Lightcast

Main Report
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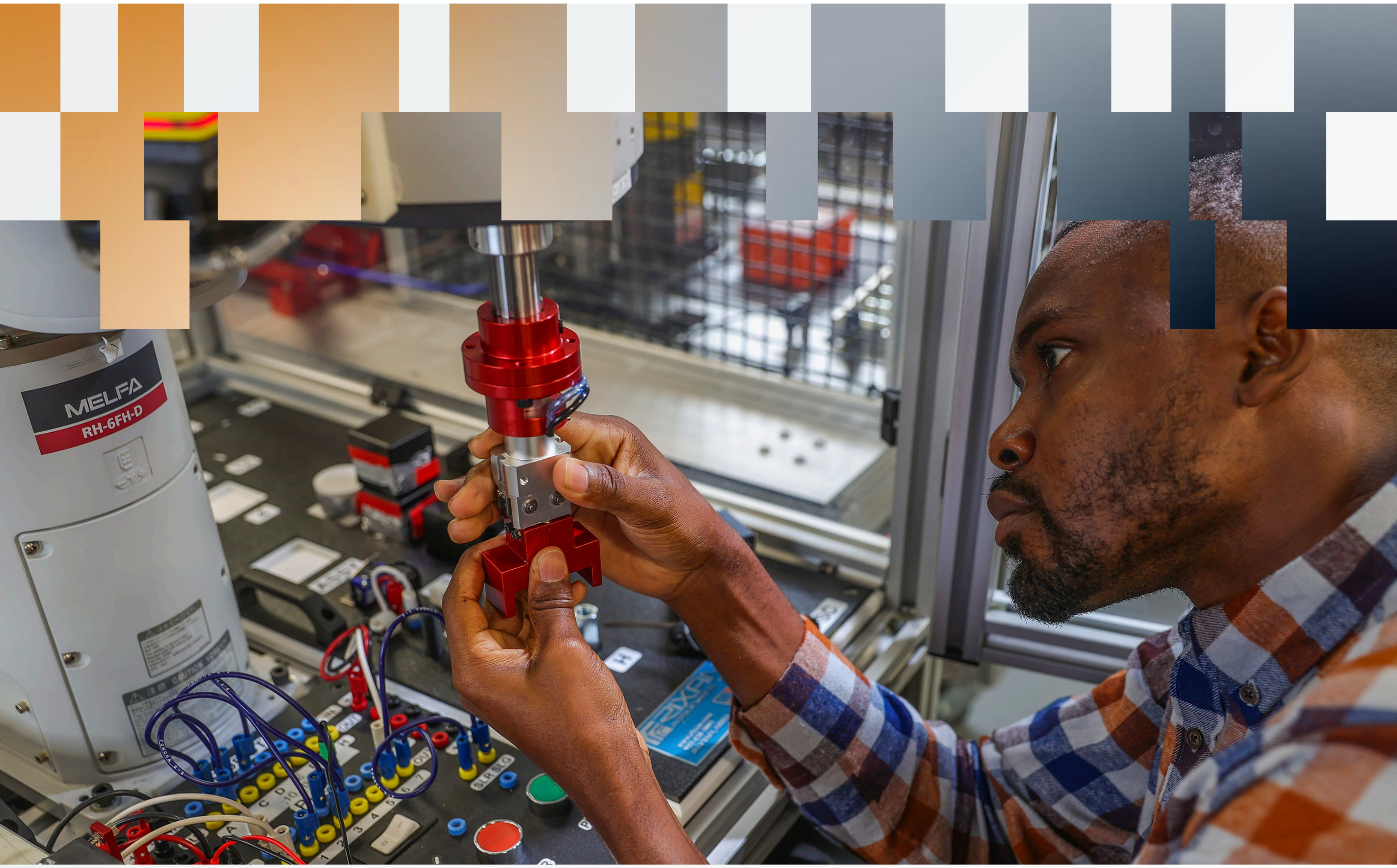

Analysis of the Economic Impact and Return on Investment of Education

The Public Universities of Ohio

BGSU · Central State University · Cleveland State University · Kent State University · Miami University · Northeast Ohio Medical University · Ohio University · The Ohio State University · Shawnee State University · The University of Akron · University of Cincinnati · The University of Toledo · Wright State University · Youngstown State University

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Preface

Lightcast 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, Lightcast has completed over 2,800 economic impact studies for educational institutions in three countries. Along the way, we have worked to continuously update and improve our methodologies to ensure that they conform to best practices. The present study reflects the latest version of our model, representing the most up-to-date theory for conducting human capital economic impact analyses.

Some changes in results are due to our efforts to conform to best practices for economic impact analyses. For example, the economic impact guidelines set by the Association for Public Land-Grant Universities discourage the inclusion of depreciation and interest expenses in operations spending impacts. Previous iterations of our model have used this measure as a proxy for capital maintenance. However, in an effort to provide more conservative and defensible results, we now exclude those expenditures from the operations and clinical spending impacts.

The model is consistently being updated as more data becomes available. For example, in prior studies the alumni impact only included the alumni served over the past 30 years. Historical headcount data beyond 30 years oftentimes did not exist and estimates were unreliable. However, historical headcount data reliability has increased over the years, making the historical headcount estimates by Lightcast more accurate. Therefore, the impact from alumni has been expanded to include all alumni active in the state workforce who have not reached the average retirement age of 67.

This current model, as with previous versions, has various external data inputs which reflect the most current economic activity and data. These data include (but are not limited to): the taxpayer discount rate; the student discount rate; the consumer savings rate; the consumer price index; national health expenditures; state and local industry earnings as a percent of total industry earnings; income tax brackets and sales tax by state; and unemployment, migration, and life tables. All data sets are maintained quarterly, although most updates occur only once a year.

These and other changes mark a considerable upgrade to the Lightcast economic impact model. Our hope is that these improvements will provide a better product for our clients—reports that are more transparent and streamlined, methodology that is more comprehensive and robust, and findings that are more relevant and meaningful to today's audiences.

While this report is useful in demonstrating the current value of the public universities of Ohio, it is not intended for comparison with the previous study conducted by Lightcast in 2018. Due to the extent of the changes in external data inputs, university data, and Lightcast's modeling since 2018, differences between results from the 2018 study and the present study do not necessarily indicate changes in the value of the universities. Lightcast encourages our readers to approach us directly with any questions or comments they may have about the study so that we can continue to improve our model and keep the public dialogue open about the positive impacts of education.

A note on comparing studies

It is important to note that the changes outlined above represent important improvements to our methodology, ultimately providing more accurate and robust results. However, these changes make it difficult to directly compare past studies to the current study, with the effectiveness of the comparison decreasing as the age of the previous study increases.

Additionally, in general Lightcast discourages comparisons between individual institutions and between educational systems since many factors, such as regional economic and political conditions, institutional differences, and student demographics are outside of the institution's control. In addition, every institution is unique, meaning the results and types of impact or investment measures are tailored to the specific institution or educational system.

Youngstown State University

Study overview

Inter-University Council of Ohio's public universities create a significant positive impact on the business community in Ohio and generate a return on investment to their major stakeholder groups.

Economic impact analysis (FY 2021-22)

- **Operations spending impact: $4.1 billion**
  The impact of the universities' payroll and day-to-day expenses in Ohio.
- **Construction spending impact: $598 million**
  The impact of the universities' construction spending in Ohio.
- **Clinical spending impact: 6.9 billion**
  The impact of the expenditures of clinics and medical centers associated with the universities.
- **Research spending impact: $1.9 billion**
  The impact of the universities' research payroll and expenses in Ohio.
- **Start-up and spin-off company impact: $1.7 billion**
  The impact of start-up and spin-off companies associated with the universities.
- **Visitor spending impact: $180.2 million**
  The impact of spending of out-of-state visitors who visited Ohio because of the universities.
- **Student spending impact: $794.6 million**
  The impact of the spending of the universities' relocated and retained students.
- **Volunteerism impact: $79.3 million**
  The impact of the productivity of student and employee volunteers.
- **Alumni impact: $52.6 billion**
  The impact of higher earnings and business productivity of the universities' alumni.

In FY 2021-22, the public universities of Ohio added **$68.9 billion** in income to the Ohio economy, equivalent to supporting **866,782 jobs**.

Investment analysis

- **Student perspective: Benefit-cost ratio = 5.6 & internal rate of return = 16.2%**
  Students will receive higher future earnings in return for their money and time invested in education at the universities.
- **Taxpayer perspective: Benefit-cost ratio = 4.6 & internal rate of return = 12.7%**
  Ohio taxpayers will receive increased tax revenues and public sector savings in return for their money invested in the universities.
- **Social perspective: Benefit-cost ratio = 7.4**
  Society in Ohio will receive added tax revenues, avoided social costs, and increased economic base in return for their money and time invested in the universities.

Executive summary

This report assesses the impact of the Inter-University Council of Ohio's[1] (IUC) public universities on the state economy and the benefits generated by the universities for students, taxpayers, and society. The results of this study show that the public universities of Ohio create a positive net impact on the state economy and generate a positive return on investment for students, taxpayers, and society.

1 See Appendix 1 for a list of the universities included within the Inter-University Council of Ohio.

📷: The University of Cincinnati

Economic impact analysis

📷: The Ohio State University

Ohio

During the analysis year, the universities spent $7.7 billion on payroll and benefits for 117,973 full-time and part-time employees, and spent another $5.8 billion on goods and services to carry out their day-to-day operations, clinical, 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 the universities that directly accounts for the fact that state and local dollars spent on the universities could have been spent elsewhere in the state if not directed towards the public universities. This spending would have created impacts regardless. We account for this by estimating the impacts that would have been created from the alternative spending and subtracting the alternative impacts from the spending impacts of the universities.

The additional income of **$68.9 billion** created by the public universities of Ohio is equal to approximately **8.8%** of the total gross state product of Ohio.

This analysis shows that in fiscal year (FY) 2021-22, operations, construction, clinical, research, entrepreneurial, visitor, and student spending of the public universities, together with volunteerism and the enhanced productivity of their alumni, generated **$68.9 billion** in added income for the Ohio economy. The additional income of $68.9 billion created by the universities is equal to approximately **8.8%** of the total gross state product (GSP) of Ohio. For perspective, this impact from the universities is larger than the entire Health Care & Social Assistance industry in the state. The impact of $68.9 billion is equivalent to supporting **866,782 jobs**. For further perspective, this means that **one out of every eight jobs** in Ohio is supported by the activities of the universities and their students. These economic impacts break down as follows:

Operations spending impact

Payroll and benefits to support the day-to-day operations of the universities (excluding payroll from research and clinical employees) amounted to $3.7 billion. The universities' non-pay expenditures amounted to $2 billion. The net impact of operations spending by the universities in Ohio during the analysis year was approximately **$4.1 billion** in added income, which is equivalent to supporting **71,726 jobs**.

Construction spending impact

The universities invest in construction each year to maintain their facilities, create additional capacities, and meet their 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 2021-22, the universities' construction spending generated **$598 million** in added income, which is equivalent to supporting **8,590 jobs**.

Clinical spending impact

In FY 2021-22, the clinics and medical centers related to and affiliated with the universities spent $5.9 billion on clinical and medical center faculty and staff and other expenditures to support their operations. The total net impact of these clinical operations in the state was **$6.9 billion** in added income, which is equivalent to supporting **78,323 jobs**.

Research spending impact

Research activities of the universities impact the state economy by employing people and making purchases for equipment, supplies, and services. They also facilitate new knowledge creation throughout Ohio. In FY 2021-22, the universities spent $858.4 million on payroll and $1.1 billion[2] on other expenditures to support research activities.[3] Research spending of the universities generated **$1.9 billion** in added income for the Ohio economy, which is equivalent to supporting **24,460 jobs**.

Start-up and spin-off company impact

The universities create an exceptional environment that fosters innovation and entrepreneurship, evidenced by the number of start-up and spin-off companies related to the universities in the state. In FY 2021-22, start-up and spin-off companies related to universities added **$1.7 billion** in income for the Ohio economy, which is equivalent to supporting **15,238 jobs**.

2 Because indirect costs are not necessarily spent during the analysis year, they are excluded from this analysis. Ultimately, excluding these measures results in more conservative and defensible estimates.

3 It should be noted that at the time of the analysis, some of the universities did not have FY 2021-22 research data available. FY 2020-21 research data was used as a proxy in those cases.

Important note

When reviewing the impacts estimated in this study, it is important to note that the study 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.

Visitor spending impact

Out-of-state visitors attracted to Ohio for activities at the universities 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 **$180.2 million** in income for the Ohio economy, which is equivalent to supporting **3,531 jobs**.

Student spending impact

Around 23% of students attending the universities originated from outside the state. Some of these students relocated to Ohio to attend the universities. In addition, some students, referred to as retained students, are residents of Ohio who would have left the state if not for the existence of the universities. The money that these students spent toward living expenses in Ohio is attributable to the universities.

The expenditures of relocated and retained students in the state during the analysis year added approximately **$794.6 million** in income for the Ohio economy, which is equivalent to supporting **13,992 jobs**. Of the $794.6 million in impact to the Ohio economy, $549.2 million was generated from out-of-state students.

Volunteerism impact

The universities encourage their students and employees to volunteer in Ohio, where they can work with businesses and organizations to help meet their goals. The work of these student and employee volunteers allows businesses and organizations to grow, increasing their output and impacting the economy at large. The universities' students and employees volunteered more than 1.3 million hours of their time in FY 2021-22. The work of the universities' student and employee volunteers is equivalent to **$33.7 million** in earnings.[4]

In terms of actual impact to the Ohio economy, student and employee volunteers generated an impact of **$79.3 million** in added income for the state in FY 2021-22, equivalent to supporting **2,593 jobs**.

Alumni impact

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

The accumulated impact of former students currently employed in the Ohio workforce amounted to **$52.6 billion** in added income for the Ohio economy, which is equivalent to supporting **648,329 jobs**.

4 By state value per volunteer hour was provided by Independent Sector (see https://independentsector.org/resource/vovt_details/).

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 evaluates the universities, collectively, 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 universities, which they will pay back over time. While some students were employed while attending the universities, 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 **$6.1 billion** in present value student costs.

In return, students will receive a present value of **$34.2 billion** in increased earnings over their working lives. This translates to a return of **$5.60** in higher future earnings for every dollar that students invest in their education at the universities. The corresponding annual rate of return is **16.2%**.

Taxpayer perspective

Taxpayers provided **$2.2 billion** of state and local funding to the universities in FY 2021-22. In return, taxpayers will receive an estimated present value of **$8.4 billion** 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 **$1.6 billion** in benefits due to a reduced demand for government-funded social services in Ohio. For every tax dollar spent educating students attending the universities, taxpayers will receive an average of **$4.60** in return over the course of the students' working lives. In other words, taxpayers enjoy an annual rate of return of **12.7%**.

For every tax dollar spent educating students attending the universities, taxpayers will receive an average of **$4.60** in return over the course of the students' working lives.

Social perspective

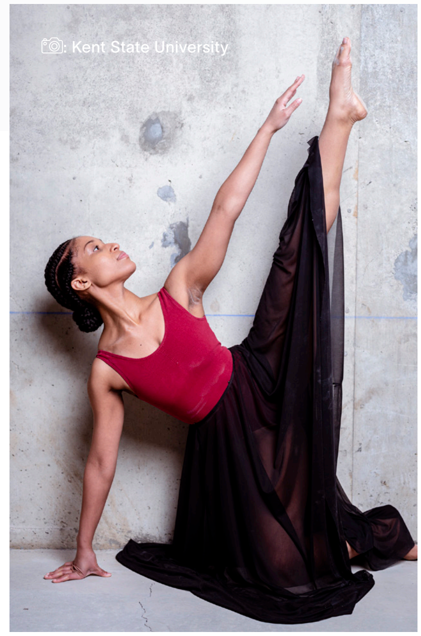
People in Ohio invested **$18 billion** in the universities in FY 2021-22. This includes the universities' expenditures, student expenses, and student opportunity costs. In return, the state of Ohio will receive an estimated present value of **$127.1 billion** in added state revenue over the course of the students' working lives. Ohio will also benefit from an estimated **$5.8 billion** in present value social savings related to reduced crime, lower welfare and unemployment assistance, and increased health and well-being across the state. For every dollar society invests in the universities, an average of **$7.40** in benefits will accrue to Ohio over the course of the students' careers.

Acknowledgments

Lightcast gratefully acknowledges the excellent support of the staff at the Inter-University Council of Ohio in making this study possible. Special thanks go to Laura Lanese, President, who approved the study, and to the individual research teams at the universities for their time and effort collecting the data and information requested. Any errors in the report are the responsibility of Lightcast and not of any of the above-mentioned individuals.


: The University of Toledo

Introduction



The Inter-University Council of Ohio was established in 1939 as a voluntary educational association of Ohio's public universities. The universities have today grown to serve 327,634 credit and 15,596 non-credit students. The universities' service region, for the purpose of this report, is the entire state of Ohio.

While the universities affect the state in a variety of ways, many of them difficult to quantify, this study considers the universities' economic benefits. The universities naturally help students achieve their individual potential and develop the knowledge, skills, and abilities they need to have fulfilling and prosperous careers. However, the universities impact Ohio beyond influencing the lives of students. The universities' program offerings supply employers with workers to make their businesses more productive. The universities; their day-to-day and research operations; their clinical, construction, and entrepreneurial activities; the expenditures of their visitors and students; and their student and employee volunteers support the state economy through the output and employment generated by state vendors. The benefits created by the universities extend as far as the state treasury in terms of the increased tax receipts and decreased public sector costs generated by students across the state.

> The universities impact Ohio beyond influencing the lives of students.

This report assesses the impact of the public universities of Ohio as a whole on the state economy and the benefits generated by the universities for students, taxpayers, and society. The approach is twofold. We begin with an economic impact analysis of the universities on the Ohio 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 Ohio 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 universities' day-to-day operations, 2) impact of construction spending, 3) impact of the universities' clinical spending, 4) impact of research spending, 5) impact of entrepreneurial activities, 6) impact of visitor spending, 7) impact of student spending, 8) impact of the universities' student and employee volunteers, and 9) impact of alumni who are still employed in the Ohio workforce.

The second component of the study measures the benefits generated by the universities 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 universities 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 Ohio as a whole.

The study uses a wide array of data that are based on several sources, including the FY 2021-22 academic and financial reports from the public universities of Ohio; industry and employment data from the Bureau of Labor Statistics and Census Bureau; outputs of Lightcast's impact model and MR-SAM model; and a variety of published materials relating education to social behavior.

: Wright State University

Chapter 1:

Profile of the Inter-University Council of Ohio and the economy

📷: Miami University

THE INTER-UNIVERSITY COUNCIL OF OHIO'S (IUC) public universities provide exceptional opportunities for Ohioans through a wide range of relevant and well-regarded programs designed for undergraduate, graduate, and lifelong learners at 14 institutions across the state. Together, Ohio's public universities offer a diverse array of educational opportunities, including associate, baccalaureate, graduate, and professional programs. In providing access to affordable education, the universities drive economic growth for communities across the state and support students of all backgrounds, interests, and goals. In FY 2021-22, Ohio's public universities served more than 340,000 undergraduate and graduate students.

: Central State University

Established in 1939 as a voluntary educational association of the state's public universities, IUC has grown to represent Ohio's 14 public universities. The universities employ world-class faculty and strive to share the rich history and traditions of each unique institution with every new class of learners. Across all universities, students are offered a vast array of educational options ranging from technical training to doctoral and professional programs in disciplines such as aviation, business, computer science, engineering, informatics, law, medicine, nursing, performing arts, robotics, and more.

Ohio public universities' excellent academic offerings provide opportunities for students to achieve their educational goals and further their careers. The universities strive to ensure education remains accessible and affordable for learners and focus on exceptional student service.

> The universities employ world-class faculty and strive to share the rich history and traditions of each unique institution with every new class of learners.

In addition to providing outstanding opportunities for students, Ohio public universities engage and enrich the Buckeye State through public lecture series, museum exhibits, theatre performances, sporting events, and visual art installations. The universities demonstrate their commitment to connecting the scholarship of higher education to Ohioans through their sponsorship and support of training and development programs, industry engagement, and continuing education opportunities. Further, the universities stimulate and support cutting-edge research and innovation that lead to economic growth and prosperity across the state.

IUC includes the following institutions:

- Bowling Green State University
- Central State University
- Cleveland State University
- Kent State University
- Miami University
- Northeast Ohio Medical University
- The Ohio State University
- Ohio University
- Shawnee State University
- The University of Akron
- The University of Cincinnati
- The University of Toledo
- Wright State University
- Youngstown State University

Ohio public universities' employee and finance data

The study uses two general types of information: 1) data collected from the universities and 2) state economic data obtained from various public sources and Lightcast's proprietary data modeling tools.[5] This chapter presents the basic underlying information from the universities used in this analysis and provides an overview of the Ohio economy.

