



IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

The Economic Value of Iowa State University
of Science and Technology

MAIN REPORT

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Executive Summary

This report assesses the impact of Iowa State University of Science and Technology (ISU) on the state economy and the benefits generated by the university for students, taxpayers, and society. The results of this study show that ISU creates a positive net impact on the state economy and generates a positive return on investment for students, taxpayers, and society.





Economic impact analysis



During the analysis year, ISU spent \$754.8 million on payroll and benefits for 9,482 full-time and part-time employees, and spent another \$384.8 million on goods and services to carry out its day-to-day operations and research activities. This initial round of spending creates more spending across other businesses throughout the state economy, resulting in the commonly referred to multiplier effects. This analysis estimates the net economic impact of ISU that directly takes into account the fact that state dollars spent on ISU could have been spent elsewhere in the state if not directed towards ISU. This spending would have created impacts regardless. We account for this by estimating the impacts that would have been created from the alternative spending and subtracting the alternative impacts from the spending impacts of ISU.

This analysis shows that in fiscal year (FY) 2017-18, operations, construction, research, entrepreneurial, visitor, and student spending of ISU, together with the enhanced productivity of its alumni, generated **\$3.4 billion** in added income for the Iowa economy. The additional income of **\$3.4 billion** created by ISU is equal to approximately **1.8%** of the total gross state product (GSP) of Iowa. For perspective, this impact from the university is nearly as large as the entire Utilities industry in the state. The impact of **\$3.4 billion** is equivalent to supporting **42,640 jobs**. For further perspective, this means that **one out of every 49 jobs**

*The additional income of **\$3.4 billion** created by ISU is equal to approximately **1.8%** of the total gross state product of Iowa.*

in Iowa is supported by the activities of ISU and its students. These economic impacts break down as follows:

Operations spending impact



Payroll and benefits to support ISU's day-to-day operations (excluding payroll from research employees) amounted to \$573.9 million.¹ The university's non-pay expenditures amounted to \$204.4 million. The net impact of operations spending by the university in Iowa during the analysis year was approximately **\$658.9 million** in added income, which is equivalent to supporting **8,364 jobs**.

Construction spending impact



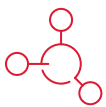
ISU spends millions of dollars on construction each year to maintain its facilities, create additional capacities, and meet its growing educational demands. While the amount varies from year to year, these quick infusions of income and jobs have a substantial impact on the state economy. In FY 2017-18, the construction spending of ISU generated **\$39.4 million** in added income, which is equivalent to supporting **595 jobs**.

Research spending impact



Research activities of ISU impact the state economy by employing people and making purchases for equipment, supplies, and services. They also facilitate new knowledge creation throughout Iowa. In FY 2017-18, ISU spent \$180.9 million on payroll and \$180.4 million on other expenditures to support research activities. Research spending of ISU generated **\$310.2 million** in added income for the Iowa economy, which is equivalent to supporting **4,139 jobs**.

Value of Extension and Outreach



ISU Extension and Outreach strengthens communities and their local economies by enhancing leadership structures, broadening engagement, teaching best practices, and providing hands-on assistance. Over the years, ISU's Extension and Outreach has helped **9,084 companies** and **1,290 organizations** across the state. ISU's Extension and Outreach has also helped **15,794 Iowa farmers**. Across the state, ISU has 100 Extension and Outreach locations. Due to the specific nature of these Extension and Outreach activities, Emsi does not attempt to measure an impact. With that said, the value that Extension and Outreach offers for state and local communities should be acknowledged.

Important Note

When reviewing the impacts estimated in this study, it's important to note that it reports impacts in the form of added income rather than sales. Sales includes all of the intermediary costs associated with producing goods and services, as well as money that leaks out of the state as it is spent at out-of-state businesses. Income, on the other hand, is a net measure that excludes these intermediary costs and leakages, and is synonymous with gross state product (GSP) and value added. For this reason, it is a more meaningful measure of new economic activity than sales.

¹ Includes royalty payments to inventors related to ISU that still live in Iowa.

Economic development impact



ISU creates an exceptional environment that fosters innovation and entrepreneurship, evidenced by the number of start-up and spin-off companies related to ISU and companies that have grown in the state with the support of the university. In FY 2017-18, start-up and spin-off companies created in the past five years and companies supported by ISU added **\$422.2 million** in income for the Iowa economy. The total added income of \$422.2 million is equivalent to supporting **8,011 jobs**.²

Visitor spending impact



Out-of-state visitors attracted to Iowa for activities at ISU brought new dollars to the economy through their spending at hotels, restaurants, gas stations, and other state businesses. The spending from these visitors added approximately **\$17.4 million** in income for the Iowa economy, which is equivalent to supporting **473 jobs**.

Value of volunteerism



Beyond positively impacting the state through the activities, such as research, occurring at the university, ISU also directly impacts the state economy through its facilitation and support of student and employee volunteer activities. Volunteers are an important part of any society because they positively impact those less fortunate. Annually,³ **more than 21,000 ISU student and employee volunteers** supported non-profit organizations and causes across the state.⁴ These students and employees volunteered **more than 650,000 hours** of their time. Their volunteer activities added **\$15.2 million in value** for the state and local communities. The impact of volunteerism is not measured in this analysis; however, the value volunteers offer should not be overlooked.

Student spending impact



Around 46% of credit students attending ISU originated from outside the state. Some of these students relocated to Iowa to attend the university. In addition, some students are residents of Iowa who would have left the state if not for the existence of ISU. The money that these students spent toward living expenses in Iowa is attributable to ISU.

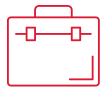
² To maintain an acceptable level of data reliability, this impact is limited to those companies that were created in the last five years. It is therefore conservative. This impact includes the positive effects ISU's Small Business Development Center and Center for Industrial Research and Service have on businesses within Iowa.

³ Due to data unavailability, the volunteer activities of employees are not considered in this analysis, meaning the value for ISU volunteerism is understated. In addition, FY 2015-16 volunteer data is used as a proxy for FY 2017-18 since the survey collecting volunteer information is only administered by ISU every three years.

⁴ Value per volunteer hour per state provided by Independent Sector. See https://independentsector.org/resource/vovt_details/.

The expenditures of relocated and retained students in the state during the analysis year added approximately **\$89.1 million** in income for the Iowa economy, which is equivalent to supporting **2,116 jobs**.

Alumni impact



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

The accumulated impact of former students currently employed in the Iowa workforce amounted to **\$1.8 billion** in added income for the Iowa economy, which is equivalent to supporting **18,944 jobs**.





Investment analysis



Investment analysis is the practice of comparing the costs and benefits of an investment to determine whether or not it is profitable. This study considers ISU as an investment from the perspectives of students, taxpayers, and society.

Student perspective



Students invest their own money and time in their education to pay for tuition, books, and supplies. Many take out student loans to attend the university, which they will pay back over time. While some students were employed while attending the university, students overall forewent earnings that they would have generated had they been in full employment instead of learning. Summing these direct outlays, opportunity costs, and future student loan costs yields a total of **\$767.6 million** in present value student costs.

In return, students will receive a present value of **\$2.9 billion** in increased earnings over their working lives. This translates to a return of **\$3.80** in higher future earnings for every \$1 that students pay for their education at ISU. The corresponding annual rate of return is **14.2%**.

Taxpayer perspective



Taxpayers provided **\$285.7 million** of state funding to ISU in FY 2017-18. In return, taxpayers will receive an estimated present value of **\$652.9 million** in added tax revenue stemming from the students'

higher lifetime earnings and the increased output of businesses. Savings to the public sector add another estimated **\$100 million** in benefits due to a reduced demand for government-funded social services in Iowa. For every tax dollar spent educating students attending ISU, taxpayers will receive an average of **\$2.60** in return over the course of the students' working lives. In other words, taxpayers enjoy an annual rate of return of **6.8%**.

Social perspective



People in Iowa invested **\$1.7 billion** in ISU in FY 2017-18. This includes the university's expenditures, student expenses, and student opportunity costs. In return, the state of Iowa will receive an estimated present value of **\$7.6 billion** in added state revenue over the course of the students' working lives. Iowa will also benefit from an estimated **\$280.6 million** in present value social savings related to reduced crime, lower welfare and unemployment, and increased health and well-being across the state. For every dollar society invests in ISU, an average of **\$4.50** in benefits will accrue to Iowa over the course of the students' careers.

*For every tax dollar spent educating students attending ISU, taxpayers will receive an average of **\$2.60** in return over the course of the students' working lives.*

Acknowledgments

Emsi gratefully acknowledges the excellent support of the staff at Iowa State University of Science and Technology in making this study possible. Special thanks go to Dr. Wendy Wintersteen, President, who approved the study, and to Lisa Lorenzen, President, ISU Research Foundation with help from Ron Cox, Director, Center for Industrial Research and Service; Lisa Shimkat, Director, Small Business Development Center; Kris Johansen, Manager, Economic Development and Industry Relations; and Chris Gannon, University photographer, who collected much of the data and information requested. Any errors in the report are the responsibility of Emsi and not of any of the above-mentioned individuals.

Introduction

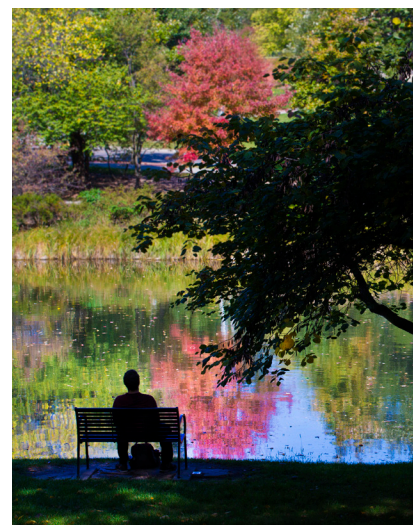
Iowa State University of Science and Technology (ISU), established in 1858, has today grown to serve 35,993 students during the Fall of 2017. The university is led by Dr. Wendy Wintersteen, President. The university's service region, for the purpose of this report is the entire state of Iowa.

While ISU affects the state in a variety of ways, many of them difficult to quantify, this study is concerned with considering its economic benefits. The university naturally helps students achieve their individual potential and develop the knowledge, skills, and abilities they need to have fulfilling and prosperous careers. However, ISU impacts Iowa beyond influencing the lives of students. The university's program offerings supply employers with workers to make their businesses more productive. The university, its day-to-day, construction, and research operations, along with its economic development activities and the expenditures of its visitors and students, support the state economy through the output and employment generated by state vendors.

The benefits created by the university extend as far as the state treasury in terms of the increased tax receipts and decreased public sector costs generated by students across the state.

This report assesses the impact of ISU as a whole on the state economy and the benefits generated by the university for students, taxpayers, and society. The approach is twofold. We begin with an economic impact analysis of the university on the Iowa economy. To derive results, we rely on a specialized Multi-Regional Social Accounting Matrix (MR-SAM) model to calculate the added income created in the Iowa economy as a result of increased consumer spending and the added knowledge, skills, and abilities of students. Results of the economic impact analysis are broken out according to the following impacts: 1) impact of the university's day-to-day operations, 2) impact of the university's construction spending, 3) impact of research spending, 4) value of Extension and Outreach, 5) impact of economic development, 6) impact of visitor spending, 7) value of volunteerism, 8) impact of student spending, and 9) impact of alumni who are still employed in the Iowa workforce.

The second component of the study measures the benefits generated by ISU for the following stakeholder groups: students, taxpayers, and society. For students, we perform an investment analysis to determine how the money



The university helps students achieve their individual potential and develop the knowledge, skills, and abilities they need to have fulfilling and prosperous careers. However, ISU impacts Iowa beyond influencing the lives of students.

spent by students on their education performs as an investment over time. The students' investment in this case consists of their out-of-pocket expenses, the cost of interest incurred on student loans, and the opportunity cost of attending the university as opposed to working. In return for these investments, students receive a lifetime of higher earnings. For taxpayers, the study measures the benefits to state taxpayers in the form of increased tax revenues and public sector savings stemming from a reduced demand for social services. Finally, for society, the study assesses how the students' higher earnings and improved quality of life create benefits throughout Iowa as a whole.

The study uses a wide array of data that are based on several sources, including the FY 2017-18 academic and financial reports from ISU; industry and employment data from the Bureau of Labor Statistics and Census Bureau; outputs of Emsi's impact model and MR-SAM model; and a variety of published materials relating education to social behavior.

CHAPTER 1:

Profile of Iowa State University of Science and Technology and the Economy



IOWA State University (ISU) is one of the premier universities in Iowa, a public land-grant research institution with a broad range of programs and specializations that plays a major role in developing intellectual and human capital for the state of Iowa. With an FY 2017-18 annual enrollment of more than 39,000 students and a staff of more than 9,000 employees, ISU is Iowa's largest university, offering hundreds of programs to students from all 50 states and countries around the world.

ISU was established in 1858 as an Agricultural College and Model Farm, before becoming the country's first designated land-grant university after the passage of the Morrill Act in 1862. With the fundamental purpose of the land-grant university being the combination of liberal arts and practical studies, and with a particular focus on agricultural studies, mechanical arts, and outreach, ISU grew rapidly through the 19th century. The university's off-campus classes in the 1870s were the forerunner of modern land-grant university "extension" programs. Its Veterinary College was the first of its kind when it opened in 1879, and the ISU Statistical Laboratory was similarly unique when it opened in 1933.

Today, ISU serves Iowa primarily from its home in the small city of Ames, in the very center of Iowa. The university's eight colleges are housed in more than 160 buildings on the 490-acre central campus, which is itself a notable piece of landscape architecture and features outstanding horticultural gardens. The campus is also home to a number of art and historical museums; ISU has one of the country's largest public art programs.

ISU has a long history of research and innovation and conducts significant research each year. Leading research fields include agriculture, engineering, technology, computer science, industrial systems, and more. ISU is the only university in the nation to host a Department of Energy Laboratory on campus, and it expects the Student Innovation Center currently under construction to further boost its culture of research and discovery.

Students at ISU enroll in hundreds of graduate and undergraduate programs. In 2018, the university offered 104 bachelor's degrees, 117 master's degrees, and 83 Ph.D. programs, as well as a professional degree through its highly regarded Veterinary College. The Veterinary College is a key part of ISU; one of the best in the country and houses the only full-service veterinary diagnostic laboratory in Iowa. The college is a cornerstone of ISU's service to its state. The Veterinary College, along with the university's other programs, create a stronger Iowa community and economy and support its mission to "Create, share, and apply knowledge to make Iowa and the world a better place."



*ISU was the country's **first**
designated land-grant university.*



ISU employee and finance data

The study uses two general types of information: 1) data collected from the university and 2) state economic data obtained from various public sources and Emsi’s proprietary data modeling tools.⁵ This chapter presents the basic underlying information from ISU used in this analysis and provides an overview of the Iowa economy.

Employee data

Data provided by ISU include information on faculty and staff by place of work and by place of residence. These data appear in Table 1.1. As shown, ISU employed 6,137 full-time and 3,345 part-time faculty and staff in FY 2017-18 (including student workers). Of these, almost all worked and lived in the state. These data are used to isolate the portion of the employees’ payroll and household expenses that remains in the state economy.

Revenues

Figure 1.1 shows the university’s annual revenues by funding source—a total of \$1.3 billion in FY 2017-18. As indicated, tuition and fees comprised 28% of total revenue, and revenues from local, state, and federal government sources comprised another 36%. Gifts, grants and contracts made up another 7%. Sales and services of auxiliary enterprises comprised 17% and the sales and services of education activities made up another 6% with the remaining 7% stemming from other revenue sources. These data are critical in identifying the annual costs of educating the student body from the perspectives of students, taxpayers, and society.

Expenditures

Figure 1.2 displays ISU’s expense data. The combined payroll at ISU, including student salaries and wages, amounted to \$754.8 million. This was equal to 56% of the university’s total expenses for FY 2017-18. Other expenditures, including operation and maintenance of plant, construction, depreciation, and purchases of supplies and services, made up \$599.8 million. When we calculate the impact of these expenditures in Chapter 2, we exclude expenses for depreciation and interest, as they represent a devaluing of the university’s assets rather than an outflow of expenditures.

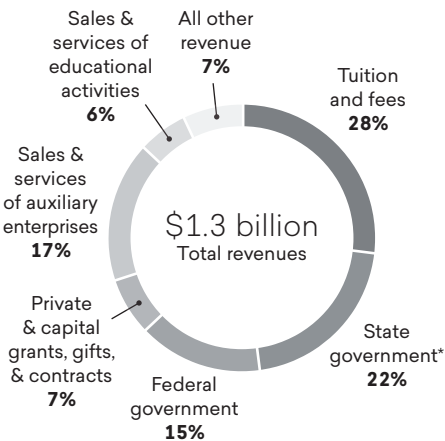
5 See Appendix 5 for a detailed description of the data sources used in the Emsi modeling tools.

TABLE 1.1: EMPLOYEE DATA, FY 2017-18

Full-time faculty and staff	6,137
Part-time faculty and staff	3,345
Total faculty and staff	9,482
% of employees who work in the state	99.5%
% of employees who live in the state	99.5%

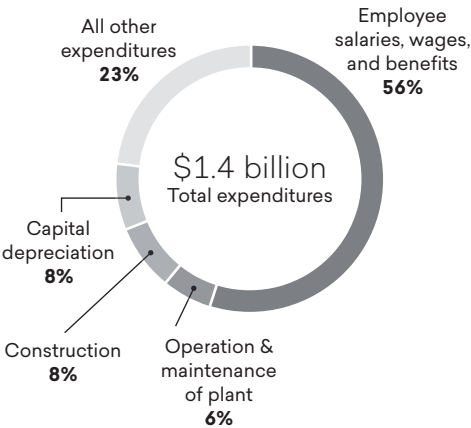
Source: Data provided by ISU.

FIGURE 1.1: ISU REVENUES BY SOURCE, FY 2017-18



*Revenue from state government includes capital appropriations.
Percentages may not add due to rounding.
Source: Data provided by ISU.

FIGURE 1.2: ISU EXPENSES BY FUNCTION, FY 2017-18



Percentages may not add due to rounding.
Source: Data provided by ISU.

Students

ISU Office of the Registrar reported a fall enrollment of 35,993 students in 2017. For the purpose of this analysis, we consider the unduplicated annual student headcount. ISU served more than 39,000 students in FY 2017-18. The breakdown of the student body by gender was 57% male and 43% female. The breakdown by ethnicity was 75% white, 21% minority, and 5% unknown. The students' overall average age was 22 years old.⁶ An estimated 47% of students remain in Iowa after finishing their time at ISU and the remaining 53% settle outside the state.⁷

Table 1.2 summarizes the breakdown of the credit and/or degree seeking student population and their corresponding awards and credits by education level. In FY 2017-18, ISU served 148 professional graduates, 351 PhD graduates, 876 master's degree graduates, and 6,612 bachelor's degree graduates. Another 29,171 students enrolled in courses for credit but did not complete a degree during the reporting year. In addition, the university enrolled 112 high school students through the Post-Secondary Enrollment Option (PSEO) over the course of the year. The university also served 47 basic education students enrolled in the Intensive English Orientation Program. Non-degree seeking students enrolled in credit courses comprised the remaining 1,007 students.

TABLE 1.2: BREAKDOWN OF STUDENT HEADCOUNT AND CHE PRODUCTION BY EDUCATION LEVEL, FY 2017-18

Category	Headcount	Total CHEs	Average CHEs
Professional graduates	148	5,980	40.4
Ph.D. graduates	351	2,280	6.5
Master's degree graduates	876	11,108	12.7
Bachelor's degree graduates	6,612	155,223	23.5
Continuing students	29,955	779,034	26.0
Dual credit (PSEO) students	112	663	5.9
Basic education students	47	1,244	26.5
All other students	1,007	6,243	6.2
Total, all students	39,108	961,775	24.6

Source: Data provided by ISU.

Not included in the economic impact analysis are the hundreds of thousands of students enrolled in non-credit courses and workshops offered by Iowa State. The university features extensive offerings to meet workforce and community needs through non-credit courses. Many of these courses allow individuals to meet required trainings or certifications for employment.

⁶ Unduplicated headcount, gender, ethnicity, and age data provided by ISU.

⁷ Settlement data provided by ISU.



Of the top five non-credit courses, 4-H Youth Development makes up more than half of the total non-credit course registrations, with almost 300,000 registrations in FY 2017-18. Ag & Natural Resources and Human Sciences came in second and third, with close to 100,000 registrations each. The fourth and fifth places were taken by Multi/Interdisciplinary Studies (26,000 registrations) and Community & Economic Development (11,000 registrations).

We use credit hour equivalents (CHEs) to track the educational workload of the students. One CHE is equal to 15 contact hours of classroom instruction per semester. The average number of CHEs per student was 24.6.



The Iowa economy

Since the university was first established, it has been serving Iowa by enhancing the workforce, providing local residents with easy access to higher education opportunities, and preparing students for highly-skilled, technical professions. Table 1.3 summarizes the breakdown of the state economy by major industrial sector, with details on labor and non-labor income. Labor income refers to wages, salaries, and proprietors' income. Non-labor income refers to profits, rents, and other forms of investment income. Together, labor and non-labor income comprise the state's total income, which can also be considered as the state's gross state product (GSP).

TABLE 1.3: INCOME BY MAJOR INDUSTRY SECTOR IN IOWA, 2018*

Industry sector	Labor income (millions)	Non-labor income (millions)	Total income (millions)**	% of total income	Sales (millions)
Manufacturing	\$17,118	\$19,477	\$36,595	19%	\$111,576
Finance & Insurance	\$10,711	\$11,327	\$22,038	11%	\$37,827
Other Services (except Public Administration)	\$2,856	\$17,776	\$20,631	11%	\$28,965
Wholesale Trade	\$5,387	\$7,944	\$13,332	7%	\$21,795
Health Care & Social Assistance	\$11,190	\$1,487	\$12,677	7%	\$20,792
Government, Non-Education	\$8,884	\$2,458	\$11,342	6%	\$50,591
Retail Trade	\$6,558	\$4,409	\$10,967	6%	\$17,963
Construction	\$6,984	\$1,845	\$8,829	5%	\$17,123
Government, Education	\$8,433	\$0	\$8,433	4%	\$9,601
Professional & Technical Services	\$5,343	\$1,424	\$6,767	4%	\$10,178
Agriculture, Forestry, Fishing & Hunting	\$4,280	\$2,101	\$6,381	3%	\$17,747
Transportation & Warehousing	\$4,618	\$1,359	\$5,977	3%	\$12,361
Information	\$1,775	\$3,568	\$5,343	3%	\$8,792
Real Estate & Rental & Leasing	\$2,482	\$2,110	\$4,592	2%	\$10,876
Accommodation & Food Services	\$2,554	\$1,605	\$4,159	2%	\$7,804
Administrative & Waste Services	\$3,156	\$807	\$3,963	2%	\$6,445
Utilities	\$948	\$2,921	\$3,868	2%	\$6,049
Management of Companies & Enterprises	\$2,085	\$184	\$2,269	1%	\$3,372
Educational Services	\$1,592	\$364	\$1,956	1%	\$2,863
Arts, Entertainment, & Recreation	\$672	\$409	\$1,082	1%	\$1,835
Mining, Quarrying, & Oil and Gas Extraction	\$245	\$372	\$617	<1%	\$1,072
Total	\$107,870	\$83,945	\$191,815	100%	\$405,627

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

** Numbers may not add due to rounding.

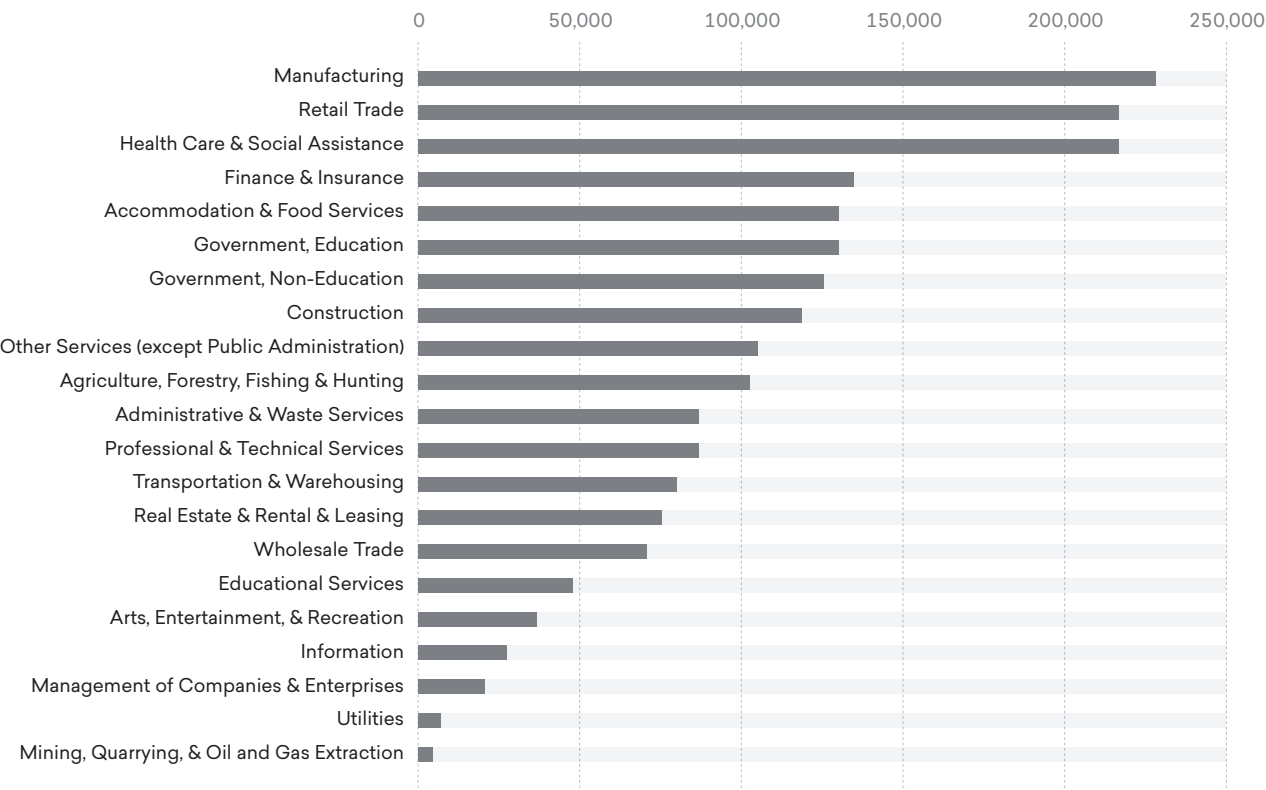
Source: Emsi industry data.



