
Welfare/unemployment	
Welfare savings	$54
Unemployment savings	$212
Total welfare/unemployment savings	**$267**
Total social savings	**$307,500**
Total, added income + social savings	**$2,581,819**

Source: EMSI impact model.

Table 3.3 above displays the results of the analysis. The first row shows the added income created in the state, equal to $2.3 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 $297.2 million, including savings due to a reduced demand for medical treatment and social services, improved worker

[34] For a full list of the data sources used to calculate the social externalities, see the "Resources and References" section. See also Appendix 6 for a more in-depth description of the methodology.

productivity and reduced absenteeism, and a reduced number of vehicle crashes and fires induced by alcohol or smoking-related incidents. Crime savings amount to $10 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 $266,538, stemming from a reduced number of persons in need of income assistance. All told, social savings amounted to $307.5 million in benefits to communities and citizens in Texas.

The sum of the social savings and the added income in the state is $2.6 billion, as shown in the bottom row of Table 3.3. These savings accrue in the future as long as the FY13 student population of TAMUK 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 societal costs of generating those benefits. Comparing the present value of the benefits and the societal costs, we have a benefit-cost ratio of 10.5. This means that for every dollar invested in an education by TAMUK, whether it is the money spent on day-to-day operations of the university or money spent by students on tuition and fees, an average of $10.50 in benefits will accrue to society in Texas.[35]

Table 3.4: Projected benefits and costs, societal perspective

1 Year	2 Benefits to society (millions)	3 Societal costs (millions)	4 Net cash flow (millions)
0	$233	$245	-$12
1	$10	$0	$10
2	$16	$0	$16
3	$26	$0	$26
4	$42	$0	$42
5	$64	$0	$64
6	$65	$0	$65
7	$67	$0	$67
8	$69	$0	$69
9	$70	$0	$70
10	$72	$0	$72
11	$73	$0	$73
12	$75	$0	$75
13	$76	$0	$76
14	$78	$0	$78
15	$79	$0	$79

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

Table 3.4: Projected benefits and costs, societal perspective

1 Year	2 Benefits to society (millions)	3 Societal costs (millions)	4 Net cash flow (millions)
16	$80	$0	$80
17	$81	$0	$81
18	$82	$0	$82
19	$83	$0	$83
20	$84	$0	$84
21	$85	$0	$85
22	$85	$0	$85
23	$86	$0	$86
24	$86	$0	$86
25	$86	$0	$86
26	$86	$0	$86
27	$86	$0	$86
28	$86	$0	$86
29	$86	$0	$86
30	$86	$0	$86
31	$85	$0	$85
32	$84	$0	$84
33	$84	$0	$84
34	$83	$0	$83
35	$82	$0	$82
36	$80	$0	$80
37	$79	$0	$79
38	$78	$0	$78
39	$76	$0	$76
40	$74	$0	$74
41	$23	$0	$23
42	$6	$0	$6
Present value	**$2,582**	**$245**	**$2,337**
Benefit-cost ratio			**10.5**

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 government. For example, benefits resulting from income growth are limited to increased state tax payments. Similarly, savings related to improved health, reduced crime, and fewer welfare and unemployment claims are limited to those received strictly by state 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 university 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 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 $201.5 million.

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

Added income from TAMUK	
Added tax revenue	**$151,271**
Government savings	
Health-related savings	$43,333
Crime-related savings	$6,606
Welfare/unemployment-related savings	$267
Total government savings	$50,205
Total taxpayer benefits	**$201,476**

Source: EMSI impact model.

3.3.2 Return on investment to taxpayers

Taxpayer costs are reported in Table 3.6 and come to $44.6 million, equal to the contribution of state government to TAMUK. In return for their public support, taxpayers are rewarded with an investment benefit-cost ratio of 4.5 (= $201.5 million ÷ $44.6 million), indicating a profitable investment.

Table 3.6: Projected benefits and costs, taxpayer perspective

1 Year	2 Benefits to taxpayers (millions)	3 State gov't costs (millions)	4 Net cash flow (millions)
0	$16	$45	-$29
1	$1	$0	$1
2	$1	$0	$1
3	$2	$0	$2
4	$3	$0	$3
5	$5	$0	$5
6	$5	$0	$5
7	$6	$0	$6
8	$6	$0	$6
9	$6	$0	$6
10	$6	$0	$6
11	$6	$0	$6
12	$6	$0	$6

Table 3.6: Projected benefits and costs, taxpayer perspective

1 Year	2 Benefits to taxpayers (millions)	3 State gov't costs (millions)	4 Net cash flow (millions)
13	$6	$0	$6
14	$6	$0	$6
15	$6	$0	$6
16	$6	$0	$6
17	$6	$0	$6
18	$6	$0	$6
19	$7	$0	$7
20	$7	$0	$7
21	$7	$0	$7
22	$7	$0	$7
23	$7	$0	$7
24	$7	$0	$7
25	$7	$0	$7
26	$7	$0	$7
27	$7	$0	$7
28	$7	$0	$7
29	$7	$0	$7
30	$7	$0	$7
31	$7	$0	$7
32	$7	$0	$7
33	$6	$0	$6
34	$6	$0	$6
35	$6	$0	$6
36	$6	$0	$6
37	$6	$0	$6
38	$6	$0	$6
39	$6	$0	$6
40	$6	$0	$6
41	$2	$0	$2
42	<$1	$0	<$1
Present value	**$201**	**$45**	**$157**
Internal rate of return			**14.4%**
Benefit-cost ratio			**4.5**
Payback period (no. of years)			**8.9**

Source: EMSI impact model.

