American Indian Higher Education Consortium

Building Local Economies of Scale:

The Impact of Tribal Colleges & Universities in Rural America

National Tribal Colleges & Universities Economic Impact Report

September 9, 2025

U.S. Tax Payer Return on Investment

Tribal Colleges & Universities (TCUs) generate more benefits for national taxpayers than the TCUs cost to support.

$3.8 BILLION

In Fiscal Year 2022-2023, Tribal Colleges & Universities (TCUs) alumni contributed $3.8 billion to the national economy.

40,700 JOBS

In Fiscal Year 2022-2023, Tribal Colleges & Universities (TCUs) alumni contributed 40,700 jobs supporting multiple industries across the nation.

American Indian Higher Education Consortium

U.S. Tax Payer Return on Investment

For every Federal Dollar invested into Tribal Colleges & Universities (TCUs), TCUs return $1.60 in tax revenue & public sector savings.

$785.6 MILLION

The return of the $1.60 in tax revenue equals to $785.6 million in additional tax revenue to local, state, and federal economies. (FY2022-2023 data)

$96.8 MILLION

Investment of federal dollars into TCUs saves U.S. Tax Payers $96.8 million annually through improved health, reduced need for justice system interventions, and decreased reliance on income assistance programs. (FY2022-2023 data)

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Preface

This study is part of a series of Economic Impact Studies conducted in partnership with the American Indian Higher Education Consortium (AIHEC) and Lightcast. Lightcast provides colleges and universities with labor market data that helps create better outcomes for students, businesses, and communities. Our data, which cover more than 99% of the U.S. workforce, are compiled from a wide variety of government sources, job postings, and online profiles and resumes.

The model is consistently being updated as more data become 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.

Also, due to increased data availability, we have improved the accuracy of the Mincer Function, a function used to project former students' earnings trajectory as they gain more experience throughout their working lives. We have switched data sources and now use a more accurate and complete data set from IPUMS[1] to calculate our Mincer Functions. In addition, the Mincer Function is now demographic profile specific, which we are able to apply to the institution's student demographic composition. Further, we have made the Mincer specific to students' education levels. As part of updating the Mincer, the age at which students reach their career midpoint in earnings was updated.

This 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

[1] IPUMS provides census and survey data from around the world integrated across time and space. This data can be accessed through their site: https://www.ipums.org/.

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 nation's 35 Tribal Colleges and Universities (TCUs), it is not intended for comparison with the previous study conducted by Lightcast for the American Indian Higher Education Consortium (AIHEC) in 2015. Due to the extent of the improvements to Lightcast's model since 2015, differences between results from the 2015 study and the present study do not necessarily indicate changes in the value of TCUs.

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.

Acknowledgments

Lightcast gratefully acknowledges the excellent support of the staff at American Indian Higher Education Consortium (AIHEC) in making this study possible. Special thanks go to Ahniwake Rose, AIHEC President and Chief Executive Officer, who approved the study, and to Jana Hanson, PhD, AIHEC Senior Director of Member and Student Services, for serving as a liaison between Lightcast and AIHEC; and to the individual research teams at TCUs for their time and effort collecting the data and information required. Any errors in the report are the responsibility of Lightcast and not any of the above-mentioned individuals.

Executive summary

This report assesses the impact of the nation's 35 Tribal Colleges and Universities (TCUs) on the national economy and the benefits generated by TCUs for students, taxpayers, and society. The results of this study show that TCUs create a positive net impact on the U.S. economy and generate a positive return on investment for students, taxpayers, and society.

Economic impact on the national economy

Over the years, students gained new skills, making them more productive workers, by studying at Tribal Colleges and Universities[2] (TCUs). Today, tens of thousands of these former students are employed in the U.S.

The accumulated impact of former students currently employed in the U.S. workforce amounted to **$3.8 billion** in added income for the U.S. economy in fiscal year (FY) 2022-23, which is equivalent to supporting **40,732 jobs.**

The additional income of **$3.8 billion** created by TCUs is equivalent to supporting **40,732 jobs** in the U.S.

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 nation as it is spent at international businesses. Income, on the other hand, is a net measure that excludes these intermediary costs and leakages and is synonymous with gross domestic product (GDP) and value added. For this reason, it is a more meaningful measure of new economic activity than sales.

[2] See Appendix 1 for the list of TCUs included in this analysis.

Investment analysis

Investment analysis is the practice of comparing the costs and benefits of an investment to determine whether it is profitable. This study evaluates TCUs 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. Some take out student loans to attend TCUs, which they will pay back over time. While some students were employed while attending TCUs, 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 **$99.0 million** in present value student costs.

In return, students will receive a present value of **$742.1 million** in increased earnings over their working lives. This translates to a return of **$7.50** in higher future earnings for every dollar that students invest in their education at TCUs. The corresponding annual rate of return is **27.2%**.