As shown in Table 1.3, the total income, or GSP, of Iowa is approximately \$191.8 billion, equal to the sum of labor income (\$107.9 billion) and non-labor income (\$83.9 billion). In Chapter 2, we use the total added income as the measure of the relative impacts of the university on the state economy.

Figure 1.3 provides the breakdown of jobs by industry in Iowa. The Manufacturing sector is the largest employer, supporting 231,194 jobs or 11.2% of total employment in the state. The second largest employer is the Retail Trade sector, supporting 219,967 jobs or 10.6% of the state's total employment. Altogether, the state supports 2.1 million jobs.⁸

FIGURE 1.3: JOBS BY MAJOR INDUSTRY SECTOR IN IOWA, 2018*



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

8 Job numbers reflect Emsi's complete employment data, which includes the following four job classes: 1) employees who are counted in the Bureau of Labor Statistics' Quarterly Census of Employment and Wages (QCEW), 2) employees who 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.

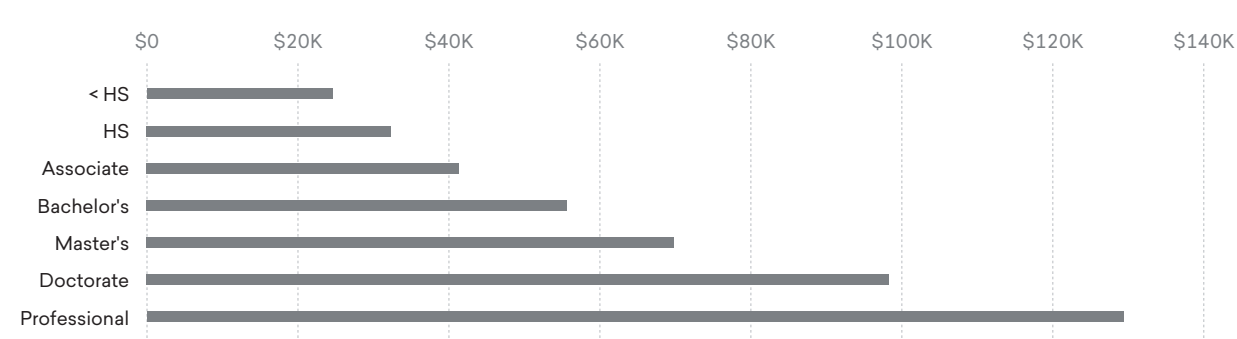
Table 1.4 and Figure 1.4 present the mean earnings by education level in Iowa at the midpoint of the average-aged worker's career. These numbers are derived from Emsi's complete employment data on average earnings per worker in the state.⁹ The numbers are then weighted by the university's demographic profile. As shown, students have the potential to earn more as they achieve higher levels of education compared to maintaining a high school diploma. Students who earn a bachelor's degree from ISU can expect approximate wages of \$55,800 per year within Iowa, approximately \$23,200 more than someone with a high school diploma. Note that the earnings below are not weighted by the specific fields within the degrees that ISU offers.

TABLE 1.4: AVERAGE EARNINGS BY EDUCATION LEVEL AT AN ISU STUDENT'S CAREER MIDPOINT

Education level	State earnings	Difference from next lowest degree
Less than high school	\$24,200	n/a
High school or equivalent	\$32,600	\$8,400
Associate degree	\$41,100	\$8,500
Bachelor's degree	\$55,800	\$14,700
Master's degree	\$68,900	\$13,100
Doctoral degree	\$98,300	\$29,400
Professional degree	\$128,500	\$59,600

Source: Emsi employment data.

FIGURE 1.4: AVERAGE EARNINGS BY EDUCATION LEVEL AT AN ISU STUDENT'S CAREER MIDPOINT



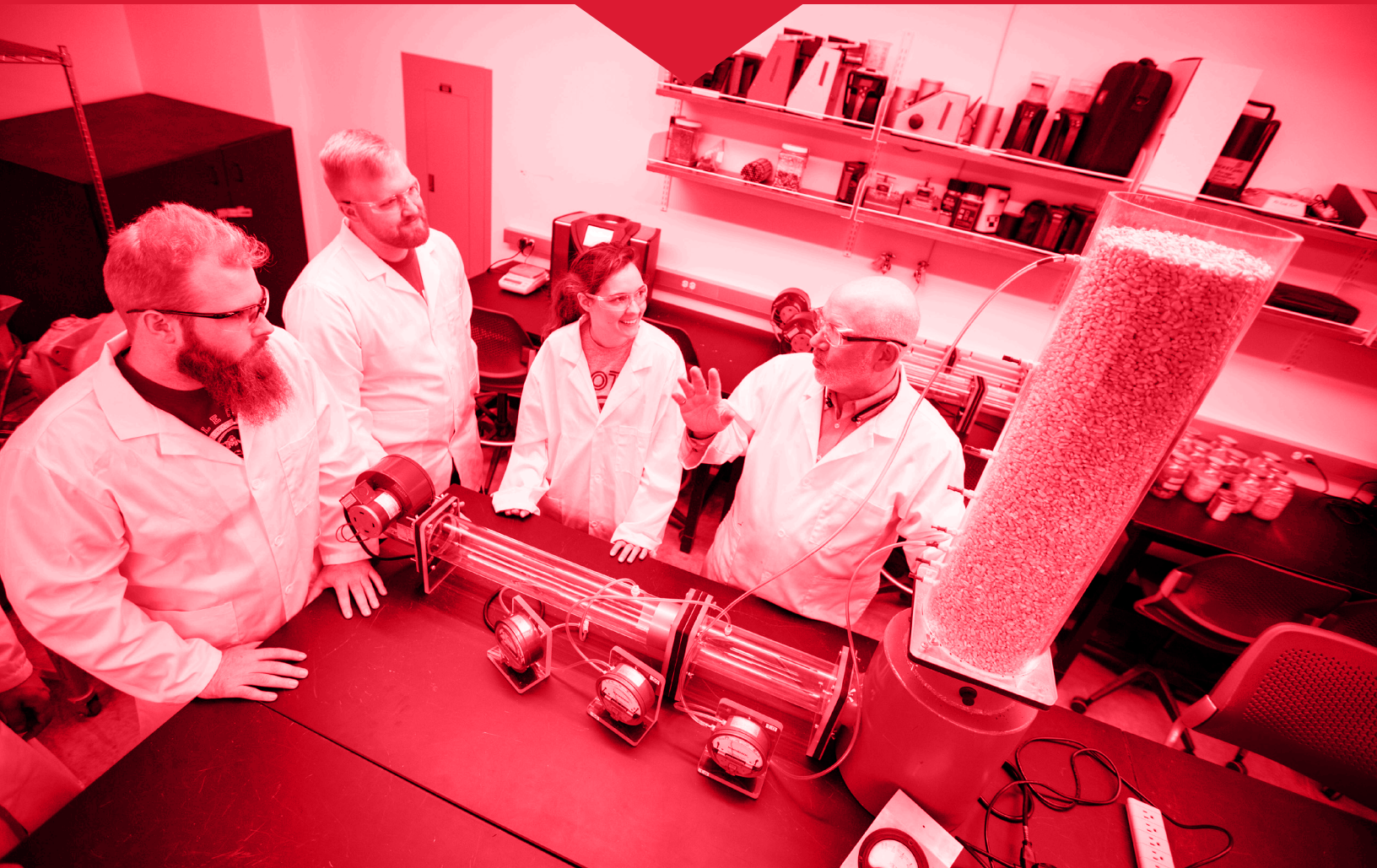
Source: Emsi employment data.

9 Wage rates in the Emsi MR-SAM model combine state and federal sources to provide earnings that reflect complete employment in the state, including proprietors, self-employed workers, and others not typically included in 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.

CHAPTER 2:

Economic Impacts on the Iowa Economy

ISU impacts the Iowa economy in a variety of ways. The university is an employer and buyer of goods and services. It attracts monies that otherwise would not have entered the state economy through its day-to-day, construction, and research operations, along with its economic development activities and the expenditures of its visitors and students. Further, it provides students with the knowledge, skills, and abilities they need to become productive citizens and add to the overall output of the state.



In this chapter, we estimate the following economic impacts of ISU: 1) the operations spending impact, 2) the construction spending impact, 3) the research spending impact, 4) the value of Extension and Outreach, 5) the economic development impact, 6) the visitor spending impact, 7) the value of volunteerism, 8) the student spending impact, and 9) the alumni impact, measuring the income added in the state as former students expand the state economy's stock of human capital.

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

How would economic activity change in Iowa if ISU and all its alumni did not exist in FY 2017-18?

Each of the economic impacts should be interpreted according to this hypothetical question. Another way to think about the question is to realize that we measure net impacts, not gross impacts. Gross impacts represent an upper-bound estimate in terms of capturing all activity stemming from the university; however, net impacts reflect a truer measure of economic impact since they demonstrate what would not have existed in the state economy if not for the university. Note that while we present the value of Extension and Outreach along with volunteer activities, given the nature of these activities we are not able to measure an impact in terms of this strict definition.

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

Another way to state the impact is in terms of **jobs**, a measure of the number of full- and part-time jobs that would be required to support the change in income. Finally, a frequently used measure is the **sales impact**, which comprises the change in business sales revenue in the economy as a result of increased economic activity. It is important to bear in mind, however, that much of this sales revenue leaves the state economy through intermediary transactions and costs.¹⁰ All of these measures—added labor and non-labor income, total income, jobs, and sales—are used to estimate the economic impact results presented in this chapter. The analysis breaks out the impact measures into different components, each based on the economic effect that caused the impact. The following is a list of each type of effect presented in this analysis:



¹⁰ See Appendix 4 for an example of the intermediary costs included in the sales impact but not in the income impact.

- The **initial effect** is the exogenous shock to the economy caused by the initial spending of money, whether to pay for salaries and wages, purchase goods or services, or cover operating expenses.
- The initial round of spending creates more spending in the economy, resulting in what is commonly known as the **multiplier effect**. The multiplier effect comprises the additional activity that occurs across all industries in the economy and may be further decomposed into the following three types of effects:
 - The **direct effect** refers to the additional economic activity that occurs as the industries affected by the initial effect spend money to purchase goods and services from their supply chain industries.
 - The **indirect effect** occurs as the supply chain of the initial industries creates even more activity in the economy through their own inter-industry spending.
 - The **induced effect** refers to the economic activity created by the household sector as the businesses affected by the initial, direct, and indirect effects raise salaries or hire more people.

Net impacts *reflect a truer measure of economic impact since they demonstrate what would not have existed in the state economy if not for the university.*

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

Emsi	Initial	Direct	Indirect	Induced
IMPLAN	Direct	Indirect		Induced

Multiplier effects in this analysis are derived using Emsi’s MR-SAM input-output model that captures the interconnection of industries, government, and households in the state. The Emsi MR-SAM contains approximately 1,000 industry sectors at the highest level of detail available in the North American Industry Classification System (NAICS) and supplies the industry-specific multipliers required to determine the impacts associated with increased activity within a given economy. For more information on the Emsi MR-SAM model and its data sources, see Appendix 5.





Operations spending impact

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

Table 2.1 presents university expenditures (not including construction and research) for the following three categories: 1) salaries, wages, and benefits, 2) operation and maintenance of plant, and 3) all other expenditures (including purchases for supplies and services). In this analysis, we exclude expenses for depreciation and interest due to the way those measures are calculated in the national input-output accounts, and because depreciation represents the devaluing of the university's assets rather than an outflow of expenditures.¹¹ The first step in estimating the multiplier effects of the university's operational expenditures is to map these categories of expenditures to the approximately 1,000 industries of the Emsi MR-SAM model. Assuming that the spending patterns of university personnel approximately match those of the average consumer, we map salaries, wages, and benefits to spending on industry outputs using national household expenditure coefficients provided by Emsi's national SAM. All ISU employees work in Iowa (see Table 1.1), and therefore we consider 100% of the salaries, wages, and benefits. For the other two expenditure categories (i.e., operation and maintenance of plant and all other expenditures), we assume the university's spending patterns approximately match national averages and apply the national spending coefficients for NAICS 611310 (Colleges, Universities,



TABLE 2.1: ISU EXPENSES BY FUNCTION (EXCLUDING DEPRECIATION & INTEREST), FY 2017-18

Expense category	In-state expenditures (thousands)	Out-of-state expenditures (thousands)	Total expenditures (thousands)
Employee salaries, wages, and benefits*	\$573,933	\$0	\$573,933
Operation and maintenance of plant	\$48,113	\$27,625	\$75,738
All other expenditures	\$60,687	\$68,012	\$128,698
Total	\$682,733	\$95,636	\$778,369

This table does not include expenditures for construction or research activities, as they are presented separately in the following sections.

* Includes royalty payments to inventors related to ISU that still live in Iowa.

Source: Data provided by ISU and the Emsi impact model.

¹¹ This aligns with the economic impact guidelines set by the Association of Public and Land-Grant Universities. Ultimately, excluding these measures results in more conservative and defensible estimates.

and Professional Schools).¹² Operation and maintenance of plant expenditures are mapped to the industries that relate to capital construction, maintenance, and support, while the university's remaining expenditures are mapped to the remaining industries.

We now have three vectors of expenditures for ISU: one for salaries, wages, and benefits; another for operation and maintenance of plant; and a third for the university's purchases of supplies and services. The next step is to estimate the portion of these expenditures that occur inside the state. The expenditures occurring outside the state are known as leakages. We estimate in-state expenditures using regional purchase coefficients (RPCs), a measure of the overall demand for the commodities produced by each sector that is satisfied by state suppliers, for each of the approximately 1,000 industries in the MR-SAM model.¹³ For example, if 40% of the demand for NAICS 541211 (Offices of Certified Public Accountants) is satisfied by state suppliers, the RPC for that industry is 40%. The remaining 60% of the demand for NAICS 541211 is provided by suppliers located outside the state. The three vectors of expenditures are multiplied, industry by industry, by the corresponding RPC to arrive at the in-state expenditures associated with the university. See Table 2.1 for a break-out of the expenditures that occur in-state. Finally, in-state spending is entered, industry by industry, into the MR-SAM model's multiplier matrix, which in turn provides an estimate of the associated multiplier effects on state labor income, non-labor income, total income, sales, and jobs.

Table 2.2 presents the economic impact of university operations spending. The people employed by ISU and their salaries¹⁴, wages, and benefits comprise the initial effect, shown in the top row of the table in terms of labor income,

TABLE 2.2: OPERATIONS SPENDING IMPACT, FY 2017-18

	Labor income (thousands)	Non-labor income (thousands)	Total income (thousands)	Sales (thousands)	Jobs supported
Initial effect	\$573,933	\$0	\$573,933	\$778,369	7,210
Multiplier effect					
Direct effect	\$30,886	\$26,118	\$57,004	\$108,800	741
Indirect effect	\$8,678	\$6,052	\$14,729	\$31,906	230
Induced effect	\$130,052	\$142,824	\$272,876	\$456,428	3,247
Total multiplier effect	\$169,616	\$174,993	\$344,609	\$597,134	4,218
Gross impact (initial + multiplier)	\$743,550	\$174,993	\$918,543	\$1,375,504	11,428
Less alternative uses of funds	-\$121,952	-\$137,654	-\$259,607	-\$429,149	-3,064
Net impact	\$621,597	\$37,339	\$658,936	\$946,354	8,364

Source: Emsi impact model.

¹² See Appendix 2 for a definition of NAICS.

¹³ See Appendix 5 for a description of Emsi's MR-SAM model.

¹⁴ Note: royalties paid to faculty and scientific researchers are included in the salaries reported with the operations spending impact.



non-labor income, total added income, sales, and jobs. The additional impacts created by the initial effect appear in the next four rows under the section labeled *multiplier effect*. Summing the initial and multiplier effects, the gross impacts are \$743.5 million in labor income and \$175 million in non-labor income. This sums to a total impact of \$918.5 million in total added income associated with the spending of the university and its employees in the state. This is equivalent to supporting 11,428 jobs.

The \$918.5 million in gross impact is often reported by researchers as the total impact. We go a step further to arrive at a net impact by applying a counterfactual scenario, i.e., what would have happened if a given event—in this case, the expenditure of in-state funds on ISU—had not occurred. ISU received an estimated 58% of its funding from sources within Iowa. These monies came from the tuition and fees paid by resident students, from the auxiliary revenue and donations from private sources located within the state, from state taxes, and from the financial aid issued to students by state government. We must account for the opportunity cost of this in-state funding. Had other industries received these monies rather than ISU, income impacts would have still been created in the economy. In economic analysis, impacts that occur under counterfactual conditions are used to offset the impacts that actually occur in order to derive the true impact of the event under analysis.

We estimate this counterfactual by simulating a scenario where in-state monies spent on the university are instead spent on consumer goods and savings. This simulates the in-state monies being returned to the taxpayers and being spent by the household sector. Our approach is to establish the total amount spent by in-state students and taxpayers on ISU, map this to the detailed industries of the MR-SAM model using national household expenditure coefficients, use the industry RPCs to estimate in-state spending, and run the in-state spending through the MR-SAM model's multiplier matrix to derive multiplier effects. The results of this exercise are shown as negative values in the row labeled *less alternative uses of funds* in Table 2.2.

The total net impact of the university's operations is equal to the gross impact less the impact of the alternative use of funds—the opportunity cost of the state money. As shown in the last row of Table 2.2, the total net impact is approximately \$621.6 million in labor income and \$37.3 million in non-labor income. This sums together to \$658.9 million in total added income and is equivalent to supporting 8,364 jobs. These impacts represent new economic activity created in the state economy solely attributable to the operations of ISU.

*The total net impact of the university's operations is **\$658.9 million** in total added income, which is equivalent to supporting **8,364 jobs**.*





Construction spending impact



In this section, we estimate the economic impact of the construction spending of ISU. Because construction funding is separate from operations funding in the budgeting process, it is not captured in the operations spending impact estimated earlier. However, like operations spending, the construction spending creates subsequent rounds of spending and multiplier effects that generate still more jobs and income throughout the state. During FY 2017-18, ISU spent a total of \$105 million on various construction projects.

ISU uses local contractors and suppliers when available and estimates that 95% of its spending occurs within the state. To estimate the multiplier effects, we assume the university construction spending approximately matches national construction spending patterns of NAICS 611310 (Colleges, Universities, and Professional Schools). We then map construction spending to the construction industries of the MR-SAM model. Next, we use the RPCs of the industries to estimate the portion of their spending that occurs in-state. Finally, the in-state spending is run through the multiplier matrix to estimate the direct, indirect, and induced effects. Because construction is so labor intensive, the non-labor income impact is relatively small.

To account for the opportunity cost of any in-state construction money, we estimate the impacts of a similar alternative uses of funds as found in the operations spending impact. This is done by simulating a scenario where in-state

*During FY 2017-18, ISU spent a total of **\$105 million** on various construction projects.*

monies spent on construction are instead spent on consumer goods. These impacts are then subtracted from the gross construction spending impacts. Again, since construction is so labor intensive, most of the added income stems from labor income as opposed to non-labor income. As a result, the non-labor impacts associated with spending in the non-construction sectors are larger than in the construction sectors, so the net non-labor impact of construction spending is negative. This means that had the construction money instead been spent on consumer goods, more non-labor income would have been created at the expense of less labor income. The total net impact is still positive and substantial.

Table 2.3 presents the impacts of ISU construction spending during FY 2017-18. Note the initial effect is purely a sales effect, so there is no initial change in labor or non-labor income. The FY 2017-18 ISU construction spending creates a net total impact of \$39.4 million in added income—the equivalent of supporting 595 jobs in Iowa.

TABLE 2.3: CONSTRUCTION SPENDING IMPACT, FY 2017-18

	Labor income (thousands)	Non-labor income (thousands)	Total income (thousands)	Sales (thousands)	Jobs supported
Initial effect	\$0	\$0	\$0	\$99,791	0
Multiplier effect					
Direct effect	\$31,698	\$8,378	\$40,076	\$77,722	561
Indirect effect	\$7,395	\$1,954	\$9,349	\$18,131	130
Induced effect	\$12,873	\$3,402	\$16,275	\$31,564	228
Total multiplier effect	\$51,966	\$13,734	\$65,700	\$127,417	919
Gross impact (initial + multiplier)	\$51,966	\$13,734	\$65,700	\$227,208	919
Less alternative uses of funds	-\$12,432	-\$13,910	-\$26,342	-\$43,907	-324
Net impact	\$39,534	-\$176	\$39,358	\$183,302	595

Source: Emsi impact model.



Research spending impact



As a land grant institution, research is critically important to ISU and an integral part of the university's commitment to improving the lives of Iowans while also contributing to the betterment of our nation and the world around us. Research scholarship is a process of inquiry and innovation that creates new understanding of both fundamental knowledge in the sciences, engineering, humanities and the arts, as well as new discoveries that directly address problems faced by society and offer new opportunities to improve our economic, social, environmental and personal well-being.

As one of the nation's leading research-intensive land-grant universities, ISU and its faculty have a proven track record of success in attracting external sponsored funding to leverage the state's investment in the university. During FY 2017-18, the university was awarded \$245.8 million in sponsored external funding from federal and non-federal sources. The majority of this funding comes from federal agencies that look to universities to:

- Create and disseminate new knowledge to advance their missions;
- Ensure a talented and diverse workforce for tomorrow's jobs; and
- Multiply the impact of discoveries by integrating them into educational, outreach and commercialization activities.

Similarly, researchers compete for and receive funding from private companies, commodity groups, nonprofit organizations, donor investors and other organiza-

tions sponsoring research that taps into ISU's extensive expertise to rigorously develop new ideas and innovations that align with their organizations' missions.

When assessing the overall value and impact ISU research has on the state, it's important to consider both the direct and the indirect, or downstream, impact of this work. For instance, ISU research activities directly impact the economy by employing people and by purchasing a wide range of equipment, services and supplies. Figure 2.1 on page 31 shows research expenses by function—payroll, equipment, external subcontracts and other—for the past four fiscal years. In FY 2017-18, the university spent more than \$361.2 million on research and development activities, with more than 63% (\$228.5 million) coming from external sources. The initial economic impact was a total of 2,274 research jobs and their associated salaries, wages and benefits. The university's research expenses have a total gross impact of \$300 million in labor income and \$74.9 million in non-labor income. This sums together to \$375 million in added income, equivalent to 4,935 jobs. Accounting for the impact of the alternative uses of funds, net research expenditure impacts of ISU are \$269.5 million in labor income and \$40.8 million in non-labor income. This sums together to \$310.2 million in total added income and is equivalent to supporting 4,139 jobs.

Equally, if not even more significant is the long-term, downstream impact that ISU research has on the economy. Discovery that results in the transfer of technology to the marketplace, and the transfer of knowledge to the university's stakeholders and constituencies through Extension, begins with research. Over the past four years, ISU has received 549 invention disclosures, filed 247 new U.S. patent applications, and produced 328 licenses (see Table 2.5). This level of innovation would not have been possible without research.

Conceived at ISU, Gross-Wen Technologies aims to revolutionize waste-water treatment

Martin Gross and Zhiyou Wen developed and patented the revolutionary revolving algal biofilm (RAB) system at ISU that launched Gross-Wen Technologies (GWT). The RAB system uses algae to capture nitrogen and phosphorus from wastewater. This algae can then be used as feedstocks for high-value products including slow-release fertilizer, high-protein foods and supplements, livestock and aquaculture feeds, and pharmaceutical products.

GWT's RAB system provides communities with a sustainable, effective, reliable, and affordable option for meeting new water quality standards. The system has been tested in pilot facilities in Chicago and Cresco, Iowa, and GWT sold its first installation to the community of Slater, Iowa in 2018. In addition, GWT has earned multiple state and national recognitions as a startup of distinction. These include the 2019 Prometheus Awards Startup Technology Company of the Year, the Pappajohn Iowa Entrepreneurial Venture Competition, and a recognition by the Association of Public and Land Grant Universities and Association of American Universities as a top university spin-off company.

While the majority of external research support at Iowa State comes from federal sources, both the state and potential private-sector partners benefit from this



federal investment. Case in point is the Center for Biorenewable Chemicals (CBiRC). CBiRC was originally established as a National Science Foundation (NSF) Engineering Research Center, with \$36 million in funding over 10 years. Over this same period, the discoveries generated by CBiRC have attracted more than \$2.8 million from more than 30 industrial dues-paying members that want to have access to CBiRC innovations and expertise. In addition, the technology developed at the center has produced multiple start-up companies, and resulted in additional external grants totaling more than \$8.3 million.

Moving forward, the investment in Iowa State University's research facilities—such as CBiRC, the BioCentury Research Farm, the Plant Sciences Institute, the Nanovaccine Institute, and the Veterinary Diagnostic Lab—has positioned ISU to play a critical leadership role in the Bioscience economic development initiative that Governor Kim Reynolds identified as a key growth engine for the state's economy. The university and the state are collaborating together to take important first steps in establishing nationally renowned innovation ecosystems in these Iowa-advantaged Bioscience platforms:

- Biobased chemicals and products;
- Precision and Digital Agriculture; and
- Vaccines and Immunotherapeutics.