At 14.4%, the rate of return to state taxpayers is also favorable. As above, we assume a 1.1% discount rate when dealing with government investments and public finance issues.[36] This is the return governments are assumed to be able to earn on generally safe investments of unused funds,

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

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 university just pays its own way. In principle, governments could borrow monies used to support TAMUK and repay the loans out of the resulting added taxes and reduced government expenditures. A rate of return of 14.4%, on the other hand, means that TAMUK not only pays its own way, but also generates a surplus that state 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 section, 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 TAMUK. 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 TAMUK. Recognizing the other point of view, Table 3.7 shows rates of return for both the societal 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 TAMUK.

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

	Including social savings	Excluding social savings
Societal perspective		
Net present value (thousands)	$2,336,987	$1,804,316
Benefit-cost ratio	10.5	8.4
Taxpayer perspective		
Net present value (thousands)	$156,908	$106,702
Benefit-cost ratio	4.5	3.4
Internal rate of return	14.4%	10.8%
Payback period (no. of years)	8.9	11.3

Source: EMSI impact model.

3.4 Conclusion

This section has shown that the education provided by TAMUK is an attractive investment to students with rates of return that exceed alternative investment opportunities. At the same time, the presence of the university 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 section we test the sensitivity of the model to the following input factors: 1) the alternative education variable, 2) the labor import effect variable, 3) the student employment variables, and 4) the 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 university in the region. Given the difficulty in accurately specifying the alternative education variable, we test the sensitivity of the taxpayer and societal 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 14.4% to 14.1%. Likewise, a decrease of 10% (from 15% to 14%) in the assumption increases the rate of return from 14.4% to 14.7%.

Table 4.1: Sensitivity analysis of alternative education variable, taxpayer and societal perspective

% variation in assumption	-50%	-25%	-10%	Base Case	10%	25%	50%
Alternative education variable	8%	11%	14%	15%	17%	19%	23%
Societal perspective							
Net present value (millions)	$2,566	$2,452	$2,383	$2,337	$2,291	$2,222	$2,108
Benefit-cost ratio	11.5	11.0	10.7	10.5	10.4	10.1	9.6
Taxpayer perspective							
Net present value (millions)	$175	$166	$160	$157	$153	$148	$139
Rate of return	15.9%	15.1%	14.7%	14.4%	14.1%	13.6%	12.9%
Benefit-cost ratio	4.9	4.7	4.6	4.5	4.4	4.3	4.1

Based on this sensitivity analysis, the conclusion can be drawn that TAMUK investment analysis results from the taxpayer and societal 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 societal perspective is not very sensitive.

4.2 Labor import effect variable

The labor import effect variable only affects the human capital impact calculation in Table 2.9. 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 human capital. The other 50% we assume would have been created in the region anyway – even without TAMUK – since the businesses that hired TAMUK's students could have substituted some of these workers with equally-qualified people from outside the region had there been no students from TAMUK 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. Human capital impacts attributable to TAMUK, for example, range from a low of $180.3 million at a -50% variation to a high of $540.8 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 human capital increases as well. The impact stemming from the human capital still remains a sizeable factor in the TAMUK Service Region 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%
Human capital impact (millions)	$180	$270	$324	$361	$397	$451	$541

4.3 Student employment variables

Student employment variables are difficult to estimate because many students do not report their employment status or because institutions generally do not collect this kind of information. Employment variables include the following: 1) the percentage of students that are employed while attending the university, 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 university. Both employment variables affect the investment analysis results from the student perspective.

Students incur substantial expense by attending TAMUK because of the time they spend not gainfully employed. Some of that cost is recaptured if students remain partially (or fully) employed while attending. Based on data supplied by TAMUK, it is estimated that 73% of students who reported their employment status are employed. This variable is tested in the sensitivity analysis by changing it first to 100% and then to 0%.

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

The changes generate results summarized in Table 4.3, with "A" defined as the percent of students employed and "B" defined as the percent that students earn relative to their full earning potential. Base case results appear in the shaded row; here the assumptions remain unchanged, with A equal to 73% 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 = 73%, B = 58%	$379.1	14.7%	3.7
Scenario 1: A = 100%, B = 58%	$395.8	16.1%	4.2
Scenario 2: A = 73%, B = 100%	$425.4	19.5%	5.4
Scenario 3: A = 100%, B = 100%	$459.7	26.4%	8.5
Scenario 4: A = 0%, B = 0%	$335.0	12.0%	2.8

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

1. Scenario 1: Increasing the percentage of students employed (A) from 73% to 100%, the net present value, internal rate of return, and benefit-cost ratio improve to $395.8 million, 16.1%, and 4.2, 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 $425.4 million, 19.5%, and 5.4, 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 $459.7 million, 26.4%, and 8.5, 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 $335 million, 12.0%, and 2.8, 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 Section 3 are realistic, indicating that investments in TAMUK 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 percentage of students employed to 0% automatically negates the percentage they earn relative to full earning potential, since none of the students receive any earnings in this case.

[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)	$648	$495	$422	$379	$341	$290	$272
Benefit-cost ratio	5.6	4.5	4.0	3.7	3.4	3.0	2.9
Societal perspective							
Discount rate	0.6%	0.8%	1.0%	1.1%	1.2%	1.4%	1.7%
Net present value (millions)	$2,631	$2,478	$2,392	$2,337	$2,283	$2,206	$2,084
Benefit-cost ratio	11.7	11.1	10.8	10.5	10.3	10.0	9.5
Taxpayer perspective							
Discount rate	0.6%	0.8%	1.0%	1.1%	1.2%	1.4%	1.7%
Net present value (millions)	$180	$168	$161	$157	$153	$147	$137
Benefit-cost ratio	5.0	4.8	4.6	4.5	4.4	4.3	4.1

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 3.7 to 2.9. Conversely, reducing the discount rate for students by 50% (from 4.5% to 2.2%) increases the benefit-cost ratio from 3.7 to 5.6. 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 societal perspective (from a 11.7 benefit-cost ratio at a -50% variation from the base case, to a 9.5 benefit-cost ratio at a 50% variation from the base case).