Employee data

Data provided by the universities include information on faculty and staff by place of work and by place of residence. These data appear in Table 1.1. As shown, the universities employed 70,106 full-time and 47,867 part-time faculty and staff in FY 2021-22 (including student workers). Of these, 99% worked in the state and 93% lived in the state. These data are used to isolate the portion of the employees' payroll and household expenses that remains in the state economy.

Table 1.1: Employee data, FY 2021-22

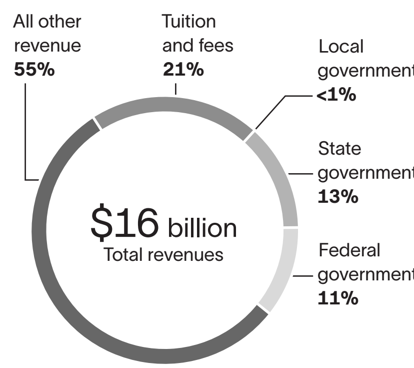
Full-time faculty and staff	70,106
Part-time faculty and staff	47,867
Total faculty and staff	**117,973**
% of employees who work in the state	99%
% of employees who live in the state	93%

Source: Data provided by the public universities of Ohio.

Revenues

Figure 1.1 shows the universities' annual revenues by funding source—a total of $16 billion in FY 2021-22. As indicated, tuition and fees comprised 21% of total revenue, and revenues from local, state, and federal government sources comprised another 24%. All other revenue (i.e., auxiliary revenue, sales and services, interest, and donations) comprised the remaining 55%. 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: Ohio's public universities' revenues by source, FY 2021-22



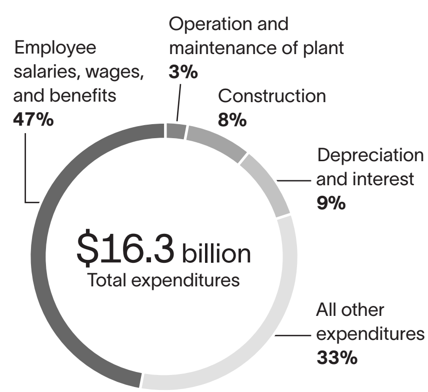
Percentages may not sum to 100% due to rounding.

Source: Data provided by the public universities of Ohio.

Expenditures

Figure 1.2 displays the universities' expense data. The combined payroll at the universities, including student salaries and wages, amounted to $7.7 billion. This was equal to 47% of the universities' total expenses for FY 2021-22. Other expenditures, operation and maintenance of plant, construction, depreciation and interest, and purchases of supplies and services, made up $8.6 billion. 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 universities' assets rather than an outflow of expenditures.

Figure 1.2: Ohio's public universities' expenses by function, FY 2021-22



Source: Data provided by the public universities of Ohio.

Students

The public universities of Ohio served 327,634 students taking courses for credit and 15,596 non-credit students in FY 2021-22. These numbers represent unduplicated student headcounts. The breakdown of the student body by gender was 44% male and 56% female. The breakdown by ethnicity was 69% white, 21% students of color,

5 See Appendix 6 for a detailed description of the data sources used in the Lightcast modeling tools.

and 10% unknown. The students' overall average age was 24 years old.[6] An estimated 72% of students remain in Ohio after finishing their time at the universities and the remaining 28% settle outside the state.[7]

Table 1.2 summarizes the breakdown of the student population and their corresponding awards and credits by education level. In FY 2021-22, the universities served 2,865 professional degree graduates, 1,673 PhD graduates, 14,433 master's degree graduates, 1,207 post-baccalaureate certificate graduates, 45,610 bachelor's degree graduates, 5,799 associate degree graduates, and 1,280 certificate graduates. Another 245,260 students enrolled in courses for credit but did not complete a degree during the reporting year. The universities offered dual credit courses to high schools, serving a total of 17,118 students over the course of the year. The universities also served 1,159 basic education students and 2,659 personal enrichment students enrolled in non-credit courses. Non-degree seeking students enrolled in workforce or professional development programs accounted for 1,614 students. Students not allocated to the other categories comprised the remaining 2,554 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 22.1.

Table 1.2: Breakdown of student headcount and CHE production by education level, FY 2021-22

Category	Headcount	Total CHEs	Average CHEs
Professional graduates	2,865	87,929	30.7
PhD graduates	1,673	40,829	24.4
Master's degree graduates	14,433	241,133	16.7
Post-baccalaureate certificate graduates	1,207	15,266	12.6
Bachelor's degree graduates	45,610	1,108,247	24.3
Associate degree graduates	5,799	134,043	23.1
Certificate graduates	1,280	29,422	23.0
Continuing students	245,260	5,689,163	23.2
Dual credit students	17,118	153,080	8.9
Basic education students	1,159	12,631	10.9
Personal enrichment students	2,659	9,260	3.5
Workforce/professional development students	1,614	1,706	1.1
All other students	2,554	15,323	6.0
Total, all students	**343,231**	**7,538,029**	**22.0**
Total, less personal enrichment students	**340,572**	**7,528,769**	**22.1**

Source: Data provided by the public universities of Ohio.

6 Unduplicated headcount, gender, ethnicity, and age data provided by the public universities of Ohio.

7 For public universities that were unable to provide settlement data, Lightcast used estimates based on student origin.

The Ohio economy

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

Table 1.3: Labor and non-labor income by major industry sector in Ohio, 2022*

Industry sector	Labor income (millions)	Non-labor income (millions)	Total income (millions)**	% of total income	Sales (millions)
Manufacturing	$59,124	$76,899	$136,022	17%	$374,467
Other Services (except Public Administration)	$12,584	$68,531	$81,115	10%	$112,035
Health Care & Social Assistance	$59,175	$9,093	$68,268	9%	$110,050
Finance & Insurance	$35,802	$31,728	$67,530	9%	$120,275
Wholesale Trade	$24,638	$33,149	$57,787	7%	$94,648
Government, Non-Education	$36,684	$11,479	$48,164	6%	$273,850
Retail Trade	$26,951	$19,774	$46,725	6%	$78,110
Professional & Technical Services	$35,235	$7,985	$43,220	6%	$65,542
Construction	$25,556	$5,204	$30,760	4%	$62,845
Transportation & Warehousing	$20,638	$6,770	$27,408	3%	$56,962
Government, Education	$25,901	$0	$25,901	3%	$29,957
Administrative & Waste Services	$19,585	$5,117	$24,702	3%	$44,107
Real Estate & Rental & Leasing	$15,634	$8,929	$24,563	3%	$56,724
Management of Companies & Enterprises	$22,016	$1,808	$23,824	3%	$38,756
Accommodation & Food Services	$12,401	$8,823	$21,224	3%	$41,735
Information	$7,868	$12,690	$20,558	3%	$34,634
Utilities	$2,868	$8,986	$11,854	2%	$19,618
Arts, Entertainment, & Recreation	$4,652	$2,345	$6,997	1%	$11,205
Agriculture, Forestry, Fishing & Hunting	$4,135	$2,828	$6,962	1%	$17,482
Educational Services	$5,511	$674	$6,185	1%	$8,742
Mining, Quarrying, & Oil and Gas Extraction	$1,051	$2,626	$3,677	<1%	$6,805
Total	**$458,009**	**$325,437**	**$783,446**	**100%**	**$1,658,547**

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

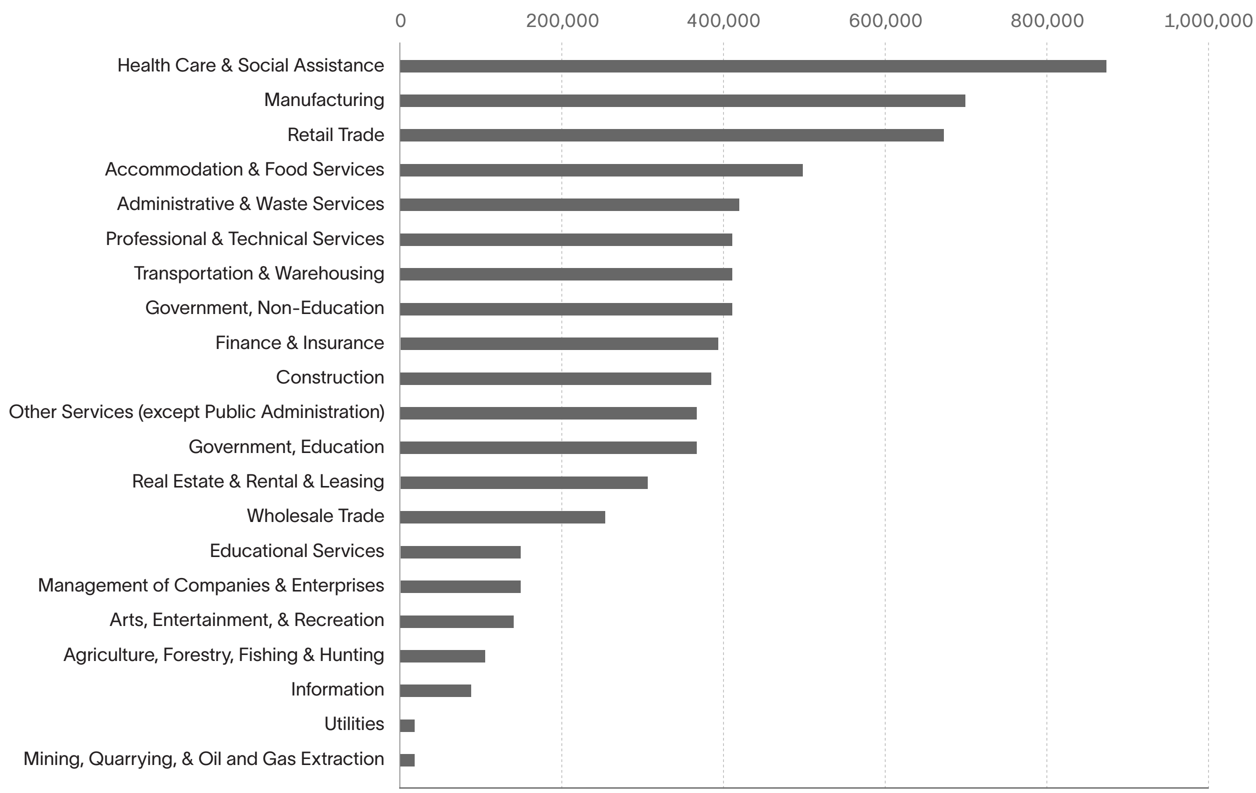
** Numbers may not add due to rounding.

Source: Lightcast industry data.

As shown in Table 1.3, the total income, or GSP, of Ohio is approximately $783.4 billion, equal to the sum of labor income ($458 billion) and non-labor income ($325.4 billion). In Chapter 2, we use the total added income as the measure of the relative impacts of the universities on the state economy.

Figure 1.3 provides the breakdown of jobs by industry in Ohio. The Health Care & Social Assistance sector is the largest employer, supporting 879,477 jobs or 12.3% of total employment in the state. The second largest employer is the Manufacturing sector, supporting 705,836 jobs or 9.8% of the state's total employment. Altogether, the state supports 7.2 million jobs.[8]

Figure 1.3: **Jobs by major industry sector in Ohio, 2022***



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

Source: Lightcast employment data.

8 Job numbers reflect Lightcast'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.

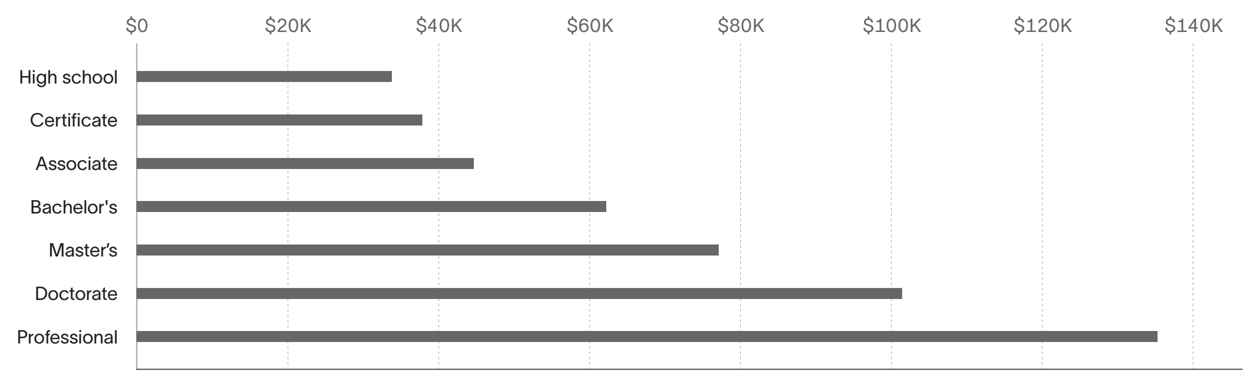
Table 1.4 and Figure 1.4 present the mean earnings by education level in Ohio at the midpoint of the average-aged worker's career. These numbers are derived from Lightcast's complete employment data on average earnings per worker in the state.[9] The numbers are then weighted by the universities' demographic profiles. 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 the universities can expect approximate wages of $62,600 per year within Ohio, approximately $28,600 more than someone with a high school diploma.

Table 1.4:
Average earnings by education level at a Ohio public university student's career midpoint

Education level	State earnings	Difference from next lowest degree
High school or equivalent	$34,000	$8,500
Certificate	$38,100	$4,100
Associate degree	$44,300	$6,200
Bachelor's degree	$62,600	$18,300
Master's degree	$77,800	$15,200
Doctoral degree	$102,000	$24,200
Professional degree*	$136,200	$58,400

* Professional degree graduate earnings are compared to master's degree graduate earnings when calculating the difference.
Source: Lightcast employment data.

Figure 1.4: **Average earnings by education level at a Ohio public university student's career midpoint**



Source: Lightcast employment data.

9 Wage rates in the Lightcast 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 regional or state data, as well as benefits and all forms of employer contributions. As such, Lightcast industry earnings-per-worker numbers are generally higher than those reported by other sources.

Chapter 2:

Economic impacts on the Ohio economy

The public universities of Ohio impact the Ohio economy in a variety of ways. The universities are employers and buyers of goods and services. They attract monies that otherwise would not have entered the state economy through their day-to-day and research operations; their clinical, construction, and entrepreneurial activities; the expenditures of their visitors and students; and their student and employee volunteers. Further, they provide students with the knowledge, skills, and abilities they need to become productive citizens and add to the overall output of the state.

: Wright State University

IN THIS CHAPTER, we estimate the following economic impacts of the universities: 1) the operations spending impact, 2) the construction spending impact, 3) the clinical spending impact, 4) the research spending impact, 5) the start-up and spin-off company impact, 6) the visitor spending impact, 7) the student spending impact, 8) the volunteerism 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.

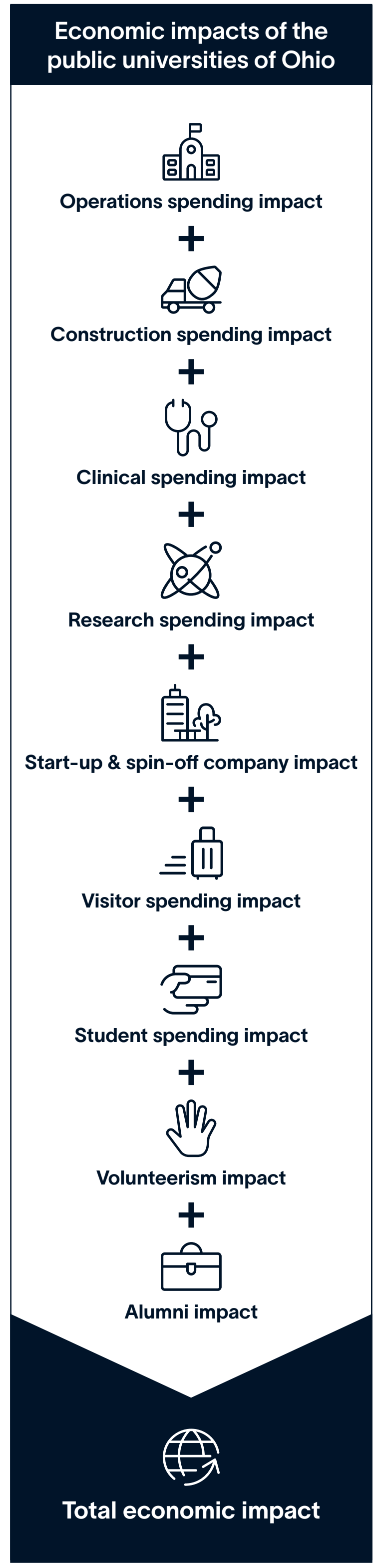
When exploring each of these economic impacts, we consider the following hypothetical question:

How would economic activity change in Ohio if the public universities of Ohio and all their alumni did not exist in FY 2021-22?

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 universities; 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 universities.

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

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



10 See Appendix 5 for an example of the intermediary costs included in the sales impact but not in the income impact.

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

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.

Lightcast	Initial	Direct	Indirect	Induced
IMPLAN	Direct	Indirect		Induced

Multiplier effects in this analysis are derived using Lightcast's Multi-Regional Social Accounting Matrix (MR-SAM) input-output model that captures the interconnection of industries, government, and households in the state. The Lightcast 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 Lightcast MR-SAM model and its data sources, see Appendix 6.

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 public universities.

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 universities themselves purchase supplies and services, and many of their vendors are located in Ohio. These expenditures create a ripple effect that generates still more jobs and higher wages throughout the economy.

Table 2.1 presents the universities' expenditures (excluding construction, clinical, and research) for the following three categories: 1) salaries, wages, and benefits, 2) operation and maintenance of plant, and 3) all other expenditures, including purchases for supplies and services. Also included in all other expenditures are expenses associated with grants and scholarships. Many students receive grants and scholarships that exceed the cost of tuition and fees. The universities then dispense this residual financial aid to

Table 2.1: Ohio public universities' expenses by function (excluding depreciation & interest), FY 2021-22

Expense category	In-state expenditures (thousands)	Out-of-state expenditures (thousands)	Total expenditures (thousands)
Employee salaries, wages, and benefits	$3,574,905	$128,903	$3,703,808
Operation and maintenance of plant	$316,051	$84,018	$400,069
All other expenditures	$685,266	$885,696	$1,570,961
Total	**$4,576,222**	**$1,098,617**	**$5,674,838**

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

Source: Data provided by the public universities of Ohio and the Lightcast impact model.

students, who spend it on living expenses. Some of this spending takes place in the state, and is therefore an injection of new money into the state economy that would not have happened if the universities did not exist. 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 universities' assets rather than an outflow of expenditures.[11]

The first step in estimating the multiplier effects of the universities' operational expenditures is to map these categories of expenditures to the approximately 1,000 industries of the Lightcast MR-SAM model. Assuming that the spending patterns of the universities' personnel approximately match those of the average U.S. consumer, we map salaries, wages, and benefits to spending on industry outputs using national household expenditure coefficients provided by Lightcast's national SAM. Approximately 99% of the universities' employees work in Ohio (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 universities' spending patterns approximately match national averages and apply the national spending coefficients for NAICS 902612 (Colleges, Universities, and Professional Schools (State Government)).[12] Operation and maintenance of plant expenditures are mapped to the industries that relate to capital construction, maintenance, and support, while the universities' remaining expenditures are mapped to the remaining industries.

We now have three vectors of expenditures for the universities: one for salaries, wages, and benefits; another for operation and maintenance of plant; and a third for the universities' purchases of supplies and services. The next step is to estimate the portion of these expenditures that occur inside the state. The expenditures occurring outside the state are known as leakages. We estimate in-state expenditures using regional purchase coefficients (RPCs), a measure of the overall demand for the commodities produced by each sector that is satisfied by state suppliers, for each of the approximately 1,000 industries in the MR-SAM model.[13] For example, if 40% of the demand for NAICS 541211 (Offices of Certified Public Accountants) is satisfied by state suppliers, the RPC for that industry is 40%. The remaining 60% of the demand for NAICS 541211 is provided by suppliers located outside the state. The three vectors of expenditures are multiplied, industry by industry, by the corresponding RPC to arrive at the in-state expenditures associated with the universities. 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.

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

12 See Appendix 3 for a definition of NAICS.

13 See Appendix 6 for a description of Lightcast's MR-SAM model.

Table 2.2 presents the economic impact of the universities' operations spending. The people employed by the universities 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 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 $5.2 billion in labor income and $1.3 billion in non-labor income. This sums to a total impact of $6.5 billion in total added income associated with the spending of the universities and their employees in the state. This is equivalent to supporting 96,770 jobs.