Taxpayer perspective

Taxpayers provided **$568.6 million** of federal, state, and local funding to TCUs in FY 2022-23. In return, taxpayers will receive an estimated present value of **$785.6 million** in added tax revenue stemming from the students' higher lifetime earnings and the increased output of businesses. Savings to the public sector add another estimated **$96.8 million** in benefits due to a reduced demand for government-funded social services in the U.S. Total taxpayer benefits amount to **$882.4 million**, the present value sum of the added tax revenue and public sector savings. For every tax dollar spent educating students attending TCUs, taxpayers will receive an average of **$1.60** in return over the course of the students' working lives. In other words, taxpayers receive an annual rate of return of **3.2%**.

For every tax dollar spent educating students attending TCUs, taxpayers in the U.S. will receive an average of **$1.60** in return over the course of the students' working lives.

Social perspective

People in the U.S. invested **$668.4 million** in TCUs in FY 2022-23. This includes the federal, state, and local government funding, as well as student expenses and student opportunity costs. In return, the nation will receive an estimated present value of **$3.0 billion** in added revenue over the course of the students' working lives. The U.S. will also benefit from an estimated **$199.0 million** in present value social savings related to reduced crime, lower welfare and unemployment assistance, and increased health and well-being across the nation. For every dollar society invests in TCUs, an average of **$4.80** in benefits will accrue to the U.S. over the course of the students' careers.

Chapter 1:

Introduction

The nation's 35 Tribal Colleges and Universities (TCUs) served 22,014 credit and 6,501 non-credit students in FY 2022-23. While this study only considers the economic benefits generated by TCUs, it is worth noting the nation receives a variety of benefits from TCUs, including social and cultural benefits that are difficult to quantify. TCUs naturally help students achieve their individual potential and develop the knowledge, skills, and abilities they need to have fulfilling and prosperous careers. However, TCUs impact the U.S. beyond influencing the lives of students. TCU program offerings supply employers with workers to make their businesses more productive. TCUs support the national economy through the output and employment generated by vendors. The benefits created by TCUs extend as far as the national treasury in terms of the increased tax receipts and decreased public sector costs generated by students across the U.S.

TCUs impact the U.S. beyond influencing the lives of students.

This report assesses the collective impact of TCUs as a whole on the national economy and the benefits generated by TCUs for students, taxpayers, and society. The approach is twofold. We begin with an economic impact analysis of TCUs on the U.S. 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 U.S. economy as a result of increased consumer spending and the added knowledge, skills, and abilities of students. The economic impact analysis is represented by the impact of alumni who are still employed in the U.S. workforce.

The second component of the study measures the benefits generated by TCUs 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 TCUs as opposed to working. In return for these investments, students receive a lifetime of higher earnings. For taxpayers, the study measures the benefits to 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 the U.S.

The study uses a wide array of data that are based on several sources, including the colleges' FY 2022-23 academic and financial reports; 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.

Chapter 2:

Profile of Tribal Colleges and Universities and the national economy

The American Indian Higher Education Consortium (AIHEC) represents a diverse array of Tribal Colleges and Universities (TCUs) across the U.S. that are rich in history and designed to provide exceptional quality higher education to American Indian and Alaskan Native students. Though the services of the nation's 35 TCUs are available to anyone, their primary purpose is to meet the unique needs of America's many Indian nations. In FY 2022-23, TCUs served 22,014 credit and 6,501 non-credit students.

Since the formation of AIHEC in 1973, the consortium has advocated on behalf of TCUs at the federal level. Throughout their history, TCUs have provided educational opportunities founded on the legacy and lifeways of the various tribes they represent. Each TCU offers an educational experience uniquely attuned to the culture, traditions, and heritage of the people it serves.

Beyond providing degrees and certificates, TCUs are active parts of their communities in many other ways and improve the quality of life of students and their families through various services.

TCUs provide exceptional opportunities for students through a wide range of relevant and well-regarded programs designed for undergraduate students, graduate students, and lifelong learners. They offer a vast array of educational options, including master's, bachelor's and associate degrees; certificates, and non-credit training programs specifically designed to lead to in-demand jobs across the national workforce.

Beyond providing degrees and certificates, TCUs are active parts of their communities in many other ways and improve the quality of life of students and their families through various services. They offer a wide array of educational and enrichment classes, including continuing education and personal leisure courses designed to serve the needs and interests of their respective communities. They house libraries, community gardens, art galleries, and performance spaces that facilitate arts and culture. Further, they directly support local businesses and entrepreneurship, further raising economic prosperity in their respective regions and far beyond.

TCU employee and finance data

The study uses two general types of information: 1) data collected from TCUs[3] and 2) economic data obtained from various public sources and Lightcast's proprietary data modeling tools.[4] This chapter presents the basic underlying information from TCUs used in this analysis and provides an overview of the U.S. economy.

