Demonstrating the Value of Barton Community College

Analysis of the Economic Impact and Return on Investment of Education

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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 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 economic 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 regional 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 labor and non-labor multipliers used in the investment analysis in Chapter 3.

Another major change in the model is the replacement of John Parr's development index with a proprietary mapping of instructional programs to regional industries. The Parr index was a significant move forward when we first applied it in 2000 to approximate the industries where students were most likely to find employment after leaving college. Now, by mapping the institution's program completers to detailed regional industries, we can move from an approach based on assumptions to one based on the actual occupations for which students are trained.

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 publicly-funded institutions in the state 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 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 more detailed view of the economy, enabling us to more accurately determine regional economic impacts. Many of our former assumptions have been replaced with observed data, as exemplified by the program-to-industry mapping and the revision to the alternative education variable. 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

Barton Community College (Barton) creates value in many ways. The college is committed to putting students on the path to success and plays a key role in helping them increase their employability and achieve their individual potential. With a wide range of program offerings, Barton enables students to earn credentials and develop the skills they need in order to have a fulfilling and prosperous career. The college also provides an excellent environment for students to meet new people and make friends, while participation in college courses improves the students' self-confidence and promotes their mental health. These social and employment-related benefits have a positive influence on the health and well-being of individuals.

However, the contribution of Barton consists of more than solely influencing the lives of students. The college's program offerings support a range of industry sectors in the Barton Service Area and supply employers with the skilled workers they need to make their businesses more productive. The expenditures of Barton, along with the spending of its employees and its students, further support the Barton Service Area economy through the output and employment generated by local businesses. Lastly, and just as importantly, the economic impact of Barton extends as far as the state treasury in terms of increased tax receipts and decreased public sector costs.

Objective of the report

In this report we aim to assess the economic impact of Barton on the Barton Service Area business community and the return on investment generated by the college for its key stakeholder groups: students, society, and taxpayers. Our approach is twofold. We begin with an economic impact analysis of Barton on the local business community in the Barton Service Area. To derive results, we rely on a specialized Social Accounting Matrix (SAM) model to calculate the additional income created in the Barton Service Area economy as a result of college-linked input purchases, consumer spending, and the added skills of Barton students. Results of the regional economic impact analysis are broken out according to the following two effects: 1) impact of college operations and 2) impact of the skills acquired by former students that are still active in the Barton Service Area workforce.

The second component of the study is a standard investment analysis to determine how money spent on Barton performs as an investment over time. The investors in this case are students, society, and taxpayers, all of whom pay a certain amount in costs to support the educational activities at Barton. The students' investment consists of their out-of-pocket expenses and the opportunity cost of attending college as opposed to working. Society invests in education by forgoing the services that it would have received had government not funded Barton and the business output that it would have enjoyed had students been employed instead of studying. Taxpayers contribute their investment through government funding.

In return for these investments, students receive a lifetime of higher incomes, society benefits from an enlarged economy and a reduced demand for social services, and taxpayers benefit from an expanded tax base and a collection of public sector savings. To determine the feasibility of the investment, the model projects benefits into the future, discounts them back to their present value, and compares them to their present value costs. Results of the investment analysis for students, society, and taxpayers are displayed in the following four ways: 1) net present value of benefits, 2) rate of return, 3) benefit-cost ratio, and 4) payback period.

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 the college, industry and employment data from the U.S. Bureau of Labor Statistics and U.S. Census Bureau, outputs of EMSI's 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 Barton with other publicly-funded 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 the Barton management team and stakeholders with pertinent information should questions arise about the extent to which Barton impacts the Barton Service Area economy and generates a return on investment. Differences between Barton'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 Barton can do next. The implied assumption is that the college can effectively improve its results if it increases the number of students it serves, helps students to achieve their educational goals, and remains 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 Barton has a significant positive impact on the Barton Service Area business community and generates a return on investment for its main stakeholder groups: students, society, and taxpayers. Using a two-pronged approach that involves a regional economic impact analysis and an investment analysis, we calculate the benefits to each of these groups. Key findings of the study are as follows:

Economic impact on Barton Service Area business community

- Barton employed **295** full-time and **494** part-time employees in 2012-13. Payroll amounted to **$19.4 million**, much of which was spent in the Barton Service Area to purchase groceries, clothing, and other household goods and services. Barton is itself a buyer of goods and services and spent **$20.5 million** to support its operations in 2012-13. The net impact of Barton payroll and expenses in the Barton Service Area was approximately **$11.7 million** in added income in FY 2012-13.
- Approximately **84%** of Barton's students stay in the Barton Service Area after exiting college. Their enhanced skills and abilities bolster the output of local employers, leading to higher regional income and a more robust economy. The accumulated contribution of former Barton students who were employed in the regional workforce in FY 2012-13 amounted to **$82.4** million in added income in the Barton Service Area economy.
- The total effect of Barton on the local business community in the Barton Service Area in FY 2012-13 was **$94.1 million**, approximately equal to **3.4**% of the Barton Service Area's total Gross Regional Product.

Economic Impact Notes

- The revenue and expenditures from Barton's Fort Riley and Fort Leavenworth campuses, and other outreach efforts, are included in the college's collective contribution to the Barton Service Area. The impact the college has on the seven counties is seen as a whole through all of Barton's operations and services. In short, this report focuses solely on Barton's impact on the seven counties within the Barton Service Area.
- Some limitations of the report:
    1. Not all employees live in the Barton Service Area; the benefits of the total jobs created are shared with communities outside the Barton Service Area.
    2. Not all students reside in the Barton Service Area; the benefits of student spending and productivity are also shared with communities outside the Barton Service Area.
    3. The majority of the college's expenses are spent within the service area, and the college prioritizes local business when possible. However, this is not always feasible, and occasionally some money has to be spent with organizations from outside the Barton Service Area.

Return on investment to students, society, and taxpayers

- Students paid a total of **$10.1 million** to cover the cost of tuition, fees, books, and supplies at Barton in 2012-13. They also forwent **$33.6 million** in earnings that they would have generated had they been working instead of learning.
- In return for the monies invested in Barton, students receive a present value of **$153.2 million** in increased earnings over their working lives. This translates to a return of **$3.50** in higher future income for every $1 that students pay for their education at Barton. The corresponding annual return on investment is **14.3%**.
- Society as a whole in the state of Kansas will receive a present value of **$370.9 million** in added state income over the course of the students' working lives. Society will also benefit from **$13.8 million** in present value social savings related to reduced crime, lower welfare and unemployment, and increased health and well-being across the state.
- For every dollar that state and Barton Service Area taxpayers spent on Barton in FY 2012-13, society as a whole will receive a cumulative value of **$21.50** in benefits, for as long as Barton's 2012-13 students remain active in the state workforce.
- State and Barton Service Area taxpayers in Kansas paid **$17.9 million** to support the operations of Barton in 2012-13. The present value of the added tax revenue stemming from the students' higher lifetime incomes and the increased output of businesses amounts to **$32.7 million** in benefits to taxpayers. Savings to the public sector add another **$3.8 million** in benefits due to a reduced demand for government-funded social services in Kansas.
- Dividing the benefits to state and local taxpayers by the amount that they paid to support Barton yields a **2.0** benefit-cost ratio, *i.e.*, every $1 in costs returns **$2.00** in benefits. Taxpayers also see an average annual return of **5.0%** on their investment in Barton.

Chapter 1: Profile of Barton and the Regional Economy

Estimating the benefits and costs of Barton requires three types of information: 1) employee and finance data, 2) student demographic and achievement data, and 3) the economic profile of the Barton Service Area and the state. For the purpose of this study, information on the college and its students was obtained from Barton, and data on the regional and 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 Barton include information on college faculty and staff by place of work and by place of residence. These data appear in Table 1.1. As shown, Barton employed 295 full-time and 494 part-time faculty and staff in FY 2012-13. Of these, 56% worked in the Barton Service Area and 56% lived in the region. These data are used to isolate the portion of the employees' payroll and household expenses that remains in the regional economy.

Table 1.1: Employee data, FY 2012-13

Full-time faculty and staff (headcount)	295
Part-time faculty and staff (headcount)	494
Total faculty and staff	**789**
% of employees that work in region	56%
% of employees that live in region	56%

Source: Data supplied by Barton.

1.1.2 Revenues

Table 1.2 shows Barton's annual revenues by funding source – a total of $41.9 million in FY 2012-13. As indicated, tuition and fees comprised 22% of total revenue, Barton Service Area government revenue another 23%, revenue from state government 19%, federal government revenue 16%, and all other revenue (*i.e.*, auxiliary revenue, sales and services, interest, and donations) the remaining 20%. These data are critical in identifying the annual costs of educating the student body from the perspectives of students and taxpayers.

Table 1.2: Barton revenue by source, FY 2012-13

Funding source	Total	% of total
Tuition and fees	$9,046,592	22%
Barton Service Area government revenue	$9,806,589	23%
State government revenue	$8,128,178	19%
Federal government revenue	$6,629,066	16%
All other revenue	$8,267,844	20%
Total revenues	**$41,878,269**	**100%**

Source: Data supplied by Barton.

1.1.3 Expenditures

Barton's combined payroll amounted to $19.4 million, equal to 49% of the college's total expenses for FY 2012-13. Other expenditures, including capital and purchases of supplies and services, made up $20.5 million. These budget data appear in Table 1.3.

Table 1.3: Barton expenses by function, FY 2012-13

Expense item	Total	%
Employee payroll	$19,415,917	49%
Capital depreciation	$786,969	2%
All other expenditures	$19,729,877	49%
Total expenses	**$39,932,763**	**100%**

Source: Data supplied by Barton.

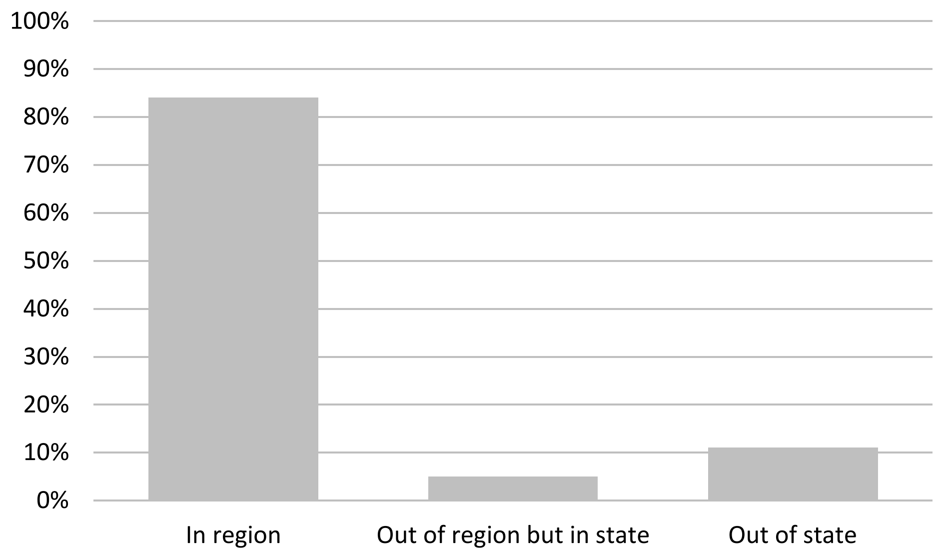
1.2. Student profile data

1.2.1 Demographics

Barton served 16,240 credit students and 332 non-credit students in the 2012-13 reporting year (unduplicated). The breakdown of the student body by gender was 58% male and 42% female, and the breakdown by ethnicity was 68% whites, 29% minorities, and 3% unknown. The students' overall average age was 24.

Figure 1.1 presents the settlement patterns of Barton students after exiting college. As indicated, 84% of students remain in the Barton Service Area. Another 5% of students settle outside the Barton Service Area but in the state, and the remaining 11% 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. 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 Barton's students are key to determining how far students advance in their education during the course of the reporting year and the associated value of that achievement.