Resources and References

Administration for Children and Families. Characteristics and Financial Circumstances of TANF Recipients, Fiscal Year 2010. August 2012. Accessed July 2013. http://www.acf.hhs.gov/sites/default/files/ofa/appendix_ys_final.pdf.

Administration for Children and Families. "Fiscal Year 2011 TANF Financial Data." Office of Family Assistance, TANF Financial Data. Updated August 2012. Accessed August 2013. http://www.acf.hhs.gov/programs/ofa/resource/tanf-financial-data-fy-2011.

American Automobile Association. "AAA Average Costs Per Mile" in "Your Driving Costs." AAA Association Communication: 2012. Accessed May 2012. http://newsroom.aaa.com/wp-content/uploads/2012/04/YourDrivingCosts2012.pdf.

American Community Survey. "Commuting in the United States: 2009" in "American Community Survey Reports." U.S. Department of Commerce Economics and Statistics Administration, September 2011.

Baryla, Edward and Douglas Dotterweich. "Student Migration: Do Significant Factors Vary by Region?" *Education Economics* 9, no. 3 (2001).

Becker, Gary S. *Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education*. New York: Columbia College Press for NBER, 1964.

Bilkic, Natasa, Thomas Gries, and Margarethe Pilichowski. "Stay in school or start working? – The human capital investment decision under uncertainty and irreversibility." *Labour Economics* 19, no. 5 (October 2012): 706-717.

Bouchery, Ellen, Carol Simon, and Hendrick Harwood. "Economic Costs of Excessive Alcohol Consumption in the United States, 2006." The Lewin Group, February 2013. Report prepared for the Centers for Disease Control and Prevention and the National Foundation for the Centers for Disease Control and Prevention. Accessed August 2013. http://www.lewin.com/~/media/Lewin/Site_Sections/Publications/CDC_Report_Rev.pdf.

Bureau of Justice Statistics. "Appendix Table 1 - Prisoners under the jurisdiction of state or federal correctional authorities, by jurisdiction, December 31, 2000, 2008, and 2009." in "Prisoners in 2009 (revised)." NCJ 231675, December 2010. Revised October 2011. Accessed July 2013. http://www.bjs.gov/content/pub/pdf/p09.pdf.

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

Bureau of Labor Statistics. Consumer Price Index. Accessed January 2013. ftp://ftp.bls.gov/pub/special.requests/cpi/cpiai.txt.

Bureau of Labor Statistics. "Earnings and unemployment rates by educational attainment." BLS Employment Projections. Last modified May 2013. Accessed July 2013. http://www.bls.gov/emp/ep_chart_001.htm.

Bureau of Labor Statistics. "May 2012 National Occupational Employment and Wage Estimates United States." Occupational Employment Statistics. Accessed July 2013. http://www.bls.gov/oes/current/oes_nat.htm.

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.

Bureau of Labor Statistics. "Table A-10. Unemployment rates by age, sex, and marital status, seasonally adjusted." Labor Force Statistics from the Current Population Survey. Last modified July 2013. Accessed July 2013. http://www.bls.gov/web/empsit/cpseea10.htm.

Buss, Christian, Jeffrey Parker, and Jon Rivenburg. "Cost, quality and enrollment demand at liberal arts colleges." *Economics of Education Review* 23, no.1 (February 2004): 57-65.

Card, David. "The causal effect of education on earnings." *Handbook of Labor Economics* 3 (1999): 1801-1863.

Card, David. "Estimating the Return to Schooling: Progress on Some Persistent Econometric Problems." *Econometrica* 69, no.5 (September 2001): 1127-1160.

Carson, Ann E. and Daniela Golinelli. "Table 1: Prisoners under the jurisdiction of state or federal correctional authorities, December 31, 2002–2012" in "Prisoners in 2012 - Advance Counts." Bureau of Justice Statistics, July 2013, NCJ 242467. Accessed August 2013. http://www.bjs.gov/content/pub/pdf/p12ac.pdf.

Center on Budget and Policy Priorities. "Policy Basics - How many weeks of unemployment are available?" Updated August 26, 2013. Accessed August 27, 2013. http://www.cbpp.org/files/PolicyBasics_UI_Weeks.pdf.

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

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.

Centers for Disease Control and Prevention. "Heavy drinkers (adult men having more than two drinks per day and adult women having more than one drink per day)" in "Alcohol Consumption - 2012." Behavioral Risk Factor Surveillance System Prevalence and Trends

Data. Accessed August 2013. http://apps.nccd.cdc.gov/brfss/list.asp?cat=AC&yr=2012&qkey=8381&state=All.

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.

Centers for Disease Control and Prevention. "Table 3: Prevalence of current depression among adults aged ≥18 years, by sociodemographic characteristics and year – Behavioral Risk Factor Surveillance System, multiple states, 2006 and 2008" in "Mental Illness Surveillance Among Adults in the United States." *Morbidity and Mortality Weekly Report* 60 supplement (September 2011): 17.

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. Accessed August 2013. http://www.cdc.gov/nchs/data/hus/2011/061.pdf.

College Board. "Figure 1: Average Estimated Full-Time Undergraduate Budgets, 2012-13 (Enrollment-Weighted)" in "Average Estimated Undergraduate Budgets, 2012-13." The College Board, Annual Survey of Colleges. Accessed August 2013. http://trends.collegeboard.org/college-pricing/figures-tables/average-estimated-undergraduate-budgets-2012-13.

