SEPTEMBER 2020

MISSISSIPPI STATE UNIVERSITY

The Economic Value of Mississippi State University

MAIN REPORT

Emsi

Contents

Executive Summary

This report assesses the impact of Mississippi State University (MSU) on the state economy and the benefits generated by the university for students, taxpayers, and society. The results of this study show that MSU creates a positive net impact on the state economy and generates a positive return on investment for students, taxpayers, and society. This study focuses on economic impacts that can be quantified, but MSU's overall impact extends well beyond the statistics in this report. MSU serves as a key driver of opportunity—both for individual students improving their life through education and for the state of Mississippi, where MSU's resources and capabilities are regularly used to pursue economic development initiatives. Additionally, MSU's land-grant mission and presence in each of Mississippi's 82 counties demonstrate the university's commitment to providing communities, agricultural producers, and industries the support they need to thrive in the state.

Economic impact analysis

During the analysis year, MSU spent $448.6 million on payroll and benefits for 6,091 full-time and part-time employees, and spent another $203.7 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 MSU that directly takes into account the fact that state and local dollars spent on MSU could have been spent elsewhere in the state if not directed towards MSU and would have created impacts regardless. We account for this by estimating the impacts that would have been created from the alternative spending and subtracting the alternative impacts from the spending impacts of MSU.

The additional income of ***$1.8 billion*** *created by MSU is equal to approximately* ***1.6%*** *of the total gross state product of Mississippi.*

MISSISSIPPI

This analysis shows that in fiscal year (FY) 2018-19, operations, research, construction, Cooperative Extension Service (Extension), Center for Advanced Vehicular Systems Extension (CAVS-E), entrepreneurial, visitor, and student spending of MSU, together with the enhanced productivity of its alumni, generated **$1.8 billion** in added income for the Mississippi economy. The additional income of **$1.8 billion** created by MSU is equal to approximately **1.6%** of the total gross state product (GSP) of Mississippi. The impact of **$1.8 billion** is equivalent to supporting **29,016 jobs**. For further perspective, this means that **one out of every 55 jobs** in Mississippi is supported by the activities of MSU and its students. These economic impacts break down as follows:

Operations spending impact

Payroll and benefits to support MSU's day-to-day operations (excluding payroll from research employees) amounted to $307.1 million. The university's non-pay expenditures amounted to $80.8 million. The net impact of operations spending by the university in Mississippi during the analysis year was approximately **$297.3 million** in added income, which is equivalent to supporting **4,028 jobs**.

Research spending impact

Research activities of MSU impact the state economy by employing people and making purchases for equipment, supplies, and services. They also facilitate new knowledge creation throughout Mississippi. In FY 2018-19, MSU spent $141.6 million on payroll and $122.9 million on other expenditures to support research activities. Research spending of MSU generated **$213.1 million** in added income for the Mississippi economy, which is equivalent to supporting **3,306 jobs**.

Construction spending impact

MSU invests in 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 2018-19, MSU's construction spending generated **$14.8 million** in added income, which is equivalent to supporting **320 jobs**.

Extension impact

Extension in Mississippi is comprised of four core components: Agriculture and Natural Resources, 4-H Youth Development, Community Resource Development, and Family Consumer Services. In FY 2018-19, MSU Extension carried out over 200 programs in areas such as food and agricultural systems, 4-H youth development, conservation and recreation, and community engagement. Due to data limitations, only the impact from Extension's Agricultural and Natural Resources units are measured. The increased productivity of Mississippi farmers and ranchers from working with Extension in FY 2018-19 yielded **$245.3 million** in added income for the state, which is equivalent to supporting **4,889 jobs**.

It should be noted that this impact is conservative because it does not include other MSU outreach activities. For example, MSU offers a variety of opportunities for forming active, future-focused partnerships that can benefit society. Whether on campus or in the community, just down the road or around the world, MSU is creating and implementing initiatives to aid and serve others. Learning to value community engagement—and using that knowledge to become actively involved—are primary components in carrying out the university's mission of service and outreach. This value from MSU is not quantified in this report.

CAVS-E impact

MSU's Center for Advanced Vehicular Systems-Extension (CAVS-E) unit provides Mississippi's manufacturers, healthcare providers, and service providers with technical expertise, professional development,

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.

and on-site consultation for product and process improvement. CAVS-E clients report that these services yield increased sales, lower costs, and improved efficiency. In FY 2018-19, CAVS-E added **$32.6 million** in income to Mississippi, which is equivalent to supporting **756 jobs**.

Start-up and spin-off company impact

MSU creates an exceptional environment that fosters innovation and entrepreneurship, evidenced by the number of start-up and spin-off companies related to MSU in the state. In FY 2018-19, start-up and spin-off companies related to MSU added **$20.8 million** in income for the Mississippi economy, which is equivalent to supporting **293 jobs**.

Visitor spending impact

Hundreds of thousands of out-of-state visitors attracted to Mississippi for activities at MSU 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 **$42.5 million** in income for the Mississippi economy, which is equivalent to supporting **1,285 jobs**.

Student spending impact

Around 26% of students attending MSU originated from outside the state. Some of these students relocated to Mississippi to attend the university. In addition, some students, referred to as retained students, are residents of Mississippi who would have left the state if not for the existence of MSU. The money that these students spent toward living expenses in Mississippi is attributable to MSU.

The expenditures of relocated and retained students in the state during the analysis year added approximately **$45 million** in income for the Mississippi economy, which is equivalent to supporting **1,115 jobs**.

Alumni impact

Over the years, students gained new skills, making them more productive workers, by studying at MSU. Today, thousands of these former students are employed in Mississippi. The accumulated impact of former students currently employed in the Mississippi workforce amounted to **$935.8 million** in added income for the Mississippi economy, which is equivalent to supporting **13,024 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 MSU 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 **$449.8 million** in present value student costs.

In return, students will receive a present value of **$1.5 billion** in increased earnings over their working lives. This translates to a return of **$3.30** in higher future earnings for every dollar that students invest in their education at MSU. The corresponding annual rate of return is **13.8%**.

Taxpayer perspective

Taxpayers provided **$212.1 million** of state and local funding to MSU in FY 2018-19. In return, taxpayers will receive an estimated present value of **$393.6 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 **$99.8 million** in benefits due to a reduced demand for government-funded social services in Mississippi. For every tax dollar spent educating students attending MSU, taxpayers will receive an average of **$2.30** in return over the course of the students' working lives. In other words, taxpayers enjoy an annual rate of return of **7.2%**. In addition to the taxpayer benefits calculated in this report, MSU benefits taxpayers by using university expertise and resources to support the needs of state agencies. For example, MSU is home to the Mississippi State Chemical Laboratory, which supports the Mississippi Department of Agriculture and Commerce by providing the analytical data to ensure the quality, accurate labeling, and safety of all fertilizers, animal feeds, human foods, pesticides, and petroleum products sold in the State of Mississippi.

For every tax dollar spent educating students attending MSU, taxpayers will receive an average of ***$2.30*** *in return over the course of the students' working lives.*

Social perspective

People in Mississippi invested **$996.4 million** in MSU in FY 2018-19. This includes the university's expenditures, student expenses, and student opportunity costs. In return, the state of Mississippi will receive an estimated present value of **$3.9 billion** in added state revenue over the course of the students' working lives. Mississippi will also benefit from an estimated **$348.4 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 MSU, an average of **$4.30** in benefits will accrue to Mississippi over the course of the students' careers.

Acknowledgments

Emsi gratefully acknowledges the excellent support of the staff at Mississippi State University in making this study possible. Special thanks go to Dr. Mark Keenum, President, who approved the study, and to Jim Martin, Associate Vice President for Economic Development and Brandy Akers, Executive Director of Research for Fiscal Affairs, 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

Mississippi State University (MSU), established in 1878, has today grown to serve 24,251 credit and 5,318 non-credit students. The university is led by Dr. Mark Keenum. The university's service region, for the purpose of this report, is the state of Mississippi.

While MSU 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, MSU impacts Mississippi 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 and research operations, its construction, Extension, CAVS-E, and entrepreneurial activities, and the expenditures of its visitors and students support the state economy through the output and employment generated by state vendors. The university's outreach activities directly support key industries and support communities with initiatives to help them thrive. 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.

MSU impacts Mississippi beyond influencing the lives of students.

This report assesses the impact of MSU 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 Mississippi 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 Mississippi 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 research spending, 3) impact of Extension services, 4) impact of CAVS-E, 5) impact of the university's construction spending, 6) impact of entrepreneurial activities, 7) impact of visitor spending, 8) impact of student spending, and 9) impact of alumni who are still employed in the Mississippi workforce.

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

spent by students on their education performs as an investment over time. The students' investment in this case consists of their out-of-pocket expenses, 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 Mississippi as a whole.

The study uses a wide array of data that are based on several sources, including the FY 2018-19 academic and financial reports from MSU; 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 Mississippi State University and the Economy

Mississippi State University (MSU) is a leading public research university and one of the key educational engines in the state of Mississippi. The university gives students from around the state and around the world access to world-class educational options in hundreds of fields. With over a century of history and hundreds of thousands of alumni, MSU's contribution to the state economy is significant. In FY 2018-19, MSU enrolled approximately 29,569 of credit and non-credit students.

MSU, established in 1878, is one of the many "land-grant" universities created under the Morrill Act to provide consistently high-quality education options in areas critical to the growth of America's state economies and to spread vital research and insights through extension offices and other community-oriented offices. Originally focused on vocational, horticultural, and agricultural education, MSU has grown to include learning, research, and service in fields as diverse as engineering and accountancy.

The original MSU campus is the town of Starkville, in northwest Mississippi where, today, it includes hundreds of acres of historic buildings, cutting-edge facilities, and cultural centers like the Ulysses S. Grant Presidential Library and the Templeton Music Museum. The Starkville campus is also one of the most energy-efficient campuses in America, as a winner of the Facility Maintenance Decision Achievement award. In addition to its main campus, MSU has locations in Meridian, Biloxi, and Vicksburg, many off-campus research facilities, and Extension locations throughout the state, as well as online offerings at every level of study.

MSU is a significant research university, one of the top 100 in the nation for science and engineering research and 6th in the world for entrepreneurial research.

MSU is a significant research university, one of the top 100 in the nation for science and engineering research and 6th in the world for entrepreneurial research, in addition to supporting valuable work in those fields and many others. In 2018-19, MSU funded more than $250 million in research, and the university is ranked a "very high research activity" institution by the Carnegie Foundation. This research activity, combined with MSU's track record of solving real-world problems for government and industry partners, helps create new private and public sector job opportunities in the state.

Some of MSU's leading undergraduate programs include business administration, kinesiology, mechanical engineering, and elementary education, among others. It also has a nationally recognized meteorology program responsible for one in three American meteorologists, and one of the best intensive forest management programs in America (along with its very own research forest, to support students' experience). In total, MSU offers more than 175 different undergraduate, graduate, and doctoral programs across nine separate colleges.

MSU 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.[1] This chapter presents the basic underlying information from MSU used in this analysis and provides an overview of the Mississippi economy.

Employee data

Data provided by MSU include information on faculty and staff by place of work and by place of residence. These data appear in Table 1.1. As shown, MSU employed 4,432 full-time and 1,659 part-time faculty and staff in FY 2018-19 (including student workers). Of these, 99% worked in the state and 98% 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.

Environment of excellence

MSU has been recognized for four consecutive years as a "Great College to Work For" by The Chronicle of Higher Education based on positive employee feedback. The Chronicle released results in Fall 2019 in "The Academic Workplace" report, which is based on a survey of 236 colleges and universities. Only 85 applicants representing four-year institutions achieved "Great College to Work For" status. The Chronicle reports results for small, medium, and large institutions, with MSU included among large universities with 10,000 or more students. MSU also earned Honor Roll status a fourth time for appearing in multiple recognition categories. The university received top rankings in nine of 12 areas: collaborative governance; professional and career development programs; teaching environment; facilities, workspace, and security; job satisfaction; work/life balance; confidence in senior leadership; respect and appreciation; and tenure clarity and process.

TABLE 1.1: EMPLOYEE DATA, FY 2018-19

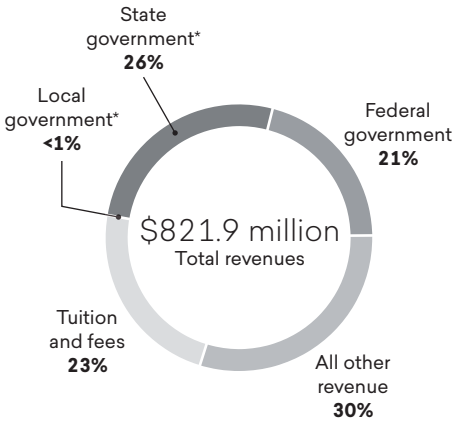
Full-time faculty and staff	4,432
Part-time faculty and staff	1,659
Total faculty and staff	**6,091**
% of employees who work in the state	99%
% of employees who live in the state	98%

Source: Data provided by MSU.

Revenues

Figure 1.1 shows the university's annual revenues by funding source—a total of $821.9 million in FY 2018-19. As indicated, tuition and fees comprised 23% of total revenue, and revenues from local, state, and federal government sources comprised another 47%. All other revenue (i.e., auxiliary revenue, sales and services, interest, and donations) comprised the remaining 30%. These data are critical in identifying the annual costs of educating the student body from the perspectives of students, taxpayers, and society.

FIGURE 1.1: MSU REVENUES BY SOURCE, FY 2018-19



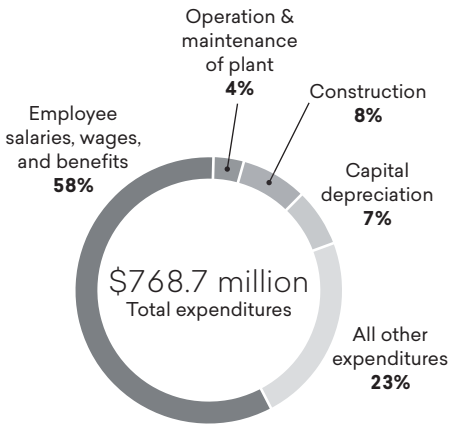
* Revenue from state and local government includes capital appropriations.
Source: Data provided by MSU.
Percentages may not add due to rounding.

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

Expenditures

Figure 1.2 displays MSU's expense data. The combined payroll at MSU, including student salaries and wages, amounted to $448.6 million. This was equal to 58% of the university's total expenses for FY 2018-19. Other expenditures, including operation and maintenance of plant, construction, depreciation, and purchases of supplies and services, made up $320.1 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.

FIGURE 1.2: MSU EXPENSES BY FUNCTION, FY 2018-19



Source: Data provided by MSU.

Students

MSU served 24,251 students taking courses for credit and 5,318 non-credit students in FY 2018-19. These numbers represent unduplicated student headcounts. The breakdown of the student body by gender was 50% female and 50% male. The breakdown by ethnicity was 71% white and 29% students of color. The students' overall average age was 23 years old.[2] An estimated 68% of students remain in Mississippi after finishing their time at MSU and the remaining 32% settle outside the state.[3]

A community campus for veterans

MSU is consistently recognized for its commitment to supporting veterans of the U.S. Armed Forces, current service members, and their dependents. In the Military Times' Best for Vets: Colleges 2020 rankings, MSU is listed 21st among four-year schools, the highest ranking of any Southeastern Conference university. The publication's annual ranking is an editorially independent news project that evaluates a variety of factors that make colleges and universities a good fit for service members and their families. Building on historical military roots, MSU has long been recognized as one of the nation's most veteran-friendly universities. Including dependents, the veteran community at MSU now comprises 2,977 students. Those students are served by MSU's G.V. "Sonny" Montgomery Center for America's Veterans and other university personnel that assist them.

Table 1.2 summarizes the breakdown of the student population and their corresponding awards and credits by education level. In FY 2018-19, MSU served 91 professional graduates, 230 PhD graduates, 1,008 master's degree graduates, and 4,100 bachelor's degree graduates. Another 18,738 students enrolled in courses for credit but did not complete a degree during the reporting year. The university offered dual credit courses to high schools, serving a total of 62 students over the course of the year. The university also served 22 personal enrichment students enrolled in non-credit courses. Non-degree seeking students

2 Unduplicated headcount, gender, ethnicity, and age data provided by MSU.

3 Settlement data provided by MSU.

enrolled in workforce or professional development programs accounted for 5,318 students.

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. In the analysis, we exclude the CHE production of personal enrichment students under the assumption that they do not attain knowledge, skills, and abilities that will increase their earnings. The average number of CHEs per student (excluding personal enrichment students) was 21.2.

TABLE 1.2: BREAKDOWN OF STUDENT HEADCOUNT AND CHE PRODUCTION BY EDUCATION LEVEL, FY 2018-19

Category	Headcount	Total CHEs	Average CHEs
Professional graduates	91	3,966	43.6
PhD graduates	230	2,607	11.3
Educational Specialist degree graduates	37	637	17.2
Master's degree graduates	971	14,364	14.8
Bachelor's degree graduates	4,100	100,021	24.4
Continuing students	18,738	491,777	26.2
Dual credit students	62	300	4.8
Personal enrichment students	22	578	26.3
Workforce/professional development students	5,318	12,763	2.4
Total, all students	**29,569**	**627,013**	**21.2**
Total, less personal enrichment students	**29,547**	**626,435**	**21.2**

Source: Data provided by MSU.