Even before Governor Reynolds released her report in 2017, ISU was making significant advancements in the Biosciences, particularly within the Biobased Chemicals and Products category. For instance, through collaboration with the United Soybean Board and Argo Genesis Chemical (AGC)—and its parent company, Seneca Petroleum—ISU developed a polymer modifier for asphalt made from 90% high-oleic soybean oil. This modifier enhances elastic recovery and low-temperature performance, allowing lower-quality asphalt binders and recycled asphalt pavements to be used in place of high-cost paving-grade binders. AGC constructed a one-ton per day pilot processing facility to produce the high-oleic soybean oil-based polymer (PAEHOSO) on a quasi-commercial scale to evaluate the bio-based polymer's performance in multiple field demonstration projects. The overall objective is to bring PAEHOSO to its first market segment with the potential to consume more than 300 million pounds of high-oleic soybean oil each year. The benefit to farmers could be even greater further down the road. Thermoplastic elastomers (TPEs) can be repeatedly stretched to at least twice their original length at room temperature, and then return to their approximate original length. TPEs also have a touch and feel that makes them appealing for many markets and uses, including soft-touch grips on products. With a wide range of applications available, the demand for soy-based TPEs could create a demand that exceeds one billion pounds of high-oleic soybean oil.



Also worth noting is the emergence of Ames-based Sumatra Biorenewables, LLC, a standalone company founded in 2015 that resulted directly from research conducted through CBiRC. The company develops and produces novel monomers that are incorporated into polyamides and polyesters to provide uniquely valuable properties—like enhanced tensile strength and low water absorption—that can be used in applications such as textiles, 3D printing and automotive parts. In July 2019, the National Corn Growers Association (NCGA) selected Sumatra Biorenewables as one of three winners of the association’s “Consider Corn Challenge.” NCGA started the annual challenge to highlight corn’s myriad potential uses and its flexibility as a feedstock for biobased products, helping farmers partner with industry to establish new value-added uses for their crop.

One of the true successes in public-private partnership at ISU is Deere and Company’s investment in the Precision and Digital Agriculture platform at ISU. After steadily increasing its investment in ISU research, Deere bumped up its sponsorship in FY 2018-19 by 12.6% compared to the previous fiscal year, funding a range of projects in areas that include precision agriculture, telematics data analytics and next-generation machinery automation. The value Deere sees in its partnership with ISU is further evidenced in the new John Deere Technology Innovation Center the company opened in the ISU Research Park in July 2019.

Within the Vaccines and Immunotherapeutics Biosciences platform, ISU is leveraging the interdisciplinary efforts of the Nanovaccine Institute (NI) to develop new vaccine paradigms based on nanotechnology. This work has resulted in recent National Institutes of Health funding for the design of room temperature-stable universal influenza nanovaccines that would protect against a wide range of influenza A strains. The grant brings together ISU and University of Iowa researchers—along with researchers from two private-sector companies—and provides support for the development of translational animal models and a lead candidate vaccine that will significantly advance progress towards clinical trials. In a study supported by Merck, NI researchers have focused on the development of a universal influenza vaccine based on equine serum that can protect animals and humans against multiple influenza strains. The novel vaccine formulation has been shown to protect mice, chickens, ferrets, pigs, and horses from multiple influenza strains. The fact that this novel vaccine offers universal protection in multiple animal species can positively impact the swine and poultry industry in Iowa and provide data and knowledge that can ultimately help in the development of a universal influenza vaccine for humans.

Two additional federally funded programs that support the growth of Iowa’s economy through research are the NSF I-Corps and EPSCoR initiatives. NSF launched the I-Corps program to help prepare scientists and engineers to extend their focus beyond the university laboratory to accelerate the economic and societal benefits of NSF-funded basic-research projects that are ready



to move to commercialization. Since ISU became an I-Corp site in 2017, the program has launched six new companies and raised more than \$1.5 million in venture financing. These companies have also engaged with the pioneering ISU Startup Factory, receiving formal training, resources and access to an invaluable business network.

ISU has taken the lead in a statewide effort in applying for EPSCoR (Established Program to Stimulate Competitive Research) funding. The \$20 million in EPSCoR funds, if awarded, would be invested to support Biobased Chemicals and Products technology development and transfer, workforce development and economic development. In addition to ISU, the project team encompasses the University of Iowa, University of Northern Iowa, and Dordt University, and would also engage private and community colleges as well as K-12 STEM education and industry partners within the state.

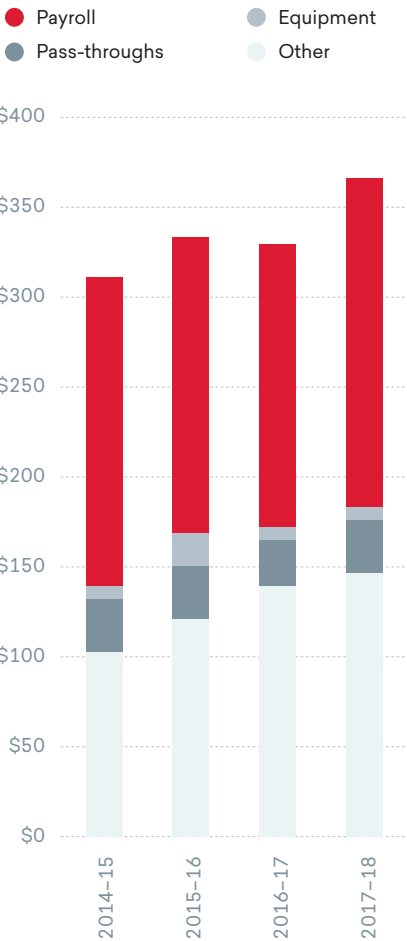
The impact of ISU’s research programs goes well beyond innovative and exciting discoveries. The federal government relies on universities to transfer new developments into commercial products, and ISU has a long tradition of doing just that, from the B73 hybrid that revolutionized corn production to environmentally beneficial lead-free solder. And the Startup Factory (see below) is playing a key role in accelerating the pace of commercializing new ideas borne from ISU research, further contributing to the state’s economic growth.

Finally, research plays a critical role in developing a highly skilled, high-value workforce. A significant portion of research funding is devoted to educating graduate and undergraduate researchers. Student researchers solve difficult problems, gain technical and project management expertise, and communicate complex concepts to the public, all skills that are highly valued by today’s employers.

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

Mapping the research expenses by category to the industries of the MR-SAM model—the only difference from our previous methodology—requires some exposition. We asked ISU to provide information on expenditures by research and development field as they report to the NSF’s Higher Education Research

FIGURE 2.1: RESEARCH EXPENSES BY FUNDING SOURCE (MILLIONS)



Source: Data provided by ISU.



and Development Survey (HERD).¹⁵ We map these fields of study to their respective industries in the MR-SAM model. The result is a distribution of research expenses to the various 1,000 industries that follows a weighted average of the fields of study reported by ISU.

Initial, direct, indirect, and induced effects of ISU's research expenses appear in Table 2.4. As with the operations spending impact, the initial effect consists of the 2,272 research jobs and their associated salaries, wages, and benefits. The university's research expenses have a total gross impact of \$300 million in labor income and \$74.9 million in non-labor income. This sums together to \$375 million in added income, equivalent to 4,935 jobs. Taking into account the impact of the alternative uses of funds, net research expenditure impacts of ISU are \$269.5 million in labor income and \$40.7 million in non-labor income. This sums together to \$310.2 million in total added income and is equivalent to supporting 4,139 jobs.

TABLE 2.4: RESEARCH SPENDING IMPACT, FY 2017-18

	Labor income (thousands)	Non-labor income (thousands)	Total income (thousands)	Sales (thousands)	Jobs supported
Initial effect	\$180,851	\$0	\$180,851	\$361,206	2,272
Multiplier effect					
Direct effect	\$47,170	\$19,271	\$66,441	\$115,496	970
Indirect effect	\$11,110	\$4,531	\$15,641	\$29,978	244
Induced effect	\$60,906	\$51,121	\$112,027	\$187,923	1,449
Total multiplier effect	\$119,186	\$74,923	\$194,109	\$333,397	2,663
Gross impact (initial + multiplier)	\$300,037	\$74,923	\$374,960	\$694,603	4,935
Less alternative uses of funds	-\$30,554	-\$34,188	-\$64,742	-\$107,913	-796
Net impact	\$269,483	\$40,735	\$310,219	\$586,690	4,139

Source: Emsi impact model.

TABLE 2.5: ISU INVENTION DISCLOSURES, PATENT APPLICATIONS, LICENSES, AND LICENSE INCOME

Fiscal Year	Invention disclosures received	Patent applications filed	Licenses and options executed	Adjusted gross license income
2017-18	145	49	51	\$4,396,000
2016-17	130	71	85	\$4,018,133
2015-16	144	60	84	\$3,583,192
2014-15	130	67	108	\$3,216,722
Total	549	247	328	\$15,214,047

Source: Data provided by ISU.

¹⁵ The fields include life sciences, math and computer sciences, physical sciences, psychology, social sciences, sciences not elsewhere classified, engineering, geosciences, and all non-science and engineering fields.

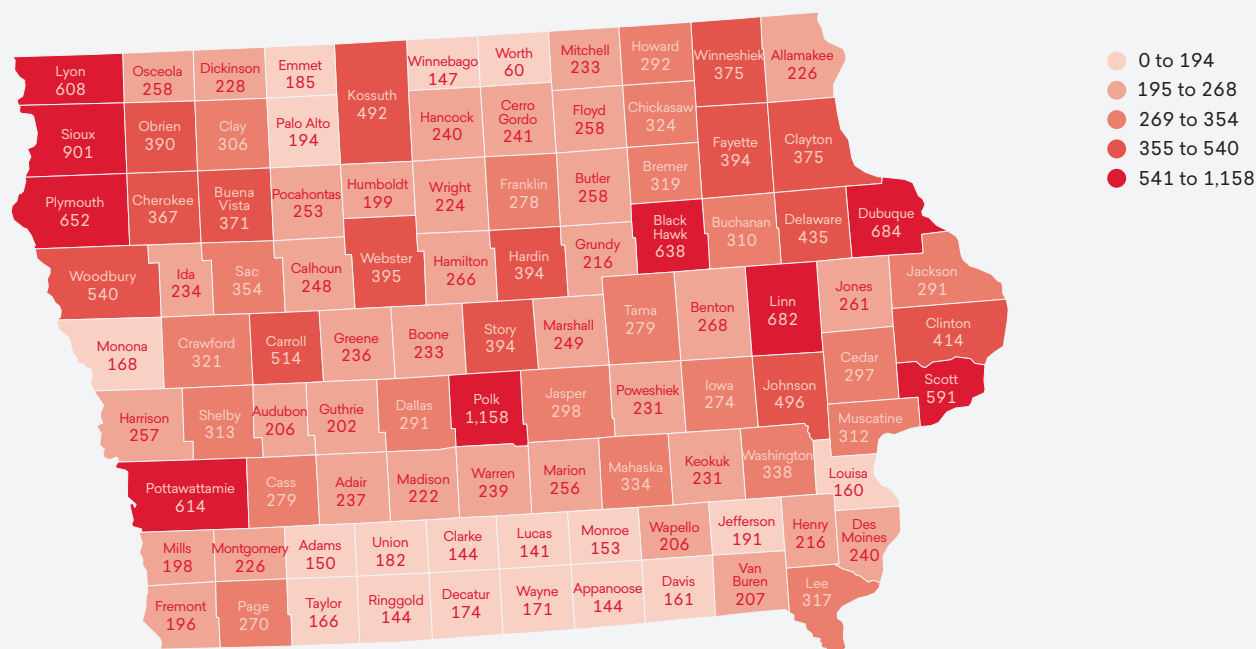
At ISU, one-third of the license income is returned to the inventor, one-third to the home college of the inventor, and one-third to the ISU Research Foundation. The income received by the college and foundation are accounted for in the analysis as operational expenditures. However, the license income earned by the inventors turn over in the economy similar to salaries and add to the economic impact of ISU on the state's economy. In FY 2017-18, \$1.2 million was paid to 112 inventors in the form of royalties. Approximately 54% of these inventors live in Iowa. This is included in the operations impact of the university.



Value of Extension and Outreach

Through campus and regional specialists and 100 county extension offices, ISU Extension and Outreach builds a strong Iowa by connecting Iowans to the resources of ISU. ISU Extension and Outreach strengthen communities and their local economies by enhancing leadership structures, broadening engagement, providing tech transfer, teaching best practices, and providing hands-on assistance. Communities are empowered to shape their own futures through research, education, community engagement, economic development, and community planning and design. In the year evaluated, ISU Extension and Outreach helped 9,084 companies and 1,290 organizations across the state (Figure 2.2). ISU Extension and Outreach also helped 15,794 Iowa farmers.

FIGURE 2.2: TOTAL NUMBER OF BUSINESSES, ORGANIZATIONS, AND FARMERS ASSISTED BY ISU EXTENSION AND OUTREACH THROUGH EDUCATIONAL PROGRAMMING OR CONNECTING THEM TO ISU EXPERTISE AND RESOURCES



In 2018, ISU Extension and Outreach made over 288,000 contacts with farmers and agribusinesses through 1,889 meetings, 7,465 face-to-face consultations, and 42,801 phone and email discussion to present information and answer technical questions. Examples of the educational programs include:



- ISU Extension and Outreach annually trains representatives from about 600 businesses and their 2,400 employees in the commercial manure applicator program. Each year, these businesses handle and apply about 1.5 million tons of solid manure and 3 billion gallons of liquid/slurry manure that has a fertilizer value of about \$250 million, while undertaking about \$70 million of business. More than 70% of commercial applicators reported this information was useful to their business.
- The Pesticide Safety Education Program (PSEP) provides recertification programs throughout Iowa and, in FY 2017-18, trained 10,934 commercial/noncommercial/public pesticide applicators and 14,468 private pesticide applicators through Continuing Instruction Course (CIC) programs. The certification focuses on safe and effective application of pesticides to lessen crop loss.

In addition, ISU Extension and Outreach provides information and resources to help Iowans deal with an uncertain farm economy. Every day, more than 7,400 visitors consult the Ag Decision Maker website. Farm financial management associates help Iowans understand their farm's financial situation. With a toll-free phone number, live chat capabilities, and a website, Iowa Concern provides free, 24/7 access to stress counselors, an attorney for legal education, and referral services. As a result, Iowa's farmers are better able to successfully navigate the cyclical nature of agriculture. In turn, all Iowans benefit from efforts to strengthen rural economies.

Finally, ISU Extension and Outreach provides research-based information to Iowa's farmers and agribusiness professionals. Educational events range from annual updates on the latest research to timely and relevant information to assist decision making. The following outlines a few examples:

- Integrated Crop Management (ICM) Conference: The ICM Conference attracts roughly 900 participants annually from Iowa and across the Midwest. At the 2017 conference, there were 39 presentations awarding 6,026 hours of continuing education credit to Iowa certified crop advisers. The respondents surveyed farmed or advised clients on 1.8 million acres of corn and soybeans in Iowa and estimated their profit per acre increase was between \$5 and \$10 dollars per acre from the information received at the conference for a collective benefit of \$14 million.
- Southeast Iowa Drought Meetings: Six drought meetings were held during the height of the 2018 drought in southeast Iowa to assist in determining the safety of the corn crop for feeding. The meetings were attended by 257 farmers. Attendees were encouraged to bring corn samples from fields for nitrate testing. A follow-up survey was sent to 160 participants six months



following the meetings. Based on the survey results from 45 respondents, the program had an economic value of over \$408,000.

- **Agricultural Lender Seminars:** Two annual Agricultural Lender seminars were developed and conducted by the dairy team to educate lenders on topics impacting their clients, including markets, technology, and policy. Lenders who attended the seminars intended to make recommendations to their clients, with 91% anticipating direct economic benefits from the workshop, with the most common response showing an expected \$101 to \$500 benefit per client. Lenders estimated a total projected client benefit of over \$190,000 from the seminars.
- **Swine Ventilation Training:** ISU swine extension specialists partnered with the Iowa Pork Producers Association and other allied industry partners to develop and deliver hands-on ventilation training and education to pork producers throughout the state. A portable trailer demonstrating state-of-the-art technology was used to deliver seven training workshops. The number of animals influenced by those attending the workshop was over 63 million pigs and over 1.2 million sows. A total of 171 individual producers participated in the workshops. Participants estimated an average value of \$4,341 per participant from the program.

Three new extension programming initiatives began in FY 2017-18. Leading Communities: A Place-Based Leadership Program provides participants with community-based skills while meeting the specific needs of the places where they live and work. The Marketing Hometown America program helps communities target what people are looking for when they choose a place to live and do business. The Iowa Retail Initiative team prepares retailers for success with technical assistance and education, and trains local leaders to collect and analyze place-based information about their retail districts. In turn, all Iowans benefit when local people join together to make their communities better places to live and work.

Iowa 4-H is the premiere youth development program of ISU Extension and Outreach and it reaches nearly 100,000 K-12 youth each year. There are more than 34,000 youth participants in 4-H STEM programs. The Iowa Governor's STEM Advisory Council notes that Iowa's economic growth depends on workers who are skilled in science, technology, engineering, and math. Overall, 4-H Youth Development connects with almost one in five Iowa K-12 students to improve their college and career readiness, provide them with community service opportunities, and prepare them as future young professionals in Iowa. In turn, all Iowans benefit when young people are prepared for college and careers and are ready to become Iowa's future workforce and successful, contributing members of society.



All Iowans benefit when local communities have a more stable workforce, when public and nonprofit organizations are resilient, and when businesses employ best practices. This is why ISU Extension and Outreach offers educational opportunities to strengthen Iowa's workforce. For example:

- Human sciences specialists teach ServSafe® food safety certification, an internationally recognized program from the National Restaurant Association Educational Foundation. Last year, more than 2,000 Iowans participated in these classes, with 86% successfully earning the Certified Food Protection Manager credential.
- In FY 2017-18, more than 32,000 early childhood care and education professionals participated in more than 160,000 hours of educational programming. In post-training evaluations, 96% of participants reported or demonstrated new knowledge, skills, or program improvements.
- Each year, more than 200 municipal professionals participate in the Iowa Municipal Professional Institute, which provides educational credit toward certification by the International Institute of Municipal Clerks and the Iowa Municipal Finance Officers Association.

Across the state, ISU has 100 extension offices. Almost 600 ISU faculty, staff, and students work off-campus delivering Extension and Outreach. Of these, 437 are employees being paid by the counties rather than on ISU payroll. These are employees that are part of the local county extension district and partner with ISU to deliver programming. Their payroll is funded through taxes on property in the county, levied specifically for Extension. The payroll for the county-paid employees amounts to \$20.8 million and office operations total \$10.8 million.¹⁶

Overall, ISU Extension and Outreach activities have proven to be very valuable to the Iowa economy, specifically to state businesses. However, the impact from these activities is very difficult to accurately quantify through traditional economic impact measures. With that said, the financial activities of the offices are included in the operations spending impact. Even though a complete impact cannot be calculated by Emsi from these activities, the significant role that ISU Extension and Outreach plays in business success across the state should not be overlooked.

¹⁶ ISU Extension and Outreach Annual Report, 2018. <https://www.extension.iastate.edu/our-story/2018-iowa-state-university-extension-and-outreach-annual-report>





Economic development impact



ISU creates an exceptional environment that fosters innovation and entrepreneurship, evidenced by the number of ISU start-up and spin-off companies related to ISU that have been created and the growth of companies that have been supported by the university. This section presents the economic impact of companies that would not have existed in the state but for the presence of ISU. In addition, the impact from the growth of companies that have been supported by the university is captured. To estimate these impacts, we categorize companies according to the following types:

- **Start-up companies:** Companies created specifically to license and commercialize technology or knowledge of ISU.
- **Spin-off companies:** Companies created, fostered, and supported through programs offered by ISU's Small Business Development Center (SBDC) and ISU Center for Industrial Research and Service (CIRAS) that support entrepreneurial business development, or companies that were created by faculty, students, or alumni as a result of their experience at the university.

We limit the scope of this impact to start-up and spin-off companies originating in the last five years. We also vary our methodology from the previous

ISU creates an exceptional environment that fosters innovation and entrepreneurship, evidenced by the number of ISU start-up and spin-off companies related to the university that have been created in the state in the last five years alone.

sections. Ideally, we would use detailed financial information for all start-up and spin-off companies to estimate their impacts. However, collecting that information would call into question the reliability of the data. As an alternative, we use the number of employees of each start-up and spin-off company that was collected and reported by the university. Table 2.6 presents the number of employees for start-up and spin-off companies created in the past five years and related to ISU that were active in Iowa during the analysis year.¹⁷ Companies that benefited from ISU's Small Business Development Center and ISU Center for Industrial Research and Service (CIRAS) are included under the count of spin-off companies. The number of employees is limited to just those employees that were provided jobs at the companies because of the support of the SBDC and CIRAS.

Small Business Development Center supports thousands of businesses every year

In FY 2017-18 alone, ISU's Small Business Development Center (SBDC) supported 4,206 companies. SBDC helps businesses in a variety of ways, including:

- Business planning
- Customer discovery
- Cash flow projections
- Financial analysis
- Loan proposal/capital request assistance
- Business growth strategies
- Marketing strategies
- Startup Assistance
- Export assistance
- Market research

According to a survey conducted by ISU, SBDC assisted in creating 1,457 jobs and starting 219 businesses. The 4,206 businesses supported by SBDC spent \$58.4 million in new capital and had an increase of \$61.3 million in sales.

It also awarded two Entrepreneur of the Year prizes. The 2019 DEB DALZIEL WOMAN ENTREPRENEUR OF THE YEAR Sara Winkleman, of S&B Farmstead Distillery, overcame the many challenges of multiple sclerosis to pursue an interest in distilling whiskey products made with Iowa corn. After she traveled south to learn from some of best moonshiners in the country, Sara contacted the Northwest Iowa SBDC for assistance, and with the help of the SBDC, launched her company in 2018. The SBDC helped Sara obtain financing and start her company, successfully launch three initial whiskeys and a new bourbon coming soon, collaborate with other local vendors to enhance tourism, and serve as a mentor for other new distillers attempting to launch.

Meanwhile, 2019 NEAL SMITH ENTREPRENEUR OF THE YEAR Staci Ackerson acquired Shankland Insurance in 2012. Staci wanted to expand her business and her husband, Stacy, a retired contractor, knew that Charles City had untapped potential. With Stacy's vision of rehabilitating the historic Charles City Western Railroad depot in mind, Staci worked with the NIACC Pappajohn Center SBDC, Community Revitalization of Charles City, and the Main Street Program to apply for and receive an IEDA Main Street Challenge Grant, the Charles City Community Grant, and funding from First Citizens Bank to rehabilitate the historic building. Their completed project not only houses Shankland Insurance, but also provides executive apartments for long-term transitional corporate hires. Mark Wicks of Community Revitalization of Charles City said, "Staci had a real vision. This was a serious nuisance property. They really cleaned it up and turned it into something Charles City could be proud of. She brought that building back to life while also expanding her business. It's a win-win for everybody in Charles City."

17 When employee data was unavailable, a conservative assumption of one employee was used.



TABLE 2.6: START-UP AND SPIN-OFF COMPANIES RELATED TO ISU THAT WERE ACTIVE IN IOWA IN FY 2017-18

	Number of companies*	Number of employees**
Start-up companies	14	42
Spin-off companies	2,017	6,040

* Number of companies reported are companies developed in the past five years and those supported by the SBDC and CIRAS.

** The number of employees includes those hired at the start-up and spin-off companies and the growth in employees at companies supported by the SBDC and CIRAS.

Source: Data provided by ISU.

First, we match each start-up and spin-off company to the closest NAICS industry. Next, we assume the companies have earnings and spending patterns—or production functions—similar to their respective industry averages. Given the number of employees reported for each company, we use industry-specific jobs-to-earnings and earnings-to-sales ratios to estimate the sales of each business. Once we have the sales estimates, we follow a similar methodology as outlined in the previous sections by running sales through the MR-SAM to generate the direct, indirect, and induced multiplier effects.

Table 2.7 presents the impact of the start-up companies. The initial effect is 42 jobs, equal to the number of employees at all start-up companies in the state (from Table 2.6). The corresponding initial effect on labor income is \$2.6 million. The amount of labor income per job created by the start-up companies is much higher than in the previous sections. This is due to the higher average wages within the industries of the start-up companies. The total impacts (the sum of the initial, direct, indirect, and induced effects) are \$4.3 million in added labor income and \$3.7 million in non-labor income. This totals to \$8 million in added income—or the equivalent of supporting 69 jobs.

TABLE 2.7: IMPACT OF START-UP COMPANIES RELATED TO ISU, FY 2017-18

	Labor income (thousands)	Non-labor income (thousands)	Total income (thousands)	Sales (thousands)	Jobs supported*
Initial effect	\$2,614	\$2,357	\$4,971	\$11,221	42
Multiplier effect					
Direct effect	\$503	\$367	\$870	\$2,104	8
Indirect effect	\$135	\$91	\$226	\$558	2
Induced effect	\$1,017	\$928	\$1,945	\$4,252	16
Total multiplier effect	\$1,656	\$1,386	\$3,042	\$6,914	27
Total impact (initial + multiplier)	\$4,270	\$3,743	\$8,013	\$18,135	69

* Number of jobs reported are representative of companies developed in the past five years.

Source: Emsi impact model.



Note that start-up companies have a strong and clearly defined link to ISU. The link between the university and the existence of its spin-off companies, however, is less direct and is thus viewed as more subjective. Many of ISU's spin-off companies included in this analysis were assisted through the university's Small Business Development Center (SBDC) and the ISU Center for Industrial Research and Service (CIRAS).

CIRAS is the ISU outreach to business and industry. Its mission is to enhance the performance of industry through applied research, education, and technical assistance. Support to Iowa industry is provided in the areas of leadership, growth, productivity, workforce, and technology. ISU's CIRAS has been helping businesses and their communities prosper and grow since 1963. In FY 2017-18, 1,705 businesses from 95 Iowa counties received assistance on projects or attended educational workshops from CIRAS staff and partners.

Through a grant-specific reporting processes, ISU works to determine the scale in which CIRAS is affecting the companies it supports. The vast majority of data collected (75%) is from the Department of Commerce NIST Manufacturing Extension Partnership (MEP) and the Department of Defense Procurement Technical Assistance Center (PTAC) cooperative agreements. The MEP impact is directly provided by ISU's funder, based on client responses to a third-party survey conducted by Fors Marsh Group. The PTAC impact is directly provided by ISU clients reporting government contracts received. The remainder of the impact (approximately 25%) is collected by CIRAS-administered surveys following a similar process as the MEP program.