Table 2.2: Operations spending impact, FY 2021-22

	Labor income (thousands)	Non-labor income (thousands)	Total income (thousands)	Sales (thousands)	Jobs supported
Initial effect	**$3,657,639**	**$0**	**$3,657,639**	**$5,674,838**	**69,841**
Multiplier effect					
Direct effect	$327,082	$197,604	$524,687	$1,001,316	4,141
Indirect effect	$109,821	$55,552	$165,373	$329,038	1,401
Induced effect	$1,141,849	$1,007,059	$2,148,908	$3,615,657	21,388
Total multiplier effect	**$1,578,751**	**$1,260,216**	**$2,838,967**	**$4,946,012**	**26,930**
Gross impact (initial + multiplier)	**$5,236,391**	**$1,260,216**	**$6,496,607**	**$10,620,850**	**96,770**
Less alternative uses of funds	-$1,252,652	-$1,185,906	-$2,438,558	-$3,837,279	-25,044
Net impact	**$3,983,738**	**$74,310**	**$4,058,048**	**$6,783,571**	**71,726**

Source: Lightcast impact model.

The $6.4 billion 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 the universities—had not occurred. The universities received an estimated 68% of their funding from sources within Ohio. This portion of the universities' funding 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 the public universities of Ohio, 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.

The total net impact of the universities' operations is **$4.1 billion** in total added income, which is equivalent to supporting **71,726 jobs**.

We estimate this counterfactual by simulating a scenario where in-state monies spent on the universities 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 the universities, 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 universities' operations is equal to the gross impact less the impact of the alternative use of funds—the opportunity cost of the state money. As shown in the last row of Table 2.2, the total net impact is approximately $4 billion in labor income and $74.3 million in non-labor income. This sums together to $4.1 billion in total added income and is equivalent to supporting 71,726 jobs. These impacts represent new economic activity created in the state economy solely attributable to the operations of the public universities of Ohio.

Construction spending impact

In this section, we estimate the economic impact of the universities' construction spending. Because construction funding is separate from operations funding in the budgeting process, it is not captured in the operations spending impact estimated earlier. However, like operations spending, the construction spending creates subsequent rounds of spending and multiplier effects that generate still more jobs and income throughout the state. During FY 2021-22, the universities spent a total of $1.4 billion on various construction projects.

During FY 2021-22, the universities spent a total of **$1.4 billion** on various construction projects.

Assuming the universities' construction spending approximately matches national construction spending patterns of NAICS 902612 (Colleges, Universities, and Professional Schools (State Government)), we map 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.

To account for the opportunity cost of any in-state construction money, we estimate the impact of a similar alternative uses of funds as found in the operations spending impact. 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 2.3 presents the impacts of the universities' construction spending during FY 2021-22. Note the initial effect is purely a sales effect, so there is no initial change in labor or non-labor income. The FY 2021-22 construction spending creates a net total short-run impact of $598 million in added income—the equivalent of supporting 8,590 jobs in Ohio.

Table 2.3: Construction spending impact, FY 2021-22

	Labor income (thousands)	Non-labor income (thousands)	Total income (thousands)	Sales (thousands)	Jobs supported
Initial effect	**$0**	**$0**	**$0**	**$1,355,095**	**0**
Multiplier effect					
Direct effect	$444,199	$90,599	$534,798	$1,092,187	6,788
Indirect effect	$149,882	$30,570	$180,452	$368,522	2,288
Induced effect	$256,554	$52,325	$308,879	$630,806	3,920
Total multiplier effect	**$850,635**	**$173,494**	**$1,024,129**	**$2,091,515**	**12,996**
Gross impact (initial + multiplier)	**$850,635**	**$173,494**	**$1,024,129**	**$3,446,609**	**12,996**
Less alternative uses of funds	-$219,663	-$206,472	-$426,135	-$646,529	-4,406
Net impact	**$630,972**	**-$32,978**	**$597,994**	**$2,800,081**	**8,590**

Source: Lightcast impact model.

Clinical spending impact

In this section, we estimate the economic impact of the spending of the clinics and medical centers related to the public universities of Ohio. These include the following:[14]

- Ohio University Heritage Community Clinical
- Ohio University Therapy Associates
- Ohio University Psychology & Social Work Clinic
- OhioHealth Health Physician Group Heritage College
- The Ohio State University Wexner Medical Center
- The University of Cincinnati Health
- The University of Toledo Medical Center

Note that the broader health-related impacts of health care provided through these clinics and medical centers are beyond the scope of this analysis and are not included.

In FY 2021-22, $5.9 billion was spent on clinical operations for the above-listed medical institutions. To avoid any double counting, this spending was not included in the operations spending impact previously reported. Any medical research expenses from the clinics and medical centers are accounted for in the research spending impact and are not included here. Similar to the operations spending impact, we exclude expenses for depreciation and interest.

14 Any clinics or medical centers not listed were excluded because we could not reasonably make the argument that they would not be operating without the presence of the public universities of Ohio.

Table 2.4: Ohio public universities' clinical expenses by function (excluding depreciation & interest), FY 2021-22

Expense category	In-state expenditures (thousands)	Out-of-state expenditures (thousands)	Total expenditures (thousands)
Salaries, wages and benefits	$3,092,069	$12,572	$3,104,641
Operation and maintenance of plant	$35,459	$5,781	$41,240
All other expenses	$2,031,920	$691,485	$2,723,405
Total	**$5,159,448**	**$709,838**	**$5,869,286**

Source: Data provided by the public universities of Ohio and the Lightcast impact model.

The methodology used here is similar to that used when estimating the operations spending impact. Salaries, wages, and benefits are mapped to industries using national household expenditure coefficients. Assuming the clinics and medical centers affiliated with the universities have a spending pattern similar to that of the national average of general and surgical hospitals, we map their operation and maintenance of plant and other expenses to the industries of the MR-SAM model using spending coefficients for NAICS 622110 (General Medical & Surgical Hospitals). Next, we remove the spending that occurs outside the state, and run the in-state expenses through the multiplier matrix. Unlike the previous section, we do not estimate the impacts that would have been created with an alternative use of these funds. This is because there is not a significant alternative to spending money on health care. Table 2.5 presents the impacts of the clinical expenses related to the public universities of Ohio.

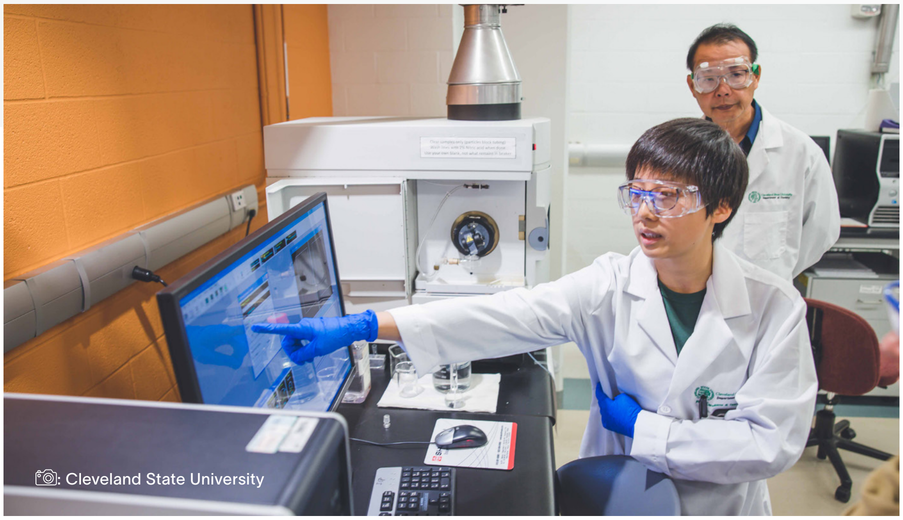
The payroll and number of people employed comprise the initial effect. The total impacts of clinical expenses (the sum of the initial and multiplier effects) are $5.5 billion in labor income and $1.4 billion in non-labor income. This totals to $6.9 billion in total added income and is equivalent to supporting 78,323 jobs.

Table 2.5: Clinical spending impact, FY 2021-22

	Labor income (thousands)	Non-labor income (thousands)	Total income (thousands)	Sales (thousands)	Jobs supported
Initial effect	**$3,088,815**	**$0**	**$3,088,815**	**$5,869,286**	**34,436**
Multiplier effect					
Direct effect	$809,430	$313,946	$1,123,376	$2,095,316	13,741
Indirect effect	$327,457	$129,855	$457,312	$910,879	5,618
Induced effect	$1,318,665	$939,711	$2,258,376	$3,867,491	24,528
Total multiplier effect	**$2,455,552**	**$1,383,511**	**$3,839,064**	**$6,873,686**	**43,887**
Total impact (initial + multiplier)	**$5,544,367**	**$1,383,511**	**$6,927,879**	**$12,742,972**	**78,323**

Source: Lightcast impact model.

Research spending impact

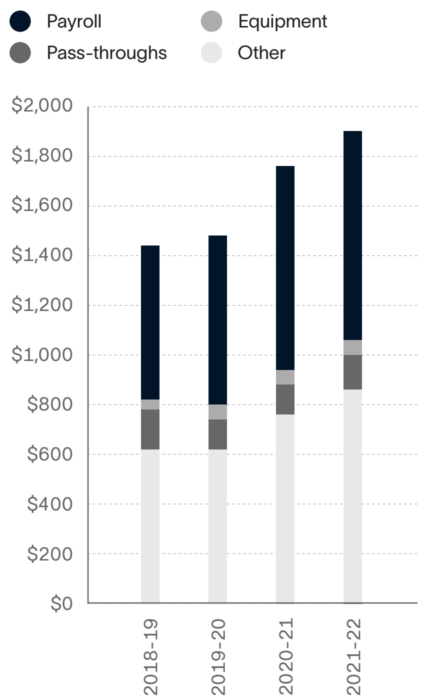


Similar to the day-to-day operations of the universities, research activities impact the economy by employing people and requiring the purchase of equipment and other supplies and services. Figure 2.1 shows the universities' research expenses by function—payroll, equipment, pass-throughs, and other (excluding indirect costs[15])—for the last four fiscal years. In FY 2021-22, the universities spent over $1.9 billion on research and development activities. These expenses would not have been possible without funding from outside the state—the universities received around 51% of their research funding from federal and other sources. In addition, at the time of the analysis, some of the universities did not have FY 2021-22 research data available. Therefore, FY 2020-21 research data was used as a proxy in those cases.

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 the universities, 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 the universities to provide information on expenditures by research and

Figure 2.1: Research expenses by function (millions) (excluding indirect costs)



Source: Data provided by the public universities of Ohio.

15 Because indirect costs are not necessarily spent during the analysis year, they are excluded from this analysis. Ultimately, excluding these measures results in more conservative and defensible estimates.

NSF funds Ohio State-based institutes to expand artificial intelligence research

The Ohio State University (OSU) is home to three recently announced National Science Foundation-funded institutes dedicated to advancing artificial intelligence research.

The AI Institute for Intelligent Cyberinfrastructure with Computational Learning in the Environment (ICICLE) is building the next generation of cyberinfrastructure with a goal of making AI data and infrastructure more accessible to the larger society. Led by OSU, the institute has a core team of 46 academic researchers and staff scientists from 13 organizations.

The AI Institute for Future Edge Networks and Distributed Intelligence (AI-EDGE) is focusing on AI innovation for wireless devices, services, and applications at the network edge rather than the traditional network core. These edge networks will encompass mobile and stationary devices, wireless and wired access, and computing and data servers. The institute's core team is comprised of 30 scientists from 11 collaborating institutions, three Department of Defense research labs, and four global companies.

The third interdisciplinary institute will establish a new field of study that has the potential to transform biomedical, agricultural, and basic biological sciences. The Imageomics Institute is creating the field of imageomics, in which scientists use images of living organisms as the basis for understanding biological processes of life on Earth.

development field as they report to the National Science Foundation's Higher Education Research and Development Survey (HERD).[16] 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 the universities.

Initial, direct, indirect, and induced effects of the universities' research expenses appear in Table 2.6. As with the operations spending impact, the initial effect consists of the 12,603 research jobs and their associated salaries, wages, and benefits. The universities' research expenses have a total gross impact of $1.9 billion in labor income and $436.1 million in non-labor income. This sums together to $2.3 billion in added income, equivalent to 29,023 jobs. Taking into account the impact of the alternative

Table 2.6: Research spending impact, FY 2021-22

	Labor income (thousands)	Non-labor income (thousands)	Total income (thousands)	Sales (thousands)	Jobs supported
Initial effect	**$853,131**	**$0**	**$853,131**	**$1,928,010**	**12,603**
Multiplier effect					
Direct effect	$395,753	$114,269	$510,022	$805,463	5,881
Indirect effect	$123,779	$32,480	$156,259	$262,814	1,888
Induced effect	$506,225	$289,313	$795,538	$1,287,485	8,651
Total multiplier effect	**$1,025,757**	**$436,062**	**$1,461,819**	**$2,355,763**	**16,420**
Gross impact (initial + multiplier)	**$1,878,888**	**$436,062**	**$2,314,951**	**$4,283,773**	**29,023**
Less alternative uses of funds	-$227,919	-$216,183	-$444,102	-$685,948	-4,563
Net impact	**$1,650,969**	**$219,880**	**$1,870,849**	**$3,597,825**	**24,460**

Source: Lightcast impact model.

16 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.

uses of funds, net research expenditure impacts of the universities are $1.7 billion in labor income and $219.9 million in non-labor income. This sums together to $1.9 billion in total added income and is equivalent to supporting 24,460 jobs.

Research and innovation play an important role in driving the Ohio economy. Some indicators of innovation are the number of invention disclosures, patent applications, and licenses and options executed. Over the last four years, the universities received 2,577 invention disclosures, filed 2,002 new US patent applications, and produced 459 licenses (see Table 2.7). Without the research activities of the public universities of Ohio, this level of innovation and sustained economic growth would not have been possible.

The universities' research activities create an economic impact beyond spending. There are impacts created through the entrepreneurial and innovative activities stemming from the universities' research. Research activities that create general added productivity 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 spill-over effects, however, remain as additional value created beyond the scope of this analysis.

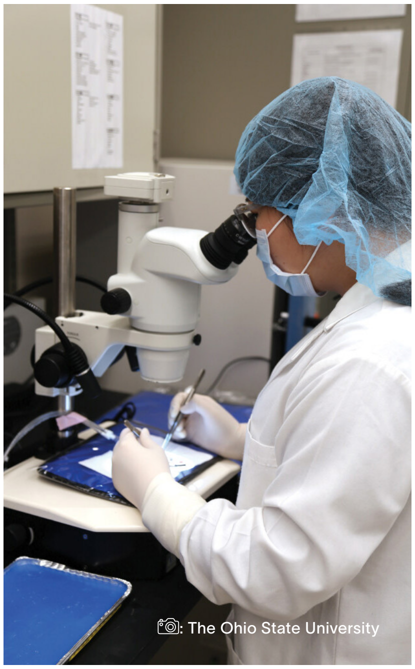

📷: The Ohio State University

Table 2.7: **Invention disclosures, patent applications, licenses, and license income of the public universities of Ohio**

Fiscal year	Invention disclosures received	Patent applications filed	Licenses and options executed	Adjusted gross license income
2021-22	594	398	115	$21,467,926
2020-21	596	387	114	$5,483,070
2019-20	646	660	118	$10,868,283
2018-19	741	557	112	$16,183,904
Total	**2,577**	**2,002**	**459**	**$54,003,183**

Source: Data provided by the public universities of Ohio.

Northeast Ohio Medical University leads in interdisciplinary innovation

Northeast Ohio Medical University's (NEOMED) NEOvations Bench-to-Bedside is a 7-month medical device innovation program that engages students to identify medical problems and work as interdisciplinary teams to develop innovative technological solutions to solve them. Students from NEOMED, together with students from other institutions of higher education, form interdisciplinary teams representing the fields of health, business, engineering, and law to complete the bench-to-bedside process. The process begins with observation of a clinical problem and identification of a specific need for which they receive support from medical, industry, and academic professionals. From there, ideation follows with design of a medical technology while patent and regulatory requirements are also being considered. Students then create a prototype and develop a commercialization strategy. The program concludes with teams presenting their technologies to a panel of judges for a chance to advance their work for further development. Judges are comprised of health and industry professionals, investors, and university leadership. Students maintain ownership of their technology while gaining experience in accelerating new technologies from concept to commercialization.

Start-up and spin-off company impact

The public universities of Ohio create an exceptional environment that fosters innovation and entrepreneurship, evidenced by the number of start-up and spin-off companies related to the universities that have been created in the state. This section presents the economic impact of companies that would not have existed in the state but for the presence of the universities.

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 the universities.
- **Spin-off companies:** Companies created and fostered through programs offered by the universities that support entrepreneurial business development, or companies that were created by faculty, students, or alumni as a result of their experience at the universities.

The public universities of Ohio create an exceptional environment that fosters innovation and entrepreneurship, evidenced by the number of start-up and spin-off companies related to the universities that have been created in the state.

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 universities. Table 2.8 presents the number of employees for all start-up and spin-off companies related to the universities that were active in Ohio during the analysis year.[17]

Table 2.8 Start-up and spin-off companies related to the universities that were active in Ohio in FY 2021-22

	Number of companies	Number of employees
Start-up companies	179	6,271
Spin-off companies	153	1,128

Source: Data provided by the public universities of Ohio.

The University of Akron honored as one of the top universities for patents

The National Academy of Inventors (NAI), in conjunction with the Intellectual Property Owners Association (IPO), issued its 10th annual report on top ranked U.S. and international universities receiving the highest issuance of U.S. utility patents by the United States Patent and Trademark Office in 2021.

The University of Akron (UA), one of the nine founding NAI charter members, has been ranked in the top 100 every year since 2017.

"To see UA recognized among the top 100 is again confirmation that UA's faculty and students are not only inventive, but that together we can take that research and transform it into innovation," said Dr. Suzanne Bausch, vice president for research and business engagement and dean of the graduate school.

UA's research faculty and the efforts of the Office of Technology Transfer (OTT) and the University of Akron Research Foundation (UARF) work together to make recognition like this possible.

By supporting development and commercialization of UA's intellectual property, OTT helps to bring faculty and student research from the lab to the market by facilitating the discussion of ideas and disclosure of inventions.

To accomplish this, OTT reviews technologies for marketability, with the inventor's involvement, then applies for and maintains patents on technologies that may have potential economic benefit. It also provides researchers with support to seek out funding opportunities, both with federal and industrial partners, assists start-up companies and arranges for the licensing of university technologies in collaboration with UARF.

Meanwhile, UARF provides training in innovation and entrepreneurship, assists faculty and students in exploring commercial applications for their technology, mentors start-up companies, and identifies collaborators for testing and scale up.

UARF runs a nationally recognized NSF I-Corps site that teaches faculty and students how to interact with potential customers, provides prototyping and testing dollars through Spark Fund, helps start-up companies secure federal small business research grants, and helps entrepreneurs develop new business skills through the STRIDE Accelerator.

"These projects show that UA, indeed, is on the cutting edge of innovation," said Bausch. "Together, OTT and UARF work in symmetry to advance our reputation and continue our legacy of research excellence."

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

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 2.9 presents the impact of the start-up companies. The initial effect is 6,271 jobs, equal to the number of employees at all start-up companies in the state (from Table 2.8). The corresponding initial effect on labor income is $469.5 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 $962.6 million in added labor income and $354.8 million in non-labor income. This totals to $1.3 billion in added income—or the equivalent of supporting 13,060 jobs.

Table 2.9: Impact of start-up companies related to the public universities of Ohio, FY 2021-22

	Labor income (thousands)	Non-labor income (thousands)	Total income (thousands)	Sales (thousands)	Jobs supported
Initial effect	**$469,497**	**$181,567**	**$651,064**	**$1,134,697**	**6,271**
Multiplier effect					
Direct effect	$119,764	$39,053	$158,817	$301,757	1,785
Indirect effect	$46,347	$14,180	$60,527	$115,302	692
Induced effect	$326,955	$120,034	$446,988	$767,246	4,311
Total multiplier effect	**$493,065**	**$173,267**	**$666,332**	**$1,184,305**	**6,788**
Total impact (initial + multiplier)	**$962,562**	**$354,834**	**$1,317,396**	**$2,319,002**	**13,060**

Source: Lightcast impact model.

Note that start-up companies have a strong and clearly defined link to the public universities of Ohio. The link between the universities and the existence of their 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 universities. But we have included them separately here in case the reader would like to exclude the impact from spin-off companies from the grand total impact.[18]

As demonstrated in Table 2.10, the universities create exceptional environments that foster innovation and entrepreneurship. As a result, the impact of spin-off companies related to the universities is $199.7 million in added labor income and $230.3 million in non-labor income, totaling $430 million in added income—the equivalent of supporting 2,178 jobs.