The Mississippi economy

Since the university was first established, it has been serving Mississippi 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 ordered by total income, 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 MISSISSIPPI, 2019*

Industry sector	Labor income (millions)	Non-labor income (millions)	Total income (millions)**	% of total income	Sales (millions)
Manufacturing	$9,480	$10,844	$20,324	17%	$69,024
Other Services (except Public Administration)	$2,179	$10,415	$12,594	11%	$18,026
Government, Non-Education	$9,156	$3,098	$12,254	11%	$61,917
Health Care & Social Assistance	$8,075	$869	$8,944	8%	$14,314
Retail Trade	$4,921	$2,966	$7,887	7%	$13,022
Wholesale Trade	$2,592	$3,236	$5,828	5%	$9,449
Finance & Insurance	$3,221	$2,419	$5,640	5%	$10,306
Government, Education	$5,505	$0	$5,505	5%	$6,326
Construction	$3,933	$807	$4,740	4%	$8,979
Transportation & Warehousing	$3,500	$1,173	$4,673	4%	$9,361
Accommodation & Food Services	$2,813	$1,739	$4,552	4%	$8,532
Professional & Technical Services	$3,085	$746	$3,831	3%	$5,686
Utilities	$885	$2,336	$3,220	3%	$4,962
Administrative & Waste Services	$2,611	$552	$3,163	3%	$5,425
Mining, Quarrying, & Oil and Gas Extraction	$1,079	$2,005	$3,084	3%	$5,450
Agriculture, Forestry, Fishing & Hunting	$1,995	$587	$2,581	2%	$7,065
Information	$772	$1,773	$2,544	2%	$4,914
Real Estate & Rental & Leasing	$1,480	$999	$2,479	2%	$5,857
Management of Companies & Enterprises	$1,221	$105	$1,326	1%	$2,148
Educational Services	$689	$82	$771	1%	$1,090
Arts, Entertainment, & Recreation	$327	$165	$491	<1%	$860
Total	**$69,516**	**$46,915**	**$116,430**	**100%**	**$272,712**

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

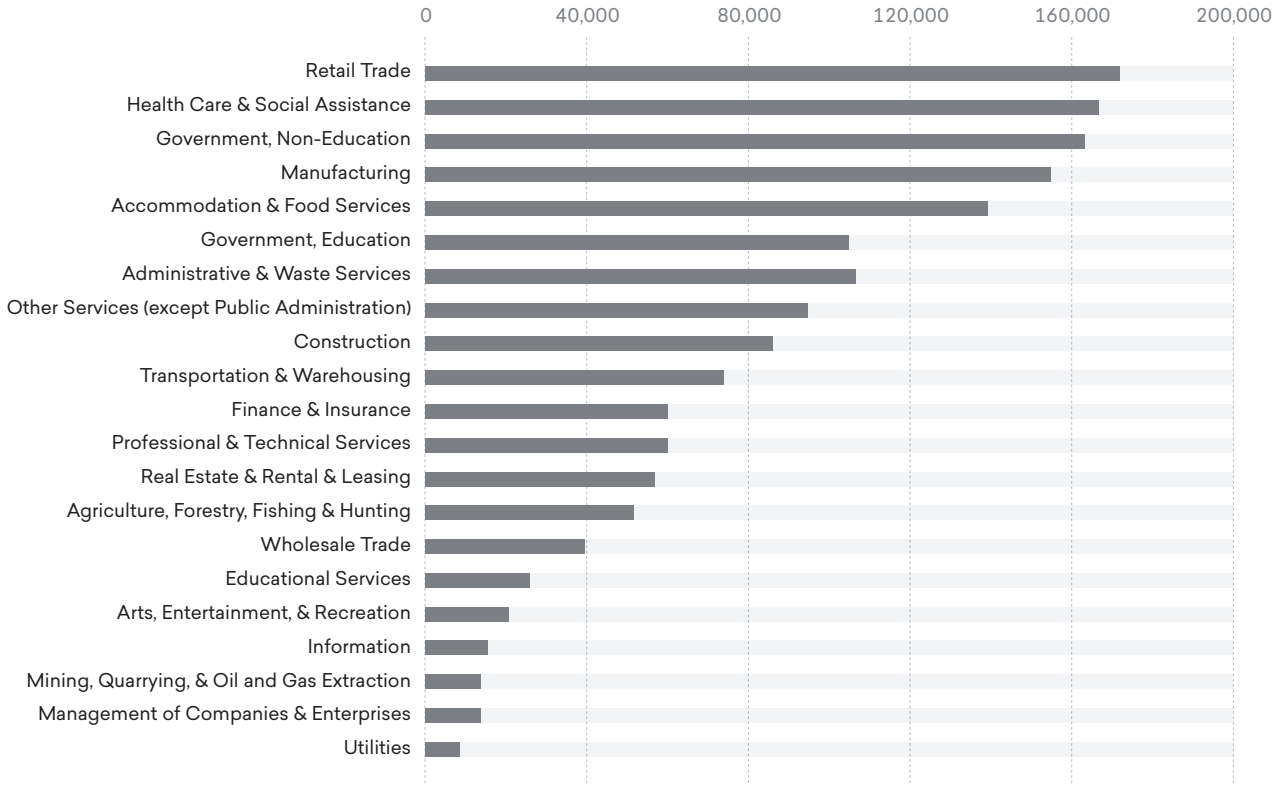
** Numbers may not add due to rounding.

Source: Emsi industry data.

As shown in Table 1.3, the total income, or GSP, of Mississippi is approximately $116.4 billion, equal to the sum of labor income ($69.5 billion) and non-labor income ($46.9 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 Mississippi. The Retail Trade sector is the largest employer, supporting 169,783 jobs or 10.6% of total employment in the state. The second largest employer is the Health Care & Social Assistance sector, supporting 164,030 jobs or 10.2% of the state's total employment. Altogether, the state supports 1.6 million jobs.[4]

FIGURE 1.3: JOBS BY MAJOR INDUSTRY SECTOR IN MISSISSIPPI, 2019*



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

4 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 Mississippi 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.[5] 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 MSU can expect approximate wages of $51,500 per year within Mississippi, approximately $19,400 more than someone with a high school diploma.

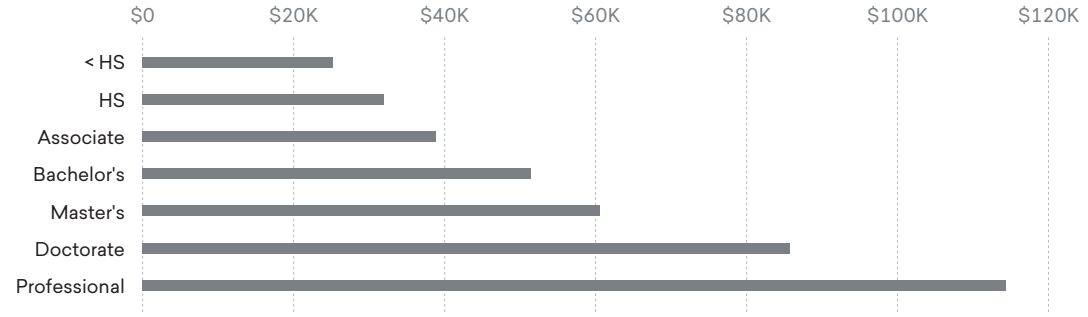
TABLE 1.4: AVERAGE EARNINGS BY EDUCATION LEVEL AT AN MSU STUDENT'S CAREER MIDPOINT

Education level	State earnings	Difference from next lowest degree
Less than high school	$25,500	n/a
High school or equivalent	$32,100	$6,600
Associate degree	$39,000	$6,900
Bachelor's degree	$51,500	$12,500
Master's degree	$60,700	$9,200
Doctoral degree	$86,400	$25,700
Professional degree	$115,300	$54,600

Source: Emsi employment data.

* Professional degree earnings are compared to master's degree earnings.

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



Source: Emsi employment data.

5 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 Mississippi Economy

MSU impacts the Mississippi 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 and research operations, its construction, Cooperative Extension Service (Extension), Center for Advanced Vehicular Systems Extension (CAVS-E), and entrepreneurial 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.

With a presence in each of Mississippi's 82 counties, MSU is an integral part of the state, creating opportunities not only for students to achieve their educational and career goals, but also opportunities for every region of the state to grow and prosper. Building on the university's land-grant mission, MSU conducts outreach across the state in support of agriculture, commerce, and community development.

IN this chapter, we estimate the following economic impacts of MSU: 1) the operations spending impact, 2) the research spending impact, 3) the construction spending impact, 4) the Extension impact, 5) the CAVS-E impact, 6) the start-up and spin-off company impact, 7) the visitor spending impact, 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:

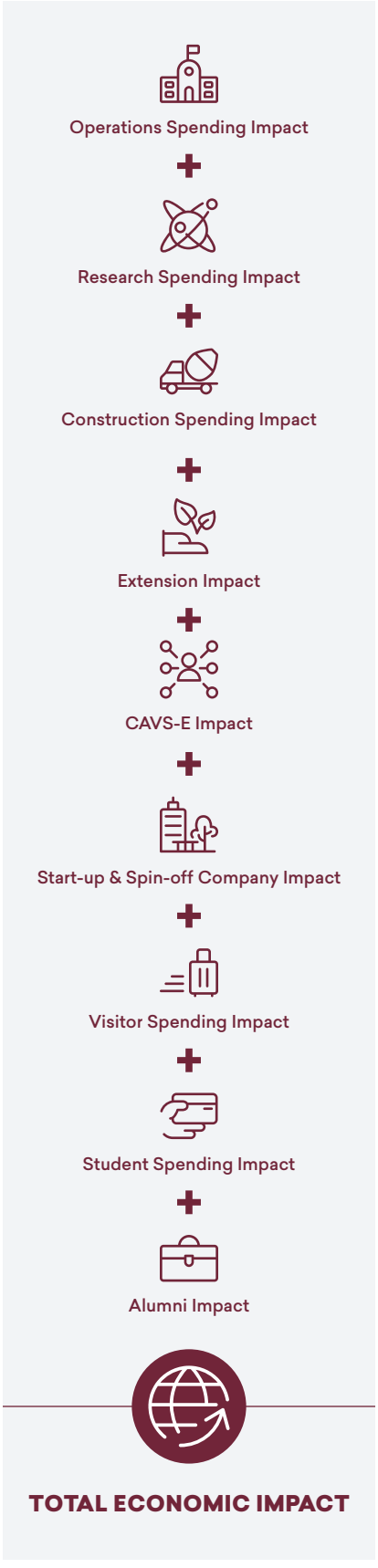
How would economic activity change in Mississippi if MSU and all its alumni did not exist in FY 2018-19?

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.

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.[6] 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:

- 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.



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

- 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 Multi-Regional Social Accounting Matrix (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 Mississippi. 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 research and construction) 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.[7] 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. Approximately 99% of MSU employees work in Mississippi (see Table 1.1), and therefore we consider 99% 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

TABLE 2.1: MSU EXPENSES BY FUNCTION (EXCLUDING DEPRECIATION & INTEREST), FY 2018-19

Expense category	In-state expenditures (thousands)	Out-of-state expenditures (thousands)	Total expenditures (thousands)
Employee salaries, wages, and benefits	$303,995	$3,071	$307,065
Operation and maintenance of plant	$17,279	$13,431	$30,710
All other expenditures	$10,420	$39,626	$50,045
Total	**$331,693**	**$56,127**	**$387,820**

This table does not include expenditures for research or construction activities, as they are presented separately in the following sections.
Source: Data provided by MSU and the Emsi impact model.

7 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.

902612 (Colleges, Universities, and Professional Schools (State Government)).[8] 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 MSU: 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.[9] 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 MSU and their salaries, wages, and benefits comprise the initial effect, shown in the top row of the table in terms of labor income, non-labor income, total added income, sales, and jobs. The additional impacts

TABLE 2.2: OPERATIONS SPENDING IMPACT, FY 2018-19

	Labor income (thousands)	Non-labor income (thousands)	Total income (thousands)	Sales (thousands)	Jobs supported
Initial effect	**$303,995**	**$0**	**$303,995**	**$387,820**	**4,127**
Multiplier effect					
Direct effect	$10,111	$4,687	$14,798	$27,699	221
Indirect effect	$1,913	$656	$2,569	$4,943	42
Induced effect	$59,184	$54,974	$114,158	$193,416	1,705
Total multiplier effect	**$71,208**	**$60,317**	**$131,525**	**$226,058**	**1,968**
Gross impact (initial + multiplier)	**$375,203**	**$60,317**	**$435,519**	**$613,878**	**6,095**
Less alternative uses of funds	-$70,711	-$67,508	-$138,218	-$314,008	-2,067
Net impact	**$304,492**	**-$7,191**	**$297,301**	**$299,870**	**4,028**

Source: Emsi impact model.

8 See Appendix 2 for a definition of NAICS.

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

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 $375.2 million in labor income and $60.3 million in non-labor income. This sums to a total impact of $435.5 million in total added income associated with the spending of the university and its employees in the state. This is equivalent to supporting 6,095 jobs.

The $435.5 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 MSU—had not occurred. MSU received an estimated 63% of its funding from sources within Mississippi. 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 and local taxes, and from the financial aid issued to students by state and local government. We must account for the opportunity cost of this in-state funding. Had other industries received these monies rather than MSU, 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 MSU, 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 **$297.3 million** *in total added income, which is equivalent to supporting* **4,028 jobs**.

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 university's operations are labor-intensive, whereas the adjustment for alternative uses of funds is non-labor-intensive, therefore the net non-labor impact is negative. Nevertheless, the overall net impact is positive and significant. It sums together to $297.3 million in total added income and is equivalent to supporting 4,028 jobs. These impacts represent new economic activity created in the state economy solely attributable to the operations of MSU.

Research spending impact

Similar to the day-to-day operations of MSU, research activities impact the economy by employing people and requiring the purchase of equipment and other supplies and services. Figure 2.1 shows MSU's research expenses by function—payroll, equipment, pass-throughs, and other—for the last four fiscal years. In FY 2018-19, MSU spent over $264.5 million on research and development activities. These expenses would not have been possible without funding from outside the state—MSU received around 40% of its research funding from federal and other sources.

MSU research and COVID-19

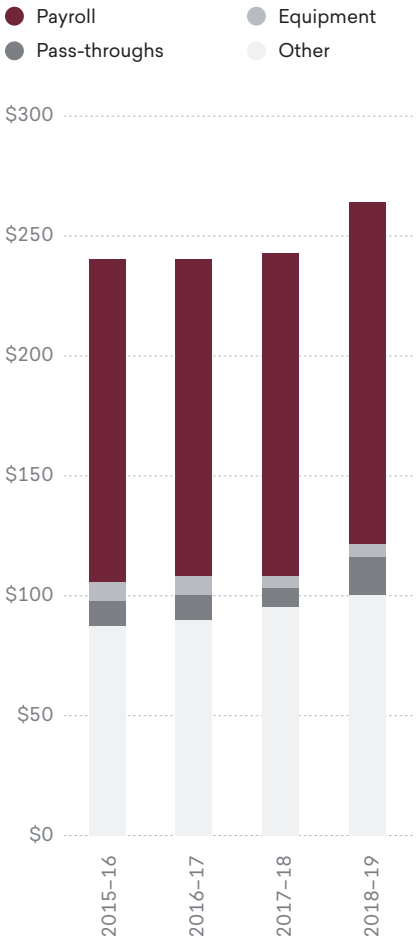
Even in hard times, MSU is an economic development force in Mississippi. Even though this economic impact study is conducted for FY 2018-19, it is worth noting that most recently, MSU's research teams are working hard to find solutions to real-world problems—including preventing the spread of COVID-19.

For example, researchers in MSU's Paul B. Jacob High Voltage Laboratory answered the call from the Mississippi Institutions of Higher Learning to convert over 550 ventilators from battery power to AC power for use in the state's medical response.

CAVS-Extension is helping Mississippi hospitals obtain isolation gowns by connecting them with in-state manufacturers capable of making the gowns needed for treating COVID-19 patients.

The Institute for Clean Energy Technology partnered with Blue Delta Jeans to clarify face mask filtration level guidelines to improve consumer safety as this Mississippi company retools to meet the nation's needs for more personal protective equipment.

FIGURE 2.1: RESEARCH EXPENSES BY FUNCTION (MILLIONS)



Source: Data provided by MSU.

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 spending impact, we also adjust the gross impacts to account for the opportunity cost of monies withdrawn from the state economy to support the research of MSU, 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 MSU to provide information on expenditures by research and development field as they report to the National Science Foundation's Higher Education Research and Development Survey (HERD).[10] 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 MSU.

Initial, direct, indirect, and induced effects of MSU's research expenses appear in Table 2.3. As with the operations spending impact, the initial effect consists of the 1,903 research jobs and their associated salaries, wages, and benefits. The university's research expenses have a total gross impact of $216.9 million in labor income and $42.3 million in non-labor income. This sums together to $259.2 million in added income, equivalent to 3,995 jobs. Taking into account the impact of the alternative uses of funds, net research expenditure impacts of

TABLE 2.3: RESEARCH SPENDING IMPACT, FY 2018-19

	Labor income (thousands)	Non-labor income (thousands)	Total income (thousands)	Sales (thousands)	Jobs supported
Initial effect	**$140,166**	**$0**	**$140,166**	**$264,526**	**1,903**
Multiplier effect					
Direct effect	$31,719	$10,925	$42,645	$75,433	831
Indirect effect	$6,701	$2,549	$9,251	$17,996	186
Induced effect	$38,325	$28,786	$67,111	$114,105	1,075
Total multiplier effect	**$76,745**	**$42,261**	**$119,006**	**$207,535**	**2,092**
Gross impact (initial + multiplier)	**$216,911**	**$42,261**	**$259,171**	**$472,060**	**3,995**
Less alternative uses of funds	-$23,575	-$22,507	-$46,083	-$104,692	-689
Net impact	**$193,335**	**$19,753**	**$213,088**	**$367,368**	**3,306**

Source: Emsi impact model.

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

MSU are $193.3 million in labor income and $19.8 million in non-labor income. This sums together to $213.1 million in total added income and is equivalent to supporting 3,306 jobs.

Research and innovation play an important role in driving the Mississippi economy. Some indicators of innovation are the number of invention disclosures, patent applications, and licenses and options executed. Over the last four years, MSU received 140 invention disclosures, filed 107 new US patent applications, and produced 28 licenses (see Table 2.4). Without the research activities of MSU, this level of innovation and sustained economic growth would not have been possible.

TABLE 2.4: MSU INVENTION DISCLOSURES, PATENT APPLICATIONS, LICENSES, AND LICENSE INCOME

Fiscal Year	Invention disclosures received	Patent applications filed	Licenses and options executed	Adjusted gross license income
2018-19	23	21	10	$114,000
2017-18	45	26	6	$193,000
2016-17	35	29	7	$144,000
2015-16	37	31	5	$204,000
Total	**140**	**107**	**28**	**$655,000**

Source: Data provided by MSU.

MSU's research activities create an economic impact beyond spending. There are impacts created through the entrepreneurial and innovative activities stemming from MSU's research. Research activities that create advances in infectious disease research, behavioural sleep research, animal production systems research, and other areas all have immense value in the state economy. However, the full magnitude of their value is difficult to quantify. Some of this value may be captured in the entrepreneurial and alumni impacts, presented later in this chapter. The broader spillover effects, however, remain as additional value created beyond the scope of this analysis.

The Thad Cochran Research, Technology, and Economic Development Park

MSU's state and national research leadership has long been recognized for its impact on local and statewide economic development. Foundational to the public service, outreach, and community engagement mission of MSU is the Thad Cochran Research, Technology, and Economic Development Park. Established in 1984 on property that was originally used as a dairy farm, it is Mississippi's oldest and largest research park. The park is located directly adjacent to campus providing access to MSU services and capabilities. It is a joint venture between MSU, the City of Starkville, and Oktibbeha County, with management and development of the park overseen by the MSU Research & Technology Corporation (RTC).

The park is an economic engine that has created high paying jobs, enhanced quality of life, and strengthened the industrial base in the region. The 272-acre park is now home to more than 1,700 employees, 12 buildings, and a diverse lineup of tenants,

including private businesses, start-up companies, government offices, and robust research centers and institutes. This represents over $100 million in infrastructure investment, over $104 million in private capital investment, and a FY 2018-19 economic impact from private tenants that exceeds $62 million. Additionally, the park is a popular destination for cycling, running, and walking.

The park's MSU-affiliated research centers have nurtured key expertise and capabilities for the state, in addition to enhancing the reputation of the university and the region.

MSU's High Performance Computing Collaboratory (HPC^2) is a key engine of the park's research and innovation. It is home to Orion, the fourth-fastest supercomputer in U.S. academia, which makes MSU an attractive research partner for federal agencies, private industry, and other universities with supercomputing needs. HPC^2 systems are powering research and advancements in weather and climate modeling, autonomous systems, materials, cybersecurity, computational modeling, and more. HPC^2 capabilities were directly tied to nearly $51 million of research activities last year.

HPC^2 consists of robust centers and institutes with researchers who use a multi-disciplinary, team-oriented effort to solve critical issues using high performance computing. These include:

- Alliance for System Safety of UAS through Research Excellence (ASSURE)
- Center for Cyber Innovation (CCI)
- Center for Computational Sciences (CCS)
- Geosystems Research Institute (GRI)
- Institute for Computational Research in Engineering and Science (ICRES)
    - Center for Advanced Vehicular Systems (CAVS)
    - CAVS Extension (CAVS-E)
    - Institute for Imaging & Analytical Technologies (I^{2}AT)
    - Institute for Systems Engineering Research (ISER)
- Institute for Genomics, Biocomputing & Biotechnology (IGBB)
- Northern Gulf Institute (NGI)

Also headquartered in the Research Park is MSU-lead ASSURE, the FAA's Center of Excellence for integrating Unmanned Aircraft Systems (UAS) into the national airspace, an alliance of 23 of the world's leading research institutions. ASSURE's research creates opportunities that will help the nation realize the multi-billion-dollar economic potential of unmanned aerial systems.