Given its importance to ISU and the state economy, Emsi calculates the economic impact of CIRAS. We use the data bulleted below as reported by the companies. The data is a five-year average from FY 2012-13 to FY 2016-17 because of the high variability from year to year of which industry the companies are working in.

- \$439.9 million in additional sales,
- \$53.3 million in additional capital investment,
- \$18.3 million in cost savings, and
- 5,612 jobs added or retained

The additional sales, capital investments, and jobs added/retained positively impact the state economy. The total impact of CIRAS, including the direct, indirect, and induced multiplier effects, amounts to \$338.7 million in added income. This comprises the majority of the impact when combined with spin-off companies and SBDC, as shown in Table 2.8.



Table 2.8 provides the combined impact from spin-off companies, SBDC, and CIRAS. The impacts in Table 2.7 and Table 2.8 (from start-up companies and spin-off companies, SBDC, and CIRAS) are presented later in the report as a combined total since they represent economic development activities of the university. But we have included them separately here in case the reader would like to exclude the impacts from spin-off companies from the grand total impact.¹⁸

ISU's CIRAS enhances industry performance

PigEasy LLC, a Templeton manufacturer of swine equipment, expects at least \$5 million in new revenue over the next few years from sales of BrEasy, an upcoming product designed to improve the air quality in large hog barns. The company was able to prove BrEasy's effectiveness through CIRAS-arranged research by a professor at ISU. "Before the ISU study, it was just conjecture," said Katie Holtz, PigEasy marketing director. "Not only did that point us toward a path to get to where we wanted to go next, but it also gave us momentum."

Orbis Corporation in Monticello saved roughly \$13,000 by turning to ISU engineering students to quiet a noisy granulator. The company, which uses plastic injection molding to make a variety of containers, implemented the recommendations made by a team of seven capstone students. The changes led to a drop in the machine noise level by more than 11 decibels, eliminating a safety problem at a nearby workstation. "They made a significant difference," said operations manager Doug Wortman.

American Power Systems in Davenport expects to at least double its current six-figure export sales once it fully implements everything learned in a CIRAS-driven ExporTech class. The company, which makes alternators and other electrical equipment for specialty vehicles, crafted an individualized plan for marketing and selling American Power System's products overseas. "We got really strategic," said marketing and communications manager Brandy Welvaert. "It answered a lot of questions we didn't know we had."

CIRAS is positively impacting the state economy by working across the state to share its expertise in enterprise leadership, growth, productivity, workforce, and technology.

JOBS CREATED: TOP SIX INDUSTRIES

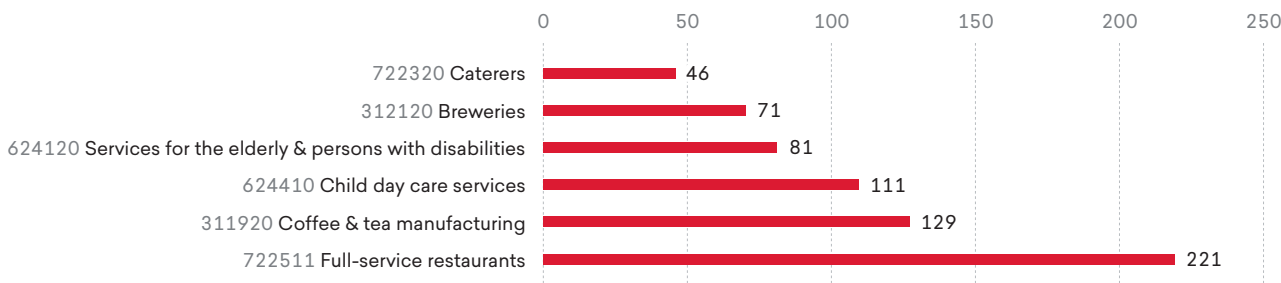


Chart above shows the top six industries most impacted in terms of jobs created by CIRAS.
Source: CIRAS, ISU.

18 The readers are ultimately responsible for making their own judgment on the veracity of the linkages between spin-off companies and ISU. At the very least, the impacts of the spin-off businesses provide important context for the broader effects of ISU.

TABLE 2.8: IMPACT OF SPIN-OFF COMPANIES RELATED TO ISU, FY 2017-18

	Labor income (thousands)	Non-labor income (thousands)	Total income (thousands)	Sales (thousands)	Jobs supported*
Initial effect	\$162,415	\$84,247	\$246,662	\$562,715	6,040
Multiplier effect					
Direct effect	\$30,386	\$14,177	\$44,563	\$96,967	500
Indirect effect	\$7,767	\$3,770	\$11,537	\$26,173	130
Induced effect	\$75,560	\$35,831	\$111,391	\$213,184	1,272
Total multiplier effect	\$113,712	\$53,778	\$167,491	\$336,323	1,901
Total impact (initial + multiplier)	\$276,127	\$138,025	\$414,153	\$899,038	7,941

* Number of jobs reported are representative of companies developed in the past five years

Source: Emsi impact model.

As demonstrated in Table 2.8, the university creates an exceptional environment that fosters innovation and entrepreneurship. As a result, the impact of spin-off companies related to ISU is \$276.1 million in added labor income and \$138 million in non-labor income, totaling \$414.2 million in added income—the equivalent of supporting 7,941 jobs. Of this \$414.2 million in added income, \$338.7 million is due to the companies assisted through ISU's CIRAS.

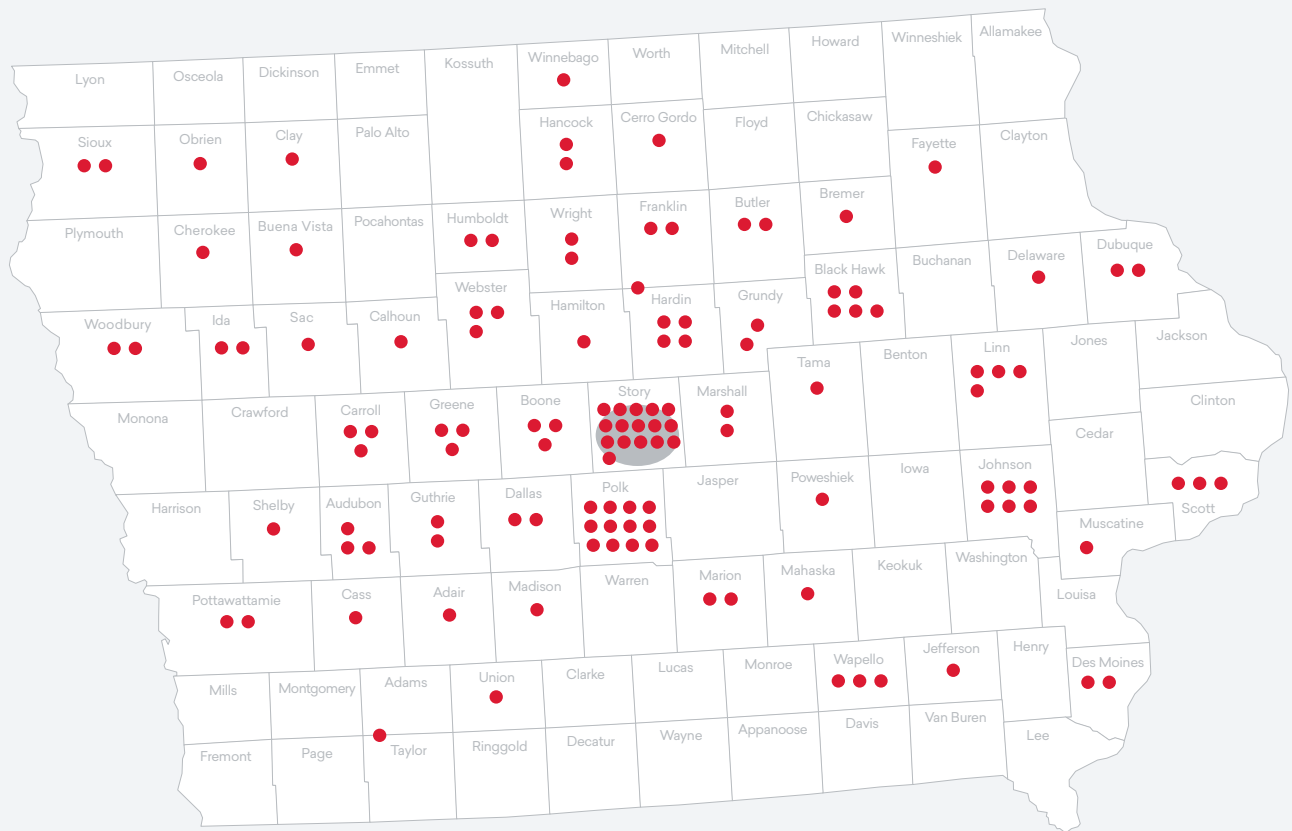
The ISU Research Park supports businesses - big and small

The Iowa State University Research Park (ISURP) is a growing technology community and incubator for new and expanding businesses, providing access to the vast array of resources available at ISU: from talent pipeline management, to specialized equipment, to access to the research infrastructure. ISURP's 400+ acre development serves upwards of 90 tenant companies, with more than 800,000 square feet of developed building space. Five companies that started at ISURP have gone public and multiple others have enjoyed successful liquidity events. The current tenant roster boasts world headquarters locations for two publicly traded companies and major research and development facilities for 10 others.

In choosing to locate in ISURP, businesses are doing more than simply occupying a building. They are joining a thriving community focused on driving innovation, researching and developing solutions to complex challenges, creating a pipeline that offers easy access to world-class talent, and supercharging the state economy.



Companies initially started at the Research Park



● Companies that initially started at ISU's Research Park

● Nearly 70 companies are located inside ISU's Research Park.

The ISU Research Park supports businesses

KENT FEEDS

Founded as a small, family-owned livestock feed operation in Indianola more than nine decades ago, Kent Feeds has grown to become one of the largest feed producers in the world. With plants in 10 states and a strong international presence, Kent Feeds is headquartered in the southeastern Iowa town of Muscatine. In recent months, Kent Feeds has extended its reach in Iowa, establishing a satellite office in the Iowa State University Research Park in Ames. Headed up by Jeff Underwood, the office serves a strategic purpose.

“We are all about innovation,” Underwood says. “We are looking for science-based solutions that will help us to better serve our customers. We want to work with world-class research universities and ISU fits that bill. It was an easy decision to establish a physical presence here.”

From the office in the Research Park, Underwood coordinates a growing intern program focused on those with expertise in information technology, software engineering, nutrition, and research that aligns with Kent Feeds’ diverse product lines.

“Our primary reason for being here is access to the talent that ISU produces,” Underwood says. “But it also offers an opportunity to keep an eye on the technology being developed here and to move to incorporate the technologies that will help us continue to innovate much quicker than we ever have. We see this office as one more way we are fostering growth organization-wide. There are so many exciting start-ups and projects coming out of Central Iowa, and Ames in particular. We wanted to be sure we had a front row seat to that innovation and that we were helping to drive it.”

Underwood says that the leadership team of the Research Park went above and beyond to ensure Kent Feeds could find the right space to meet its corporate objectives with the satellite office.

“This was all brand new to us,” Underwood says. “We really don’t have anything like it anywhere else. We relied on the Research Park staff to help us through it. They were very responsive when we had questions and provided input that ensured we were ready to go as soon as we opened our doors. They made it easy for us to make this happen.”

The ISU Research Park supports businesses

JOHN DEERE

By placing an emphasis on research, talent acquisition, and developing a pipeline to efficiently advance technology, John Deere has become a leader in innovation across a variety of industry segments. With an eye toward strengthening relationships with key partners and expanding the reach of the development pipeline, John Deere recently opened a strategic technology innovation center in the Iowa State University Research Park.

The new center, which opened in November 2017, houses approximately 60 full- and part-time employees. “John Deere is a company driven by innovation to solve important problems,” says Pushpa Manukonda, the Director of the ISU John Deere Technology Innovation Center. “Our employees are involved in autonomy, machine learning, artificial intelligence, cyber security and other leading technologies.” Manukonda said the facility represents a brick-and-mortar commitment by the company to grow its on-campus presence in recognition of the world-class research, education, and talent at ISU.

“Specifically, we are focused on building technical capabilities for engineering and information technology. Our location in the Research Park allows them to stay with us all year,” Manukonda continues, adding that having students work year-round allows for continuity on longer-term projects. “Students can still go to one of our larger centers during the summer, but this enables them to know they will have part-time work, close to school, during the school year developing strategic skills and capabilities.”





Visitor spending impact



Tens of thousands of out-of-state visitors came to ISU in FY 2017-18 to participate in various activities, including commencement, sports events, and orientation. ISU estimated that 129,753 out-of-state visitors attended events it hosted in FY 2017-18.¹⁹ Table 2.9 presents the average expenditures per person-trip for accommodation, food, transportation, and other personal expenses (including shopping and entertainment).

Based on these figures, the gross spending of out-of-state visitors totaled \$40.2 million in FY 2017-18. However, some of this spending includes monies paid to the university through non-textbook items (e.g., event tickets, food, etc.). These have already been accounted for in the operations impact and should thus be removed to avoid double-counting. We estimate that on-campus sales generated by out-of-state visitors totaled \$7.5 million. The net sales from out-of-state visitors in FY 2017-18 thus come to \$32.8 million.

Calculating the increase in income as a result of visitor spending again requires use of the MR-SAM model. The analysis begins by discounting the off-campus sales generated by out-of-state visitors to account for leakage in the trade sector, and then bridging the net figures to the detailed sectors of the MR-SAM

Tens of thousands of out-of-state visitors
*came to ISU in FY 2017-18 to participate in
various activities, including commencement,
sports events, and orientation.*

¹⁹ See Appendix 1 for a sensitivity analysis of the number of visitors.

model. The model runs the net sales figures through the multiplier matrix to arrive at the multiplier effects. As shown in Table 2.10, the net impact of visitor spending in FY 2017-18 is \$10 million in labor income and \$7.4 million in non-labor income. This totals to \$17.4 million in added income and is equivalent to supporting 473 jobs.

TABLE 2.9: AVERAGE PER-TRIP VISITOR COSTS AND SALES GENERATED BY OUT-OF-STATE VISITORS IN IOWA, FY 2017-18*

Accommodation	\$52
Food	\$98
Entertainment and shopping	\$82
Transportation	\$78
Total expenses per visitor	\$310
Number of out-of-state visitors	129,753
Gross sales	\$40,223,430
On-campus sales (excluding textbooks)	\$7,471,956
Net off-campus sales	\$32,751,474

* Costs have been adjusted to account for the length of stay of out-of-state visitors. Accommodation and transportation have been adjusted downward to recognize that, on average, two visitors share the costs of housing and transportation. Numbers may not add due to rounding.

Source: Sales calculations estimated by Emsi based on data provided by ISU

TABLE 2.10: VISITOR SPENDING IMPACT, FY 2017-18

	Labor income (thousands)	Non-labor income (thousands)	Total income (thousands)	Sales (thousands)	Jobs supported
Initial effect	\$0	\$0	\$0	\$32,751	0
Multiplier effect					
Direct effect	\$5,838	\$4,302	\$10,140	\$18,702	276
Indirect effect	\$1,502	\$1,128	\$2,630	\$4,938	72
Induced effect	\$2,672	\$1,953	\$4,625	\$8,458	125
Total multiplier effect	\$10,012	\$7,383	\$17,395	\$32,098	473
Total impact (initial + multiplier)	\$10,012	\$7,383	\$17,395	\$64,850	473

Source: Emsi impact model.





Value of volunteerism



Beyond positively impacting the state through the activities occurring at ISU, such as research, ISU also directly impacts the state economy through its facilitation and support of student and employee volunteer activities. Volunteers are an important part of any society because they positively impact those less fortunate. Many non-profit organizations would not exist without the support of their volunteers. Volunteerism is often seen as a selfless act, but it can also provide personal benefits, such as decreasing the risk of depression, promoting an active mind and body, reducing stress, meeting new friends, and creating a feeling of self-fulfilment and belonging.

For example, there are many volunteers and volunteer hours through ISU Extension and Outreach, which coordinates volunteers statewide in two programs with a significant impact. First, the 4-H and Youth Development program recruits, trains, and organizes volunteers to reach nearly 100,000 K-12 youth per year. In FY 2017-18, 6,967 adult volunteers worked directly with youth and, based on a survey, estimated spending 57 hours per year supporting the 4-H program. From that estimate, ISU direct volunteers provided 398,840 hours to the 4-H program, which becomes \$9.3 million in value for the state and local communities. This does not include the volunteer time that the youth involved in 4-H gave back to their communities.

Another large volunteer program coordinated by ISU Extension and Outreach is Master Gardener. These volunteers are organized in 81 counties across the state and provide value by answering homeowner yard and garden questions,

conducting community beautification projects, and growing fresh fruits and vegetables for local food pantries. In FY 2017-2018, 1,938 Master Gardeners recorded 114,224 volunteer hours in Iowa. At \$23.41 per hour, this becomes \$2.7 million of value to the state.

Overall, more than 21,000 ISU student and employee volunteers per year support non-profit organizations and causes across the state.²⁰ These students and employees volunteered more than 650,000 hours of their time. Beyond 4-H and Master Gardening, the students and employees spent their time volunteering at organizations such as animal rescue shelters, national parks, food pantries, Habitat for Humanity, and local libraries. According to Independent Sector,²¹ the only national membership organization that brings together the charitable community, the average value of a volunteer hour in Iowa in FY 2017-18 was \$23.41. Multiplying this by the hours that ISU students and employees volunteered amounts to \$15.2 million in value for the state and local communities. The impact of volunteerism is not quantified in this study because accurately measuring the counterfactual scenarios associated with volunteerism is too difficult. For example, would some of these organizations hire employees if they no longer had ISU volunteers? Thus, we simply measure the gross value of employees and not the impact they have on Iowa society.

Value of volunteers in growing tomorrow's leaders

Iowa 4-H is the premiere youth development program of ISU Extension and Outreach. For over 100 years, Iowa 4-H has been delivering research-based educational programs for K-12 Youth in Iowa. 4-H is a community of 6 million young people across the world who are learning how to live healthily, be leaders, become engaged in their communities, and use science and technology to make good decisions for their future and their community's future.

4-H programs are designed to teach Healthy Living, STEM, Leadership/Civic Engagement, and Communication and the Arts. Each year, almost 100,000 youth in Iowa participate via one of ISU's program delivery modes. The 4-H program utilizes nearly 7,000 volunteers to initiate direct educational program delivery to the youth participating in 4-H. These people volunteer nearly 400,000 hours educating and mentoring Iowa youth.

The Iowa 4-H Youth Development Program provides opportunities for youth to develop skills that they can use now and throughout their lives. Iowa 4-H builds upon a century of experience as it fosters positive youth development that is based on the needs and strengths of youth, their families, and communities.

Iowa 4-H follows the principles of experiential learning and draws on the knowledge base of ISU and other institutions of higher education in cooperation with the United States Department of Agriculture. The Iowa 4-H Program's vision and mission statements clearly view youth as partners working with caring adults, and as full participants in planning and working for individual and community change.

20 Due to data unavailability, the volunteer activities of employees are not considered in this analysis, meaning the value for ISU volunteerism is understated. In addition, FY 2015-16 volunteer data is used as a proxy for FY 2017-18 since the survey collecting volunteer information is only administered by ISU every three years.

21 Value per volunteer hour per state was provided by Independent Sector, https://independentsector.org/resource/vovt_details/.





Student spending impact



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

While there were 21,375 students attending ISU who originated from Iowa,²² not all of them would have remained in the state if not for the existence of ISU. We apply a conservative assumption that 20% of these students would have left Iowa for other education opportunities if ISU did not exist.²³ Therefore, we recognize that the in-state spending of 4,275 students retained in the state is attributable to ISU. These students, called retained students, spent money at businesses in the state for everyday needs such as groceries, accommodation, and transportation. Of the retained students, we estimate 1,183 lived on campus while attending the university. While these students spend money

²² Note that because the university was unable to provide origin data for their non-credit students, we assume that all non-credit students originated from within the state.

²³ See Appendix 1 for a sensitivity analysis of the retained student variable.

while attending the university, we exclude most of their spending for room and board since these expenditures are already reflected in the impact of the university's operations.

Relocated students are also accounted for in ISU's student spending impact. In fact, 10,925 students came from outside the state and lived off campus while attending ISU in FY 2017-18. Another 5,463 out-of-state students lived on campus while attending the university. We apply the same adjustment as described above to the students who relocated and lived on campus during their time at the university. Collectively, the off-campus expenditures of out-of-state students supported jobs and created new income in the state economy.²⁴

The average costs for students appear in the first section of Table 2.11, equal to \$10,976 per student. Note that this table excludes expenses for books and supplies, since many of these monies are already reflected in the operations impact discussed in the previous section. We multiply the \$10,976 in annual costs by the 14,017 students who either were retained or relocated to the state because of ISU and lived in-state but off campus. This provides us with an estimate of their total spending. For students living on campus, we multiply the per-student cost of personal expenses, transportation, and off-campus food purchases (assumed to be equal to 25% of room and board) by the number of

TABLE 2.11: AVERAGE STUDENT COSTS AND TOTAL SALES GENERATED BY RELOCATED AND RETAINED STUDENTS IN IOWA, FY 2017-18

Room and board	\$8,546
Personal expenses	\$1,571
Transportation	\$859
Total expenses per student	\$10,976
Number of students retained	4,275
Number of students relocated	16,388
Gross retained student sales	\$39,339,333
Gross relocated student sales	\$144,857,571
Total gross off-campus sales	\$184,196,905
Wages and salaries paid to student workers*	\$46,635,672
Net off-campus sales	\$137,561,233

* This figure reflects only the portion of payroll that was used to cover the living expenses of relocated and retained student workers who lived in the state.

Source: Student costs and wages provided by ISU. The number of relocated and retained students who lived in the state off campus or on campus while attending is derived by Emsi from the student origin data and in-term residence data provided by ISU. The data is based on credit students.

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



students who lived in the state but on campus while attending (6,646 students). Altogether, off-campus spending of relocated and retained students generated gross sales of \$184.2 million. This figure, once net of the monies paid to student workers, yields net off-campus sales of \$137.6 million, as shown in the bottom row of Table 2.11.

Estimating the impacts generated by the \$137.6 million in student spending follows a procedure similar to that of the operations impact described above. We distribute the \$137.6 million in sales to the industry sectors of the MR-SAM model, apply RPCs to reflect in-state spending, and run the net sales figures through the MR-SAM model to derive multiplier effects.

Table 2.12 presents the results. The initial effect is purely sales-oriented and there is no change in labor or non-labor income. The impact of relocated and retained student spending thus falls entirely under the multiplier effect. The total impact of student spending is \$53.9 million in labor income and \$35.1 million in non-labor income. This sums together to \$89.1 million in total added income and is equivalent to supporting 2,116 jobs. These values represent the direct effects created at the businesses patronized by the students, the indirect effects created by the supply chain of those businesses, and the effects of the increased spending of the household sector throughout the state economy as a result of the direct and indirect effects.

The total impact of student spending is \$89.1 million in total added income and is equivalent to supporting 2,116 jobs.

TABLE 2.12: STUDENT SPENDING IMPACT, FY 2017-18

	Labor income (thousands)	Non-labor income (thousands)	Total income (thousands)	Sales (thousands)	Jobs supported
Initial effect	\$0	\$0	\$0	\$137,561	0
Multiplier effect					
Direct effect	\$31,712	\$20,778	\$52,490	\$93,495	1,242
Indirect effect	\$7,511	\$4,819	\$12,329	\$22,786	314
Induced effect	\$14,715	\$9,538	\$24,254	\$42,549	560
Total multiplier effect	\$53,938	\$35,135	\$89,073	\$158,830	2,116
Total impact (initial + multiplier)	\$53,938	\$35,135	\$89,073	\$296,392	2,116

Source: Emsi impact model.





Alumni impact



In this section, we estimate the economic impacts stemming from the added labor income of alumni in combination with their employers' added non-labor income. This impact is based on the number of students who have attended ISU throughout its history. We then use this total number to consider the impact of those students in the single FY 2017-18. Former students who earned a degree as well as those who may not have finished their degree or did not take courses for credit are considered alumni.

While ISU creates an economic impact through its operations, construction, research, economic development, visitor, and student spending, the greatest economic impact of ISU stems from the added human capital—the knowledge, creativity, imagination, and entrepreneurship—found in its alumni. While attending ISU, students gain experience, education, and the knowledge, skills, and abilities that increase their productivity and allow them to command a higher wage once they enter the workforce. But the reward of increased productivity does not stop there. Talented professionals make capital more productive too (e.g., buildings, production facilities, equipment). The employers of ISU alumni enjoy the fruits of this increased productivity in the form of additional non-labor income (i.e., higher profits).

*The greatest economic impact of ISU stems from the **added human capital**—the knowledge, creativity, imagination, and entrepreneurship—found in its alumni.*

The methodology here differs from the previous impacts in one fundamental way. Whereas the previous spending impacts depend on an annually renewed injection of new sales into the state economy, the alumni impact is the result of years of past instruction and the associated accumulation of human capital. The initial effect of alumni is comprised of two main components. The first and largest of these is the added labor income of ISU's former students. The second component of the initial effect is comprised of the added non-labor income of the businesses that employ former students of ISU.

We begin by estimating the portion of alumni who are employed in the workforce. To estimate the historical employment patterns of alumni in the state, we use the following sets of data or assumptions: 1) settling-in factors to determine how long it takes the average student to settle into a career;²⁵ 2) death, retirement, and unemployment rates from the National Center for Health Statistics, the Social Security Administration, and the Bureau of Labor Statistics; and 3) state migration data from the Census Bureau. The result is the estimated portion of alumni from each previous year who were still actively employed in the state as of FY 2017-18.