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

Table 2.10: Impact of spin-off companies related to the public universities of Ohio, FY 2021-22

	Labor income (thousands)	Non-labor income (thousands)	Total income (thousands)	Sales (thousands)	Jobs supported
Initial effect	**$103,723**	**$123,346**	**$227,069**	**$383,716**	**1,128**
Multiplier effect					
Direct effect	$20,273	$21,157	$41,430	$76,264	231
Indirect effect	$7,550	$7,466	$15,017	$27,776	88
Induced effect	$68,115	$78,325	$146,440	$237,295	732
Total multiplier effect	**$95,938**	**$106,948**	**$202,887**	**$341,336**	**1,050**
Total impact (initial + multiplier)	**$199,661**	**$230,295**	**$429,956**	**$725,051**	**2,178**

Source: Lightcast impact model.

Cleveland State University driving growth in healthcare and I.T.—the Cleveland Innovation District

Beyond start-up and spin-off companies, the public universities also aid in attracting, expanding, and retaining companies in Ohio. Cleveland State University (CSU) is the lead public higher education institution in the Cleveland Innovation District—a partnership focused on making Northeast Ohio and the state more attractive and competitive in the burgeoning healthcare and IT sectors. CSU is joined by Jobs Ohio, the Ohio Department of Development, The Cleveland Clinic, University Hospitals, The MetroHealth System, and Case Western Reserve University in the $565-million collaboration focused on research, technology, emerging biological threats, epidemiology and training, and talent development in STEM education.

Launched in 2021, the district is expected to create 20,000 jobs over the next ten years, develop $3 billion in new research, and contribute $3 billion in economic impact.

CSU is tasked with recruiting, educating, and graduating the skilled talent needed to fuel that growth by strategically matching the demand from employers to produce 10,000 new STEM graduates. Thanks to hit-the-ground-running investments in student recruitment, the university has already seen tremendous growth in the 16 targeted STEM programs, including a 40% enrollment increase, a 54% increase in certificates awarded, and a 14% rise in the number of degrees awarded.

Visitor spending impact

: Shawnee State University

Thousands of out-of-state visitors came to the universities in FY 2021-22 to participate in various activities, including commencement, sports events, and orientation. The public universities of Ohio estimated that 808,170 out-of-state visitors attended events hosted by the universities in FY 2021-22. Table 2.11 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 $318.4 million in FY 2021-22. However, some of this spending includes monies paid to the universities through non-textbook

Table 2.11: **Average per-trip visitor costs and sales generated by out-of-state visitors in Ohio, FY 2021-22***

Accommodation	$101
Food	$225
Entertainment and shopping	$72
Transportation	$86
Total expenses per visitor	**$485**
Number of out-of-state visitors	*808,170*
Gross sales	$318,504,897
On-campus sales (excluding textbooks)	-$51,054,970
Net off-campus sales	**$267,449,927**

* 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 these costs.

Source: Sales calculations estimated by Lightcast based on data provided by the public universities of Ohio.

items (e.g., event tickets, food, etc.). These have already been accounted for in the operations spending impact and should thus be removed to avoid double-counting. We estimate that on-campus sales generated by out-of-state visitors totaled $51 million. The net sales from out-of-state visitors in FY 2021-22 thus come to $267.4 million.

Thousands of out-of-state visitors came to the universities in FY 2021-22 to participate in various activities, including commencement, sports events, and orientation.

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 2.12, the net impact of visitor spending in FY 2021-22 is $98 million in labor income and $82.2 million in non-labor income. This totals to $180.2 million in added income and is equivalent to supporting 3,531 jobs.

Table 2.12: Visitor spending impact, FY 2021-22

	Labor income (thousands)	Non-labor income (thousands)	Total income (thousands)	Sales (thousands)	Jobs supported
Initial effect	**$0**	**$0**	**$0**	**$267,450**	**0**
Multiplier effect					
Direct effect	$48,258	$40,586	$88,844	$165,416	1,738
Indirect effect	$18,106	$15,442	$33,548	$63,691	660
Induced effect	$31,591	$26,177	$57,768	$106,717	1,133
Total multiplier effect	**$97,955**	**$82,205**	**$180,160**	**$335,824**	**3,531**
Total impact (initial + multiplier)	**$97,955**	**$82,205**	**$180,160**	**$603,274**	**3,531**

Source: Lightcast impact model.

Student spending impact

Both in-state and out-of-state students contribute to the student spending impact of the public universities of Ohio; 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 the universities, 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 Ohio economy regardless of the universities. In addition, only the out-of-state students who relocated to Ohio to attend the universities 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 244,689 students attending the universities who originated from Ohio (excluding personal enrichment students and dual credit high school students),[19] not all of them would have remained in the state if not for the existence of the public universities of Ohio. We apply a conservative assumption that 10% of these students would have left Ohio for other education opportunities if the universities did not exist.[20] Therefore, we recognize that the in-state spending of 24,469 students retained in the state is attributable to the universities. These students, called retained students, spent money at businesses in the state for everyday needs such as groceries, accommodation, and transportation. Of the retained students, we estimate 4,619 lived on campus

19 For public universities that were unable to provide origin data for their non-credit students, we assume that all non-credit students originated from within the state.

20 See Appendix 2 for a sensitivity analysis of the retained student variable.

while attending the universities. While these students spend money while attending the universities, we exclude most of their spending for room and board since these expenditures are already reflected in the impact of the universities' operations.

Relocated students are also accounted for in universities' student spending impact. An estimated 38,943 students came from outside the state and lived off campus while attending the universities in FY 2021-22. Another estimated 15,812 out-of-state students lived on campus while attending the universities. We apply the same adjustment as described above to the students who relocated and lived on campus during their time at the universities. Collectively, the off-campus expenditures of out-of-state students supported jobs and created new income in the state economy.[21]

The average costs for students appear in the first section of Table 2.13, equal to $15,229 per student. Note that this table excludes expenses for books and supplies, since many of these costs are already reflected in the operations spending impact discussed in the previous section. We multiply the $15,229 in annual costs by the 58,793 students who either were retained or relocated to the state because of the universities and lived in-state but off campus. This provides us with an estimate of their total spending. For students living on campus, we multiply the per-student cost of off-campus food purchases (assumed to be equal to 25% of room and board), personal expenses, and transportation by the number of students who lived in the state but on campus while attending (20,431 students). Altogether, off-campus spending of relocated and retained students generated gross sales of $1 billion. This figure, once net of the monies paid to student workers, yields net off-campus sales of $933.6 million, as shown in the bottom row of Table 2.13.

Table 2.13: Average student costs and total sales generated by relocated and retained students in Ohio, FY 2021-22

Room and board	$11,410
Personal expenses	$2,437
Transportation	$1,381
Total expenses per student	**$15,229**
Number of students retained	*24,469*
Number of students relocated	*54,755*
Gross retained student sales	$334,781,966
Gross relocated student sales	$708,003,753
Total gross off-campus sales	**$1,042,785,719**
Wages and salaries paid to student workers*	$109,142,077
Net off-campus sales	**$933,643,642**

* 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 the public universities of Ohio. The number of relocated and retained students who lived in the state off campus or on campus while attending is derived by Lightcast from the student origin data and in-term residence data provided by the public universities of Ohio.

21 Online students and students who commuted to Ohio 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.

Estimating the impacts generated by the $933.6 million in student spending follows a procedure similar to that of the operations spending impact described above. We distribute the $933.7 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 **$794.6 million** in total added income and is equivalent to supporting **13,992 jobs**.

Table 2.14 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 $460.8 million in labor income and $333.8 million in non-labor income. This sums together to $794.6 million in total added income and is equivalent to supporting 13,992 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. Of the $794.6 million in impact to the Ohio economy, $549.2 million was generated from out-of-state students.

Table 2.14: **Student spending impact, FY 2021-22**

	Labor income (thousands)	Non-labor income (thousands)	Total income (thousands)	Sales (thousands)	Jobs supported
Initial effect	**$0**	**$0**	**$0**	**$933,644**	**0**
Multiplier effect					
Direct effect	$224,486	$164,028	$388,514	$701,371	6,782
Indirect effect	$81,013	$60,272	$141,285	$264,231	2,609
Induced effect	$155,309	$109,534	$264,843	$472,929	4,601
Total multiplier effect	**$460,809**	**$333,834**	**$794,643**	**$1,438,531**	**13,992**
Total impact (initial + multiplier)	**$460,809**	**$333,834**	**$794,643**	**$2,372,174**	**13,992**

Source: Lightcast impact model.

Volunteerism impact

Bowling Green State University

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

The universities' student and employee volunteer hours are valued at **$33.7 million**.

Overall, 30,205 student and employee volunteers supported non-profit organizations and causes across the state in FY 2021-22. Altogether, the universities' students and employees volunteered 1.3 million hours of their time. According to Independent Sector,[22] the only national membership organization that brings together the charitable community, the average value of a volunteer hour in Ohio in 2020 was $25.47. Multiplying this by the hours the universities' students and employees volunteered amounts to $33.7 million in value to the community.

Next, we convert the $33.7 million in value or, for the purposes of economic impact modeling, earnings by industry to sales using the MR-SAM model's earnings-to-sales ratios, and run the sales figures through the MR-SAM model to derive multiplier effects.

22 By state value per volunteer hour was provided by Independent Sector (see https://independentsector.org/resource/vovt_details/).

Unlike other components of this analysis, we do not include the initial effect. This is because volunteers are not paid employees of the businesses and organizations, so there is no initial labor income associated with their increased productivity or increased initial non-labor income associated with the business output. Therefore, we only include the multiplier effects from the volunteers in the total impact. The volunteers' productivity allows leaders of the businesses and organizations to devote resources to other projects, generating effects throughout the economy—the multiplier effects.

Table 2.15 outlines this process. In FY 2021-22, the universities' volunteers added $72 million in labor income and $7.3 million in non-labor income. The total added income from the universities' volunteers to the Ohio economy sums to 79.3 million in FY 2021-22. This $79.3 million is equivalent to supporting 2,593 jobs in the state.

Table 2.15: Volunteerism impact, FY 2021-22

	Labor income (thousands)	Non-labor income (thousands)	Total income (thousands)	Sales (thousands)	Jobs supported
Initial effect	**$0**	**$0**	**$0**	**$0**	**0**
Multiplier effect					
Direct effect	$33,715	$3,448	$37,163	$77,313	1,196
Indirect effect	$15,158	$1,515	$16,673	$38,010	600
Induced effect	$23,148	$2,356	$25,504	$51,681	797
Total multiplier effect	**$72,021**	**$7,319**	**$79,341**	**$167,004**	**2,593**
Total impact (initial + multiplier)	**$72,021**	**$7,319**	**$79,341**	**$167,004**	**2,593**

Source: Lightcast 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 the universities *throughout their history*. We then use this total number to consider the impact of those students in the single FY 2021-22. 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 the universities stems from the added human capital—the knowledge, creativity, imagination, and entrepreneurship—found in their alumni.

While the public universities of Ohio create an economic impact through their operations, construction, clinical, research, entrepreneurial, visitor, and student spending, as well as volunteerism, the greatest economic impact of the universities stems from the added human capital—the knowledge, creativity, imagination, and entrepreneurship—found in the universities' alumni. While attending the universities, 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 the universities' 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 the universities' 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 the universities.

Wright State University fuels the workforce in Raider Country and beyond

Wright State University's (WSU) greatest economic impact on the region it serves comes from the creativity, entrepreneurship, experience, and innovation provided by alumni.

WSU has over 120,000 alumni living in all 50 states and several dozen countries. More than two-thirds of WSU alumni—nearly 70%—choose to stay in Ohio. In addition, about 56% of graduates, more than 67,000 alumni, make their living in Raider Country, the contiguous 16-county region in western Ohio anchored by WSU's Dayton Campus and Lake Campus.

Based on available data, Raider alumni make vital contributions to the area's major employers. The top employers of WSU alumni living in Raider Country are a mix of 19 school systems, 16 corporations, four higher education institutions, three military organizations, two government entities, and one nonprofit organization. More than 1,900 alumni are employed by the U.S. Air Force/Wright-Patterson Air Force Base, the largest single employer of WSU alumni.

Thousands of skilled employees graduate from WSU and join the labor force each year. WSU provides industries in the region and beyond with dynamic leaders and bold entrepreneurs. According to 2022 alumni data, more than 1,850 alumni list "owner" or "founder" as their job title. These businesses span a wealth of industries, including health, wellness, and fitness; marketing and advertising; hospital and health care; and information technology and services, to name a few.

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;[23] 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 Internal Revenue

23 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.

Service.[24] The result is the estimated portion of alumni from each previous year who were still actively employed in the state as of FY 2021-22.

The next step is to quantify the skills and human capital that alumni acquired from the universities. We use the students' production of CHEs as a proxy for accumulated human capital. The average number of CHEs completed per student in FY 2021-22 was 22.1. To estimate the number of CHEs present in the workforce during the analysis year, we use the universities' historical student headcount over the past 45 years,[25] from FY 1977-78 to FY 2021-22. We apply a 45-year time horizon to include all alumni active in the state workforce who have not reached the average retirement age of 67. The time horizon, or number of years in the workforce, is calculated by subtracting students' average age from the retirement age of 67. However, because the alumni impact is based on credits achieved and not headcount, we calculate and use an average age per credit rather than per student.

We multiply the 22.1 average CHEs per student by the headcounts that we estimate are still actively employed from each of the previous years.[26] Students who enroll at the universities 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 137.4 million CHEs from alumni active in the workforce.

Bowling Green State University aviation—flight center investment/Republic Airways partnership

With nearly 400 students in the program, Bowling Green State University (BGSU) is home to the largest aviation program in the state of Ohio—and one of the few programs with an airport on the land of its campus. BGSU aviation continues to expand through a $5 million investment in the BG Flight Center by partner North Star Aviation that demonstrates the university's shared commitment to addressing a critical workforce need of today. The reputation of BGSU aviation continues to attract more partnerships, such as the pact with Republic Airways that creates a workforce pipeline for aviation students. The partnership with Republic, one of the largest regional airlines in the U.S., provides conditional job offers to BGSU students as early as their second year in the aviation program, allowing students to engage with an airline early and putting them in the pilot's seat faster, as the global demand for pilots climbs.

24 According to a study performed by Pew Research Center, people who have already moved are more likely to move again than people who do not move. Therefore, migration rates are dampened to account for the idea that if they do not move in the first two years after leaving the public universities, then they are less likely to migrate out compared to the average person.

25 The 45-year time horizon reflects the aggregate value for all universities and are subject to fluctuations due to the universities' varying time horizons.

26 This assumes the average level of study from past years is equal to the level of study of students today. Lightcast used data provided by the universities for previous studies to estimate students' credit load in prior years.

Next, we estimate the value of the CHEs, or the skills and human capital acquired by the universities' 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 the universities' alumni and the alternative wage they would have earned had they not attended the universities. Using the state incremental earnings, credits required, and distribution of credits at each level of study, we estimate the average value per CHE to equal $267. This value represents the state average incremental increase in wages that the universities' alumni 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 2021-22, 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 7. 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 $35.9 billion in gross labor income from increased wages received by former students in FY 2021-22 (as shown in Table 2.16).

Table 2.16: Number of CHEs in workforce and initial labor income created in Ohio, FY 2021-22

Number of CHEs in workforce	137,395,676
Average value per CHE	$267
Initial labor income, gross	**$35,941,488,151**
Adjustments for counterfactual scenarios	
Percent reduction for alternative education opportunities	10%
Percent reduction for adjustment for labor import effects	50%
Initial labor income, net	**$19,072,249,447**

Source: Lightcast 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 the universities 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 the universities did not exist, we assume a portion of the universities' 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 the universities' alumni. The adjustment for alternative education opportunities amounts to a 10% reduction of the $35.9 billion in added labor income. This means that 10% of the added labor income from the universities' alumni would have been generated in the state anyway, even if the universities did not exist. For more information on the alternative education adjustment, see Appendix 8.

The other adjustment in Table 2.16 accounts for the importation of labor. Suppose the public universities of Ohio 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 Ohio. 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 universities did not exist.[27] 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 universities. We conduct a sensitivity analysis for this assumption in Appendix 2. With the 50% adjustment, the net added labor income added to the economy comes to $19.1 billion, as shown in Table 2.16.

Ohio University leads workforce development in Appalachian Ohio

Intel has awarded Ohio University (OHIO) $3 million in grant funding to serve as the lead institution for the Appalachian Semiconductor Education and Technical (ASCENT) Ecosystem, a program that will create an inclusive workforce development and training program to cultivate the next generation of skilled technical professionals for Ohio's emerging semiconductor industry.

ASCENT is comprised of a broad coalition of institutions, colleges, and technical centers across the southeastern Appalachian region of Ohio. Each will play a vital role in the visualization, delivery, and programming of the overall ASCENT Ecosystem.

Over the next three years, ASCENT will collaboratively develop and deliver diverse educational options across the region, including standalone and stackable certificates, associate degrees, bachelor's degrees, and graduate degrees that prepare students for career opportunities created by Intel's arrival to Ohio.

The $19.1 billion 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 the universities 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 ($19.1 billion) 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

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

maps the detailed occupations to the six-digit industry sectors in the MR-SAM model.[28] Using a crosswalk created by National Center for Education Statistics (NCES) and the Bureau of Labor Statistics, we map the breakdown of the universities' 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 $19.1 billion in initial labor income effects to the detailed industry sectors in the MR-SAM model.[29]

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 $7.6 billion in added non-labor income attributable to the universities' alumni. Summing initial labor and non-labor income together provides the total initial effect of alumni productivity in the Ohio economy, equal to approximately $26.7 billion. To estimate multiplier effects, we convert the industry-specific income figures generated through the initial effect to sales using sales-to-income ratios from the MR-SAM model. We then run the values through the MR-SAM's multiplier matrix.

Table 2.17: Alumni impact, FY 2021-22

	Labor income (thousands)	Non-labor income (thousands)	Total income (thousands)	Sales (thousands)	Jobs supported
Initial effect	**$19,072,249**	**$7,593,179**	**$26,665,429**	**$57,103,866**	**322,673**
Multiplier effect					
Direct effect	$3,868,458	$1,643,213	$5,511,671	$11,069,607	66,223
Indirect effect	$1,585,271	$680,676	$2,265,947	$4,593,372	27,377
Induced effect	$13,453,774	$4,744,562	$18,198,336	$34,188,383	232,056
Total multiplier effect	**$18,907,504**	**$7,068,452**	**$25,975,955**	**$49,851,363**	**325,656**
Total impact (initial + multiplier)	**$37,979,753**	**$14,661,631**	**$52,641,384**	**$106,955,229**	**648,329**

Source: Lightcast impact model.

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 universities' alumni. The final results are $18.9 billion in added labor income and $7.1 billion in added non-labor income, for an overall total of $26 billion in multiplier effects. The grand total of the alumni impact is $52.6 billion in total added income, the sum of all initial and multiplier labor and non-labor income effects. This is equivalent to supporting 648,329 jobs.

28 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).

29 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.

The University of Cincinnati's No. 1 ranked co-op program provides real-world experience for students, talent for employers

The University of Cincinnati (UC) is the global founder of cooperative education, and its co-op program is ranked No. 1 among the country's public universities and No. 4 among all college and universities by U.S. News & World Report. Collectively, UC students earn $75 million annually via their cooperative education semesters.

The earning-and-learning advantages of co-op are exemplified by student Tre Harris, who has long been a fan of college and professional football. Watching is a favorite pastime, but like many sports enthusiasts, the UC student admits he had no clue what happened behind the scenes of a sports broadcast.

That was the case until an adviser suggested Harris sign up for a new class known as Introduction to Sports Media Production. Harris, now in his third year of study at UC's College-Conservatory of Music (CCM), is part of a regular student production crew.

The students in sports media classes that are offered in the CCM Media Production Division are part of an experience-based learning effort that allows them to work outside of the classroom to produce and direct television broadcasts that air live on ESPN+. This partnership between the college, broadcaster, UC Athletics, and this class offering are part of UC's Co-op 2.0 program, which builds on the university's long tradition of academic-industry co-op partnerships for design, engineering, IT, business, and other majors.

The innovative class has attracted media coverage, along with campus attention for the student expertise it has helped cultivate.