As indicated, Barton served 551 associate's degree graduates and 86 certificate graduates in the 2012-13 reporting year. A total of 6,407 credit-bearing students pursued but did not complete a credential during the reporting year, while another 1,565 students prepared for transfer to a different institution. Barton also served 540 dual credit students and 6,645 personal enrichment students. Workforce and all other students comprised the remaining 778 students.

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

Category	Headcount	Total CHEs	Average CHEs
Associate's degree graduates	551	12,309	22.3
Certificate graduates	86	2,029	23.6
Continuing students	6,407	39,498	6.2
Transfer track students	1,565	19,558	12.5
Dual credit students	540	3,974	7.4
Personal enrichment students	6,645	25,498	3.8
Workforce and all other students	778	5,634	7.2
Total, all students	**16,572**	**108,498**	**6.5**
Total, less personal enrichment students	**9,927**	**83,000**	**8.4**

Source: Data supplied by Barton.

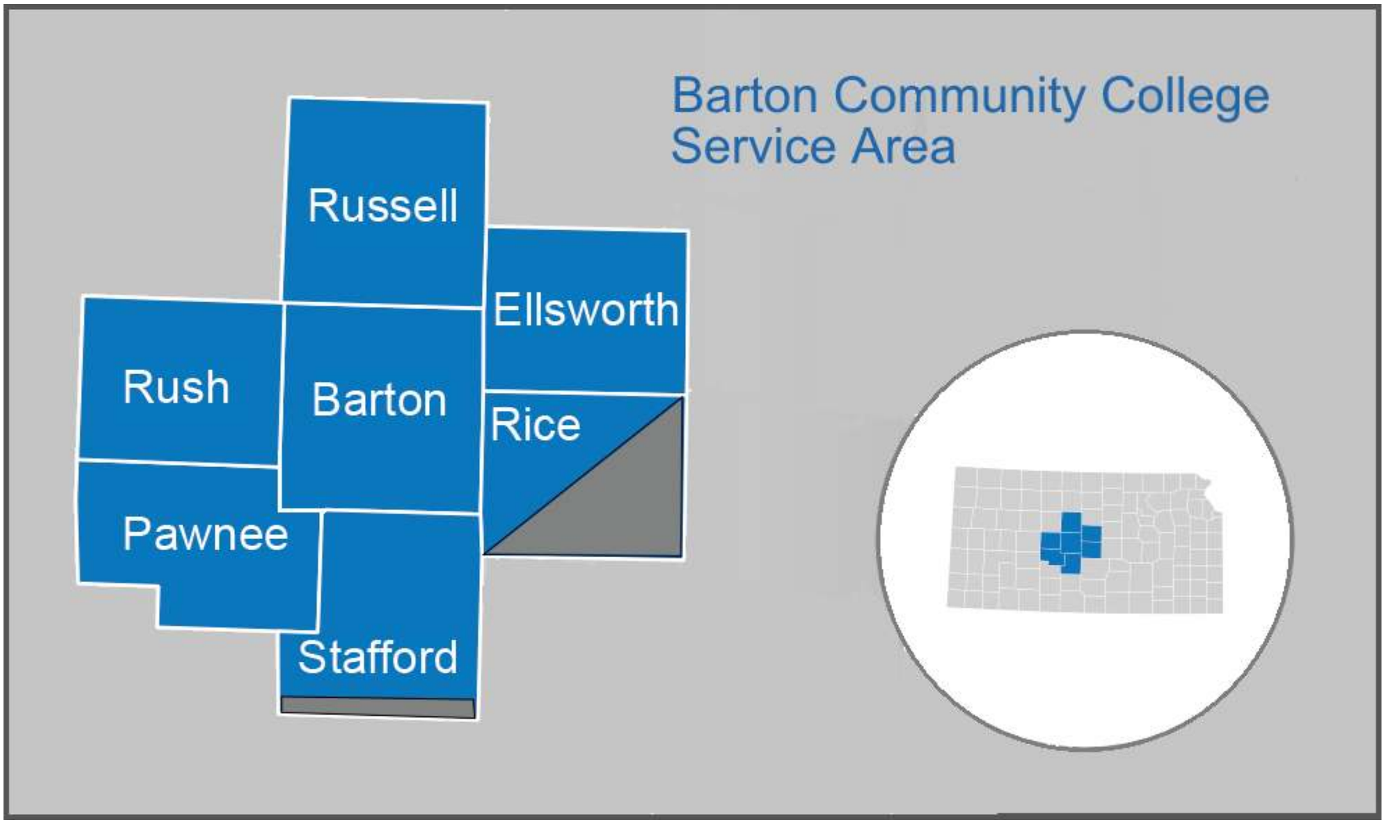
Altogether, Barton students completed 108,498 credit hour equivalents (or CHEs) during the 2012-13 reporting year. In the analysis, we exclude the CHE production of personal enrichment students under the assumption that they do not attain workforce skills that will increase their earnings. The average number of CHEs per student (excluding personal enrichment students) was 8.4.

1.3 Regional profile data

1.3.1 Gross Regional Product

Barton serves a region defined by the Barton Service Area in Kansas.[1] Since the college was first established in 1965, it has been serving the Barton Service Area by enhancing the workforce, providing Barton Service Area residents with easy access to higher education opportunities, and preparing students for highly-skilled, technical professions. Table 1.5 summarizes the breakdown of the Barton Service Area economy by major industrial sector, with details on labor and non-labor income. Labor income refers to wages, salaries, and proprietors' income; while non-labor income refers to profits, rents, and other forms of investment income. Together, labor and non-labor income comprise the region's total Gross Regional Product, or GRP.

[1] The Barton Service Area is made up of the following counties: Barton, Ellsworth, Pawnee, Rice, Rush, Russell, and Stafford.



As shown in Table 1.5, the Barton Service Area's GRP is approximately $2.8 billion, equal to the sum of labor income ($1.7 billion) and non-labor income ($1.1 billion). In Chapter 2, we use the GRP of the Barton Service Area as the backdrop against which we measure the relative impacts of the college on the regional economy.

Table 1.5: Labor and non-labor income by major industry sector in the Barton Service Area, 2012

Industry sector	Labor income (millions)	Non-labor income (millions)	Total income (millions)	% of Total
Agriculture, Forestry, Fishing and Hunting	$130	$51	$182	6.5%
Mining	$318	$452	$769	27.6%
Utilities	$12	$32	$44	1.6%
Construction	$107	$7	$114	4.1%
Manufacturing	$135	$92	$227	8.2%
Wholesale Trade	$73	$53	$125	4.5%
Retail Trade	$91	$52	$143	5.1%
Transportation and Warehousing	$60	$19	$78	2.8%
Information	$17	$27	$44	1.6%
Finance and Insurance	$83	$64	$147	5.3%
Real Estate and Rental and Leasing	$23	$41	$64	2.3%
Professional and Technical Services	$44	$12	$56	2.0%
Management of Companies and Enterprises	$7	$1	$8	0.3%
Administrative and Waste Services	$29	$4	$33	1.2%
Educational Services	$11	$1	$13	0.5%
Health Care and Social Assistance	$148	$12	$160	5.8%
Arts, Entertainment, and Recreation	$4	$2	$6	0.2%
Accommodation and Food Services	$27	$14	$41	1.5%
Other Services (except Public Administration)	$33	$5	$38	1.4%
Public Administration	$313	$32	$345	12.4%
Other Non-industries	$0	$148	$148	5.3%
Total	**$1,664**	**$1,120**	**$2,784**	**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 the Barton Service Area. Among the region's non-government industry sectors, the "Mining" sector is the largest employer, supporting 5,977 jobs or 13.4% of total employment in the region. The second largest employer is the "Agriculture, Forestry, Fishing and Hunting" sector, supporting 4,282 jobs or 9.6% of the region's total employment. Altogether, the Barton Service Area supports 44,446 jobs.[2]

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

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

Industry sector	Total jobs	% of Total
Agriculture, Forestry, Fishing and Hunting	4,282	9.6%
Mining	5,977	13.4%
Utilities	115	0.3%
Construction	1,973	4.4%
Manufacturing	2,736	6.2%
Wholesale Trade	1,322	3.0%
Retail Trade	3,785	8.5%
Transportation and Warehousing	1,040	2.3%
Information	363	0.8%
Finance and Insurance	2,199	4.9%
Real Estate and Rental and Leasing	963	2.2%
Professional and Technical Services	1,209	2.7%
Management of Companies and Enterprises	73	0.2%
Administrative and Waste Services	1,153	2.6%
Educational Services	471	1.1%
Health Care and Social Assistance	4,234	9.5%
Arts, Entertainment, and Recreation	371	0.8%
Accommodation and Food Services	1,924	4.3%
Other Services (except Public Administration)	2,026	4.6%
Public Administration	8,231	18.5%
Total	**44,446**	**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 levels by education level in the Barton Service Area at the midpoint of the average-aged worker's career. These numbers are derived from EMSI's complete employment data on average income per worker in the region.[3] As shown, students who achieve an associate's degree can expect $30,500 in income per year, approximately $7,300 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 $17,400 in higher income.

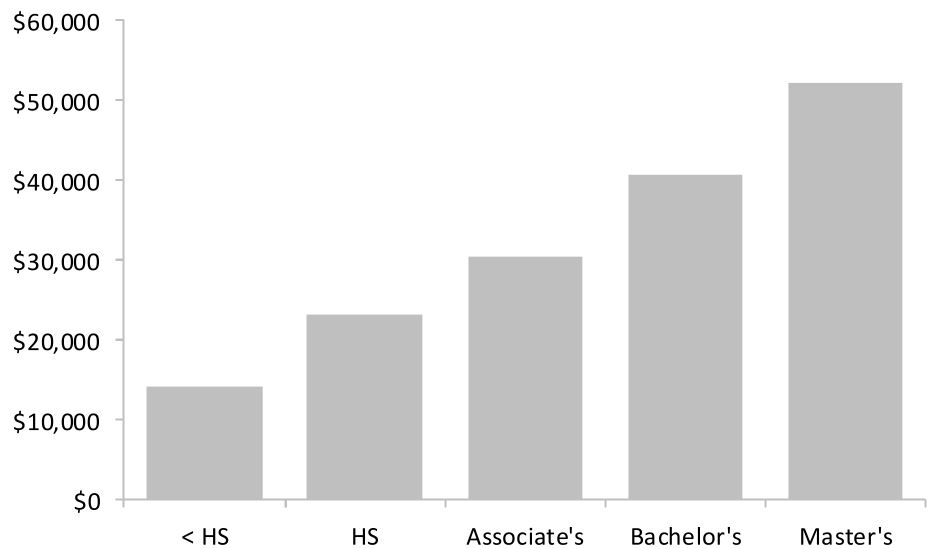
[3] Wage rates in the EMSI SAM model combine state and federal sources to provide earnings that reflect complete employment in the region, including proprietors, self-employed workers, and others not typically included in state data, as well as benefits and all forms of employer contributions. As such,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

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

Education level	Income	Difference
Less than high school	$14,100	n/a
High school or equivalent	$23,200	$9,100
Associate's degree	$30,500	$7,300
Bachelor's degree	$40,600	$10,100
Master's degree	$52,100	$11,500
Doctoral degree	$65,200	$13,100

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 Barton's impact on the regional economy, and Chapter 3 looks at Barton as an investment. The appendices detail a collection of miscellaneous theory and data issues.

Chapter 2: Economic Impact Analysis

Barton impacts the Barton Service Area in a variety of ways. The college is an employer and a buyer of goods and services. It attracts monies to the Barton Service Area that would not have otherwise entered the economy through the revenue it receives from non-local sources. Further, as a primary source of education to area residents, Barton supplies trained workers to local industry and contributes to associated increases in regional output.

In this chapter we track Barton's regional economic impact under two headings: 1) the college operations effect, stemming from Barton's payroll and purchases; and 2) the student productivity effect, comprising the added income created in the Barton Service Area as former Barton students expand the economy's stock of human capital.

2.1 College operations effect

Nearly all employees of Barton live in the Barton Service Area (see Table 1.1). Faculty and staff payroll counts as part of the region's overall income, and their spending for groceries, apparel, and other household expenditures helps support Barton Service Area businesses. Barton is itself a purchaser of supplies and services, and many of Barton's vendors are located in the Barton Service Area. These expenditures create a ripple effect that generates still more jobs and income throughout the economy.