The next step is to quantify the skills and human capital that alumni acquired from the university. We use the students' production of CHEs as a proxy for accumulated human capital. The average number of CHEs completed per student in FY 2017-18 was 24.6. To estimate the number of CHEs present in the workforce during the analysis year, we use the university's historical student headcount over the past 30 years, from FY 1988-89 to FY 2017-18.²⁶ We multiply the 24.6 average CHEs per student by the headcounts that we estimate are still actively employed from each of the previous years.²⁷ Students who enroll at the university more than one year are counted at least twice in the historical enrollment data. However, CHEs remain distinct regardless of when and by whom they were earned, so there is no duplication in the CHE counts. We estimate there are approximately 8.8 million CHEs from alumni active in the workforce.

Next, we estimate the value of the CHEs, or the skills and human capital acquired by ISU alumni. This is done using the *incremental* added labor income stemming from the students' higher wages. The incremental added labor income is the difference between the wage earned by ISU alumni and the alternative wage they would have earned had they not attended ISU. Using the state incremental earnings, credits required, and distribution of credits at each level of study, we

25 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.

26 We apply a 30-year time horizon because the data on students who attended ISU prior to FY 1988-89 is less reliable, and because most of the students served more than 30 years ago had left the state workforce by FY 2017-18.

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

estimate the average value per CHE to equal \$182. This value represents the state average incremental increase in wages that alumni of ISU received during the analysis year for every CHE they completed.

Because workforce experience leads to increased productivity and higher wages, the value per CHE varies depending on the students' workforce experience, with the highest value applied to the CHEs of students who had been employed the longest by FY 2017-18, 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 6. In determining the amount of added labor income attributable to alumni, we multiply the CHEs of former students in each year of the historical time horizon by the corresponding average value per CHE for that year, and then sum the products together. This calculation yields approximately \$1.6 billion in gross labor income from increased wages received by former students in FY 2017-18 (as shown in Table 2.13).

TABLE 2.13: NUMBER OF CHES IN WORKFORCE AND INITIAL LABOR INCOME CREATED IN IOWA, FY 2017-18

Number of CHEs in workforce	8,774,557
Average value per CHE	\$182
Initial labor income, gross	\$1,595,565,540
Counterfactuals	
Percent reduction for alternative education opportunities	15%
Percent reduction for adjustment for labor import effects	50%
Initial labor income, net	\$678,115,355

Source: Emsi impact model.

The next two rows in Table 2.13 show two adjustments used to account for counterfactual outcomes. As discussed above, counterfactual outcomes in economic analysis represent what would have happened if a given event had not occurred. The event in question is the education and training provided by ISU and subsequent influx of skilled labor into the state economy. The first counterfactual scenario that we address is the adjustment for alternative education opportunities. In the counterfactual scenario where ISU does not exist, we assume a portion of ISU alumni would have received a comparable education elsewhere in the state or would have left the state and received a comparable education and then returned to the state. The incremental added labor income that accrues to those students cannot be counted towards the added labor income from ISU alumni. The adjustment for alternative education opportunities amounts to a 15% reduction of the \$1.6 billion in added labor income. This means that 15% of the added labor income from ISU alumni would

have been generated in the state anyway, even if the university did not exist. For more information on the alternative education adjustment, see Appendix 7.

The other adjustment in Table 2.13 accounts for the importation of labor. Suppose ISU did not exist and in consequence there were fewer skilled workers in the state. Businesses could still satisfy some of their need for skilled labor by recruiting from outside Iowa. We refer to this as the labor import effect. Lacking information on its possible magnitude, we assume 50% of the jobs that students fill at state businesses could have been filled by workers recruited from outside the state if the university did not exist.²⁸ Consequently, the gross labor income must be adjusted to account for the importation of this labor, since it would have happened regardless of the presence of the university. We conduct a sensitivity analysis for this assumption in Appendix 1. With the 50% adjustment, the net added labor income added to the economy comes to \$678.1 million, as shown in Table 2.13.

The \$678.1 million in added labor income appears under the initial effect in the labor income column of Table 2.14. To this we add an estimate for initial non-labor income. As discussed earlier in this section, businesses that employ former students of ISU 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 (\$678.1 million) to the six-digit NAICS industry sectors where students are most likely to be employed. This allocation entails a process that maps completers in the state to the detailed occupations for which those completers have been trained, and then maps the detailed occupations to the six-digit industry sectors in the MR-SAM model.²⁹ Using a crosswalk created by National Center for Education Statistics (NCES) and the Bureau of Labor Statistics, we map the breakdown of the university's completers to the approximately 700 detailed occupations in the Standard Occupational Classification (SOC) system. Finally, we apply a matrix of wages by industry and by occupation from the MR-SAM model to map the occupational distribution of the \$678.1 million in initial labor income effects to the detailed industry sectors in the MR-SAM model.³⁰

Once these allocations are complete, we apply the ratio of non-labor to labor income provided by the MR-SAM model for each sector to our estimate of initial labor income. This computation yields an estimated \$441.1 million in added non-labor income attributable to the university's alumni. Summing initial labor and

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

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

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



non-labor income together provides the total initial effect of alumni productivity in the Iowa economy, equal to approximately \$1.1 billion. To estimate multiplier effects, we convert the industry-specific income figures generated through the initial effect to sales using sales-to-income ratios from the MR-SAM model. We then run the values through the MR-SAM's multiplier matrix.

TABLE 2.14: ALUMNI IMPACT, FY 2017-18

	Labor income (thousands)	Non-labor income (thousands)	Total income (thousands)	Sales (thousands)	Jobs supported
Initial effect	\$678,115	\$441,054	\$1,119,169	\$2,617,135	11,277
Multiplier effect					
Direct effect	\$105,309	\$71,071	\$176,380	\$409,385	1,823
Indirect effect	\$30,543	\$20,998	\$51,541	\$122,257	540
Induced effect	\$315,556	\$184,812	\$500,368	\$1,021,451	5,304
Total multiplier effect	\$451,408	\$276,880	\$728,288	\$1,553,093	7,667
Total impact (initial + multiplier)	\$1,129,524	\$717,934	\$1,847,457	\$4,170,228	18,944

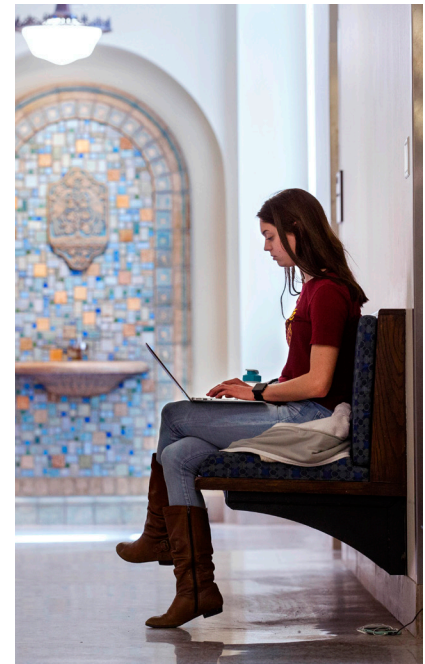
Source: Emsi impact model.

Table 2.14 shows the multiplier effects of alumni. Multiplier effects occur as alumni generate an increased demand for consumer goods and services through the expenditure of their higher wages. Further, as the industries where alumni are employed increase their output, there is a corresponding increase in the demand for input from the industries in the employers' supply chain. Together, the incomes generated by the expansions in business input purchases and household spending constitute the multiplier effect of the increased productivity of the university's alumni. The final results are \$451.4 million in added labor income and \$276.9 million in added non-labor income, for an overall total of \$728.3 million in multiplier effects. The grand total of the alumni impact is \$1.8 billion in total added income, the sum of all initial and multiplier labor and non-labor income effects. This is equivalent to supporting 18,944 jobs.



Total ISU impact

The total economic impact of ISU on Iowa can be generalized into two broad types of impacts. First, on an annual basis, ISU generates a flow of spending that has a significant impact on the Iowa economy. The impacts of this spending are captured by the operations, construction, research, economic development, visitor, and student spending impacts. While not insignificant, these impacts do not capture the true purpose of ISU. The basic mission of ISU is to foster human capital. Every year, a new cohort of former ISU students adds to the stock of human capital in Iowa, and a portion of alumni continues to add to the Iowa economy. Table 2.15 displays the grand total impacts of ISU on the Iowa economy in FY 2017-18. For context, the percentages of ISU compared to the total labor income, total non-labor income, combined total income, sales, and jobs in Iowa, as presented in Table 1.3 and Figure 1.3, are included. The total added value of ISU is **\$3.4 billion**, equivalent to **1.8%** of the GSP of Iowa. By comparison, this contribution that the university provides on its own is nearly as large as the entire Utilities industry in the state. ISU's total impact supported **42,640 jobs** in FY 2017-18. For perspective, this means that **one out of every 49 jobs** in Iowa is supported by the activities of ISU and its students.



Even though a \$3.4 billion impact is significant, this figure does not take into account all the activities of ISU. More specifically, ISU's Extension, Outreach, and volunteer activities should be recognized as adding significant value to the state of Iowa. ISU's Extension and Outreach have helped over 10,000 companies and organizations, as well as 15,000 farmers across the state. More than 21,000 ISU students volunteered over 650,000 hours to organizations and groups that

TABLE 2.15: TOTAL ISU IMPACT, FY 2017-18*

	Labor income (thousands)	Non-labor income (thousands)	Total income (thousands)	Sales (thousands)	Jobs supported
Operations spending	\$621,597	\$37,339	\$658,936	\$946,354	8,364
Construction spending	\$39,534	-\$176	\$39,358	\$183,302	595
Research spending	\$269,483	\$40,735	\$310,219	\$586,690	4,139
Economic development	\$280,397	\$141,768	\$422,165	\$917,173	8,011
Visitor spending	\$10,012	\$7,383	\$17,395	\$64,850	473
Student spending	\$53,938	\$35,135	\$89,073	\$296,392	2,116
Alumni	\$1,129,524	\$717,934	\$1,847,457	\$4,170,228	18,944
Total impact	\$2,404,486	\$980,117	\$3,384,603	\$7,164,988	42,640
% of the Iowa economy	2.2%	1.2%	1.8%	1.8%	2.1%

* This table excludes the positive impacts of ISU Extension, Outreach, and volunteer activities.
Source: Emsi impact model.



are helping those less fortunate. In FY 2017-18, ISU volunteers added \$15.2 million in value for state and local communities. Even though the impact of the Extension, Outreach, and volunteer activities are not quantitatively measured in terms of a true economic impact, they play a significant role in state and local economies and communities. In fact, we do not measure the impact from these activities not because these activities are insignificant, but because measuring the impact of these activities does not meet the Emsi standard of a robust economic impact methodology.

These impacts from the university and its students stem from different industry sectors and spread throughout the state economy. Table 2.16 displays the total impact of ISU by each industry sector based on their two-digit NAICS code. The table shows the total impact of operations, construction, research, economic development, visitors, students, and alumni, as shown in Table 2.15, broken down by each industry sector's individual impact on the state economy using processes outlined earlier in this chapter. By showing the impact from individual industry sectors, it is possible to see in finer detail the industries that drive the greatest impact on the state economy from the university's spending and from where ISU alumni are employed. For example, ISU's spending and alumni in the Manufacturing industry sector generated an impact of \$548.1 million in FY 2017-18.

TABLE 2.16: TOTAL ISU IMPACT BY INDUSTRY, FY 2017-18

Industry sector	Total income (thousands)	Jobs supported
Government, Education	\$995,913	13,837
Manufacturing	\$548,087	2,998
Professional & Technical Services	\$249,222	3,489
Finance & Insurance	\$193,872	1,156
Government, Non-Education	\$188,779	2,144
Information	\$164,805	907
Agriculture, Forestry, Fishing, & Hunting	\$163,522	2,563
Health Care & Social Assistance	\$133,584	2,671
Wholesale Trade	\$127,426	737
Utilities	\$105,139	228
Retail Trade	\$87,647	1,928
Construction	\$86,211	1,305
Accommodation & Food Services	\$79,235	3,013
Real Estate & Rental & Leasing	\$57,862	1,116
Administrative & Waste Services	\$45,081	962
Management of Companies & Enterprises	\$44,064	453
Other Services (except Public Administration)	\$42,003	1,265
Educational Services	\$34,516	833
Transportation & Warehousing	\$20,526	258
Arts, Entertainment, & Recreation	\$15,922	766
Mining, Quarrying, & Oil and Gas Extraction	\$1,186	9
Total impact	\$3,384,603	42,640

Source: Emsi impact model.



CHAPTER 3:

Investment Analysis

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

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





Student perspective

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

Calculating student costs

Student costs consist of three main items: direct outlays, opportunity costs, and future principal and interest costs incurred from student loans. Direct outlays include tuition and fees, equal to \$362.2 million from Figure 1.1. Direct outlays also include the cost of books and supplies. On average, full-time students spent \$994 each on books and supplies during the reporting year.³¹ Multiplying this figure by the number of full-time equivalents (FTEs) produced by ISU in FY 2017-18³² generates a total cost of \$26.8 million for books and supplies.

In order to pay the cost of tuition, many students had to take out loans. These students not only incur the cost of tuition from the university but also incur the interest cost of taking out loans. In FY 2017-18, students received a total of \$195.7 million in loans to attend ISU. Students pay back these loans along with interest over the span of several years in the future. Since students pay off these loans over time, they accrue no initial cost during the analysis year. Hence, to avoid double counting, the \$195.7 million in loans is subtracted from the costs incurred by students in FY 2017-18.

In addition to the cost of tuition, books, and supplies, students also experienced an opportunity cost of attending college during the analysis year. Opportunity cost is the most difficult component of student costs to estimate. It measures the value of time and earnings foregone by students who go to the university rather than work. To calculate it, we need to know the difference between the students' full earning potential and what they actually earn while attending the university.

³¹ Based on the data provided by ISU.

³² A single FTE is equal to 30 CHEs for undergraduate students and 24 CHEs for graduate students, so there were 32,059 FTEs produced by students in FY 2017-18, equal to 961,775 CHEs divided by 30.



STUDENT COSTS



Out-of-Pocket Expenses



Opportunity Costs

STUDENT BENEFITS



Higher Earnings from Education



We derive the students' full earning potential by weighting the average annual earnings levels in Table 1.4 according to the education level breakdown of the student population when they first enrolled.³³ However, the earnings levels in Table 1.4 reflect what average workers earn at the midpoint of their careers, not while attending the university. Because of this, we adjust the earnings levels to the average age of the student population (22) to better reflect their wages at their current age.³⁴ This calculation yields an average full earning potential of \$20,022 per student.

In determining how much students earn while enrolled in postsecondary education, an important factor to consider is the time that they actually spend on postsecondary education, since this is the only time that they are required to give up a portion of their earnings. We use the students' CHE production as a proxy for time, under the assumption that the more CHEs students earn, the less time they have to work, and, consequently, the greater their foregone earnings. Overall, students attending ISU earned an average of 24.6 CHEs per student (excluding dual credit high school students), which is approximately equal to 84% of a full academic year.³⁵ We thus include no more than \$16,887 (or 84%) of the students' full earning potential in the opportunity cost calculations.

Another factor to consider is the students' employment status while enrolled in postsecondary education. It is estimated that 60% of students are employed.³⁶ For the remainder of students, we assume that they are either seeking work or planning to seek work once they complete their educational goals. By choosing to enroll, therefore, non-working students give up everything that they can potentially earn during the academic year (i.e., the \$16,887). The total value of their foregone earnings thus comes to \$266.7 million.

Working students are able to maintain all or part of their earnings while enrolled. However, many of them hold jobs that pay less than statistical averages, usually because those are the only jobs they can find that accommodate their course schedule. These jobs tend to be at entry level, such as restaurant servers or cashiers. To account for this, we assume that working students hold jobs that pay 70% of what they would have earned had they chosen to work full-time rather than go to college.³⁷ The remaining 30% comprises the percentage of their full earning potential that they forego. Obviously, this assumption varies



33 This is based on students who reported their prior level of education to ISU. The prior level of education data was then adjusted to exclude dual credit high school students.

34 Further discussion on this adjustment appears in Appendix 6.

35 Equal to 24.6 CHEs divided by 30 for the proportion of undergraduate students and 24 for the proportion of graduate students, the assumed number of CHEs in a full-time academic year.

36 Based on data provided by ISU. This figure excludes dual credit high school students, who are not included in the opportunity cost calculations.

37 The 70% assumption is based on the average hourly wage of jobs commonly held by working students divided by the national average hourly wage. Occupational wage estimates are published by the Bureau of Labor Statistics (see http://www.bls.gov/oes/current/oes_nat.htm).

by person; some students forego more and others less. Since we do not know the actual jobs that students hold while attending, the 30% in foregone earnings serves as a reasonable average.

Working students also give up a portion of their leisure time in order to attend higher education institutions. According to the Bureau of Labor Statistics American Time Use Survey, students forego up to 0.5 hours of leisure time per day.³⁸ 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 is \$144.6 million, equal to the sum of their foregone earnings (\$118.7 million) and foregone leisure time (\$26 million).

Thus far we have discussed student costs during the analysis year. Recall that some students take out student loans to attend college during the year, which they will have to pay back over time. The amount they will be paying in the future must be a part of their decision to attend the university today. Students who take out loans are not only required to pay back the principal of the loan but to also pay back a certain amount in interest. The first step in calculating students' loan interest cost is to determine the payback time for the loans. The \$195.7 million in loans was awarded to 17,270 students, averaging \$11,332 per student in the analysis year. However, this figure represents only one year of loans. Because loan payback time is determined by total indebtedness, we assume that since ISU is a four-year university, students will be indebted four times that amount, or \$45,327 on average. According to the U.S. Department of Education, this level of indebtedness will take 25 years to pay back under the standard repayment plan.³⁹

This indebtedness calculation is used solely to estimate the loan payback period. Students will be paying back the principal amount of \$195.7 million over time. After taking into consideration the time value of money, this means that students will pay off a discounted present value of \$105.6 million in principal over the 25 years. In order to calculate interest, we only consider interest on the loans awarded to students in FY 2017-18. Using the student discount rate of 4.5%⁴⁰ as our interest rate, we calculate that students will pay a total discounted present value of \$87.9 million in interest on student loans throughout the first 25 years of their working lifetime. The stream of these future interest

38 "Charts by Topic: Leisure and Sports Activities," American Time Use Survey, Last modified December 2016. <http://www.bls.gov/TUS/CHARTS/LEISURE.HTM>.

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

40 The student discount rate is derived from the baseline forecasts for the 10-year discount rate published by the Congressional Budget Office. See the Congressional Budget Office, Student Loan and Pell Grant Programs – April 2018 Baseline. <https://www.cbo.gov/system/files?file=2018-06/51310-2018-04-studentloan.pdf>.



costs together with the stream of loan payments is included in the costs of Column 5 of Table 3.2.

The steps leading up to the calculation of student costs appear in Table 3.1. Direct outlays amount to \$193.2 million, the sum of tuition and fees (\$362.2 million) and books and supplies (\$26.8 million), less loans received (\$195.7 million). Opportunity costs for working and non-working students amount to \$380.7 million, excluding \$30.6 million in offsetting residual aid that is paid directly to students.⁴¹ Finally, we have the present value of future student loan costs, amounting to \$193.6 million between principal and interest. Summing direct outlays, opportunity costs, and future student loan costs together yields a total of \$767.6 million in present value student costs.

TABLE 3.1: PRESENT VALUE OF STUDENT COSTS, FY 2017-18 (THOUSANDS)

Direct outlays in FY 2017-18	
Tuition and fees	\$362,191
Less loans received	-\$195,700
Books and supplies	\$26,751
Total direct outlays	\$193,241
Opportunity costs in FY 2017-18	
Earnings foregone by non-working students	\$266,700
Earnings foregone by working students	\$118,658
Value of leisure time foregone by working students	\$25,987
Less residual aid	-\$30,596
Total opportunity costs	\$380,749
Future student loan costs (present value)	
Student loan principal	\$105,618
Student loan interest	\$87,946
Total present value student loan costs	\$193,564
Total present value student costs	\$767,554

Source: Based on data provided by ISU and outputs of the Emsi impact model.

Linking education to earnings

Having estimated the costs of education to students, we weigh these costs against the benefits that students receive in return. The relationship between education and earnings is well documented and forms the basis for determining student benefits. As shown in Table 1.4, state mean earnings levels at the midpoint of the average-aged worker's career increase as people achieve higher

⁴¹ Residual aid is the remaining portion of scholarship or grant aid distributed directly to a student after the university applies tuition and fees.



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

A key component in determining the students' return on investment is the value of their future benefits stream; i.e., what they can expect to earn in return for the investment they make in education. We calculate the future benefits stream to the university's FY 2017-18 students first by determining their average annual increase in earnings, equal to \$192.4 million. This value represents the higher wages that accrue to students at the midpoint of their careers and is calculated based on the marginal wage increases of the CHEs that students complete while attending the university. Using the state of Iowa earnings, the marginal wage increase per CHE is \$200. For a full description of the methodology used to derive the \$192.4 million, see Appendix 6.

The second step is to project the \$192.4 million annual increase in earnings into the future, for as long as students remain in the workforce. We do this using the Mincer function to predict the change in earnings at each point in an individual's working career.⁴² The Mincer function originated from Mincer's seminal work on human capital (1958). The function estimates earnings using an individual's years of education and post-schooling experience. While some have criticized Mincer's earnings function, it is still upheld in recent data and has served as the foundation for a variety of research pertaining to labor economics. Card (1999 and 2001) addresses a number of these criticisms using U.S. based research over the last three decades and concludes that any upward bias in the Mincer parameters is on the order of 10% or less. We use state-specific and education level-specific Mincer coefficients. To account for any upward bias, we incorporate a 10% reduction in our projected earnings, otherwise known as the ability bias. With the \$192.4 million representing the students' higher earnings at the midpoint of their careers, we apply scalars from the Mincer function to yield a stream of projected future benefits that gradually increase from the time students enter the workforce, peak shortly after the career midpoint, and then dampen slightly as students approach retirement at age 67. This earnings stream appears in Column 2 of Table 3.2.

As shown in Table 3.2, the \$192.4 million in gross higher earnings occurs around Year 17, which is the approximate midpoint of the students' future working careers given the average age of the student population and an assumed retirement age of 67. In accordance with the Mincer function, the gross higher earnings that accrue to students in the years leading up to the midpoint are less than \$192.4 million and the gross higher earnings in the years after the midpoint are greater than \$192.4 million.

42 Appendix 6 provides more information on the Mincer function and how it is used to predict future earnings growth.



TABLE 3.2: PROJECTED BENEFITS AND COSTS, STUDENT PERSPECTIVE

1	2	3	4	5	6
Year	Gross higher earnings to students (millions)	% active in workforce*	Net higher earnings to students (millions)	Student costs (millions)	Net cash flow (millions)
0	\$57.9	10%	\$6.1	\$574.0	-\$567.9
1	\$64.0	20%	\$12.5	\$13.0	-\$0.5
2	\$70.4	29%	\$20.5	\$13.0	\$7.5
3	\$77.1	46%	\$35.3	\$13.0	\$22.3
4	\$84.2	69%	\$58.1	\$13.0	\$45.1
5	\$91.5	97%	\$88.4	\$13.0	\$75.4
6	\$99.1	97%	\$95.8	\$13.0	\$82.8
7	\$107.0	97%	\$103.4	\$13.0	\$90.4
8	\$115.1	97%	\$111.2	\$13.0	\$98.2
9	\$123.4	97%	\$119.2	\$13.0	\$106.2
10	\$131.8	97%	\$127.3	\$13.0	\$114.3
11	\$140.4	97%	\$135.5	\$13.0	\$122.6
12	\$149.1	97%	\$143.9	\$13.0	\$130.9
13	\$157.8	96%	\$152.2	\$13.0	\$139.2
14	\$166.6	96%	\$160.5	\$13.0	\$147.5
15	\$175.3	96%	\$168.8	\$13.0	\$155.8
16	\$183.9	96%	\$177.0	\$13.0	\$164.0
17	\$192.4	96%	\$185.0	\$13.0	\$172.0
18	\$200.8	96%	\$192.8	\$13.0	\$179.8
19	\$209.0	96%	\$200.3	\$13.0	\$187.3
20	\$216.9	96%	\$207.5	\$13.0	\$194.6
21	\$224.4	96%	\$214.4	\$13.0	\$201.4
22	\$231.7	95%	\$220.8	\$13.0	\$207.8
23	\$238.5	95%	\$226.8	\$13.0	\$213.8
24	\$245.0	95%	\$232.3	\$13.0	\$219.3
25	\$250.9	95%	\$237.2	\$13.0	\$224.2
26	\$256.3	94%	\$241.6	\$0.0	\$241.6
27	\$261.2	94%	\$245.3	\$0.0	\$245.3
28	\$265.5	94%	\$248.3	\$0.0	\$248.3
29	\$269.3	93%	\$250.7	\$0.0	\$250.7
30	\$272.4	93%	\$252.4	\$0.0	\$252.4
31	\$274.8	92%	\$253.4	\$0.0	\$253.4
32	\$276.6	92%	\$253.6	\$0.0	\$253.6
33	\$277.8	91%	\$253.2	\$0.0	\$253.2
34	\$278.3	91%	\$252.0	\$0.0	\$252.0
35	\$278.1	90%	\$250.1	\$0.0	\$250.1
36	\$277.3	89%	\$247.4	\$0.0	\$247.4
37	\$275.8	89%	\$244.1	\$0.0	\$244.1
38	\$273.7	88%	\$240.1	\$0.0	\$240.1
39	\$270.9	87%	\$235.4	\$0.0	\$235.4
40	\$267.6	86%	\$230.0	\$0.0	\$230.0
41	\$263.7	85%	\$224.1	\$0.0	\$224.1
42	\$259.2	84%	\$217.6	\$0.0	\$217.6
43	\$254.2	83%	\$210.6	\$0.0	\$210.6
44	\$248.8	82%	\$203.1	\$0.0	\$203.1
Present value			\$2,895.8	\$767.6	\$2,128.2

Internal rate of return	Benefit-cost ratio	Payback period (no. of years)
14.2%	3.8	9.4

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

Source: Emsi impact model.



