Demonstrating the Economic Value of the Kansas Independent College Association

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Acknowledgments

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Preface

Since 2002, Economic Modeling Specialists International (EMSI) has helped address a widespread need in the U.S., Canada, the U.K., and Australia to demonstrate the impact of education. To date we have conducted more than 1,200 economic impact studies for educational institutions in the U.S. and internationally. Along the way we have worked to continuously update and improve the college impact model to ensure that it conforms to best practices and stays relevant in today's economy.

The present study reflects the latest version of our model, representing the most up-to-date theory and practices for conducting human capital economic impact analysis. Among the most vital departures from EMSI's previous college impact model is the conversion from traditional Leontief input-output multipliers to those generated by EMSI's multi-regional Social Accounting Matrix (SAM). Though Leontief multipliers are based on sound theory, they are less comprehensive and adaptable than SAM multipliers. Moving to the more robust SAM framework allows us to increase the level of sectoral detail in the model and remove any aggregation error that may have occurred under the previous framework. This change in methodology primarily affects the economic impact analysis provided in Chapter 2; however, the multi-regional capacity of the SAM also increases the accuracy with which we calculate the statewide multipliers applied in Chapter 3.

The new model also reflects significant changes to the calculation of the alternative education variable. This variable addresses the counterfactual scenario of what would have occurred if the institutions under analysis did not exist, leaving the students to obtain an education elsewhere. The previous model used a small-sample regression analysis to estimate the variable. The current model goes further and measures the distance between institutions and the associated differences in tuition prices, program offerings, and student preferences to determine the change in the students' demand for education. This methodology is a more robust approach than the regression analysis and significantly improves our estimate of alternative education opportunities.

These and other changes mark a considerable upgrade to the EMSI college impact model. With the SAM we have a detailed view of the economy, enabling us to more accurately determine economic impacts. Many of our former assumptions have been replaced with observed data. Further, we have researched the latest sources in order to update the background data with the most up-to-date data and information. Finally, we have revised and re-worked the documentation of our findings and methodology. Our hope is that these improvements will provide a better product to our clients – reports that are more transparent and streamlined, methodology that is more comprehensive and robust, and findings that are more relevant and meaningful to today's audiences. We encourage our readers to approach us directly with any questions or comments they may have about the study so that we can continue to improve our model and keep the public dialogue open about the positive impacts of education.

Introduction

The Kansas Independent College Association (KICA) supports the individual missions of its 18 independent, regionally-accredited, degree-granting member colleges and universities in the state of Kansas. Each of KICA's member institutions have an important impact on the students they serve, helping them achieve their individual potential and develop the skills they need in order to have a fulfilling and prosperous career. However, the impact of KICA's member institutions consists of more than influencing the lives of students. The institutions' program offerings supply employers with workers to make their businesses more productive. The expenditures of the institutions and the expenditures of their employees, students, and visitors support the state economy through the output and employment generated by state vendors. The benefits created by the institutions extend as far as the state treasury, in terms of the increased tax receipts and decreased public sector costs generated by students across the state.

A list of KICA's member colleges and universities appears in the table below, along with the year in which the institutions were founded, the degrees they offer, and their primary location. A number of institutions also offer services at other locations in Kansas and in other states.

KICA's Member Colleges and Universities

Institution	Founded	Degrees offered	Main location
Baker University	1858	Associate's, bachelor's, masters', doctorate	Baldwin City, KS
Benedictine College	1858	Bachelor's, masters	Atchison, KS
Bethany College	1881	Bachelor's	Lindsborg, KS
Bethel College	1887	Bachelor's	North Newton, KS
Central Christian College	1884	Associate's, bachelor's	McPherson, KS
Donnelly College	1949	Associate's, bachelor's	Kansas City, KS
Friends University	1898	Associate's, bachelor's, master's	Wichita, KS
Hesston College	1909	Associate's	Hesston, KS
Kansas Wesleyan University	1886	Bachelors, master's	Salina, KS
Manhattan Christian College	1927	Associates, bachelor's	Manhattan, KS
McPherson College	1887	Bachelor's	McPherson, KS
MidAmerica Nazarene University	1966	Associate's, bachelor's, master's	Olathe, KS
Newman University	1933	Associate's, bachelor's, master's	Wichita, KS
Ottawa University	1865	Bachelor's, master's	Ottawa, KS
Southwestern College	1885	Bachelor's, master's, doctorate	Winfield, KS
Sterling College	1887	Bachelor's	Sterling, KS
Tabor College	1908	Associate's, bachelor's, master's	Hillsboro, KS
University of Saint Mary	1923	Bachelor's, masters, doctorate	Leavenworth, KS

Objective of report

The purpose of this report is to assess the impact of KICA's member institutions on the state economy and the benefits generated by the institutions for students, for society, and for taxpayers.

The approach is twofold. We begin with an economic impact analysis of the institutions on the business community in Kansas. To derive results, we rely on a specialized Social Accounting Matrix (SAM) model to calculate the additional income created in the Kansas economy as a result of increased consumer spending and the added skills of students. Results of the economic impact analysis are broken out according to the following four effects: 1) impact of the institutions' day-to-day operations, 2) impact of student spending, 3) impact of visitor spending, and 4) impact of the skills acquired by former students who are still employed in the Kansas workforce.

The second component of the study measures the benefits generated by KICA's member institutions for the following groups: students, society, and taxpayers. For students, we perform a standard 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 college as opposed to working. In return for these investments, students receive a lifetime of higher incomes. For society, the study assesses how the students' higher incomes and improved quality of life translate to an enlarged economy and a reduced demand for social services across the state. Finally, the study measures the benefits to state and local taxpayers, in the form of increased tax revenues and public sector savings.

A wide array of data and assumptions are used in the study based on several sources, including the 2012-13 academic and financial reports from KICA's member institutions, industry and employment data from the U.S. Bureau of Labor Statistics and U.S. Census Bureau, outputs of EMSI's college impact model and SAM model, and a variety of published materials relating education to social behavior. The study aims to apply a conservative methodology and follows standard practice using only the most recognized indicators of investment effectiveness and economic impact.

Notes of importance

There are two notes of importance that readers should bear in mind when reviewing the findings presented in this report. First, this report is not intended to be a vehicle for comparing KICA's member institutions with other institutions in the state or elsewhere. Other studies comparing the gains in income and social benefits of one institution relative to another address such questions more directly and in greater detail. Our intent is simply to provide KICA with pertinent information should questions arise about the extent to which its member institutions impact the state economy and generate a return on investment to students. Differences between KICA's results and those of other institutions, however, do not necessarily indicate that one institution is doing a better job than another. Results are a reflection of location, student body profile, and other factors that have little or nothing to do with the relative efficiency of the institutions. For this reason, comparing results between institutions or using the data to rank institutions is strongly discouraged.

Second, this report is useful in establishing a benchmark for future analysis, but it is limited in its ability to put forward recommendations on what KICA can do next. The implied assumption is that KICA's member intitutions can effectively improve the results if they increase the number of students they serve, help students to achieve their educational goals, and remain responsive to employer needs in order to ensure that students find meaningful jobs after exiting. Establishing a strategic plan for achieving these goals, however, is not the purpose of this report.

Key findings

The results of this study show that KICA's member institutions have a positive impact on the state economy and generate benefits for students, society, and taxpayers. Key findings of the study are as follows:

Impact on state economy

- KICA's member institutions employed **2,680** full-time and **1,712** part-time employees in 2012-13. Payroll amounted to **$177.6 million**, much of which was spent in Kansas to purchase groceries, clothing, and other household goods and services. The institutions themselves buy goods and services and spent **$181.1 million** to support their operations in 2012-13. The net impact of the institutions' payroll and expenses in the Kansas economy was approximately **$223.9 million** in added income in FY 2012-13.

- A total of **2,356** out-of-state students lived in the state but off campus while attending the institutions. These students spent money at local businesses to buy food, rent accommodation, pay for transportation, attend sporting events, and so on. The expenses of out-of-state students added approximately **$15.6** million in income to the Kansas economy in FY 2012-13.

- Thousands of visitors came from outside the state to participate in various activities hosted by KICA's member institutions, including commencement, new student orientation, and sports events. The expenditures of the institutions' out-of-state visitors for accommodation, food, transportation, and other personal expenses added approximately **$12.2 million** in income to the state economy in FY 2012-13.

- Approximately **62%** of students who attend KICA's member institutions stay in Kansas after exiting college. Their enhanced skills and abilities bolster the output of state employers, leading to higher income and a more robust economy. The accumulated contribution of former students who were employed in the state workforce in FY 2012-13 amounted to **$720 million** in added income in the Kansas economy.

- The total effect of KICA's member institutions on the state economy in FY 2012-13 was **$971.6 million**, approximately equal to **0.8**% of Kansas' gross state product.

Benefits to students, society, and taxpayers

- Students paid a total of **$201.9 million** to cover the cost of tuition, fees, books, and supplies at KICA's member institutions in 2012-13. They also forwent **$294.4 million** in earnings that they would have generated had they been working instead of learning.
- In return for the monies invested in their education, students receive a present value of **$1.4 billion** in increased earnings over their working lives. This translates to a return of **$2.80** in higher future income for every $1 that students pay for their education at KICA's member institutions. The corresponding annual return on investment is **12.5%**.
- Society as a whole in the state of Kansas will receive a present value of **$2.3 billion** in added state income over the course of the students' working lives. Society will also benefit from **$496.5 million** in present value social savings related to reduced crime, lower welfare and unemployment, and increased health and well-being across the state.
- The present value of the added tax revenue stemming from the students' higher lifetime incomes and the increased output of businesses amounts to **$212.6 million** in benefits to taxpayers. Savings to the public sector add another **$84.1 million** in benefits due to a reduced demand for government-funded social services in Kansas.

Chapter 1: Profile of Institutions and the State Economy

Demonstrating the economic value of KICA and its member institutions requires three types of information: 1) employee and finance data, 2) student demographic and achievement data, and 3) the economic profile of the state. For the purpose of this study, data on employees, finances, and students were obtained from the institutions, and data on the state economy were drawn from EMSI's proprietary data modeling tools.

1.1 Employee and finance data

1.1.1 Employee data

Data provided by KICA's member institutions include information on faculty and staff by place of work and by place of residence. These data appear in Table 1.1. As shown, KICA employed 2,680 full-time and 1,712 part-time faculty and staff in FY 2012-13. Of these, 94% worked in the state and 89% lived in the state. These data are used to isolate the portion of the employees' payroll and household expenses that remains in the state economy.

Table 1.1: Employee data, FY 2012-13

Full-time faculty and staff	2,680
Part-time faculty and staff	1,712
Total faculty and staff	**4,392**
% of employees that work in state	94%
% of employees that live in state	89%

Source: Data supplied by KICA's member institutions.

1.1.2 Revenues

Table 1.2 shows the institutions' annual revenues by funding source – a total of $361.3 million in FY 2012-13. As indicated, tuition and fees comprised 51% of total revenue, and student aid from government sources comprised another 9%. All other revenue (*i.e.*, auxiliary revenue, sales and services, interest, and donations) comprised the remaining 40%.

Table 1.2: Revenue by source, FY 2012-13

Funding source	Total	% of total
Tuition and fees	$183,169,175	51%
Student aid from government sources		
Local government	$580,111	0%
State government	$7,465,630	2%
Federal government	$24,382,887	7%
All other revenue	$145,743,774	40%
Total revenues	**$361,341,577**	**100%**

Source: Data supplied by KICA's member institutions.

1.1.3 Expenditures

The combined payroll at KICA's member institutions amounted to $177.6 million, equal to 50% of the institutions' total expenses for FY 2012-13. Other expenditures, including capital and purchases of supplies and services, made up $181.1 million. These budget data appear in Table 1.3.

Table 1.3: Expenses by function, FY 2012-13

Expense item	Total	%
Employee payroll	$177,579,571	50%
Capital depreciation	$45,123,390	13%
All other expenditures	$136,012,911	38%
Total expenses	**$358,715,872**	**100%**

Source: Data supplied by KICA's member institutions.

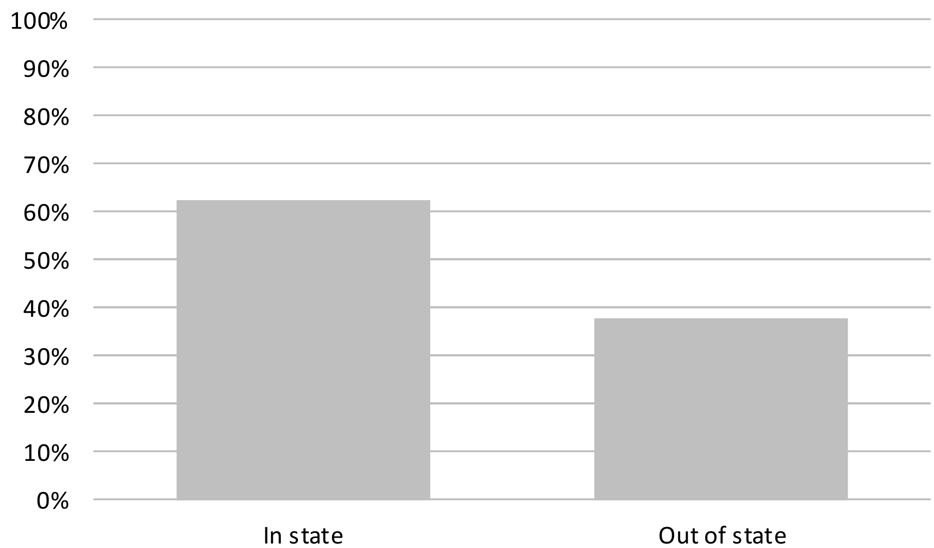
1.2. Student profile data

1.2.1 Demographics

KICA's member institutions served 29,369 credit students and 61 non-credit students in the 2012-13 reporting year (unduplicated). The breakdown of the student body by gender was 44% male and 57% female, and the breakdown by ethnicity was 71% whites and 29% minorities. The students' overall average age was 27.