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.

Criminal Justice Expenditure and Employment Extracts Program (CJEE). "Table 4. Justice system expenditure by character, state and type of government, fiscal year 2009 (preliminary)." Justice Expenditure and Employment Extracts 2009 (preliminary), NCJ 237913. Accessed July 2013. http://bjs.ojp.usdoj.gov/index.cfm?ty=pbdetail&iid=4335.

Dean Runyan Associates, *The Economic Impact of Travel on Texas,* prepared for Texas Tourism, Office of the Governor, and Texas Economic Development & Tourism. June 2014.

Dickerson, Andy, and Steven McIntosh. "The Impact of Distance to Nearest Education Institution on the Post Compulsory Education Participation Decision." *Urban Studies* 50, no. 4 (2013): 742-758.

Dynarski, Susan M. "Does Aid Matter? Measuring the Effect of Student Aid on College Attendance and Completion." *American Economic Review* 93, no. 1 (2003): 279-288.

Economic Modeling Specialists, Intl. Labor market data and software. www.economicmodeling.com.

Federal Bureau of Investigation, Criminal Justice Information Services Division. "Table 12: Crime Trends by Population Group, 2009-2010" in "Uniform Crime Reports." Crime in the United States, Offenses Known to Law Enforcement. Accessed August 2013. http://www.fbi.gov/about-us/cjis/ucr/crime-in-the-u.s/2010/crime-in-the-u.s.-2010/offenses-known-to-law-enforcement.

Federal Bureau of Investigation, Criminal Justice Information Services Division. "Table 29: Estimated Number of Arrests, United States, 2010" in "Uniform Crime Reports." Crime in the United States, Persons Arrested. Accessed August 2013. http://www.fbi.gov/about-us/cjis/ucr/crime-in-the-u.s/2010/crime-in-the-u.s.-2010/tables/10tbl29.xls.

Federal Bureau of Prisons. "Quick Facts About the Bureau of Prisons." Last updated July 27, 2013. Accessed August 19, 2013. http://www.bop.gov/news/quick.jsp#1.

Finkelstein, Eric A., 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.

Guerino, Paul, Paige M. Harrison, and William J. Sabol. "Prisoners in 2010." Bureau of Justice Statistics, December 2011, NCJ 236096. Accessed August 2013. http://www.bjs.gov/content/pub/pdf/p10.pdf.

Hamadeh, Mohamad and Roy Khoueiri. "Demand Elasticities for Higher Education in the United States." *International Journal of Business and Economic Perspectives* 5, no. 2 (2010): 60-67.

Harlow, Caroline Wolf. "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.

Henderson, James M. and Richard E. Quandt. *Microeconomic Theory: A Mathematical Approach*. New York: McGraw-Hill Book Company, 1971.

Jaeger, David A. and Marianne E. Page. "New Evidence on Sheepskin Effects in the Returns to Education." *The Review of Economics and Statistics* 78, no. 4 (November 1996): 733-740.

Kelchtermans, Stijn and Frank Verboven. "Participation and Study Decisions in a Public System of Higher Education." *Journal of Applied Econometrics* 25, no.3 (2010): 355-391.

Knapp, Laura G., Janice E. Kelly-Reid, and Scott A. Ginder. "Table 1. Enrollment at all Title IV institutions, by control of institution, student level, level of institution, attendance status, gender, and race/ethnicity: United States, fall 2011" in *Enrollment in Postsecondary Institutions, Fall 2011; Financial Statistics, Fiscal Year 2011; and Graduation Rates, Selected Cohorts, 2003-2008.*

Washington, DC: National Center for Education Statistics, December 2012. Accessed July 2013. http://nces.ed.gov/pubs2012/2012174rev.pdf.

Leigh, Andrew and Chris Ryan. "Estimating returns to education using different natural experiments techniques." *Economics of Education Review* 27 (2008): 149-160.

Leonesio, Michael V. "The Economics of Retirement: A Nontechnical Guide." *Social Security Bulletin* 59 no. 4 (Winter 1996): 29-50.

McCollister, Kathryn E., Michael T. French, and Hai Fang. "The Cost of Crime to Society: New Crime-Specific Estimates for Policy and Program Evaluation." *Drug and Alcohol Dependence* 108 no.1-2 (April 1, 2010): 98-109. Accessed August 2013. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2835847/.

Mincer, Jacob. "Investment in Human Capital and Personal Income Distribution." *Journal of Political Economy* 66, no. 4 (August 1958): 281–302.

Mincer, Jacob. *Schooling, Experience and Earnings*. New York: National Bureau of Economic Research, 1974.

Minton, Todd. "Table 1: Inmates confined in local jails at midyear, average daily population, and incarceration rates, 2000–2012" in "Jail Inmates at Midyear 2012 - Statistical Tables." Bureau of Justice Statistics, May 2013, NCJ 241264. Accessed August 2013. www.bjs.gov/content/pub/pdf/jim12st.pdf.

Morgan, James N. and Edward H. Robb. "The impact of age upon interregional migration." *The Annals of Regional Science* 15, no. 3 (November 1981): 31-45.

National Center for Education Statistics. *Digest of Education Statistics: 2011*. Accessed July 2013. http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2012001.

National Center for Education Statistics, Integrated Post-secondary Education Data System (IPEDS). http://nces.ed.gov/ipeds/.

National Center for Health Statistics. "Table 74. Healthy weight, overweight, and obesity among persons 20 years of age and over, by selected characteristics: United States, selected years 1960-1962 through 2007-2010" in *Health, United States, 2011 With Special Feature on Socioeconomic Status and Health.* Hyattsville, MD: National Center for Health Statistics, 2012.