Table 2.1 presents the economic impact of Barton's operations. The top row shows the overall labor and non-labor income in the region, which we use as the backdrop for gauging the relative role of Barton in the Barton Service Area economy. These data match the total labor and non-labor income figures provided in Table 1.5 of Chapter 1.

Table 2.1: Impact of college operations

	Labor income (thousands)	Non-labor income (thousands)	Total income (thousands)	% of total income in region
Total income in region	$1,663,903	$1,120,230	$2,784,133	100.0%
Initial effect	**$10,873**	**$0**	**$10,873**	**0.4%**
Multiplier effect				
Direct effect	$984	$1,090	$2,075	<0.1%
Indirect effect	$73	$67	$140	<0.1%
Induced effect	$1,123	$1,324	$2,447	<0.1%
Total multiplier effect	**$2,180**	**$2,481**	**$4,662**	**0.2%**
Gross effect (initial + multiplier)	**$13,053**	**$2,481**	**$15,534**	**0.6%**
Less alternative uses of funds	-$1,783	-$2,025	-$3,808	<0.1%
Net effect	**$11,270**	**$456**	**$11,726**	**0.4%**

Source: EMSI IO model.

As for the impacts themselves, we follow best practice and draw the distinction between initial effects and multiplier effects. The initial effect of Barton operations is simple – it amounts to the $10.9 million in college payroll (including employee benefits, less monies paid to employees who work at locations outside the region). Total college payroll appeared in the list of college expenditures reported in Table 1.3. Note that, as a public entity, Barton does not generate property income in the traditional sense, so non-labor income is not associated with college operations under the initial effect.

Multiplier effects refer to the additional income created in the economy as Barton and its employees spend money in the region. 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 Barton and its employees. Indirect effects occur as the supply chain of the initial industries creates even more income in the region. 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 region. The EMSI SAM model contains approximately 1,100 industry sectors at the highest level of detail available in the North American Industry Classification System (NAICS), and it supplies the industry-specific multipliers required to determine the impacts associated with economic activity within the region. For more information on the EMSI SAM model and its data sources, see Appendix 3.

Table 1.3 in Chapter 1 breaks Barton's 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 college personnel approximately match those of the average consumer, we map college 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 college's spending patterns approximately match national averages and apply the national spending coefficients for NAICS 611210 (Junior Colleges).[4] Capital depreciation is mapped to the construction sectors of NAICS 611210 and the college's remaining expenditures to the non-construction sectors of NAICS 611210.

We now have three vectors detailing the spending of Barton: one for college payroll, another for capital items, and a third for Barton's purchases of supplies and services. Before entering these items into the SAM model, we factor out the portion of them that occurs locally. 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

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[4] NAICS 611210 comprises junior colleges, community colleges, and junior college academies and schools.

satisfied by local suppliers. For example, if 40% of the demand for NAICS 541211 (Offices of Certified Public Accountants) is satisfied by local suppliers, the RPC for that sector is 40%. The remaining 60% of the demand for NAICS 541211 is provided by suppliers located outside the region. The three college spending vectors are thus multiplied sector-by-sector by the corresponding RPC for each sector to arrive at the strictly local spending associated with the college.

Local spending is entered into the SAM model's multiplier matrix, which in turn provides an estimate of the associated multiplier effects on regional 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, Barton's spending creates $2.2 million in labor income and another $2.5 million in non-labor income through multiplier effects – a total of $4.7 million. This together with the $10.9 million in initial effects generates a gross total of $15.5 million in impacts associated with the spending of Barton and its employees in the region.

Here we make a significant qualification. Barton received an estimated 54.4% of its funding from sources in the Barton Service Area. These monies came from students living in the region, from private sources located within the region, and from state and local taxes.[5] Had other industries received these monies rather than Barton, 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 local funds on Barton – 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.

For Barton, we calculate counterfactual outcomes by modeling the local monies spent on the college as regular spending on consumer goods and savings. Our assumption is that, had students not spent money on the college, they would have used that money instead to buy consumer goods. Similarly, had the monies that taxpayers spent on Barton been returned to them 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 local students and taxpayers on Barton, 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 local spending only. Finally, we run the local spending through the SAM model's regional 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 fund" in Table 2.1.

The net total income effect of Barton spending can now be computed. As shown in the last row of Table 2.1, the net effect is approximately $11.3 million in labor income and $456,160 in non-labor

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[5] Local taxpayers pay state taxes, and it is thereby fair to assume that a portion of the state funds received by Barton comes from local sources. The portion of state revenue paid by local taxpayers is estimated by applying the ratio of regional earnings to total earnings in the state.

income. The overall total is $11.7 million, representing the added income created in the regional economy as a result of Barton operations.

2.2 Student productivity effect

Barton's greatest economic impact stems from the education, skills training, and career enhancement that it provides. Since it was established, the college has supplied skills training to students who have subsequently entered or re-entered the regional workforce. As these skills accumulated, the Barton Service Area's stock of human capital expanded, boosting the competiveness of existing industries, attracting new industries, and generally enlarging overall output. The sum of all these several and varied effects, measured in terms of added regional income, constitutes the total impact of current and past Barton student productivity on the Barton Service Area economy.

The student productivity effect differs from the college operations effect in one fundamental way. Whereas the effects of college operations depend on an annually-renewed injection of new sales in the local economy, the student productivity effect is the result of years of past instruction and the associated workforce accumulation of Barton skills. Should Barton cease to exist, the college operations effect would also immediately cease to exist; however, the impact of the college's 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 former Barton 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 Barton students.

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 Barton's historical student headcount (both credit and non-credit) over the past 30 years,[6] from 1983-84 to 2012-13. From this vector of historical enrollments we remove the number of students who are not currently active in the regional workforce, whether because they're still enrolled in education, or because they're unemployed, employed but working in a different region, or out of the workforce completely due to retirement or death. We estimate the historical employment patterns of students in the Barton Service Area using the following sets of data or assumptions: 1) a set of settling-in

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

factors to determine how long it takes the average student to settle into a career;[7] 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) regional migration data from the U.S. Census Bureau. The end result of these several computations is an estimate of the portion of students who were still actively employed in the Barton Service Area as of FY 2012-13.

The next step is to transition from the number of students who were still employed in the Barton Service Area to the number of skills they acquired from Barton. 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 8.4 CHEs. Using this figure as proxy for previous years, we multiply the 8.4 average CHEs per student by the number of students still active in the workforce to derive an estimate of the number of Barton CHEs that were present in the workforce during the analysis year.[8] The result – 1.2 million CHEs – appears in the top row of Table 2.2.

Table 2.2: Number of Barton CHEs in workforce and initial labor income created in region

Number of CHEs in workforce	1,180,296
Average value per CHE	$110
Initial labor income, gross	**$129,335,798**
Percent reduction for alternative education opportunities	25%
Percent reduction for adjustment for substitution effects	50%
Initial labor income, net	**$48,678,505**

Source: EMSI college impact model.

The next row in Table 2.2 shows the average value per CHE, equal to $110. This value represents the average increase in wages that former Barton students received during the analysis year for every CHE they completed at the college. 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 Barton's 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

[7] 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 and transfer track students. Workforce and professional development students are usually already employed while attending college, so they experience no delay in the onset of their benefits.

[8] Students who enroll at Barton 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.

calculation yields approximately $129.3 million in gross labor income in increased wages received by former students in FY 2012-13 (as shown in Table 2.2).

The next two rows in the table show two adjustments that we make 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 training provided by Barton and subsequent influx of skilled labor into the local economy. The first counterfactual scenario that we address is the adjustment for alternative education opportunities. Our assumption is that, if a portion of the students could have received training even if Barton did not exist, the higher wages that accrue to those students cannot be counted as added labor income in the region. The adjustment for alternative education opportunities amounts to a 25% reduction of the $129.3 million in added labor income, meaning that 25% of the added labor income would have been generated in the Barton Service Area anyway, even if Barton did not exist. For more information on the calculation of the alternative education variable, see Appendix 5.

The other adjustment in Table 2.2 accounts for the substitution of workers. Suppose Barton did not exist and in consequence there were fewer skilled workers in the region. Businesses could still satisfy some of their need for skilled labor by recruiting from outside the Barton Service Area. We refer to this phenomenon as the out-of-region worker substitution effect. Lacking exact information on its possible magnitude, we set the value of out-of-region worker substitution at 50%. In other words, of the jobs that students fill at local businesses, we assume 50% of them could have been filled by workers recruited from outside the Barton Service Area if Barton did not exist.[9] With the 50% adjustment, the net labor income added to the economy comes to $48.7 million, as shown in Table 2.2.

The $48.7 million in added labor income appears under the initial effect in the "Labor income" column of Table 2.3. To this we add an estimate for initial non-labor income. As discussed earlier in this section, businesses that employ former Barton students 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 ($48.7 million) to the specific NAICS six-digit industry sectors where former Barton students are employed. This allocation entails a process that maps Barton's completers[10] 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 regional SAM model. Completer data comes from the Integrated Postsecondary Education Data System (IPEDS), which organizes Barton program completions according to the Classification of Instructional Programs (CIP) developed by the National Center for Education Statistics (NCES). Using a crosswalk created

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

[10] The Integrated Postsecondary Education Data System (IPEDS) defines a completer as the following: "A student who receives a degree, diploma, certificate, or other formal award. In order to be considered a completer, the degree/award must actually be conferred." IPEDS Glossary, accessed July 2013, http://nces.ed.gov/ipeds/glossary/?text=1.

by NCES and the Bureau of Labor Statistics (BLS), we map the breakdown of Barton completers by CIP code to the approximately 700 detailed occupations in the Standard Occupational Classification (SOC) system used by the BLS. We then allocate the $48.7 million in initial labor income effects proportionately to the SOC framework based on the occupational distribution of the completions. Finally, we apply a matrix of wages by industry and by occupation from the regional SAM model to map the detailed occupational distribution of the $48.7 million to the NAICS six-digit industry sectors of the model.[11]

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 $16.5 million in non-labor income attributable to the former Barton students. Summing initial labor and non-labor income together provides the total initial effect of student productivity in the Barton Service Area economy, equal to approximately $65.2 million.

Table 2.3: Student productivity effect

	Labor income (thousands)	Non-labor income (thousands)	Total income (thousands)	% of total income in region
Total income in region	$1,663,903	$1,120,230	$2,784,133	100.0%
Initial effect	**$48,679**	**$16,516**	**$65,194**	**2.3%**
Multiplier effect				
Direct effect	$2,429	$907	$3,336	0.1%
Indirect effect	$223	$80	$302	<0.1%
Induced effect	$10,214	$3,315	$13,529	0.5%
Total multiplier effect	**$12,865**	**$4,302**	**$17,167**	**0.6%**
Total effect (initial + multiplier)	**$61,544**	**$20,817**	**$82,361**	**3.0%**

Source: EMSI IO model.

The next few rows of Table 2.3 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 Barton students 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 former Barton students.

To estimate multiplier effects, we convert the industry-specific income figures generated through the initial effect to regional 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 region. Finally, we convert all increases in regional sales back to income

[11] For example, if the regional 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.

using the income-to-sales ratios supplied by the SAM model. The final results are $12.9 million in labor income and $4.3 million in non-labor income, for an overall total of $17.2 million in multiplier effects. The grand total impact of student productivity thus comes to $82.4 million, the sum of all initial and multiplier labor and non-labor income effects. The total figures appear in the last row of Table 2.3.

2.3 Summary of income effects

Table 2.4 displays the grand total of Barton's impact on the Barton Service Area in 2012-13, including the college operations effect and the student productivity effect.

Table 2.4: Barton total effect, 2012-13

	Total (thousands)	% of Total
Total income in region	$2,784,133	100.0%
College operations effect	$11,726	0.4%
Student productivity effect	$82,361	3.0%
Total	**$94,088**	**3.4%**

Source: EMSI college impact model.