Total impact of the public universities of Ohio

The total economic impact of the public universities of Ohio on the state of Ohio can be generalized into two broad types of impacts. First, on an annual basis, the universities generate a flow of spending that has a significant impact on the state economy. The impacts of this spending are captured by the operations, construction, clinical, research, entrepreneurial, visitor, and student spending impacts, along with the volunteerism impact. While not insignificant, these impacts do not capture the true purpose of the universities. The basic mission of the public universities of Ohio is to foster human capital. Every year, a new cohort of the universities' former 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: Total impact of the public universities of Ohio, FY 2021-22

	Labor income (thousands)	Non-labor income (thousands)	Total income (thousands)	Sales (thousands)	Jobs supported
Operations spending	$3,983,738	$74,310	$4,058,048	$6,783,571	71,726
Construction spending	$630,972	-$32,978	$597,994	$2,800,081	8,590
Clinical spending	$5,544,367	$1,383,511	$6,927,879	$12,742,972	78,323
Research spending	$1,650,969	$219,880	$1,870,849	$3,597,825	24,460
Start-up and spin-off companies	$1,162,223	$585,128	$1,747,352	$3,044,053	15,238
Visitor spending	$97,955	$82,205	$180,160	$603,274	3,531
Student spending	$460,809	$333,834	$794,643	$2,372,174	13,992
Volunteerism	$72,021	$7,319	$79,341	$167,004	2,593
Alumni	$37,979,753	$14,661,631	$52,641,384	$106,955,229	648,329
Total impact	**$51,582,809**	**$17,314,840**	**$68,897,649**	**$139,066,183**	**866,782**
% of the Ohio economy	11.3%	5.3%	8.8%	8.4%	12.1%

Source: Lightcast impact model.

Table 2.18 displays the grand total impacts of the universities on the Ohio economy in FY 2021-22. For context, the percentages of the universities compared to the total labor income, total non-labor income, combined total income, sales, and jobs in Ohio, as presented in Table 1.3 and Figure 1.3, are included. The total added value of the universities is **$68.9 billion**, equivalent to **8.8%** of the GSP of Ohio. By comparison, this contribution that the universities provide on their own is larger than the entire Health Care & Social Assistance industry in the state. The universities' total impact supported **866,782 jobs** in FY 2021-22. For perspective, this means that **one out of every eight jobs** in Ohio is supported by the activities of the universities and their students.

These impacts from the universities and their students stem from different industry sectors and spread throughout the state economy. Table 2.19 displays the total impact of the universities by each industry sector based on their two-digit NAICS code. The table shows the total impact of operations, construction, clinical, research, start-up and spin-off companies, visitors, students, volunteerism, 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 activities of the universities and from where alumni are employed. For example, the activities of the universities and their alumni in the Health Care & Social Assistance industry sector generated an impact of $12.7 billion in FY 2021-22.

: Youngstown State University

Table 2.19: **Total impact of the public universities of Ohio by industry, FY 2021-22**

Industry sector	Total income (thousands)	Jobs supported
Health Care & Social Assistance	$12,733,560	167,218
Government, Education	$8,770,672	145,172
Professional & Technical Services	$7,567,368	74,680
Manufacturing	$6,585,838	37,729
Government, Non-Education	$4,608,748	39,622
Finance & Insurance	$4,198,758	22,584
Construction	$2,808,449	36,643
Information	$2,789,264	13,718
Retail Trade	$2,479,595	38,999
Administrative & Waste Services	$2,381,095	38,209
Wholesale Trade	$2,364,567	11,393
Other Services (except Public Administration)	$2,158,282	68,205
Management of Companies & Enterprises	$1,939,291	12,498
Educational Services	$1,633,354	43,629
Arts, Entertainment, & Recreation	$1,550,254	57,038
Real Estate & Rental & Leasing	$1,542,137	21,555
Accommodation & Food Services	$965,738	22,490
Utilities	$810,981	1,343
Transportation & Warehousing	$775,755	11,678
Mining, Quarrying, & Oil and Gas Extraction	$127,200	676
Agriculture, Forestry, Fishing, & Hunting	$106,744	1,703
Total impact	**$68,897,649**	**866,782**

Source: Lightcast impact model.

Chapter 3:

Investment analysis

The benefits generated by the public universities of Ohio affect the lives of many people. The most obvious beneficiaries are the universities' students; they give up time and money to go to the universities 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 Ohio 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 the universities, collectively, as a worthwhile investment from the perspectives of students, taxpayers, and society.

The University of Toledo

Student perspective

To enroll in postsecondary education, students pay 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 tuition and fees that students pay and the opportunity cost 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 $3.3 billion from Figure 1.1. Direct outlays also include the cost of books and supplies. On average, full-time students spent $1,077 each on books and supplies during the reporting year.[30] Multiplying this figure by the number of full-time equivalents (FTEs) produced by the universities in FY 2021-22[31] generates a total cost of $255.4 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 universities but also incur the interest cost of taking out loans. In FY 2021-22, students received a total of $630.9 million in federal loans to attend the universities.[32] 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 $630.9 million in federal loans is subtracted from the costs incurred by students in FY 2021-22.

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

30 Based on the data provided by the public universities of Ohio.

31 A single FTE is equal to 30 CHEs for undergraduate students and 24 CHEs for graduate students, so there were 262,132 FTEs produced by students in FY 2021-22.

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

time and earnings foregone by students who go to the universities 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 universities.

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 at the start of the analysis year.[33] However, the earnings levels in Table 1.4 reflect what average workers earn at the midpoint of their careers, not while attending the universities. Because of this, we adjust the earnings levels to the average age of the student population (24) to better reflect their wages at their current age.[34] This calculation yields an average full earning potential of $21,843 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 the universities in FY 2021-22 earned an average of 22.8 CHEs per student (excluding personal enrichment students and dual credit high school students), which is approximately equal to 80% of a full academic year.[35] We thus include no more than $17,551 (or 80%) of the students' full earning potential in the opportunity cost calculations.

Shawnee State University's free tuition program provides economic impact to the region and state

Shawnee State University (SSU) developed a Free Tuition program to make college possible for Pell-eligible students in Ohio's most distressed regions: Scioto, Lawrence, Adams, Pike, Jackson, Ross, Brown, Gallia, Highland, and Vinton Counties in Ohio, as well as Greenup, Boyd and Lewis Counties in Kentucky.

The program is funded in part through donations to the Friends of Shawnee Scholarship within the SSU Development Foundation and is helping students overcome financial barriers that may keep them from completing their degrees.

Providing more opportunities for students in the region, who use their SSU degrees to fill vital healthcare, business, education and technology jobs in the region, benefits the entire southern Ohio community.

Application for free tuition is automatically considered when students complete their general university application.

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

34 Further discussion on this adjustment appears in Appendix 7.

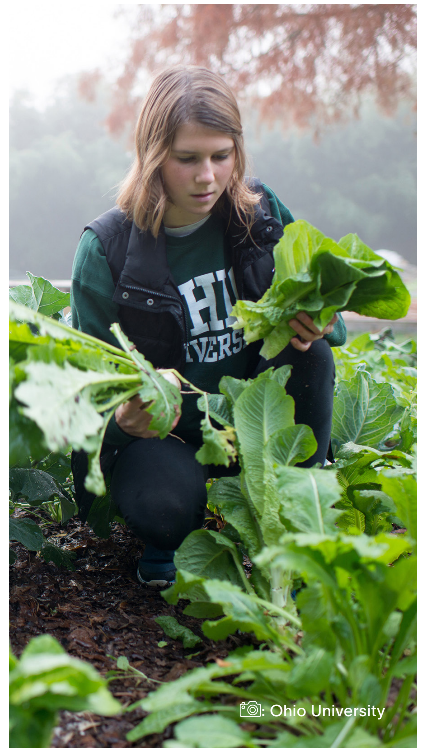
35 Equal to 22.8 CHEs divided by 30 for the proportion of undergraduate students and 24 for the proportion of graduate students, the assumed number of CHEs in a full-time academic year.

Another factor to consider is the students' employment status while enrolled in post-secondary education. It is estimated that 58% of students are employed.[36] For the remainder of students, we assume that they are either seeking work or planning to seek work once they complete their educational goals (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 $17,551). The total value of their foregone earnings thus comes to $2.4 billion.

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 77% of what they would have earned had they chosen to work full-time rather than go to college.[37] The remaining 23% comprises the percentage of 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 23% 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 0.3 hours of leisure time per day.[38] Assuming that an hour of leisure is equal in value to an hour of work, we derive the total cost of leisure by multiplying the number of leisure hours foregone during the academic year by the average hourly pay of the students' full earning potential. For working students, therefore, their total opportunity cost is $841.8 million, equal to the sum of their foregone earnings ($726.2 million) and foregone leisure time ($115.6 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 universities 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 $630.9 million in loans was awarded to 94,389 students, averaging $6,684 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 the universities are four-year universities, students will be indebted four times that amount, or $26,736 on average. According



: Ohio University

: Cleveland State University

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

37 The 77% assumption is based on the average hourly wage of jobs commonly held by working students divided by the state average hourly wage. Occupational wage estimates are published by the Bureau of Labor Statistics (see http://www.bls.gov/oes/current/oes_nat.htm).

38 American Time Use Survey. 2017-2019. Last modified November 30, 2021. Accessed March 2022. https://www.bls.gov/tus/data.htm.

to the U.S. Department of Education, this level of indebtedness will take 20 years to pay back under the standard repayment plan.[39]

This indebtedness calculation is used solely to estimate the loan payback period. Students will be paying back the principal amount of $630.9 million over time. After taking into consideration the time value of money, this means that students will pay off a discounted present value of $414.4 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 2021-22. Using the student discount rate of 3.7%[40] as our interest rate, we calculate that students will pay a total discounted present value of $209.4 million in interest on student loans throughout 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 $2.9 billion, the sum of tuition and fees ($3.3 billion) and books and supplies ($255.7 million), less federal loans received ($630.9 million) and $3.4 million in direct outlays of personal enrichment students (those students are excluded

Table 3.1: Present value of student costs, FY 2021-22 (thousands)

Direct outlays in FY 2021-22	
Tuition and fees	$3,288,952
Less federal loans received	-$630,901
Books and supplies	$255,723
Less direct outlays of personal enrichment students	-$3,367
Total direct outlays	**$2,910,406**
Opportunity costs in FY 2021-22	
Earnings foregone by non-working students	$2,354,055
Earnings foregone by working students	$726,186
Value of leisure time foregone by working students	$115,577
Less residual aid	-$582,791
Total opportunity costs	**$2,613,027**
Future student loan costs (present value)	
Student loan principal	$414,426
Student loan interest	$209,438
Total present value student loan costs	**$623,864**
Total present value student costs	**$6,147,297**

Source: Based on data provided by the public universities of Ohio and outputs of the Lightcast impact model.

39 Repayment period based on total education loan indebtedness, U.S. Department of Education, 2022. https://studentaid.ed.gov/sa/repay-loans/understand/plans/standard.

40 The student discount rate is derived from the baseline forecasts for the 10-year discount rate published by the Congressional Budget Office. See the Congressional Budget Office, Student Loan and Pell Grant Programs—July 2021 Baseline. https://www.cbo.gov/system/files/2021-07/51310-2021-07-studentloan.pdf.

from the cost calculations). Opportunity costs for working and non-working students amount to $2.6 billion, excluding $582.8 million in offsetting residual aid that is paid directly to students.[41] Finally, we have the present value of future student loan costs, amounting to $623.9 million between principal and interest. Summing direct outlays, opportunity costs, and future student loan costs together yields a total of $6.1 billion in present value student costs.

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 universities' FY 2021-22 students first by determining their average annual increase in earnings, equal to $1.9 billion. 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 universities. Using the state of Ohio earnings, the marginal wage increase per CHE is $257. For a full description of the methodology used to derive the $1.9 billion, see Appendix 7.

The second step is to project the $1.9 billion annual increase in earnings into the future, for as long as students remain in the workforce. We do this using the Mincer function to predict the change in earnings at each point in an individual's working career.[42] The Mincer function originated from Mincer's seminal work on human capital (1958). The function estimates earnings using an individual's years of education and post-schooling experience. While some have criticized Mincer's earnings function, it is still upheld in recent data and has served as the foundation for a variety of research pertaining to labor economics. Card (1999 and 2001) addresses a number of these criticisms using U.S. based research over the last three decades and concludes that any upward bias in the Mincer parameters is on the order of 10% or less. We use state-specific and education level-specific Mincer coefficients. To account for any upward bias, we incorporate a 10% reduction in our projected earnings, otherwise known as the ability bias. With the $1.9 billion 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.


: The Ohio State University


: The University of Akron

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

42 Appendix 7 provides more information on the Mincer function and how it is used to predict future earnings growth.

As shown in Table 3.2, the $1.9 billion 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 $1.9 billion and the gross higher earnings in the years after the midpoint are greater than $1.9 billion.

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 2021-22 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 universities 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.

Miami University cultivates nursing excellence

Miami University Nursing faculty are immersed in health care communities across southwestern Ohio, contributing to long standing relationships with many area hospitals and agencies such as Cincinnati Children's Hospital, Harbor House, YMCA Hamilton, Kettering Health Hospitals, TriHealth Hospitals, and Lindner Center of Hope. These relationships allow students to engage in high-quality, diverse clinical experiences that have real impact on real communities. Miami students receive hands-on experiences in hospitals, schools, military bases, and nonprofits. Miami graduates have highly marketable skills that enable them to find immediate employment and positively affect the lives of their communities.

Miami University Nursing graduates are equipped with the clinical, professional, and interpersonal skills needed to make a meaningful impact in any health care environment. Graduates learn and practice the latest care techniques and collaborate with professionals in a variety of clinical settings and state-of-the-art facilities. The newly renovated $10 million Nursing Innovation Hub in Hamilton features high-tech classrooms, high-fidelity simulation labs, and a multi-bed skilled nursing area. This space provides students and faculty with the equipment needed to adapt to emerging healthcare trends. The new Clinical Health Sciences and Wellness (opening Fall 2023) on Miami's Oxford campus will house Miami's new Master of Medical Science/Physician Associate studies program; Nursing, Speech Pathology, and Audiology programs; and the TriHealth Health Services clinic. This building will be a one-stop shop for health science classes, research, and experiential learning.

Table 3.2: **Projected benefits and costs, student perspective**

1 Year	2 Gross higher earnings to students (millions)	3 % active in workforce*	4 Net higher earnings to students (millions)	5 Student costs (millions)	6 Net cash flow (millions)
0	$671.1	11%	$74.4	$5,523.4	-$5,449.0
1	$733.5	19%	$142.0	$44.2	$97.9
2	$798.9	29%	$232.3	$44.2	$188.1
3	$867.4	45%	$391.0	$44.2	$346.8
4	$938.7	67%	$630.6	$44.2	$586.5
5	$1,012.8	97%	$987.3	$44.2	$943.2
6	$1,089.5	97%	$1,060.9	$44.2	$1,016.8
7	$1,168.4	97%	$1,136.6	$44.2	$1,092.4
8	$1,249.4	97%	$1,213.9	$44.2	$1,169.8
9	$1,332.2	97%	$1,292.7	$44.2	$1,248.6
10	$1,416.4	97%	$1,372.7	$44.2	$1,328.5
11	$1,501.7	97%	$1,453.3	$44.2	$1,409.2
12	$1,587.8	97%	$1,534.3	$44.2	$1,490.2
13	$1,674.3	96%	$1,615.3	$44.2	$1,571.2
14	$1,760.6	96%	$1,695.9	$44.2	$1,651.7
15	$1,846.5	96%	$1,775.6	$44.2	$1,731.4
16	$1,931.5	96%	$1,854.0	$44.2	$1,809.8
17	$2,015.1	96%	$1,930.5	$44.2	$1,886.4
18	$2,096.9	96%	$2,004.8	$44.2	$1,960.7
19	$2,176.4	95%	$2,076.3	$44.2	$2,032.2
20	$2,253.1	95%	$2,144.6	$44.2	$2,100.4
21	$2,326.6	95%	$2,209.1	$2.3	$2,206.7
22	$2,396.5	95%	$2,269.3	$2.3	$2,267.0
23	$2,462.4	94%	$2,324.9	$2.3	$2,322.6
24	$2,523.7	94%	$2,375.4	$2.3	$2,373.1
25	$2,580.2	94%	$2,420.4	$2.3	$2,418.0
26	$2,631.6	93%	$2,459.4	$2.3	$2,457.0
27	$2,677.3	93%	$2,492.1	$2.3	$2,489.8
28	$2,717.3	93%	$2,518.2	$2.3	$2,515.9
29	$2,751.2	92%	$2,537.3	$2.3	$2,535.0
30	$2,778.9	92%	$2,549.2	$2.3	$2,546.9
31	$2,800.1	91%	$2,553.8	$0.0	$2,553.8
32	$2,814.7	91%	$2,550.9	$0.0	$2,550.9
33	$2,802.8	90%	$2,524.8	$0.0	$2,524.8
34	$2,804.7	89%	$2,507.7	$0.0	$2,507.7
35	$2,799.8	89%	$2,483.4	$0.0	$2,483.4
36	$2,788.5	88%	$2,451.9	$0.0	$2,451.9
37	$2,770.6	87%	$2,413.4	$0.0	$2,413.4
38	$2,746.5	86%	$2,368.3	$0.0	$2,368.3
39	$2,716.2	85%	$2,317.0	$0.0	$2,317.0
40	$2,680.1	84%	$2,260.0	$0.0	$2,260.0
41	$2,508.6	83%	$2,093.9	$0.0	$2,093.9
42	$2,178.5	83%	$1,801.7	$0.0	$1,801.7
43	$1,313.8	82%	$1,079.4	$0.0	$1,079.4
44	$207.5	83%	$171.9	$0.0	$171.9
45	$182.6	82%	$149.4	$0.0	$149.4
Present value			**$34,200.6**	**$6,147.3**	**$28,053.3**

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

Source: Lightcast impact model.

Benefit-cost ratio	Internal rate of return	Payback period (years)
5.6	16.2%	8.0

Beyond the first five years of the time horizon, students will leave the workforce for any number of reasons, whether death, retirement, or unemployment. We estimate the rate of attrition using the same data and assumptions applied in the calculation of the attrition rate in the economic impact analysis of Chapter 2.[43] The likelihood of leaving the workforce increases as students age, so the attrition rate is more aggressive near the end of the time horizon than in the beginning. Column 4 of Table 3.2 shows the net higher earnings to students after accounting for both the settling-in patterns and attrition.

Return on investment for students

Having estimated the students' costs and their future benefits stream, the next step is to discount the results to the present to reflect the time value of money. For the student perspective we assume a discount rate of 3.7% (see below). Because students tend to rely upon debt to pay for education—i.e. they are negative savers—their discount rate is based upon student loan interest rates.[44] In Appendix 2, 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.

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 3.7% discount rate from the student perspective and a -0.3% discount rate from the perspectives of taxpayers and society.

In Table 3.2, the net higher earnings of students yield a cumulative discounted sum of approximately $34.2 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 2021-22 student body is rewarded for its investment in the universities with a capital asset valued at $34.2 billion.

43 See the discussion of the alumni impact in Chapter 2. The main sources for deriving the attrition rate are the National Center for Health Statistics, the Social Security Administration, and the Bureau of Labor Statistics. Note that we do not account for migration patterns in the student investment analysis because the higher earnings that students receive as a result of their education will accrue to them regardless of where they find employment.

44 The student discount rate is derived from the baseline forecasts for the 10-year Treasury rate published by the Congressional Budget Office. See the Congressional Budget Office, Student Loan and Pell Grant Programs—July 2021 Baseline. https://www.cbo.gov/system/files/2021-07/51310-2021-07-studentloan.pdf.

The students' cost of attending the universities is shown in Column 5 of Table 3.2, equal to a present value of $6.1 billion. Comparing the cost with the present value of benefits yields a student benefit-cost ratio of 5.6 (equal to $34.2 billion in benefits divided by $6.1 billion in costs).

Another way to compare the same benefits stream and associated cost is to compute the rate of return. The rate of return indicates the interest rate that a bank would have to pay a depositor to yield an equally attractive stream of future payments.[45] Table 3.2 shows the universities' students earning average returns of 16.2% on their investment of time and money. This is a favorable return compared, for example, to approximately 1% on a standard bank savings account, or 10.5% on stocks and bonds (30-year average return).

Ohio's public universities' students see an average rate of return of **16.2%** for their investment of time and money.