Figure 1.1 presents the settlement patterns of students after exiting the institutions. Although KICA's member institutions predominantly serve students from Kansas, more than a third of students come from other states, especially Missouri, where institutions located near the state border have a significant presence. Other institutions offer long-distance services to students in other states and in other countries, including dual credit programs and online programs. Although it is difficult to track exactly where the institutions' out-of-state students settle after exiting, it is assumed that the majority of them settle in the states where they came from. As shown in Figure 1.1, an estimated 62% of students remain in Kansas, and the remaining 38% settle outside the state.

Figure 1.1: Student settlement patterns



1.2.2 Achievements

Table 1.4 summarizes the breakdown of the student population and their corresponding achievements by education level. As shown, KICA's member institutions served 20 PhD graduates, 1,446 master's degree graduates, 3,582 bachelor's degree graduates, 429 associate's degree graduates, and 105 certificate graduates in the 2012-13 reporting year. Another 20,228 credit-bearing students pursued but did not complete a credential during the reporting year. Nine of the institutions also offered dual credit courses to high schools, serving a total of 2,181 students over the course of the year. The institutions also served 45 personal enrichment students enrolled in non-credit courses. Students not allocated to the other categories – including non-degree seeking workforce students – comprised the remaining 1,394 students.

Achievements are measured in terms of credit hour equivalents (CHEs), which are equal in value to one credit (or 15 contact hours) of classroom instruction. The educational level and CHE production of students are key to determining how far students advance in their education during the course of the year and the associated value of that achievement. Altogether, students at KICA's member institutions completed 489,162 CHEs in FY 2012-13. In the analysis, we exclude the CHE production of personal enrichment students under the assumption that they do not attain skills that will increase their earnings. The average number of CHEs per student (excluding personal enrichment students) was 16.6.

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

Category	Headcount	Total CHEs	Average CHEs
PhD graduates	20	247	12.4
Master's degree graduates	1,446	12,467	8.6
Bachelor's degree graduates	3,582	68,442	19.1
Associate's degree graduates	429	7,925	18.5
Certificate graduates	105	1,832	17.4
Continuing students	20,228	371,017	18.3
Dual credit students	2,181	14,398	6.6
Personal enrichment students	45	49	1.1
Workforce and all other students	1,394	12,786	9.2
Total, all students	**29,430**	**489,162**	**16.6**
Total, less personal enrichment students	**29,385**	**489,113**	**16.6**

Source: Data supplied by KICA's member institutions.

1.3 Economic profile data

1.3.1 Gross state product

Table 1.5 summarizes the breakdown of the Kansas economy by major industrial sector, with details on labor and non-labor income. Labor income refers to wages, salaries, and proprietors' income; non-labor income refers to profits, rents, and other forms of investment income. Together, labor and non-labor income comprise the state's total gross state product, or GSP.

As shown in Table 1.5, Kansas' GSP is approximately $129.5 billion, equal to the sum of labor income ($80.8 billion) and non-labor income ($48.7 billion). In Chapter 2, we use GSP as the backdrop against which we measure the relative impacts of the institutions on the state economy.

Table 1.5: Labor and non-labor income by major industry sector in Kansas, 2013

Industry sector	Labor income (millions)	Non-labor income (millions)	Total income (millions)	% of Total
Agriculture, Forestry, Fishing and Hunting	$2,162	$1,063	$3,225	2.5%
Mining	$1,995	$2,558	$4,552	3.5%
Utilities	$882	$2,543	$3,424	2.6%
Construction	$3,882	$275	$4,157	3.2%
Manufacturing	$10,803	$6,869	$17,672	13.7%
Wholesale Trade	$4,442	$3,429	$7,871	6.1%
Retail Trade	$4,702	$2,854	$7,556	5.8%
Transportation and Warehousing	$2,836	$1,041	$3,877	3.0%
Information	$2,355	$4,208	$6,563	5.1%
Finance and Insurance	$5,707	$4,266	$9,972	7.7%
Real Estate and Rental and Leasing	$1,601	$4,451	$6,052	4.7%
Professional and Technical Services	$5,505	$1,372	$6,877	5.3%
Management of Companies and Enterprises	$1,518	$265	$1,783	1.4%
Administrative and Waste Services	$3,545	$635	$4,180	3.2%
Educational Services	$772	$98	$870	0.7%
Health Care and Social Assistance	$8,759	$728	$9,486	7.3%
Arts, Entertainment, and Recreation	$433	$216	$649	0.5%
Accommodation and Food Services	$1,878	$1,034	$2,912	2.2%
Other Services (except Public Administration)	$1,999	$256	$2,255	1.7%
Public Administration	$15,015	$2,789	$17,804	13.8%
Other Non-industries	$0	$7,721	$7,721	6.0%
Total	**$80,790**	**$48,669**	**$129,459**	**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.

1.3.2 Jobs by industry

Table 1.6 provides the breakdown of jobs by industry in Kansas. Among the state's non-government industry sectors, the "Health Care and Social Assistance" sector is the largest employer, supporting 192,133 jobs or 10.5% of total employment in the state. The second largest employer is the "Retail Trade" sector, supporting 179,990 jobs or 9.8% of the state's total employment. Altogether, the state supports 1.8 million jobs.[1]

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[1] 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 Kansas, 2013

Industry sector	Total jobs	% of Total
Agriculture, Forestry, Fishing and Hunting	72,958	4.0%
Mining	34,252	1.9%
Utilities	8,149	0.4%
Construction	85,668	4.7%
Manufacturing	169,089	9.2%
Wholesale Trade	64,636	3.5%
Retail Trade	179,990	9.8%
Transportation and Warehousing	58,377	3.2%
Information	32,320	1.8%
Finance and Insurance	102,993	5.6%
Real Estate and Rental and Leasing	61,497	3.4%
Professional and Technical Services	95,937	5.2%
Management of Companies and Enterprises	15,122	0.8%
Administrative and Waste Services	100,012	5.5%
Educational Services	27,820	1.5%
Health Care and Social Assistance	192,133	10.5%
Arts, Entertainment, and Recreation	30,476	1.7%
Accommodation and Food Services	113,288	6.2%
Other Services (except Public Administration)	91,581	5.0%
Public Administration	292,275	16.0%
Total	**1,828,572**	**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.

1.3.3 Earnings by education level

Table 1.7 and Figure 1.2 present the mean income by education level in Kansas at the midpoint of the average-aged worker's career. These numbers are derived from EMSI's complete employment data on average income per worker in the state.[2] As shown, students who achieve an associate's degree can expect $37,100 in income per year, approximately $8,900 more than someone with a high school diploma. The difference between a high school diploma and the attainment of a bachelor's degree is even greater – up to $21,000 in higher income.

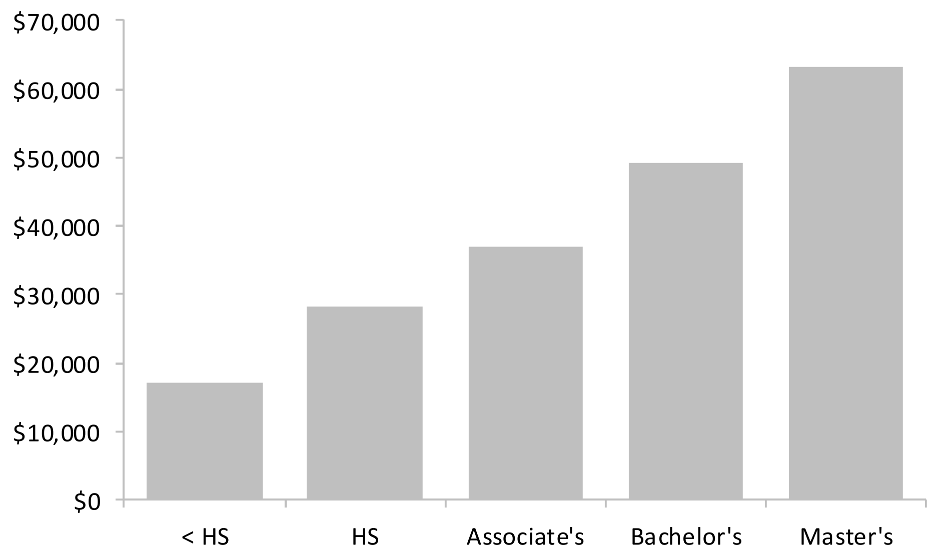
[2] Wage rates in the EMSI SAM model combine state and federal sources to provide earnings that reflect complete employment in the state, including proprietors, self-employed workers, and others not typically included in state data, as well as benefits and all forms of employer contributions. As such,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

Table 1.7: Expected income in Kansas at the midpoint of individual's working career by education level

Education level	Income	Difference
Less than high school	$17,100	n/a
High school or equivalent	$28,200	$11,100
Associate's degree	$37,100	$8,900
Bachelor's degree	$49,200	$12,100
Master's degree	$63,200	$14,000
Doctoral degree	$79,100	$15,900

Source: EMSI complete employment data.

Figure 1.2: Expected income by education level at career midpoint



1.4 Conclusion

This chapter presents the broader elements of the database used to determine the results of the study. Additional detail on data sources, assumptions, and general methods underlying the analyses are conveyed in the remaining chapters and appendices. The core of the findings is presented in the next two chapters – Chapter 2 considers the impact of KICA's member institutions on the state economy, and Chapter 3 looks at the benefits generated by the institutions for students, taxpayers, and society as a whole. The appendices detail a collection of miscellaneous theory and data issues.

Chapter 2: Impact on State Economy

KICA's member institutions impact the Kansas economy in a variety of ways. The institutions are employers and buyers of goods and services. They attract monies that would not have otherwise entered the state economy through their own revenue streams and through the expenditures of their out-of-state students and visitors. Further, they provide students with the skills they need to become productive citizens and contribute to the state's overall output.

In this chapter we track the economic impact of KICA's member institutions under four headings: 1) the operations effect, stemming from the institutions' payroll and purchases; 2) the student spending effect, due to the spending of out-of-state students for room and board and other personal expenses, 3) the visitor spending effect, due to the spending of out-of-state visitors, and 4) the student productivity effect, comprising the added income created in the state as former students expand the economy's stock of human capital.

2.1 Operations effect

Approximately 89% of the people working at KICA's member institutions live in Kansas (see Table 1.1). Faculty and staff payroll counts as part of the state's overall income, and the spending of employees for groceries, apparel, and other household expenditures helps support state businesses. The institutions themselves purchase supplies and services, and many of their vendors are located in Kansas. These expenditures create a ripple effect that generates still more jobs and income throughout the economy.

Table 2.1 presents the economic impact of the institutions' operations. The top row shows the overall labor and non-labor income in the state, which we use as the backdrop for gauging the relative role of the institutions in the Kansas economy (see Table 1.5). As for the impacts themselves, we follow best practice and draw the distinction between initial effects and multiplier effects. The initial effect of the institutions' operations is simple – it amounts to the $166.1 million in payroll (including employee benefits, less monies paid to employees who work at locations outside the state). Total payroll appeared in the list of expenditures reported in Table 1.3. Note that, as non-profit entities, KICA's member institutions do not generate property income in the traditional sense, so non-labor income is not associated with the impact of the institutions' operations under the initial effect.

Table 2.1: Operations effect

	Labor income (thousands)	Non-labor income (thousands)	Total income (thousands)	% of total income in state
Total income in state	$80,789,796	$48,669,480	$129,459,276	100.0%
Initial effect	**$166,056**	**$0**	**$166,056**	**0.1%**
Multiplier effect				
Direct effect	$29,163	$22,515	$51,678	<0.1%
Indirect effect	$6,048	$3,418	$9,466	<0.1%
Induced effect	$47,369	$40,782	$88,151	<0.1%
Total multiplier effect	**$82,581**	**$66,714**	**$149,295**	**0.1%**
Gross effect (initial + multiplier)	**$248,637**	**$66,714**	**$315,351**	**0.2%**
Less alternative uses of funds	-$49,423	-$42,048	-$91,471	<0.1%
Net effect	**$199,214**	**$24,666**	**$223,880**	**0.2%**

Source: EMSI SAM model.

Multiplier effects refer to the additional income created in the economy as the institutions and their employees spend money in the state. They are categorized according to the following three effects: the direct effect, the indirect effect, and the induced effect. Direct effects refer to the income created by the industries initially affected by the spending of the institutions and their employees. Indirect effects occur as the supply chain of the initial industries creates even more income in the state. Finally, induced effects refer to the income created by the increased spending of the household sector as a result of the direct and indirect effects.

Calculating multiplier effects requires a specialized Social Accounting Matrix (SAM) model that captures the interconnection of industries, government, and households in the state. The EMSI SAM model contains approximately 1,100 industry sectors at the highest level of detail available in the North American Industry Classification System (NAICS), and it supplies the industry-specific multipliers required to determine the impacts associated with economic activity within the state. For more information on the EMSI SAM model and its data sources, see Appendix 3.

Table 1.3 in Chapter 1 divides the institutions' expenditures into the following three categories: payroll, capital depreciation, and all other expenditures (including purchases for supplies and services). The first step in estimating the multiplier effect of these expenditures is to map them individually to the approximately 1,100 industry sectors of the EMSI SAM model. Assuming that the spending patterns of the institutions' personnel approximately match those of the average consumer, we map payroll to spending on industry outputs using national household expenditure coefficients supplied by EMSI's national SAM. For the other two expenditure categories (*i.e.*, capital depreciation and all other expenditures), we again assume that the institutions' spending patterns approximately match national averages and apply the national spending coefficients for NAICS 611310 (Colleges, Universities, and Professional Schools). Capital depreciation is mapped to the construction sectors of NAICS 611310 and the institutions' remaining expenditures to the non-construction sectors of NAICS 611310.