The final step in calculating the students' future benefits stream is to net out the potential benefits generated by students who are either not yet active in the workforce or who leave the workforce over time. This adjustment appears in Column 3 of Table 3.2 and represents the percentage of the FY 2017-18 student population that will be employed in the workforce in a given year. Note that the percentages in the first five years of the time horizon are relatively lower than those in subsequent years. This is because many students delay their entry into the workforce, either because they are still enrolled at the university or because they are unable to find a job immediately upon graduation. Accordingly, we apply a set of “settling-in” factors to account for the time needed by students to find employment and settle into their careers. As discussed in Chapter 2, settling-in factors delay the onset of the benefits by one to three years for students who graduate with a certificate or a degree and by one to five years for degree-seeking students who do not complete during the analysis year.

Beyond the first five years of the time horizon, students will leave the workforce for any number of reasons, whether death, retirement, or unemployment. We estimate the rate of attrition using the same data and assumptions applied in the calculation of the attrition rate in the economic impact analysis of Chapter 2.⁴³ The likelihood of leaving the workforce increases as students age, so the attrition rate is more aggressive near the end of the time horizon than in the beginning. Column 4 of Table 3.2 shows the net higher earnings to students after accounting for both the settling-in patterns and attrition.

Return on investment for students

Having estimated the students' costs and their future benefits stream, the next step is to discount the results to the present to reflect the time value of money. For the student perspective we assume a discount rate of 4.5% (see below). Because students tend to rely upon debt to pay for education—i.e. they are negative savers—their discount rate is based upon student loan interest rates.⁴⁴ In Appendix 1, we conduct a sensitivity analysis of this discount rate. The present value of the benefits is then compared to student costs to derive the investment analysis results, expressed in terms of a benefit-cost ratio, rate of return, and payback period. The investment is feasible if returns match or exceed the minimum threshold values; i.e., a benefit-cost ratio greater than 1, a rate of return that exceeds the discount rate, and a reasonably short payback period.

- ⁴³ See the discussion of the alumni impact 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.
- ⁴⁴ The student discount rate is derived from the baseline forecasts for the 10-year Treasury rate published by the Congressional Budget Office. See the Congressional Budget Office, Student Loan and Pell Grant Programs – April 2018 Baseline. <https://www.cbo.gov/system/files?file=2018-06/51310-2018-04-studentloan.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 1.0% discount rate from the perspectives of taxpayers and society.



In Table 3.2, the net higher earnings of students yield a cumulative discounted sum of approximately \$2.9 billion, the present value of all of the future earnings increments (see the bottom section of Column 4). This may also be interpreted as the gross capital asset value of the students' higher earnings stream. In effect, the aggregate FY 2017-18 student body is rewarded for its investment in ISU with a capital asset valued at \$2.9 billion.

The students' cost of attending the university is shown in Column 5 of Table 3.2, equal to a present value of \$767.6 million. Comparing the cost with the present value of benefits yields a student benefit-cost ratio of 3.8 (equal to \$2.9 billion in benefits divided by \$767.6 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.⁴⁵ Table 3.2 shows students of ISU earning average returns of 14.2% 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 10% on stocks and bonds (30-year average return).

Note that returns reported in this study are real returns, not nominal. When a bank promises to pay a certain rate of interest on a savings account, it employs an implicitly nominal rate. Bonds operate in a similar manner. If it turns out that the inflation rate is higher than the stated rate of return, then money is lost in real terms. In contrast, a real rate of return is on top of inflation. For example, if inflation is running at 3% and a nominal percentage of 5% is paid, then the real rate of return on the investment is only 2%. In Table 3.2, the 14.2% student rate of return is a real rate. With an inflation rate of 2.2% (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 16.4%, higher than what is reported in Table 3.2.

The payback period is defined as the length of time it takes to entirely recoup the initial investment.⁴⁶ Beyond that point, returns are what economists would

*ISU students see an average rate of return of **14.2%** for their investment of time and money.*

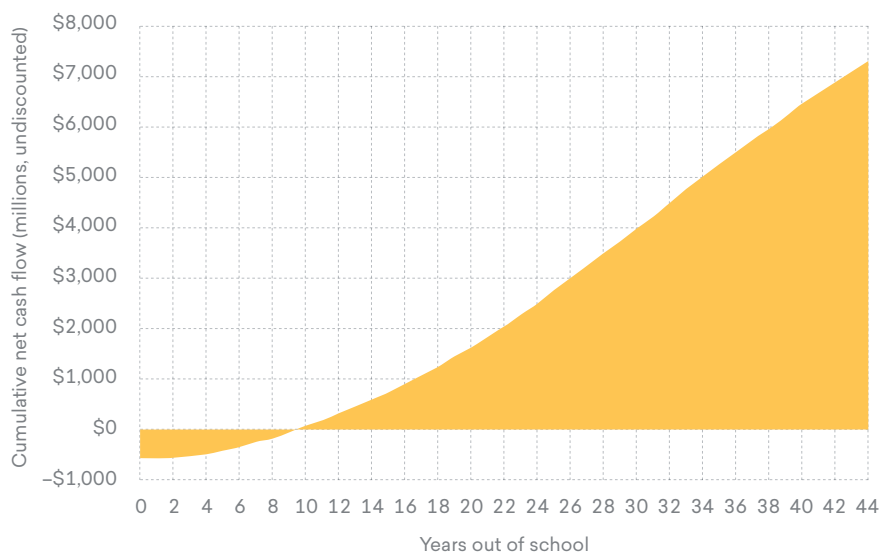
45 Rates of return are computed using the familiar internal rate-of-return calculation. Note that, with a bank deposit or stock market investment, the depositor puts up a principal, receives in return a stream of periodic payments, and then recovers the principal at the end. Someone who invests in education, 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.

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



call pure costless rent. As indicated in Table 3.2, students at ISU see, on average, a payback period of 9.4 years, meaning 9.4 years after their initial investment of foregone earnings and out-of-pocket costs, they will have received enough higher future earnings to fully recover those costs (Figure 3.1).

FIGURE 3.1: STUDENT PAYBACK PERIOD



Source: Emsi impact model.



Taxpayer perspective

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

Growth in state tax revenues

As a result of their time at ISU, students earn more because of the skills they learned while attending the university, and businesses earn more because student skills make capital more productive (buildings, machinery, and everything else). This in turn raises profits and other business property income. Together, increases in labor and non-labor (i.e., capital) income are considered the effect of a skilled workforce. These in turn increase tax revenues since state government is able to apply tax rates to higher earnings.

Estimating the effect of ISU on increased tax revenues begins with the present value of the students' future earnings stream, which is displayed in Column 4 of Table 3.2. To this, we apply a multiplier derived from Emsi's MR-SAM model to estimate the added labor income created in the state as students and businesses spend their higher earnings.⁴⁷ As labor income increases, so does non-labor income, which consists of monies gained through investments. To calculate the growth in non-labor income, we multiply the increase in labor income by a ratio of the Iowa gross state product to total labor income in the state. We also include the spending impacts discussed in Chapter 2 that were created in FY 2017-18 from operations, construction, research, visitor, and student spending. To each of these, we apply the prevailing tax rates so we capture only the tax revenues attributable to state government from this additional revenue.

Not all of these tax revenues may be counted as benefits to the state, however. Some students leave the state during the course of their careers, and the higher earnings they receive as a result of their education leaves the state with them. To account for this dynamic, we combine student settlement data from the university with data on migration patterns from the Census Bureau to estimate the number of students who will leave the state workforce over time.

⁴⁷ For a full description of the Emsi MR-SAM model, see Appendix 5.



TAXPAYER COSTS



State Funding

TAXPAYER BENEFITS



Increased Tax Revenue



Avoided Costs to
State Government

We apply another reduction factor to account for the students' alternative education opportunities. This is the same adjustment that we use in the calculation of the alumni impact in Chapter 2 and is designed to account for the counterfactual scenario where ISU does not exist. The assumption in this case is that any benefits generated by students who could have received an education even without the university cannot be counted as new benefits to society. For this analysis, we assume an alternative education variable of 15%, meaning that 15% of the student population at the university would have generated benefits anyway even without the university. For more information on the alternative education variable, see Appendix 7.

We apply a final adjustment factor to account for the “shutdown point” that nets out benefits that are not directly linked to the state government costs of supporting the university. As with the alternative education variable discussed under the alumni impact, the purpose of this adjustment is to account for counterfactual scenarios. In this case, the counterfactual scenario is where state government funding for ISU did not exist and ISU had to derive the revenue elsewhere. To estimate this shutdown point, we apply a sub-model that simulates the students' demand curve for education by reducing state support to zero and progressively increasing student tuition and fees. As student tuition and fees increase, enrollment declines. For ISU, the shutdown point adjustment is 0%, meaning that the university 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 9.

After adjusting for attrition, alternative education opportunities, and the shutdown point, we calculate the present value of the future added tax revenues that occur in the state, equal to \$652.9 million. Recall from the discussion of the student return on investment that the present value represents the sum of the future benefits that accrue each year over the course of the time horizon, discounted to current year dollars to account for the time value of money. Given that the stakeholder in this case is the public sector, we use the discount rate of 1.0%. This is the real treasury interest rate recommended by the Office of Management and Budget (OMB) for 30-year investments, and in Appendix 1, we conduct a sensitivity analysis of this discount rate.⁴⁸

Government savings

In addition to the creation of higher tax revenues to the state government, education is statistically associated with a variety of lifestyle changes that generate social savings, also known as external or incidental benefits of education.



⁴⁸ Office of Management and Budget. “Discount Rates for Cost-Effectiveness Analysis of Federal Programs.” *Real Interest Rates on Treasury Notes and Bonds of Specified Maturities (in Percent)*. Last modified November 2018. <https://www.whitehouse.gov/wp-content/uploads/2018/12/Discount-History.pdf>.

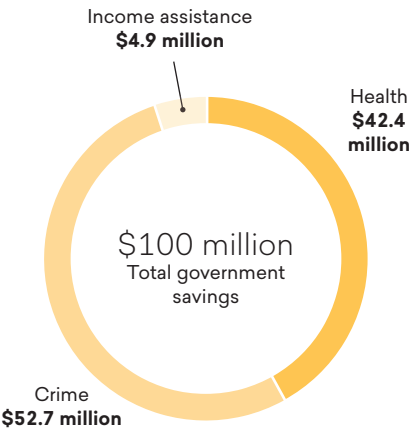
These represent the avoided costs to the government that otherwise would have been drawn from public resources absent the education provided by ISU. Government savings appear in Figure 3.2 and Table 3.3 and break down into three main categories: 1) health savings, 2) crime savings, and 3) income assistance savings. Health savings include avoided medical costs that would have otherwise been covered by state government. Crime savings consist of avoided costs to the justice system (i.e., police protection, judicial and legal, and corrections). Income assistance benefits comprise avoided costs due to the reduced number of welfare and unemployment insurance claims.

The model quantifies government savings by calculating the probability at each education level that individuals will have poor health, commit crimes, or claim welfare and unemployment benefits. Deriving the probabilities involves assembling data from a variety of studies and surveys analyzing the correlation between education and health, crime, and income assistance at the national and state level. We spread the probabilities across the education ladder and multiply the marginal differences by the number of students who achieved CHEs at each step. The sum of these marginal differences counts as the upper bound measure of the number of students who, due to the education they received at the university, will not have poor health, commit crimes, or demand income assistance. We dampen these results by the ability bias adjustment discussed earlier in the student perspective section and in Appendix 6 to account for factors (besides education) that influence individual behavior. We then multiply the marginal effects of education times the associated costs of health, crime, and income assistance.⁴⁹ Finally, we apply the same adjustments for attrition, alternative education, and the shutdown point to derive the net savings to the government. Total government savings appear in Figure 3.2 and sum to \$100 million.

Table 3.3 displays all benefits to taxpayers. The first row shows the added tax revenues created in the state, equal to \$652.9 million, from students' higher earnings, increases in non-labor income, and spending impacts. The sum of the government savings and the added income in the state is \$753 million, as shown in the bottom row of Table 3.3. These savings continue to accrue in the future as long as the FY 2017-18 student population of ISU remains in the workforce.

In addition to the creation of higher tax revenues to the state government, education is statistically associated with a variety of lifestyle changes that generate social savings.

FIGURE 3.2: PRESENT VALUE OF GOVERNMENT SAVINGS



Source: Emsi impact model.

⁴⁹ For a full list of the data sources used to calculate the social externalities, see the Resources and References section. See also Appendix 10 for a more in-depth description of the methodology.

TABLE 3.3: PRESENT VALUE OF ADDED TAX REVENUE AND GOVERNMENT SAVINGS (THOUSANDS)

Added tax revenue	\$652,944
Government savings	
Health-related savings	\$42,400
Crime-related savings	\$52,714
Income assistance savings	\$4,915
Total government savings	\$100,029
Total taxpayer benefits	\$752,973

Source: Emsi impact model.

Return on investment for taxpayers

Taxpayer costs are reported in Table 3.4 and come to \$285.7 million, equal to the contribution of state government to ISU. In return for their public support, taxpayers are rewarded with an investment benefit-cost ratio of 2.6 (= \$753 million ÷ \$285.7 million), indicating a profitable investment.

At 6.8%, the rate of return to state taxpayers is favorable. Given that the stakeholder in this case is the public sector, we use the discount rate of 1.0%, the real treasury interest rate recommended by the Office of Management and Budget for 30-year investments.⁵⁰ 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 1.0% would mean that the university just pays its own way. In principle, governments could borrow monies used to support ISU and repay the loans out of the resulting added taxes and reduced government expenditures. A rate of return of 6.8%, on the other hand, means that ISU not only pays its own way, but also generates a surplus that the state government can use to fund other programs. It is unlikely that other government programs could make such a claim.

A rate of return of 6.8% means that ISU not only pays its own way, but also generates a surplus that the state government can use to fund other programs.

⁵⁰ Office of Management and Budget. "Discount Rates for Cost-Effectiveness Analysis of Federal Programs." *Real Interest Rates on Treasury Notes and Bonds of Specified Maturities (in Percent)*. Last modified November 2018. <https://www.whitehouse.gov/wp-content/uploads/2018/12/Discount-History.pdf>.

TABLE 3.4: PROJECTED BENEFITS AND COSTS, TAXPAYER PERSPECTIVE

1	2	3	4
Year	Benefits to taxpayers (millions)	State gov't costs (millions)	Net cash flow (millions)
0	\$83.6	\$285.7	-\$202.1
1	\$1.7	\$0.0	\$1.7
2	\$2.7	\$0.0	\$2.7
3	\$4.5	\$0.0	\$4.5
4	\$7.2	\$0.0	\$7.2
5	\$10.7	\$0.0	\$10.7
6	\$11.4	\$0.0	\$11.4
7	\$12.1	\$0.0	\$12.1
8	\$12.8	\$0.0	\$12.8
9	\$13.6	\$0.0	\$13.6
10	\$14.3	\$0.0	\$14.3
11	\$15.1	\$0.0	\$15.1
12	\$15.9	\$0.0	\$15.9
13	\$16.7	\$0.0	\$16.7
14	\$17.5	\$0.0	\$17.5
15	\$18.2	\$0.0	\$18.2
16	\$19.0	\$0.0	\$19.0
17	\$19.8	\$0.0	\$19.8
18	\$20.5	\$0.0	\$20.5
19	\$21.2	\$0.0	\$21.2
20	\$21.9	\$0.0	\$21.9
21	\$22.5	\$0.0	\$22.5
22	\$23.2	\$0.0	\$23.2
23	\$23.7	\$0.0	\$23.7
24	\$24.2	\$0.0	\$24.2
25	\$24.7	\$0.0	\$24.7
26	\$25.1	\$0.0	\$25.1
27	\$25.4	\$0.0	\$25.4
28	\$25.7	\$0.0	\$25.7
29	\$25.9	\$0.0	\$25.9
30	\$26.0	\$0.0	\$26.0
31	\$26.1	\$0.0	\$26.1
32	\$26.1	\$0.0	\$26.1
33	\$26.0	\$0.0	\$26.0
34	\$25.9	\$0.0	\$25.9
35	\$25.7	\$0.0	\$25.7
36	\$25.4	\$0.0	\$25.4
37	\$25.0	\$0.0	\$25.0
38	\$24.5	\$0.0	\$24.5
39	\$24.0	\$0.0	\$24.0
40	\$23.5	\$0.0	\$23.5
41	\$22.9	\$0.0	\$22.9
42	\$22.2	\$0.0	\$22.2
43	\$21.4	\$0.0	\$21.4
44	\$20.7	\$0.0	\$20.7
Present value	\$753.0	\$285.7	\$467.3
Internal rate of return	Benefit-cost ratio	Payback period (no. of years)	
6.8%	2.6	16.4	

Source: Emsi impact model.





Social perspective

Iowa benefits from the education that ISU provides through the earnings that students create in the state and through the savings that they generate through their improved lifestyles. To receive these benefits, however, members of society must pay money and forego services that they otherwise would have enjoyed if ISU did not exist. Society's investment in ISU stretches across a number of investor groups, from students to employers to taxpayers. We weigh the benefits generated by ISU to these investor groups against the total social costs of generating those benefits. The total social costs include all ISU expenditures, all student expenditures (including interest on student loans) less tuition and fees, and all student opportunity costs, totaling a present value of \$1.7 billion.

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

Growth in state economic base

In the process of absorbing the newly acquired skills of students who attend ISU, not only does the productivity of the Iowa workforce increase, but so does the productivity of its physical capital and assorted infrastructure. Students earn more because of the skills they learned while attending the university, and businesses earn more because student skills make capital more productive (buildings, machinery, and everything else). This in turn raises profits and other business property income. Together, increases in labor and non-labor (i.e., capital) income are considered the effect of a skilled workforce.

Estimating the effect of ISU on the state's economic base follows the same process used when calculating increased tax revenues in the taxpayer perspective. However, instead of looking at just the tax revenue portion, we include all of the added earnings and business output. We again factor in student attrition and alternative education opportunities. The shutdown point does not apply to the growth of the economic base because the social perspective captures not only the state taxpayer support to the university, but also the support from the students and other non-governmental sources.



SOCIAL COSTS



ISU Expenditures



Student Out-of-Pocket Expenses



Student Opportunity Costs

SOCIAL BENEFITS



Increased State Earnings



Avoided Costs to Society

After adjusting for attrition and alternative education opportunities, we calculate the present value of the future added income that occurs in the state, equal to \$7.6 billion. Recall from the discussion of the student and taxpayer return on investment that the present value represents the sum of the future benefits that accrue each year over the course of the time horizon, discounted to current year dollars to account for the time value of money. As stated in the taxpayer perspective, given that the stakeholder in this case is the public sector, we use the discount rate of 1.0%.

Social savings

Similar to the government savings discussed above, society as a whole sees savings due to external or incidental benefits of education. These represent the avoided costs that otherwise would have been drawn from private and public resources absent the education provided by ISU. Social benefits appear in Table 3.5 and break down into three main categories: 1) health savings, 2) crime savings, and 3) income assistance savings. These are similar to the categories from the taxpayer perspective above, although health savings now also include lost productivity and other effects associated with smoking, alcohol dependence, obesity, depression, and drug abuse. In addition to avoided costs to the justice system, crime savings also consist of avoided victim costs and benefits stemming from the added productivity of individuals who otherwise would have been incarcerated. Income assistance savings are comprised of the avoided government costs due to the reduced number of welfare and unemployment insurance claims.

Table 3.5 displays the results of the analysis. The first row shows the increased economic base in the state, equal to \$7.6 billion, from students' higher earnings and their multiplier effects, increases in non-labor income, and spending impacts. Social savings appear next, beginning with a breakdown of savings related to health. These include 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. Although the prevalence of these health conditions generally declines as individuals attain higher levels of education, prevalence rates are sometimes higher for individuals with certain levels of education. For example, adults with college degrees may be more likely to spend more on alcohol and become dependent on alcohol. Thus, in some cases the social savings associated with a health factor can be negative. Nevertheless, the overall health savings for society are positive, amounting to \$217 million. Crime savings amount to \$58.6 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



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 activities that produce positive externalities, such as beekeeping.

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



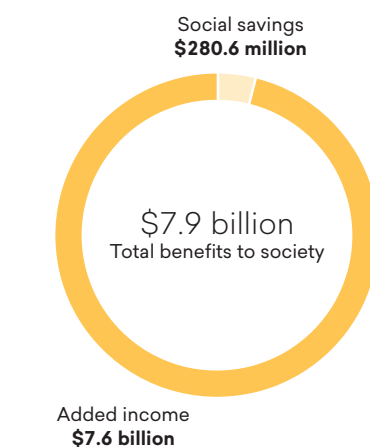
justice, and corrective services. Finally, the present value of the savings related to income assistance amount to \$4.9 million, stemming from a reduced number of persons in need of welfare or unemployment benefits. All told, social savings amounted to \$280.6 million in benefits to communities and citizens in Iowa.

TABLE 3.5: PRESENT VALUE OF THE FUTURE INCREASED ECONOMIC BASE AND SOCIAL SAVINGS IN THE STATE (THOUSANDS)

Increased economic base	\$7,598,792
Social savings	
Health	
Smoking	\$97,965
Alcohol dependence	-\$8,158
Obesity	\$66,113
Depression	\$51,158
Drug abuse	\$9,961
Total health savings*	\$217,039
Crime	
Criminal justice system savings	\$51,886
Crime victim savings	\$1,121
Added productivity	\$5,639
Total crime savings	\$58,646
Income assistance	
Welfare savings	\$2,096
Unemployment savings	\$2,819
Total income assistance savings	\$4,915
Total social savings	\$280,601
Total, increased economic base + social savings	\$7,879,393

* In some cases, health savings may be negative. This is due to increased prevalence rates at certain education levels.
Source: Emsi impact model.

FIGURE 3.3: PRESENT VALUE OF BENEFITS TO SOCIETY



Source: Emsi impact model.

The sum of the social savings and the increased state economic base is \$7.9 billion, as shown in the bottom row of Table 3.5 and in Figure 3.4. These savings accrue in the future as long as the FY 2017-18 student population of ISU remains in the workforce.

Return on investment for society

Table 3.6 presents the stream of benefits accruing to the Iowa society and the total social costs of generating those benefits. Comparing the present value of the benefits and the social costs, we have a benefit-cost ratio of 4.5. This means that for every dollar invested in an education from ISU, whether it is the



TABLE 3.6: PROJECTED BENEFITS AND COSTS, SOCIAL PERSPECTIVE

1	2	3	4
Year	Benefits to society (millions)	Social costs (millions)	Net cash flow (millions)
0	\$1,131.1	\$1,455.8	-\$324.7
1	\$15.4	\$13.0	\$2.4
2	\$25.0	\$13.0	\$12.0
3	\$42.5	\$13.0	\$29.5
4	\$69.3	\$13.0	\$56.3
5	\$104.3	\$13.0	\$91.3
6	\$111.8	\$13.0	\$98.8
7	\$119.5	\$13.0	\$106.5
8	\$127.4	\$13.0	\$114.4
9	\$135.5	\$13.0	\$122.5
10	\$143.6	\$13.0	\$130.6
11	\$151.8	\$13.0	\$138.9
12	\$160.1	\$13.0	\$147.1
13	\$168.4	\$13.0	\$155.4
14	\$176.6	\$13.0	\$163.6
15	\$184.7	\$13.0	\$171.7
16	\$192.7	\$13.0	\$179.7
17	\$200.5	\$13.0	\$187.5
18	\$208.0	\$13.0	\$195.0
19	\$215.3	\$13.0	\$202.3
20	\$222.2	\$13.0	\$209.2
21	\$228.7	\$13.0	\$215.8
22	\$234.8	\$13.0	\$221.9
23	\$240.5	\$13.0	\$227.5
24	\$245.6	\$13.0	\$232.6
25	\$250.1	\$13.0	\$237.1
26	\$254.1	\$0.0	\$254.1
27	\$257.4	\$0.0	\$257.4
28	\$260.1	\$0.0	\$260.1
29	\$262.1	\$0.0	\$262.1
30	\$263.4	\$0.0	\$263.4
31	\$264.0	\$0.0	\$264.0
32	\$263.8	\$0.0	\$263.8
33	\$263.0	\$0.0	\$263.0
34	\$261.4	\$0.0	\$261.4
35	\$259.2	\$0.0	\$259.2
36	\$256.2	\$0.0	\$256.2
37	\$252.5	\$0.0	\$252.5
38	\$248.2	\$0.0	\$248.2
39	\$243.1	\$0.0	\$243.1
40	\$237.5	\$0.0	\$237.5
41	\$231.2	\$0.0	\$231.2
42	\$224.4	\$0.0	\$224.4
43	\$217.1	\$0.0	\$217.1
44	\$209.3	\$0.0	\$209.3
Present value	\$7,879.4	\$1,741.8	\$6,137.6

Benefit-cost ratio

Payback period (no. of years)

4.5

6.3

Source: Emsi impact model.



money spent on operations of the university or money spent by students on tuition and fees, an average of \$4.50 in benefits will accrue to society in Iowa.⁵¹

With and without social savings

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

TABLE 3.7: TAXPAYER AND SOCIAL PERSPECTIVES WITH AND WITHOUT SOCIAL SAVINGS

	Including social savings	Excluding social savings
Taxpayer perspective		
Net present value (millions)	\$467.3	\$367.2
Benefit-cost ratio	2.6	2.3
Internal rate of return	6.8%	5.7%
Payback period (no. of years)	16.4	20.0
Social perspective		
Net present value (millions)	\$6,137.6	\$5,857.0
Benefit-cost ratio	4.5	4.4

Source: Emsi impact model.

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



CHAPTER 4:

Conclusion



WHILE ISU's value to Iowa is larger than simply its economic impact, understanding the dollars and cents value is an important asset to understanding the university's value as a whole. In order to fully assess ISU's value to the state economy, this report has evaluated the university from the perspectives of economic impact analysis and investment analysis.