National Survey on Drug Use and Health. "Table 1 (REVISED). Serious Mental Illness (SMI) in Past Year among Persons Aged 18 or Older, by location: Percentages, Annual Averages Based on 2008 and 2009 NSDUHs" in *The NSDUH Mental Illness: State Estimates of Adult Mental Illness*. Center for Behavioral Health Statistics and Quality, Substance Abuse and Mental Health Services Administration, May 2012.

National Survey on Drug Use and Health. "Table B.1 – Illicit Drug Use in the Past Month, by Age Group and State: Percentages, Annual Averages Based on 2009 and 2010 NSDUHs" in *State*

Estimates of Substance Use and Mental Disorders from the 2009-2010 National Surveys on Drug Use and Health. NSDUH Series H-43, HHS Publication No. (SMA) 12-4703. Rockville, MD: Substance Abuse and Mental Health Services Administration, 2012.

Office of Management and Budget. Circular A-94 Appendix C. Last modified December 2012. Accessed July 2013. http://www.whitehouse.gov/omb/circulars_a094/a94_appx-c.

Ogden, Cynthia L., 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.

Polachek, Solomon W. "Earnings Over the Lifecycle: The Mincer Earnings Function and its Applications." *Foundations and Trends in Microeconomics* 4, no. 3 (2008): 165-272.

Polachek, Solomon W. "Mincer's Overtaking Point and the Lifecycle Earnings Distribution." *Review of the Economics of the Household* 1, no. 4 (December 2003): 273-304.

Ramey, Valerie and Neville Francis. "A Century of Work and Leisure." *American Economic Journal: Macroeconomics* 1, no.2 (2009): 189-224.

Sevilla, Almudena, Jose Ignacio Gimenez-Nadal, and Jonathan I. Gershuny. "Leisure Inequality in the United States: 1965-2003." IZA Discussion Paper no. 6708, July 2012.

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." SAMHSA, Center for Behavioral Health Statistics and Quality, National Survey on Drug Use and Health, 2010 and 2011. Accessed August 2013. http://www.samhsa.gov/data/NSDUH/2011SummNatFindDetTables/NSDUH-DetTabsPDFWHTML2011/2k11DetailedTabs/Web/HTML/NSDUH-DetTabsSect5peTabs1to56-2011.htm.

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.

Supplemental Nutrition Assistance Program. "State Activity Report Fiscal Year 2011." Food and Nutrition Service, Supplemental Nutrition Assistance Program, Program Accountability and Administration Division, December 2012. Accessed August 2013. http://www.fns.usda.gov/snap/qc/pdfs/2011_state_activity.pdf.

Truffer, Christopher J., Sean Keehan, Sheila Smith, Jonathan Cylus, Andrea Sisko, John Poisal, Joseph Lizonitz, and M. Kent Clemens. "Health Spending Projections Through 2019: The Recession's Impact Continues." *Health Affairs* 29, no. 3 (March 2010): 522-529.

U.S. Census Bureau. "Table 1. Educational Attainment of the Population 18 Years and Over, by Age, Sex, Race, and Hispanic Origin: 2012." Educational Attainment in the United States: 2012 - Detailed Tables. Accessed August 2013. http://www.census.gov/hhes/socdemo/education/data/cps/2012/tables.html.

U.S. Census Bureau. "Table 1363. Household Net Savings Rate by Country: 1995 to 2008" in "The 2012 Statistical Abstract International Statistics." Accessed June 2013. http://www.census.gov/compendia/statab/2012/tables/12s1363.pdf.

U.S. Census Bureau. "Social Insurance and Human Services" in "The 2012 Statistical Abstract." Accessed August 2013. http://www.census.gov/compendia/statab/cats/social_insurance_human_services.html.

U.S. Census Bureau. "State Characteristics: Vintage 2012." Population Estimates. Updated June 13, 2013. Accessed August 28, 2013. http://www.census.gov/popest/data/state/asrh/2012/index.html.

U.S. Department of Health and Human Services. "Chapter II. Indicators of Dependence" in "2008 Indicators of Welfare Dependence." Annual Report to Congress, 2008. Accessed August 2013. http://aspe.hhs.gov/hsp/indicators08/index.shtml.

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, FY2009" in Temporary Assistance for Needy Families Program Ninth Report to Congress, 2012. Accessed August 2013. http://www.acf.hhs.gov/sites/default/files/ofa/ar9appendix.pdf.

U.S. Department of Labor. "Minimum Wage Laws in the States - January 1, 2013." U.S. Department of Labor Wage and Hour Division (WHD). Accessed May 2013. http://www.dol.gov/whd/minwage/america.htm.

U.S. Department of Labor. Unemployment Insurance Data Summary, 4th Quarter 2012. Accessed July 2013. http://www.ows.doleta.gov/unemploy/content/data.asp.

U.S. Department of the Treasury. "The Economic Costs of Smoking in the United States and the Benefits of Comprehensive Tobacco Legislation." Office of Public Affairs Report-3113, March 1998. Accessed August 2013. http://www.treasury.gov/press-center/press-releases/Documents/tobacco.pdf.

Walden, Michael, "The Local Economic Impact of the Cooperating Raleigh Colleges: Update 2013." March 2014, Accessed September 2014. http://crcraleighcolleges.org/files/crcimpact2013-final.pdf

Witters, Dan, Sengeeta Agrawal, and Diana Liu. "Depression Costs U.S. Workplaces $23 Billion in Absenteeism." Gallup-Healthways Well-Being Index, Gallup Wellbeing, July 24, 2013. Accessed August 28, 2013. http://www.gallup.com/poll/163619/depression-costs-workplaces-billion-absenteeism.aspx.

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 university 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 university in order to obtain their education.