We now have three vectors detailing the spending of KICA's member institutions: one for payroll, another for capital items, and a third for the institutions' purchases of supplies and services. Before entering these items into the SAM model, we factor out the portion of them that occurs in the state. Each of the approximately 1,100 sectors in the SAM model is represented by a regional purchase coefficient (RPC), a measure of the overall demand for the commodities produced by each sector that is satisfied by state suppliers. For example, if 40% of the demand for NAICS 541211 (Offices of Certified Public Accountants) is satisfied by state suppliers, the RPC for that sector is 40%. The remaining 60% of the demand for NAICS 541211 is provided by suppliers located outside the state. The three spending vectors of the institutions are thus multiplied sector-by-sector by the corresponding RPC for each sector to arrive at the strictly in-state spending associated with the institutions.

In-state spending is entered into the SAM model's multiplier matrix, which in turn provides an estimate of the associated multiplier effects on state sales. We convert the sales figures to income using income-to-sales ratios, also provided by the SAM model. Final results appear in the section labeled "Multiplier effect" in Table 2.1. Altogether, the spending of KICA's member institutions creates $82.6 million in labor income and another $66.7 million in non-labor income through multiplier effects – a total of $149.3 million. This together with the $166.1 million in initial effects generates a gross total of $315.4 million in impacts associated with the spending of the institutions and their employees in the state.

Here we make a significant qualification. KICA's member institutions received an estimated 65.5% of their funding from sources within Kansas. These monies came from the tuition and fees paid by resident students, from the auxiliary revenue and donations from private sources located within the state, and from the financial aid issued to students by state and local government. Had other industries received these monies rather than the institutions, income effects would have still been created in the economy. This scenario is commonly known as a counterfactual outcome, *i.e.*, what has not happened but what would have happened if a given event – in this case, the expenditure of in-state funds on KICA's member institutions – had not occurred. 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 calculate counterfactual outcomes by modeling the in-state monies spent on the institutions as regular spending on consumer goods and savings. Our assumption is that, had students not spent money on the institutions, they would have used that money instead to buy consumer goods. Similarly, had the financial aid issued to students been returned to state and local taxpayers in the form of a tax decrease, we assume that they too would have spent that money on consumer goods. Our approach, therefore, is to establish the total amount spent by in-state students and taxpayers on KICA's member institutions, map this to the detailed sectors of the SAM model using national household expenditure coefficients, and scale the spending vector to reflect the change in in-state spending only. Finally, we run the in-state spending through the SAM model's multiplier matrix to derive initial and multiplier effects, and then we convert the sales figures to income. The income effects of this new consumer spending are shown as negative values in the row labeled "Less alternative uses of funds" in Table 2.1.

The net total income effect of the institutions' spending can now be computed. As shown in the last row of Table 2.1, the net effect is approximately $199.2 million in labor income and $24.7 million in non-labor income. The overall total is $223.9 million, representing the added income created in the state economy as a result of the operations of KICA's member institutions.

2.2 Student spending effect

An estimated 2,356 out-of-state students lived in the state but off campus while attending the institutions in FY 2012-13. These students spent money at state businesses to purchase groceries, rent accommodation, pay for transportation, and so on. The off-campus expenditures of out-of-state students supported jobs and created new income in the state economy.[3]

The average off-campus costs of out-of-state students appear in the first section of Table 2.2, equal to $11,486 per student. Note that this figure excludes expenses for books and supplies, since many of these monies are already reflected in the operations effect discussed in the previous section. Multiplying the $11,486 in annual costs by the number of students who lived in the state but off-campus while attending (2,356 students) generates gross sales of $27.1 million. This figure net of the monies paid to student workers yields net off-campus sales of $26.7 million, as shown in the bottom row of the table.

Table 2.2: Average student costs and total sales generated by out-of-state students in Kansas, 2012-13

Room and board	$6,446
Personal expenses	$2,719
Transportation	$2,321
Total expenses per student (A)	**$11,486**
Number of students who lived in the state but off campus (B)	2,356
Gross sales (A * B)	$27,064,801
Wages and salaries paid to student workers*	$376,601
Net off-campus sales	**$26,688,200**

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

Source: Student costs supplied by KICA's member institutions. The number of students who lived in the state but off-campus while attending is derived from the student origin data and in-term residence data also supplied by the institutions.

Estimating the impacts generated by the $26.7 million in student spending follows a procedure similar to that of the operations effect described above. We begin by mapping the $26.7 million in

[3] Online students and students who commuted to Kansas from outside the state are not considered in this calculation because their living expenses predominantly occurred in the state where they resided during the analysis year. Out-of-state students who lived on campus while attending are also excluded because most of their living expenses are already captured in the effect of the institutions' operations.

sales to the industry sectors of the SAM model, applying RPCs to reflect in-state spending only, and running the net sales figures through the SAM model to derive multiplier effects. Finally, we convert the results to income through the application of income-to-sales ratios.

Table 2.3 presents the results. The initial effect is $0 because the impact of out-of-state students only occurs when they spend part of their income to make a purchase. Otherwise, the students' income has no impact on the state economy. The impact of out-of-state student spending thus falls entirely under the multiplier effect, equal to a total of $15.6 million in added income. This value represents the direct added income created at the businesses patronized by the students, the indirect added income created by the supply chain of those businesses, and the increased spending of the household sector throughout the state economy as a result of the direct and indirect effects.

Table 2.3: Student spending effect

	Labor income (thousands)	Non-labor income (thousands)	Total income (thousands)	% of total income in state
Total income in state	$80,789,796	$48,669,480	$129,459,276	100.0%
Initial effect	**$0**	**$0**	**$0**	**<0.1%**
Multiplier effect				
Direct effect	$5,119	$4,072	$9,191	<0.1%
Indirect effect	$928	$674	$1,603	<0.1%
Induced effect	$2,588	$2,203	$4,792	<0.1%
Total multiplier effect	**$8,636**	**$6,949**	**$15,585**	**<0.1%**
Total effect (initial + multiplier)	**$8,636**	**$6,949**	**$15,585**	**<0.1%**

Source: EMSI SAM model.

2.3 Visitor spending effect

In addition to out-of-state students, thousands of visitors also came to the institutions to participate in various activities, including commencement, new student orientation, and sports events. Based on information provided by the institutions, approximately 231,500 visitors attended events hosted by the institutions in FY 2012-13. Of these visitors, an estimated 38% were from outside the state.

Table 2.4 presents the average expenditures per visitor for accommodation, food, transportation, and other personal expenses (including shopping and entertainment). Based on these figures, the total sales generated by the spending of the institutions' out-of-state visitors in FY 2012-13 was $21 million, net of monies paid by out-of-state visitors to the institutions for non-textbook items (*e.g.*, event tickets, gifts and souvenirs, and food).

Table 2.4: Average expenditures per visitor

Accommodation	$31
Food	$57
Entertainment and shopping	$104
Transportation	$43
Total expenses per visitor (A)	**$236**
Number of out-of-state visitors (B)	89,102
Gross sales (A * B)	$21,006,942
On-campus sales (excluding textbooks)	$49,777
Net off-campus sales	**$20,957,166**

* Expenditure data reflect the average expenditures for all visitors, including day-trips and overnight stays.

Source: Number of out-of-state visitors and amount of on-campus sales based on data supplied by the institutions. Visitor expenditures supplied by IHS Consulting, "Kansas Tourism 2011," accessed March 27, 2013, http://www.travelks.com/includes/content/docs/media/2011-Kansas-TSA-Results-with-Regional-Analysis.pdf.

Calculating the increase in state income as a result of visitor spending again requires use of the SAM model. The analysis begins by discounting the off-campus sales generated by out-of-state visitors to account for leakage in the trade sector, and then bridging the net figures to the detailed sectors of the SAM model. The model runs the net sales figures through the multiplier matrix to arrive at the multiplier effects and finally converts the results to income. The net impact of visitor spending on state income thus comes to $12.2 million in FY 2012-13, as show in Table 2.5. Note that, as with the student spending effect, the initial effect of visitor spending is $0 because the money that visitors bring to the state has no impact until it is actually spent.

Table 2.5: Visitor spending effect

	Labor income (thousands)	Non-labor income (thousands)	Total income (thousands)	% of total income in state
Total income in state	$80,789,796	$48,669,480	$129,459,276	100.0%
Initial effect	**$0**	**$0**	**$0**	**<0.1%**
Multiplier effect				
Direct effect	$4,450	$2,576	$7,026	<0.1%
Indirect effect	$808	$484	$1,292	<0.1%
Induced effect	$2,445	$1,415	$3,860	<0.1%
Total multiplier effect	**$7,703**	**$4,476**	**$12,178**	**<0.1%**
Total effect (initial + multiplier)	**$7,703**	**$4,476**	**$12,178**	**<0.1%**

Source: EMSI SAM model.

2.4 Student productivity effect

The greatest economic impact of KICA's member institutions stems from the education and skills training that they provide. Since they were established, the institutions have educated students who have subsequently entered or re-entered the state workforce. As the skills of these students accumulated, they expanded the stock of human capital in the workforce, boosted the competitiveness of the state's industries, and enlarged the state's overall output. The sum of all these several and varied effects, measured in terms of added state income, constitutes the total impact of current and past student productivity on the Kansas economy.

The student productivity effect differs from the other effects presented in this chapter in one fundamental way. Whereas the operations effects, student spending effect, and visitor spending effect depend on an annually-renewed injection of new sales in the state economy, the student productivity effect is the result of years of past instruction and the associated accumulation of workforce skills. Should KICA's member institutions cease to exist, the operations effect and the effect of student and visitor spending would also immediately cease to exist; however, the impact of the institutions' former students would continue, as long as those students remained active in the workforce. Over time, though, students would leave the workforce, and the expanded economic output that they provided through their increased productivity would leave with them.

The initial effect of student productivity comprises two main components. The first and largest of these is the added labor income (*i.e.*, higher wages) of the institutions' former students. Higher wages occur as the increased productivity of workers leads to greater business output. The reward to increased productivity does not stop there, however. Skilled workers make capital goods (*e.g.*, buildings, production facilities, equipment, *etc.*) more productive too, thereby increasing the return on capital in the form of higher profits. The second component of the initial effect thus comprises the added non-labor income (*i.e.*, higher profits) of the businesses that employ former students of KICA's member institutions.

The first step in estimating the initial effect of student productivity is to determine the added labor income stemming from the students' higher wages. We begin by assembling the record of the institutions' historical student headcount over the past 30 years,[4] from 1983-84 to 2012-13. From this vector of historical enrollments we remove the number of students who were not active in the state workforce in FY 2012-13, whether because they were still enrolled in education, or because they were unemployed, employed but working in a different state, or out of the workforce completely due to retirement or death. We estimate the historical employment patterns of students in the state using the following sets of data or assumptions: 1) a set of settling-in factors to determine how long it takes the average student to settle into a career;[5] 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

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[4] We apply a 30-year time horizon because the data on students who attended KICA's member institutions prior to 1983-84 is less reliable, and because most of the students whom the institutions served more than 30 years ago had left the state workforce by 2012-13.

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

Bureau. The end result of these several computations is an estimate of the portion of students who were still actively employed in the state as of FY 2012-13.

The next step is to transition from the number of students who were still employed in the state to the number of skills they acquired from the institutions. The students' production of credit hour equivalents (CHEs) serves as a reasonable proxy for accumulated skills. Table 1.4 in Chapter 1 provides the average number of CHEs completed per student in 2012-13, equal to 16.6 CHEs. Using this figure as proxy for previous years, we multiply the 16.6 average CHEs per student by the number of students still active in the workforce to derive an estimate of the number of CHEs that were present in the workforce during the analysis year.[6] The result – 6.7 million CHEs – appears in the top row of Table 2.6.

Table 2.6: Number of CHEs in workforce and initial labor income created in state

Number of CHEs in workforce	6,741,935
Average value per CHE	$164
Initial labor income, gross	**$1,108,582,810**
Percent reduction for alternative education opportunities	38%
Percent reduction for adjustment for substitution effects	50%
Initial labor income, net	**$342,839,224**

Source: EMSI college impact model.

The next row in Table 2.6 shows the average value per CHE, equal to $164. This value represents the average increase in wages that former students of KICA's member institutions received during the analysis year for every CHE they completed. The value per CHE varies depending on the students' age, with the highest value applied to the CHE production of students who had been employed the longest by FY 2012-13, and the lowest value per CHE applied to students who were just entering the workforce. More information on the theory and calculations behind the value per CHE appears in Appendix 4. In determining the amount of added labor income attributable to former students, we multiply the CHE production of former students in each year of the historical time horizon times the corresponding average value per CHE for that year, then sum the products together. This calculation yield approximately $1.1 billion in gross labor income in increased wages received by former students in FY 2012-13 (as shown in Table 2.6).

The next two rows in the table show two adjustments used to account for counterfactual outcomes. As discussed above, counterfactual outcomes in economic analysis represent what would have happened if a given event had not occurred. The event in this case is the education and training provided by KICA's member institutions and subsequent influx of skilled labor into the state economy. The first counterfactual scenario that we address is the adjustment for alternative

[6] Students who enroll at the institutions more than one year were counted at least twice – if not more – in the historical enrollment data. However, CHEs remain distinct regardless of when and by whom they were earned, so there is no duplication in the CHE counts.

education opportunities. Our assumption is that, if a portion of the students could have received comparable training even if KICA's member institutions did not exist, the higher wages that accrue to those students cannot be counted as added labor income in the state. The adjustment for alternative education opportunities amounts to an 38% reduction of the $1.1 billion in added labor income, meaning that 38% of the added labor income would have been generated in the state anyway, even if the institutions did not exist. For more information on the calculation of the alternative education variable, see Appendix 5.

The other adjustment in Table 2.6 accounts for the substitution of workers. Suppose KICA's member institutions did not exist and in consequence there were fewer skilled workers in the state. Businesses could still satisfy some of their need for skilled labor by recruiting from outside Kansas. We refer to this phenomenon as the out-of-state worker substitution effect. Lacking exact information on its possible magnitude, we set the value of out-of-state worker substitution at 50%. In other words, of the jobs that students fill at state businesses, we assume 50% of them could have been filled by workers recruited from outside the state if the institutions did not exist.[7] With the 50% adjustment, the net labor income added to the economy comes to $342.8 million, as shown in Table 2.6.