These results demonstrate several important points. First, Barton creates regional economic impacts through its own operations spending and through the increase in productivity as former Barton students remain active in the regional workforce. Second, the student productivity effect is by far the largest and most important impact of Barton, stemming from higher incomes of students and their employers. And third, regional income in the Barton Service Area would be substantially lower without the educational activities of Barton.

Calculating Job Equivalents Based on Income

In this study the impacts of Barton on the regional economy are expressed in terms of income, specifically, the added income that would not have occurred in the Barton Service Area if the college 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 Barton Service Area that a given amount of income could potentially support. Job equivalents are calculated by dividing the added income created by the college and its students by the average income per worker in the region.

Based on the added income figures from Table 2.4, the job equivalents supported by the activities of Barton and its students are as follows:

- *College operations effect = **310** job equivalents*
- *Student productivity effect = **2,178** job equivalents*

*Overall, the income created by Barton during the analysis year supported **2,488** average-wage jobs in the region.*

Chapter 3: Investment Analysis

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

3.1 Student perspective

Analyzing the benefits and costs of education from the perspective of students is the most obvious – they give up time and money to go to college in return for a lifetime of higher income. The cost component of the analysis thus comprises the monies students pay (in the form of tuition and fees and forgone time and money), and the benefit component focuses on the extent to which the students' incomes increase 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 $9 million from Table 1.2. Direct outlays also include the cost of books and supplies. On average, full-time students spent $1,133 each on books and supplies during the reporting year.[12] Multiplying this figure times the number of full-time equivalents (FTEs) produced by Barton in 2012-13[13] generates a total cost of $3.1 million for books and supplies.

Opportunity cost is the most difficult component of student costs to estimate. It measures the value of time and earnings forgone by students who go to 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.[14] 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

[12] Based on the data supplied by Barton.

[13] A single FTE is equal to 30 CHEs, so there were 2,767 FTEs produced by Barton students in 2012-13, equal to 83,000 CHEs divided by 30 (excluding the CHE production of personal enrichment students).

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

of the student population (24) to better reflect their wages at their current age.[15] This calculation yields an average full earning potential of $17,441 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, Barton students earned an average of 8.4 CHEs per student (excluding personal enrichment students), which is approximately equal to 28% of a full academic year.[16] We thus include no more than $4,861 (or 28%) of the students' full earning potential in the opportunity cost calculations.

Another factor to consider is the students' employment status while attending college. Barton estimates that 75% of its students are employed. For the 25% that are not working, we assume that they are either seeking work or planning to seek work once they complete their educational goals (with the exception of personal enrichment students, who are not included in this calculation). By choosing to go to college, therefore, non-working students give up everything that they can potentially earn during the academic year (*i.e.*, the $4,861). The total value of their forgone income thus comes to $12.1 million.

Working students are able to maintain all or part of their income while enrolled. However, many of them hold jobs that pay less than statistical averages, usually because those are the only jobs they can find that accommodate their course schedule. These jobs tend to be at entry level, such as restaurant servers or cashiers. To account for this, we assume that working students hold jobs that pay 58% of what they would have earned had they chosen to work full-time rather than go to college.[17] 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, however, 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.[18] According to the Bureau of Labor Statistics American

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[15] 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.

[16] Equal to 8.4 CHEs divided by 30, the assumed number of CHEs in a full-time academic year.

[17] 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).

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

Time Use Survey, students forgo up to 1.4 hours of leisure time per day.[19] 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 $21.6 million, equal to the sum of their foregone income ($15.3 million) and forgone leisure time ($6.2 million).

The steps leading up to the calculation of student costs appear in Table 3.1. Direct outlays amount to $10.1 million, the sum of tuition and fees ($9.0 million) and books and supplies ($3.1 million), less $2.1 million 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 $33.6 million. Summing all values together yields a total of $43.7 million in student costs.

Table 3.1: Barton student costs, 2012-13 (thousands)

Direct outlays	
Tuition and fees	$9,047
Books and supplies	$3,135
Less direct outlays of personal enrichment students	-$2,126
Total direct outlays	**$10,055**
Opportunity costs	
Earnings forgone by non-working students	$12,063
Earnings forgone by working students	$15,344
Value of leisure time forgone by working students	$6,220
Total opportunity costs	**$33,627**
Total student costs	**$43,683**

Source: Based on data supplied by Barton 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.[20]

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

[19] "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.

[20] 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.

education. We calculate the future benefits stream to Barton's 2012-13 students first by determining their average annual increase in income, equal to $10.3 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 $10.3 million, see Appendix 4.

The second step is to project the $10.3 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.[21] Appendix 4 provides more information on the Mincer function and how it is used to predict future earnings growth. With the $10.3 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 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	2	3	4	5	6
Year	Gross added income to students (millions)	Less adjustments (millions)*	Net added income to students (millions)	Student costs (millions)	Net cash flow (millions)
0	$6.7	8%	$0.6	$43.7	-$43.1
1	$7.0	12%	$0.9	$0.0	$0.9
2	$7.3	21%	$1.5	$0.0	$1.5
3	$7.5	37%	$2.8	$0.0	$2.8
4	$7.8	61%	$4.8	$0.0	$4.8
5	$8.1	94%	$7.6	$0.0	$7.6
6	$8.3	95%	$7.9	$0.0	$7.9
7	$8.6	95%	$8.1	$0.0	$8.1
8	$8.8	95%	$8.4	$0.0	$8.4
9	$9.1	95%	$8.6	$0.0	$8.6
10	$9.3	95%	$8.9	$0.0	$8.9
11	$9.6	95%	$9.1	$0.0	$9.1
12	$9.8	95%	$9.3	$0.0	$9.3
13	$10.0	95%	$9.5	$0.0	$9.5
14	$10.3	95%	$9.7	$0.0	$9.7
15	$10.5	95%	$9.9	$0.0	$9.9
16	$10.7	95%	$10.1	$0.0	$10.1
17	$10.8	95%	$10.2	$0.0	$10.2
18	$11.0	94%	$10.4	$0.0	$10.4
19	$11.2	94%	$10.5	$0.0	$10.5

[21] See Mincer, 1958.

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)
20	$11.3	94%	$10.6	$0.0	$10.6
21	$11.4	94%	$10.7	$0.0	$10.7
22	$11.5	94%	$10.8	$0.0	$10.8
23	$11.6	94%	$10.9	$0.0	$10.9
24	$11.7	93%	$10.9	$0.0	$10.9
25	$11.8	93%	$11.0	$0.0	$11.0
26	$11.8	93%	$11.0	$0.0	$11.0
27	$11.9	92%	$11.0	$0.0	$11.0
28	$11.9	92%	$10.9	$0.0	$10.9
29	$11.9	91%	$10.9	$0.0	$10.9
30	$11.9	91%	$10.8	$0.0	$10.8
31	$11.8	90%	$10.7	$0.0	$10.7
32	$11.8	90%	$10.6	$0.0	$10.6
33	$11.7	89%	$10.5	$0.0	$10.5
34	$11.7	89%	$10.3	$0.0	$10.3
35	$11.6	88%	$10.2	$0.0	$10.2
36	$11.4	87%	$10.0	$0.0	$10.0
37	$11.3	86%	$9.8	$0.0	$9.8
38	$11.2	85%	$9.5	$0.0	$9.5
39	$11.0	84%	$9.3	$0.0	$9.3
40	$10.9	83%	$9.1	$0.0	$9.1
41	$10.5	26%	$2.7	$0.0	$2.7
42	$10.3	7%	$0.7	$0.0	$0.7
Present value			**$153.2**	**$43.7**	**$109.5**
Internal rate of return					**14.3%**
Benefit-cost ratio					**3.5**
Payback period (no. of years)					**9.1**

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

Source: EMSI college impact model.

As shown in Table 3.2, the $10.3 million in gross added income occurs at Year 14, 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 $10.3 million, and the gross added income in the years after the midpoint is greater than $10.3 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 college or because they are unable to find a job immediately upon graduation. Accordingly, we apply a set of "settling-in" factors to account for the time needed by students to find employment and settle into their careers. As discussed in 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 returning students and transfer track students. We apply no settling-in factors to the benefits for workforce and professional development students because the majority of them are employed while attending.

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.[22] 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).[23] 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.

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[22] 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.

[23] 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.

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 taxpayer perspective. The discount rate for taxpayers is lower than it is for students because governments are large and can therefore spread their risks over a larger and more diverse investment portfolio than the private sector can.

In Table 3.2, the net added income of Barton students yields a cumulative discounted sum of approximately $153.2 million, the present value of all of the future income increments (see the bottom section of Column 4). This may also be interpreted as the gross capital asset value of the students' higher income stream. In effect, the aggregate 2012-13 student body is rewarded for their investment in Barton with a capital asset valued at $153.2 million.

The students' cost of attending Barton is shown in Column 5 of Table 3.2, equal to a present value of $43.7 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 3.5 (equal to $153.2 million in benefits divided by $43.7 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.[24] Table 3.2 shows Barton students earning average returns of 14.3% on their investment of time and money. This is a favorable return compared, for example, to approximately 1% on a standard bank savings account, or 7% on stocks and bonds (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 14.3% student rate of return is a real rate. With an inflation

[24] 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.

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 16.8%, substantially 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.[25] Beyond that point, returns are what economists would call "pure costless rent." As indicated in Table 3.2, students at Barton see, on average, a payback period of 9.1 years on their forgone earnings and out-of-pocket costs.

3.2 Social perspective

Society as a whole in Kansas benefits from the education that Barton provides through the income that students create in the state and through the savings that they generate through their improved lifestyles. To receive these benefits, however, members of society must pay money and forgo services that they would have otherwise enjoyed if Barton did not exist. Society's investment in Barton stretches across a number of investor groups, from students to employers to taxpayers. Of these groups, taxpayers are the most uniquely motivated to invest in Barton, not for the monetary gains they expect to receive in return (although this is certainly a consideration), but for the well-being of society as a whole. From the social perspective, therefore, we weigh the benefits generated by Barton to society against the funding received by the college from state and local taxpayers, equal to $17.9 million (see Table 1.2). This comprises the cost component of the analysis.

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

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

Beekeeper Analogy

Beekeepers provide a classic example of positive externalities (sometimes called "neighborhood effects"). The beekeeper's intention is to make money selling honey. Like any other business, receipts must at least cover operating costs. If they 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 of taxpayer expenditures on education, the college impact model tracks and accounts for many of these external social benefits.

It is important to note that by comparing benefits to society against costs to taxpayers, we are including more benefits than a standard investment analysis typically allows. As such, most of the standard measures used in investment analysis (*i.e.*, the net present value, rate of return, and payback period) no longer apply. Under the social perspective, we only present the benefit-cost ratio, recognizing that the benefits component accrues to a lot more people than just the taxpayers and that, because of this, the results calculated on the basis of those benefits should be viewed strictly as a comparison between public benefits and taxpayer costs.

3.2.1 Income growth in the state

In the process of absorbing the newly-acquired skills of Barton students, not only does the productivity of Kansas's workforce increase, but so does the productivity of its physical capital and assorted infrastructure. Students earn more because of the skills they learned while attending college, 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 Barton 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.[26] As labor income increases, so does non-labor income, which consists of monies gained through investments. To calculate the growth in

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

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.

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 Barton 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 Barton does not exist. The assumption in this case is that any benefits generated by students who could have received an education even without Barton cannot be counted as new benefits to society.[27] For this analysis, we assume an alternative education variable of 25%, meaning that 25% of the student population at Barton would have generated benefits anyway even without the college. For more information on the calculation of the alternative education variable, please see Appendix 5.

Another adjustment – the "shutdown point" – nets out benefits that are not directly linked to the state and local government costs of supporting the college. As with the alternative education variable, the purpose of this adjustment is to account for counterfactual scenarios, in this case, the situation where state and local government funding for Barton did not exist. To estimate the shutdown point, we apply a sub-model that simulates the students' demand curve for education by reducing state and local support to zero and progressively increasing student tuition and fees. As student tuition and fees increase, enrollment declines. For Barton, the shutdown point adjustment is 0%, meaning that the college could not operate without taxpayer support. As such, no reduction applies. For more information on the theory and methodology behind the estimation of the shutdown point, see Appendix 7.