Employee data

Data provided by TCUs include information on faculty and staff by place of work and by place of residence. These data appear in Table 2.1. As shown, TCUs employed 3,456 full-time and 1,344 part-time faculty and staff in FY 2022-23 (including student workers).

Table 2.1: Employee data, FY 2022-23

Full-time faculty and staff	3,456
Part-time faculty and staff	1,344
Total faculty and staff	**4,800**

Source: Data provided by TCUs

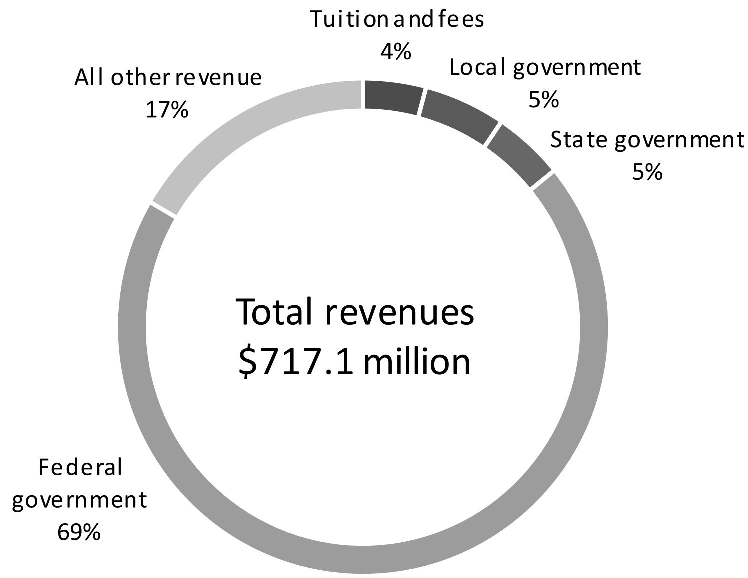
Revenues

Figure 2.1 shows TCUs' annual revenues by funding source—a total of $717.1 million in FY 2022-23. As indicated, tuition and fees comprised 4% of total revenue, and revenues from local, state, and federal government sources comprised another 79%. All other revenue (i.e., auxiliary revenue, sales and services, interest, and donations) comprised the remaining 17%. These data are critical in identifying the annual costs of educating the student body from the perspectives of students, taxpayers, and society.

[3] Lightcast utilized publicly available data compiled from the Integrated Postsecondary Education System (IPEDS) and assumptions for TCUs unable to provide data.

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

Figure 2.1: TCU revenues by source, FY 2022-23

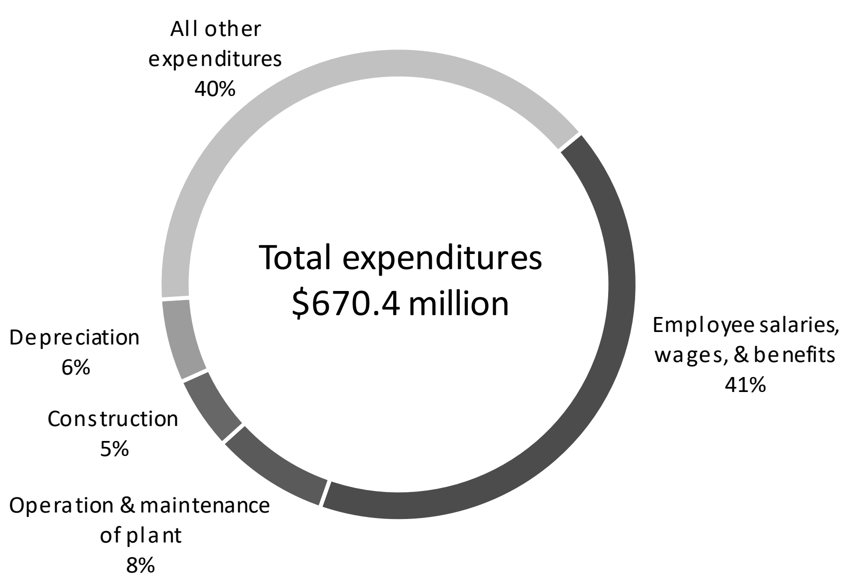


Source: Data provided by TCUs

Expenditures

Figure 2.2 displays TCU expense data. The combined payroll at TCUs, including student salaries and wages, amounted to $277.8 million. This was equal to 41% of TCUs' total expenses for FY 2022-23. Other expenditures, including capital construction, operation and maintenance of plant, depreciation, and purchases of supplies and services, made up $392.5 million.