From an economic impact perspective, we calculated that ISU generates a total economic impact of **\$3.4 billion** in total added income for the state economy. This represents the sum of several different impacts, including the university's:

- Operations spending impact (**\$658.9 million**);
- Construction spending impact (**\$39.4 million**);
- Research spending impact (**\$310.2 million**);
- Economic development impact (**\$422.2 million**);
- Visitor spending impact (**\$17.4 million**);
- Student spending impact (**\$89.1 million**); and
- Alumni impact (**\$1.8 billion**).

The total impact of \$3.4 billion is equivalent to approximately **1.8%** of the total GSP of Iowa and is equivalent to supporting **42,640 jobs**. For perspective, this means that **one out of every 49 jobs** in Iowa is supported by the activities of ISU and its students. This \$3.4 billion impact does not take into account ISU's Extension, Outreach, and volunteer activities. These activities benefit state and local communities and economies by helping thousands of companies and farmers, as well as those less fortunate.

Since ISU's activity represents an investment by various parties, including students, taxpayers, and society as a whole, we also considered the university as an investment to see the value it provides to these investors. For each dollar invested by students, taxpayers, and society, ISU offers a benefit of **\$3.80**, **\$2.60**, and **\$4.50**, respectively. These results indicate that ISU is an attractive investment to students with rates of return that exceed alternative investment opportunities. At the same time, the presence of the university expands the state economy and creates a wide range of positive social benefits that accrue to taxpayers and society in general within Iowa.

Modeling the impact of the university is subject to many factors, the variability of which we considered in our sensitivity analysis (Appendix 1). With this variability accounted for, we present the findings of this study as a robust picture of the economic value of ISU.



One out of every 49 jobs in Iowa is supported by the activities of ISU and its students.



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Appendix 1: Sensitivity Analysis

Sensitivity analysis measures the extent to which a model's outputs are affected by hypothetical changes in the background data and assumptions. This is especially important when those variables are inherently uncertain. This analysis allows us to identify a plausible range of potential results that would occur if the value of any of the variables is in fact different from what was expected. In this chapter we test the sensitivity of the model to the following input factors: 1) the number of out-of-state visitors, 2) the alternative education variable, 3) the labor import effect variable, 4) the student employment variables, 5) the discount rate, and 6) the retained student variable.

Number of out-of-state visitors

While we can calculate the impact of visitors, it can be difficult for universities to determine how many originated from outside the state. Table A1.1 presents a sensitivity analysis for the annual number of out-of-state visitors. The assumption increases and decreases relative to the base case of 129,753 visitors by the increments indicated in the table. The visitor spending impact is then recalculated with each number of out-of-state visitors, holding all else constant. Visitor spending impacts attributable to ISU's event hosting range from a high of \$26.1 million with 194,630 visitors to a low of \$8.7 million with 64,877 visitors.

TABLE A1.1: SENSITIVITY ANALYSIS OF ANNUAL NUMBER OF OUT-OF-STATE VISITORS

% variation in assumption	-50%	-25%	-10%	Base Case	10%	25%	50%
Annual out-of-state visitors	64,877	97,315	116,778	129,753	142,728	162,191	194,630
Visitor spending impact (million)	\$8,697	\$13,046	\$15,655	\$17,395	\$19,134	\$21,743	\$26,092

Alternative education variable

The alternative education variable (15%) accounts for the counterfactual scenario where students would have to seek a similar education elsewhere absent the publicly-funded university in the state. Given the difficulty in accurately specifying the alternative education variable, we test the sensitivity of the taxpayer and social investment analysis results to its magnitude. Variations in the alternative education assumption are calculated around base case results listed in the middle column of Table A1.2. 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 repeated introducing one change at a time, holding all other variables constant. For example, an increase of 10% in

the alternative education assumption (from 15% to 17%) reduces the taxpayer perspective rate of return from 6.8% to 6.7%. Likewise, a decrease of 10% (from 15% to 14%) in the assumption increases the rate of return from 6.8% to 7.0%.

TABLE A1.2: SENSITIVITY ANALYSIS OF ALTERNATIVE EDUCATION VARIABLE, TAXPAYER AND SOCIAL PERSPECTIVES

% variation in assumption	-50%	-25%	-10%	Base Case	10%	25%	50%
Alternative education variable	8%	11%	14%	15%	17%	19%	23%
Taxpayer perspective							
Net present value (millions)	\$534	\$500	\$481	\$467	\$454	\$434	\$401
Rate of return	7.5%	7.2%	7.0%	6.8%	6.7%	6.4%	6.1%
Benefit-cost ratio	2.9	2.8	2.7	2.6	2.6	2.5	2.4
Social perspective							
Net present value (millions)	\$6,833	\$6,485	\$6,277	\$6,138	\$5,999	\$5,790	\$5,442
Benefit-cost ratio	4.9	4.7	4.6	4.5	4.4	4.3	4.1

Based on this sensitivity analysis, the conclusion can be drawn that ISU investment analysis results from the taxpayer and social perspectives are not very sensitive to relatively large variations in the alternative education variable. As indicated, results are still above their threshold levels (net present value greater than 0, benefit-cost ratio greater than 1, and rate of return greater than the discount rate of 1.0%), even when the alternative education assumption is increased by as much as 50% (from 15% to 23%). The conclusion is that although the assumption is difficult to specify, its impact on overall investment analysis results for the taxpayer and social perspectives is not very sensitive.

Labor import effect variable

The labor import effect variable only affects the alumni impact calculation in Table 2.14. In the model we assume a labor import effect variable of 50%, which means that 50% of the state's labor demands would have been satisfied without the presence of ISU. In other words, businesses that hired ISU students could have substituted some of these workers with equally-qualified people from outside the state had there been no ISU students to hire. Therefore, we attribute only the remaining 50% of the initial labor income generated by increased alumni productivity to the university.

Table A1.3 presents the results of the sensitivity analysis for the labor import effect variable. As explained earlier, the assumption increases and decreases relative to the base case of 50% by the increments indicated in the table. Alumni productivity impacts attributable to ISU, for example, range from a high of \$2.8 billion at a -50% variation to a low of \$923.7 million at a +50% variation from the base case assumption. This means that if the labor import effect variable

increases, the impact that we claim as attributable to alumni decreases. Even under the most conservative assumptions, the alumni impact on the Iowa economy still remains sizeable.

TABLE A1.3: SENSITIVITY ANALYSIS OF LABOR IMPORT EFFECT VARIABLE

% variation in assumption	-50%	-25%	-10%	Base Case	10%	25%	50%
Labor import effect variable	25%	38%	45%	50%	55%	63%	75%
Alumni impact (millions)	\$2,771	\$2,309	\$2,032	\$1,847	\$1,663	\$1,386	\$924

Student employment variables

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

Students incur substantial expense by attending ISU 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 60% of students are employed.⁵² 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 who are working while attending the university earn only 70%, on average, of the earnings that they statistically would have received if not attending ISU. This suggests that many students hold part-time jobs that accommodate their ISU attendance, though it is at an additional cost in terms of receiving a wage that is less than what they otherwise might make. The 70% 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 70% estimate is tested in the sensitivity analysis by changing it to 100% and then to 0%.

The changes generate results summarized in Table A1.4, with *A* defined as the percent of students employed and *B* defined as the percent that students earn

⁵² Based on data provided by ISU. This figure excludes dual credit high school students, who are not included in the opportunity cost calculations.

relative to their full earning potential. Base case results appear in the shaded row; here the assumptions remain unchanged, with A equal to 60% and B equal to 70%. 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 A1.4: SENSITIVITY ANALYSIS OF STUDENT EMPLOYMENT VARIABLES

Variations in assumptions	Net present value (millions)	Internal rate of return	Benefit-cost ratio
Base case: A = 60%, B = 70%	\$2,128.2	14.2%	3.8
Scenario 1: A = 100%, B = 70%	\$2,296.5	17.5%	4.8
Scenario 2: A = 60%, B = 100%	\$2,246.9	16.3%	4.5
Scenario 3: A = 100%, B = 100%	\$2,495.9	25.6%	7.2
Scenario 4: A = 0%, B = 0%	\$1,881.1	11.4%	2.9

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

- **Scenario 1:** Increasing the percentage of students employed (A) from 60% to 100%, the net present value, internal rate of return, and benefit-cost ratio improve to \$2.3 billion, 17.5%, and 4.8, respectively, relative to base case results. Improved results are attributable to a lower opportunity cost of time; all students are employed in this case.
- **Scenario 2:** Increasing earnings relative to statistical averages (B) from 70% to 100%, the net present value, internal rate of return, and benefit-cost ratio results improve to \$2.2 billion, 16.3%, and 4.5, respectively, relative to base case results; a strong improvement, again attributable to a lower opportunity cost of time.
- **Scenario 3:** Increasing both assumptions A and B to 100% simultaneously, the net present value, internal rate of return, and benefit-cost ratio improve yet further to \$2.5 billion, 25.6%, and 7.2, respectively, relative to base case results. This scenario assumes that all students are fully employed and earning full salaries (equal to statistical averages) while attending classes.
- **Scenario 4:** Finally, decreasing both A and B to 0% reduces the net present value, internal rate of return, and benefit-cost ratio to \$1.9 billion, 11.4%, and 2.9, respectively, relative to base case results. These results are reflective of an increased opportunity cost; none of the students are employed in this case.⁵³

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

⁵³ 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.

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

Discount rate

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

In this study, we assume a 4.5% discount rate for students and a 1.0% discount rate for society and taxpayers.⁵⁴ Similar to the sensitivity analysis of the alternative education variable, we vary the base case discount rates for students, taxpayers, and society on either side by increasing the discount rate by 10%, 25%, and 50%, and then reducing it by 10%, 25%, and 50%. Note that, because the rate of return and the payback period are both based on the undiscounted cash flows, they are unaffected by changes in the discount rate. As such, only variations in the net present value and the benefit-cost ratio are shown for students, taxpayers, and society in Table A1.5.

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 3.8 to 2.9. Conversely, reducing the discount rate for students by 50% (from 4.5% to 2.2%) increases the benefit-cost ratio from 3.8 to 6.1. The sensitivity analysis results for taxpayers and society 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 5.0 benefit-cost ratio at a -50% variation from the base case, to a 4.1 benefit-cost ratio at a 50% variation from the base case).

54 These values are based on the baseline forecasts for the 10-year Treasury rate published by the Congressional Budget Office and the real treasury interest rates recommended by the Office of Management and Budget for 30-year investments. See the Congressional Budget Office "Table 4. Projection of Borrower Interest Rates: CBO's April 2018 Baseline" and the Office of Management and Budget "Discount Rates for Cost-Effectiveness of Federal Programs."

TABLE A1.5: SENSITIVITY ANALYSIS OF DISCOUNT RATE

% variation in assumption	-50%	-25%	-10%	Base Case	10%	25%	50%
Student perspective							
Discount rate	2.2%	3.3%	4.0%	4.5%	4.9%	5.6%	6.7%
Net present value (millions)	\$3,882	\$2,868	\$2,397	\$2,128	\$1,890	\$1,581	\$1,461
Benefit-cost ratio	6.1	4.7	4.1	3.8	3.5	3.1	2.9
Taxpayer perspective							
Discount rate	0.5%	0.8%	0.9%	1.0%	1.1%	1.3%	1.5%
Net present value (millions)	\$556	\$510	\$484	\$467	\$451	\$428	\$391
Benefit-cost ratio	2.9	2.8	2.7	2.6	2.6	2.5	2.4
Social perspective							
Discount rate	0.5%	0.8%	0.9%	1.0%	1.1%	1.3%	1.5%
Net present value (millions)	\$7,020	\$6,562	\$6,303	\$6,138	\$5,977	\$5,745	\$5,381
Benefit-cost ratio	5.0	4.8	4.6	4.5	4.4	4.3	4.1

Retained student variable

The retained student variable only affects the student spending impact calculation in Table 2.12. For this analysis, we assume a retained student variable of 20%, which means that 20% of ISU's students who originated from Iowa would have left the state for other opportunities, whether that be education or employment, if ISU did not exist. The money these retained students spent in the state for accommodation and other personal and household expenses is attributable to ISU.

Table A1.6 presents the results of the sensitivity analysis for the retained student variable. The assumption increases and decreases relative to the base case of 20% by the increments indicated in the table. The student spending impact is recalculated at each value of the assumption, holding all else constant. Student spending impacts attributable to ISU range from a high of \$98.8 million when the retained student variable is 30% to a low of \$79.4 million when the retained student variable is 10%. This means as the retained student variable decreases, the student spending attributable to ISU decreases. Even under the most conservative assumptions, the student spending impact on the Iowa economy remains substantial.

TABLE A1.6: SENSITIVITY ANALYSIS OF RETAINED STUDENT VARIABLE

% variation in assumption	-50%	-25%	-10%	Base Case	10%	25%	50%
Retained student variable	10%	15%	18%	20%	22%	25%	30%
Student spending impact (thousands)	\$79,385	\$84,229	\$87,135	\$89,073	\$91,011	\$93,917	\$98,761

Appendix 2: Glossary of Terms

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

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

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

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

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

Counterfactual scenario What would have happened if a given event had not occurred. In the case of this economic impact study, the counterfactual scenario is a scenario where the university did not exist.

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.

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

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 or decreases total enrollment by a significant amount, demand is elastic. If enrollment remains the same or changes only slightly, demand is inelastic.

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

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

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

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

Internal rate of return Rate of interest that, when used to discount cash flows associated with investing in education, reduces its net present value to zero (i.e., where the present value of revenues accruing from the investment are just equal to the present value of costs incurred). This, in effect, is the breakeven rate of return on investment since it shows the highest rate of interest at which the investment makes neither a profit nor a loss.

Multiplier effect Additional income created in the economy as the university and its students spend money in the state. It consists of the income created by the supply chain of the industries initially affected by the spending of the university and its students (i.e., the direct effect), income created by the supply chain of the initial supply chain (i.e., the indirect effect), and the income created by the increased spending of the household sector (i.e., the induced effect).

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

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

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

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

Opportunity cost Benefits foregone from alternative B once a decision is made to allocate resources to alternative A. Or, if individuals choose to attend college, they forego earnings that they would have received had they chose instead to work full-time. Foregone earnings, therefore, are the “price tag” of choosing to attend college.

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

$$\text{Payback period} = \text{cost of investment} / \text{net return per period}$$

Appendix 3: Frequently Asked Questions (FAQs)

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

What is economic impact analysis?

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

What is investment analysis?

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

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

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

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

In general, Emsi discourages comparisons between institutions since many factors, such as regional economic conditions, institutional differences, and student demographics are outside of the university's control. It is best to compare the rate of return to the discount rates of 4.5% (for students) and 1.0% (for society and taxpayers), which can also be seen as the opportunity cost of the investment (since these stakeholder groups could be spending their time and money in other investment schemes besides education). If the rate of return is higher than the discount rate, the stakeholder groups can expect to receive a positive return on their educational investment.

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

Net present value (NPV): How do I communicate this in laymen’s terms?

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

Internal rate of return (IRR): How do I communicate this in laymen’s terms?

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

Total economic impact: How do I communicate this in laymen’s terms?

Big numbers are great, but putting them into perspective can be a challenge. To add perspective, find an industry with roughly the same “% of GSP” as your university (Table 1.3). This percentage represents its portion of the total gross state product in the state (similar to the nationally recognized gross domestic product but at a state level). This allows the university to say that their single brick and mortar campus does just as much for Iowa as the entire Utilities *industry*, for example. This powerful statement can help put the large total impact number into perspective.

Appendix 4: Example of Sales versus Income

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

$$\text{Income} = \text{Sales} - \text{Intermediary Costs}$$

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

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

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

$$\text{Income} = \$5.00 - \$3.00 = \$2.00$$

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

Appendix 5: Emsi MR-SAM

Emsi's MR-SAM represents the flow of all economic transactions in a given region. It replaces Emsi's previous input-output (IO) model, which operated with some 1,000 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 state economy as a result of industries entering or exiting the region. The MR-SAM model performs the same tasks as the old IO model, but it also does much more. Along with the same 1,000 industries, government, household and investment sectors embedded in the old IO tool, the MR-SAM exhibits much more functionality, a greater amount of data, and a higher level of detail on the demographic and occupational components of jobs (16 demographic cohorts and about 750 occupations are characterized).

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

Data sources for the model

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

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

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

The MUTs are used in the Emsi MR-SAM model to produce an industry-by-industry matrix describing all industry purchases from all industries.

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

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

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

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

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

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

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

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

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

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

Overview of the MR-SAM model

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

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

NATIONAL SAM

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

those column accounts). Read down columns, SAM entries show the flow of funds into row accounts (also known as expenditures or the dispersal of funds to those row accounts).

The SAM may be broken into three different aggregation layers: broad accounts, sub-accounts, and detailed accounts. The broad layer is the most aggregate and will be covered first. Broad accounts cover between one and four sub-accounts, which in turn cover many detailed accounts. This appendix will not discuss detailed accounts directly because of their number. For example, in the industry broad account, there are two sub-accounts and over 1,000 detailed accounts.

MULTI-REGIONAL ASPECT OF THE MR-SAM

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

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

Components of the Emsi MR-SAM model

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

COUNTY EARNINGS DISTRIBUTION MATRIX

The county earnings distribution matrices describe the earnings spent by every industry on every occupation for a year—i.e., earnings by occupation.

The matrices are built utilizing Emsi's industry earnings, occupational average earnings, and staffing patterns.

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

COMMUTING MODEL

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

NATIONAL SAM

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

One of the major issues that affect any SAM project is the combination of data from multiple sources that may not be consistent with one another. Matrix balancing is the broad name for the techniques used to correct this problem.

Emsi uses a modification of the “diagonal similarity scaling” algorithm to balance the national SAM.

GRAVITATIONAL FLOWS MODEL

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

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

Appendix 6: Value per Credit Hour Equivalent and the Mincer Function

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

Value per CHE

Typically, the educational achievements of students are marked by the credentials they earn. However, not all students who attended ISU in the 2017-18 analysis year obtained a degree or certificate. Some returned the following year to complete their education goals, while others took a few courses and entered the workforce without graduating. As such, the only way to measure the value of the students' achievement is through their credit hour equivalents, or CHEs. This approach allows us to see the benefits to all students who attended the university, 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 120 CHEs in order to move from a high school diploma to a bachelor's degree, another 60 CHEs to move from a bachelor's degree to a master's degree, and so on. This progression of CHEs generates an education ladder beginning at the less than high school level and ending with the completion of a doctoral degree, with each level of education representing a separate stage in the progression.

The second step is to assign a unique value to the CHEs in the education ladder based on the wage differentials presented in Table 1.4. For example, the difference in state earnings between a high school diploma and a bachelor's degree is \$23,200. We spread this \$23,200 wage differential across the 60 CHEs that occur between a high school diploma and a bachelor's degree, applying a ceremonial "boost" to the last CHE in the stage to mark the achievement of the degree.⁵⁵ We repeat this process for each education level in the ladder.

Next we map the CHE production of the FY 2017-18 student population to the education ladder. Table 1.2 provides information on the CHE production of students attending ISU, broken out by educational achievement. In total, students completed 961,775 CHEs during the analysis year. We map each of

⁵⁵ Economic theory holds that workers that acquire education credentials send a signal to employers about their ability level. This phenomenon is commonly known as the sheepskin effect or signaling effect. The ceremonial boosts applied to the achievement of degrees in the Emsi impact model are derived from Jaeger and Page (1996).

these CHEs to the education ladder depending on the students’ education level and the average number of CHEs they completed during the year. For example, bachelor’s degree graduates are allocated to the stage between the associate degree and the bachelor’s degree, and the average number of CHEs they completed informs the shape of the distribution curve used to spread out their total CHE production within that stage of the progression.

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

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

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 A6.1 displays the result for the students’ aggregate annual increase in income (ΔE), a total of \$192.4 million. By dividing this value by the students’ total production of 961,775 CHEs during the analysis year, we derive an overall value of \$200 per CHE.

TABLE A6.1: AGGREGATE ANNUAL INCREASE IN INCOME OF STUDENTS AND VALUE PER CHE

Aggregate annual increase in income	\$192,446,976
Total credit hour equivalents (CHEs) in FY 2017-18	961,775
Value per CHE	\$200

Source: Emsi impact model.

Mincer Function

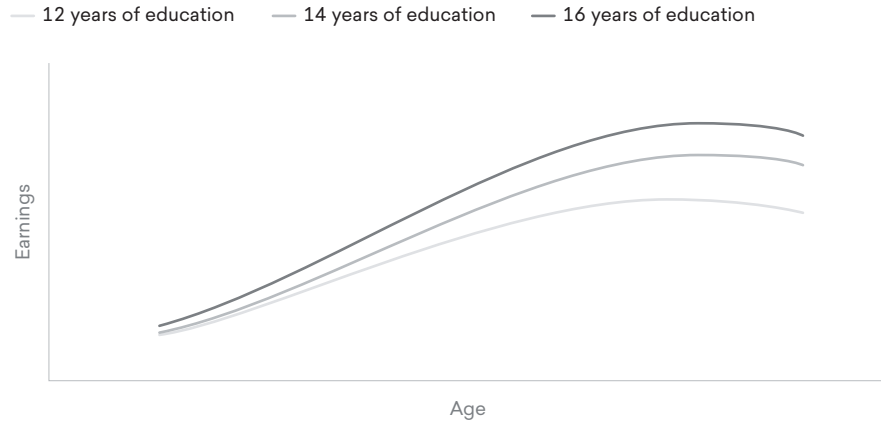
The \$200 value per CHE in Table A6.1 only tells part of the story, however. Human capital theory holds that earnings levels do not remain constant; rather, they start relatively low and gradually increase as the worker gains more experience. Research also shows that the earnings increment between educated and non-educated workers grows through time. These basic patterns in earnings over time were originally identified by Jacob Mincer, who viewed the lifecycle earnings distribution as a function with the key elements being earnings, years of education, and work experience, with age serving as a proxy for experience.⁵⁶ While some have criticized Mincer’s earnings function, it is still upheld in recent data and has served as the foundation for a variety of research pertaining to labor economics. Those critical of the Mincer function point to several unobserved factors such as ability, socioeconomic status, and family background that also

56 See Mincer (1958 and 1974).

help explain higher earnings. Failure to account for these factors results in what is known as an “ability bias.” Research by Card (1999 and 2001) suggests that the benefits estimated using Mincer’s function are biased upwards by 10% or less. As such, we reduce the estimated benefits by 10%. We use state-specific and education level-specific Mincer coefficients.

Figure A6.1 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 A6.1: LIFECYCLE CHANGE IN EARNINGS



In calculating the alumni impact in Chapter 2, we use the slope of the curve in Mincer’s earnings function to condition the \$200 value per CHE to the students’ age and work experience. To the students just starting their career during the analysis year, we apply a lower value per CHE; to the students in the latter half or approaching the end of their careers we apply a higher value per CHE. The original \$200 value per CHE applies only to the CHE production of students precisely at the midpoint of their careers during the analysis year.

In Chapter 3 we again apply the Mincer function, this time to project the benefits stream of the FY 2017-18 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 A6.1.

Appendix 7: Alternative Education Variable

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

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

In the absence of the university, we assume 15% of the university's students would find alternative education opportunities and remain in or return to the state. We account for this by discounting the alumni impact, the benefits to taxpayers, and the benefits to society in the state in Chapters 2 and 3 by 15%. In other words, we assume 15% of the benefits created by the university's students would have occurred anyways in the counterfactual scenario where the university did not exist. A sensitivity analysis of this adjustment is presented in Appendix 1.

Appendix 8: Overview of Investment Analysis Measures

The appendix provides context to the investment analysis results using the simple hypothetical example summarized in Table A8.1 below. The table shows the projected benefits and costs for a single student over time and associated investment analysis results.⁵⁷

TABLE A8.1: EXAMPLE OF THE BENEFITS AND COSTS OF EDUCATION FOR A SINGLE STUDENT

1	2	3	4	5	6
Year	Tuition	Opportunity cost	Total cost	Higher earnings	Net cash flow
1	\$1,500	\$20,000	\$21,500	\$0	-\$21,500
2	\$0	\$0	\$0	\$5,000	\$5,000
3	\$0	\$0	\$0	\$5,000	\$5,000
4	\$0	\$0	\$0	\$5,000	\$5,000
5	\$0	\$0	\$0	\$5,000	\$5,000
6	\$0	\$0	\$0	\$5,000	\$5,000
7	\$0	\$0	\$0	\$5,000	\$5,000
8	\$0	\$0	\$0	\$5,000	\$5,000
9	\$0	\$0	\$0	\$5,000	\$5,000
10	\$0	\$0	\$0	\$5,000	\$5,000
Net present value			\$21,500	\$35,753	\$14,253

Internal rate of return	Benefit-cost ratio	Payback period (no. of years)
18.0%	1.7	4.2

Assumptions are as follows:

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

⁵⁷ Note that this is a hypothetical example. The numbers used are not based on data collected from an existing university.

- Together, tuition and earnings foregone cost sum to \$21,500. This represents the out-of-pocket investment made by the student (Column 4).
- In return, the student earns \$5,000 more per year than he otherwise would have earned without the education (Column 5).
- The net cash flow (NCF) in Column 6 shows higher earnings (Column 5) less the total cost (Column 4).
- The assumed going rate of interest is 4%, the rate of return from alternative investment schemes for the use of the \$21,500.

Results are expressed in standard investment analysis terms, which are as follows: the net present value, the internal rate of return, the benefit-cost ratio, and the payback period. Each of these is briefly explained below in the context of the cash flow numbers presented in Table A8.1.

Net present value

The student in Table A8.1 can choose either to attend college or to forego post-secondary education and maintain his present employment. If he decides to enroll, certain economic implications unfold. Tuition and fees must be paid, and earnings will cease for one year. In exchange, the student calculates that with post-secondary education, his earnings will increase by at least the \$5,000 per year, as indicated in the table.