After adjusting for attrition, alternative education opportunities, and the shutdown point, we calculate the present value of the future added income that occurs in the state, equal to $370.9 million (this value appears again later in this chapter 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

[27] A situation in which there were no public institutions in the state is virtually impossible. The adjustment is entirely hypothetical and is used merely to examine Barton in standard investment analysis terms by accounting for benefits that would have occurred anyway, even if the college did not exist.

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.[28]

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 Barton. Social benefits appear in Table 3.3 and break down into three main categories: 1) health savings, 2) crime savings, and 3) welfare and unemployment savings. Health savings include avoided medical costs, lost productivity, and other effects associated with smoking, alcoholism, obesity, mental illness, and drug abuse. Crime savings consist of avoided costs to the justice system (*i.e.*, police protection, judicial and legal, and corrections), avoided victim costs, and benefits stemming from the added productivity of individuals who would have otherwise been incarcerated. Welfare and unemployment benefits comprise avoided costs due to the reduced number of social assistance and unemployment insurance claims.

The model quantifies social savings by calculating the probability at each education level that individuals will have poor health, commit crimes, or claim welfare and unemployment benefits. 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 Barton, 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.[29] Finally, we apply the same adjustments for attrition, alternative education, and the shutdown point to derive the net savings to society.

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[28] 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).

[29] For a full list of the data sources used to calculate the social externalities, see Appendix 1. See also Appendix 8 for a more in-depth description of the methodology.

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

Added Income	**$370,876**
Social Savings	
Health	
Smoking	$6,809
Alcoholism	$612
Obesity	$3,333
Mental illness	$438
Drug abuse	$399
Total health savings	**$11,592**
Crime	
Criminal Justice System savings	$1,767
Crime victim savings	$114
Added productivity	$270
Total crime savings	**$2,151**
Welfare/unemployment	
Welfare savings	$49
Unemployment savings	$33
Total welfare/unemployment savings	**$83**
Total social savings	**$13,825**
Total, added income + social savings	**$384,701**

Source: EMSI college impact model.

Table 3.3 above displays the results of the analysis. The first row shows the added income created in the state, equal to $370.9 million. Social savings appear next, beginning with a breakdown of savings related to health. These savings amount to a present value of $11.6 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 $2.2 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 $82,875, stemming from a reduced number of persons in need of income assistance. All told, social savings amounted to $13.8 million in benefits to society as a whole in Kansas.

The sum of the social savings and the added income in the state is $384.7 million, as shown in the bottom row of Table 3.3. These savings accrue for years out into the future, for as long as Barton's 2012-13 students remain in the workforce.

3.2.3 Benefit-cost ratio to society

The $384.7 million in present value benefits re-appears at the bottom of Column 2 in Table 3.4. State and local government support of Barton is listed in the next column, equal to $17.9 million. Note that, unlike streams of benefits that go on into the future, the state and local government contribution of $17.9 million was made in the single reporting year. Its present value and nominal dollar value are thus the same.

Table 3.4: Projected benefits and costs, social perspective

1 Year	2 Benefits to society (millions)	3 State and local gov't costs (millions)	4 Net cash flow (millions)
0	$0.9	$17.9	-$17.0
1	$1.2	$0.0	$1.2
2	$2.2	$0.0	$2.2
3	$4.0	$0.0	$4.0
4	$6.8	$0.0	$6.8
5	$10.8	$0.0	$10.8
6	$11.1	$0.0	$11.1
7	$11.4	$0.0	$11.4
8	$11.6	$0.0	$11.6
9	$11.9	$0.0	$11.9
10	$12.1	$0.0	$12.1
11	$12.4	$0.0	$12.4
12	$12.6	$0.0	$12.6
13	$12.8	$0.0	$12.8
14	$13.0	$0.0	$13.0
15	$13.2	$0.0	$13.2
16	$13.3	$0.0	$13.3
17	$13.5	$0.0	$13.5
18	$13.6	$0.0	$13.6
19	$13.8	$0.0	$13.8
20	$13.9	$0.0	$13.9
21	$13.9	$0.0	$13.9
22	$14.0	$0.0	$14.0
23	$14.0	$0.0	$14.0
24	$14.1	$0.0	$14.1
25	$14.1	$0.0	$14.1
26	$14.1	$0.0	$14.1
27	$14.0	$0.0	$14.0
28	$14.0	$0.0	$14.0
29	$13.9	$0.0	$13.9
30	$13.8	$0.0	$13.8
31	$13.6	$0.0	$13.6
32	$13.5	$0.0	$13.5
33	$13.3	$0.0	$13.3
34	$13.1	$0.0	$13.1
35	$12.9	$0.0	$12.9
36	$12.7	$0.0	$12.7
37	$12.5	$0.0	$12.5

Table 3.4: Projected benefits and costs, social perspective

1 Year	2 Benefits to society (millions)	3 State and local gov't costs (millions)	4 Net cash flow (millions)
38	$12.2	$0.0	$12.2
39	$11.9	$0.0	$11.9
40	$11.6	$0.0	$11.6
41	$3.5	$0.0	$3.5
42	$0.9	$0.0	$0.9
Present value	**$384.7**	**$17.9**	**$366.8**
Benefit-cost ratio			**21.5**

Source: EMSI college impact model.

Having now defined the present values of costs and benefits, the model forms a benefit-cost ratio of roughly 21.5 (= $384.7 million worth of benefits ÷ $17.9 million worth of state and local government support). Recall that this ratio reflects the measure of all benefits generated regardless of to whom they may accrue. Students are the beneficiaries of higher income, employers are beneficiaries of lower absenteeism and increased worker productivity, still others are beneficiaries of improved health, and so on. These are widely-dispersed benefits that do not necessarily return to taxpayers, who pay costs at full measure. Inasmuch as investors and beneficiaries are not the same individuals, measures common to standard investment analyses such as rate of return, return on investment, and payback period no longer apply. From the social perspective, therefore, the benefit-cost ratio should be viewed strictly as a comparison between public benefits and taxpayer costs.

3.3 Taxpayer perspective

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

3.3.1 Benefits to taxpayers

Table 3.5 presents the 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 $36.5 million.

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

Added tax revenue	**$32,705**
Government savings	
Health-related savings	$1,940
Crime-related savings	$1,801
Welfare/unemployment-related savings	$83
Total government savings	$3,824
Total taxpayer benefits	**$36,529**

Source: EMSI college impact model.

3.3.2 Return on investment

Taxpayer costs are reported in Table 3.6 and come to $17.9 million, equal to the contribution of state and local government to Barton (note that this number is repeated from Table 3.4). In return for their public support, therefore, taxpayers are rewarded with an investment benefit-cost ratio of 2.0 (= $36.5 million ÷ $17.9 million), indicating a profitable investment.

Table 3.6: Projected benefits and costs, taxpayer perspective

1 Year	2 Benefits to taxpayers (millions)	3 State and local gov't costs (millions)	4 Net cash flow (millions)
0	$0.1	$17.9	-$17.8
1	$0.1	$0.0	$0.1
2	$0.2	$0.0	$0.2
3	$0.4	$0.0	$0.4
4	$0.6	$0.0	$0.6
5	$1.0	$0.0	$1.0
6	$1.1	$0.0	$1.1
7	$1.1	$0.0	$1.1
8	$1.1	$0.0	$1.1
9	$1.1	$0.0	$1.1
10	$1.2	$0.0	$1.2
11	$1.2	$0.0	$1.2
12	$1.2	$0.0	$1.2
13	$1.2	$0.0	$1.2
14	$1.2	$0.0	$1.2
15	$1.3	$0.0	$1.3
16	$1.3	$0.0	$1.3
17	$1.3	$0.0	$1.3
18	$1.3	$0.0	$1.3
19	$1.3	$0.0	$1.3
20	$1.3	$0.0	$1.3
21	$1.3	$0.0	$1.3
22	$1.3	$0.0	$1.3

Table 3.6: Projected benefits and costs, taxpayer perspective

1 Year	2 Benefits to taxpayers (millions)	3 State and local gov't costs (millions)	4 Net cash flow (millions)
23	$1.3	$0.0	$1.3
24	$1.3	$0.0	$1.3
25	$1.3	$0.0	$1.3
26	$1.3	$0.0	$1.3
27	$1.3	$0.0	$1.3
28	$1.3	$0.0	$1.3
29	$1.3	$0.0	$1.3
30	$1.3	$0.0	$1.3
31	$1.3	$0.0	$1.3
32	$1.3	$0.0	$1.3
33	$1.3	$0.0	$1.3
34	$1.2	$0.0	$1.2
35	$1.2	$0.0	$1.2
36	$1.2	$0.0	$1.2
37	$1.2	$0.0	$1.2
38	$1.2	$0.0	$1.2
39	$1.1	$0.0	$1.1
40	$1.1	$0.0	$1.1
41	$0.3	$0.0	$0.3
42	$0.1	$0.0	$0.1
Present value	**$36.5**	**$17.9**	**$18.6**
Internal rate of return			**5.0%**
Benefit-cost ratio			**2.0**
Payback period (no. of years)			**19.0**

Source: EMSI college impact model.

At 5.0%, the rate of return to state and local taxpayers is also favorable. As above, we assume a 1.1% discount rate when dealing with government investments and public finance issues. This is the return governments are assumed to be able to earn on generally safe investments of unused funds, or alternatively, the interest rate for which governments, as relatively safe borrowers, can obtain funds. A rate of return of 1.1% would mean that the college just pays its own way. In principle, governments could borrow monies used to support Barton and repay the loans out of the resulting added taxes and reduced government expenditures. A rate of return of 5.0%, on the other hand, means that Barton not only pays its own way, but it also generates a surplus that state and local government can use to fund other programs. It is unlikely that other government programs could make such a claim.

3.3.3 With and without social savings

Earlier in this chapter, social benefits attributable to education (reduced crime, lower welfare, lower unemployment, and improved health) were defined as externalities that are incidental to the operations of Barton. Some would question the legitimacy of including these benefits in the calculation of rates of return to education, arguing that only the tangible benefits, *i.e.*, higher income, should be counted. Tables 3.4 and 3.6 are inclusive of social benefits reported as attributable to Barton. Recognizing the other point of view, Table 3.7 shows rates of return for both the social and taxpayer perspectives exclusive of social benefits. As indicated, returns are still above threshold values (a benefit-cost ratio greater than 1.0 and a rate of return greater than 1.1%), confirming that taxpayers receive value from investing in Barton.

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

	Including social savings	Excluding social savings
Social perspective		
Net present value	$366,767	$352,941
Benefit-cost ratio	21.5	20.7
Taxpayer perspective		
Net present value	$18,594	$14,770
Benefit-cost ratio	2.0	1.8
Internal rate of return	5.0%	4.3%
Payback period (no. of years)	19.0	20.8

Source: EMSI college impact model.

3.4 Conclusion

This chapter has shown that Barton is an attractive investment to its major stakeholders – students, society, and taxpayers. Rates of return to students invariably exceed alternative investment opportunities. At the same time, state and local government can take comfort in knowing that its expenditure of taxpayer funds creates a wide range of positive social benefits and, perhaps more importantly, actually returns more to government budgets than it costs. Without these increased tax receipts and public sector savings provided by the educational activities of Barton and its students, state and local government would have to raise taxes to make up for lost revenues and added costs.

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 (25%) accounts for the counterfactual scenario where students would have to seek a similar education elsewhere absent the publicly-funded community colleges in the state. Given the difficulty in accurately specifying the alternative education variable, we test the sensitivity of the taxpayer investment analysis results to its magnitude. Variations in the alternative education assumption are calculated around base case results listed in the middle column of Table 4.1. Next, the model brackets the base case assumption on either side with a plus or minus 10%, 25%, and 50% variation in assumptions. Analyses are then redone introducing one change at a time, holding all other variables constant. For example, an increase of 10% in the alternative education assumption (from 25% to 27%) reduces the taxpayer perspective rate of return from 5.0% to 4.7%. Likewise, a decrease of 10% (from 25% to 22%) in the assumption increases the rate of return from 5.0% to 5.2%.