The $342.8 million in added labor income appears under the initial effect in the "Labor income" column of Table 2.7. To this we add an estimate for initial non-labor income. As discussed earlier in this section, businesses that employ former students of KICA's member institutions 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 ($342.8 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 state to the detailed occupations for which those completers have been trained, and then maps the detailed occupations to the six-digit industry sectors in the SAM model.[8] Using a crosswalk created by National Center for Education Statistics (NCES) and the Bureau of Labor Statistics (BLS), we map the breakdown of the state's completers to the approximately 700 detailed occupations in the Standard Occupational Classification (SOC) system. Finally, we apply a matrix of wages by industry and by occupation from the SAM model to map the occupational distribution of the $342.8 million in initial labor income effects to the detailed industry sectors in the SAM model.[9]

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[7] For a sensitivity analysis of the substitution variable, see Chapter 4.

[8] 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).

[9] 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.

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 $82.3 million in non-labor income attributable to the institutions' former students. Summing initial labor and non-labor income together provides the total initial effect of student productivity in the Kansas economy, equal to approximately $425.1 million.

Table 2.7: Student productivity effect

	Labor income (thousands)	Non-labor income (thousands)	Total income (thousands)	% of total income in state
Total income in state	$80,789,796	$48,669,480	$129,459,276	100.0%
Initial effect	**$342,839**	**$82,277**	**$425,116**	**0.3%**
Multiplier effect				
Direct effect	$41,477	$12,255	$53,733	<0.1%
Indirect effect	$8,966	$2,640	$11,606	<0.1%
Induced effect	$189,443	$40,096	$229,539	0.2%
Total multiplier effect	**$239,886**	**$54,991**	**$294,878**	**0.2%**
Total effect (initial + multiplier)	**$582,725**	**$137,269**	**$719,994**	**0.6%**

Source: EMSI SAM model.

The next few rows of Table 2.7 show the multiplier effects of student productivity. Multiplier effects occur as students generate an increased demand for consumer goods and services through the expenditure of their higher wages. Further, as the industries where students of KICA's member institutions 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 institutions' former students.

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 to determine the corresponding increases in industry output that occur in the state. Finally, we convert all increases in sales back to income using the income-to-sales ratios supplied by the SAM model. The final results are $239.9 million in labor income and $55 million in non-labor income, for an overall total of $294.9 million in multiplier effects. The grand total impact of student productivity thus comes to $720 million, the sum of all initial and multiplier labor and non-labor income effects. The total figures appear in the last row of Table 2.7.

2.5 Summary of income effects

Table 2.8 displays the grand total impact of KICA's member institutions on the Kansas economy in 2012-13, including the operations effect, the student spending effect, the visitor spending effect, and the student productivity effect.

Table 2.8: Total effect, 2012-13

	Total (thousands)	% of Total
Total income in state	$129,459,276	100.0%
Operations effect	$223,880	0.2%
Student spending effect	$15,585	<0.1%
Visitor spending effect	$12,178	<0.1%
Student productivity effect	$719,994	0.6%
Total	**$971,638**	**0.8%**

Source: EMSI SAM model.

These results demonstrate several important points. First, KICA's member institutions create economic impacts through their own operations spending, the spending of their out-of-state students and visitors, and through the increase in productivity as former students remain active in the state workforce. Second, the student productivity effect is by far the largest and most important impact of the institutions, stemming from the higher incomes of students and their employers. And third, income in the state of Kansas would be substantially lower without the institutions.

Calculating Job Equivalents Based on Income

In this study the impacts of KICA's member institutions on the state economy are expressed in terms of income, specifically, the added income that would not have occurred in the state if the institutions did not exist. Added income means that there is more money to spend, and increased spending means an increased demand for goods and services. Businesses hire more people to meet this demand, and thus jobs are created.

Not every job is the same, however. Some jobs pay more, others less. Some are full-time, others are part-time. Some jobs are year-round, others are temporary. Deciding what constitutes an actual job, therefore, is difficult to do. To address this problem, this study counts all jobs equally and reports them in terms of job equivalents, i.e., the number of average-wage jobs in the state that a given amount of income could potentially support. Job equivalents are calculated by dividing the added income created by the institutions and their students by the average income per worker in the state.

Based on the added income figures from Table 2.8, the job equivalents supported by the activities of the institutions and their students are as follows:

- *Operations effect =* ***5,015*** *job equivalents*
- *Student spending effect =* ***349*** *job equivalents*
- *Visitor spending effect =* ***273*** *job equivalents*
- *Student productivity effect =* ***16,127*** *job equivalents*

Overall, the income created by KICA's member institutions during the analysis year supported ***21,763*** *average-wage jobs in the state.*

Chapter 3: Benefits to Students, Society, and Taxpayers

The benefits generated by KICA's member institutions affect the lives of many people. The most obvious beneficiaries are the institutions' students – they give up time and money to go to college in return for a lifetime of higher income and improved quality of life. The benefits do not stop there, however. As students earn more, society as a whole benefits from an enlarged economy and a reduced demand for social services. The benefits of education extend as far as the state and local government, in the form of increased tax revenues and public sector savings.

In this chapter, we consider the benefits generated by KICA's member institutions from the perspectives of their main beneficiary groups – students, society, taxpayers. For students, the approach is a standard investment analysis where benefits are weighed against costs to determine if it makes economic sense for students to enroll in education. For society and taxpayers, standard investment metrics no longer apply, so the analysis only assesses benefits without taking costs into account.[10] Benefits for society and taxpayers are limited to those that occur in the state of Kansas.

3.1 Benefits to students

To attend college, students pay money for tuition and forgo monies that they would have otherwise earned had they chosen to work instead of learn. From the perspective of students, therefore, education is the same as an investment, *i.e.*, where they put up a certain amount of money with the expectation of receiving benefits in return. The process of evaluating total costs and measuring these against total benefits is known as investment analysis, which is useful in determining 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 study, the cost component comprises the monies that students pay (in the form of tuition, fees, and forgone time and money), and the benefit component comprises 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 $183.2 million from Table 1.2. Direct outlays also include the cost of books and supplies. On average, full-time students spent $1,153 each on books and supplies during the

[10] Benefit-cost analysis is only useful when two criteria are met: (1) the express intent of the investor group is to generate a return on the investment, and (2) the returns that investors receive only exist after the investment has been made. These criteria are evident on the part of students, but for society and taxpayers, their motives for financially supporting students and the link between their financial support and the benefits they receive in return are not nearly as clear.

reporting year.[11] Multiplying this figure times the number of full-time equivalents (FTEs) produced by KICA's member institutions in 2012-13[12] generates a total cost of $18.8 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 college rather than work. To calculate it, we need to know the difference between the students' full earning potential and what they actually earn while attending college.

We derive the students' full earning potential by weighting the average annual income levels in Table 1.7 according to the education level breakdown of the student population when they first enrolled.[13] However, the income levels in Table 1.7 reflect what average workers earn at the midpoint of their careers, not while attending college. Because of this, we adjust the income levels to the average age of the student population (27) to better reflect their wages at their current age.[14] This calculation yields an average full earning potential of $26,520 per student.

In determining what students earn while attending college, an important factor to consider is the time that they actually spend at college, since this is the only time that they are required to give up a portion of their earnings. We use the students' CHE production as a proxy for time, under the assumption that the more CHEs students earn, the less time they have to work, and, consequently, the greater their forgone earnings. Overall, students attending KICA's member institutions earned an average of 16.6 CHEs per student (excluding personal enrichment students), which is approximately equal to 55% of a full academic year.[15] We thus include no more than $14,714 (or 55%) of the students' full earning potential in the opportunity cost calculations.

Another factor to consider is the students' employment status while attending college. Based on data supplied by the institutions, approximately 69% of students are employed. For the 31% 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 go to college, therefore, non-working students give up everything that they can potentially earn during the academic year (*i.e.*, the $14,714). The total value of their forgone income thus comes to $135.9 million.

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[11] Based on the data supplied by the institutions.

[12] A single FTE is equal to 30 CHEs, so there were 16,304 FTEs produced by students in 2012-13, equal to 489,113 CHEs divided by 30 (excluding the CHE production of personal enrichment students).

[13] Based on the number of students who reported their entry level of education to the institutions.

[14] We use the lifecycle earnings function identified by Jacob Mincer to scale the income levels to the students' current age. See Jacob Mincer, "Investment in Human Capital and Personal Income Distribution," *Journal of Political Economy,* vol. 66 issue 4, August 1958: 281-302. Further discussion on the Mincer function and its role in calculating the students' return on investment appears later in this chapter and in Appendix 4.

[15] Equal to 16.6 CHEs divided by 30, the assumed number of CHEs in a full-time academic year.

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 college.[16] 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. Without knowing the actual jobs that students hold while attending, the 42% in forgone earnings serves as a reasonable average.

Working students also give up a portion of their leisure time in order to go to school, and mainstream theory places a value on this.[17] According to the Bureau of Labor Statistics American Time Use Survey, students forgo up to 1.4 hours of leisure time per day.[18] Assuming that an hour of leisure is equal in value to an hour of work, we derive the total cost of leisure by multiplying the number of leisure hours foregone during the academic year by the average hourly pay of the students' full earning potential. For working students, therefore, their total opportunity cost comes to $174.3 million, equal to the sum of their foregone income ($124 million) and forgone leisure time ($50.3 million).

The steps leading up to the calculation of student costs appear in Table 3.1. Direct outlays amount to $201.9 million, the sum of tuition and fees ($183.2 million) and books and supplies ($18.8 million), less $21,980 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 $294.4 million, excluding $15.7 million in offsetting residual aid that is paid directly to students. Summing all values together yields a total of $496.4 million in student costs.

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16 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).

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

18 "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.

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

Direct outlays	
Tuition and fees	$183,169
Books and supplies	$18,802
Less direct outlays of personal enrichment students	-$22
Total direct outlays	**$201,950**
Opportunity costs	
Earnings forgone by non-working students	$135,864
Earnings forgone by working students	$124,013
Value of leisure time forgone by working students	$50,272
Less residual aid	-$15,719
Total opportunity costs	**$294,430**
Total student costs	**$496,380**

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

3.1.2 Linking education to earnings

Having estimated the costs of education to students, we weigh these costs against the benefits that students receive in return. The relationship between education and earnings is well documented and forms the basis for determining student benefits. As shown in Table 1.7, mean income levels at the midpoint of the average-aged worker's career increase as people achieve higher levels of education. The differences between income levels define the upper bound benefits of moving from one education level to the next.[19]

A key component in determining the students' return on investment is the value of their future benefits stream, *i.e.*, what they can expect to earn in return for the investment they make in education. We calculate the future benefits stream to the institutions' 2012-13 students first by determining their average annual increase in income, equal to $91.3 million. This value represents the higher income that accrues to students at the midpoint of their careers and is calculated based on the marginal wage increases of the CHEs that students complete while attending college. For a full description of the methodology used to derive the $91.3 million, see Appendix 4.

The second step is to project the $91.3 million annual increase in income into the future, for as long as students remain in the workforce. We do this by applying a set of scalars derived from the slope of the earnings function developed by Jacob Mincer to predict the change in earnings at each age in an individual's working career.[20] Appendix 4 provides more information on the Mincer function and how it is used to predict future earnings growth. With the $91.3 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

[19] As discussed in Appendix 4, the upper bound benefits of education must be controlled for participant characteristics that also correlate with future wage increases, including inherent ability, socioeconomic status, and family background.

[20] See Mincer, 1958.

workforce, come to a 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 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)
0	$66.2	8%	$5.0	$496.4	-$491.3
1	$68.5	14%	$9.9	$0.0	$9.9
2	$70.8	26%	$18.4	$0.0	$18.4
3	$73.1	44%	$31.9	$0.0	$31.9
4	$75.3	64%	$48.4	$0.0	$48.4
5	$77.5	96%	$74.3	$0.0	$74.3
6	$79.7	96%	$76.4	$0.0	$76.4
7	$81.9	96%	$78.4	$0.0	$78.4
8	$83.9	96%	$80.4	$0.0	$80.4
9	$85.9	96%	$82.3	$0.0	$82.3
10	$87.9	96%	$84.1	$0.0	$84.1
11	$89.7	96%	$85.8	$0.0	$85.8
12	$91.5	96%	$87.4	$0.0	$87.4
13	$93.2	95%	$88.9	$0.0	$88.9
14	$94.8	95%	$90.3	$0.0	$90.3
15	$96.2	95%	$91.6	$0.0	$91.6
16	$97.6	95%	$92.7	$0.0	$92.7
17	$98.8	95%	$93.7	$0.0	$93.7
18	$100.0	95%	$94.6	$0.0	$94.6
19	$101.0	94%	$95.3	$0.0	$95.3
20	$101.9	94%	$95.9	$0.0	$95.9
21	$102.6	94%	$96.3	$0.0	$96.3
22	$103.2	93%	$96.5	$0.0	$96.5
23	$103.7	93%	$96.6	$0.0	$96.6
24	$104.0	93%	$96.5	$0.0	$96.5
25	$104.2	92%	$96.3	$0.0	$96.3
26	$104.3	92%	$95.8	$0.0	$95.8
27	$104.2	91%	$95.2	$0.0	$95.2
28	$104.0	91%	$94.5	$0.0	$94.5
29	$103.6	90%	$93.6	$0.0	$93.6
30	$103.1	90%	$92.5	$0.0	$92.5
31	$102.5	89%	$91.2	$0.0	$91.2
32	$101.7	88%	$89.8	$0.0	$89.8
33	$100.5	80%	$80.3	$0.0	$80.3
34	$99.1	66%	$65.2	$0.0	$65.2
35	$79.5	67%	$53.5	$0.0	$53.5
36	$55.8	88%	$49.2	$0.0	$49.2

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)
37	$55.1	83%	$45.7	$0.0	$45.7
38	$50.1	85%	$42.8	$0.0	$42.8
39	$49.2	67%	$32.9	$0.0	$32.9
40	$47.2	0%	$29.3	$0.0	$29.3
41	$32.0	0%	$27.7	$0.0	$27.7
42	$31.6	0%	$27.0	$0.0	$27.0
43	$31.1	0%	$25.1	$0.0	$25.1
44	$30.4	0%	$15.7	$0.0	$15.7
45	$27.6	0%	$7.2	$0.0	$7.2
46	$13.3	0%	$1.8	$0.0	$1.8
47	$4.4	0%	$0.3	$0.0	$0.3
Present value			**$1,368.643**	**$496.380**	**$872.263**
Internal rate of return					**12.5%**
Benefit-cost ratio					**2.8**
Payback period (no. of years)					**9.9**

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

Source: EMSI college impact model.