The question is simple: Will the prospective student be economically better off by choosing to enroll? If he adds up higher earnings of \$5,000 per year for the remaining nine years in Table A8.1, the total will be \$45,000. Compared to a total investment of \$21,500, this appears to be a very solid investment. The reality, however, is different. Benefits are far lower than \$45,000 because future money is worth less than present money. Costs (tuition plus earnings foregone) are felt immediately because they are incurred today, in the present. Benefits, on the other hand, occur in the future. They are not yet available. All future benefits must be discounted by the going rate of interest (referred to as the discount rate) to be able to express them in present value terms.⁵⁸

Let us take a brief example. At 4%, the present value of \$5,000 to be received one year from today is \$4,807. If the \$5,000 were to be received in year 10, the present value would reduce to \$3,377. Put another way, \$4,807 deposited in the bank today earning 4% interest will grow to \$5,000 in one year; and \$3,377 deposited today would grow to \$5,000 in 10 years. An “economically rational” person would, therefore, be equally satisfied receiving \$3,377 today or \$5,000

⁵⁸ 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.

10 years from today given the going rate of interest of 4%. The process of discounting—finding the present value of future higher earnings—allows the model to express values on an equal basis in future or present value terms.

The goal is to express all future higher earnings in present value terms so that they can be compared to investments incurred today (in this example, tuition plus earnings foregone). As indicated in Table A8.1 the cumulative present value of \$5,000 worth of higher earnings between years 2 and 10 is \$35,753 given the 4% interest rate, far lower than the undiscounted \$45,000 discussed above.

The net present value of the investment is \$14,253. This is simply the present value of the benefits less the present value of the costs, or $\$35,753 - \$21,500 = \$14,253$. In other words, the present value of benefits exceeds the present value of costs by as much as \$14,253. The criterion for an economically worthwhile investment is that the net present value is equal to or greater than zero. Given this result, it can be concluded that, in this case, and given these assumptions, this particular investment in education is very strong.

Internal rate of return

The internal rate of return is another way of measuring the worth of investing in education using the same cash flows shown in Table A8.1. 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 A8.1. Or, if a discount rate of 18.0% were applied to the net present value calculations instead of the 4%, then the net present value would reduce to zero.

What does this mean? The internal rate of return of 18.0% defines a breakeven solution—the point where the present value of benefits just equals the present value of costs, or where the net present value equals zero. Or, at 18.0%, higher earnings of \$5,000 per year for the next nine years will earn back all investments of \$21,500 made plus pay 18.0% for the use of that money (\$21,500) in the meantime. Is this a good return? Indeed, it is. If it is compared to the 4% going rate of interest applied to the net present value calculations, 18.0% is far higher than 4%. It may be concluded, therefore, that the investment in this case is solid. Alternatively, comparing the 18.0% rate of return to the long-term 10% rate or so obtained from investments in stocks and bonds also indicates that the investment in education is strong relative to the stock market returns (on average).

Benefit-cost ratio

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

Payback period

This is the length of time from the beginning of the investment (consisting of tuition and earnings foregone) until higher future earnings give a return on the investment made. For the student in Table A8.1, it will take roughly 4.2 years of \$5,000 worth of higher earnings to recapture his investment of \$1,500 in tuition and the \$20,000 in earnings foregone while attending the university. Higher earnings that occur beyond 4.2 years are the returns that make the investment in education in this example economically worthwhile. The payback period is a fairly rough, albeit common, means of choosing between investments. The shorter the payback period, the stronger the investment.

Appendix 9: Shutdown Point

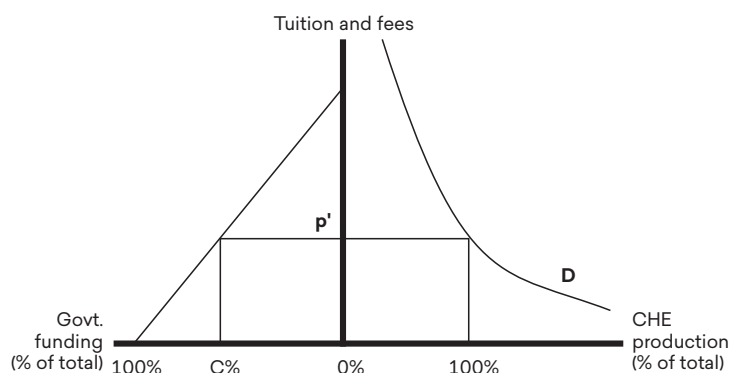
The investment analysis in Chapter 3 weighs the benefits generated by the university against the state taxpayer funding that the university receives to support its operations. An important part of this analysis is factoring out the benefits that the university would have been able to generate anyway, even without state taxpayer support. This adjustment is used to establish a direct link between what taxpayers pay and what they receive in return. If the university is able to generate benefits without taxpayer support, then it would not be a true investment.⁵⁹

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

State government support versus student demand for education

Figure A9.1 presents a simple model of student demand and state 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

FIGURE A9.1: STUDENT DEMAND AND GOVERNMENT FUNDING BY TUITION AND FEES

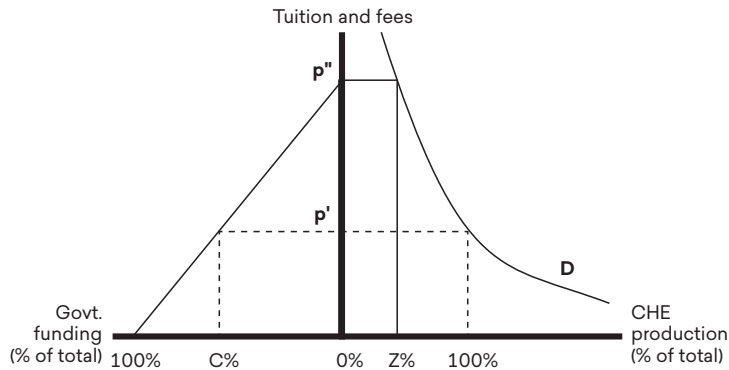


⁵⁹ Of course, as a public training provider, the university would not be permitted to continue without public funding, so the situation in which it would lose all state support is entirely hypothetical. The purpose of the adjustment factor is to examine the university in standard investment analysis terms by netting out any benefits it may be able to generate that are not directly linked to the costs of supporting it.

percentage of the university's current CHE production. Current student tuition and fees are represented by p' , and state government support covers $C\%$ of all costs. At this point in the analysis, it is assumed that the university has only two sources of revenues: 1) student tuition and fees and 2) state government support.

Figure A9.2 shows another important reference point in the model—where state government support is 0%, student tuition and fees are increased to p'' , and CHE production is at $Z\%$ (less than 100%). The reduction in CHEs reflects the price elasticity of the students' demand for education, *i.e.*, the extent to which the students' decision to attend the university is affected by the change in tuition and fees. Ignoring for the moment those issues concerning the university's minimum operating scale (considered below in the section called "Calculating benefits at the shutdown point"), the implication for the investment analysis is that benefits to state government must be adjusted to net out the benefits that the university can provide absent state government support, represented as $Z\%$ of the university's current CHE production in Figure A9.2.

FIGURE A9.2: CHE PRODUCTION AND GOVERNMENT FUNDING BY TUITION AND FEES



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 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 university's current CHE production. Equation 1 is thus as follows:

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

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

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

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

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

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

Calculating benefits at the shutdown point

Colleges and universities cease to operate when the revenue they receive from the quantity of education demanded is insufficient to justify their continued operations. This is commonly known in economics as the shutdown point.⁶⁰ The shutdown point is introduced graphically in Figure A9.3 as S%. The location of point S% indicates that the university can operate at an even lower enrollment level than Z% (the point at which the university receives zero state government funding). State government support at point S% is still zero, and student tuition and fees have been raised to p'''. State 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 university would no longer be able to attract enough students to keep the doors open, and it would shut down.

FIGURE A9.3: SHUTDOWN POINT AFTER ZERO GOVERNMENT FUNDING

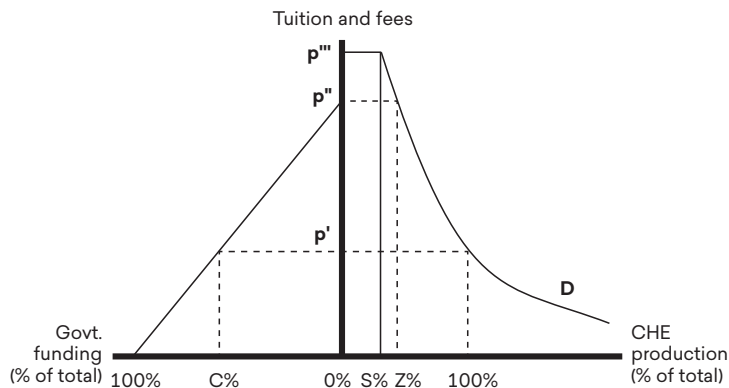
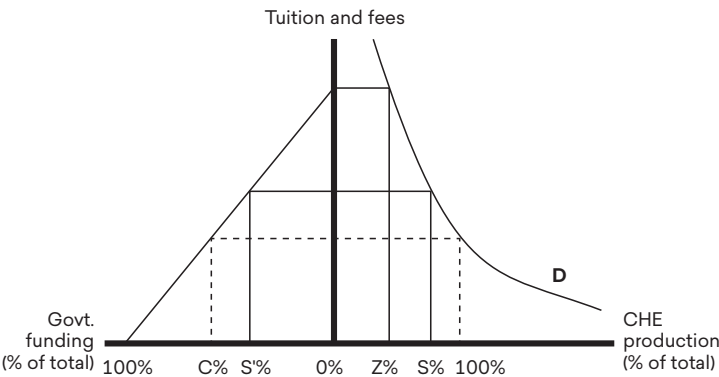


Figure A9.4 illustrates yet another scenario. Here, the shutdown point occurs at a level of CHE production greater than Z% (the level of zero state government support), meaning some minimum level of state government support is needed for the university to operate at all. This minimum portion of overall funding is indicated by S% on the left side of the chart, and as before, the shutdown

⁶⁰ In the traditional sense, the shutdown point applies to firms seeking to maximize profits and minimize losses. Although profit maximization is not the primary aim of colleges and universities, the principle remains the same, *i.e.*, that there is a minimum scale of operation required in order for colleges and universities to stay open.

point is indicated by S% on the right side of chart. In this case, state government support is appropriately credited with all the benefits generated by the university's CHE production, or $B = B(100\%)$.

FIGURE A9.4: SHUTDOWN POINT BEFORE ZERO GOVERNMENT FUNDING



Appendix 10: Social Externalities

Education has a predictable and positive effect on a diverse array of social benefits. These, when quantified in dollar terms, represent significant social savings that directly benefit society communities and citizens throughout the state, including taxpayers. In this appendix we discuss the following three main benefit categories: 1) improved health, 2) reductions in crime, and 3) reduced demand for government-funded income assistance.

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.

Health

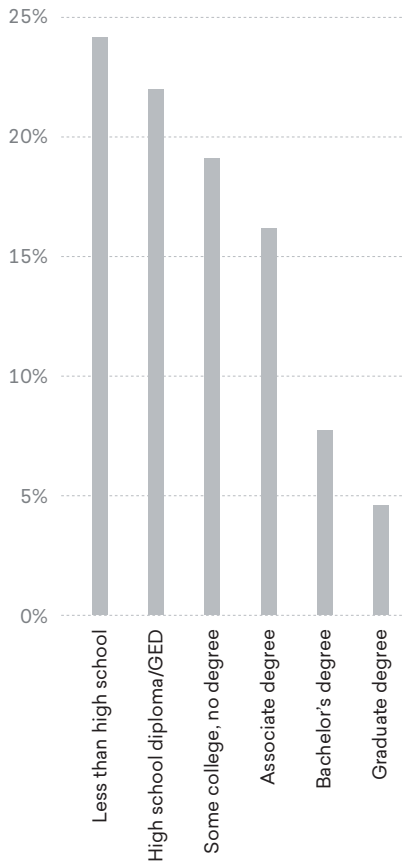
Statistics show a correlation between increased education and improved health. The manifestations of this are found in five health-related variables: smoking, alcohol dependence, obesity, depression, and drug abuse. There are other health-related areas that link to educational attainment, but these are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

SMOKING

Despite a marked decline over the last several decades in the percentage of U.S. residents who smoke, a sizeable percentage of the U.S. population still smokes. 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 A10.1 shows the prevalence of cigarette smoking among adults, 25 years and over, based on data provided by the National Health Interview Survey.⁶¹ The data include adults who reported smoking more than 100 cigarettes during their lifetime and who, at the time of interview, reported smoking every day or some days. As indicated, the percent of who smoke begins to decline beyond the level of high school education.

FIGURE A10.1: PREVALENCE OF SMOKING AMONG U.S. ADULTS BY EDUCATION LEVEL



61 Centers for Disease Control and Prevention. "Table. Characteristics of current adult cigarette smokers," National Health Interview Survey, United States, 2016.

Source: Centers for Disease Control and Prevention.

The Centers for Disease Control and Prevention (CDC) reports the percentage of adults who are current smokers by state.⁶² We use this information to create an index value by which we adjust the national prevalence data on smoking to each state. For example, 16.7% of Iowa adults were smokers in 2016, relative to 15.5% for the nation. We thus apply a scalar of 1.08 to the national probabilities of smoking in order to adjust them to the state of Iowa.

ALCOHOL DEPENDENCE

Although alcohol dependence has large public and private costs, it 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 health care expenditures for treatment, prevention, and support; workplace losses due to reduced worker productivity; and other effects.

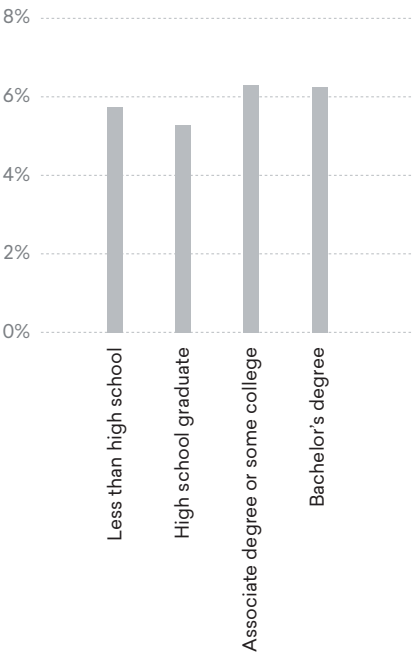
Figure A10.2 compares the percentage of adults, 18 and older, that abuse or depend on alcohol by education level, based on data from the Substance Abuse and Mental Health Services Administration (SAMHSA).⁶³ These statistics give an indication of the correlation between education and the reduced probability of alcohol dependence. Adults with an associate degree or some college have higher rates of alcohol dependence than adults with a high school diploma or lower. Prevalence rates are lower for adults with a bachelor’s degree or higher than those with an associate degree or some college. Although the data do not maintain a pattern of decreased alcohol dependence at every level of increased education, we include these rates in our model to ensure we provide a comprehensive view of the social benefits and costs correlated with education.

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.⁶⁴

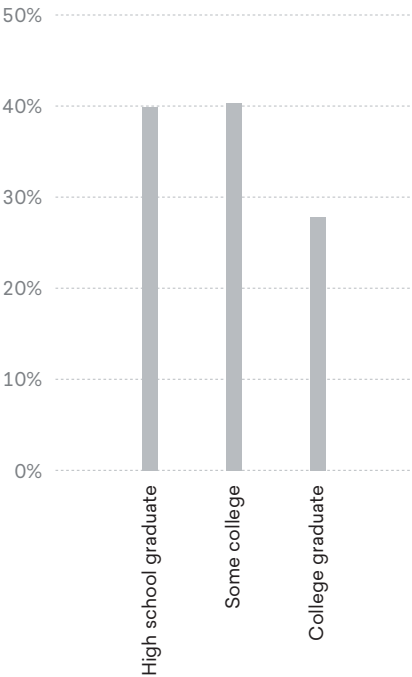
Data for Figure A10.3 is derived from the National Center for Health Statistics which shows the prevalence of obesity among adults aged 20 years and over

FIGURE A10.2: PREVALENCE OF ALCOHOL DEPENDENCE OR ABUSE BY EDUCATION LEVEL



Source: Centers for Disease Control and Prevention.

FIGURE A10.3: PREVALENCE OF OBESITY BY EDUCATION LEVEL



Source: Derived from data provided by the National Center for Health Statistics.

62 Centers for Disease Control and Prevention. "Current Cigarette Use Among Adults (Behavior Risk Factor Surveillance System) 2016." *Behavioral Risk Factor Surveillance System Prevalence and Trends Data*, 2016.

63 Substance Abuse and Mental Health Services Administration. "Table 5.5B - Alcohol Use Disorder in the Past Year among Persons Aged 18 or Older, by Demographic Characteristics: Percentages, 2015 and 2016." SAMSHA, Center for Behavioral Health Statistics and Quality, National Survey on Drug Use and Health, 2015 and 2016.

64 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.

by education, gender, and ethnicity.⁶⁵ As indicated, college graduates are less likely to be obese than individuals with a high school diploma. However, the prevalence of obesity among adults with some college is actually greater than those with just a high school diploma. In general, though, obesity tends to decline with increasing levels of education.

DEPRESSION

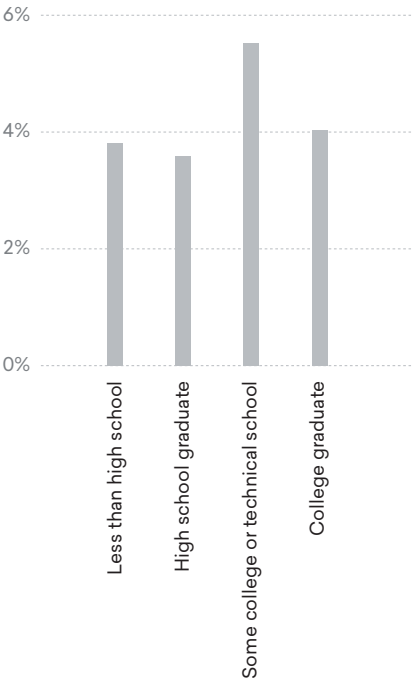
Capturing the full economic cost of mental illness is difficult because not all mental disorders have a correlation with education. For this reason, we only examine the economic costs associated with major depressive disorder (MDD), which are comprised of medical and pharmaceutical costs, workplace costs such as absenteeism, and suicide-related costs.⁶⁶

Figure A10.4 summarizes the prevalence of MDD among adults by education level, based on data provided by the CDC.⁶⁷ As shown, people with some college are most likely to have MDD compared to those with other levels of educational attainment. People with a high school diploma or less, along with college graduates, are all fairly similar in the prevalence rates.

DRUG ABUSE

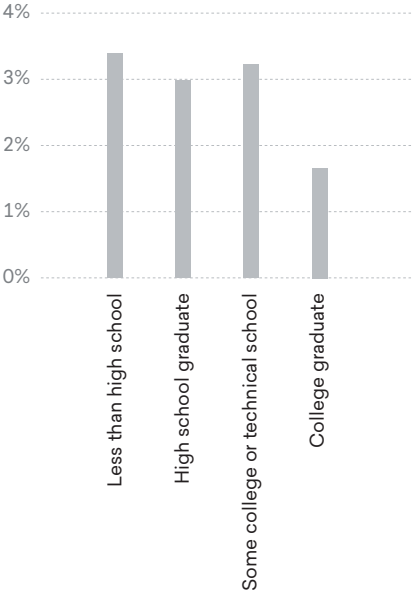
The burden and cost of illicit drug abuse is enormous in the U.S., but little is known about the magnitude of costs and effects at a national level. What is known is that the rate of people abusing drugs is inversely proportional to their education level. The higher the education level, the less likely 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 3.4%, twice as large as the probability of drug abuse for college graduates (1.7%). This relationship is presented in Figure A10.5 based on data supplied by SAMHSA.⁶⁸ Similar to alcohol abuse, prevalence does not strictly decline at every education level. Health costs associated with illegal drug use are also available from SAMSHA, with costs to state government representing 40% of the total cost related to illegal drug use.⁶⁹

FIGURE A10.4: PREVALENCE OF MAJOR DEPRESSIVE EPISODE BY EDUCATION LEVEL



Source: National Survey on Drug Use and Health.

FIGURE A10.5: PREVALENCE OF ILLICIT DRUG DEPENDENCE OR ABUSE BY EDUCATION LEVEL



Source: Substance Abuse and Mental Health Services Administration.

65 Ogden Cynthia L., Tala H. Fakhouri, Margaret D. Carroll, Craig M. Hales, Cheryl D. Fryar, Xianfen Li, David S. Freedman. "Prevalence of Obesity Among Adults, by Household Income and Education — United States, 2011–2014" National Center for Health Statistics, Morbidity and Mortality Weekly Report, 66:1369–1373 (2017).

66 Greenberg, Paul, Andree-Anne Fournier, Tammy Sisitsky, Crystal Pike, and Ronald Kessler. "The Economic Burden of Adults with Major Depressive Disorder in the United States (2005 and 2010)" Journal of Clinical Psychiatry 76:2, 2015.

67 National Survey on Drug Use and Health. "Table 8.59B: Had at Least One Major Depressive Episode (MDE) or MDE with Severe Impairment in Past Year among Persons Aged 18 or Older, and Receipt of Treatment for Depression in Past Year among Persons Aged 18 or Older with MDE or MDE with Severe Impairment in Past Year, by Geographic, Socioeconomic, and Health Characteristics: Percentages, 2015 and 2016."

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

69 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, 2014." Behavioral Health Spending & Use Accounts, 1986 – 2014. HHS Publication No. SMA-16-4975, 2016.

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 A10.6 displays the educational attainment of the incarcerated population in the U.S. Data are derived from the breakdown of the inmate population by education level in federal, state, and local prisons as provided by the U.S. Census Bureau.⁷⁰

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.⁷¹

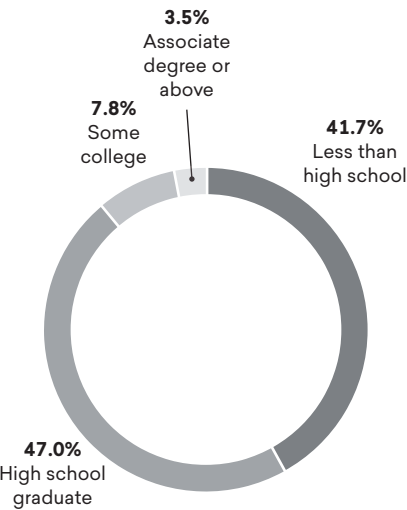
Yet another measurable cost is the economic productivity of people who are incarcerated and are thus not employed. The measurable productivity cost is simply the number of additional incarcerated people, who could have been in the labor force, multiplied by the average income of their corresponding education levels.

Income Assistance

Statistics show that as education levels increase, the number of applicants for government-funded income assistance such as welfare and unemployment benefits 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.⁷²

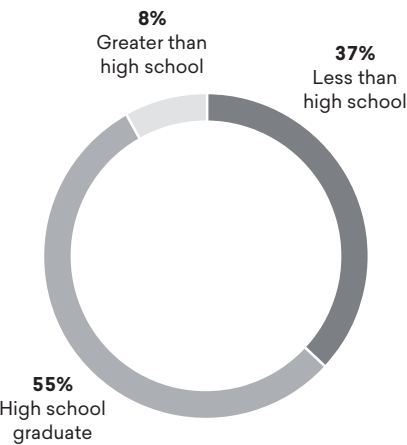
Figure A10.7 relates the breakdown of TANF recipients by education level, derived from data provided by the U.S. Department of Health and Human Services.⁷³ As shown, the demographic characteristics of TANF recipients are weighted heavily towards the less than high school and high school categories.

FIGURE A10.6: EDUCATIONAL ATTAINMENT OF THE INCARCERATED POPULATION



Source: Derived from data provided by the U.S. Census Bureau.

FIGURE A10.7: BREAKDOWN OF TANF RECIPIENTS BY EDUCATION LEVEL



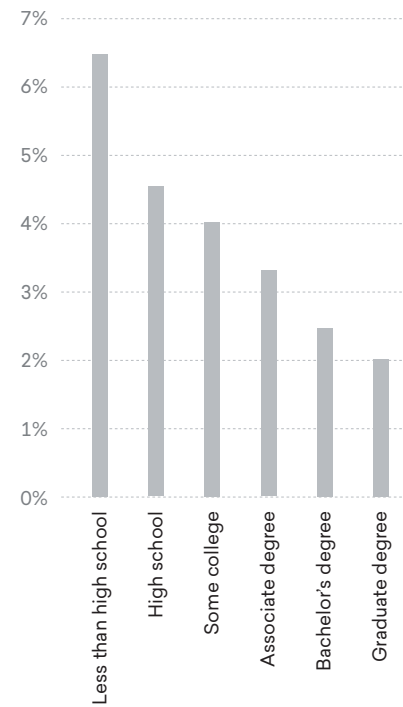
Source: U.S. Department of Health and Human Services, Office of Family Assistance.

70 U.S. Census Bureau. "Educational Characteristics of Prisoners: Data from the ACS." 2011.
71 McCollister, Kathryn E., Michael T. French, and Hai Fang. "The Cost of Crime to Society: New Crime-Specific Estimates for Policy and Program Evaluation." *Drug and Alcohol Dependence* 108, no. 1-2 (April 2010): 98-109.
72 Medicaid is not considered in this analysis because it overlaps with the medical expenses in the analyses for smoking, alcohol dependence, obesity, depression, and drug abuse. We also exclude any welfare benefits associated with disability and age.
73 U.S. Department of Health and Human Services, Office of Family Assistance. "Characteristics and Financial Circumstances of TANF Recipients, Fiscal Year 2016."

ries, with a much smaller representation of individuals with greater than a high school education.

Unemployment rates also decline with increasing levels of education, as illustrated in Figure A10.8. These data are provided by the Bureau of Labor Statistics.⁷⁴ As shown, unemployment rates range from 6.5% for those with less than a high school diploma to 2.0% for those at the graduate degree level or higher.

FIGURE A10.8: UNEMPLOYMENT BY EDUCATION LEVEL



Source: Bureau of Labor Statistics.

74 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, Household Data Annual Averages, 2017.