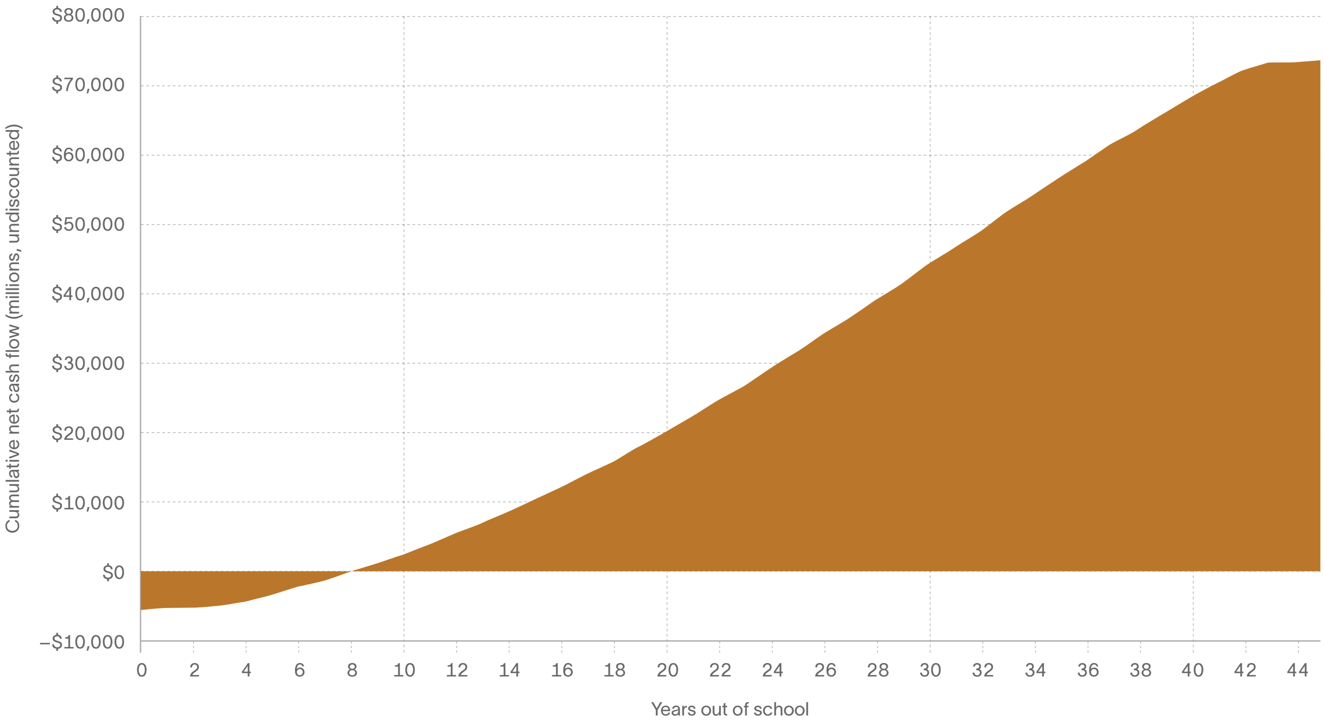
Note that returns reported in this study are real returns, not nominal. When a bank promises to pay a certain rate of interest on a savings account, it employs an implicitly nominal rate. Bonds operate in a similar manner. If it turns out that the inflation rate is higher than the stated rate of return, 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 16.2% student rate of return is a real rate. With an inflation rate of 2.2% (the average rate reported over the past 20 years as per the U.S. Department of Commerce, Consumer Price Index), the corresponding nominal rate of return is 18.4%, higher than what is reported in Table 3.2.

The payback period is defined as the length of time it takes to entirely recoup the initial investment.[46] Beyond that point, returns are what economists would call pure costless rent. As indicated in Table 3.2, students at the universities see, on average, a payback period of 8.0 years, meaning 8.0 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).

45 Rates of return are computed using the familiar internal rate-of-return calculation. Note that, with a bank deposit or stock market investment, the depositor puts up a principal, receives in return a stream of periodic payments, and then recovers the principal at the end. Someone who invests in education, on the other hand, receives a stream of periodic payments that include the recovery of the principal as part of the periodic payments, but there is no principal recovery at the end. These differences notwithstanding comparable cash flows for both bank and education investors yield the same internal rate of return.

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

Figure 3.1: **Student payback period**



Source: Lightcast impact model.

📷: The University of Cincinnati

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 the universities, students earn more because of the skills they learned while attending the universities, 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 the universities 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 Lightcast's MR-SAM model to estimate the added labor income created in the state as students and businesses spend their higher earnings.[47] As labor income increases, so does non-labor income, which consists of monies gained through investments. To calculate the growth in non-labor income, we multiply the increase in labor income by a ratio of the Ohio 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 2021-22 from operations, construction, clinical, research, visitor, and student spending. To each of these, we apply the prevailing tax rates so we capture only the tax revenues attributable to state and local government from this additional revenue.

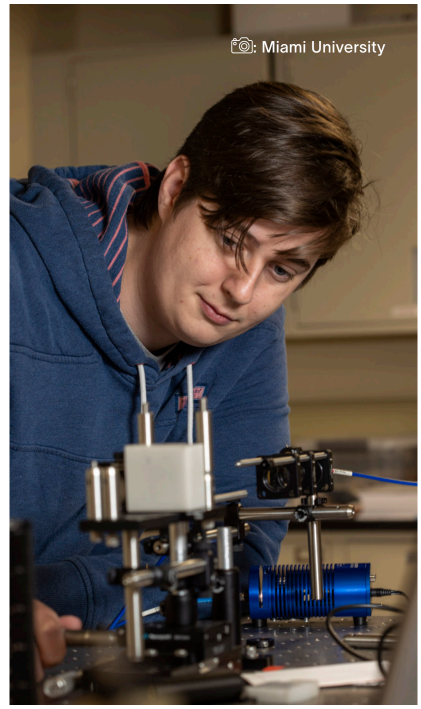
47 For a full description of the Lightcast MR-SAM model, see Appendix 6.

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 universities with data on migration patterns from the Internal Revenue Service to estimate the number of students who will leave the state workforce over time.

We apply another reduction factor to account for the students' alternative education opportunities. This is the same adjustment that we use in the calculation of the alumni impact in Chapter 2 and is designed to account for the counterfactual scenario where the universities do not exist. The assumption in this case is that any benefits generated by students who could have received an education even without the universities cannot be counted as new benefits to society. For this analysis, we assume an alternative education variable of 10%, meaning that 10% of the student population at the universities would have generated benefits anyway even without the universities. For more information on the alternative education variable, see Appendix 8.

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 universities. 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 the universities did not exist and the universities had to derive the revenue elsewhere. To estimate this shutdown point, we apply a sub-model that simulates the students' demand curve for education by reducing state and local support to zero and progressively increasing student tuition and fees. As student tuition and fees increase, enrollment declines. For the universities, the shutdown point adjustment is 7%, meaning that the added tax revenue results are discounted by 7% to account for the benefits that the institutions could still potentially generate even without taxpayer support. For more information on the theory and methodology behind the estimation of the shutdown point, see Appendix 10.

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 $8.4 billion. 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 -0.3%. This is the real treasury interest rate reported by the Office of Management and Budget (OMB) for 30-year investments, and in Appendix 2, we conduct a sensitivity analysis of this discount rate.[48]



48 Office of Management and Budget. "Discount Rates for Cost-Effectiveness, Lease Purchase, and Related Analyses." *Real Interest Rates on Treasury Notes and Bonds of Specified Maturities (in Percent)*. https://www.whitehouse.gov/wp-content/uploads/2020/12/discount-history.pdf.

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 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 drawn from public resources absent the education provided by the universities. 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.

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**.

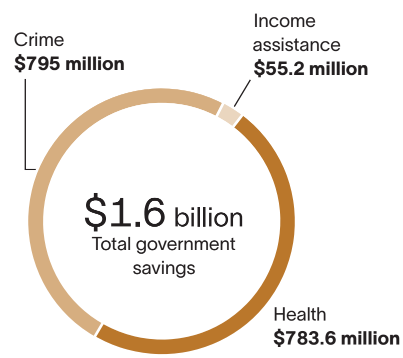
The model quantifies government savings by calculating the probability at each education level that individuals will have poor health, commit crimes, or claim welfare and unemployment benefits. Deriving the probabilities involves assembling data from a variety of studies and surveys analyzing the correlation 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 universities, 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 7 to account for factors (besides education) that influence individual behavior. We then multiply the marginal effects of education times the associated costs of health, crime, and income assistance.[49] Finally, we apply the same adjustments for attrition, alternative

Table 3.3: Present value of added tax revenue and government savings (thousands)

Added tax revenue	**$8,367,530**
Government savings	
Health-related savings	$783,604
Crime-related savings	$795,022
Income assistance savings	$55,238
Total government savings	**$1,633,864**
Total taxpayer benefits	**$10,001,394**

Source: Lightcast impact model.

Figure 3.2: Present value of government savings



Source: Lightcast impact model.

49 For a full list of the data sources used to calculate the social externalities, see the Resources and References section. See also Appendix 11 for a more in-depth description of the methodology.

education, and the shutdown point to derive the net savings to the government. Total government savings appear in Figure 3.2 and sum to $1.6 billion.

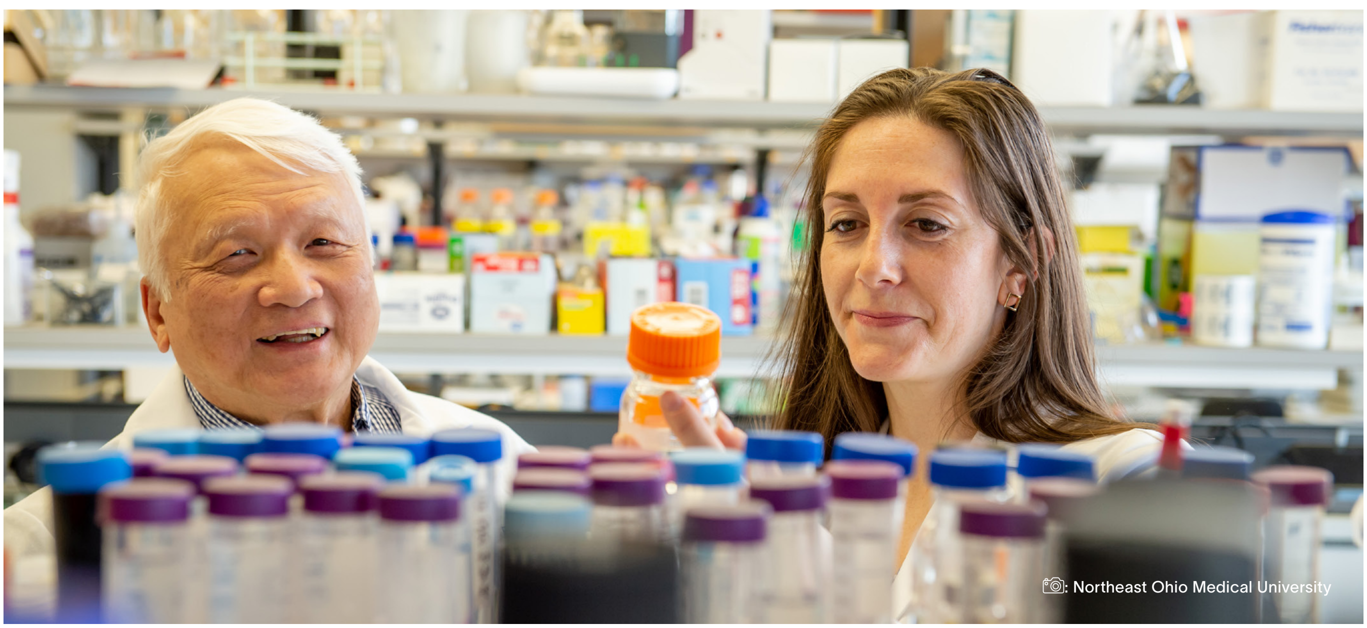
Table 3.3 displays all benefits to taxpayers. The first row shows the added tax revenues created in the state, equal to $8.2 billion, from students' higher earnings, increases in non-labor income, and spending impacts. The sum of the government savings and the added income in the state is $10 billion, as shown in the bottom row of Table 3.3. These savings continue to accrue in the future as long as the FY 2021-22 student population of the universities remains in the workforce.

Return on investment for taxpayers

Taxpayer costs are reported in Table 3.4 and come to $2.2 billion, equal to the contribution of state and local government to the public universities of Ohio. In return for their public support, taxpayers are rewarded with an investment benefit-cost ratio of 4.6 (= $10 billion ÷ $2.2 billion), indicating a profitable investment.

Given that the stakeholder in this case is the public sector, we use the discount rate of -0.3%, the real treasury interest rate reported by the Office of Management and Budget for 30-year investments. However, due to the abnormal Treasury interest rate, U.S. inflation rate, and amount of government economic incentives in FY 2020-21, it is more reasonable to look at the benefit-cost ratio than the internal rate of return. A benefit-cost ratio greater than 1.0 indicates a good public investment since the taxes from the universities' student higher earnings and reduced government expenditures not only recover taxpayer costs but grow Ohio's tax base.

A benefit-cost ratio of **4.6** means the public universities of Ohio are a good public investment since the taxes from student higher earnings and reduced government expenditures not only recover taxpayer costs but grow Ohio's tax base.



📷: Northeast Ohio Medical University

Table 3.4: **Projected benefits and costs, taxpayer perspective**

1	2	3	4
Year	**Benefits to taxpayers (millions)**	**State & local government costs (millions)**	**Net cash flow (millions)**
0	$1,076.0	$2,167.1	-$1,091.1
1	$28.1	$0.0	$28.1
2	$43.2	$0.0	$43.2
3	$69.7	$0.0	$69.7
4	$107.6	$0.0	$107.6
5	$161.5	$0.0	$161.5
6	$165.6	$0.0	$165.6
7	$170.0	$0.0	$170.0
8	$174.7	$0.0	$174.7
9	$179.2	$0.0	$179.2
10	$183.9	$0.0	$183.9
11	$187.8	$0.0	$187.8
12	$192.6	$0.0	$192.6
13	$197.0	$0.0	$197.0
14	$201.0	$0.0	$201.0
15	$205.6	$0.0	$205.6
16	$209.8	$0.0	$209.8
17	$213.9	$0.0	$213.9
18	$217.9	$0.0	$217.9
19	$221.7	$0.0	$221.7
20	$225.0	$0.0	$225.0
21	$228.0	$0.0	$228.0
22	$231.0	$0.0	$231.0
23	$233.2	$0.0	$233.2
24	$235.3	$0.0	$235.3
25	$236.7	$0.0	$236.7
26	$237.4	$0.0	$237.4
27	$238.0	$0.0	$238.0
28	$238.1	$0.0	$238.1
29	$237.6	$0.0	$237.6
30	$236.5	$0.0	$236.5
31	$234.9	$0.0	$234.9
32	$232.6	$0.0	$232.6
33	$229.2	$0.0	$229.2
34	$225.9	$0.0	$225.9
35	$222.0	$0.0	$222.0
36	$217.6	$0.0	$217.6
37	$212.8	$0.0	$212.8
38	$207.4	$0.0	$207.4
39	$201.7	$0.0	$201.7
40	$195.6	$0.0	$195.6
41	$175.4	$0.0	$175.4
42	$146.7	$0.0	$146.7
43	$78.3	$0.0	$78.3
44	$10.5	$0.0	$10.5
45	$8.5	$0.0	$8.5
Present value	**$9,996.9**	**$2,167.1**	**$7,829.8**

Source: Lightcast impact model.

Benefit-cost ratio
4.6

Internal rate of return
12.7%

Payback period (years)
9.0

Social perspective

Ohio benefits from the education that the public universities of Ohio provide 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 the universities did not exist. Society's investment in the universities stretches across a number of investor groups, from students to employers to taxpayers. We weigh the benefits generated by the universities to these investor groups against the total social costs of generating those benefits. The total social costs include all of the universities' expenditures, all student expenditures (including interest on student loans) less tuition and fees, and all student opportunity costs, totaling a present value of $18 billion.

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

- Expenditures of Ohio's public universities
- Student out-of-pocket expenses
- Student opportunity costs

Social benefits

- Increased economic base
- Avoided social costs

Growth in state economic base

In the process of absorbing the newly acquired skills of students who attend the universities, not only does the productivity of the Ohio 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 universities, 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 the universities on the state's economic base follows a similar process used when calculating increased tax revenues in the taxpayer perspective.

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.

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 Lightcast'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 (added student and business income in Figure 3.3.). We also include the operations, construction, clinical, research, visitor, and student spending impacts discussed in Chapter 2 that were created in FY 2021-22 (added income from the universities' activities in Figure 3.3.). 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 universities, 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 $127.1 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 -0.3%.

📷: Bowling Green State University

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 the universities. 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

Central State University's Center of Excellence HBCU Corporate Engagement provides opportunity

Central State University (CSU) has increased its focus on strengthening corporate partnerships by establishing the Center of Excellence HBCU Corporate Engagement under the Division of Institutional Advancement. The center focuses on outreach, research, and development for student placement and talent pipeline development.

Through partnerships with companies including Dominion Energy, P&G, Grange Insurance, Nationwide, PNC, JPMorgan Chase, Fifth Third Bank, Strada, and others, over $2 million has been raised for the center, forming the foundation for a multimillion-dollar capital campaign.

Focusing on its key principles, the center provides student-focused opportunities for CSU undergraduates to acquire the tools, develop the skills, and cultivate the mindset central to planning, launching, and managing a successful career. The center cultivates the development of mutually beneficial relationships that include sponsorships, workforce development partnerships, and education philanthropy. Students are served through intentional placement for experiential student learning, access to industry experts, and resources and funds for academic scholarship, producing graduates equipped with analytical skills required for success in a global workforce. Further, the center prioritizes data and research to provide case statements that maximize the relationship between education and employment, providing research assistance to corporate partners to help meet the needs of a diverse workforce.

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.

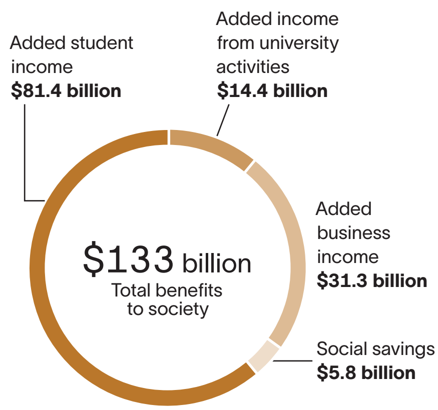
Table 3.5 displays the results of the analysis. The first row shows the increased economic base in the state, equal to $127.1 billion, from students' higher earnings and their multiplier effects, increases in non-labor income, and spending impacts. Social savings appear next, beginning with a breakdown 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 $4.8 billion. Crime savings amount to $990.3 million, including savings associated with a reduced number of crime victims, added worker productivity, and reduced expenditures for police and law enforcement, courts and administration of justice, and corrective services. Finally, the present value of the savings related to income assistance amount to $61.2 million, stemming from a reduced number of persons in need of welfare or unemployment benefits. All told, social savings amounted to $5.8 billion in benefits to communities and citizens in Ohio.

Table 3.5: Present value of the future increased economic base and social savings in the state (thousands)

Increased economic base	**$127,141,205**
Social savings	
Health	
Smoking	$1,185,125
Alcohol dependence	$606,445
Obesity	$1,168,041
Depression	$1,574,881
Drug abuse	$235,602
Total health savings	**$4,770,094**
Crime	
Criminal justice system savings	$848,968
Crime victim savings	$23,394
Added productivity	$117,944
Total crime savings	**$990,305**
Income assistance	
Welfare savings	$40,380
Unemployment savings	$20,806
Total income assistance savings	**$61,185**
Total social savings	**$5,821,584**
Total, increased economic base + social savings	**$132,962,789**

Source: Lightcast impact model.

Figure 3.3: Present value of benefits to society



Source: Lightcast impact model.

The sum of the social savings and the increased state economic base is $133 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 2021-22 student population of the universities remains in the workforce.

Return on investment for society

Table 3.6 presents the stream of benefits accruing to the Ohio 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 7.4. This means that for every dollar invested in an education from the universities, whether it is the money spent on operations of the universities or money spent by students on tuition and fees, an average of $7.40 in benefits will accrue to society in Ohio.[50]

Workforce development opportunities abound at Youngstown State University

In July 2021, Youngstown State University (YSU) opened a one-of-a-kind workforce, education, research, and commercial center focused on advanced manufacturing. The Excellence Training Center (ETC) in Kohli Hall, associated with the Division of Workforce Education and Innovation, provides career pathways for all types of students that include traditional and non-traditional certifications and industry recognized credentials offered in a wide range of areas, such as manual and Computer Narrative Control (CNC) machining, a subtractive manufacturing process in industrial maintenance, robotics, automation and additive manufacturing. The ETC houses over $10 million of advanced manufacturing equipment that is used to bring the programs to life and is owned and operated by YSU.

50 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.