As shown in Table 3.2, the $91.3 million in gross added income occurs around Year 11, 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 Mincer function, the gross added income that accrues to students in the years leading up to the midpoint is less than $91.3 million, and the gross added income in the years after the midpoint is greater than $91.3 million.

The final step in calculating the students' future benefits stream is to net out the potential benefits generated by students who are either not yet active in the workforce or who leave the workforce over time. This adjustment appears in Column 3 of Table 3.2 and represents the percentage of the 2012-13 student population that will be employed in the workforce in a given year. Note that the percentages in the first five years of the time horizon are relatively lower than those in subsequent years. This is because many students delay their entry into the workforce, either because they are still enrolled at the institutions or because they are unable to find a job immediately upon graduation. Accordingly, we apply a set of "settling-in" factors to account for the time needed by students to find employment and settle into their careers. As discussed in Chapter 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 over time 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 Chapter 2.[21] The likelihood that students leave the workforce increases as they 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% (see the "Discount Rate" box).[22] The present value of the benefits is then compared to student costs to derive the investment analysis results, expressed in terms of a benefit-cost ratio, rate of return, and payback period. The investment is feasible if returns match or exceed the minimum threshold values, *i.e.*, a benefit-cost ratio greater than 1, a rate of return that exceeds the discount rate, and a reasonably short payback period.

Discount Rate

The discount rate is a rate of interest that converts future costs and benefits to present values. For example, $1,000 in higher earnings realized 30 years in the future is worth much less than $1,000 in the present. All future values must therefore be expressed in present value terms in order to compare them with investments (i.e., costs) made today. The selection of an appropriate discount rate, however, can become an arbitrary and controversial undertaking. As suggested in economic theory, the discount rate should reflect the investor's opportunity cost of capital, i.e., the rate of return one could reasonably expect to obtain from alternative investment schemes. In this study we assume a 4.5% discount rate from the student perspective and a 1.1% discount rate from the perspective of society and taxpayers. The discount rate for students is higher because they are a smaller investor group and can therefore only spread their risks over a smaller and less diverse investment portfolio than the public sector can.

In Table 3.2, the net added income of students yields a cumulative discounted sum of approximately $1.4 billion, the present value of all of the future income increments (see the bottom section of Column 4). This may also be interpreted as the gross capital asset value of the students' higher income stream. In effect, the aggregate 2012-13 student body is rewarded for its investment in KICA's member institutions with a capital asset valued at $1.4 billion.

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[21] See the discussion of the student productivity effect in Chapter 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.

[22] The student discount rate is derived from the baseline forecasts for the ten-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.

The students' cost of attending the institutions is shown in Column 5 of Table 3.2, equal to a present value of $496.4 million. Note that costs only occur 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 2.8 (equal to $1.4 billion in benefits divided by $496.4 million in costs).

Another way to compare the same benefits stream and associated cost is to compute the rate of return. The rate of return indicates the interest rate that a bank would have to pay a depositor to yield an equally attractive stream of future payments.[23] Table 3.2 shows students of KICA's member institutions earning average returns of 12.5% on their investment of time and money. This is a favorable return compared, for example, to approximately 1% on a standard bank savings account, or 7% on stocks and bonds (thirty-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 12.5% 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 15.0%, higher than what is reported in Table 3.2.

The payback period is defined as the length of time it takes to entirely recoup the initial investment.[24] Beyond that point, returns are what economists would call "pure costless rent." As indicated in Table 3.2, students at KICA's member institutions see, on average, a payback period of 9.9 years on their forgone earnings and out-of-pocket costs.

3.2 Benefits to society

Society as a whole in Kansas benefits from the education that KICA's member institutions provide through the income that students create in the state and through the savings that they generate

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[23] 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.

[24] 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.

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

Beekeeper Analogy

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

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

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

3.2.1 Income growth in the state

In the process of absorbing the newly-acquired skills of students that attend KICA's member institutions, not only does the productivity of Kansas' workforce increase, but so does the productivity of its physical capital and assorted infrastructure. Students earn more because of the skills they learned while attending the institutions, and businesses earn more because student skills make capital more productive (*i.e.*, 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 KICA's member institutions on income growth in the state begins with the present value of the students' future income stream, which is displayed in Column 4 of Table 3.2. To this we apply a multiplier derived from EMSI's SAM model to estimate the added labor income created in the state as students and businesses spend their higher incomes.[25] 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 Kansas' gross state product to total labor income in the state.

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[25] For a full description of the EMSI SAM model, see Appendix 3.

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

We apply another reduction factor to account for the students' alternative education opportunities. This is the same adjustment that we use in the calculation of the student productivity effect in Chapter 2 and is designed to account for the counterfactual scenario where KICA's member institutions do not exist. The assumption in this case is that any benefits generated by students who could have received an education even without the institutions cannot be counted as new benefits to society. For this analysis, we assume an alternative education variable of 38%, meaning that 38% of the student population at the institutions would have generated benefits anyway even without the institutions. For more information on the calculation of the alternative education variable, see Appendix 5.

After adjusting for attrition and alternative education opportunities, we calculate the present value of the future added income that occurs in the state, equal to $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. The discount rate in this case is 1.1%, the real treasury interest rate recommended by the Office for Management and Budget (OMB) for 30-year investments.[26]

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 KICA's member institutions. 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

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[26] 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).

comprise avoided costs due to the reduced number of social assistance and unemployment insurance claims.

The model quantifies social savings by calculating the probability at each education level that individuals will have poor health, commit crimes, or claim welfare and unemployment benefits. Deriving the probabilities involves assembling data from a variety of studies and surveys analyzing the correlation between education and health, crime, welfare, and unemployment at the national and state level. We spread the probabilities across the education ladder and multiply the marginal differences by the number of students who achieved CHEs at each step. The sum of these marginal differences counts as the upper bound measure of the number of students who, due to the education they received at the institutions, will not have poor health, commit crimes, or claim welfare and unemployment benefits. We dampen these results by the "ability bias" adjustment discussed earlier in this chapter and in Appendix 4 to account for other 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.[27] 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	**$2,320,580**
Social Savings	
Health	
Smoking	$242,975
Alcoholism	$8,290
Obesity	$177,054
Mental illness	$47,524
Drug abuse	$12,075
Total health savings	**$487,918**
Crime	
Criminal Justice System savings	$6,302
Crime victim savings	$405
Added productivity	$1,313
Total crime savings	**$8,019**
Welfare/unemployment	
Welfare savings	$223
Unemployment savings	$354
Total welfare/unemployment savings	**$576**
Total social savings	**$496,513**
Total, added income + social savings	**$2,817,094**

Source: EMSI college impact model.

[27] For a full list of the data sources used to calculate the social externalities, see Appendix 1. See also Appendix 7 for a more in-depth description of the methodology.

Table 3.3 above displays the results of the analysis. The first row shows the added income created in the state, equal to $2.3 billion. Social savings appear next, beginning with a breakdown of savings related to health. These savings amount to a present value of $487.9 million, including savings due to a reduced demand for medical treatment and social services, improved worker productivity and reduced absenteeism, and a reduced number of vehicle crashes and fires induced by alcohol or smoking-related incidents. Crime savings sum to $8 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 $576,156, stemming from a reduced number of persons in need of income assistance. All told, social savings amounted to $496.5 million in benefits to society as a whole in Kansas.

The sum of the social savings and the added income in the state is $2.8 billion, as shown in the bottom row of Table 3.3. These savings accrue for years out into the future, for as long as the 2012-13 student population of KICA's member institutions remains in the workforce.

3.3 Benefits to taxpayers

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

Table 3.4 presents the present value of the benefits to taxpayers. Added tax revenue appears in the first row. These figures are derived by multiplying the income growth figures from Table 3.3 by the prevailing state and local government tax rates in the state. 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 $296.6 million.

Table 3.4: Present value of added tax revenue and government savings (thousands)

Added tax revenue	**$212,576**
Government savings	
Health-related savings	$77,020
Crime-related savings	$6,468
Welfare/unemployment-related savings	$576
Total government savings	$84,064
Total taxpayer benefits	**$296,640**

Source: EMSI college impact model.

3.4 Conclusion

This chapter has shown that the education provided by KICA's member institutions is an attractive investment to students with rates of return that exceed alternative investment opportunities. At the same time, the presence of the institutions expands the state economy and creates a wide range of positive social benefits that accrue to taxpayers and to society as a whole.

Chapter 4: Sensitivity Analysis

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

4.1 Alternative education variable

The alternative education variable (38%) accounts for the counterfactual scenario where students would have to seek a similar education elsewhere absent KICA's member institutions. Given the difficulty in accurately specifying the alternative education variable, we test the sensitivity of the social and taxpayer perspective results to its magnitude. Variations in the alternative education assumption are calculated around base case results listed in the middle column of Table 4.1. Next, the model brackets the base case assumption on either side with a plus or minus 10%, 25%, and 50% variation in assumptions. Analyses are then redone introducing one change at a time, holding all other variables constant. For example, an increase of 10% in the alternative education assumption (from 38% to 42%) reduces the benefits to taxpayers from $296.6 million to $278.1 million. Likewise, a decrease of 10% (from 38% to 34%) in the assumption increases the benefits to taxpayers from $296.6 million to $314.7 million.

Table 4.1: Sensitivity analysis of alternative education variable, social and taxpayer perspectives

% variation in assumption	-50%	-25%	-10%	Base Case	10%	25%	50%
Alternative education variable	19%	29%	34%	38%	42%	48%	57%
Benefits to society (millions)	$3,725.8	$3,286.8	$3,023.3	$2,848.3	$2,672.0	$2,408.6	$1,969.5
Benefits to taxpayers (millions)	$387.8	$342.1	$314.7	$296.6	$278.1	$250.7	$205.0

Based on this sensitivity analysis, the conclusion can be drawn that results from the social and taxpayer perspective are not very sensitive to relatively large variations in the alternative education variable. As indicated, benefits to society and benefits to taxpayers are still strong, even when the alternative education assumption is increased by as much as 50% (from 38% to 57%). The conclusion is that although the assumption is difficult to specify, its impact on the overall results from the taxpayer perspective is not very sensitive.

4.2 Substitution effect variable

The substitution effect variable only affects the student productivity calculation in Table 2.7. In the model we assume a substitution effect variable of 50%, which means that we claim only 50% of the initial labor income generated by increased student productivity. The other 50% we assume would have been created in the state anyway – even without KICA's member institutions – since the businesses that hired the institutions' students could have substituted some of these workers with equally-qualified people from outside the state.

Table 4.2 presents the results of the sensitivity analysis for the substitution effect variable. As above, the assumption increases and decreases relative to the base case of 50% by the increments indicated in the table. Student productivity effects attributable to KICA's member institutions, for example, range from a low of $360 million at a -50% variation to a high of $1.1 billion at a +50% variation from the base case assumption. This means that if the substitution variable increases, the impact that we claim as attributable to student productivity increases as well. Nonetheless, the effect of student productivity still remains a sizeable factor in the Kansas economy, even under the most conservative assumptions.

Table 4.2: Sensitivity analysis of substitution effect variable

% variation in assumption	-50%	-25%	-10%	Base Case	10%	25%	50%
Substitution effect variable	25%	38%	45%	50%	55%	63%	75%
Student productivity effect (millions)	$360.0	$540.0	$648.0	$720.0	$792.0	$900.0	$1,080.0

4.3 Student employment variables

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

Students incur substantial expense by attending KICA's member institutions because of the time they spend not gainfully employed. Some of that cost is recaptured if students remain partially (or fully) employed while attending. It is estimated that 69% of students who reported their employment status are employed, based on data provided by the institutions. 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 earn only 58%, on average, of the income that they would have statistically received if not attending the institutions. This suggests that many students hold part-time jobs that accommodate their college attendance, though it is at an additional cost in terms of receiving a wage that is less than what they might otherwise make. The 58% variable is an estimation based on the average hourly wages of the most common jobs held by students while attending college relative to the average hourly wages of all occupations in the U.S. The model captures this difference in wages and counts it as part of the opportunity cost of time. As above, the 58% estimate is tested in the sensitivity analysis by changing it to 100% and then to 0%.

The changes generate results summarized in Table 4.3, with "A" defined as the percent of students employed and "B" defined as the percent that students earn relative to their full earning potential. Base case results appear in the shaded row – here the assumptions remain unchanged, with A equal to 69% 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 = 69%, B = 58%	$872.3	12.5%	2.8
Scenario 1: A = 100%, B = 58%	$927.2	13.7%	3.1
Scenario 2: A = 69%, B = 100%	$996.3	15.6%	3.7
Scenario 3: A = 100%, B = 100%	$1,108.8	20.3%	5.3
Scenario 4: A = 0%, B = 0%	$754.1	10.5%	2.2

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

1. Scenario 1: Increasing the percent of students employed (A) from 69% to 100%, the net present value, internal rate of return, and benefit-cost ratio improve to $927.2 million, 13.7%, and 3.1, 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 $996.3 million, 15.6%, and 3.7, respectively, relative to base case results – a strong improvement, again attributable to a lower opportunity cost of time.
3. Scenario 3: Increasing both assumptions A and B to 100% simultaneously, the net present value, internal rate of return, and benefit-cost ratio improve yet further to $1.1 billion, 20.3%, and 5.3, 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 $754.1 million, 10.5%, and 2.2, respectively, relative to base case results. These results are reflective of an increased opportunity cost – none of the students are employed in this case.[28]

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

It is strongly emphasized in this section that base case results are very attractive in that results are all above their threshold levels. As is clearly demonstrated here, results of the first three alternative scenarios appear much more attractive, although they overstate benefits. Results presented in Chapter 3 are realistic, indicating that investments in KICA's member institutions 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 this study, we assume a 4.5% discount rate for students and a 1.1% discount rate for society and taxpayers.[29] 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%.