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

% variation in assumption	-50%	-25%	-10%	Base Case	10%	25%	50%
Alternative education variable	12%	19%	22%	25%	27%	31%	37%
Net present value (millions)	$25	$22	$20	$19	$17	$16	$13
Rate of return	5.9%	5.4%	5.2%	5.0%	4.7%	4.4%	3.9%
Benefit-cost ratio	2.4	2.2	2.1	2.0	2.0	1.9	1.7

Based on this sensitivity analysis, the conclusion can be drawn that Barton investment analysis results from the taxpayer perspective are not very sensitive to relatively large variations in the alternative education variable. As indicated, results are still above their threshold levels (net present value greater than 0, benefit-cost ratio greater than 1, and rate of return greater than the discount rate of 1.1%), even when the alternative education assumption is increased by as much as 50% (from 25% to 37%). The conclusion is that although the assumption is difficult to specify, its impact on overall investment analysis results for the taxpayer perspective is not very sensitive.

4.2 Substitution effect variable

The substitution effect variable only affects the student productivity calculation in Table 2.3. 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 Barton Service Area anyway – even without Barton – since the businesses that hired Barton students could have substituted some of these workers with equally-qualified people from outside the Barton Service Area had there been no Barton students to hire.

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 Barton, for example, range from a low of $41.2 million at a -50% variation to a high of $123.5 million 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 Barton Service Area 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)	$41	$62	$74	$82	$91	$103	$124

4.3 Student employment variables

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

Students incur substantial expense by attending Barton because of the time they spend not gainfully employed. Some of that cost is recaptured if students remain partially (or fully) employed while attending. It is estimated that 75% of students who reported their employment status are employed, based on data provided by Barton. This variable is tested in the sensitivity analysis by changing it first to 100% and then to 0%.

The second student employment variable is more difficult to estimate. In this study we estimate that students that are working while attending college earn only 58%, on average, of the income that they would have statistically received if not attending Barton. This suggests that many students hold part-time jobs that accommodate their Barton 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 75% and B equal to 58%. Sensitivity analysis results are shown in non-shaded rows. Scenario 1 increases A to 100% while holding B constant, Scenario 2 increases B to 100% while holding A constant, Scenario 3 increases both A and B to 100%, and Scenario 4 decreases both A and B to 0%.

Table 4.3: Sensitivity analysis of student employment variables

Variations in assumptions	Net present value (millions)	Internal rate of return	Benefit-cost ratio
Base case: A = 75%, B = 58%	$110	14.3%	3.5
Scenario 1: A = 100%, B = 58%	$114	15.6%	3.9
Scenario 2: A = 75%, B = 100%	$125	19.5%	5.4
Scenario 3: A = 100%, B = 100%	$135	26.1%	8.3
Scenario 4: A = 0%, B = 0%	$95	11.5%	2.6

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

1. Scenario 1: Increasing the percent of students employed (A) from 75% to 100%, the net present value, internal rate of return, and benefit-cost ratio improve to $114.4 million, 15.6%, and 3.9, 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 $124.8 million, 19.5%, and 5.4, respectively, relative to base case results – a strong improvement, again attributable to a lower opportunity cost of time.
3. Scenario 3: Increasing both assumptions A and B to 100% simultaneously, the net present value, internal rate of return, and benefit-cost ratio improve yet further to $134.8 million, 26.1%, and 8.3, 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 $94.9 million, 11.5%, and 2.6, respectively, relative to

base case results. These results are reflective of an increased opportunity cost – none of the students are employed in this case.[30]

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

4.4 Discount rate

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

In this study, we assume a 4.5% discount rate for students and a 1.1% discount rate for society and taxpayers.[31] Similar to the sensitivity analysis of the alternative education variable, we vary the base case discount rates for students, society, and taxpayers on either side by increasing the discount rate by 10%, 25%, and 50%, and then reducing it by 10%, 25%, and 50%. Note that, because the rate of return and the payback period are both based on the undiscounted cash flows, they are unaffected by changes in the discount rate. As such, only variations in the net present value and the benefit-cost ratio are shown for students, society, and taxpayers in Table 4.4.

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[30] 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.

[31] 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.

Table 4.4: Sensitivity analysis of discount rate

% variation in assumption	-50%	-25%	-10%	Base Case	10%	25%	50%
Student perspective							
Discount rate	2.2%	3.4%	4.0%	4.5%	4.9%	5.6%	6.7%
Net present value (millions)	$188	$143	$122	$110	$98	$84	$64
Benefit-cost ratio	5.3	4.3	3.8	3.5	3.3	2.9	2.5
Social perspective							
Discount rate	0.6%	0.8%	1.0%	1.1%	1.2%	1.4%	1.7%
Net present value (millions)	$414	$390	$376	$367	$358	$346	$326
Benefit-cost ratio	24.1	22.7	21.9	21.5	21.0	20.3	19.2
Taxpayer perspective							
Discount rate	0.6%	0.8%	1.0%	1.1%	1.2%	1.4%	1.7%
Net present value (millions)	$23	$21	$19	$19	$18	$17	$15
Benefit-cost ratio	2.3	2.2	2.1	2.0	2.0	1.9	1.8

As demonstrated in the table, an increase in the discount rate leads to a corresponding decrease in the expected returns, and vice versa. For example, increasing the student discount rate by 50% (from 4.5% to 6.7%) reduces the students' benefit-cost ratio from 3.5 to 2.5. Conversely, reducing the discount rate for students by 50% (from 4.5% to 2.2%) increases the benefit-cost ratio from 3.5 to 5.3. The sensitivity analysis results for society and taxpayers show the same inverse relationship between the discount rate and the benefit-cost ratio, with the variance in results being the greatest under the social perspective (from a 24.1 benefit-cost ratio at a -50% variation from the base case to a 19.2 benefit-cost ratio at a 50% variation from the base case).

Appendix 1: Resources and References

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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 absent the publicly-funded educational institutions in the state. An estimate of 10%, for example, means that 10% of students do not depend directly on the existence of the institution in order to obtain their education.

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

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

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

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

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

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

Discounting Expressing future revenues and costs in present value terms.

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

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

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

Gross regional product Measure of the final value of all goods and services produced in a region after netting out the cost of goods used in production. Alternatively, gross regional product (GRP) equals the combined incomes of all factors of production, *i.e.*, labor, land and capital. These include wages, salaries, proprietors' incomes, profits, rents, and other. Gross regional product is also sometimes called "value added."

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

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

Internal rate of return Rate of interest 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 institution and its students spend money in the region. It consists of the income created by the supply chain of the industries initially affected by the spending of the institution and its students (*i.e.*, the direct effect), income created by the supply chain of the initial supply chain (*i.e.*, the indirect effect), and the income created by the increased spending of the household sector (*i.e.*, the induced effect).

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

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

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

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

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

Payback period = cost of investment/net return per period

Appendix 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's 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 determining the economic impact and return on investment of education 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 Barton 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 Barton, 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 $7,300. We spread this $7,300 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.[32] 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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[32] 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%.[33] As such, we reduce the marginal differences between education levels by 10%.

Next we map the CHE production of Barton's 2012-13 student population to the education ladder. Table 1.4 provides information on the CHE production of Barton's students broken out by educational achievement. In total, students completed 83,000 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 \$10.3 million. By dividing this value by the students' total production of 83,000 CHEs during the analysis year, we derive an overall average value of \$124 per CHE.

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

Aggregate annual increase in income	$10,254,586
Total credit hour equivalents (CHEs) in FY 2012-13*	83,000
Average value per CHE	$124

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

A4.2 Mincer Function

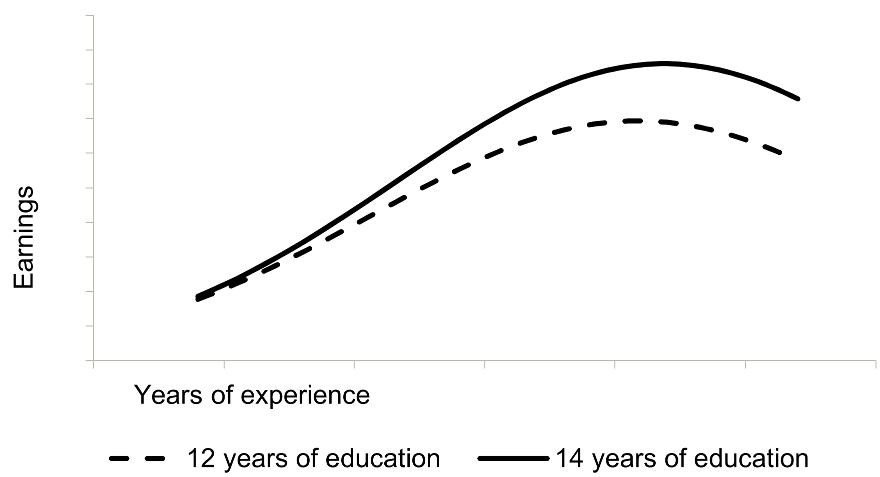
The $124 value per CHE in Table A4.1 only tells part of the story, however. Human capital theory holds that earnings levels do not remain constant; rather, they start relatively low and gradually increase as the worker gains more experience. Research also shows that the earnings increment

33 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.[34] 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 $124 value per CHE to the students' age and work experience.[35] To the students just starting their career during the analysis year, we apply a lower value per CHE; to

[34] 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).

[35] 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 $124 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 Barton's 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 regional 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 Barton did not exist, some of its students would still be able to avail themselves of an education. These students create benefits in the region even in the absence of Barton. The alternative education variable is an estimate of this portion of students and is used to discount the benefits we attribute to Barton. 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 Barton students' demand for an alternative institution, where the alternative institution is the closest peer education institution in the region. 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.[36] Program offerings are also critical in the enrollment decision, especially since college offerings can vary so widely. The fact that the students enroll in Barton and not the alternative institution reveals that they preferred the programs offered at Barton over those of the alternative institution. 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:

$$AE\theta = f\left(C_j, C\theta\right)\theta$$

Where:

C_j = Cost of attendance per student at institution j

C_a = Cost of attendance per student at alternative institution a

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[36] 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:[37]

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

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 between institutions. With completer data from IPEDs at the two-digit CIP level, we have information on the program offerings for each institution. Supposing there are n possible programs offered, we calculate an n-dimensional Euclidean distance between institution j and a. We use this Euclidean distance as a measure of the difference between the two institution's program offerings in order to estimate the equivalent variation E_{ja}, which is incorporated as part of the total cost of attendance for our alternative institution.

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:

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

[37] 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 social and taxpayer investment analysis 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.[38]

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).

[38] 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.[39]

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

[39] 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: Shutdown Point

The investment analysis in Chapter 3 weighs the benefits generated by the college against the state and local taxpayer funding that the college receives to support its operations. An important part of this analysis is factoring out the benefits that the college would have been able to generate anyway, even without state and local taxpayer support. This adjustment is used to establish a direct link between what taxpayers pay and what they receive in return. If the college is able to generate benefits without taxpayer support, then it would not be a true investment.[40]

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

A7.1 State and local government support versus student demand for education

Figure A7.1 presents a simple model of student demand and state and local government support. The right side of the graph is a standard demand curve (*D*) showing student enrollment as a function of student tuition and fees. Enrollment is measured in terms of total credit hour equivalents (CHEs) and expressed as a percentage of the college's current CHE production. Current student tuition and fees are represented by p', and state and local government support covers $C\%$ of all costs. At this point in the analysis, it is assumed that the college has only two sources of revenues: 1) student tuition and fees and 2) state and local government support.