Figure 2.2: TCU expenses by function, FY 2022-23



Source: Data provided by TCUs

Students

TCUs served 22,014 students taking courses for credit and 6,501 non-credit students in FY 2022-23. These numbers represent unduplicated student headcounts. The breakdown of the student body by gender was 66% female and 34% male. The breakdown by ethnicity was 87% students of color, 12% white, and 1% unknown. The students' overall average age was 30 years old.[5] It is assumed that all students remain in the U.S. after finishing their time at the TCUs.

Table 2.2 summarizes the breakdown of the student population and their corresponding awards and credits by education level. In FY 2022-23, TCUs served 92 master's degree graduates, 458 bachelor's degree graduates, 1,476 associate degree graduates, and 648 certificate completers. Another 17,657 students enrolled in courses for credit but did not complete a degree during the reporting year. TCUs offered dual credit courses to high schools, serving a total of 1,733 students over the course of the year. TCUs also served 714 basic education students and 2,072 personal enrichment students enrolled in non-credit courses. Non-degree seeking students enrolled in workforce or professional development programs accounted for 3,357 students. Students not allocated to the other categories comprised the remaining 308 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 12.9.

[5] Unduplicated headcount, gender, ethnicity, and age data provided by TCUs.

Table 2.2: Breakdown of student headcount and CHE production by education level, FY 2022-23

Category	Headcount	Total CHEs	Average CHEs
Master's degree graduates	92	1,118	12.2
Bachelor's degree graduates	458	10,160	22.2
Associate degree graduates	1,476	30,478	20.6
Certificate graduates	648	12,535	19.3
Continuing students	17,657	259,056	14.7
Dual credit students	1,733	9,742	5.6
Basic education students	714	7,934	11.1
Personal enrichment students	2,072	2,025	1.0
Workforce/professional development students	3,357	8,109	2.4
All other students	308	1,349	4.4
Total, all students	**28,515**	**342,505**	**12.0**
Total, less personal enrichment students	**26,442**	**340,481**	**12.9**

Source: Data provided by TCUs. For TCUs unable to provide CHEs for students, estimates were provided by Lightcast based on TCU averages.

The U.S. economy

Table 2.3 summarizes the breakdown of the national 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 nation's total income, which can also be considered the nation's gross domestic product (GDP).

As shown in Table 2.3, the total income, or GDP, of the U.S. is approximately $24.6 trillion, equal to the sum of labor income ($16.1 trillion) and non-labor income ($8.5 trillion).

Table 2.3: Income by major industry sector in the U.S., 2023*

Industry sector	Labor income (millions)	Non-labor income (millions)	Total income (millions)+	% of total income	Sales (millions)
Manufacturing	$1,339,397	$1,456,900	$2,796,298	11%	$7,408,644
Finance & Insurance	$1,506,142	$883,261	$2,389,403	10%	$3,881,151
Professional & Technical Services	$1,768,793	$341,006	$2,109,798	9%	$3,220,863
Health Care & Social Assistance	$1,760,188	$227,940	$1,988,128	8%	$3,185,796
Government, Non-Education	$1,426,832	$533,445	$1,960,277	8%	$11,295,332
Wholesale Trade	$747,944	$890,949	$1,638,893	7%	$2,860,444
Retail Trade	$865,005	$766,798	$1,631,804	7%	$2,742,097
Information	$570,836	$899,857	$1,470,693	6%	$2,491,936
Construction	$932,225	$236,547	$1,168,772	5%	$2,263,753
Real Estate & Rental & Leasing	$720,361	$412,927	$1,133,289	5%	$2,446,274
Transportation & Warehousing	$644,597	$342,199	$986,797	4%	$1,923,017
Government, Education	$842,669	$0	$842,669	3%	$980,951
Administrative & Waste Services	$688,124	$134,907	$823,031	3%	$1,501,702
Accommodation & Food Services	$494,958	$309,734	$804,692	3%	$1,541,133
Other Services (except Public Administration)	$466,913	$59,692	$526,606	2%	$903,345
Management of Companies & Enterprises	$470,323	$37,246	$507,569	2%	$793,761
Mining, Quarrying, & Oil and Gas Extraction	$110,086	$370,996	$481,081	2%	$894,175
Utilities	$104,153	$364,108	$468,260	2%	$737,494
Educational Services	$272,424	$37,868	$310,292	1%	$433,438
Agriculture, Forestry, Fishing & Hunting	$157,956	$134,902	$292,858	1%	$653,688
Arts, Entertainment, & Recreation	$192,473	$90,147	$282,620	1%	$484,501
Total	**$16,082,399**	**$8,531,429**	**$24,613,828**	**100%**	**$52,643,495**