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

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. GRP 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 university 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 university 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 university 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 chose 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

Semester credit hour A 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.

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 TAMUK in FY13 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 university, 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 in the TAMUK Service Region presented in Figure 1.2. For example, the difference in earnings between a high school diploma and an associate's degree is $10,800. We spread this $10,800 wage differential across the 60 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 FY13 student population to the education ladder. Table 1.4 provides information on the SCH production of students attending TAMUK, broken out by educational achievement. In total, students completed 177,015 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 completed during the year. For example, bachelor's degree graduates are allocated to the stage

[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).

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:

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

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

Table A3.1 displays the result for the students' aggregate annual increase in income (ΔE), a total of $35.8 million. By dividing this value by the students' total production of 177,015 SCHs during the analysis year, we derive an overall value of $202 per SCH.

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

Aggregate annual increase in income	$35,782,820
Total semester credit hours (SCHs) in FY13*	177,015
Value per SCH	$202

* Excludes the SCH production of personal enrichment students.

Source: EMSI impact model.

A3.2 Mincer function

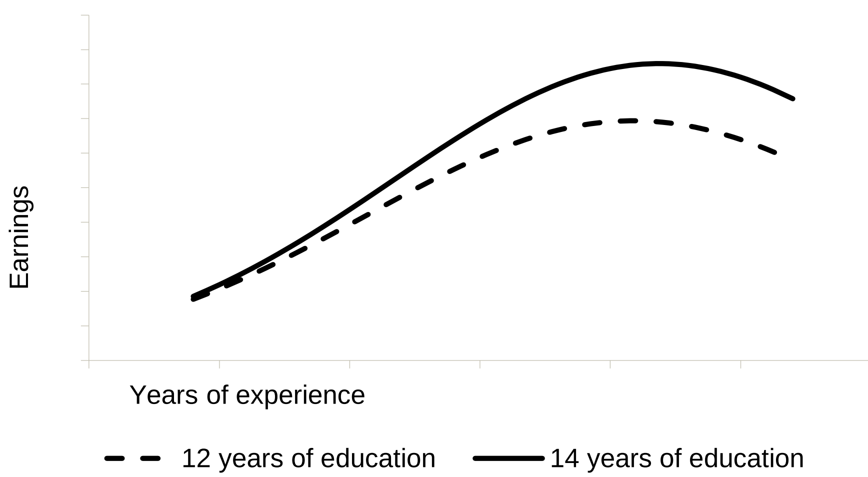
The $202 value per SCH in Table A3.1 only tells part of the story, however. Human capital theory holds that earnings levels do not remain constant; rather, they start relatively low and gradually increase as the worker gains more experience. Research also shows that the earnings increment between educated 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 also 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 human capital impact in Section 2, we use the slope of the curve in Mincer's earnings function to condition the $202 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 $202 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 FY13 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 A3.1.

Appendix 4: Alternative Education Variable

In a scenario where TAMUK does 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 university. The alternative education variable accounts for these students and is used to discount the benefits presented in the analysis.

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

In the absence of TAMUK, we assume 15% of students attending TAMUK would find alternative education opportunities and remain in or return to the TAMUK Service Region. We account for this by discounting the human capital impact, the benefits to taxpayers, and the benefits to society in Texas in Sections 2 and 3 by 15%. In other words, we assume 15% of the benefits created by students attending TAMUK would have occurred anyways in the counterfactual scenario where TAMUK does not exist. A sensitivity analysis of this adjustment is presented in Section 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 university for one year, and the cost of tuition is $1,500 (Column 2).
3. Earnings forgone while attending the university 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 university 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

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[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 A3.1. 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 university. 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.