CAVS, one of the park's most prominent research centers, works closely with the state's automotive manufacturing industry, and is also an international leader in autonomous systems, mobility systems, and advanced materials research and development. It includes an Off-Road Proving Ground as a part of its research developing autonomous solutions for non-urban environments. CAVS-E, the center's industrial outreach facility located in Canton, Mississippi, has generated over $6 billion in economic impact since FY 2005-06 and has helped create over 5,500 jobs. MSU research centers like CAVS have played a key role in industrial recruitment efforts both in Mississippi and in the tri-county area surrounding MSU.

Other MSU centers and institutes with facilities in the Research Park include the Social Science Research Center, the Stennis Center for Public Service, the National Strategic Planning and Analysis Research Center, and the Institute for Clean Energy Technology.

The Research Park's available office space helps launch, retain, and recruit businesses in Starkville, diversifying the region's economic assets and combating the state's "brain drain" by providing job opportunities for Mississippi's college graduates. The Business Incubator Building provides office space for start-up companies from MSU and the surrounding area. Office space is leased at a reduced rate and mentoring services are provided by the MSU Center of Entrepreneurship and Outreach (ECenter). This building has allowed student-led start-up companies, as well as companies created by faculty that have developed new technologies, to utilize much-needed office space during the critical early stages of launching a new business. Providing this space for start-up businesses is one of the many ways the university supports transitioning MSU-owned intellectual property to the marketplace, where it can create new jobs and opportunities in Mississippi.

New and expanding companies are drawn to the Research Park in part because of its proximity to the high-level research and development taking place at MSU. MSU purposely located industry partners with its researchers to create opportunities for economic development. MSU is proud to partner with leading technology companies such as Camgian Microsystems, HBM nCode Federal LLC, HORNE Cyber, II-VI, Inc., C Spire, and the Tennessee Valley Authority.

Locating these companies in the park has increased the Starkville area's status as a regional hub for technology and innovation, which helps in turn draw more people and companies to the area.

MSU's service efforts extend beyond the borders of the park. The MSU Research and Technology Corporation recently acquired property in downtown Starkville and established an Innovation Hub. The acquisition is one of many ways MSU is working to ensure a thriving downtown in Starkville. Babel Street, a world leading "data-to-knowledge" company, expanded its presence in Starkville by moving into the building last year, earning recognition as "Industry of the Year" for 2019 from the Greater Starkville Development Partnership.

MSU's research park and expansion efforts represent the university's investment and commitment to helping communities grow and thrive.

Research advancements and developments at MSU

For more than 142 years, MSU has been using its core mission of learning, research, and service to make an impact in Mississippi and beyond. Locally, MSU and the City of Starkville blend together to create a wonderful atmosphere for students from 50 states and 83 countries, visitors, and residents. With an enrollment of over 29,000 credit and non-credit students, a 4,200-acre campus that employs over 6,000 faculty and staff, and expenditures totaling over $750 million, MSU has a measurable economic impact on the state of Mississippi.

"Our research leadership is a vital resource for economic development," said MSU President Mark E. Keenum. "We partner with organizations around the world to share our expertise in engineering, agriculture, architecture, medicine, social science, and other fields that are key to our nation's growth and prosperity. At home and abroad, our students, faculty, staff, and alumni are making a positive impact on the future."

MSU research is an economic development success story. The National Science Foundation ranks MSU among the nation's top 100 research institutions earning designation as a "Very High Research Activity" R1 doctoral university.

As the Magnolia State's leading research university, MSU's research expenditures totaled over $244 million in FY 2017-18, accounting for more than half of all R&D expenditures in the state:

- MSU has increased its research and development expenditures for five consecutive years. MSU holds the "Very High Research Activity" designation from the Carnegie Foundation.
- With a diverse research portfolio, MSU ranks in the top 15 nationally in both agricultural sciences (11th) and social sciences (12th). For the seventh consecutive year, MSU leads all Southeastern Conference universities in social sciences research funding. MSU leads the state with nearly 4,000 research personnel, including 661 principal investigators.
- With $105 million in reported funding for agricultural sciences and natural resources conservation, MSU's commitment to Mississippi's $8 billion agriculture and forestry industry is affirmed.
- Three Bagley College of Engineering disciplines are rated in the top 50, with aerospace and mechanical engineering both ranking 34th and industrial engineering ranking 38th. MSU also ranks 28th in the NSF's "Other Engineering" subfield. In the College of Arts and Sciences, MSU ranked 43rd in atmospheric science and 50th in geological and Earth science.

MSU's R&D funding comes from a wide range of sources, including business and industry; trade groups; and local governments, state offices, and federal agencies, such as the USDA, National Institutes of Health, FAA, NASA, NSF, and the Department of Defense.

MSU is a recognized leader in several research disciplines, and well known for innovative partnerships, real-world impact, and offering undergraduate and graduate students unique research opportunities. This research is powered in part by MSU's High Performance Computing Collaboratory, which is home to Orion, the fourth-fastest supercomputer in U.S. academia. MSU's high performance computing (HPC) capabilities were directly tied to nearly $51 million of research activities last year. The Collaboratory's computing power allows MSU personnel to work with state, federal, and industry partners to solve complex problems and utilize advanced modeling and simulation capabilities. For example, MSU uses its computing power to work with the National Oceanic and Atmospheric Administration to improve weather forecasts and with industry in Mississippi to strengthen manufacturing processes.

The university's Center for Advanced Vehicular Systems (CAVS) works closely with the state's growing automotive manufacturing industry, and is also an international leader in autonomous vehicle, mobility systems and advanced materials research and development. CAVS-E, the center's industrial outreach facility located in Canton, Mississippi, has generated over $6 billion in economic impact since FY 2005-06, as measured and verified by the U.S. Department of Commerce.

As it works to support the state's $8 billion agriculture and forestry industry, MSU's $105 million in R&D expenditures in agricultural sciences in FY 2017-18 places the university in the nation's top 5%. MSU manages agriculture and forestry experiment stations located strategically throughout the state, in addition to Extension offices in each of Mississippi's 82 counties. These research centers address issues relevant to Mississippi farmers, industry, communities, and families. The Delta Research and Experiment Station in Stoneville, consisting of almost 5,000 acres, is a world-renowned center for agricultural research on commodities such as cotton, rice, soybeans, corn, and catfish.

MSU also leads the Federal Aviation Administration's (FAA) national Center of Excellence for integrating Unmanned Aircraft Systems (UAS) into the national airspace. The Alliance for System Safety of UAS through Research Excellence (ASSURE), which is the FAA's UAS Center of Excellence led by MSU and comprised of 23 of the world's leading research institutions, will also begin doing research sponsored by the FAA in the area of cybersecurity that will likely include further research into autonomy and artificial

intelligence (AI). This research will open commercial opportunities that will safely integrate autonomy and AI in the UAS industry which will help realize the multi-billion-dollar potential.

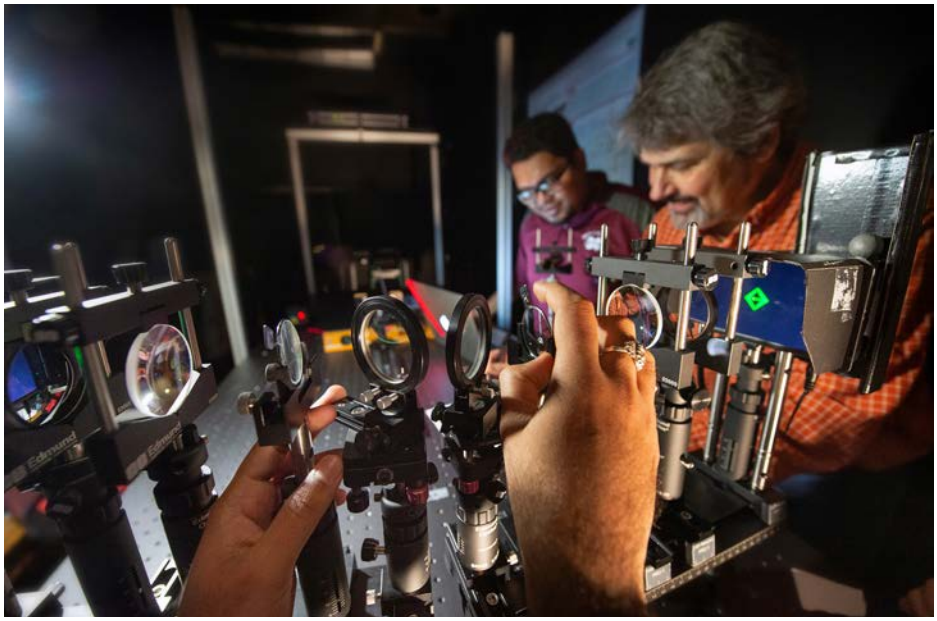
MSU's Raspet Flight Research Laboratory stands out as one of the university's most long standing and prominently established research entities. Raspet is on the leading-edge advances of modern concepts in experimental aviation through the research, development, testing, and evaluation of Unmanned Aircraft Systems (UAS) using advanced technologies. Raspet also leads the Department of Homeland Security's Systems Demonstration Range Facility for UAS.

In partnership with Boeing, the Advanced Composite Institute (ACI) was created at MSU with Boeing's donation of a revolutionary stitched composite process and equipment originally developed at NASA by pioneering scientist Marvin B. Dow. ACI is a university resource with a collaborative vision of bridging engineering and science disciplines by establishing an internationally recognized institute of excellence for advanced composites research and technology.

MSU's Geosystems Research Institute (GRI) leverages advanced technologies to provide capabilities in remote sensing computational technologies, visualization techniques, agriculture and natural resource management, and the transition of these into operational agency research, planning, and decision-support programs. GRI has developed nationally recognized research strengths with strong relationships and inherent respect from state, regional, and national agencies and business entities.

The National Strategic Planning and Analysis Research Center (NSPARC) connects academic research to real-world issues, representing the university as an innovative branch in society. NSPARC has a mission to expand MSU's reach to policymakers, industry, and the public. The center uses smart data, analytical techniques, and high technology to make a difference, such as explaining education outcomes, helping Mississippi attract new businesses, and connecting job seekers to employment opportunities. NSPARC bases its innovative solutions on academic research from an ever-growing number of fields and always keeps an eye on the big picture.

MSU was the first in the state to achieve Innovation and Economic Prosperity University status from the Association of Public and Land-grant Universities (APLU) and its Commission on Innovation, Competitiveness and Economic Prosperity. The designation—attained after a rigorous review process—recognizes MSU for working to advance engagement and economic well-being in the state, region, and the nation.



Construction spending impact

In this section, we estimate the economic impact of the construction spending of MSU. 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. For the past five years, MSU spent an annual average of $62.7 million on various construction projects.[11] In FY 2018-19, construction projects included multiple purposes including instructional buildings for the Animal and Dairy Science Department and Civil and Environmental Engineering Department, an additional parking garage, and a baseball sports stadium.

Assuming MSU construction spending approximately matches national construction spending patterns of NAICS 902612 (Colleges, Universities, and Professional Schools (State Government)), we map MSU construction spending to the construction industries of the MR-SAM model. Next, we use the RPCs to estimate the portion of this 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.

For the past five years, MSU spent an annual average of ***$62.7 million*** *on various construction projects.*

11 Given the high volatility of construction expenditures from year to year, the average amount MSU spent on construction activities over the past five years was used as a proxy for the construction expenditures in FY 2018-19.

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 and research spending impacts. This is done by simulating a scenario where in-state 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 2.5 presents the impacts of MSU construction spending during FY 2018-19. Note the initial effect is purely a sales effect, so there is no initial change in labor or non-labor income. The FY 2018-19 MSU construction spending creates a net total short-run impact of $14.8 million in added income—the equivalent of supporting 320 jobs in Mississippi.

TABLE 2.5: CONSTRUCTION SPENDING IMPACT, FY 2018-19

	Labor income (thousands)	Non-labor income (thousands)	Total income (thousands)	Sales (thousands)	Jobs supported
Initial effect	**$0**	**$0**	**$0**	**$62,685**	**0**
Multiplier effect					
Direct effect	$15,804	$3,231	$19,035	$36,055	350
Indirect effect	$2,991	$611	$3,603	$6,824	66
Induced effect	$5,149	$1,053	$6,202	$11,747	114
Total multiplier effect	**$23,945**	**$4,895**	**$28,840**	**$54,626**	**530**
Gross impact (initial + multiplier)	**$23,945**	**$4,895**	**$28,840**	**$117,310**	**530**
Less alternative uses of funds	-$7,191	-$6,865	-$14,056	-$63,866	-210
Net impact	**$16,754**	**-$1,971**	**$14,783**	**$53,444**	**320**

Source: Emsi impact model.

MSU supports strong town and gown relationship with Starkville

MSU works closely with local leadership to support economic development in Starkville and to make the city a premier college town. Recently, MSU made significant investments to help create a vibrant downtown area. The MSU Idea Shop, opened in 2019 on Main Street, includes a makerspace open to the community and a retail storefront, providing a space for entrepreneurs to prototype new products and test their viability in the marketplace.

The MSU Research and Technology Corporation recently purchased a bank building in downtown Starkville that will be turned into office space for new companies, many of which have connections to MSU. The building is already home to Babel Street, a leading technology company founded by an MSU alumnus.

In 2019, the $67 million College View development opened. The public-private partnership between MSU and Greystar includes 600 residential beds and 46,000 square-feet of retail space. It is the first university housing development of its kind in the state.

Extension impact

Cooperative Extension Service (Extension) in Mississippi is comprised of four core components: Agriculture and Natural Resources, 4-H Youth Development, Community Resource Development, and Family Consumer Services. Extension's clients include row-crop planters, forest landowners, livestock producers, families and their children, business leaders, and elected local officials. In FY 2018-19, MSU Extension carried out over 200 programs in areas such as food and agricultural systems, 4-H youth development, conservation and recreation, family health, and community engagement. These programs are developing state residents' knowledge in agriculture, health and nutrition, and science, technology, engineering and mathematics (STEM).

Fred Carl Jr. Small Town Center

With a presence in each of Mississippi's 82 counties, MSU is committed to helping every community in the state thrive. One embodiment of this commitment is the Fred Carl Jr. Small Town Center.

Founded in 1979, the Fred Carl Jr. Small Town Center (STC) in the College of Architecture, Art, and Design (CAAD) at MSU serves as an advocate of meaningful planning and design services to small communities throughout Mississippi. Comprised of architects, planners, and students, the research that is conducted provides solutions to problems faced by communities across the nation. The outreach efforts run a wide gamut from community engagement and visioning, grant writing, project feasibility studies, master planning, downtown revitalizations, small town research, design education seminars and workshops, to bike and pedestrian planning and development. The STC works with community and city leaders, public and private partners, and residents to provide solutions to multiple community needs.

The STC has many success stories such as the Baptist Town Master Plan that was created for an impoverished town in the Delta to improve neighborhood housing conditions and promote economic development in the area. This master plan effort was unique in that partnerships with local, regional, and national entities worked together toward this common goal. The project partners included energetic residents of Baptist Town, the City of Greenwood, and a wide variety of non-profit and for-profit groups. These project partners ensured that the residents' needs and wants were addressed in the master plan and were committed to securing funding and support to implement this plan. Working together with the project members and local community leaders, the STC held several community meetings, focus group meetings, and interactive information sessions which assessed the needs of Baptist Town residents. An ongoing dialogue over the years with residents and committed city leaders propelled this project forward by garnering financial commitment and in-kind services from many entities.

As part of STC's commitment to communities, it was able to ensure nearly all master plan elements were realized. Entrances into the neighborhood were improved with new sidewalks, landscaping, lighting and signage. A playground was renovated with assistance from a local business. A new pocket park was constructed with leadership from STC and MSU architecture students. Perhaps the most important realization of the plan was the improvement of the poverty-stricken neighborhood's housing conditions with the placement of 11 Katrina cottages on a vacant parcel of land and the rehabilitation of a dozen homeowner occupied houses. In addition, the renovation of a neighborhood eyesore into a new community center was established to offer a place for after school education, neighborhood meetings, and community activities. This is just one example of how STC and community partners turned a vision for a revitalized neighborhood into a reality through strategic planning and project implementation.

Another significant success story is the Mississippi Delta community of Marks. Upon realizing the impoverished community had lost touch with its historical role in the Civil Rights Movement, the Center engaged the community in telling their town's story of the

Mule Train, a pivotal part of Dr. Martin Luther King, Jr.'s 1968 Poor People's Campaign. The goal of the project was to commemorate the historical event, while bringing economic development to the area through cultural tourism. It also helped Marks promote its history as a means of boosting community pride, while encouraging biking and walking in an obesity-ridden region.

The team creatively maximized limited grant funds to tackle multiple community needs, including the design and construction of wayfinding and trail signage. The team also master planned a trailhead park and provided in depth analysis of infrastructure improvements to execute the trail. Today, phase one of the biking and walking trail has been implemented and permanent sign markers are being installed.

Both research and innovation are a vital part of STC's mission, especially in the way STC applies its research in practice to benefit communities. In its Ripley Master Plan project, for example, the Center created a successful model for planning and design excellence as a replicable model for other communities.

Funded in part by MSU's National Strategic Planning and Analysis Research Center, the Ripley Master Plan sets a 20-year vision for the community. STC sought to develop a new approach to planning in small towns that combined the Center's expertise in planning, design, and implementation with NSPARC's proficiency in data analytics for three key projects: a transportation bypass, the development of downtown loft apartments, and the construction of Town Creek Greenway. The economic projections made for these projects allowed local leaders to prioritize development decisions, moving the plan from concept to reality.

In addition, the plan addressed key design challenges faced by the community on two sites. The First Monday project, completed in partnership with the MSU School of Architecture's fourth year studio, improved the site for the town's monthly market. The downtown improvements were envisioned as part of STC's CREATE Common Ground class which implemented one of their ideas through a tactical urbanism approach. This resulted in a success story for the Ripley community.

As is the case with the many communities it works with, STC applied a holistic approach to its work with Ripley, tackling multiple issues with multiple partners through multiple applications such as engagement activities and public outreach initiatives in response to the specific needs of the community. The meaningful impact made in this and other communities demonstrates how the Center has realized four decades of economic success throughout Mississippi.

The Center celebrated its 40th anniversary in FY 2018-19. Through 50-plus partnerships and participation from more than 500 students, faculty, and staff, the Center has invested over $2 million in service to more than 100 small towns over the past 40 years. Projects start out as an idea, concept or sketch, but through action-oriented teams of public/private partners working together, transformation in small towns occur, making communities more vibrant and sustainable.

In addition, Extension trains government officials to make Mississippi even more attractive and profitable to prospective residents and businesses. Extension experts have provided training for officials in each of Mississippi's 82 counties and 298 municipalities. To prepare future government leaders, thousands of Mississippi teens participated in Extension's Keys to Community high school curriculum to learn how local government works.

Extension's HappyHealthy initiative is helping Mississippians live happier, healthier lives. Its Supplemental Nutrition Assistance Program Education (SNAP-ED) and Expanded Food and Nutrition Education Program (EFNEP) focus on reaching the limited-resource audience in Mississippi to provide practical, hands-on nutrition education and policy, systems, and environmental strategies to address some of the state's most pervasive challenges of poverty, food insecurity, and obesity. Addressing these issues can save money on healthcare by changing behaviors to help prevent chronic diseases associated with obesity, poor quality nutrition intake, and lack of physical activity. Working with 474 community partners, these programs reached 1,776 families and 15,877 youth.

Extension's programs provide a strong return on investment for Mississippi producers. With 2,105 individual forestry programs presented to landowners, $2.8 million in value was added to properties. Over 4,000 producers attended Extension programs on insect pest-management solutions, with $40 million saved statewide. Irrigation programs resulted in $30 saved per acre, or $60 million statewide. 2,195 individuals were trained to either purchase or apply auxin-containing herbicides.