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

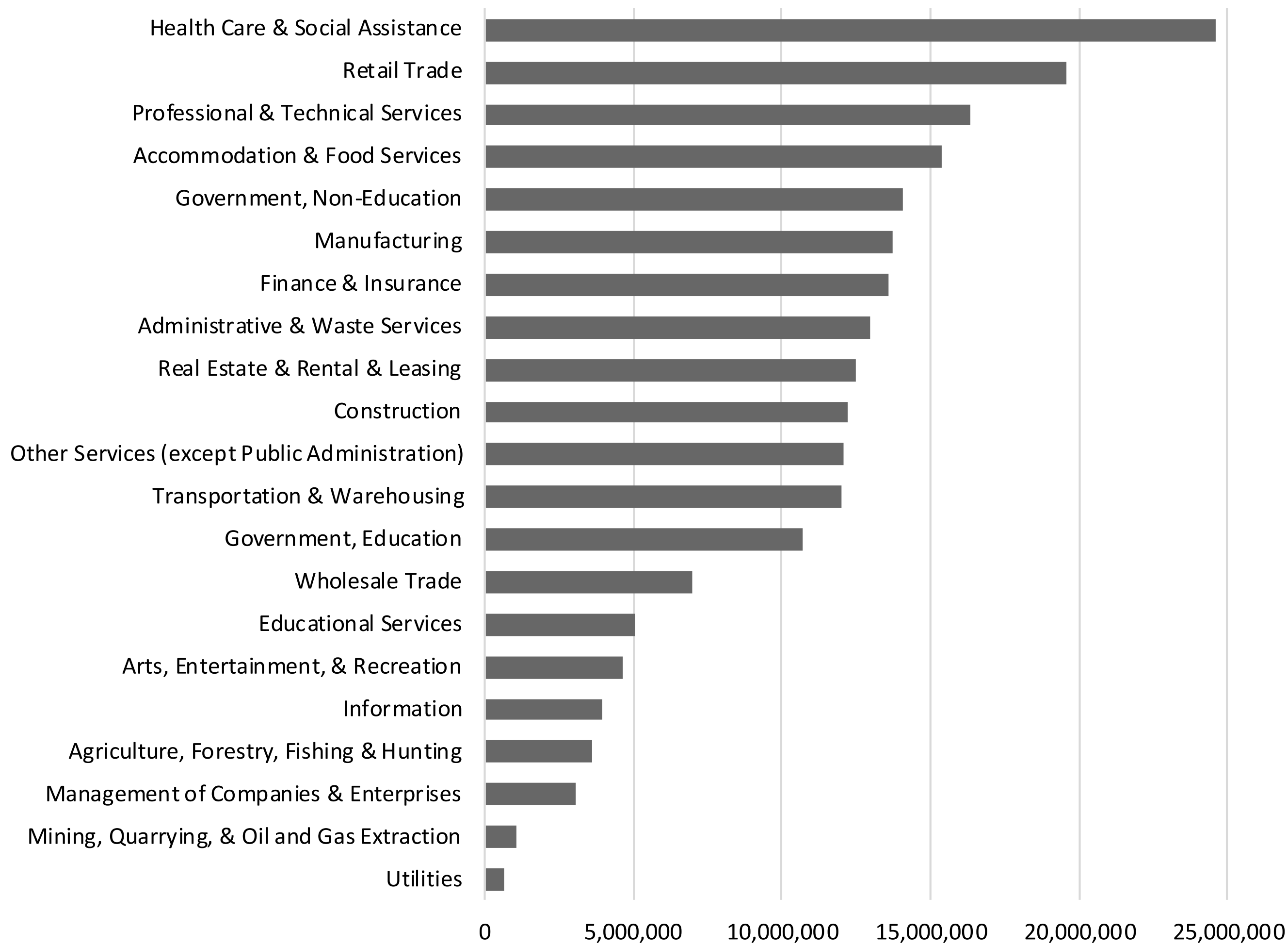
+Numbers may not sum to totals due to rounding.

Source: Lightcast industry data

Figure 2.3 provides the breakdown of jobs by industry in the U.S. The Health Care & Social Assistance sector is the largest employer, supporting 24.6 million jobs or 11.3% of total employment in the nation. The second largest employer is the Retail Trade sector, supporting 19.6 million jobs or 9.0% of the nation's total employment. Altogether, the U.S. supports 218.5 million jobs.[6]

[6] 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.

Figure 2.3: Jobs by major industry sector in the U.S., 2023*



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

Source: Lightcast employment data

Table 2.4 and Figure 2.4 present the mean earnings by education level in the U.S. 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 nation.[7] The numbers are then weighted by TCUs' 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 an associate degree from TCUs can expect approximate wages of $43,100 per year within the U.S., approximately $9,400 more than someone with a high school diploma.