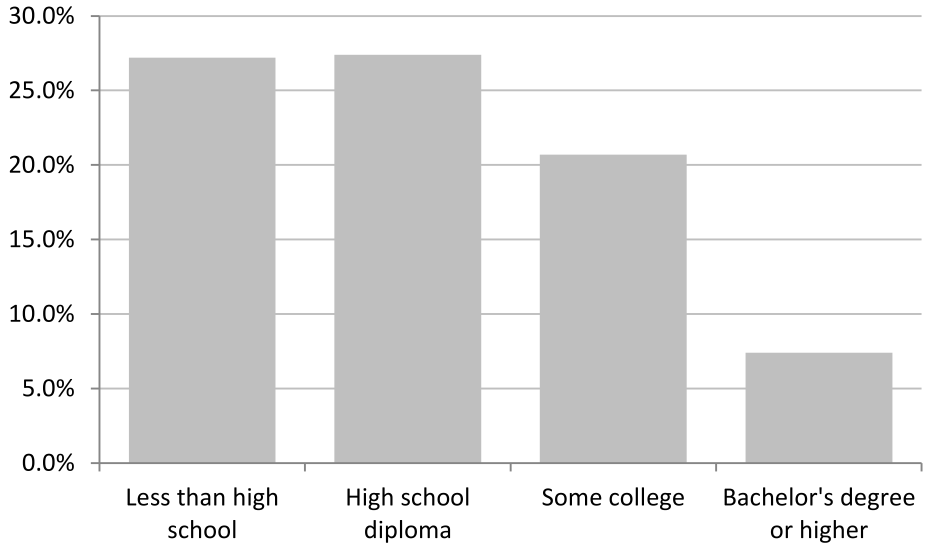
A6.1.1 Smoking

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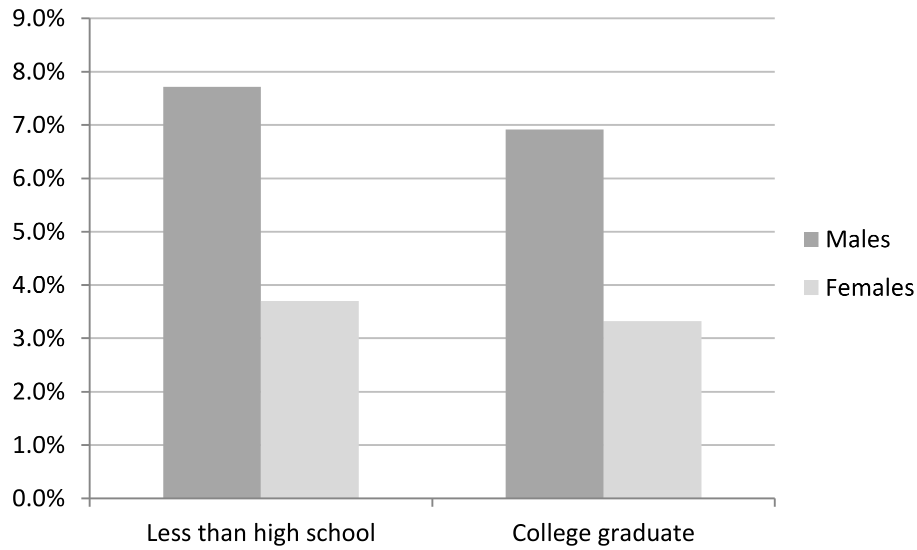
[44] Centers for Disease Control and Prevention, "Adults who are current smokers" in "Tobacco Use – 2011," Behavioral Risk Factor Surveillance System Prevalence and Trends Data, accessed August 2013, http://apps.nccd.cdc.gov/brfss/list.asp?cat=TU&yr=2011&qkey=8161&state=All.

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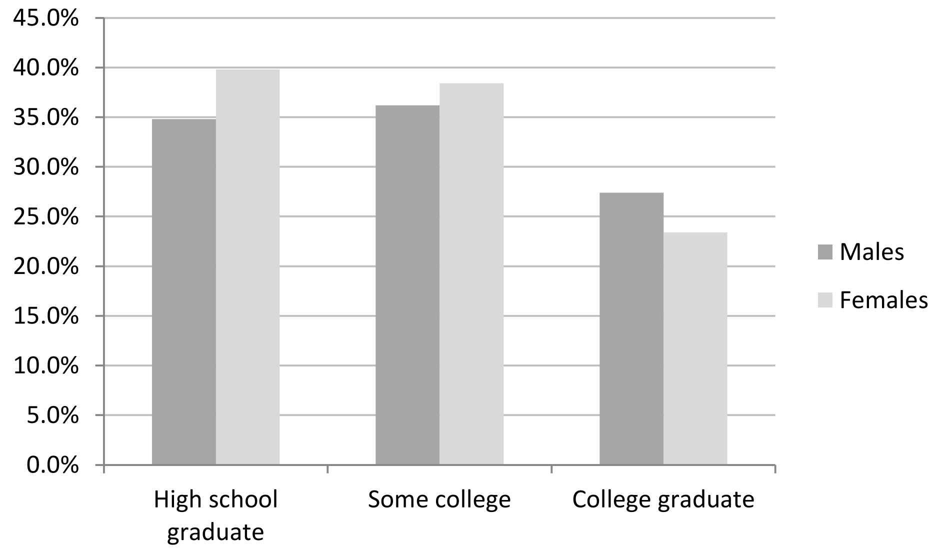
[46] Eric A. Finkelstein, Marco da Costa DiBonaventura, Somali M. Burgess, and Brent C. Hale, "The Costs of Obesity in the Workplace," *Journal of Occupational and Environmental Medicine* 52, no. 10 (October 2010): 971-976.

[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

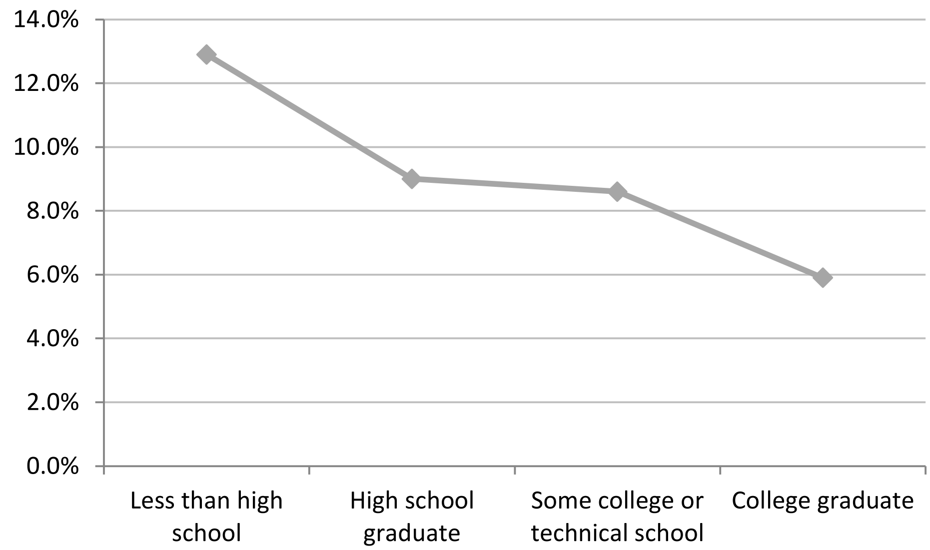


A6.1.4 Mental illness

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.