Overall, Extension delivered 2,957 local programs in FY 2018-19 and reported 712,553 direct client contacts and over 4 million total contacts. These programs and contacts represent millions saved and reinvested in Mississippi's economy.

MSU Extension supports Mississippians in times of need

Much like how Extension was there when the boll weevil threatened the state's cotton production in the early 20th century, Extension was there to support producers in FY 2018-19 when 544,000 acres were flooded in Mississippi, including 250,000 agricultural acres. Extension held community listening sessions, conducted surveys among farmers to gather important data on flooding impact, and advised on flood cleanup.

In Mississippi, wildlife-related recreation is a $2.9 billion industry vital to Mississippi residents. When chronic wasting disease was confirmed in Mississippi deer, Extension partnered with the Mississippi Department of Wildlife, Fisheries, and Parks to contain the disease and its spread, aiding a key part of wildlife-recreation in the state.

As part of the Preventing Opioid Misuse in the Southeast (PROMISE) initiative, Extension is fighting Mississippi's opioid epidemic by promoting proper use and disposal of prescriptions, extending knowledge about proper opioid use, and training Extension agents and community volunteers in Mental Health First Aid.

In 2002, USDA agricultural economists began estimating the impact of one of these four core components: Agriculture and Natural Resources. In a series of peer reviewed publications, these economists developed a standardized measurement of extension services in the southeastern U.S. and then estimated the impact of a state's extension services on farm productivity in that state. MSU confirmed the validity of these results for Mississippi's farmers with the author of the original series of papers, who is presently employed as the USDA's Deputy Director for Research and Communication.

Survey results indicated that annual farm productivity increases from 7.9% to 12.1% as a result of the agricultural services, research, and outreach conducted by extension services in the state. The most conservative estimate was then applied to Mississippi's farm productivity to identify the lower bound of MSU's Extension impact. We assume that this productivity gain is reflected in farm sales, as measured by the annual cash receipts of crops and livestock, and therefore exclude income from other sources, such as grants and government payments.

The Bureau of Economic Analysis (BEA) reports that Mississippi farm cash receipts from livestock and crops in FY 2018-19 totaled $6.1 billion. The direct

impact of MSU's Extension Agricultural and Natural Resource units is therefore $6.1 billion divided by 1.079 is then subtracted from $6.1 billion resulting in $446.4 million. Given the fact that this valuation uses the smallest of the USDA's productivity estimates and only one of the four core Extension components has been valued, this should be considered an extremely conservative, lower-bound estimate of the true benefit of MSU's Extension units.

Similar to the CAVS-E impact above, we measure the impact from the increase in sales stemming from the businesses that were supported by MSU's Extension. As shown in Table 2.8, the net impact of Extension in FY 2018-19 is $189.6 million in labor income and $55.6 million in non-labor income. This totals to $245.3 million in added income and is equivalent to supporting 4,889 jobs.

TABLE 2.8: IMPACT OF EXTENSION, FY 2018-19

	Labor income (thousands)	Non-labor income (thousands)	Total income (thousands)	Sales (thousands)	Jobs supported
Initial effect	**$126,017**	**$37,067**	**$163,084**	**$446,370**	**3,246**
Multiplier effect					
Direct effect	$21,774	$7,019	$28,793	$83,766	559
Indirect effect	$5,095	$1,726	$6,820	$19,966	132
Induced effect	$36,747	$9,838	$46,584	$120,443	952
Total multiplier effect	**$63,615**	**$18,582**	**$82,197**	**$224,176**	**1,643**
Total impact (initial + multiplier)	**$189,632**	**$55,649**	**$245,281**	**$670,546**	**4,889**

Source: Emsi impact model.

It should be noted that this impact is conservative because it does not include other MSU outreach activities. For example, MSU offers a variety of opportunities for forming active, future-focused partnerships that can benefit society. Whether on campus or in the community, just down the road or around the world, MSU is creating and implementing initiatives to aid and serve others. Learning to value community engagement—and using that knowledge to become actively involved—are primary components in carrying out the university's mission of service and outreach. This value from MSU is not quantified in this report.

Although data limitations prevent a full accounting of MSU's outreach activities, the university is recognized for its commitment to supporting innovation and economic activity. Since 2015, MSU has been designated as an Innovation and Economic Prosperity University by the Association of Public and Land Grant Universities. The designation—attained after a rigorous review process—recognizes MSU for working to advance engagement and economic well-being in the state, region, and nation.

Improving health and wellness across Mississippi

MSU's deep roots in the Delta are growing deeper, thanks to a unique partnership between the MSU Extension Service and the University of Mississippi Medical Center (UMMC) that is making a positive impact on health and wellness in Humphreys County.

The UMMC Community Care Clinic in Belzoni, which opened its doors to patient care in December 2017, is much more than an after-hours, acute-care medical facility. It offers a range of services to help people of all ages live healthier lifestyles—from family education and disease prevention to nutrition and fitness guidance.

The clinic's health care outreach builds on the work the MSU Extension Service has been doing in Humphreys County for decades, says David Buys, assistant Extension and research professor in the department of food science, nutrition, and health promotion at MSU.

Buys is referring to the origins of the national Cooperative Extension System, which was created by the Smith-Lever Act in 1914 as part of an effort to modernize the country's outmoded, inefficient agricultural industry.

MSU and other land-grant universities were charged with establishing and leading Extension programs in each state. Over the next century, they played vital roles in transforming American agriculture by partnering with farmers at the local level to advance farming practices and techniques.

While increased agricultural production was the primary goal, the Extension model recognized that healthy, connected communities were at the heart of thriving agricultural economies. In addition to their focus on agricultural and natural resources, Extension agents promoted family and consumer science—for example, by teaching safe food-handling practices to prevent food-borne illnesses and introducing 4-H programs to support positive youth development.

Building on a century of success, the MSU Extension Service continues to offer research-based education programs in Mississippi communities, many of which lack access to quality health care. That was the situation facing Humphreys County in 2013 when the local hospital in Belzoni closed its doors. Two primary care clinics continued providing services but were open only during normal business hours. That meant those seeking urgent-care attention after hours or on weekends had no choice but to drive at least 20 miles to the nearest hospital.

After consulting with UMMC leaders, the Humphreys County Board of Supervisors agreed that an after-hours clinic could effectively cover gaps in the county's health care needs. They offered space to UMMC for the clinic in the Humphreys County Sherrill Building, next to the MSU Extension office. The board felt that co-locating the entities would create a convenient and accessible health care hub for area residents.

With a grant from the U.S. Department of Agriculture, UMMC formed a consortium with MSU Extension, the State Department of Health, and Mississippi Delta Community College to expand the clinic's focus to include preventive care, healthy living, and health care job training. The grant also funded the addition of classroom space, a fitness room, and a walking track.

"When our only hospital closed, we were faced with a serious health care crisis that UMMC and the consortium helped solve," says Dickie Stevens, president of the Humphreys County Board of Supervisors. "Now residents have access to quality health care in a convenient location that offers many state-of-the-art programs and services. It's definitely a step in the right direction to improve our community's quality of life."

The UMMC Community Care Clinic, which is staffed by nurse practitioners and registered nurses, is open from 2 to 10 p.m. on weekdays and 10 a.m. to 6 p.m. on weekends and is equipped to treat acute illnesses and injuries that are not life-threatening and do not require emergency room visits. Its capabilities are augmented by telehealth services that provide access to 35 specialties based at the Medical Center in Jackson in addition to remote patient monitoring equipment.

"UMMC worked with local leaders and health care providers to design a sustainable solution for the community," says Dr. Tonya Moore, administrator of community health services for UMMC's Center for Telehealth. "Our partnership with MSU's Extension Service is increasing the impact of our services and helping improve the overall health and wellness of Humphreys County residents."

The fact that UMMC's clinic and the MSU Extension office are next-door neighbors bodes well for clinic patients, especially those dealing with chronic conditions that can be improved by acquiring new life skills. For instance, local agents Preston Aust and Regina Boykins offer those with diabetes healthier ways to shop for and cook food while providing home environment assistance to asthma sufferers.

Increasing the Extension Service's access to residents who are likely to benefit from health education is one of the many strengths of UMMC's innovative health care partnership. It also builds on the Extension Service's foundational mission—extending knowledge and changing lives.

CAVS-E impact

MSU's outreach activities extend to each of the state's 82 counties. Many MSU units heavily engage in outreach by translating university research into support and assistance to enhance Mississippi businesses and improve the lives of citizens. The Center for Advanced Vehicular Systems Extension (CAVS-E) and the Cooperative Extension Service (Extension) specialize in these outreach activities and support job creation, increased sales and revenues, and growth in the state. This section is concerned with measuring the impact from CAVS-E and the following section presents the impact of Extension.

MSU's CAVS-E unit provides Mississippi's manufacturers, healthcare providers, and service providers with technical expertise, professional development, and on-site consultation for product and process improvement. CAVS-E clients report that these services yield increased sales, lower costs, and improved efficiency. Quarterly CAVS-E client surveys collect data regarding the clients' valuation of these services. Clients receiving services in FY 2018-19 reported $24.3 million in increased sales and an additional $35.9 million in retained sales attributable CAVS-E. In addition, clients reported that they created 362 new jobs and were able to retain 316 employees because of the services offered by CAVS-E. CAVS-E clients also saved $11.7 million through cost savings, savings on investments, and unnecessary investments avoided. Finally, through these savings and business growth, CAVS-E clients were able to purchase $18 million in equipment and goods, further supporting Mississippi.

TABLE 2.6: CAVS-E CLIENT SUPPORT, FY 2018-19

Increase in sales	$24,265,000
Retained sales	$35,910,000
Total sales	**$60,175,000**
Jobs created	362
Jobs retained	316
Employment	**678**

Source: Emsi impact model.

To measure the impact CAVS-E has on Mississippi, we use the NAICS industries of CAVS-E's clients and assume the clients have earnings and spending patterns—or production functions—similar to their respective industry averages. Starting with the initial jobs of 678 and sales of $60.2 million, 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. As shown in Table 2.7, the net impact of CAVS-E in FY 2018-19 is $22.8 million in labor income and $9.8 million in non-labor income. This totals to $32.6 million in added income and is equivalent to supporting 756 jobs.

TABLE 2.7: IMPACT OF CAVS-E, FY 2018-19

	Labor income (thousands)	Non-labor income (thousands)	Total income (thousands)	Sales (thousands)	Jobs supported
Initial effect	**$16,244**	**$7,042**	**$23,287**	**$60,175**	**678**
Multiplier effect					
Direct effect	$1,866	$801	$2,667	$7,288	22
Indirect effect	$410	$176	$586	$1,608	5
Induced effect	$4,256	$1,762	$6,018	$14,589	51
Total multiplier effect	**$6,532**	**$2,740**	**$9,271**	**$23,485**	**78**
Total impact (initial + multiplier)	**$22,776**	**$9,782**	**$32,558**	**$83,660**	**756**

Source: Emsi impact model.

Start-up & spin-off company impact

MSU creates an exceptional environment that fosters innovation and entrepreneurship, evidenced by the number of MSU start-up and spin-off companies that have been created in the state. This subsection presents the economic impact of companies that would not have existed in the state but for the presence of MSU. 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 MSU.
- **Spin-off companies**: Companies created and fostered through programs offered by MSU that support entrepreneurial business development, or companies that were created by faculty, students, or alumni as a result of their experience at MSU.

We vary our methodology from the previous sections in order to estimate the impacts of start-up and spin-off companies. Ideally, we would use detailed financial information for all start-up and spin-off companies to estimate their impacts. However, collecting that information is not feasible and would raise a number of privacy concerns. 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 2.9 presents the number of employees for all start-up and spin-off companies related to MSU that were active in Mississippi during the analysis year.

MSU creates an exceptional environment *that fosters innovation and entrepreneurship, evidenced by the number of MSU start-up and spin-off companies that have been created in the state.*

TABLE 2.9: START-UP AND SPIN-OFF COMPANIES RELATED TO MSU THAT WERE ACTIVE IN MISSISSIPPI IN FY 2018-19

	Number of companies	Number of employees
Start-up companies	16	149
Spin-off companies	9	38

Source: Data provided by MSU.

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 2.10 presents the impact of the start-up companies. The initial effect is 149 jobs, equal to the number of employees at all start-up companies in the state (from Table 2.9). The corresponding initial effect on labor income is $7.6 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 $11.9 million in added labor income and $3.3 million in non-labor income. This totals to $15.2 million in added income—or the equivalent of supporting 234 jobs.

Preparing future entrepreneurs

Located in the heart of MSU's campus, MSU's Center for Entrepreneurship and Outreach strives to help students, faculty, and staff at MSU start and grow successful companies. The Center for Entrepreneurship and Outreach supports over 100 student start-up teams every year as they work to launch a new business. Through these efforts, MSU aggressively seeks to unify, grow, and foster culture of entrepreneurship at MSU in the local community and throughout the state.

TABLE 2.10: IMPACT OF START-UP COMPANIES RELATED TO MSU, FY 2018-19

	Labor income (thousands)	Non-labor income (thousands)	Total income (thousands)	Sales (thousands)	Jobs supported
Initial effect	**$7,581**	**$2,111**	**$9,692**	**$18,215**	**149**
Multiplier effect					
Direct effect	$1,297	$298	$1,595	$3,108	27
Indirect effect	$311	$77	$388	$767	7
Induced effect	$2,730	$767	$3,497	$6,324	51
Total multiplier effect	**$4,339**	**$1,141**	**$5,480**	**$10,199**	**85**
Total impact (initial + multiplier)	**$11,920**	**$3,252**	**$15,172**	**$28,414**	**234**

Source: Emsi impact model.

Note that start-up companies have a strong and clearly defined link to MSU. The link between the university and the existence of its spin-off companies, however, is less direct and is thus viewed as more subjective. We include the

impacts from spin-off companies in the grand total impact presented later in the report since they represent entrepreneurial 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.[12]

TABLE 2.11: IMPACT OF SPIN-OFF COMPANIES RELATED TO MSU, FY 2018-19

	Labor income (thousands)	Non-labor income (thousands)	Total income (thousands)	Sales (thousands)	Jobs supported
Initial effect	**$2,455**	**$1,161**	**$3,616**	**$7,096**	**38**
Multiplier effect					
Direct effect	$335	$160	$495	$1,111	6
Indirect effect	$78	$37	$115	$265	1
Induced effect	$937	$437	$1,373	$2,327	13
Total multiplier effect	**$1,350**	**$633**	**$1,983**	**$3,704**	**20**
Total impact (initial + multiplier)	**$3,805**	**$1,794**	**$5,599**	**$10,800**	**58**

Source: Emsi impact model.

As demonstrated in Table 2.11, the university creates an exceptional environment that fosters innovation and entrepreneurship. As a result, the impact of spin-off companies related to MSU is $3.8 million in added labor income and $1.8 million in non-labor income, totaling $5.6 million in added income—the equivalent of supporting 58 jobs.

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

Visitor spending impact

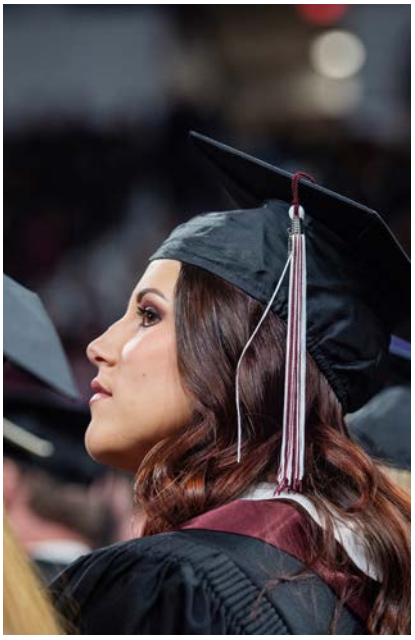
Hundreds of thousands of out-of-state visitors came to MSU in FY 2018-19 to participate in various activities, including commencement, sports events, and orientation. MSU estimated that 329,840 out-of-state visitors attended events it hosted in FY 2018-19. Table 2.12 presents the average expenditures 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 $104.1 thousand in FY 2018-19. 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 $80.9 million. The net sales from out-of-state visitors in FY 2018-19 thus come to $81 million. We conduct a sensitivity analysis for the estimated number of out-of-state visitors in Appendix 1.

Hundreds of thousands of out-of-state visitors *came to MSU in FY 2018-19 to participate in various activities, including commencement, sports events, and orientation.*

TABLE 2.12: AVERAGE PER-TRIP VISITOR COSTS AND SALES GENERATED BY OUT-OF-STATE VISITORS IN MISSISSIPPI, FY 2018-19*

Accommodation	$85
Food	$120
Entertainment and shopping	$100
Transportation	$10
Total expenses per visitor	**$315**
Number of out-of-state visitors	329,840
Gross sales	$104,058
On-campus sales (excluding textbooks)	$80,864,885
Net off-campus sales	**$80,968,942**

* 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 MSU.



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 model. The model runs the net sales figures through the multiplier matrix to arrive at the multiplier effects. As shown in Table 2.13, the net impact of visitor spending in FY 2018-19 is $26.3 million in labor income and $16.1 million in non-labor income. This totals to $42.5 million in added income and is equivalent to supporting 1,285 jobs.

TABLE 2.13: VISITOR SPENDING IMPACT, FY 2018-19

	Labor income (thousands)	Non-labor income (thousands)	Total income (thousands)	Sales (thousands)	Jobs supported
Initial effect	**$0**	**$0**	**$0**	**$80,969**	**0**
Multiplier effect					
Direct effect	$16,675	$10,242	$26,917	$48,950	815
Indirect effect	$3,495	$2,124	$5,619	$10,465	174
Induced effect	$6,158	$3,784	$9,942	$17,876	297
Total multiplier effect	**$26,328**	**$16,150**	**$42,478**	**$77,291**	**1,285**
Total impact (initial + multiplier)	**$26,328**	**$16,150**	**$42,478**	**$158,260**	**1,285**

Source: Emsi impact model.

Student spending impact

Both in-state and out-of-state students contribute to the student spending impact of MSU; 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 MSU, 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 Mississippi economy regardless of MSU. In addition, only the out-of-state students who relocated to Mississippi 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 21,679 students attending MSU who originated from Mississippi (not including personal enrichment students and dual credit high school students),[13] not all of them would have remained in the state if not for the existence of MSU. We apply a conservative assumption that 10% of these students would have left Mississippi for other education opportunities if MSU did not exist.[14] Therefore, we recognize that the in-state spending of 2,168 students retained in the state is attributable to MSU. 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

13 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.

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

estimate 297 lived on campus while attending the university. While these students spend money 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 MSU's student spending impact. An estimated 2,218 students came from outside the state and lived off campus while attending MSU in FY 2018-19. Another estimated 2,011 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.[15]

The average costs for students appear in the first section of Table 2.14, equal to $15,107 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 $15,107 in annual costs by the 4,088 students who either were retained or relocated to the state because of MSU 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

TABLE 2.14: AVERAGE STUDENT COSTS AND TOTAL SALES GENERATED BY RELOCATED AND RETAINED STUDENTS IN MISSISSIPPI, FY 2018-19

Room and board	$9,815
Personal expenses	$3,420
Transportation	$1,872
Total expenses per student	**$15,107**
Number of students retained	2,168
Number of students relocated	4,228
Gross retained student sales	$30,560,677
Gross relocated student sales	$49,076,734
Total gross off-campus sales	**$79,637,410**
Wages and salaries paid to student workers*	$2,930,991
Net off-campus sales	**$76,706,419**

* 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 MSU. 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 MSU. The data are based on all students.