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	$14,644.4	$17,042.5	-$2,398.0
1	$293.1	$44.2	$249.0
2	$461.2	$44.2	$417.1
3	$762.0	$44.2	$717.9
4	$1,203.3	$44.2	$1,159.2
5	$1,848.1	$44.2	$1,803.9
6	$1,931.8	$44.2	$1,887.7
7	$2,017.4	$44.2	$1,973.3
8	$2,104.4	$44.2	$2,060.2
9	$2,191.9	$44.2	$2,147.7
10	$2,279.0	$44.2	$2,234.9
11	$2,365.0	$44.2	$2,320.8
12	$2,449.5	$44.2	$2,405.3
13	$2,532.4	$44.2	$2,488.2
14	$2,613.2	$44.2	$2,569.0
15	$2,691.4	$44.2	$2,647.3
16	$2,766.6	$44.2	$2,722.5
17	$2,838.2	$44.2	$2,794.1
18	$2,905.8	$44.2	$2,861.7
19	$2,968.8	$44.2	$2,924.6
20	$3,026.7	$44.2	$2,982.5
21	$3,079.0	$2.3	$3,076.7
22	$3,125.4	$2.3	$3,123.1
23	$3,165.5	$2.3	$3,163.1
24	$3,198.7	$2.3	$3,196.4
25	$3,224.9	$2.3	$3,222.5
26	$3,243.6	$2.3	$3,241.3
27	$3,254.7	$2.3	$3,252.4
28	$3,257.8	$2.3	$3,255.5
29	$3,252.8	$2.3	$3,250.5
30	$3,239.5	$2.3	$3,237.1
31	$3,217.9	$0.0	$3,217.9
32	$3,188.1	$0.0	$3,188.1
33	$3,141.9	$0.0	$3,141.9
34	$3,096.7	$0.0	$3,096.7
35	$3,043.9	$0.0	$3,043.9
36	$2,983.7	$0.0	$2,983.7
37	$2,916.6	$0.0	$2,916.6
38	$2,843.1	$0.0	$2,843.1
39	$2,763.8	$0.0	$2,763.8
40	$2,679.1	$0.0	$2,679.1
41	$2,423.3	$0.0	$2,423.3
42	$2,054.0	$0.0	$2,054.0
43	$1,114.2	$0.0	$1,114.2
44	$137.2	$0.0	$137.2
45	$108.8	$0.0	$108.8
Present value	**$132,962.8**	**$17,979.1**	**$114,983.6**

Source: Lightcast impact model.

Benefit-cost ratio

7.4

Payback period (years)

3.9

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 the universities. 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 the universities. 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 levels (net present value greater than zero and a benefit-cost ratio greater than 1.0), confirming that taxpayers and society as a whole receive value from investing in the public universities of Ohio.

Table 3.7: Taxpayer and social perspectives with and without social savings

	Including social savings	Excluding social savings
Taxpayer perspective		
Net present value (millions)	$7,829.8	$6,881.8
Benefit-cost ratio	4.6	4.2
Internal rate of return	12.7%	11.2%
Payback period (no. of years)	9.0	11.4
Social perspective		
Net present value (millions)	$114,983.6	$109,162.1
Benefit-cost ratio	7.4	7.1

Source: Lightcast impact model.

University of Toledo to lead U.S. Department of Energy solar consortium

The U.S. Department of Energy announced in August 2022 the launch of the Cadmium Telluride Accelerator Consortium that will be led by The University of Toledo (UToledo).

The multimillion-dollar initiative is designed to make cadmium telluride (CdTe) solar cells less expensive, more efficient and develop new markets for solar cell products.

As a leader in solar energy innovation for more than 30 years, UToledo was selected to help lead the effort to spur technological advancements that will increase America's competitiveness, bolster domestic innovation and support clean electricity deployment.

"Our world requires scientific innovation to address the inefficient ways we find, produce and consume energy," UToledo President Gregory Postel said. "The University of Toledo is proud to help power the future by leading this consortium that leverages our expertise in solar energy research and commercialization and strengthens our partnership with the U.S. Department of Energy and other leaders in this important and growing field."

The new Cadmium Telluride Accelerator Consortium will work on continued cost and efficiency improvements that will make CdTe cheaper and more efficient and more competitive on the global market. To achieve these goals, the team has a broad research plan that includes CdTe doping strategies, characterizing and exploring new CdTe contacting materials and work to enable a bifacial CdTe module that absorbs light from the front and back of the module.

Kent State University awarded $960,000 in Choose Ohio First scholarships to strengthen state's STEM workforce

The Ohio Department of Higher Education and the Governor's Office of Workforce Transformation have announced that Kent State University (KSU) will receive $960,000 in new scholarships through the Choose Ohio First program that supports students in the critical fields of science, technology, engineering, and mathematics (STEM).

"We are very excited and grateful for the generous support for our students in this impactful program," said Lique Coolen, Ph.D., assistant to the provost for special projects, assistant director of KSU's Brain Health Research Institute and professor of biological sciences, who also serves as program lead for Choose Ohio First at KSU. "This award highlights the state's commitment to higher education, and we are dedicated to educating and developing students to help meet the state's need for STEM-trained professionals."

The new Choose Ohio First resources will greatly enhance STEM education at KSU, with a focus on health- and medicine-related undergraduate and graduate programs for a diverse population of Ohio students. The goal is to provide students enrolled in these programs with affordable higher education and career opportunities in Ohio and fill the statewide need for professionals in jobs in healthcare. Students in five KSU colleges—the College of Arts and Sciences; the College of Communication and Information; the College of Education, Health, and Human Services; the College of Nursing; and the College of Public Health—are eligible for these scholarships.

KSU is among the 45 Ohio public and independent colleges and universities to be selected as the new Choose Ohio First award recipients in Fiscal Year 2023 that will support an estimated 3,400 students pursuing STEM degrees and certificates. Of the nearly $28 million awarded, KSU received the highest award to a public university and tied for the highest amount awarded to all Ohio institutions ($959,999.94).

"Choose Ohio First is an important part of Ohio's strategy to develop STEM talent in our state," wrote Randy Gardner, Ohio Department of Higher Education chancellor, in his award letter to the KSU president. "As such, this administration has committed more than $161.3 million over the past four years to STEM and STEM Education scholarships. Your support and your institution's commitment to high-quality STEM programs that meet the needs of Ohio's employers is essential to the success of this strategy."

The Choose Ohio First program began in 2008 to increase the number of Ohio students enrolling in and successfully completing STEM programs at Ohio's public and independent colleges and universities. Higher education institutions are vital engines for workforce vitality in the state, and the Choose Ohio First program provides support that will advance the economic growth of each region in the state. Designated Choose Ohio First programs are integrated with regional economies, meeting statewide educational needs, facilitating the completion of baccalaureate degrees in a cost-effective manner, and recruiting underserved STEM student groups, including women and students of color.

KSU holds the esteemed distinction of being one of only five institutions in Ohio to be recognized as an R1 top-tier research university by the Carnegie Classification of Institutions of Higher Education.

Chapter 4:

Conclusion

: Kent State University

WHILE THE PUBLIC UNIVERSITIES OF OHIO'S VALUE to the state is larger than simply their economic impact, understanding the dollars and cents value is an important asset to understanding the universities' value as a whole. In order to fully assess the universities' value to the state economy, this report has evaluated the universities from the perspectives of economic impact analysis and investment analysis.

From an economic impact perspective, we calculated that the universities generate a total economic impact of **$68.9 billion** in total added income for the state economy. This represents the sum of several different impacts, including the universities':

- Operations spending impact (**$4 billion**);
- Construction spending impact (**$598 million**);
- Clinical spending impact (**$6.9 billion**);
- Research spending impact (**$1.9 billion**);
- Start-up and spin-off company impact (**$1.7 billion**);
- Visitor spending impact (**$180.2 million**);
- Student spending impact (**$794.6 million**);
- Volunteerism impact (**$79.3 million**); and
- Alumni impact (**$52.6 billion**).

One out of every eight jobs in Ohio is supported by the activities of the universities and their students.

The total impact of $68.9 billion is equivalent to approximately **8.8%** of the total GSP of Ohio and is equivalent to supporting **866,782 jobs**. For perspective, this means that **one out of every eight jobs** in Ohio is supported by the activities of the universities and their students.


Central State University

Since the universities' activity represents an investment by various parties, including students, taxpayers, and society as a whole, we also considered the universities as an investment to see the value they provide to these investors. For each dollar invested by students, taxpayers, and society, the universities offer a benefit of **$5.60**, **$4.60**, and **$7.40**, respectively. These results indicate that the universities, collectively, are an attractive investment to students with rates of return that exceed alternative investment opportunities. At the same time, the presence of the universities expands the state economy and creates a wide range of positive social benefits that accrue to taxpayers and society in general within Ohio.

Modeling the impact of the universities is subject to many factors, the variability of which we considered in our sensitivity analysis (Appendix 2). With this variability accounted for, we present the findings of this study as a robust picture of the economic value of the universities.

Lightcast

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Appendix 1: The Inter-University Council of Ohio's Public Universities

The Inter-University Council of Ohio was established in 1939 as a voluntary educational association of Ohio's public universities. Today the association represents Ohio's 14 public universities.

Institution	Establishment year	Headcount in FY 2021-22
Bowling Green State University	1910	22,966
Central State University	1887	7,963
Cleveland State University	1954	18,359
Kent State University	1910	37,602
Miami University	1809	25,106
Northeast Ohio Medical University	1973	1,011
The Ohio State University	1870	73,130
Ohio University	1804	34,166
Shawnee State University	1986	3,852
The University of Akron	1870	17,651
The University of Cincinnati	1819	55,894
The University of Toledo	1872	18,931
Wright State University	1967	13,461
Youngstown State University	1908	13,138

Appendix 2: 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 alternative education variable, 2) the labor import effect variable, 3) the student employment variables, 4) the discount rate, 5) the retained student variable and 6) the number of out-of-state visitors.

Alternative education variable

The alternative education variable (10%) accounts for the counterfactual scenario where students would have to seek a similar education elsewhere absent the public universities 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 A2.1. 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 10% to 11%) reduces the taxpayer perspective rate of return from 12.7% to 12.5%. Likewise, a decrease of 10% (from 10% to 9%) in the assumption increases the rate of return from 12.7% to 13.0%.

Table A2.1: Sensitivity analysis of alternative education variable, taxpayer and social perspectives

% variation in assumption	-50%	-25%	-10%	Base case	10%	25%	50%
Alternative education variable	**5%**	**8%**	**9%**	**10%**	**11%**	**13%**	**15%**
Taxpayer perspective							
Net present value (millions)	$8,431	$8,130	$7,950	$7,830	$7,710	$7,529	$7,229
Rate of return	13.9%	13.3%	13.0%	12.7%	12.5%	12.2%	11.6%
Benefit-cost ratio	4.9	4.8	4.7	4.6	4.6	4.5	4.3
Social perspective							
Net present value (millions)	$122,370	$118,677	$116,461	$114,984	$113,506	$111,290	$107,597
Benefit-cost ratio	7.8	7.6	7.5	7.4	7.3	7.2	7.0

Based on this sensitivity analysis, the conclusion can be drawn that Ohio public universities' 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 and a benefit-cost ratio greater than 1.0), even when the alternative education assumption is increased by as much as 50% (from 10% to 15%). 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 2.17. 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 the universities. In other words, businesses that hired the universities' students could have substituted some of these workers with equally-qualified people from outside the state had there been no students from the universities to hire. Therefore, we attribute only the remaining 50% of the initial labor income generated by increased alumni productivity to the universities.

Table A2.2 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 the universities, for example, range from a high of $79 billion at a -50% variation to a low of $26.3 billion 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 Ohio economy still remains sizeable.

Table A2.2: Sensitivity analysis of labor import effect variable

% variation in assumption	-50%	-25%	-10%	Base case	10%	25%	50%
Labor import effect variable	25%	38%	45%	50%	55%	63%	75%
Alumni impact (millions)	$78,962	$65,802	$57,906	$52,641	$47,377	$39,481	$26,321

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 universities 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 universities. Both employment variables affect the investment analysis results from the student perspective.

Students incur substantial expense by attending the universities 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 58% of students are employed.[51] 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 universities earn only 77%, on average, of the earnings that they statistically would have received if not attending the universities. This suggests that many students hold part-time jobs that accommodate their attendance at the universities, though it is at an additional cost in terms of receiving a wage that is less than what they otherwise might make. The 77% 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 Ohio. The model captures this difference in wages and counts it as part of the opportunity cost of time. As above, the 77% estimate is tested in the sensitivity analysis by changing it to 100% and then to 0%.

The changes generate results summarized in Table A2.3, with *A* defined as the percent of students employed and *B* defined as the percent that students earn relative to their full earning potential. Base case results appear in the shaded row; here the assumptions remain unchanged, with *A* equal to 58% and *B* equal to 77%. 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 A2.3: Sensitivity analysis of student employment variables

Variations in assumptions	Net present value (millions)	Internal rate of return	Benefit-cost ratio
Base case: A = 58%, B = 77%	$28,053.3	16.2%	5.6
Scenario 1: A = 100%, B = 77%	$29,787.6	20.5%	7.7
Scenario 2: A = 58%, B = 100%	$28,779.5	17.7%	6.3
Scenario 3: A = 100%, B = 100%	$31,048.5	26.2%	10.9
Scenario 4: A = 0%, B = 0%	$25,695.1	12.9%	4.0

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

- **Scenario 1:** Increasing the percentage of students employed (A) from 58% to 100%, the net present value, internal rate of return, and benefit-cost ratio improve to $29.8 billion, 20.5%, and 7.7, 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 77% to 100%, the net present value, internal rate of return, and benefit-cost ratio results improve to $28.8 billion, 17.7%, and 6.3, respectively, relative to base case results; a strong improvement, again attributable to a lower opportunity cost of time.

51 Based on data provided by the public universities of Ohio. This figure excludes dual credit high school students, who are not included in the opportunity cost calculations.

- **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 $31 billion, 26.2%, and 10.9, 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 $25.7 billion, 12.9%, and 4.0, respectively, relative to base case results. These results are reflective of an increased opportunity cost; none of the students are employed in this case.[52]

It is strongly emphasized in this section that base case results are very attractive in that results are all above their threshold levels. As is clearly demonstrated here, results of the first three alternative scenarios appear much more attractive, although they overstate benefits. Results presented in Chapter 3 are realistic, indicating that investments in the public universities of Ohio 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 3.7% discount rate for students and a -0.3% discount rate for society and taxpayers.[53] 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 A2.4.

52 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.

53 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 reported by the Office of Management and Budget for 30-year investments. See the Congressional Budget Office "Table 5. Federal Student Loan Programs: Projected Interest Rates: CBO's July 2021 Baseline" and the Office of Management and Budget "Discount Rates for Cost-Effectiveness, Lease Purchase, and Related Analyses."

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 3.7% to 5.6%) reduces the students' benefit-cost ratio from 5.6 to 3.9. Conversely, reducing the discount rate for students by 50% (from 3.7% to 1.9%) increases the benefit-cost ratio from 5.6 to 8.3. The sensitivity analysis results for society and taxpayers show the same inverse relationship between the discount rate and the benefit-cost ratio.

Table A2.4: Sensitivity analysis of discount rate

% variation in assumption	-50%	-25%	-10%	Base case	10%	25%	50%
Student perspective							
Discount rate	1.9%	2.8%	3.4%	3.7%	4.1%	4.7%	5.6%
Net present value (millions)	$44,992	$35,429	$30,780	$28,053	$25,585	$22,309	$17,792
Benefit-cost ratio	8.3	6.8	6.0	5.6	5.2	4.6	3.9
Taxpayer perspective							
Discount rate	-0.15%	-0.23%	-0.27%	-0.30%	-0.33%	-0.38%	-0.45%
Net present value (millions)	$7,516	$7,671	$7,766	$7,830	$7,894	$7,992	$8,158
Benefit-cost ratio	4.47	4.54	4.58	4.61	4.64	4.69	4.76
Social perspective							
Discount rate	-0.15%	-0.23%	-0.27%	-0.30%	-0.33%	-0.38%	-0.45%
Net present value (millions)	$110,748	$112,842	$114,121	$114,984	$115,854	$117,175	$119,417
Benefit-cost ratio	7.2	7.3	7.3	7.4	7.4	7.5	7.6

Retained student variable

The retained student variable only affects the student spending impact calculation in Table 2.14. For this analysis, we assume a retained student variable of 10%, which means that 10% of the universities' students who originated from Ohio would have left the state for other opportunities, whether that be education or employment, if the universities did not exist. The money these retained students spent in the state for accommodation and other personal and household expenses is attributable to the universities.

Table A2.5: 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)	$664,480	$728,840	$767,456	$794,643	$818,945	$857,561	$921,922

Table A2.5 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 the universities range from a high of $921.9 million when the retained student variable is 15% to a low of $664.5 million when the retained student variable is 5%. This means as the retained student variable decreases, the student spending attributable to the universities decreases. Even under the most conservative assumptions, the student spending impact on the Ohio economy remains substantial.

Number of out-of-state visitors

The estimate of the number of visitors from outside the state only affects the visitor spending impact calculation in Table 2.15. The universities hold many events that attract out-of-state visitors, such as commencement, prospective student days, and athletic events. The money these visitors spent in the state for accommodation and other personal expenses is attributable to the universities. However, the number of visitors that came to Ohio because of the universities was generated by estimates provided by each university. Therefore, we provide a sensitivity analysis of the number of out-of-state visitors.

Table A2.6 presents the results of the sensitivity analysis for the number of visitors from outside the state. The estimate increases and decreases relative to the base case of 808,118 visitors by the increments indicated in the table. The visitor spending impact is recalculated at each estimate, holding all else constant. Visitor spending impacts attributable to the universities range from a high of $406.3 million when the number of visitors increases by 50% to 1.2 million out-of-state visitors to a low of $135.4 million when the number of visitors drops by -50% at 404,085 out-of-state visitors. This means that as the number of out-of-state visitors decreases, the visitor spending attributable to the universities decreases. Similar to the retained student sensitivity analysis, even under the most conservative assumptions, the visitor spending impact on the Ohio economy remains substantial.

Table A2.6: Sensitivity analysis of out-of-state visitors

% variation in assumption	-50%	-25%	-10%	Base case	10%	25%	50%
Number of out-of-state visitors	404,085	606,127	727,353	808,170	888,986	1,010,212	1,212,254
Visitor spending impact (thousands)	$135,434	$203,150	$243,780	$180,160	$297,954	$338,584	$406,301

Appendix 3: 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 universities 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 universities in order to obtain their education.

Alternative use of funds: A measure of how monies that are currently used to fund the universities might otherwise have been used if the universities 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: The 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 universities 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 universities and the higher earnings of their students.

Input-output analysis: Relationship between a given set of demands for final goods and services and the implied amounts of manufactured inputs, raw materials, and labor that this requires. 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 universities and their students spend money in the state. It consists of the income created by the supply chain of the industries initially affected by the spending of the universities and their students (i.e., the direct effect), income created by the supply chain of the initial supply chain (i.e., the indirect effect), and the income created by the increased spending of the household sector (i.e., the induced effect).

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 4: 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 the universities—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 Lightcast'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 universities. Therefore, model results for the universities are specific to the given region.

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

Lightcast'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 universities. Rather, it is an impact assessment of the additional income created in the region as a result of the universities' spending on payroll and other non-pay expenditures, net of any impacts that would have occurred anyway if the universities did not exist.

How do my universities' rates of return compare to that of other institutions?

In general, Lightcast discourages comparisons between systems or institutions since many factors, such as regional economic conditions, institutional differences, and student demographics are outside of the universities' control. It is best to compare the rate of return to the discount rates of 3.7% (for students) and -0.3% (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.

Lightcast 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 Lightcast, 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.

Lightcast conducted an economic impact study for my universities a few years ago. Why have results changed?

Lightcast 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, Lightcast has completed over 2,800 economic impact studies for educational institutions in three countries. Along the way we have worked to continuously update and improve our methodologies to ensure that they conform to best practices and stay relevant in today's economy. The present study reflects the latest version of our model, representing the most up-to-date theory, practices, and data for conducting economic impact and investment analyses. Many of our former assumptions have been replaced with observed data, and we have researched the latest sources in order to update the background data used in our model. Additionally, changes in the data the universities provide to Lightcast can influence the results of the study.

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 universities (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 universities to say that the brick and mortar campuses do just as much for Ohio as the entire Utilities *industry*, for example. This powerful statement can help put the large total impact number into perspective.

Appendix 5: Example of sales versus income

Lightcast'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 6: Lightcast MR-SAM

Lightcast's MR-SAM represents the flow of all economic transactions in a given region. It replaces Lightcast'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 Lightcast 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.

Lightcast 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 Lightcast 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 Lightcast 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 Lightcast 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. Lightcast 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 Lightcast 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 Lightcast 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 Lightcast's gravitational flows model that estimates the amount of trade between counties in the country.

Overview of the MR-SAM model

Lightcast'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 Lightcast 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.

Lightcast'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 Lightcast'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 considers 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 Lightcast MR-SAM model

The Lightcast 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. Lightcast'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 Lightcast'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 Lightcast'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 Lightcast'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. Lightcast uses a modification of the "diagonal similarity scaling" algorithm to balance the national SAM.