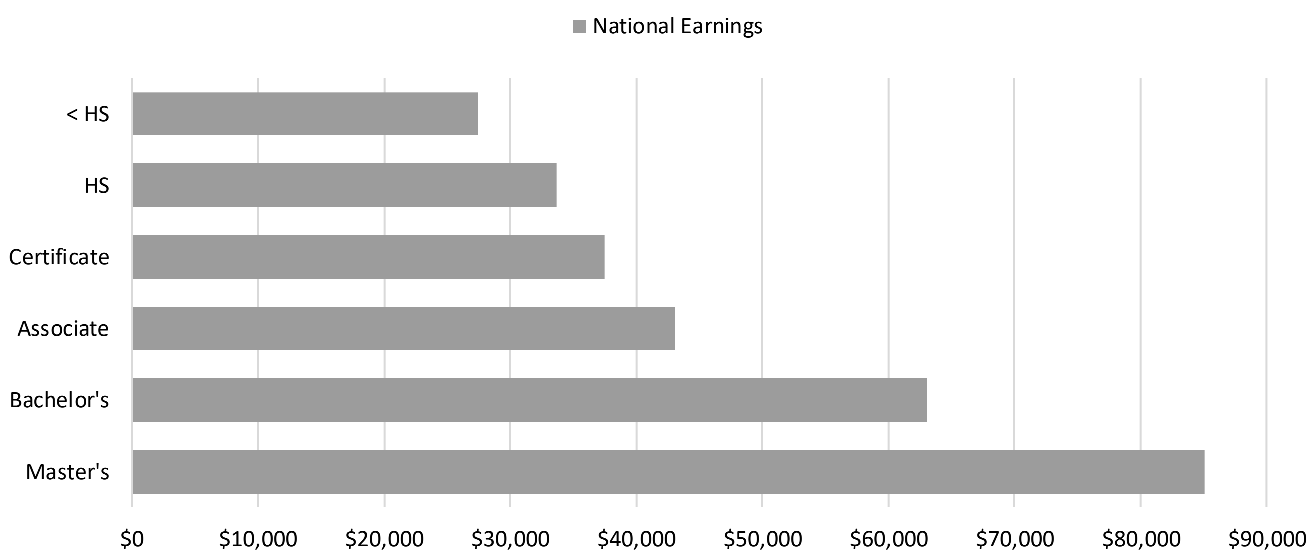
[7] Wage rates in the Lightcast MR-SAM model combine state and federal sources to provide earnings that reflect complete employment in the nation, including proprietors, self-employed workers, and others not typically included in regional or state data, as well as benefits and all forms of employer contributions.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

Table 2.4: Average earnings by education level at a TCU student's career midpoint

Education level	National earnings	Difference from next lowest degree
Less than high school	$27,400	n/a
High school or equivalent	$33,700	$6,300
Certificate	$37,500	$3,800
Associate degree	$43,100	$5,600
Bachelor's degree	$63,100	$20,000
Master's degree	$85,100	$22,000

Source: Lightcast employment data

Figure 2.4: Average earnings by education level at a TCU student's career midpoint



Source: Lightcast employment data

Chapter 3:

Economic impacts on the U.S. economy

Since their establishment, TCUs have been serving the nation by enhancing the workforce, providing local residents with easy access to higher education opportunities and preparing students for highly-skilled professions. TCUs provide students with the knowledge, skills, and abilities they need to become productive citizens and add to the overall output of the nation. Thus, in this chapter, we estimate the alumni impact of TCUs, measuring the income added in the nation as former students expand the national economy's stock of human capital.

When exploring this economic impact, we consider the following hypothetical question:

How would economic activity change in the U.S. if TCUs and all their alumni did not exist in FY 2022-23?

The economic impact should be interpreted according to this hypothetical question. Another way to think about the question is to realize that we measure the net impact, not gross impact. Gross impact represents an upper-bound estimate in terms of capturing all activity stemming from TCUs; however, a net impact reflects a truer measure of economic impact since it demonstrates what would not have existed in the nation economy if not for TCUs.

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 domestic product (GDP). 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.

> The **net impact** reflects a truer measure of economic impact since it demonstrates what would not have existed in the national economy if not for TCUs.

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 national economy through intermediary transactions and costs.[8] All of these measures—

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

added labor and non-labor income, total income, jobs, and sales—are used to estimate the economic impact results presented in this chapter. The analysis breaks out the impact measures into different components, each based on the economic effect that caused the impact. The following is a list of each type of effect presented in this analysis:

- The **initial effect** is the exogenous shock to the economy caused by the initial spending of money, whether to pay for salaries and wages, purchase goods or services, or cover operating expenses. This effect is only represented by labor income and sales and has zero non-labor income, as the initial effect of the college spending stems exclusively from its employees' salaries, wages, and benefits, while any other direct expenditures of the college are reflected in the sales amount.
- 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 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.[9]

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 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

[9] Many regional and state studies also include "induced effects" created by consumer spending. In national models, however, induced effects generally overstate impacts and are thus excluded from the analysis.

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 nation. 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.