15 Online students and students who commuted to Mississippi 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.

per-student cost of personal expenses, transportation, and off-campus food purchases (assumed to be equal to 25% of room and board) by the number of students who lived in the state but on campus while attending (2,308 students). Altogether, off-campus spending of relocated and retained students generated gross sales of $79.6 million. This figure, once net of the monies paid to student workers, yields net off-campus sales of $76.7 million, as shown in the bottom row of Table 2.14.

Estimating the impacts generated by the $76.7 million in student spending follows a procedure similar to that of the operations impact described above. We distribute the $76.7 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.

The total impact of student spending is **$45 million** *in total added income and is equivalent to supporting* **1,115 jobs**.

Table 2.15 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 $28.8 million in labor income and $16.2 million in non-labor income. This sums together to $45 million in total added income and is equivalent to supporting 1,115 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.

TABLE 2.15: STUDENT SPENDING IMPACT, FY 2018-19

	Labor income (thousands)	Non-labor income (thousands)	Total income (thousands)	Sales (thousands)	Jobs supported
Initial effect	**$0**	**$0**	**$0**	**$76,706**	**0**
Multiplier effect					
Direct effect	$18,288	$10,222	$28,510	$51,021	708
Indirect effect	$3,664	$2,119	$5,783	$10,746	151
Induced effect	$6,861	$3,822	$10,683	$18,760	256
Total multiplier effect	**$28,813**	**$16,163**	**$44,976**	**$80,527**	**1,115**
Total impact (initial + multiplier)	**$28,813**	**$16,163**	**$44,976**	**$157,234**	**1,115**

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 MSU *throughout its history.* We then use this total number to consider the impact of those students in the single FY 2018-19. 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.

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

While MSU creates an economic impact through its operations, research, construction, Extension, CAVS-E, entrepreneurial, visitor, and student spending, the greatest economic impact of MSU stems from the added human capital—the knowledge, creativity, imagination, and entrepreneurship—found in its alumni. While attending MSU, 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 MSU alumni enjoy the fruits of this increased productivity in the form of additional non-labor income (i.e., higher profits).

The methodology here differs from the previous 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 MSU'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 MSU.

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;[16] 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 2018-19.

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 2018-19 was 21.2. 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 1989-90 to FY 2018-19.[17] We multiply the 21.2 average CHEs per student by the headcounts that we estimate are still actively employed from each of the previous years.[18] 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 6.9 million CHEs from alumni active in the workforce.

Next, we estimate the value of the CHEs, or the skills and human capital acquired by MSU 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 MSU alumni and the alternative wage they would have earned had they not attended MSU. Using the state incremental earnings, credits required, and distribution of credits at each level

16 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.

17 We apply a 30-year time horizon because the data on students who attended MSU prior to FY 1989-90 is less reliable, and because most of the students served more than 30 years ago had left the state workforce by FY 2018-19.

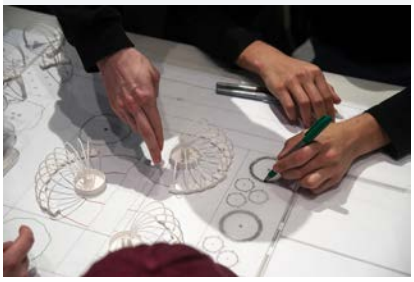
18 This assumes the average credit load and level of study from past years is equal to the credit load and level of study of students today.

Actively meeting the state workforce demands

Seeking to close the skills gap for qualified software development programmers in the state, MSU is partnering with telecommunications company C Spire to create hundreds of new student academic and computer science career opportunities.

With Mississippi's only accredited programs in veterinary medicine and architecture, MSU is the state's primary source of professionals in these fields. MSU is also a leading source of individuals with degrees in agriculture and engineering.

MSU also offers the state's only petroleum engineering degree program in response to a high demand from industry for graduates with experience in drilling, production, petroleum economics, and reservoir engineering.



of study, we estimate the average value per CHE to equal $147. This value represents the state average incremental increase in wages that alumni of MSU 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 2018-19, 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 billion in gross labor income from increased wages received by former students in FY 2018-19 (as shown in Table 2.16).

TABLE 2.16: NUMBER OF CHES IN WORKFORCE AND INITIAL LABOR INCOME CREATED IN MISSISSIPPI, FY 2018-19

Number of CHEs in workforce	6,877,658
Average value per CHE	$147
Initial labor income, gross	**$1,008,511,403**
Adjustments for counterfactual scenarios	
Percent reduction for alternative education opportunities	15%
Percent reduction for adjustment for labor import effects	50%
Initial labor income, net	**$428,617,346**

Source: Emsi impact model.

The next two rows in Table 2.16 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 MSU 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 MSU does not exist, we assume a portion of MSU 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 MSU alumni. The adjustment for alternative education opportunities amounts to a 15% reduction of the $1 billion in added labor income. This means that 15% of the added labor income from MSU 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 2.16 accounts for the importation of labor. Suppose MSU 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 Mississippi. 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.[19] 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 $428.6 million, as shown in Table 2.16.

The $428.6 million in added labor income appears under the initial effect in the labor income column of Table 2.17. To this we add an estimate for initial non-labor income. As discussed earlier in this section, businesses that employ former students of MSU 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 ($428.6 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.[20] 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 $428.6 million in initial labor income effects to the detailed industry sectors in the MR-SAM model.[21]

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

20 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).

21 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.

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 $203.7 million in added non-labor income attributable to the university's alumni. Summing initial labor and non-labor income together provides the total initial effect of alumni productivity in the Mississippi economy, equal to approximately $632.3 million. To estimate multiplier effects, we convert the industry-specific income figures generated through the initial effect to sales using sales-to-income ratios from the MR-SAM model. We then run the values through the MR-SAM's multiplier matrix.

Table 2.17 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 $211.6 million in added labor income and $91.9 million in added non-labor income, for an overall total of $303.5 million in multiplier effects. The grand total of the alumni impact is $935.8 million in total added income, the sum of all initial and multiplier labor and non-labor income effects. This is equivalent to supporting 13,024 jobs.

2019 Top 50 Alma Mater

MSU is listed as a U.S. "2019 Top 50 Alma Mater" for education graduates earning the distinction of National Board Certified Teacher (NBCT). Making the announcement, the National Board for Professional Teaching Standards ranks MSU 14th for total number of NBCTs. Currently, 914 NBCTs are MSU graduates. With its World Class Teaching Program, MSU is among five of the state's Institutions of Higher Learning training teachers in pursuit of National Board Certification. In Mississippi, a 2017 MSU study showed that kindergarten and third-grade students with a NBCT in reading on average perform at a significantly higher level on literacy assessments than peers.

TABLE 2.17: ALUMNI IMPACT, FY 2018-19

	Labor income (thousands)	Non-labor income (thousands)	Total income (thousands)	Sales (thousands)	Jobs supported
Initial effect	**$428,617**	**$203,698**	**$632,316**	**$1,935,656**	**8,516**
Multiplier effect					
Direct effect	$47,368	$25,360	$72,728	$175,335	1,008
Indirect effect	$11,880	$6,178	$18,058	$43,389	258
Induced effect	$152,307	$60,376	$212,684	$489,170	3,242
Total multiplier effect	**$211,555**	**$91,914**	**$303,469**	**$707,894**	**4,507**
Total impact (initial + multiplier)	**$640,173**	**$295,613**	**$935,785**	**$2,643,550**	**13,024**

Source: Emsi impact model.

Total MSU impact

The total economic impact of MSU on Mississippi can be generalized into two broad types of impacts. First, on an annual basis, MSU generates a flow of spending that has a significant impact on the state economy. The impacts of this spending are captured by the operations, research, construction, Extension, CAVS-E, entrepreneurial, visitor, and student spending impacts. While not insignificant, these impacts do not capture the true purpose of MSU. The basic mission of MSU is to foster human capital. Every year, a new cohort of former MSU students adds to the stock of human capital in the state, and a portion of alumni continues to add to the state economy. Table 2.18 displays the grand total impacts of MSU on the Mississippi economy in FY 2018-19. For context, the percentages of MSU compared to the total labor income, total non-labor income, combined total income, sales, and jobs in Mississippi, as presented in Table 1.3 and Figure 1.3, are included. The total added value of MSU is **$1.8 billion**, equivalent to **1.6%** of the GSP of Mississippi. MSU's total impact supported **29,016 jobs** in FY 2018-19. For perspective, this means that **one out of every 55 jobs** in Mississippi is supported by the activities of MSU and its students.

TABLE 2.18: TOTAL MSU IMPACT, FY 2018-19

	Labor income (thousands)	Non-labor income (thousands)	Total income (thousands)	Sales (thousands)	Jobs supported
Operations spending	$304,492	-$7,191	$297,301	$299,870	4,028
Research spending	$193,335	$19,753	$213,088	$367,368	3,306
Construction spending	$16,754	-$1,971	$14,783	$53,444	320
Extension	$189,632	$55,649	$245,281	$670,546	4,889
CAVS-E	$22,776	$9,782	$32,558	$83,660	756
Start-up and spin-off companies	$15,725	$5,047	$20,771	$39,214	293
Visitor spending	$26,328	$16,150	$42,478	$158,260	1,285
Student spending	$28,813	$16,163	$44,976	$157,234	1,115
Alumni	$640,173	$295,613	$935,785	$2,643,550	13,024
Total impact	**$1,438,027**	**$408,995**	**$1,847,022**	**$4,473,145**	**29,016**
% of the Mississippi economy	2.1%	0.9%	1.6%	1.6%	1.8%

Source: Emsi impact model.

These impacts from the university and its students stem from different industry sectors and spread throughout the state economy. Table 2.19 displays the total impact of MSU by each industry sector based on their two-digit NAICS code. The table shows the total impact of operations, research, construction, Extension, CAVS-E, start-up and spin-off companies, visitors, students, and alumni, as shown in Table 2.18, 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 MSU alumni are employed. For example, MSU's spending and alumni in the Agriculture, Forestry, Fishing, & Hunting industry sector generated an impact of $282.8 million in FY 2018-19.

TABLE 2.19: TOTAL MSU IMPACT BY INDUSTRY, FY 2018-19

Industry sector	Total income (thousands)	Jobs supported
Government, Education	$543,353	7,870
Agriculture, Forestry, Fishing, & Hunting	$282,754	5,608
Manufacturing	$218,946	1,624
Government, Non-Education	$168,146	2,011
Professional & Technical Services	$115,250	1,839
Health Care & Social Assistance	$92,378	1,972
Retail Trade	$59,052	1,286
Accommodation & Food Services	$57,996	1,898
Construction	$52,153	986
Utilities	$44,441	101
Finance & Insurance	$37,599	323
Information	$36,972	281
Wholesale Trade	$25,377	173
Administrative & Waste Services	$22,360	712
Management of Companies & Enterprises	$21,317	217
Real Estate & Rental & Leasing	$14,723	342
Transportation & Warehousing	$14,032	165
Arts, Entertainment, & Recreation	$11,964	811
Other Services (except Public Administration)	$11,593	473
Educational Services	$8,737	269
Mining, Quarrying, & Oil and Gas Extraction	$7,879	54
Total impact	**$1,847,022**	**29,016**

Source: Emsi impact model.

CHAPTER 3:

Investment Analysis

The benefits generated by MSU 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 Mississippi benefit from an enlarged economy and a reduced demand for social services. In the form of increased tax revenues and public sector savings, the benefits of education extend as far as the state and local government.

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

STUDENT COSTS

Out-of-Pocket Expenses

Opportunity Costs

STUDENT BENEFITS

Higher Earnings from 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 $190.7 million from Figure 1.1. Direct outlays also include the cost of books and supplies. On average, full-time students spent $1,200 each on books and supplies during the reporting year.[22] Multiplying this figure by the number of full-time equivalents (FTEs) produced by MSU in FY 2018-19[23] generates a total cost of $15.7 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 2018-19, students received a total of $59 million in federal loans to attend MSU.[24] 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 $59 million in federal loans is subtracted from the costs incurred by students in FY 2018-19.

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.

22 Based on the data provided by MSU.

23 A single FTE is equal to 30 CHEs for undergraduate students and 24 CHEs for graduate students, so there were 21,061 FTEs produced by students in FY 2018-19, equal to 627,013 CHEs divided by 30 (excluding personal enrichment students).

24 Due to data limitations, only federal loans are considered in this analysis.

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.[25] 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 (23) to better reflect their wages at their current age.[26] This calculation yields an average full earning potential of $18,117 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 MSU earned an average of 21.2 CHEs per student (excluding personal enrichment students and dual credit high school students), which is approximately equal to 74% of a full academic year.[27] We thus include no more than $13,339 (or 74%) 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 47% of students are employed.[28] For the remainder of students, we assume that they are either seeking work or planning to seek work once they complete their educational goals (with the exception of personal enrichment students, who are not included in this calculation). By choosing to enroll, therefore, non-working students give up everything that they can potentially earn during the academic year (i.e., the $13,339). The total value of their foregone earnings thus comes to $210.4 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 72% of what they would have earned had they chosen to work full-time rather than go to college.[29] The remaining 28% comprises the percentage of

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

26 Further discussion on this adjustment appears in Appendix 6.

27 Equal to 21.2 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.

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

29 The 72% 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).

their full earning potential that they forego. Obviously this assumption varies by person; some students forego more and others less. Since we do not know the actual jobs that students hold while attending, the 28% 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.[30] 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 $63.8 million, equal to the sum of their foregone earnings ($51.6 million) and foregone leisure time ($12.1 million).

Thus far we have discussed student costs during the analysis year. However, recall that 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 $59 million in loans was awarded to 8,683 students, averaging $6,799 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 MSU is a four-year university, students will be indebted four times that amount, or $27,195 on average. According to the U.S. Department of Education, this level of indebtedness will take 20 years to pay back under the standard repayment plan.[31]

This indebtedness calculation is used solely to estimate the loan payback period. Students will be paying back the principal amount of $59 million over time. After taking into consideration the time value of money, this means that students will pay off a discounted present value of $33.7 million in principal over the 20 years. In order to calculate interest, we only consider interest on the federal loans awarded to students in FY 2018-19. Using the student discount rate of 5.1%[32] as our interest rate, we calculate that students will pay a total discounted present value of $24.5 million in interest on student loans throughout

30 "Charts by Topic: Leisure and Sports Activities," American Time Use Survey, Last modified December 2016. http://www.bls.gov/tus/charts/leisure.htm.

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

32 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 – May 2019 Baseline. https://www.cbo.gov/system/files?file=2019-05/51310-2019-05-studentloan.pdf.

the first 20 years of their working lifetime. The stream of these future interest 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 $147.2 million, the sum of tuition and fees ($190.7 million) and books and supplies ($15.7 million), less federal loans received ($59 million) and $175.8 thousand in direct outlays of personal enrichment students (those students are excluded from the cost calculations). Opportunity costs for working and non-working students amount to $244.3 million, excluding $29.8 million in offsetting residual aid that is paid directly to students.[33] Finally, we have the present value of future student loan costs, amounting to $58.3 million between principal and interest. Summing direct outlays, opportunity costs, and future student loan costs together yields a total of $449.8 million in present value student costs.

TABLE 3.1: PRESENT VALUE OF STUDENT COSTS, FY 2018-19 (THOUSANDS)

Direct outlays in FY 2018-19	
Tuition and fees	$190,693
Less federal loans received	-$59,033
Books and supplies	$15,682
Less direct outlays of personal enrichment students	-$176
Total direct outlays	**$147,167**
Opportunity costs in FY 2018-19	
Earnings foregone by non-working students	$210,412
Earnings foregone by working students	$51,637
Value of leisure time foregone by working students	$12,129
Less residual aid	-$29,842
Total opportunity costs	**$244,337**
Future student loan costs (present value)	
Student loan principal	$33,749
Student loan interest	$24,510
Total present value student loan costs	**$58,259**
Total present value student costs	**$449,762**

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

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

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 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 2018-19 students first by determining their average annual increase in earnings, equal to $103.8 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 Mississippi earnings, the marginal wage increase per CHE is $166. For a full description of the methodology used to derive the $103.8 million, see Appendix 6.

The second step is to project the $103.8 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.[34] 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 $103.8 million representing the students' higher earnings at the midpoint of their careers, we apply scalars from the Mincer function to yield a stream of projected future benefits that gradually increase from the time students enter the workforce, peak shortly after the career midpoint, and then dampen slightly as students approach retirement at age 67. This earnings stream appears in Column 2 of Table 3.2.

34 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	$38.0	22%	$8.3	$391.5	-$383.2
1	$41.3	32%	$13.4	$4.7	$8.7
2	$44.7	41%	$18.2	$4.7	$13.5
3	$48.3	55%	$26.4	$4.7	$21.7
4	$52.0	74%	$38.4	$4.7	$33.7
5	$55.9	97%	$54.0	$4.7	$49.3
6	$59.9	96%	$57.8	$4.7	$53.1
7	$64.0	96%	$61.7	$4.7	$57.0
8	$68.2	96%	$65.6	$4.7	$60.9
9	$72.5	96%	$69.7	$4.7	$65.0
10	$76.8	96%	$73.8	$4.7	$69.1
11	$81.3	96%	$78.0	$4.7	$73.3
12	$85.8	96%	$82.2	$4.7	$77.5
13	$90.3	96%	$86.4	$4.7	$81.7
14	$94.8	96%	$90.6	$4.7	$85.9
15	$99.3	95%	$94.8	$4.7	$90.1
16	$103.8	95%	$98.9	$4.7	$94.2
17	$108.3	95%	$103.0	$4.7	$98.3
18	$112.7	95%	$107.0	$4.7	$102.3
19	$117.0	95%	$110.9	$4.7	$106.2
20	$121.2	95%	$114.6	$4.7	$109.9
21	$125.3	94%	$118.2	$0.0	$118.2
22	$129.2	94%	$121.6	$0.0	$121.6
23	$133.0	94%	$124.9	$0.0	$124.9
24	$136.6	94%	$127.9	$0.0	$127.9
25	$140.0	93%	$130.6	$0.0	$130.6
26	$143.1	93%	$133.1	$0.0	$133.1
27	$146.0	93%	$135.3	$0.0	$135.3
28	$148.7	92%	$137.2	$0.0	$137.2
29	$151.1	92%	$138.7	$0.0	$138.7
30	$153.2	91%	$139.9	$0.0	$139.9
31	$155.1	91%	$140.8	$0.0	$140.8
32	$156.6	90%	$141.3	$0.0	$141.3
33	$157.8	90%	$141.5	$0.0	$141.5
34	$158.8	89%	$141.3	$0.0	$141.3
35	$159.4	88%	$140.7	$0.0	$140.7
36	$159.6	88%	$139.8	$0.0	$139.8
37	$159.6	87%	$138.5	$0.0	$138.5
38	$159.2	86%	$136.8	$0.0	$136.8
39	$158.5	85%	$134.9	$0.0	$134.9
40	$157.5	84%	$132.5	$0.0	$132.5
41	$156.3	83%	$129.9	$0.0	$129.9
42	$154.7	82%	$127.0	$0.0	$127.0
43	$152.8	81%	$123.7	$0.0	$123.7
Present value			**$1,467.6**	**$449.8**	**$1,017.8**

Internal rate of return	Benefit-cost ratio	Payback period (no. of years)
13.8%	3.3	9.3

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

Source: Emsi impact model.

As shown in Table 3.2, the $103.8 million in gross higher earnings occurs around Year 16, which is the approximate midpoint of the students' future working careers given the average age of the student population and an assumed retirement age of 67. In accordance with the Mincer function, the gross higher earnings that accrue to students in the years leading up to the midpoint are less than $103.8 million and the gross higher earnings in the years after the midpoint are greater than $103.8 million.

The final step in calculating the students' future benefits stream is to net out the potential benefits generated by students who are either not yet active in the workforce or who leave the workforce over time. This adjustment appears in Column 3 of Table 3.2 and represents the percentage of the FY 2018-19 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.[35] 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 5.1% (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.[36]

35 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.