Gravitational flows model

The most important piece of the Lightcast 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 7: 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 the universities in FY 2021-22 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 universities, 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 $28,600. We spread this $28,600 wage differential across the 120 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.[54] We repeat this process for each education level in the ladder.

Next, we map the CHE production of the FY 2021-22 student population to the education ladder. Table 1.2 provides information on the CHE production of students attending the universities, broken out by educational achievement. In total, students completed 7.5 million CHEs during the analysis year, excluding personal enrichment students. We map each of these CHEs to the education ladder depending on the

54 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 Lightcast impact model are derived from Jaeger and Page (1996).

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:

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

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

Table A7.1 displays the result for the students' aggregate annual increase in income (ΔE), a total of $1.9 billion. By dividing this value by the students' total production of 7.5 million CHEs during the analysis year, we derive an overall value of $257 per CHE.

Table A7.1: Aggregate annual increase in income of students and value per CHE

Aggregate annual increase in income	$1,935,771,518
Total credit hour equivalents (CHEs) in FY 2021-22*	7,528,769
Value per CHE	**$257**

* Excludes the CHE production of personal enrichment students.

Source: Lightcast impact model.

Mincer function

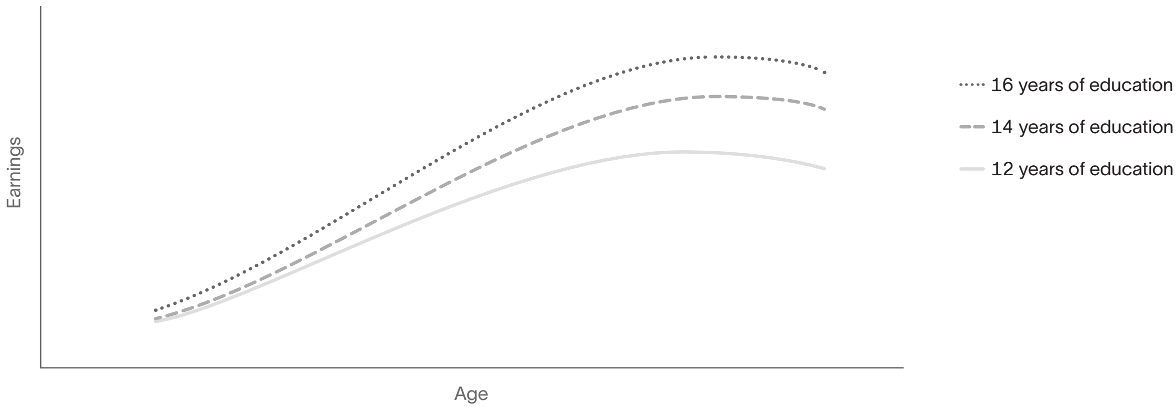
The $257 value per CHE in Table A7.1 only tells part of the story, however. Human capital theory holds that earnings levels do not remain constant; rather, they start relatively low and gradually increase as the worker gains more experience. Research also shows that the earnings increment between educated 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.[55] While some have criticized Mincer's earnings function, it is still upheld in recent data and has served as the foundation for a variety of research pertaining to labor economics. Those critical of the Mincer function point to several unobserved factors such as ability, socioeconomic status, and family background that also help explain higher earnings. Failure to account for these factors results in what is known as an "ability bias." Research by Card (1999 and 2001) suggests that the benefits estimated using Mincer's function are biased upwards by 10% or less. As

55 See Mincer (1958 and 1974).

such, we reduce the estimated benefits by 10%. We use state-specific and education level-specific Mincer coefficients.

Figure A7.1 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 A7.1: 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 $257 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 $257 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 2021-22 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 A7.1.

Appendix 8: Alternative education variable

In a scenario where the universities did not exist, some of their 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 universities. The alternative education variable accounts for these students and is used to discount the benefits we attribute to the universities.

Recall this analysis considers only relevant economic information regarding the universities. Considering the existence of various other academic institutions surrounding the universities, 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 universities—we discount the benefits attributed to the universities. 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 universities, they must be included.

In the absence of the universities, we assume 10% of the universities' 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 10%. In other words, we assume 10% of the benefits created by the universities' students would have occurred anyway in the counterfactual scenario where the universities did not exist. A sensitivity analysis of this adjustment is presented in Appendix 2.

Appendix 9: Overview of investment analysis measures

The appendix provides context to the investment analysis results using the simple hypothetical example summarized in Table A9.1 below. The table shows the projected benefits and costs for a single student over time and associated investment analysis results.[56]

Table A9.1: **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**

Benefit-cost ratio	Internal rate of return	Payback period (years)
1.7	18.0%	4.2

Assumptions are as follows:

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

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

- 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 A9.1.

Net present value

The student in Table A9.1 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 A9.1, 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.[57]

Let us take a brief example. At 4%, the present value of $5,000 to be received one year from today is $4,807. If the $5,000 were to be received in year 10, the present value would reduce to $3,377. Put another way, $4,807 deposited in the bank today earning 4% interest will grow to $5,000 in one year; and $3,377 deposited today would grow to $5,000 in 10 years. An "economically rational" person would, therefore, be equally satisfied receiving $3,377 today or $5,000 10 years from today given the going rate of interest of 4%. The process of discounting—finding the present value of future higher earnings—allows the model to express values on an equal basis in future or present value terms.

57 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.

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 A9.1 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 A9.1. 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 A9.1. 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 10.5% 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 A9.1, 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 universities. 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 10: Shutdown point

The investment analysis in Chapter 3 weighs the benefits generated by the universities against the state and local taxpayer funding that the universities receive to support their operations. An important part of this analysis is factoring out the benefits that the universities 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 universities are able to generate benefits without taxpayer support, then it would not be a true investment.[58]

The overall approach includes a sub-model that simulates the effect on student enrollment if the universities lose their state and local funding and have to raise student tuition and fees in order to stay open. If the universities can still operate without state and local support, then any benefits they generate at that level are discounted from total benefit estimates. If the simulation indicates that the universities 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 A10.1 presents a simple model of student demand and state and local government support. The right side of the graph is a standard demand curve (*D*) showing student enrollment as a function of student tuition and fees. Enrollment is measured in terms of total credit hour equivalents (CHEs) and expressed as a percentage of the universities' 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 universities have only two sources of revenues: 1) student tuition and fees and 2) state and local government support.

Figure A10.2 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 universities is affected by the change in tuition and fees. Ignoring for the moment those issues concerning the universities' 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

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

must be adjusted to net out the benefits that the universities can provide absent state and local government support, represented as *Z%* of the universities' current CHE production in Figure A10.2.

Figure A10.1:
Student demand and government funding by tuition and fees

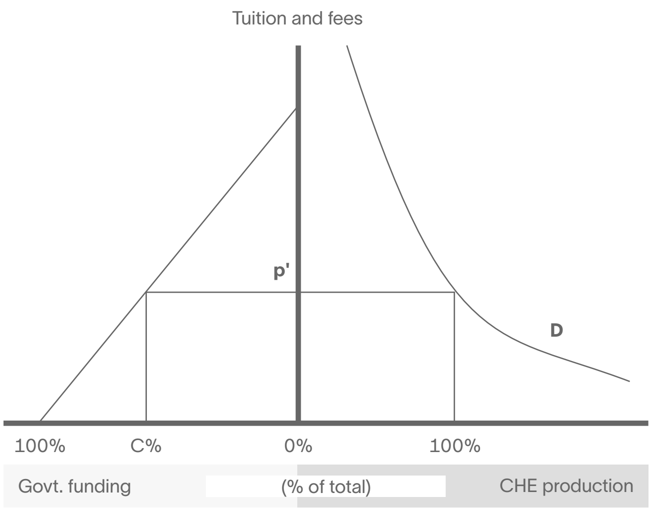
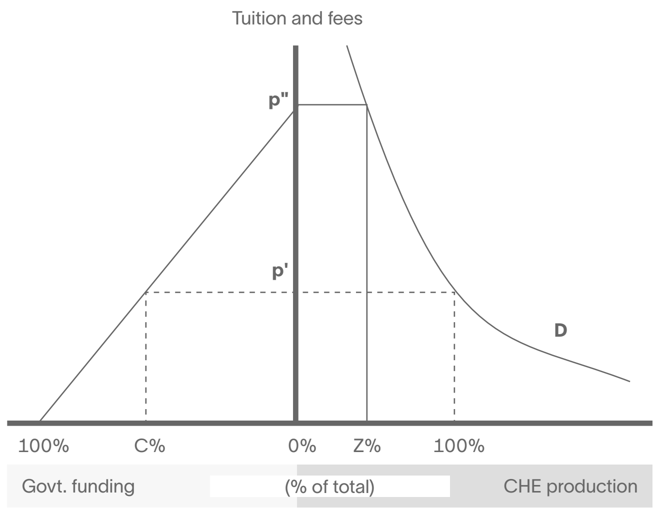


Figure A10.2:
CHE production and government funding by tuition and fees



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 universities' 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.[59] The shutdown point is introduced graphically in Figure A10.3 as *S%*. The location of point *S%* indicates that the universities can operate at an even lower enrollment level than *Z%* (the point at which the universities receive 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 universities would no longer be able to attract enough students to keep their doors open, and they would shut down.

Figure A10.4 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 universities 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 universities' CHE production, or *B = B (100%)*.

Figure A10.3: Shutdown point after zero government funding

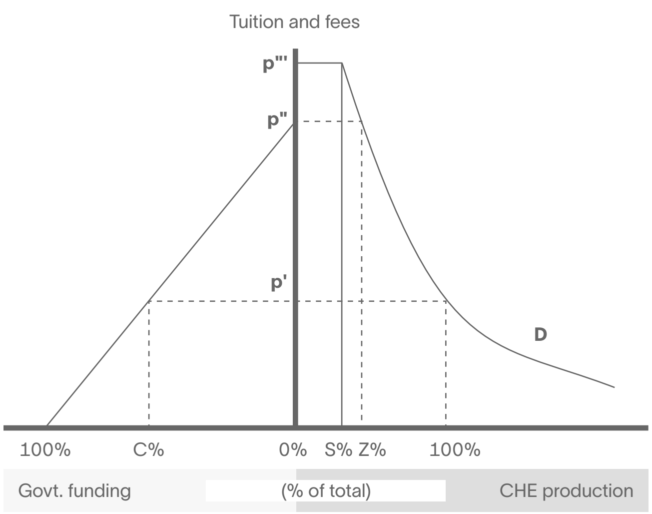
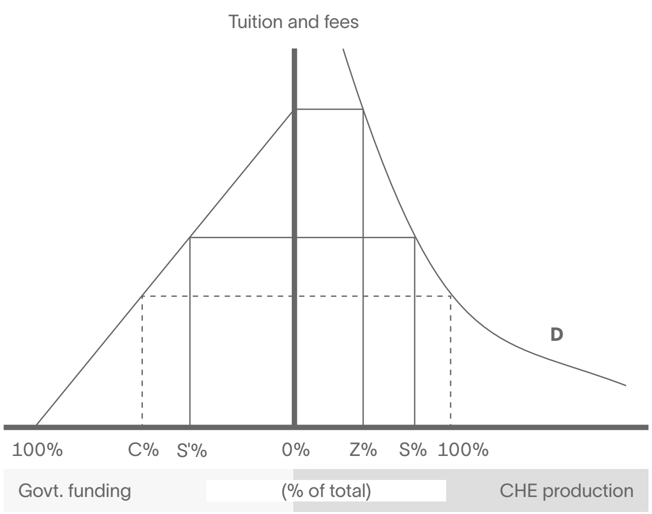


Figure A10.4: Shutdown point before zero government funding



59 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.

Appendix 11: 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.

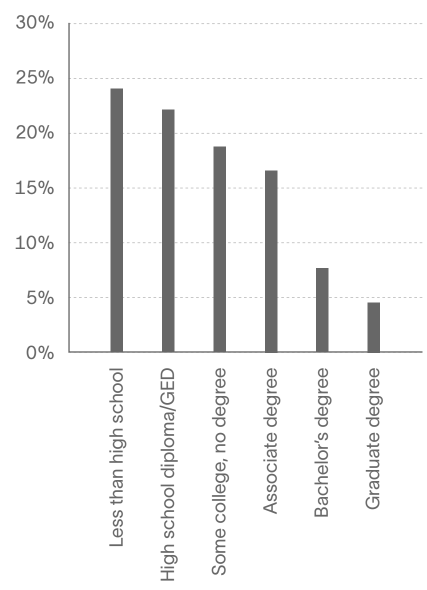
Smoking

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 A11.1 shows the prevalence of cigarette smoking among adults, 25 years and over, based on data provided by the National Health Interview Survey.[60] 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.

The Centers for Disease Control and Prevention (CDC) reports the percentage of adults who are current smokers by state.[61] We use this information to create an index

Figure A11.1: Prevalence of smoking among U.S. adults by education level



Source: Centers for Disease Control and Prevention.

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

61 Centers for Disease Control and Prevention. "Current Cigarette Use Among Adults (Behavior Risk Factor Surveillance System) 2018." *Behavioral Risk Factor Surveillance System Prevalence and Trends Data,* 2018.

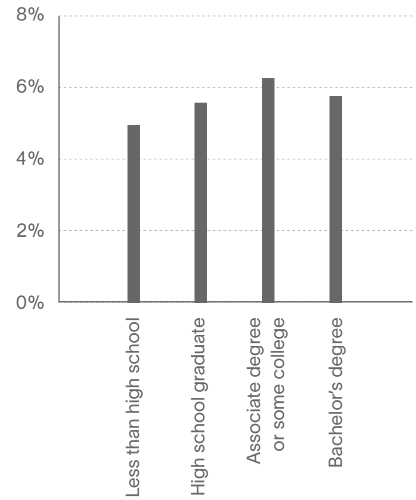
value by which we adjust the national prevalence data on smoking to each state. For example, 20.5% of Ohio adults were smokers in 2018, relative to 15.9% for the nation. We thus apply a scalar of 1.29 to the national probabilities of smoking in order to adjust them to the state of Ohio.

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 A11.2 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).[62] 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.

Figure A11.2: Prevalence of alcohol dependence or abuse by education level



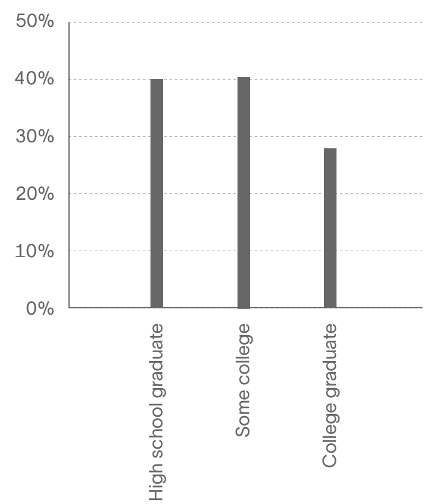
Source: Centers for Disease Control and Prevention.

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.[63]

Data for Figure A11.3 is derived from the National Center for Health Statistics which shows the prevalence of obesity among adults aged 20 years and over by education, gender, and ethnicity.[64] 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.

Figure A11.3: Prevalence of obesity by education level



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

62 Substance Abuse and Mental Health Services Administration. "Table 5.4B—Alcohol Use Disorder in Past Year among Persons Aged 12 or Older, by Age Group and Demographic Characteristics: Percentages, 2017 and 2018." SAMHSA, Center for Behavioral Health Statistics and Quality, National Survey on Drug Use and Health, 2017 and 2018.

63 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.

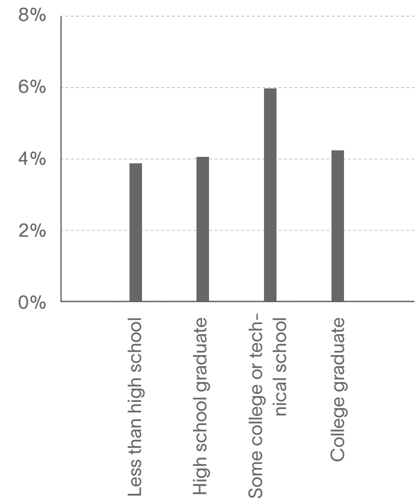
64 Ogden Cynthia L., Tala H. Fakhouri, Margaret D. Carroll, Craig M. Hales, Cheryl D. Fryar, Xianfen Li, David S. Freedman. "Prevalence of Obesity Among Adults, by Household Income and Education—United States, 2011–2014" National Center for Health Statistics, *Morbidity and Mortality Weekly Report*,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

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.[65]

Figure A11.4 summarizes the prevalence of MDD among adults by education level, based on data provided by the CDC.[66] 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.

Figure A11.4: Prevalence of major depressive episode by education level

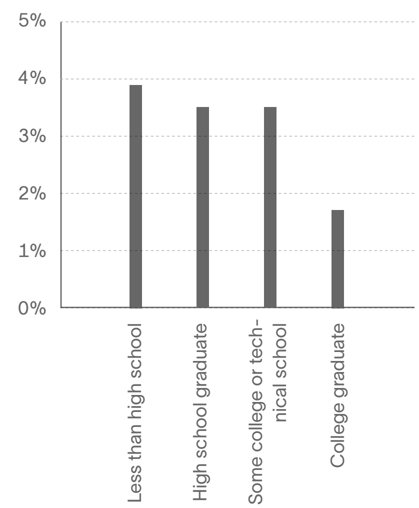


Source: National Survey on Drug Use and Health.

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 3.9%, twice as large as the probability of drug abuse for college graduates (1.7%). This relationship is presented in Figure A11.5 based on data supplied by SAMHSA.[67] 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.[68]

Figure A11.5: 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.

65 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.

66 National Survey on Drug Use and Health. "Table 8.40B: 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: Numbers in Thousands, 2017 and 2018."

67 Substance Abuse and Mental Health Services Administration. "Table 5.3B—Illicit Drug Use Disorder in Past Year among Persons Aged 12 or Older, by Age Group and Demographic Characteristics: Percentages, 2017 and 2018." SAMHSA, Center for Behavioral Health Statistics and Quality, National Survey on Drug Use and Health, 2017 and 2018.

68 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 A11.6 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.[69]

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.[70]

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

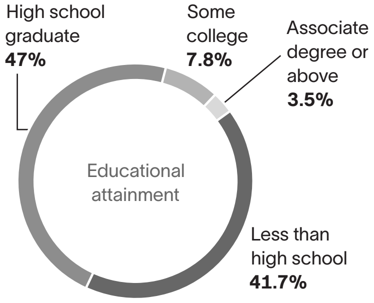
Income assistance

Statistics show that as education levels increase, the number of applicants for government-funded income assistance such as welfare and unemployment benefits declines. Welfare and unemployment claimants can receive assistance from a variety of different sources, including Temporary Assistance for Needy Families (TANF), Supplemental Nutrition Assistance Program (SNAP), Medicaid, Supplemental Security Income (SSI), and unemployment insurance.[71]

Figure A11.7 relates the breakdown of TANF recipients by education level, derived from data provided by the U.S. Department of Health and Human Services.[72] As shown, the demographic characteristics of TANF recipients are weighted heavily towards the less than high school and high school categories, with a much smaller representation of individuals with greater than a high school education.

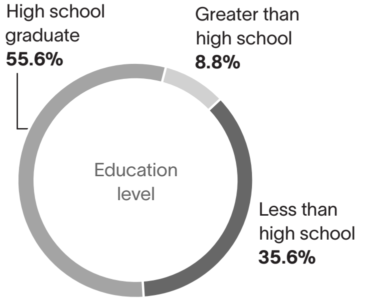
Unemployment rates also decline with increasing levels of education, as illustrated in Figure A11.8. These data are provided by the Bureau of Labor Statistics.[73] As shown, unemployment rates range from 5.4% for those with less than a high school diploma to 1.9% for those at the graduate degree level or higher.

Figure A11.6:
Educational attainment of the incarcerated population



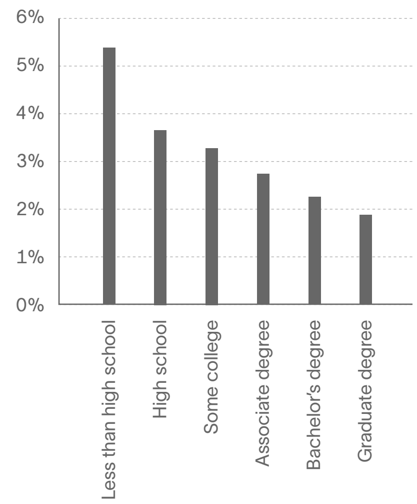
Source: Derived from data provided by the U.S. Census Bureau.

Figure A11.7:
Breakdown of TANF recipients by education level



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

Figure A11.8: Unemployment by education level



Source: Bureau of Labor Statistics.

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

70 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.

71 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.

72 U.S. Department of Health and Human Services, Office of Family Assistance. "Characteristics and Financial Circumstances of TANF Recipients, Fiscal Year 2018."

73 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, 2019.