Alumni impact

In this analysis, 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 TCUs *throughout their history.* We then use this total number to consider the impact of those students in the single FY 2022-23. 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 TCUs stems from the added human capital—the knowledge, creativity, imagination, and entrepreneurship—found in TCU alumni. While attending TCUs, 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 TCU alumni enjoy the fruits of this increased productivity in the form of additional non-labor income (i.e., higher profits).

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

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 former TCU students. The second component of the initial effect is comprised of the added non-labor income of the businesses that employ former students of TCUs.

We begin by estimating the portion of alumni who are employed in the workforce. To estimate the historical employment patterns of alumni in the nation, 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;[10] and 2) death, retirement, and unemployment rates from the National Center for Health Statistics, the Social Security Administration, and the Bureau of Labor Statistics. The result is the estimated portion of alumni from each previous year who were still actively employed in the U.S. as of FY 2022-23.

The next step is to quantify the skills and human capital that alumni acquired from TCUs. We use the students' production of CHEs as a proxy for accumulated human capital. The average number of CHEs completed per student in FY 2022-23 was 12.9. To estimate the number of CHEs present in the workforce during the analysis year, we use TCUs' historical student headcount over the past 42 years, from FY 1981-82 to FY 2022-23. We apply a 42-year time horizon to include all alumni active in the 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 the average age of TCU students 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 12.9 average CHEs per student by the headcounts that we estimate are still actively employed from each of the previous years.[11] Students who enroll at TCUs 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 10.5 million CHEs from alumni active in the workforce.

Next, we estimate the value of the CHEs, or the skills and human capital acquired by TCU 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 TCU alumni and the alternative wage they would have earned had they not attended TCUs. Using the national incremental earnings, credits required, and distribution of credits at each level of study, we estimate the average value per CHE to equal $182. This value represents the national average incremental increase in wages that the TCU alumni received during the analysis year for every CHE they completed.

[10] 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.

[11] 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 some TCUs for previous studies to estimate students' credit load in prior years.

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 2022-23, 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 $1.9 billion in gross labor income from increased wages received by former students in FY 2022-23 (as shown in Table 3.1).

Table 3.1: Number of CHEs in workforce and initial labor income created in the U.S., FY 2022-23

Number of CHEs in workforce	10,497,536
Average value per CHE	$182
Initial labor income, gross	**$1,909,543,790**
Adjustments for counterfactual scenario	
Percent reduction for alternative education opportunities	10%
Initial labor income, net	**$1,721,679,556**

Source: Lightcast impact model

The next row in Table 3.1 shows an adjustment used to account for a counterfactual outcome. 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 TCUs and subsequent influx of skilled labor into the economy. The counterfactual scenario that we address is the adjustment for alternative education opportunities. In the counterfactual scenario where TCUs do not exist, we assume a portion of TCU alumni would have received a comparable education elsewhere in the nation or would have left the U.S. and received a comparable education and then returned. The incremental added labor income that accrues to those students cannot be counted toward the added labor income from TCU alumni. The adjustment for alternative education opportunities amounts to a 10% reduction of the $1.9 billion in added labor income. This means that 10% of the added labor income from TCU alumni would have been generated in the nation anyway, even if TCUs did not exist. For more information on the alternative education adjustment, see Appendix 8. With the 10% adjustment, the net added labor income added to the economy comes to $1.7 billion, as shown in Table 3.1.

The $1.7 billion in added labor income appears under the initial effect in the labor income column of Table 3.2. To this we add an estimate for initial non-labor income. As discussed earlier in this section, businesses that employ former TCU students see higher profits as a result of the increased productivity of their capital assets. To estimate this additional income, we allocate the initial increase in labor income ($1.7 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 nation to the detailed occupations for which those completers have been trained, and then maps the detailed occupations to the six-digit industry sectors in the MR-SAM model.[12] Using a crosswalk created by National Center for Education Statistics (NCES) and the Bureau of Labor Statistics, we map the breakdown of TCUs' 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 $1.7 billion in initial labor income effects to the detailed industry sectors in the MR-SAM model.[13]

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 $659.2 million in added non-labor income attributable to TCU alumni. Summing initial labor and non-labor income together provides the total initial effect of alumni productivity in the U.S. economy, equal to approximately $2.4 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 3.2: Alumni impact, FY 2022-23

	Labor income (thousands)	Non-labor income (thousands)	Total income (thousands)	Sales (thousands)	Jobs supported
Initial effect	**$1,721,680**	**$659,237**	**$2,380,917**	**$5,339,191**	**25,736**
Multiplier effect					
Direct effect	$548,554	$249,730	$798,285	$1,656,495	8,502
Indirect effect	$410,935	$183,178	$594,112	$1,250,777	6,494
Total multiplier effect	**$959,489**	**$432,908**	**$1,392,397**	**$2,907,272**	**14,996**
Total impact (initial + multiplier)	**$2,681,169**	**$1,092,145**	**$3,773,314**	**$8,246,463**	**40,732**

Source: Lightcast impact model

Table 3.2 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

[12] 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).