36 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 – May 2019 Baseline. https://www.cbo.gov/system/files?file=2019-05/51310-2019-05-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 5.1% discount rate from the student perspective and a 1.5% discount rate from the perspectives of taxpayers and society.

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 1.0, a rate of return that exceeds the discount rate, and a reasonably short payback period.

In Table 3.2, the net higher earnings of students yield a cumulative discounted sum of approximately $1.5 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 2018-19 student body is rewarded for its investment in MSU with a capital asset valued at $1.5 billion.

The students' cost of attending the university is shown in Column 5 of Table 3.2, equal to a present value of $449.8 million. Comparing the cost with the present value of benefits yields a student benefit-cost ratio of 3.3 (equal to $1.5 billion in benefits divided by $449.8 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.[37] Table 3.2 shows students of MSU earning average returns of 13.8% 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).

MSU students see an average rate of return of **13.8%** *for their investment of time and money.*

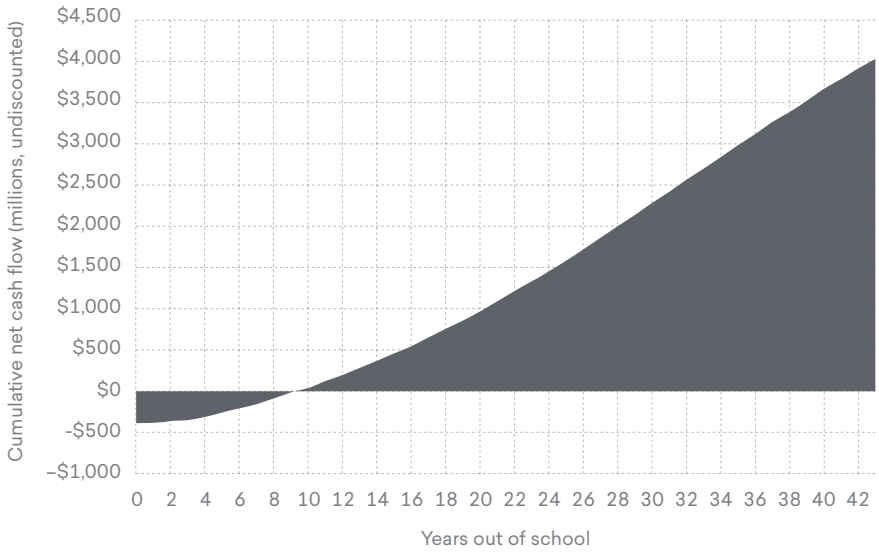
Note that returns reported in this study are real returns, not nominal. When a bank promises to pay a certain rate of interest on a savings account, it employs an implicitly nominal rate. Bonds operate in a similar manner. If it turns out that the inflation rate is higher than the stated rate of return, 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 13.8% 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

37 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.

Price Index), the corresponding nominal rate of return is 15.9%, 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.[38] Beyond that point, returns are what economists would call pure costless rent. As indicated in Table 3.2, students at MSU see, on average, a payback period of 9.3 years, meaning 9.3 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.

38 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.

Taxpayer perspective

From the taxpayer perspective, the pivotal step is to determine the public benefits that specifically accrue to state and local government. For example, benefits resulting from earnings growth are limited to increased state and local 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 and local government. In all instances, benefits to private residents, local businesses, or the federal government are excluded.

TAXPAYER COSTS

State/Local Funding

TAXPAYER BENEFITS

Increased Tax Revenue

Avoided Costs to State/Local Government

Growth in state tax revenues

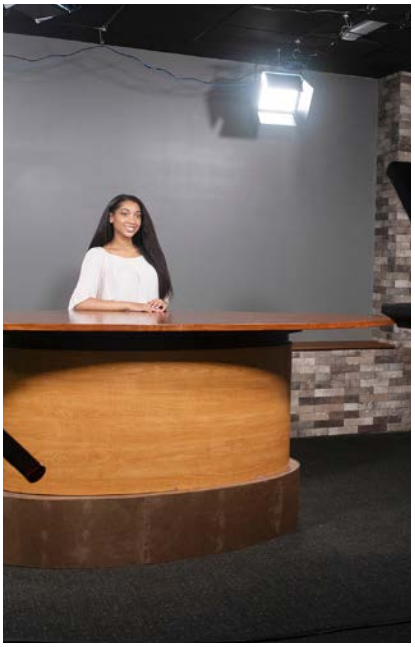
As a result of their time at MSU, students earn more because of the skills they learned while attending the university, and businesses earn more because student skills make capital more productive (buildings, machinery, and everything else). This in turn raises profits and other business property income. 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 and local government is able to apply tax rates to higher earnings.

Estimating the effect of MSU 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 these net higher earnings, 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.[39] 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 Mississippi 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 2018-19 from operations, research, construction, visitor, and student spending, measured at the state level. To each of these, we apply the prevailing tax rates so we capture only the tax revenues attributable to state and local 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.

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

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 MSU 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 and local 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 and local government funding for MSU did not exist and MSU had to derive the revenue elsewhere. To estimate this shutdown point, we apply a submodel that simulates the students' demand curve for education by reducing state and local support to zero and progressively increasing student tuition and fees. As student tuition and fees increase, enrollment declines. For MSU, 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 $393.6 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 1.5%. 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.[40]

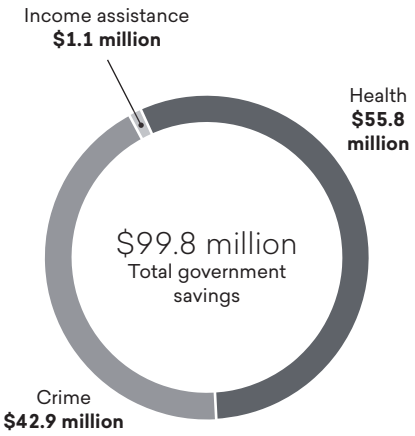
Government savings

In addition to the creation of higher tax revenues to the state and local government, education is statistically associated with a variety of lifestyle changes

40 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 May 2019. https://www.whitehouse.gov/wp-content/uploads/2018/12/Discount-History.pdf.

that generate social savings, also known as external or incidental benefits of education. These represent the avoided costs to the government that otherwise would have been drawn from public resources absent the education provided by MSU. 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 and local 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.

FIGURE 3.2: PRESENT VALUE OF GOVERNMENT SAVINGS



Source: Emsi impact model.

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.[41] 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 $99.8 million.

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

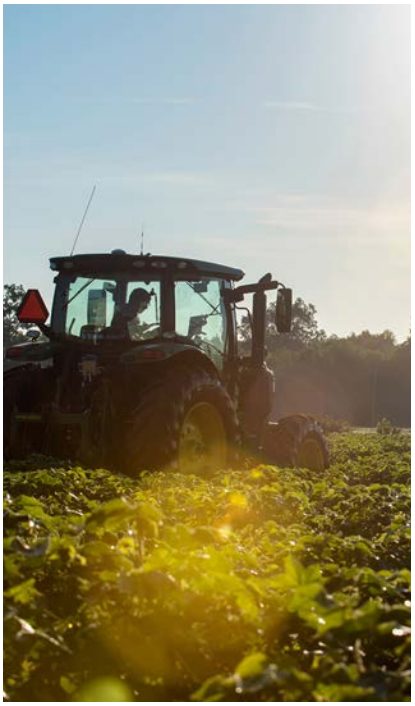
Table 3.3 displays all benefits to taxpayers. The first row shows the added tax revenues created in the state, equal to $393.6 million, from students' higher earnings, increases in non-labor income, and spending impacts. The sum of the government savings and the added income in the state is $493.4 million, as shown in the bottom row of Table 3.3. These savings continue to accrue in the future as long as the FY 2018-19 student population of MSU remains in the workforce.

41 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	**$393,617**
Government savings	
Health-related savings	$55,789
Crime-related savings	$42,895
Income assistance savings	$1,115
Total government savings	**$99,799**
Total taxpayer benefits	**$493,416**

Source: Emsi impact model.



In addition to the taxpayer benefits calculated in this report, MSU benefits taxpayers by using university expertise and resources to support the needs of state agencies. For example, MSU is home to the Mississippi State Chemical Laboratory, which supports the Mississippi Department of Agriculture and Commerce by providing the analytical data to ensure the quality, accurate labeling, and safety of all fertilizers, animal feeds, human foods, pesticides, and petroleum products sold in the State of Mississippi.

Return on investment for taxpayers

Taxpayer costs are reported in Table 3.4 and come to $212.1 million, equal to the contribution of state and local government to MSU. In return for their public support, taxpayers are rewarded with an investment benefit-cost ratio of 2.3 (= $493.4 million ÷ $212.1 million), indicating a profitable investment.

At 7.2%, the rate of return to state and local taxpayers is favorable. Given that the stakeholder in this case is the public sector, we use the discount rate of 1.5%, the real treasury interest rate recommended by the Office of Management and Budget for 30-year investments.[42] 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 1.5% would mean that the university just pays its own way. In principle, governments could borrow monies used to support MSU and repay the loans out of the resulting added taxes and reduced government expenditures. A rate of return of 7.2%, on the other hand, means that MSU not only pays its own way, but also generates a surplus that the state and local government can use to fund other programs. It is unlikely that other government programs could make such a claim.

*A rate of return of **7.2%** means that MSU not only pays its own way, but also generates a surplus that the state and local government can use to fund other programs.*

42 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 May 2019. 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 and local gov't costs (millions)	Net cash flow (millions)
0	$62.2	$212.1	-$149.9
1	$3.0	$0.0	$3.0
2	$3.9	$0.0	$3.9
3	$5.4	$0.0	$5.4
4	$7.6	$0.0	$7.6
5	$10.2	$0.0	$10.2
6	$10.6	$0.0	$10.6
7	$10.9	$0.0	$10.9
8	$11.2	$0.0	$11.2
9	$11.6	$0.0	$11.6
10	$11.9	$0.0	$11.9
11	$12.3	$0.0	$12.3
12	$12.7	$0.0	$12.7
13	$13.1	$0.0	$13.1
14	$13.5	$0.0	$13.5
15	$13.9	$0.0	$13.9
16	$14.3	$0.0	$14.3
17	$14.7	$0.0	$14.7
18	$15.0	$0.0	$15.0
19	$15.4	$0.0	$15.4
20	$15.7	$0.0	$15.7
21	$16.0	$0.0	$16.0
22	$16.3	$0.0	$16.3
23	$16.6	$0.0	$16.6
24	$16.8	$0.0	$16.8
25	$17.0	$0.0	$17.0
26	$17.2	$0.0	$17.2
27	$17.4	$0.0	$17.4
28	$17.5	$0.0	$17.5
29	$17.6	$0.0	$17.6
30	$17.6	$0.0	$17.6
31	$17.6	$0.0	$17.6
32	$17.6	$0.0	$17.6
33	$17.5	$0.0	$17.5
34	$17.4	$0.0	$17.4
35	$17.3	$0.0	$17.3
36	$17.1	$0.0	$17.1
37	$16.9	$0.0	$16.9
38	$16.6	$0.0	$16.6
39	$16.3	$0.0	$16.3
40	$16.0	$0.0	$16.0
41	$15.6	$0.0	$15.6
42	$15.3	$0.0	$15.3
43	$14.9	$0.0	$14.9
Present value	**$493.4**	**$212.1**	**$281.3**

Internal rate of return	Benefit-cost ratio	Payback period (no. of years)
7.2%	2.3	14.9

Source: Emsi impact model.

Social perspective

Mississippi benefits from the education that MSU 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 MSU did not exist. Society's investment in MSU stretches across a number of investor groups, from students to employers to taxpayers. We weigh the benefits generated by MSU to these investor groups against the total social costs of generating those benefits. The total social costs include all MSU expenditures, all student expenditures (including interest on student loans) less tuition and fees, and all student opportunity costs, totaling a present value of $996.4 million.

On the benefits side, any benefits that accrue to Mississippi as a whole—including students, employers, taxpayers, and anyone else who stands to benefit from the activities of MSU—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.

SOCIAL COSTS

MSU Expenditures

Student Out-of-Pocket Expenses

Student Opportunity Costs

SOCIAL BENEFITS

Increased State Earnings

Avoided Costs to Society

Growth in state economic base

In the process of absorbing the newly acquired skills of students who attend MSU, not only does the productivity of the Mississippi 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 MSU on the state's economic base follows a similar 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. First, we calculate the students' future higher earnings stream. We factor in student attrition and alternative education opportunities to arrive at net higher earnings. We again apply multipliers derived from Emsi's MR-SAM model to estimate the added labor and non-labor income created in the state as students and businesses spend

their higher earnings and as businesses generate additional profits from this increased output. We also include the operations, research, construction, visitor, and student spending impacts discussed in Chapter 2 that were created in FY 2018-19, measured at the state level. The shutdown point does not apply to the growth of the economic base because the social perspective captures not only the state and local taxpayer support to the university, but also the support from the students and other non-government sources.

Using this process, we calculate the present value of the future added income that occurs in the state, equal to $3.9 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 1.5%.

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 MSU. 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 $3.9 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. These savings amount to $294.2 million. Crime savings amount to $53 million, including savings associated with a reduced number of crime victims, added worker productivity, and reduced expenditures for police and law enforcement, courts and administration of justice, and

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.

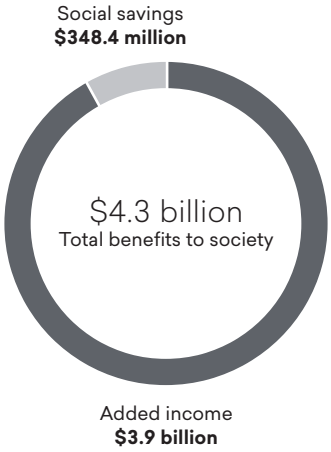
corrective services. Finally, the present value of the savings related to income assistance amount to $1.1 million, stemming from a reduced number of persons in need of welfare or unemployment benefits. All told, social savings amounted to $348.4 million in benefits to communities and citizens in Mississippi.

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

Increased economic base	**$3,925,003**
Social savings	
Health	
Smoking	$97,314
Alcohol dependence	$51,562
Obesity	$74,964
Depression	$55,967
Drug abuse	$14,396
Total health savings	**$294,202**
Crime	
Criminal justice system savings	$41,848
Crime victim savings	$2,016
Added productivity	$9,171
Total crime savings	**$53,034**
Income assistance	
Welfare savings	$601
Unemployment savings	$513
Total income assistance savings	**$1,115**
Total social savings	**$348,351**
Total, increased economic base + social savings	**$4,273,355**

* 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 $4.3 billion, as shown in the bottom row of Table 3.5 and in Figure 3.3. These savings accrue in the future as long as the FY 2018-19 student population of MSU remains in the workforce.

Return on investment for society

Table 3.6 presents the stream of benefits accruing to the Mississippi 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 4.3. This means that for every dollar invested in an education from MSU, whether it is the money spent on operations of the university or money spent

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	$632.6	$915.8	-$283.2
1	$21.5	$4.7	$16.8
2	$28.3	$4.7	$23.6
3	$40.0	$4.7	$35.3
4	$57.0	$4.7	$52.3
5	$78.2	$4.7	$73.5
6	$81.6	$4.7	$76.9
7	$85.0	$4.7	$80.3
8	$88.6	$4.7	$83.9
9	$92.2	$4.7	$87.5
10	$96.0	$4.7	$91.3
11	$99.9	$4.7	$95.2
12	$104.0	$4.7	$99.3
13	$108.1	$4.7	$103.4
14	$112.1	$4.7	$107.4
15	$116.0	$4.7	$111.4
16	$119.9	$4.7	$115.2
17	$123.7	$4.7	$119.0
18	$127.4	$4.7	$122.7
19	$130.9	$4.7	$126.2
20	$134.2	$4.7	$129.5
21	$137.4	$0.0	$137.4
22	$140.3	$0.0	$140.3
23	$143.0	$0.0	$143.0
24	$145.5	$0.0	$145.5
25	$147.7	$0.0	$147.7
26	$149.6	$0.0	$149.6
27	$151.2	$0.0	$151.2
28	$152.4	$0.0	$152.4
29	$153.3	$0.0	$153.3
30	$153.9	$0.0	$153.9
31	$154.1	$0.0	$154.1
32	$154.0	$0.0	$154.0
33	$153.5	$0.0	$153.5
34	$152.6	$0.0	$152.6
35	$151.4	$0.0	$151.4
36	$149.8	$0.0	$149.8
37	$147.9	$0.0	$147.9
38	$145.6	$0.0	$145.6
39	$143.0	$0.0	$143.0
40	$140.1	$0.0	$140.1
41	$136.9	$0.0	$136.9
42	$133.5	$0.0	$133.5
43	$129.7	$0.0	$129.7
Present value	**$4,273.4**	**$996.4**	**$3,276.9**

Benefit-cost ratio	Payback period (no. of years)
4.3	6.1

Source: Emsi impact model.

by students on tuition and fees, an average of $4.30 in benefits will accrue to society in Mississippi.[43]

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 MSU. 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 MSU. 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 1.5%), confirming that taxpayers receive value from investing in MSU.

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

	Including social savings	Excluding social savings
Taxpayer perspective		
Net present value (millions)	$281.3	$181.5
Benefit-cost ratio	2.3	1.9
Internal rate of return	7.2%	5.3%
Payback period (no. of years)	14.9	20.1
Social perspective		
Net present value (millions)	$3,276.9	$2,928.6
Benefit-cost ratio	4.3	3.9

Source: Emsi impact model.

MSU's benefits beyond the state

Not quantitatively measured in this analysis but nonetheless important is MSU's work on solving hunger and poverty. MSU researchers are using unmanned aerial systems, advanced irrigation techniques, and other technologies to help Mississippi farmers increase crop yields.

Scientists in MSU's Fish Innovation Lab continue to work with partners in developing countries on projects to empower communities, improve the aquaculture sector, and make food systems more resilient and productive.

MSU is also actively supporting the production of poultry and timber, the state's top two agricultural products, through research and advisory roles. MSU Extension specialists are a key resource for poultry producers as they step up production to meet increased demand and keep grocery stores stocked. For the timber industry, Extension is retooling the Professional Logging Manager courses for online delivery so loggers can keep their training current and continue operating.

43 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 MSU's value to Mississippi 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 MSU'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 MSU generates a total economic impact of **$1.8 billion** in total added income for the state economy. This represents the sum of several different impacts, including the university's:

- Operations spending impact (**$297.3 million**);
- Research spending impact (**$213.1 million**);
- Construction spending impact (**$14.8 million**);
- Extension impact (**$245.3 million**);
- CAVS-E impact (**$32.6 million**);
- Start-up and spin-off company impact (**$20.8 million**);
- Visitor spending impact (**$42.5 million**);
- Student spending impact (**$45 million**); and
- Alumni impact (**$935.8 million**).

The total impact of $1.8 billion is equivalent to approximately **1.6%** of the total GSP of Mississippi and is equivalent to supporting **29,016 jobs**. For perspective, this means that **one out of every 55 jobs** in Mississippi is supported by the activities of MSU and its students.

One out of every 55 jobs *in Mississippi is supported by the activities of MSU and its students.*

Since MSU'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, MSU offers a benefit of **$3.30**, **$2.30**, and **$4.30**, respectively. These results indicate that MSU 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 Mississippi.

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 MSU.

Resources and References

Administration for Children and Families. "Fiscal Year 2016 TANF Financial Data." *Office of Family Assistance, TANF Financial Data*. 2018. https://www.acf.hhs.gov/ofa/resource/tanf-financial-data-fy-2016.

Arias, Elizabeth. "United States Life Tables, 2008." *National Vital Statistics Reports* 61, no. 3 (September 24, 2012). Hyattsville, MD: National Center for Health Statistics. http://www.cdc.gov/nchs/data/nvsr/nvsr61/nvsr61_03.pdf.