Table 4.4: Sensitivity analysis of discount rate

% variation in assumption	-50%	-25%	-10%	Base Case	10%	25%	50%
Student perspective							
Discount rate	2.2%	3.4%	4.0%	4.5%	4.9%	5.6%	6.7%
Benefits (millions)	$2,014.2	$1,648.9	$1,472.2	$1,368.6	$1,275.0	$1,150.7	$979.0
Social perspective							
Discount rate	0.6%	0.8%	1.0%	1.1%	1.2%	1.4%	1.7%
Benefits (millions)	$3,162.2	$2,999.9	$2,907.7	$2,848.3	$2,790.5	$2,706.6	$2,574.1
Taxpayer perspective							
Discount rate	0.6%	0.8%	1.0%	1.1%	1.2%	1.4%	1.7%
Benefits (millions)	$330.1	$312.8	$303.0	$296.6	$290.5	$281.6	$267.5

As demonstrated in Table 4.4, an increase in the discount rate leads to a corresponding decrease in benefits, and vice versa. For example, increasing the student discount rate by 50% (from 4.5% to 6.7%) reduces student benefits from $1.4 billion to $979 million. Conversely, reducing the discount rate for students by 50% (from 4.5% to 2.2%) increases benefits from $1.4 billion to $2 billion. The sensitivity analysis results for society and taxpayers show the same inverse relationship between benefits and the discount rate, with the variance in results being the greatest under the social perspective (from $3.2 billion in benefits at a -50% variation from the base case to $2.6 billion in benefits at a 50% variation from the base case).

[29] These values are based on the baseline forecasts for the ten-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.

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Appendix 2: Glossary of Terms

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

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

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

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

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

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

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

Discounting Expressing future revenues and costs in present value terms.

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

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

	decreases total revenues, demand is inelastic. If total revenues remain the same, elasticity of demand is unitary.
Externalities	Impacts (positive and negative) for which there is no compensation. Positive externalities of education include improved social behaviors such as lower crime, reduced welfare and unemployment, and improved health. Educational institutions do not receive compensation for these benefits, but benefits still occur because education is statistically proven to lead to improved social behaviors.
Gross state product	Measure of the final value of all goods and services produced in a state after netting out the cost of goods used in production. Alternatively, gross state product (GSP) equals the combined incomes of all factors of production, *i.e.*, labor, land and capital. These include wages, salaries, proprietors' incomes, profits, rents, and other. Gross state product is also sometimes called "value added."
Initial effect	Income generated by the initial injection of monies into the economy through the payroll of the institutions and the higher earnings of their students.
Input-output analysis	Relationship between a given set of demands for final goods and services and the implied amounts of manufactured inputs, raw materials, and labor that this requires. In an educational setting, when institutions pay wages and salaries and spend money for supplies in the state, they also generate earnings in all sectors of the economy, thereby increasing the demand for goods and services and jobs. Moreover, as students enter or rejoin the workforce with higher skills, they earn higher salaries and wages. In turn, this generates more consumption and spending in other sectors of the economy.
Internal rate of return	Rate of interest which, 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 which is received as a result of labor, *i.e.*, wages.
Multiplier effect	Additional income created in the economy as the institutions and their students spend money in the state. It consists of the income created by the supply chain of the industries initially affected by the spending of the institutions and their students (*i.e.*, the direct effect),

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

Appendix 3: EMSI MR-SAM

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

This appendix presents a high-level overview of the MR-SAM. Additional detail on the technical aspects of the model is available upon request; however, we are unable to provide information that discloses confidential or proprietary methodology.

A3.1 Data sources for the model

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

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

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

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

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

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

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

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

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

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

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

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

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

A3.2 Overview of the MR-SAM model

EMSI's multi-regional social accounting matrix (MR-SAM) modeling system is a "comparative static" type 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" type 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" type model that shows year-by-year changes over time (as REMI's does).

A3.2.1 National SAM

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

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

A3.2.2 Multi-regional aspect of the SAM

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

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

With the flows finalized, EMSI is able to use industry standard equations to adjust the national SAM and bring it into focus for the given region or regions. If the model being created is multi-regional, the amount and kind of transactions that occur between those regions is also calculated.

A3.3 Components of the EMSI SAM model

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

A3.3.1 County earnings distribution matrix

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

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

A3.3.2 Commuting model

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

A3.3.3 National SAM

The national SAM as described above is made up of several different components. Many of the elements already discussed are filled in with values from the national Z or transactions 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 (NIPA).

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

A3.3.4 Gravitational flows model

The most important piece of the EMSI MR-SAM model is the gravitational flows model that produces county sales, county subsidies, and county-by-county regional purchasing coefficients (RPCs). County sales are the vector of total output for every sector in the SAM applied to a given county. County subsidies are an estimation of the governmental subsidies given to specific industries in a given county. RPCs estimate how much an industry purchases from other industries inside and outside of the defined region. This information is critical for calculating regional economic SAM and IO models. As discussed earlier, the national SAM incorporates data from the national Z matrix, so from this point on, the national SAM will be referred to as the national Z SAM.

Before we explain how EMSI creates RPCs, one more concept must be introduced, namely the A matrix. An A matrix is mathematically derived from a Z matrix and shows the production function for each sector (*i.e.*, what a sector requires from all other sectors in order to maintain its output). The matrix is calculated by normalizing the columns of a Z matrix with respect to the sales for that column. In other words, each column is scaled so that it sums to 1.

Table A3.1 shows a sample A matrix. Each cell value represents the percentage of a column industry's output that goes toward purchasing inputs from each row industry. So the cell containing 5% shows that Industry 2 spends 5% of its total output to obtain inputs from Industry 1.

Table A3.1: Sample "A" Matrix

	Industry 1	Industry 2	…	Industry n
Industry 1	1%	5%	…	3%
Industry 2	20%	0%	…	12%
…	…	…	…	…
Industry n	3%	9%	…	2%

When calculating RPCs, EMSI uses two methods:

Supply/demand pool method: This method uses regional industry presence and the national A matrix to estimate the regional industry demand that remains unmet by regional industry supply. The difference is assumed to be imported or exported, which defines the basis for all RPC calculation methods.

Gravitational flows method: This is a far more complex method for estimating RPCs, but it yields multi-regional data. Gravity modeling starts with the creation of an impedance matrix that values the difficulty of moving a product from county to county. Next, the impedance matrix is converted into a base matrix that contains seeds of multi-regional flows between counties in a given sector. This base matrix is then fed to a bi-proportional with supply and demand as the row and column constraints, respectively. 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.

A3.4 Model usages

The previous sections described the components of the EMSI SAM model and the data used to create regional and multi-regional models. This section describes how we use the data to create the models, beginning with a discussion of regional models and moving on to a less comprehensive overview of multi-regional models (multi-regional models are essentially the same as regional models but with additional information).

A3.4.1 Regional models

Regional models are simply county or ZIP code models that we aggregate together. Because the aggregated data would fill approximately 3,000 terabytes, we keep the models to a manageable size by constructing them using only the national SAM, county-by-county RPCs, county sales, county subsidies, county earnings distribution matrices, and the commuting data. For ZIP code models, we use county models as a basis and then scale them to the correct size.

A3.4.2 Multi-regional models

A multi-regional model is able to look at trade between several different county regions. It works by creating a very large matrix with each region's model in the diagonal and inter-region trade matrices in the off-diagonals. These off-diagonal matrices are created in a similar way to the regional county matrices. The major differences are the number of zeros in the matrix and which RPCs are used. Flows between regions are only accounted for within industries (calculated with RPCs) and residence adjustment earnings (from the commuting model).

A3.4.3 Using the model

There are a large number of uses for regional and multi-regional SAM models. Some examples of model usages are the following:

1. Multiplier effects: Estimate the jobs/earnings effects on industries and demographics due to an initial set of changes in one or more industries.
2. Regional requirements: Estimate the amount of industry requirements (goods/services purchased by the industry) that are obtained within a region versus those imported.
3. Regional exports: Estimate the amount that each industry exports from a region (exporting industries drive regional economic growth).
4. Gross Regional Product: GRP, similar to a nation's GDP, can be estimated for any region from the MR-SAM model.

Appendix 4: Value per Credit Hour Equivalent and the Mincer Function

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

A4.1 Value per CHE

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

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

The second step is to assign a unique value to the CHEs in the education ladder based on the wage differentials presented in Table 1.7. For example, the difference in earnings between a high school diploma and an associate's degree is $8,900. We spread this $8,900 wage differential across the 60 CHEs that occur between the high school diploma and the associate's degree, applying a ceremonial "boost" to the last CHE in the stage to mark the achievement of the degree.[30] We repeat this process for each education level in the ladder.

Of course, several other factors such as ability, socioeconomic status, and family background also positively correlate with higher earnings. Failure to account for these factors results in what is known as an "ability bias." Research by Card (1999) indicates that the upper limit benefits defined

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[30] 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" or "signaling" effect. The ceremonial boosts applied to the achievement of degrees in the EMSI college impact model are derived from David Jaeger and Marianne Page, "Degrees Matter: New Evidence on Sheepskin Effects in the Returns to Education," *Review of Economics and Statistics* 78, no. 4 (November 1996): 733-740.

by correlation should be discounted by 10%.[31] As such, we reduce the marginal differences between education levels by 10%.

Next we map the CHE production of the 2012-13 student population to the education ladder. Table 1.4 provides information on the CHE production of students attending KICA's member institutions, broken out by educational achievement. In total, students completed 489,113 CHEs during the analysis year, excluding the CHE production of personal enrichment students. We map each of these CHEs to the education ladder depending on the students' education level and the average number of CHEs they completed during the year. For example, associate's degree graduates are allocated to the stage between the high school diploma and the associate's degree, and the average number of CHEs they completed informs the shape of the distribution curve used to spread out their total CHE production within that stage of the progression.

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

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

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

Table A4.1 displays the result for the students' aggregate annual increase in income (ΔE), a total of $91.3 million. By dividing this value by the students' total production of 489,113 CHEs during the analysis year, we derive an overall value of $187 per CHE.

Table A4.1: Aggregate annual increase in income of students and value per CHE

Aggregate annual increase in income	$91,266,609
Total credit hour equivalents (CHEs) in FY 2012-13*	489,113
Value per CHE	$187

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

A4.2 Mincer Function

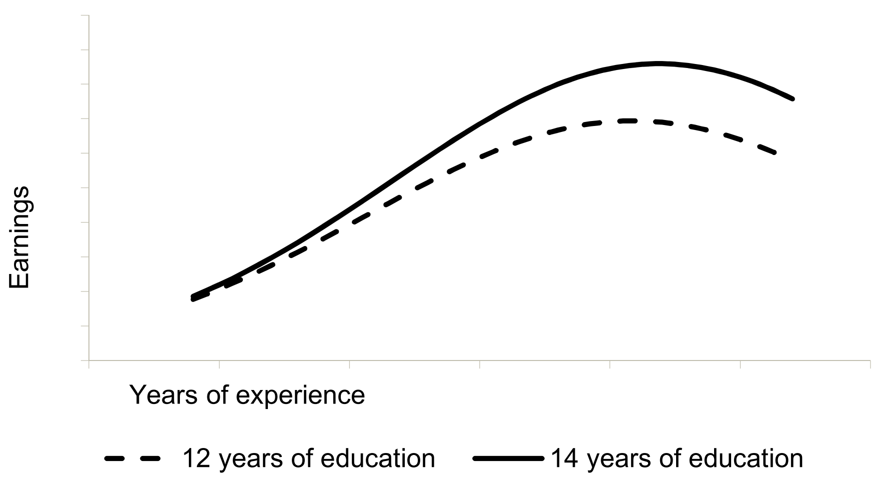
The $187 value per CHE in Table A4.1 only tells part of the story, however. Human capital theory holds that earnings levels do not remain constant; rather, they start relatively low and gradually increase as the worker gains more experience. Research also shows that the earnings increment

[31] David Card, "The causal effect of education on earnings," *Handbook of Labor Economics* 3 (1999): 1801-1863. Card acknowledges that ability is unobservable and the instrumental variable techniques for measuring the ability bias are different. He concludes that the "best available" evidence suggests a "small upward bias (on the order of 10%)."

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.[32] Mincer's earnings function is still upheld in recent data and has served as the foundation for a variety of research pertaining to labor economics.

Figure A4.1 illustrates several important points about the Mincer function. First, as demonstrated by the shape of the curves, an individual's earnings initially increase at an increasing rate, then increase at a decreasing rate, reach a maximum somewhere well after the midpoint of the working career, and then decline in later years. Second, individuals with higher levels of education reach their 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 A4.1: Lifecycle change in earnings, 12 years versus 14 years of education



In calculating the student productivity effect in Chapter 2, we use the slope of the curve in Mincer's earnings function to condition the $187 value per CHE to the students' age and work experience.[33] To the students just starting their career during the analysis year, we apply a lower value per CHE; to

[32] See Mincer, 1958 and Jacob Mincer, "Schooling, Experience and Earnings" (New York: National Bureau of Economic Research, 1974). See also Gary S. Becker, *Human Capital: a Theoretical Analysis with Specific Reference to Education* (New York: Columbia College Press for NBER, 1964).

[33] The Mincer equation is computed based on estimated coefficients presented in Robert J. Willis, "Wage Determinants: A Survey and Reinterpretation of Human Capital Earnings Function" in *Handbook of Labor Economics*, Vol. 1 (Amsterdam: Elsevier Science Publishers, 1986): 525–602. These are adjusted to current year dollars in the usual fashion by applying the GDP implicit price deflator. The function does not factor in temporary economic volatility, such as high growth periods or recessions. In the long run, however, the Mincer function is a reasonable predictor.

the students in the latter half or approaching the end of their careers we apply a higher value per CHE. The original $187 value per CHE applies only to the CHE production of students precisely at the midpoint of their careers during the analysis year.