[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 SAMHSA, with costs to state government representing 48% of the total cost related to illegal drug use.[51]

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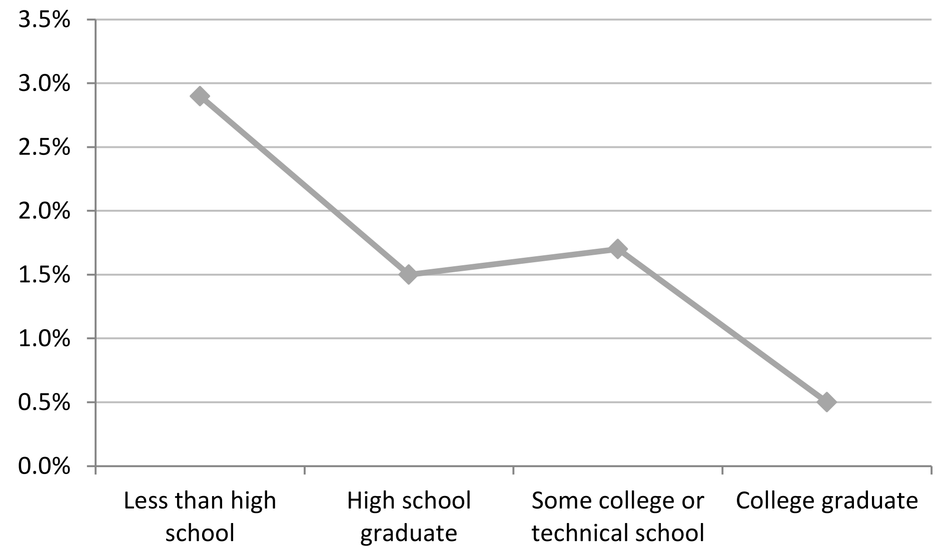
[50] Substance Abuse and Mental Health Services Administration, National Survey on Drug Use and Health, 2010 and 2011.

[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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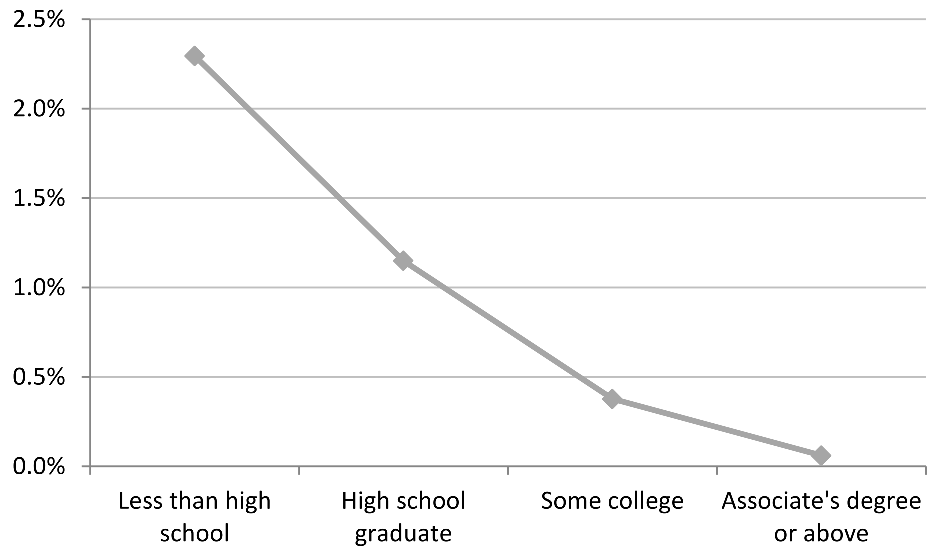
[52] Caroline Wolf Harlow. "Table 1. Educational attainment for State and Federal prison inmates, 1997 and 1991, local jail inmates, 1996 and 1989, probationers, 1995, and the general population, 1997" in "Education and Correctional Populations." Bureau of Justice Statistics Special Report, January 2003, 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.

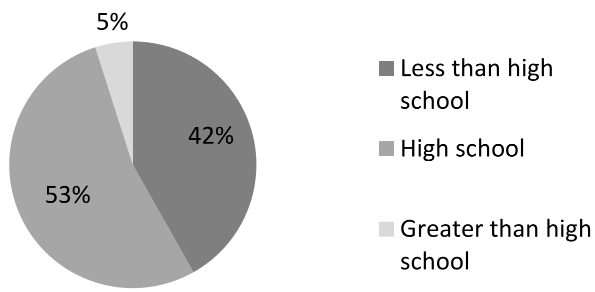
A6.3 Welfare and unemployment

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.

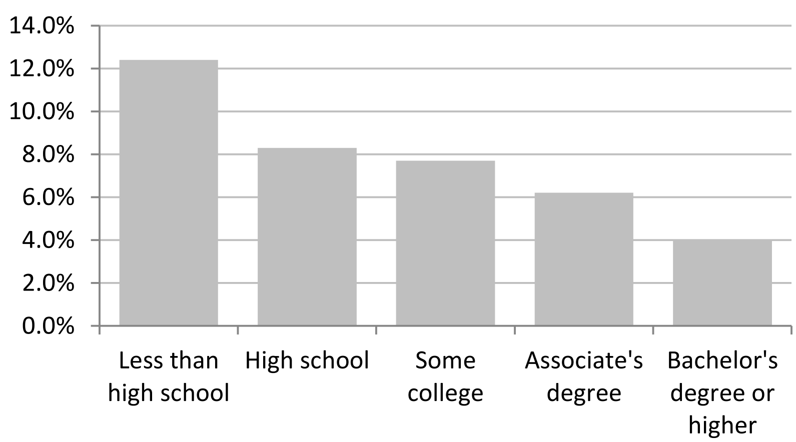
Figure A6.7 relates the breakdown of TANF recipients by education level, derived from data supplied by the U.S. Department of Health and Human Services.[54] As shown, the demographic characteristics of TANF recipients are weighted heavily towards the less than high school and high school categories,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



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[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, FY2009" 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.