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

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

Bilkic, Natasa, Thomas Gries, and Margarethe Pilichowski. "Stay in School or Start Working? The Human Capital Investment Decision under Uncertainty and Irreversibility." *Labour Economics* 19, no. 5 (October 2012): 706-717.

Bureau of Economic Analysis. "Table 1.1.6. Real Gross Domestic Product, Chained Dollars." *GDP and Personal Income*. Last modified January 27, 2017. http://www.bea.gov/iTable/iTableHtml.cfm?reqid=9&step=3&isuri=1&903=6.

Bureau of Justice Statistics. "Table 2: Prisoners under the Jurisdiction of State or Federal Correctional Authorities, by Jurisdiction, December 31, 2015 and 2016. *Prisoners in 2016, NCJ 251149, 2018.* https://www.bjs.gov/content/pub/pdf/p16.pdf.

Bureau of Labor Statistics. "Charts by Topic: Leisure and Sports Activities." *American Time Use Survey*. December 2016. http://www.bls.gov/tus/charts/leisure.htm.

Bureau of Labor Statistics. "Charts by Topic: Students." *American Time Use Survey*. December 2016. https://www.bls.gov/tus/charts/students.htm.

Bureau of Labor Statistics. "Table 7. Employment status of the civilian noninstitutional population 25 years and over by educational attainment, sex, race, and Hispanic or Latino ethnicity." Current Population Survey, Labor Force Statistics, Household Data Annual Averages, 2017. http://www.bls.gov/cps/cpsaat07.pdf.

Bureau of Labor Statistics. "Table 24: Historical Consumer Price Index for all Urban Consumers (CPI-U): U.S. City Average, All Items." 2020. https://www.bls.gov/cpi/tables/supplemental-files/historical-cpi-u-201901.pdf.

Emsi

Emsi is a leading provider of economic impact studies and labor market data to educational institutions, workforce planners, and regional developers in the U.S. and internationally. Since 2000, Emsi has completed over 2,000 economic impact studies for educational institutions in three countries. Visit www.economicmodeling.com for more information about Emsi's products and services.

Buss, Christian, Jeffrey Parker, and Jon Rivenburg. "Cost, Quality and Enrollment Demand at Liberal Arts Colleges." *Economics of Education Review* 23, no. 1 (February 2004): 57-65.

Card, David. "The Causal Effect of Education on Earnings." *Handbook of Labor Economics* 3 (1999): 1801-1863.

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

Center on Budget and Policy Priorities. "Policy Basics - How Many Weeks of Unemployment are Available?" April 2018. https://www.cbpp.org/sites/default/files/atoms/files/policybasics-uiweeks.pdf.

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* [Data set]. https://www.cdc.gov/statesystem/cigaretteuseadult.html.

Centers for Disease Control and Prevention. "Heavy Drinkers (Adult Men Having More Than Two Drinks per Day and Adult Women Having More Than One Drink per Day)." *Alcohol Consumption - 2016 Behavioral Risk Factor Surveillance System Prevalence and Trends Data*. https://nccd.cdc.gov/BRFSSPrevalence/rdPage.aspx?rdReport=DPH_BRFSS.ExploreByTopic&irbLocationType=StatesAndMMSA&islClass=CLASS01&islTopic=TOPIC30&islYear=2016&islLocation=.

Centers for Disease Control and Prevention. "Table. Characteristics of Current Adult Cigarette Smokers." *National Health Interview Survey, United States, 2016*. https://www.cdc.gov/mmwr/volumes/67/wr/mm6702a1.htm#T1_down.

Centers for Medicare and Medicaid Services. "Table 16: National Health Expenditures, Amounts and Average Annual Growth from Previous Year Shown, by Type of Sponsor, Selected Calendar Years 2011-2027." *NHE Projections 2018-2027 – Tables*. February 2019. https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/NationalHealthAccountsProjected.html.

College Board. "Figure 1: Average Estimated Full-Time Undergraduate Budgets, 2018-19 (Enrollment-Weighted)." *The College Board, Annual Survey of Colleges, Average Estimated Undergraduate Budgets, 2018-19*. https://trends.collegeboard.org/college-pricing/figures-tables/average-estimated-undergraduate-budgets-2018-19.

Congressional Budget Office. "Table 4. Projection of Borrower Interest Rates: CBO's April 2018 Baseline." *Congressional Budget Office Publications CBO's April 2018 Baseline Projections for the Student Loan Program*. Last modified April 2018. https://www.cbo.gov/system/files?file=2018-06/51310-2018-04-studentloan.pdf.

Criminal Justice Expenditure and Employment Extracts Program. "Table 4. Justice System Expenditure by Character, State and Type of Government, Fiscal Year 2015" *Justice Expenditure and Employment Extracts 2015 (preliminary) NCJ 251780*. https://www.bjs.gov/index.cfm?ty=dcdetail&iid=286.

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

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

Emsi Labor Market Data and Software. www.economicmodeling.com.

Federal Bureau of Investigation, Criminal Justice Information Services Division. "Table 1: Crime in the United States." Crime in the United States 2016, Offenses Known to Law Enforcement. https://ucr.fbi.gov/crime-in-the-u.s/2016/crime-in-the-u.s.-2016/tables/table-1.

Federal Bureau of Investigation, Criminal Justice Information Services Division. "Table 18: Estimated Number of Arrests, United States, 2016" in "Uniform Crime Reports." Crime in the United States, 2016, Persons Arrested. https://ucr.fbi.gov/crime-in-the-u.s/2016/crime-in-the-u.s.-2016/tables/table-18.

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

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

Guerino, Paul, Paige M. Harrison, and William J. Sabol. "Prisoners in 2016." *Bureau of Justice Statistics* NCJ 236096, January 2018. https://www.bjs.gov/content/pub/pdf/p16.pdf.

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

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

Hernández-Murillo, Rubén, Lesli S. Ott, Michael T. Owyang, and Denise Whalen. "Patterns of Interstate Migration in the United States from the Survey of Income and Program Participation." *Federal Reserve Bank of St. Louis Review* 93, no. 3 (May/June 2011): 169-186. https://files.stlouisfed.org/files/htdocs/publications/review/11/05/169-186Hernandez.pdf.

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

Jamal Ahmed, Elyse Phillips, Andrea S. Gentzke, David M. Homa, Stephen D. Babb, Brian A. King, and Linda J. Neff. "Current Cigarette Smoking Among Adults – United States, 2016." *Morbidity and Mortality Weekly Report 2018* 67:53-59. DOI: http://dx.doi.org/10.15585/mmwr.mm6702a1.

Kaeding, Nicole. "State Individual Income Tax Rates and Brackets for 2019." *Tax Foundation Fiscal Fact* no. 500 (March 2019). https://taxfoundation.org/state-individual-income-tax-rates-brackets-2019.

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

Leigh, Andrew and Chris Ryan. "Estimating Returns to Education Using Different Natural Experiments Techniques." *Economics of Education Review* 27 (2008): 149-160.

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

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

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

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

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

National Center for Education Statistics. "Table 219.60 Number of People Taking the GED Test and Percentage Distribution of Those who Passed, by Age Group: 1971 through 2013." *Digest of Education Statistics.* 2015. https://nces.ed.gov/programs/digest/d15/tables/dt15_219.60.asp?current=yes.

National Center for Education Statistics. "Table 507.20 Participants in State-Administered Adult Basic Education, Secondary Education, and English as a Second Language Programs, by Type of Program and State or Jurisdiction: Selected Fiscal Years, 2000 through 2014." *Digest of Education Statistics.* 2015. https://nces.ed.gov/programs/digest/d15/tables/dt15_507.20.asp?current=yes.

National Center for Health Statistics. "Table 58. Normal Weight, Overweight, and Obesity Among Persons 20 Years of Age and Over, by Selected Characteristics: United States, Selected Years 1988-1994 through 2011-2014." *Centers for Disease Control and Prevention, Health, United States, 2015*. https://www.cdc.gov/nchs/data/hus/2015/058.pdf.

National Employment Law Project. "Unemployment Insurance: An Overview of the Challenges and Strengths of Today's System". 2016. https://waysandmeans.house.gov/wp-content/uploads/2016/09/20160907HR-Testimony-Conti.pdf.

National Survey on Drug Use and Health. "Table 19. Illicit Drug Use Disorder in the Past Year, by Age Group and State: Percentages, Annual Averages Based on 2015 and 2016 NSDUHs." *National Survey on Drug Use and Health: Model-Based Prevalence Estimates (50 States and the District of Columbia).* https://www.samhsa.gov/data/sites/default/files/NSDUHsaePercents2016/NSDUHsaePercents2016.pdf.

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." https://www.samhsa.gov/data/sites/default/files/NSDUH-DetTabs-2016/NSDUH-DetTabs-2016.pdf.

National Survey on Drug Use and Health. "Table 15: Major Depressive Episode in the Past Year, by age group and state: Percentages, annual averages, and P values from tests of differences between percentages, 2008-2009 and 2015-2016." https://www.samhsa.gov/data/sites/default/files/NSDUHsaeShortTermCHG2016/NSDUHsaeShortTermCHG2016.htm.

Nowotny, Kathryn, Ryan Masters, and Jason Boardman, 2016. "The relationship between education and health among incarcerated man and women in the United States" BMC Public Health. September 2016. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5009667/.

OECD. "Household Net Saving Rates: As a Percentage of Household Disposable Income." *OECD Factbook 2015-2016: Economic, Environmental and Social Statistics* (2016). http://dx.doi.org/10.1787/factbook-2015-19-en.

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.

Ogden, Cynthia L., Molly M. Lamb, Margaret D. Carroll, and Katherine M. Flegal. "Figure 3. Prevalence of Obesity among Adults Aged 20 Years and Over, by Education, Sex, and Race and Ethnicity: United States 2005-2008." *Obesity and Socioeconomic Status in Adults: United States 2005-2008, National Center for Health Statistics* no. 50. (2010).

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). https://www.cdc.gov/mmwr/volumes/66/wr/mm6650a1.htm?s_cid=mm6650a1_w#suggestedcitation.

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

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

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

Sacks, Gonzales, Bouchery, Tomedi, & Brewer (2015). 2010 National and State Costs of Excessive Alcohol Consumption. American Journal of Preventive Medicine, 49(5), E73-E79. https://www.ajpmonline.org/article/S0749-3797(15)00354-2/pdf/.

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

Social Security Administration. "Retirement Benefits." *Full Retirement Age*. May 2016. https://www.ssa.gov/pubs/EN-05-10035.pdf.

State of Obesity. "Adult Obesity in the United States." Adult Obesity Rate by State, 2016. https://stateofobesity.org/adult-obesity/.

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.* https://store.samhsa.gov/shin/content/SMA16-4975/SMA16-4975.pdf.

Substance Abuse and Mental Health Services Administration. "Table 5.4B - Illicit Drug Use Disorder in Past Year among Persons Aged 12 or Older, by Age Group and Demographic Characteristics: Percentages, 2015 and 2016" SAMSHA, Center for Behaviorial Health Statistics and Quality, National Survey on Drug Use and Health, 2015 and 2016. https://www.samhsa.gov/data/sites/default/files/NSDUH-DetTabs-2016/NSDUH-DetTabs-2016.htm#tab5-4B.

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. https://www.samhsa.gov/data/sites/default/files/NSDUH-DetTabs-2016/NSDUH-DetTabs-2016.htm#tab5-6A.

Supplemental Nutrition Assistance Program. "State Activity Report Fiscal Year 2016." *Food and Nutrition Service, Supplemental Nutrition Assistance Program, Program Accountability and Administration Division* (September 2017). https://fns-prod.azureedge.net/sites/default/files/snap/FY16-State-Activity-Report.pdf.

U.S. Census Bureau. "Annual Estimates of the Resident Population for Selected Age Groups by Sex: April 1, 2010 to July 1, 2015." *National Population by Characteristics Tables: 2010-2015*. December 2016. http://www.census.gov/data/tables/2015/demo/popest/nation-detail.html.

U.S. Census Bureau, Current Population Survey, 2017 Annual Social and Economic Supplement. "Table 1. General Mobility, by Race and Hispanic Origin, Region, Sex, Age, Relationship to Householder, Educational Attainment, Marital Status, Nativity, Tenure, and Poverty Status: 2016 to 2017." https://www.census.gov/data/tables/2017/demo/geographic-mobility/cps-2017.html.

U.S. Census Bureau. "Educational Characteristics of Prisoners: Data from the ACS." 2011. https://www.census.gov/library/working-papers/2011/demo/SEHSD-WP2011-08.html.

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

U.S. Department of Agriculture, Office of Policy Support. Supplemental Nutrition Assistance Program Nutrition Assistance Program Report Series. "Characteristics of Supplemental Nutrition Assistance Program Households: Fiscal Year 2016." https://fns-prod.azureedge.net/sites/default/files/ops/Characteristics2016.pdf.

U.S. Department of Education, Federal Student Aid Office. "The Standard Repayment Plan." https://studentaid.ed.gov/sa/repay-loans/understand/plans/standard.

U.S. Department of Health and Human Services. "2016 Welfare Indicators and Risk Factors: Fifteenth Report to Congress" Annual Report to Congress, 2016. https://aspe.hhs.gov/system/files/pdf/206736/WelfareIndicators15thReport.pdf.

U.S. Department of Health and Human Services, Office of Family Assistance. "Characteristics and Financial Circumstances of TANF Recipients, Fiscal Year 2016." https://www.acf.hhs.gov/ofa/resource/characteristics-and-financial-circumstances-of-tanf-recipients-fiscal-year-2016-0.

U.S. Department of Health & Human Services. "The Health Consequences of Smoking—50 Years of Progress." A Report of the Surgeon General, 2014. https://www.surgeongeneral.gov/library/reports/50-years-of-progress/50-years-of-progress-by-section.html.

U.S. Department of Labor. "Unemployment Insurance Data Summary, 4th Quarter 2017." https://workforcesecurity.doleta.gov/unemploy/content/data_stats/datasum17/DataSum_2017_4.pdf.

Walczak, Jared, Scott Drenkard. "State and Local Sales Tax Rates, Midyear 2018." *Tax Foundation Fiscal Fact* no. 600 (July 2018). https://files.taxfoundation.org/20180713135343/Tax-Foundation-FF600.pdf.

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

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 329,840 visitors by the following increments: 10%, 25%, and 50% as both an increase and a decrease to the baseline assumption. The visitor spending impact is then recalculated with each number of out-of-state visitors, holding all else constant. Visitor spending impacts attributable to MSU's event hosting range from a high of $63.7 million with 494,760 visitors to a low of $21.2 million with 164,920 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	164,920	247,380	296,856	329,840	362,824	412,300	494,760
Visitor spending impact (millions)	$21,239	$31,859	$38,230	$42,478	$46,726	$53,098	$63,717

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 A1.1. Next, the model brackets the base case assumption on either side with a plus or minus 10%, 25%, and 50% variation in assumptions. Analyses are then 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 7.2% to 7.1%. Likewise, a decrease of 10% (from 15% to 14%) in the assumption increases the rate of return from 7.2% to 7.4%.

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)	$325	$303	$290	$281	$273	$260	$238
Rate of return	8.1%	7.6%	7.4%	7.2%	7.1%	6.8%	6.4%
Benefit-cost ratio	2.5	2.4	2.4	2.3	2.3	2.2	2.1
Social perspective							
Net present value (millions)	$3,654	$3,465	$3,352	$3,277	$3,202	$3,088	$2,900
Benefit-cost ratio	4.7	4.5	4.4	4.3	4.2	4.1	3.9

Based on this sensitivity analysis, the conclusion can be drawn that MSU 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 zero, benefit-cost ratio greater than 1.0, and rate of return greater than the discount rate of 1.5%), 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 2.16. 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 MSU. In other words, businesses that hired MSU students could have substituted some of these workers with equally-qualified people from outside the state had there been no MSU students to hire. Therefore, we attribute only the remaining 50% of the initial labor income generated by increased alumni productivity to the university.

Table A1.2 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 MSU, for example, range from a high of $1.4 billion at a -50% variation to a low of $467.9 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 Mississippi 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)	$1,404	$1,170	$1,029	$936	$842	$702	$468

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 MSU 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 47% of students are employed.[44] 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 72%, on average, of the earnings that they statistically would have received if not attending MSU. This suggests that many students hold part-time jobs that accommodate their MSU attendance, though it is at an additional cost in terms of receiving a wage that is less than what they otherwise might make. The 72% 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 72% estimate is tested in the sensitivity analysis by changing it to 100% and then to 0%.

The changes generate results summarized in Table A1.3, with A defined as the percent of students employed and *B* defined as the percent that students earn relative to their full earning potential. Base case results appear in the shaded

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

row; here the assumptions remain unchanged, with A equal to 47% and B equal to 72%. 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 = 47%, B = 72%	$1,017.8	13.8%	3.3
Scenario 1: A = 100%, B = 72%	$1,154.9	18.2%	4.7
Scenario 2: A = 47%, B = 100%	$1,069.5	15.1%	3.7
Scenario 3: A = 100%, B = 100%	$1,265.9	26.4%	7.3
Scenario 4: A = 0%, B = 0%	$898.7	11.5%	2.6

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

- **Scenario 1:** Increasing the percentage of students employed (A) from 47% to 100%, the net present value, internal rate of return, and benefit-cost ratio improve to $1.2 billion, 18.2%, and 4.7, 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 72% to 100%, the net present value, internal rate of return, and benefit-cost ratio results improve to $1.1 billion, 15.1%, and 3.7, 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 $1.3 billion, 26.4%, and 7.3, respectively, relative to base case results. This scenario assumes that all students are fully employed and earning full salaries (equal to statistical averages) while attending classes.
- **Scenario 4:** Finally, decreasing both A and B to 0% reduces the net present value, internal rate of return, and benefit-cost ratio to $898.7 million, 11.5%, and 2.6, respectively, relative to base case results. These results are reflective of an increased opportunity cost; none of the students are employed in this case.[45]

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

45 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 MSU 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 5.1% discount rate for students and a 1.5% discount rate for society and taxpayers.[46] 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 A1.4.

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 5.1% to 7.6%) reduces the students' benefit-cost ratio from 3.3 to 2.4. Conversely, reducing the discount rate for students by 50% (from 5.1% to 2.5%) increases the benefit-cost ratio from 3.3 to 5.5. 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 3.7 benefit-cost ratio at a 50% variation from the base case).

46 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	2.5%	3.8%	4.5%	5.1%	5.6%	6.3%	7.6%
Net present value (millions)	$2,002	$1,426	$1,165	$1,018	$889	$724	$621
Benefit-cost ratio	5.5	4.2	3.6	3.3	3.0	2.6	2.4
Taxpayer perspective							
Discount rate	0.8%	1.1%	1.4%	1.5%	1.7%	1.9%	2.3%
Net present value (millions)	$362	$319	$296	$281	$267	$247	$216
Benefit-cost ratio	2.7	2.5	2.4	2.3	2.3	2.2	2.0
Social perspective							
Discount rate	0.8%	1.1%	1.4%	1.5%	1.7%	1.9%	2.3%
Net present value (millions)	$3,968	$3,603	$3,403	$3,277	$3,156	$2,985	$2,723
Benefit-cost ratio	5.0	4.6	4.4	4.3	4.2	4.0	3.7

Retained student variable

The retained student variable only affects the student spending impact calculation in Table 2.15. For this analysis, we assume a retained student variable of 10%, which means that 10% of MSU's students who originated from Mississippi would have left the state for other opportunities, whether that be education or employment, if MSU did not exist. The money these retained students spent in the state for accommodation and other personal and household expenses is attributable to MSU.