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

Figure A7.1

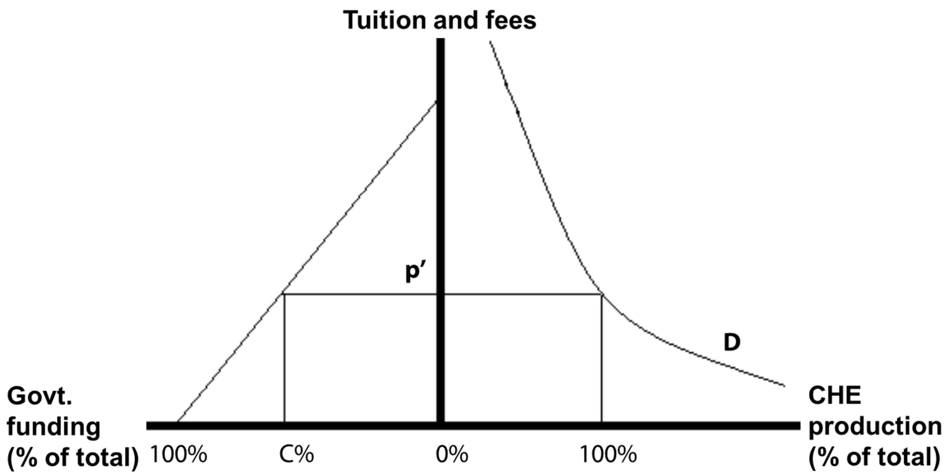
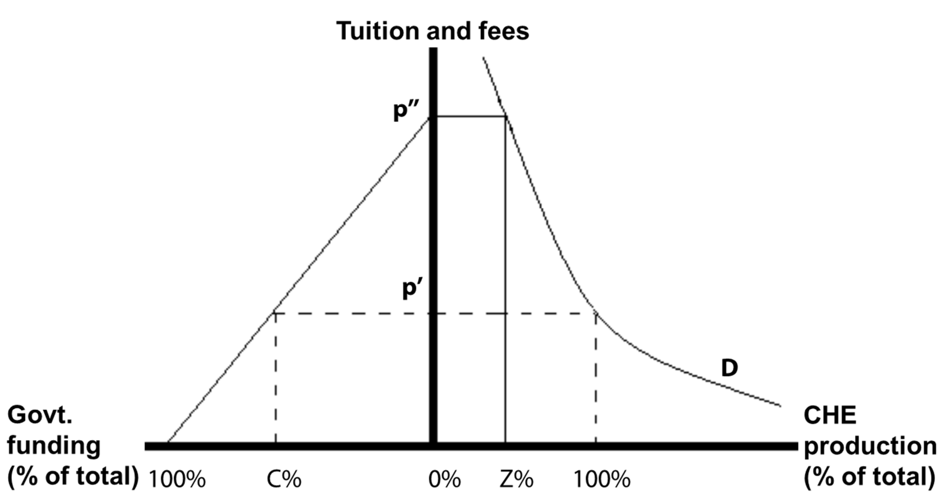


Figure A7.2 shows another important reference point in the model – where state and local government support is 0%, student tuition and fees are increased to p'', and CHE production is at $Z\%$ (less than 100%). The reduction in CHEs reflects the price elasticity of the students' demand for education, *i.e.*, the extent to which the students' decision to attend college is affected by the change in tuition and fees. Ignoring for the moment those issues concerning the college's minimum operating scale (considered below in the section called "Shutdown Point"), the implication for the investment analysis is that benefits to state and local government must be adjusted to net out the benefits that the college can provide absent state and local government support, represented as $Z\%$ of the college's current CHE production in Figure A7.2.

Figure A7.2



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

1) $B = B\,(100\%)$

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

Consider benefits now with reference to Figure A4.2. The point at which state and local government support is zero nonetheless provides for $Z\%$ (less than 100%) of the current enrollment, and benefits are symbolically indicated by the following equation:

2) $B = B\,(Z\%)$

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

3) $B = B\,(100\%) - B\,(Z\%)$

A7.2 Calculating benefits at the shutdown point

Colleges cease to operate when the revenue they receive from the quantity of education demanded is insufficient to justify their continued operations. This is commonly known in economics as the shutdown point.[41] The shutdown point is introduced graphically in Figure A7.3 as $S\%$. The location of point $S\%$ indicates that the college can operate at an even lower enrollment level than $Z\%$ (the point at which the college receives zero state and local government funding). State and local government support at point $S\%$ is still zero, and student tuition and fees have been raised to p'''. State and local government support is thus credited with the benefits given by equation 3, or $B = B\,(100\%) - B\,(Z\%)$. With student tuition and fees still higher than p''', the college would no longer be able to attract enough students to keep the doors open, and it would shut down.

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

Figure A7.3

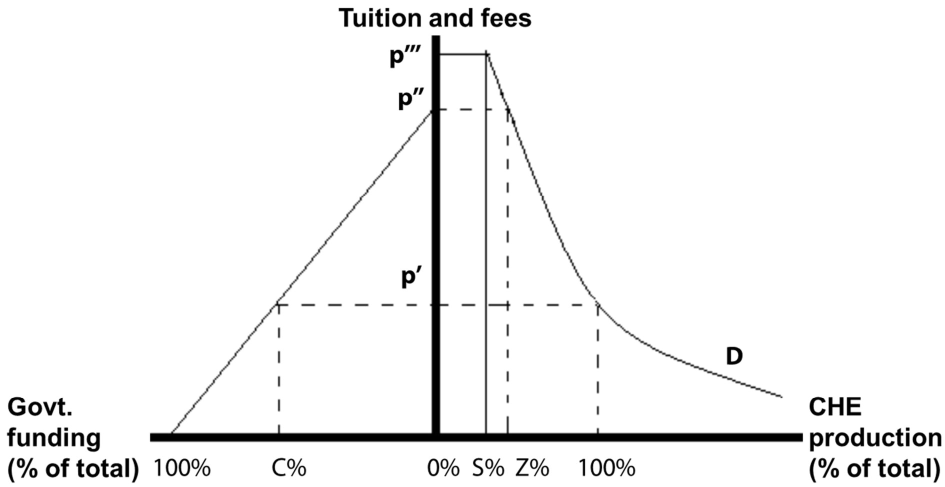
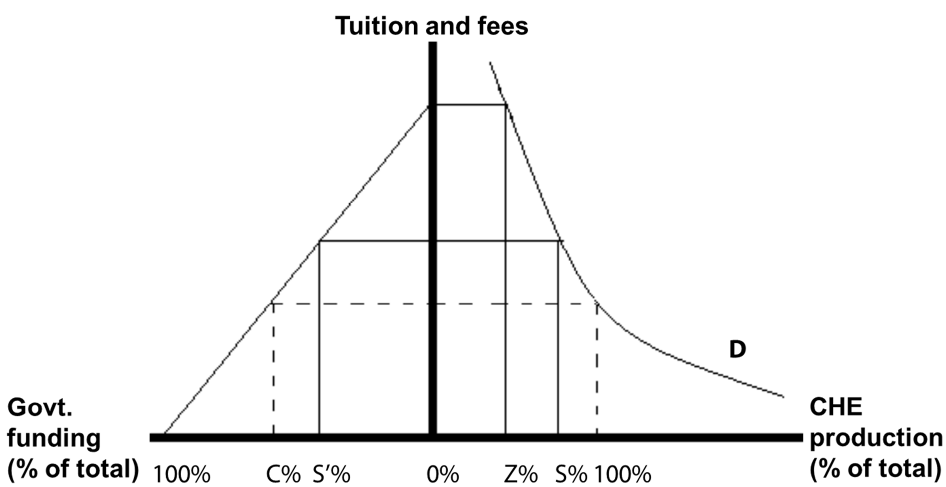


Figure A7.4 illustrates yet another scenario. Here the shutdown point occurs at a level of CHE production greater than *Z%* (the level of zero state and local government support), meaning some minimum level of state and local government support is needed for the college to operate at all. This minimum portion of overall funding is indicated by *S′%* on the left side of the chart, and as before, the shutdown point is indicated by *S%* on the right side of chart. In this case, state and local government support is appropriately credited with all the benefits generated by the college's CHE production, or *B = B (100%)*.

Figure A7.4



Appendix 8: 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.

A8.1 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.

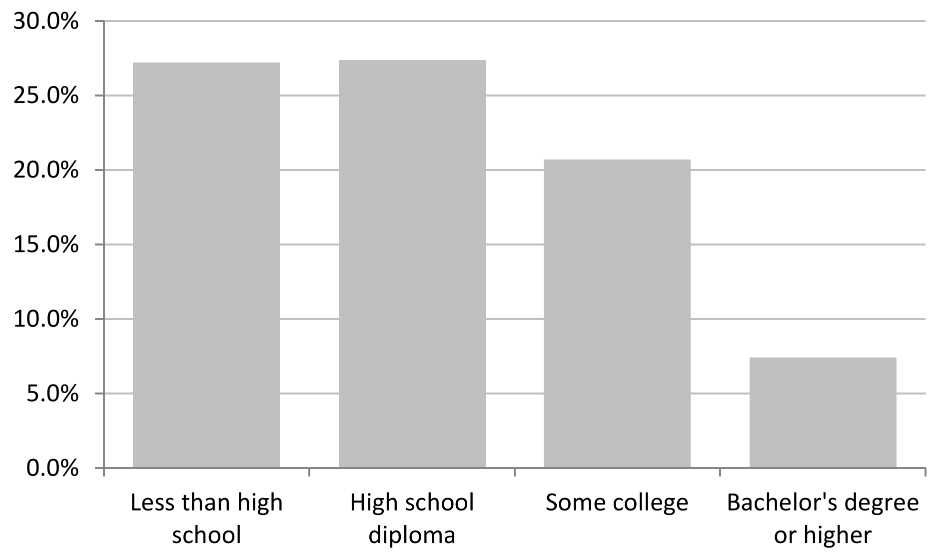
A8.1.1 Smoking

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 A8.1 shows the prevalence of cigarette smoking among adults aged 25 years and over, based on data provided by the National Health Interview Survey.[42] As indicated, the percent of persons who smoke begins to decline beyond the level of high school education.

[42] 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 A8.1: 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.[43] 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's 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.

A8.1.2 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 A8.2 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).[44] 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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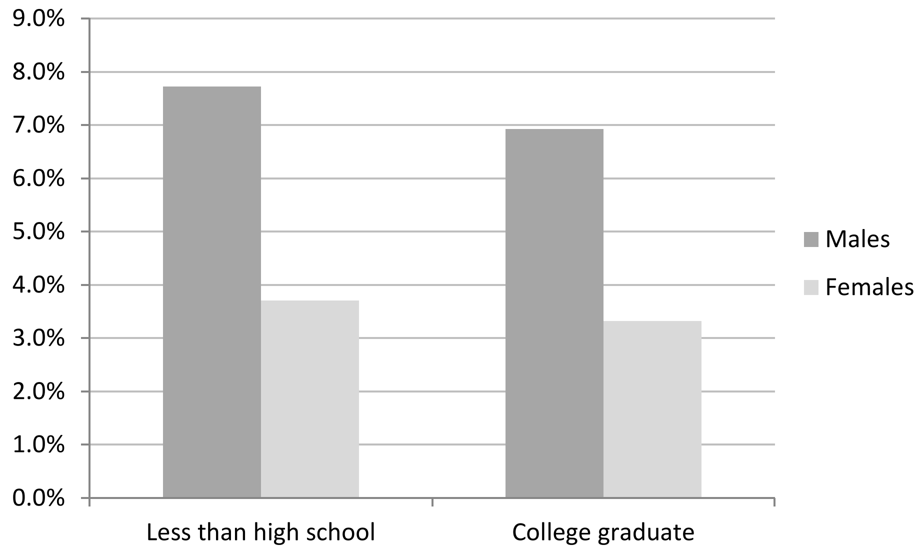
[43] Centers for Disease Control and Prevention, "Adults who are current smokers" in "Tobacco Use – 2011," Behavioral Risk Factor Surveillance System Prevalence and Trends Data, accessed August 2013, http://apps.nccd.cdc.gov/brfss/list.asp?cat=TU&yr=2011&qkey=8161&state=All.