In Chapter 3 we again apply the Mincer function, this time to project the benefits stream of the 2012-13 student population into the future. Here too the value per CHE is lower for students at the start of their career and higher near the end of it, in accordance with the scalars derived from the slope of the Mincer curve illustrated in Figure A4.1.

A4.3 Conclusion

This appendix demonstrates the significance of the value per CHE and the Mincer function in determining the initial effect of student productivity on the state economy in Chapter 2 and the students' return on their educational investment in Chapter 3. Both chapters provide further discussion on the role that the students' CHE production and corresponding increase in earnings play in calculating the study outcomes.

Appendix 5: Alternative Education Variable

In a scenario where KICA's member institutions did not exist, some of their students would still be able to avail themselves of a comparable education. These students create benefits in the state even in the absence of the institutions. The alternative education variable is an estimate of this portion of students and is used to discount the benefits we attribute to KICA. This appendix outlines the theoretical framework and data used in estimating the alternative education variable.

A5.1 Theory

The alternative education variable is essentially an estimation of the students' demand for an alternative institution, where the alternative institution is the closest peer education institution in the state. Student demand for education is determined by a number of different factors. Among the most important of these factors are price, distance, and program offerings in every institution. The more students have to pay in tuition and the further they have to travel to receive an education, the less likely they are to enroll.[34] Program offerings are also critical in the enrollment decision, especially since they can vary so widely across institutions. The fact that students enrolled at KICA's member institutions and not at other institutions reveals that they preferred the programs and culture offered at KICA's member institutions over those of the alternative institutions. Using tuition prices, distances, and program differences, we estimate the alternative education variable *(AE)* as the reduction in enrollment at institution j given the alternative institution a.

We estimate the alternative education variable as a function of the costs of attending institution j and the alternative institution a:

$$AE = f(C_j, C_a)$$

Where:

C_j = Cost of attendance per student at institution j

C_a = Cost of attendance per student at alternative institution a

[34] For more discussion on the impact of price and distance on an individual's decision to enroll in higher education, see Andy Dickerson 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. See also Stijn Kelchtermans and Frank Verboven, "Participation and Study Decisions in a Public System of Higher Education," *Journal of Applied Econometrics* 25 (2010): 355-391. Additional variables were tested but did not show a clear effect on our dependent variables. For example, financial aid - which was suggested by Dynarski as a potential influence on student preferences – proved to be too difficult to factor out the effect on enrollment (see Susan Dynarski, "Does Aid Matter? Measuring the Effect of Student Aid on College Attendance and Completion," *American Economic Review* 93 no. 1 (2003): 279-288.

The cost of attendance at institution *j* (C_j) is assumed to be equal to the tuition price per student at institution *j* (P_j). Thus:

$C_j = P_j$

There are three components to the cost of attending institution *a*. The first two are tuition prices and distance. The third is a cost associated with the program differences between institution *j* and *a*. Given the students chose institution *j* over institution *a,* the alternative institution's program offerings are second best to institution *j*'s. All else equal, in order to attend institution *a* over institution *j*, students would need to be compensated with some amount of money. The compensation such that they are indifferent between choosing institution *j* and *a* is known as the equivalent variation. For institution *a*, the cost of attendance per student (C_a) is represented by the following equation:

$C_a = P_a + M_a + E_{ja}$

Where:

P_a	=	Tuition price per student at alternative institution *a*
M_a	=	Additional transportation costs as a result of increased mileage to institution *a,* including the opportunity cost of wages forgone as a result of increased travel time to institution *a*
E_{ja}	=	Equivalent variation between institution *j* and *a*.

Combining the tuition prices, costs associated with distance, and the equivalent variation, we control for the substitution and income effects of attending the alternative institution.

A5.2 Data

Data on tuition prices for approximately 1,700 private and public institutions with associate's degree as the highest degree offering are available from IPEDs.

The opportunity cost of wages forgone and the additional transportation cost (M_a) are dependent on the distance *(d)* and travel time *(t)* between institution *j* and *a*. Travel time *(t)* is measured in terms of hours and is a function of *d* (measured in terms of miles) and the average number of miles that an individual can travel in one hour. In this analysis, we assume the average speed to be 45 miles per hour. Accordingly, travel time *(t)* is calculated as follows:

$t = d / 45$

The distance *(d)* between institution *j* and alternative institution *a* is dependent upon the latitude (θ) and longitude (τ) of institutions *j* and *a*. Latitudes and longitudes for all private and public institutions are available from IPEDS. We measure distance between institutions in accordance with the standard haversine formula, as follows:[35]

$$d\left(f\left(\theta_{(j,a)}, \tau_{(j,a)}\right)\right) = 2R * \left\{arcsin\left(\sqrt{sin^2\left(\frac{\theta_a - \theta_j}{2}\right) + cos(\theta_j)cos(\theta_a)sin^2\left(\frac{\tau_a - \tau_j}{2}\right)}\right)\right\}$$

Where:

R = Earth's radius, a total 3,959 miles

Having established t and d, the opportunity cost of wages forgone and additional transportation costs, (M_a) may now be determined. The equation for M_a is:

$$M_a = t * w * e * 160 + 2 * d * 0.596 * 160$$

Such that $d \geq 0$

And where w is hourly wages per student, e is the percent of students who are employed at institution j, 160 is the number of days in a standard academic year, and 0.596 is the average driving cost (in terms of dollars) per mile. The average cost per mile is an estimate provided by the American Automobile Association. Hourly wages (w) are conservatively estimated to be equal to the minimum hourly wage in the state where institution j is located. Information on minimum wage rates per state is available from the U.S. Census Bureau.

We estimate the equivalent variation as a function of program differences and student preferences. For KICA's member institutions in particular, student preferences are heavily influenced by the culture and lifestyle that the institutions have to offer, given the institutions' relatively small size, the communities in which they are located, and the mission and values that they embrace. These features are unique to KICA's member institutions, and many of their students would not have been able to find the same features elsewhere, especially given the other constraints of price and distance. The equivalent variation E_{ja} takes these factors into account and incorporates them as part of the total cost of attendance for the alternative institutions.

A5.3 Estimation

The previous equations set the parameters for calculating the cost of attendance at institutions j and a based on tuition prices, distance, and program differences. We now apply an arc price elasticity of demand function to calculate the percent reduction in enrollment at institution j should a portion of its students choose instead to attend institution a. The equation is as follows:

$$AE = \frac{\varepsilon_d * (C_a - C_j) + (C_a + C_j)}{(C_a + C_j) - \varepsilon_d * (C_a + C_j)}$$

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[35] The harversine formula is used in navigation to calculate the great-circle distance between two points on a sphere given their latitudes and longitudes.

Where ε_d represents the elasticity of demand and is equal to an assumed value of -.75.

The result of this equation *(AE)* is the alternative education variable used in the counterfactual adjustments to the student productivity effect in Chapter 2 and the calculation of the benefits to society and taxpayers in Chapter 3. More information on how the alternative education variable is applied in these analyses is provided in the main body of the report.

Appendix 6: Overview of Investment Analysis Measures

The purpose of this appendix is to provide context to the investment analysis results using the simple hypothetical example summarized in Table A6.1 below. The table shows the projected benefits and costs for a single student over time and associated investment analysis results.[36]

Table A6.1: 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 ten years into the future (Column 1).
2. The student attends college for one year, and the cost of tuition is $1,500 (Column 2).
3. Earnings forgone while attending college for one year (opportunity cost) come to $20,000 (Column 3).
4. Together, tuition and earnings forgone cost sum to $21,500. This represents the out-of-pocket investment made by the student (Column 4).
5. In return, the student earns $5,000 more per year than he would have otherwise earned without the education (Column 5).
6. The net cash flow (NCF) in Column 6 shows higher earnings (Column 5) less the total cost (Column 4).

[36] 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 A6.1.

A6.1 Net present value

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

The question is simple – will the prospective student be economically better off by choosing to enroll? If he adds up higher earnings of $5,000 per year for the remaining nine years in Table 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.[37]

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

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

The net present value of the investment is $14,253. This is simply the present value of the benefits less the present value of the costs, or $35,753 - $21,500 = $14,253. In other words, the present value

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[37] 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.

A6.2 Internal rate of return

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

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

A word of caution – the approach for calculating the internal rate of return can sometimes generate wild or unbelievable results that defy the imagination. Technically, the approach requires at least one negative cash flow to offset all subsequent positive flows. For example, if the student works full-time while attending college, the opportunity cost of time would be much lower. The only out-of-pocket cost would be the $1,500 paid for tuition. In this case, it would still be possible to compute the internal rate of return, but it would be a staggering 333% because only a negative $1,500 cash flow would be offsetting nine subsequent years of $5,000 worth of higher earnings. Although the 333% return would technically be correct, it would not be consistent with the conventional understanding of returns expressed as percentages.

A6.3 Benefit-cost ratio

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

A6.4 Payback period

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

Appendix 7: Social Externalities

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

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

A7.1 Health

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

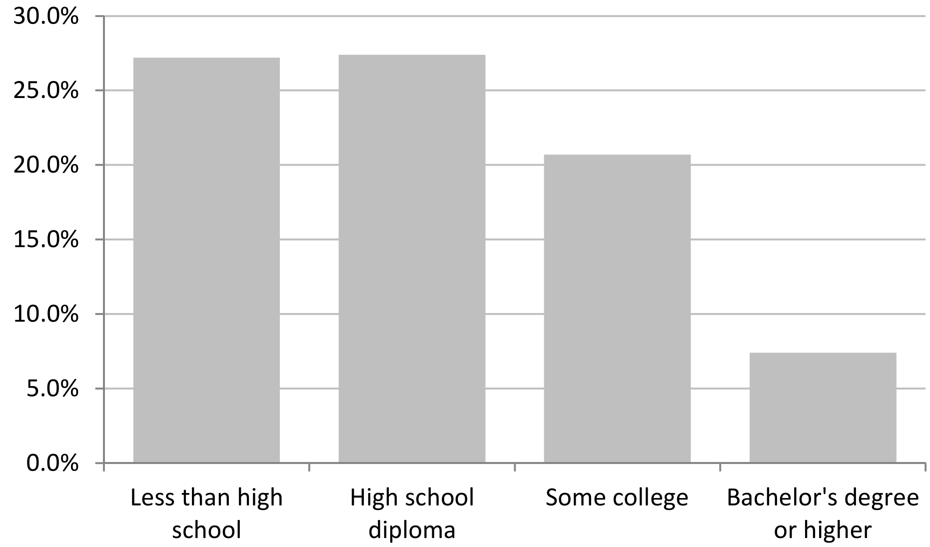
A7.1.1 Smoking

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

Figure A7.1 shows the prevalence of cigarette smoking among adults aged 25 years and over, based on data provided by the National Health Interview Survey.[38] As indicated, the percent of persons who smoke begins to decline beyond the level of high school education.

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

Figure A7.1: Prevalence of smoking among U.S. adults by education level



The Centers for Disease Control and Prevention (CDC) reports the percentage of adults who are current smokers by state.[39] We use this information to create an index value by which we adjust the national prevalence data on smoking to each state. For example, 22.0% of Kansas' adults were smokers in 2011, relative to 21.2% for the nation. We thus apply a scalar of 1.0 to the national probabilities of smoking in order to adjust them to the state of Kansas.

A7.1.2 Alcohol abuse

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

Figure A7.2 compares the percent of males and females aged 26 and older that abuse or depend on alcohol at the less than high school level to the prevalence rate of alcoholism among college graduates, based on data supplied by the Substance Abuse and Mental Health Services Administration (SAMHSA).[40] 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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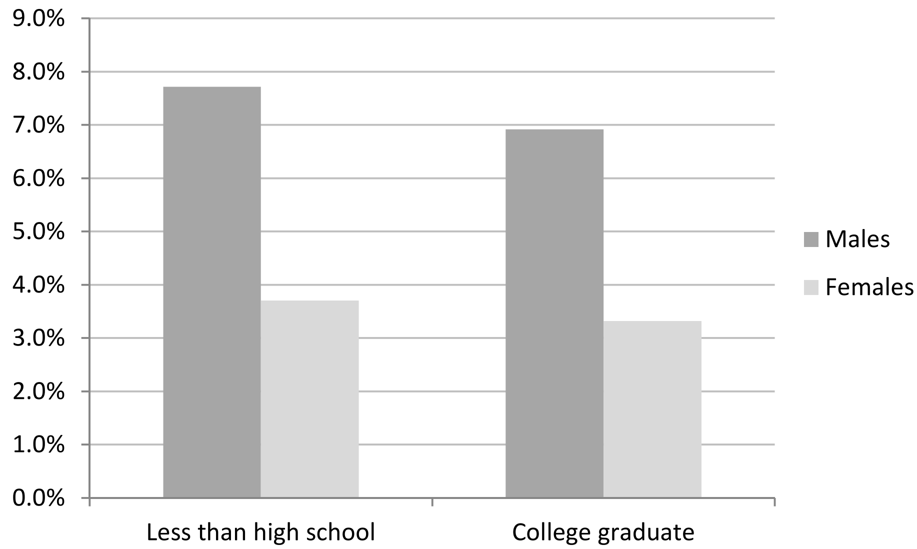
[39] Centers for Disease Control and Prevention, "Adults who are current smokers" in "Tobacco Use – 2011," Behavioral Risk Factor Surveillance System Prevalence and Trends Data, accessed August 2013, http://apps.nccd.cdc.gov/brfss/list.asp?cat=TU&yr=2011&qkey=8161&state=All.