Table A1.5 presents the results of the sensitivity analysis for the retained student variable. The assumption increases and decreases relative to the base case of 10% 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 MSU range from a high of $53.7 million when the retained student variable is 15% to a low of $36.3 million when the retained student variable is 5%. This means as the retained student variable decreases, the student spending attributable to MSU decreases. Even under the most conservative assumptions, the student spending impact on the Mississippi 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	5%	8%	9%	10%	11%	13%	15%
Student spending impact (thousands)	$36,259	$40,618	$43,233	$44,976	$46,720	$49,335	$53,694

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:

Payback period = cost of investment/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.

Do the results differ by region, and if so, why?

Yes. Regional economic data are drawn from Emsi's proprietary MR-SAM model, the Census Bureau, and other sources to reflect the specific earnings levels, jobs numbers, unemployment rates, population demographics, and other key characteristics of the region served by the university. Therefore, model results for the university are specific to the given region.

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 5.1% (for students) and 1.5% (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 Mississippi 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:

Income = Sales – 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:

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 MSU in the 2018-19 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 $19,400. We spread this $19,400 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.[47] We repeat this process for each education level in the ladder.

Next we map the CHE production of the FY 2018-19 student population to the education ladder. Table 1.2 provides information on the CHE production of students attending MSU, broken out by educational achievement. In total, students completed 626,435 CHEs during the analysis year, excluding personal enrichment students. We map each of these CHEs to the education ladder

47 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).

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:

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

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

Table A6.1 displays the result for the students' aggregate annual increase in income (*ΔE)*, a total of $103.8 million. By dividing this value by the students' total production of 626,435 CHEs during the analysis year, we derive an overall value of $166 per CHE.

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

Aggregate annual increase in income	$103,839,629
Total credit hour equivalents (CHEs) in FY 2018-19*	626,435
Value per CHE	**$166**

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

Mincer function

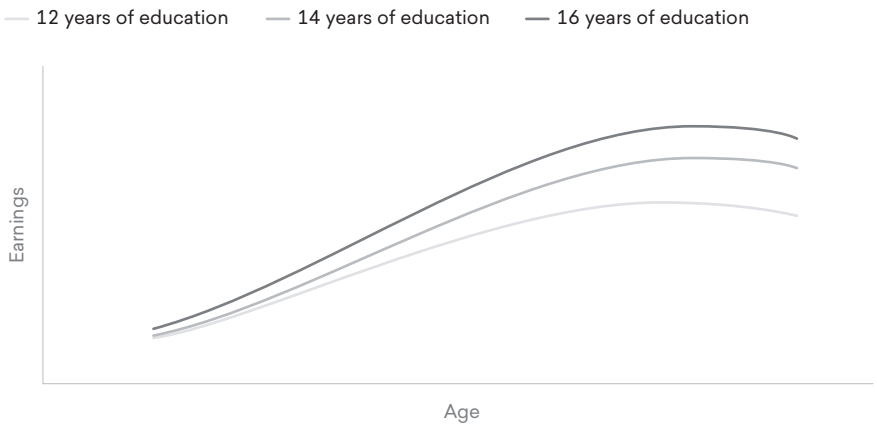
The $166 value per CHE in Table A6.1 only tells part of the story, however. Human capital theory holds that earnings levels do not remain constant; rather, they start relatively low and gradually increase as the worker gains more experience. Research also shows that the earnings increment between educated 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.[48] 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

48 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 $166 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 $166 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 2018-19 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 anyway 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.[49]

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).

49 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.[50]

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

50 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 ÷ $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

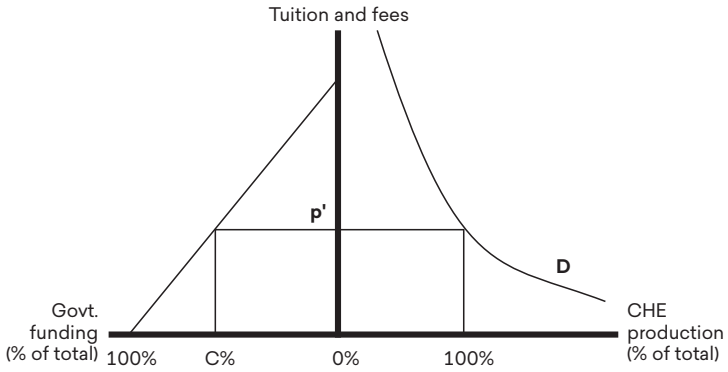
The investment analysis in Chapter 3 weighs the benefits generated by the university against the state and local taxpayer funding that the university receives to support its operations. An important part of this analysis is factoring out the benefits that the university would have been able to generate anyway, even without state and local taxpayer support. This adjustment is used to establish a direct link between what taxpayers pay and what they receive in return. If the university is able to generate benefits without taxpayer support, then it would not be a true investment.[51]

The overall approach includes a sub-model that simulates the effect on student enrollment if the university loses its state and local funding and has to raise student tuition and fees in order to stay open. If the university can still operate without state and local support, then any benefits it generates at that level are discounted from total benefit estimates. If the simulation indicates that the 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 and local government support versus student demand for education

Figure A9.1 presents a simple model of student demand and state and local government support. The right side of the graph is a standard demand curve (*D*) showing student enrollment as a function of student tuition and fees. Enrollment

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

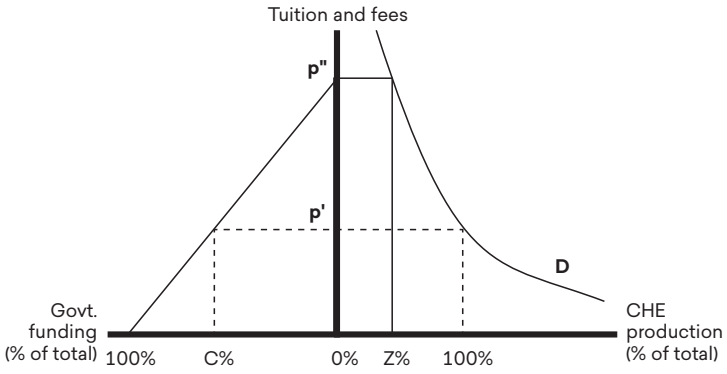


51 Of course, as a public training provider, the university would not be permitted to continue without public funding, so the situation in which it would lose all state support is entirely hypothetical. The purpose of the adjustment factor is to examine the university in standard investment analysis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

is measured in terms of total credit hour equivalents (CHEs) and expressed as a percentage of the university's current CHE production. Current student tuition and fees are represented by *p'*, and state and local government support covers *C%* of all costs. At this point in the analysis, it is assumed that the university has only two sources of revenues: 1) student tuition and fees and 2) state and local government support.

Figure A9.2 shows another important reference point in the model—where state and local government support is 0%, student tuition and fees are increased to *p"*, and CHE production is at *Z%* (less than 100%). The reduction in CHEs reflects the price elasticity of the students' demand for education, *i.e.*, the extent to which the students' decision to attend 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 and local government must be adjusted to net out the benefits that the university can provide absent state and local 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 and local government support. The analysis derives all benefits as a function of student enrollment, measured in terms of CHEs produced. For consistency with the graphs in this appendix, *B* is expressed as a function of the percent of the 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 and local government support is zero nonetheless provides for *Z%* (less than 100%) of the current enrollment, and benefits are symbolically indicated by the following equation:

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

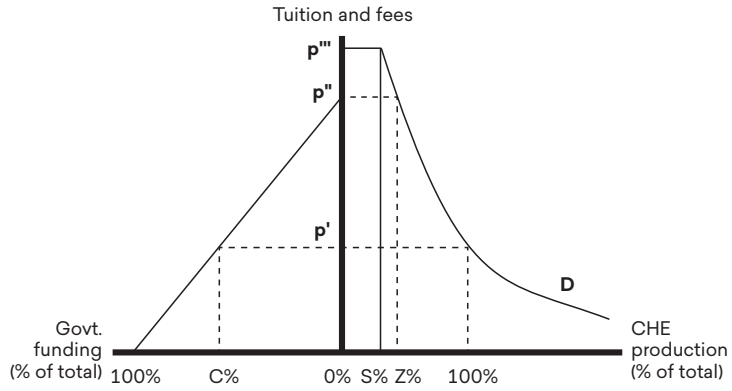
Inasmuch as the benefits in equation 2 occur with or without state and local government support, the benefits appropriately attributed to state and local government support are given by equation 3 as follows:

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

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.[52] 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 and local government funding). State and local government support at point S% is still zero, and student tuition and fees have been raised to p'". State and local government support is thus credited with the benefits given by equation 3, or B = B (100%) − B (Z%). With student tuition and fees still higher than p'", the university would no longer be able to attract enough students to keep the doors open, and it would shut down.

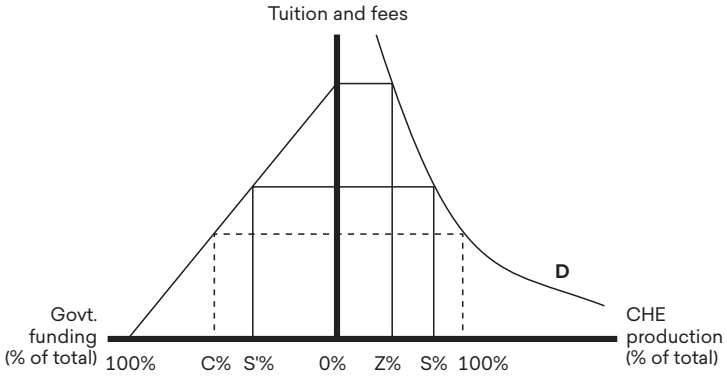
FIGURE A9.3: SHUTDOWN POINT AFTER ZERO GOVERNMENT FUNDING



52 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.

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 and local government support), meaning some minimum level of state and local 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 point is indicated by S% on the right side of chart. In this case, state and local government support is appropriately credited with all the benefits generated by the 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

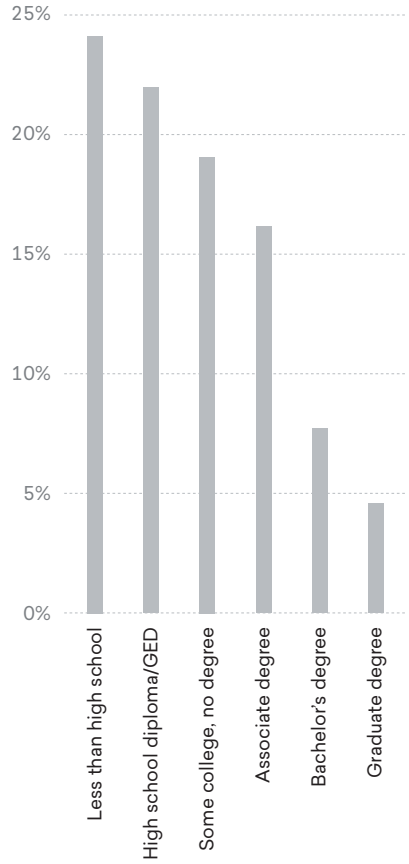
Statistics show a correlation between increased education and improved health. The manifestations of this are found in five health-related variables: smoking, alcohol dependence, obesity, depression, and drug abuse. There are other health-related areas that link to educational attainment, but these are 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.[53] 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



Source: Centers for Disease Control and Prevention.

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

The Centers for Disease Control and Prevention (CDC) reports the percentage of adults who are current smokers by state.[54] We use this information to create an index value by which we adjust the national prevalence data on smoking to each state. For example, 22.7% of Mississippi adults were smokers in 2016, relative to 15.5% for the nation. We thus apply a scalar of 1.46 to the national probabilities of smoking in order to adjust them to the state of Mississippi.

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.

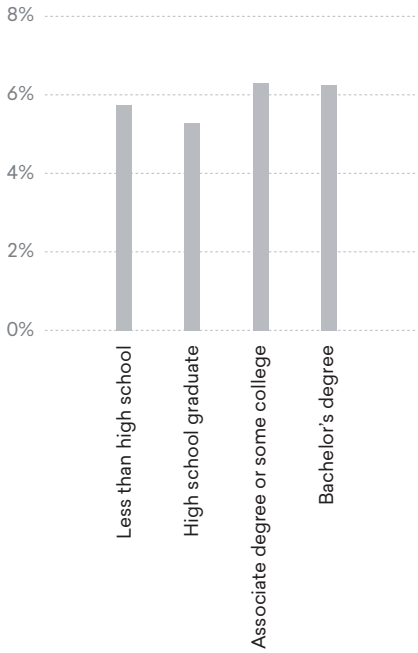
Figure A10.2 compares the percentage of adults, 18 and older, that abuse or depend on alcohol by education level, based on data from the Substance Abuse and Mental Health Services Administration (SAMHSA).[55] These statistics give an indication of the correlation between education and the reduced probability 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.[56]

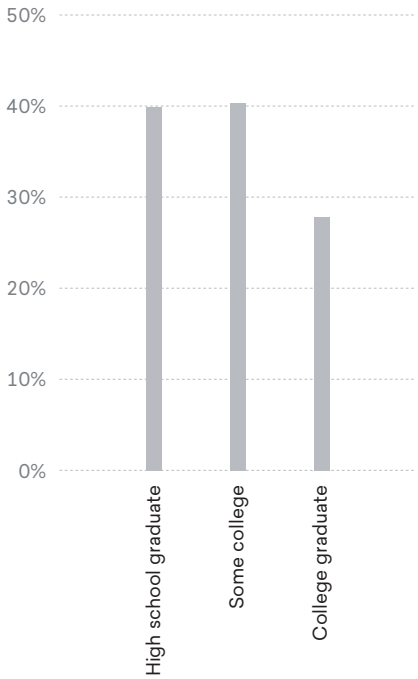
Data for Figure A10.3 is derived from the National Center for Health Statistics which shows the prevalence of obesity among adults aged 20 years and over

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.

54 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.

55 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.

56 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.[57] 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.[58]

Figure A10.4 summarizes the prevalence of MDD among adults by education level, based on data provided by the CDC.[59] 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.[60] 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 and local government representing 40% of the total cost related to illegal drug use.[61]

57 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).

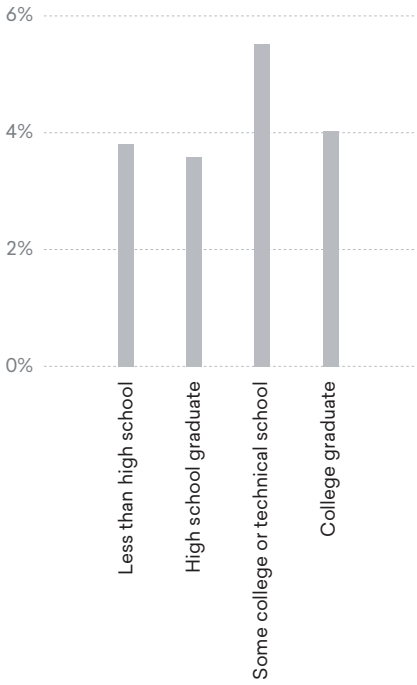
58 Greenberg, Paul, Andree-Anne Fournier, Tammy Sisitsky, Crystal Pike, and Ronald Kesslaer. "The Economic Burden of Adults with Major Depressive Disorder in the United States (2005 and 2010)" Journal of Clinical Psychiatry 76:2, 2015.

59 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."

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

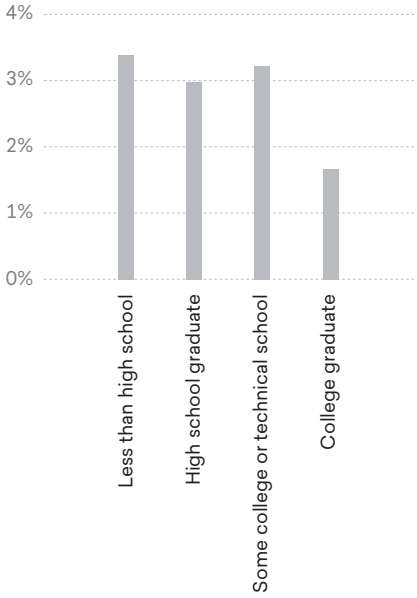
61 Substance Abuse and Mental Health Services Administration. "Table A.2. Spending by Payer: Levels and Percent Distribution for Mental Health and Substance Abuse (MHSA), Mental Health (MH), Substance Abuse (SA), Alcohol Abuse (AA), Drug Abuse (DA), and All-Health, 2014." *Behavioral Health Spending & Use Accounts, 1986 – 2014. HHS Publication No. SMA-16-4975*, 2016.

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.

Crime

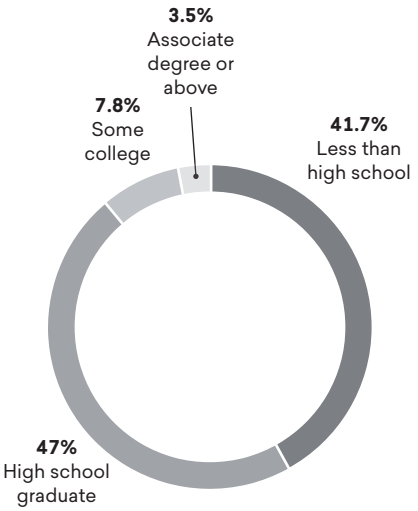
As people achieve higher education levels, they are statistically less likely to commit crimes. The analysis identifies the following three types of crime-related expenses: 1) criminal justice expenditures, including police protection, judicial and legal, and corrections, 2) victim costs, and 3) productivity 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.[62]

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.[63]

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.

FIGURE A10.6: EDUCATIONAL ATTAINMENT OF THE INCARCERATED POPULATION



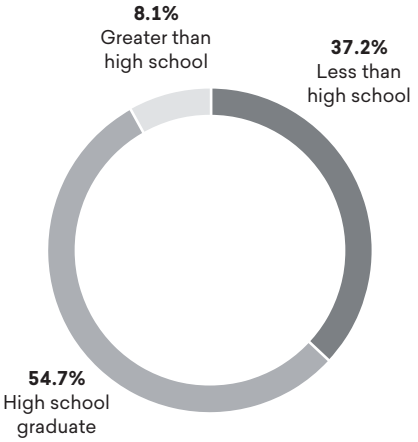
Source: Derived from data provided by the U.S. Census Bureau.

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.[64]

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.[65] As shown, the demographic characteristics of TANF recipients are weighted heavily towards the less than high school and high school categories,

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



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

62 U.S. Census Bureau. "Educational Characteristics of Prisoners: Data from the ACS." 2011.

63 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.

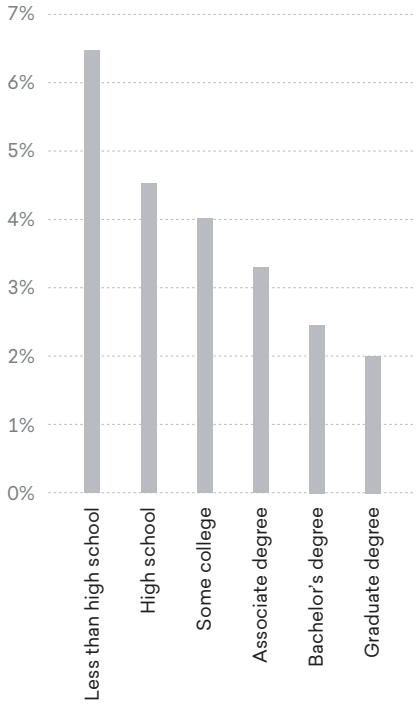
64 Medicaid is not considered in this analysis because it overlaps with the medical expenses in the analyses for smoking, alcohol dependence, obesity, depression, and drug abuse. We also exclude any welfare benefits associated with disability and age.

65 U.S. Department of Health and Human Services, Office of Family Assistance. "Characteristics and Financial Circumstances of TANF Recipients, Fiscal Year 2016."

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.[66] 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.

66 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.