[44] 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 A8.2: Prevalence of alcohol dependence or abuse by sex and education level



A8.1.3 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.[45] The CDC also reports the prevalence of obesity among adults by state.[46]

Data for Figure A8.3 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.[47] 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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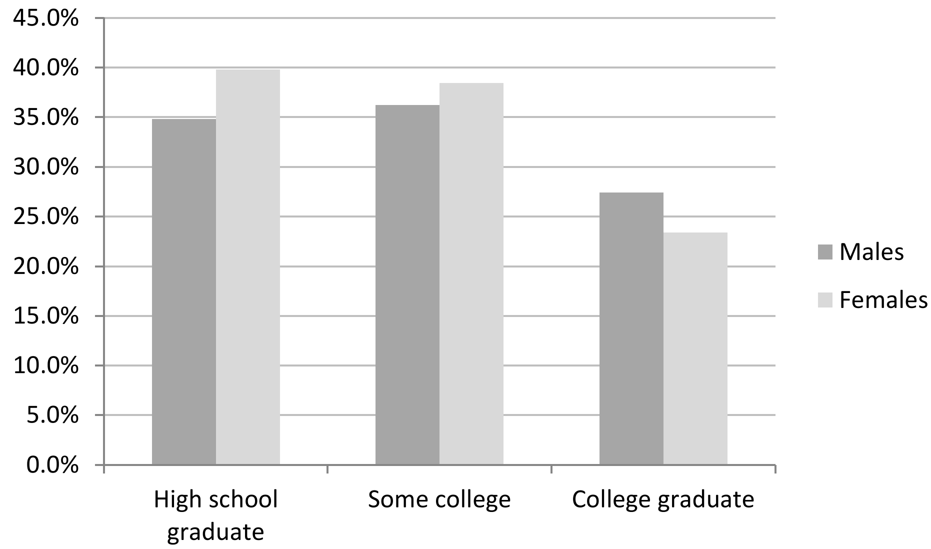
[45] Eric A. Finkelstein, Marco da Costa DiBonaventura, Somali M. Burgess, and Brent C. Hale, "The Costs of Obesity in the Workplace," *Journal of Occupational and Environmental Medicine* 52, no. 10 (October 2010): 971-976.

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

[47] 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 A8.3: Prevalence of obesity by education level

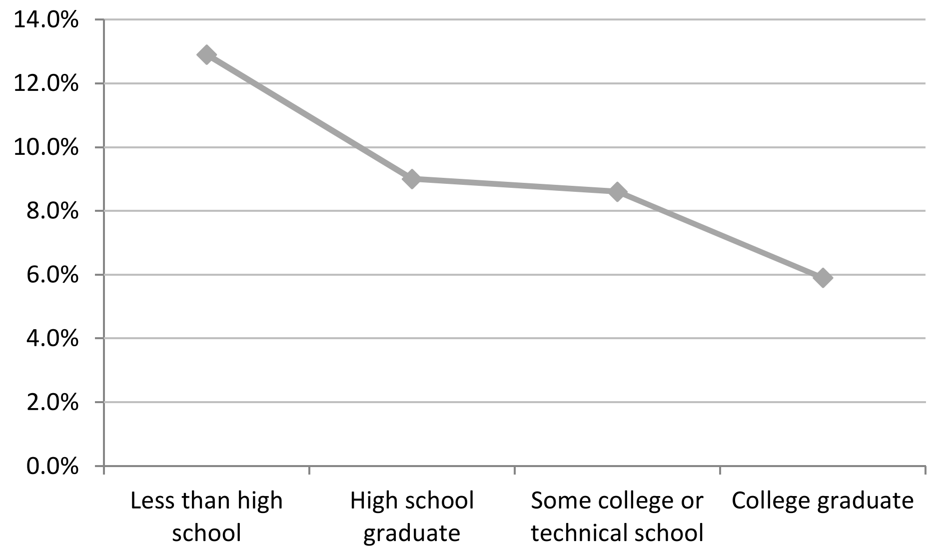


A8.1.4 Mental illness

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 A8.4 summarizes the prevalence of self-reported frequent mental distress among adults by education level, based on data supplied by the CDC.[48] 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.

[48] 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 A8.4: Prevalence of frequent mental distress by education level



A8.1.5 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 A8.5 based on data supplied by SAMHSA.[49] 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.[50]

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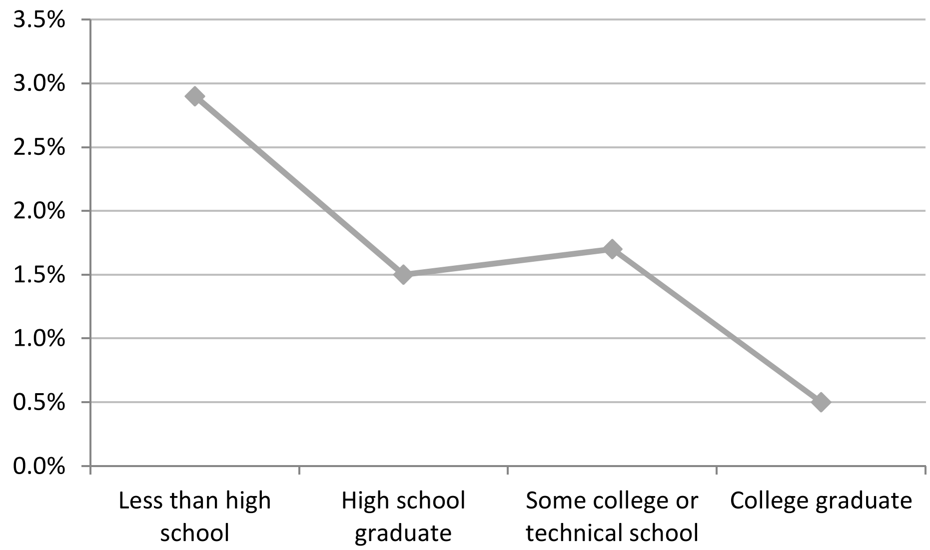
[49] Substance Abuse and Mental Health Services Administration, National Survey on Drug Use and Health, 2010 and 2011.

[50] 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 A8.5: Prevalence of illicit drug dependence or abuse by education level



A8.2 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 A8.6 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,[51] divided by the total adult population. As indicated, incarceration drops on a sliding scale as education levels rise.

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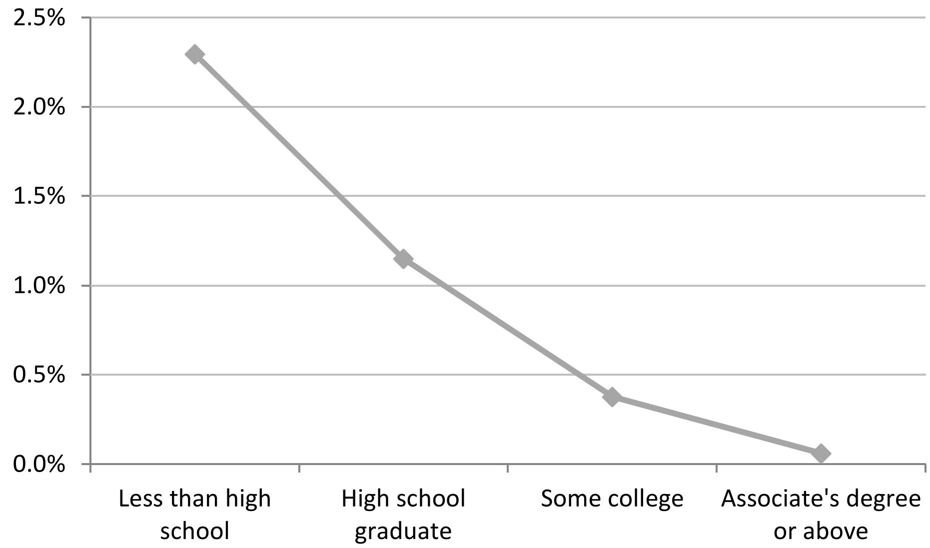
[51] Caroline Wolf Harlow. "Table 1. Educational attainment for State and Federal prison inmates, 1997 and 1991, local jail inmates, 1996 and 1989, probationers, 1995, and the general population, 1997" in "Education and Correctional Populations." Bureau of Justice Statistics Special Report, January 2003,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

Figure A8.6: 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.[52]

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.

A8.3 Welfare and unemployment

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

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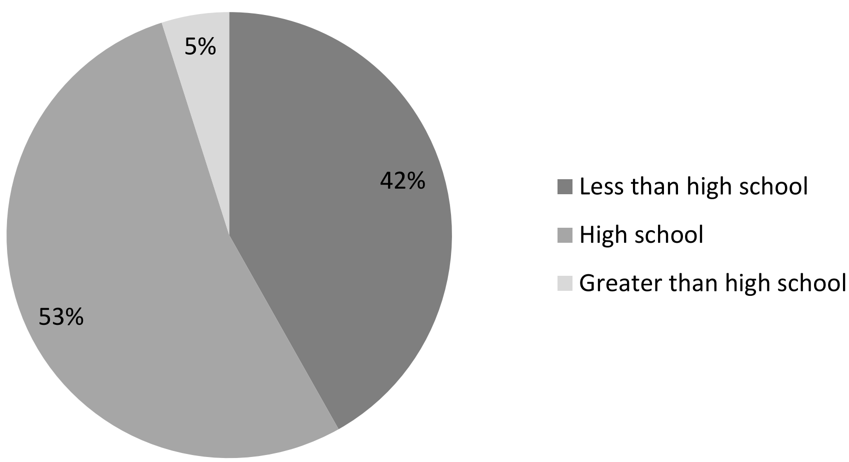
[52] Kathryn E. McCollister, Michael T. French, and Hai Fang, "The Cost of Crime to Society: New Crime-Specific Estimates for Policy and Program Evaluation." *Drug and Alcohol Dependence* 108, no. 1-2 (April 1, 2010): 98-109.

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

Figure A8.7 relates the breakdown of TANF recipients by education level, derived from data supplied by the U.S. Department of Health and Human Services.[54] As shown, the demographic characteristics of TANF recipients are weighted heavily towards the less than high school and high school categories, with a much smaller representation of individuals with greater than a high school education.

Figure A8.7: Breakdown of TANF recipients by education level

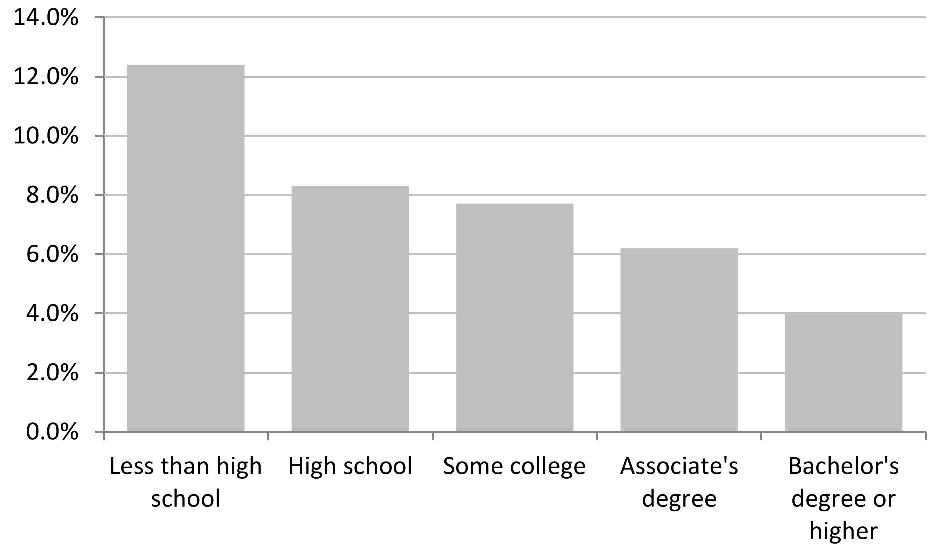


Unemployment rates also decline with increasing levels of education, as illustrated in Figure A8.8. These data are supplied by the Bureau of Labor Statistics.[55] As shown, unemployment rates range from 12.4% for those with less than a high school diploma to 4.0% for those at the bachelor's degree level or higher.

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

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

Figure A8.8: Unemployment by education level



A8.4 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.