[40] 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 A7.2: Prevalence of alcohol dependence or abuse by sex and education level



A7.1.3 Obesity

The rise in obesity and diet-related chronic diseases has led to increased attention on how expenditures relating to obesity have increased in recent years. The average cost of obesity-related medical conditions is calculated using information from the *Journal of Occupational and Environmental Medicine*, which reports incremental medical expenditures and productivity losses due to excess weight.[41] The CDC also reports the prevalence of obesity among adults by state.[42]

Data for Figure A7.3 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.[43] 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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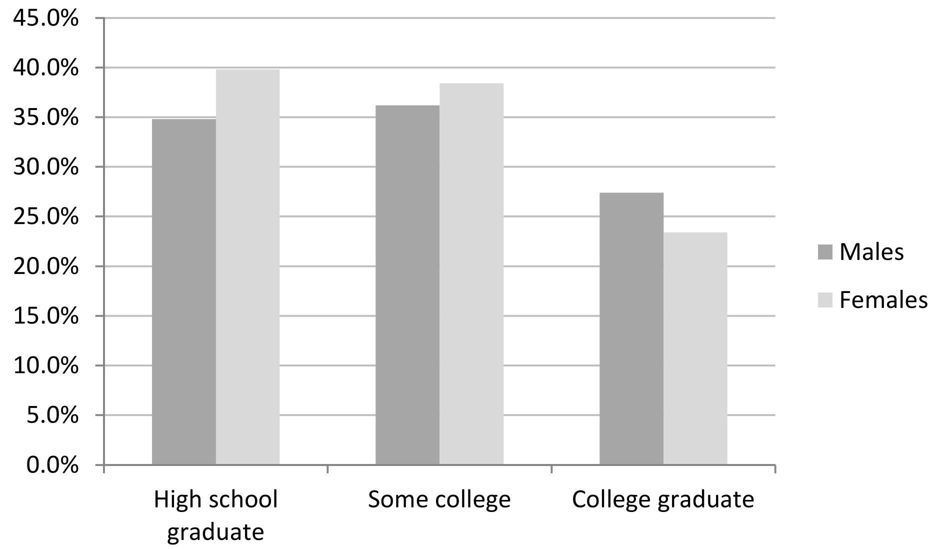
[41] Eric A. Finkelstein, Marco da Costa DiBonaventura, Somali M. Burgess, and Brent C. Hale, "The Costs of Obesity in the Workplace," *Journal of Occupational and Environmental Medicine* 52, no. 10 (October 2010): 971-976.

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

[43] 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 A7.3: Prevalence of obesity by education level

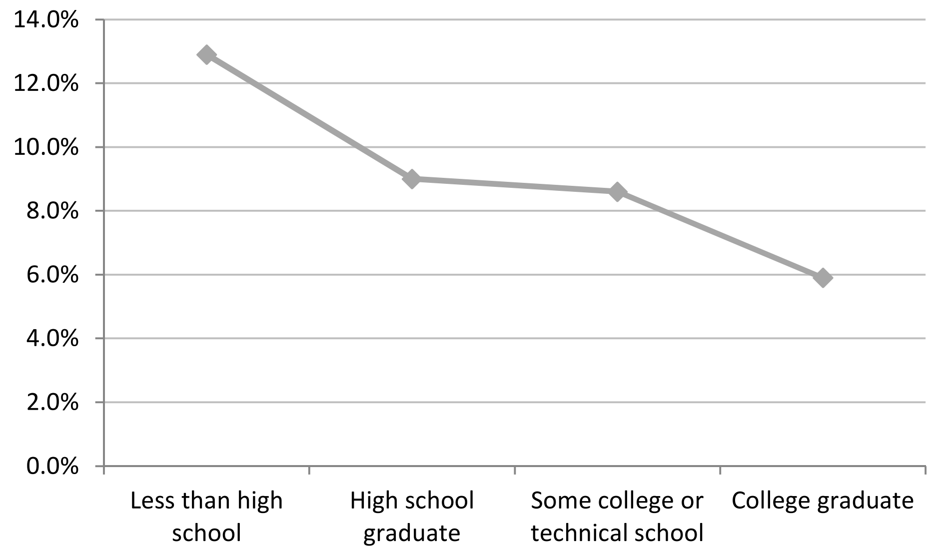


A7.1.4 Mental illness

Capturing the full economic cost of mental disorders is problematic because many of the costs are hidden or difficult to detach from others externalities, such as drug abuse or alcoholism. For this reason, this study only examines the costs of absenteeism caused by depression in the workplace. Figure A7.4 summarizes the prevalence of self-reported frequent mental distress among adults by education level, based on data supplied by the CDC.[44] 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.

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

Figure A7.4: Prevalence of frequent mental distress by education level



A7.1.5 Drug abuse

The burden and cost of illicit drug abuse is enormous in our society, but little is known about potential costs and effects at a population level. What is known is that the rate of people abusing drugs is inversely proportional to their education level. The higher the education level, the less likely a person is to abuse or depend on illicit drugs. The probability that a person with less than a high school diploma will abuse drugs is 2.9%, nearly six times greater than the probability of drug abuse for college graduates (0.5%). This relationship is presented in Figure A7.5 based on data supplied by SAMHSA.[45] Health costs associated with illegal drug use are also available from SAMSHA, with costs to state and local government representing 48% of the total cost related to illegal drug use.[46]

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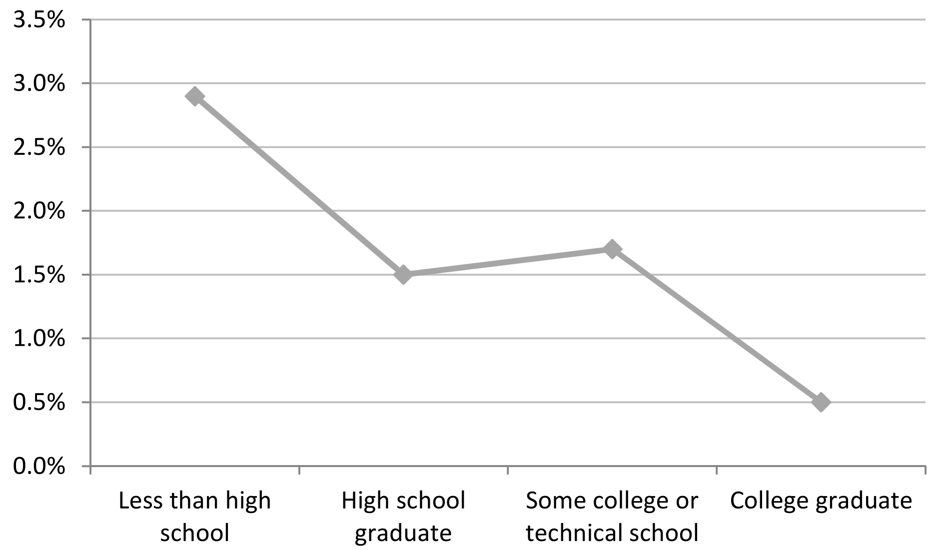
[45] Substance Abuse and Mental Health Services Administration, National Survey on Drug Use and Health, 2010 and 2011.

[46] 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 A7.5: Prevalence of illicit drug dependence or abuse by education level



A7.2 Crime

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

Figure A7.6 displays the probability that an individual will be incarcerated by education level. Data are derived from the breakdown of the inmate population by education level in federal, state, and local prisons as provided by the Bureau of Justice Statistics,[47] divided by the total adult population. As indicated, incarceration drops on a sliding scale as education levels rise.

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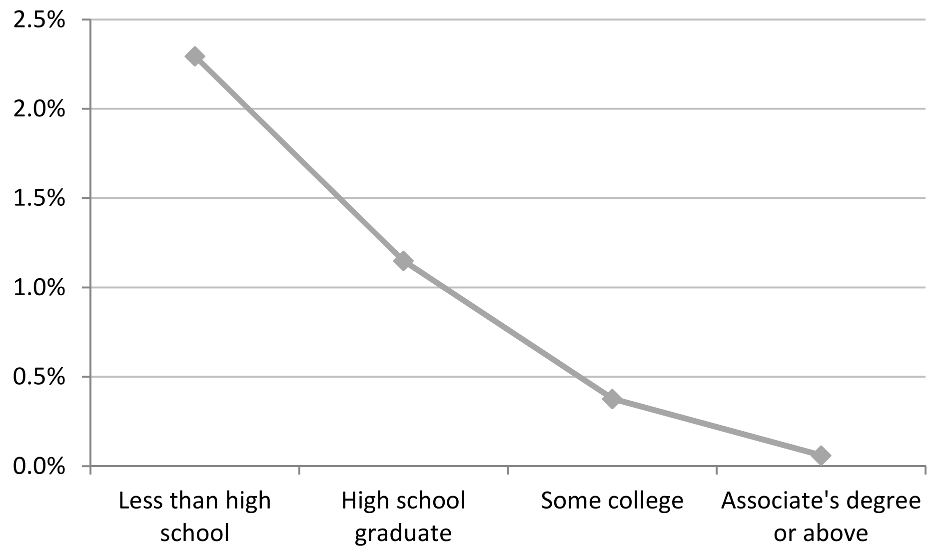
[47] Caroline Wolf Harlow. "Table 1. Educational attainment for State and Federal prison inmates, 1997 and 1991, local jail inmates, 1996 and 1989, probationers, 1995, and the general population, 1997" in "Education and Correctional Populations." Bureau of Justice Statistics Special Report, January 2003,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

Figure A7.6: 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.[48]

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

A7.3 Welfare and unemployment

Statistics show that as education levels increase, the number of welfare and unemployment applicants declines. Welfare and unemployment claimants can receive assistance from a variety of different sources, including Temporary Assistance for Needy Families (TANF), Supplemental Nutrition Assistance Program (SNAP), Medicaid, Supplemental Security Income (SSI), and unemployment insurance.[49]

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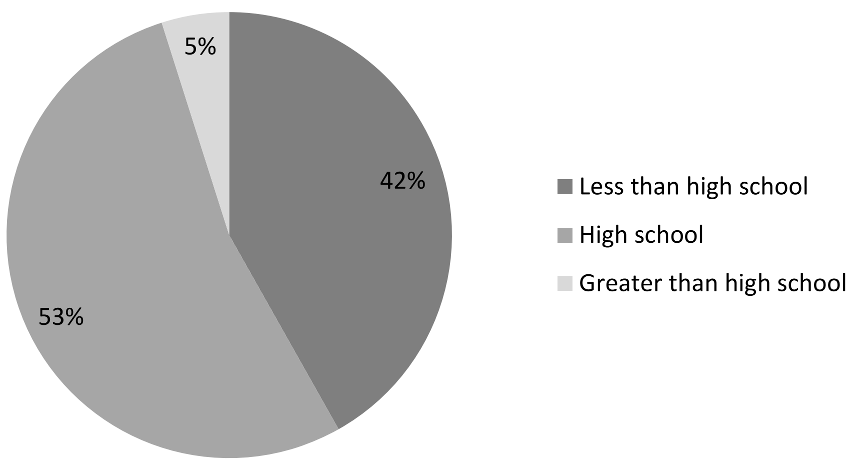
[48] Kathryn E. McCollister, Michael T. French, and Hai Fang, "The Cost of Crime to Society: New Crime-Specific Estimates for Policy and Program Evaluation." *Drug and Alcohol Dependence* 108, no. 1-2 (April 1, 2010): 98-109.

[49] 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 A7.7 relates the breakdown of TANF recipients by education level, derived from data supplied by the U.S. Department of Health and Human Services.[50] As shown, the demographic characteristics of TANF recipients are weighted heavily towards the less than high school and high school categories, with a much smaller representation of individuals with greater than a high school education.

Figure A7.7: Breakdown of TANF recipients by education level



Unemployment rates also decline with increasing levels of education, as illustrated in Figure A7.8. These data are supplied by the Bureau of Labor Statistics.[51] 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.

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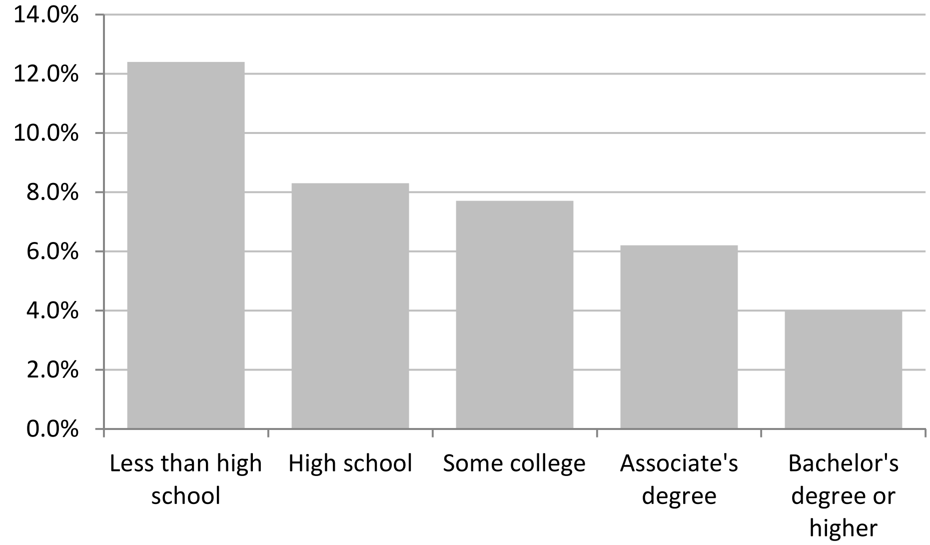
[50] U.S. Department of Health and Human Services, Office of Family Assistance, "Table 10:26 - Temporary Assistance for Needy Families - Active Cases: Percent Distribution of TANF Adult Recipients by Educational Level, FY 2009" in Temporary Assistance for Needy Families Program Ninth Report to Congress,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

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

Figure A7.8: Unemployment by education level



A7.4 Conclusion

The statistical databases bear out the simple correlation between education and improved health, lower incarceration rates, and reduced welfare and unemployment. These by no means comprise the full range of benefits one possibly can link to education. Other social benefits certainly may be identified in the future as reliable statistical sources are published and data are incorporated into the analytical framework. However, the fact that these incidental benefits occur and can be measured is a bonus that enhances the economic attractiveness of education.