[13] For example, if the MR-SAM model indicates that 20% of jobs in SOC 51-4121 (Welders) occur in NAICS 332313 (Plate Work Manufacturing) in the given region, then we allocate 20% of the initial labor income effect under SOC 51-4121 to NAICS 332313.

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 TCU alumni. The final results are $959.5 million in added labor income and $432.9 million in added non-labor income, for an overall total of $1.4 billion in multiplier effects. The grand total of the alumni impact is $3.8 billion in total added income, the sum of all initial and multiplier labor and non-labor income effects. This is equivalent to supporting 40,732 jobs.

Table 3.3 displays the total impact of TCUs by each industry sector based on their two-digit NAICS code. 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 national economy from where TCU alumni are employed. For example, the activities of their alumni in the Health Care & Social Assistance industry sector generated an impact of $513.9 million in FY 2022-23.

Table 3.3: Total TCUs impact by industry, FY 2022-23

Industry sector	Total income (thousands)	Jobs supported
Health Care & Social Assistance	$513,919	7,692
Government, Non-Education	$416,474	2,974
Professional & Technical Services	$374,947	3,346
Government, Education	$320,495	3,972
Retail Trade	$298,178	3,843
Manufacturing	$250,422	1,389
Wholesale Trade	$188,542	847
Finance & Insurance	$182,520	845
Construction	$175,097	1,847
Information	$152,207	474
Real Estate & Rental & Leasing	$140,277	1,651
Other Services (except Public Administration)	$127,490	3,227
Educational Services	$123,690	2,367
Administrative & Waste Services	$118,126	1,661
Transportation & Warehousing	$83,530	969
Arts, Entertainment, & Recreation	$70,051	1,383
Management of Companies & Enterprises	$68,752	404
Accommodation & Food Services	$57,684	1,028
Agriculture, Forestry, Fishing, & Hunting	$50,546	697
Utilities	$36,032	51
Mining, Quarrying, & Oil and Gas Extraction	$24,332	65
Total impact	**$3,773,314**	**40,732**

Source: Lightcast impact model

Chapter 4:

Investment analysis

The benefits generated by TCUs affect the lives of many people. The most obvious beneficiaries are TCUs' students; they give up time and money to go to TCUs 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 the U.S. 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 local, state, and federal government.

Investment analysis is the process of evaluating total costs and measuring these against total benefits to determine whether a proposed venture will be profitable. If benefits outweigh costs, the investment is worthwhile. If costs outweigh benefits, the investment will lose money and could be considered infeasible. In this chapter, we evaluate TCUs as an investment from the perspectives of students, taxpayers, and society.

Student perspective

To enroll in postsecondary education, students pay for tuition and forgo 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. Students 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 as well as student loan interest that students pay and the opportunity cost of forgone time and money. The benefits are the higher earnings that students receive as a result of their education.

Calculating student costs

Student costs consist of three main items: direct outlays, opportunity costs, and future principal and interest costs incurred from student loans. Direct outlays include tuition and fees, equal to $29.6 million from Figure 2.1. Direct outlays also include the cost of books and supplies. On average, full-time students spent $1,244 each on books and supplies during the reporting year.[14] Multiplying this figure by the number of full-time equivalents (FTEs) produced by TCUs in FY 2022-23[15] generates a total cost of $14.4 million for books and supplies.

In order to pay the cost of tuition, some students had to take out loans. These students not only incur the cost of tuition from TCUs but also incur the interest cost of taking out loans. In FY 2022-23, students received a total of $2.1 million in federal loans to attend TCUs.[16] 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 $2.1 million in federal loans is subtracted from the costs incurred by students in FY 2022-23.

In addition to the cost of tuition, books, and supplies, students also experienced an opportunity cost of attending college during the analysis year. Opportunity cost is the most difficult component of student costs to estimate. It measures the value of time and earnings forgone by students who go to TCUs 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 TCUs.

[14] Based on the data provided by TCUs. For institutions unable to provide data, values pulled by Lightcast from the Integrated Postsecondary Education Data System (IPEDS).

[15] A single FTE is equal to 30 CHEs for undergraduate students and 24 CHEs for graduate students, so there were 11,359 FTEs produced by students in FY 2022-23, equal to 340,481 CHEs divided by the weighted average number of CHEs per student (excluding personal enrichment students).

[16] Due to data limitations, only federal loans are considered in this analysis.

We derive the students' full earning potential by weighting the average annual earnings levels in Table 2.4 according to the education level breakdown of the student population at the start of the analysis year.[17] However, the earnings levels in Table 2.4 reflect what average workers earn at the midpoint of their careers, not while attending TCUs. Because of this, we adjust the earnings levels to the average age of the student population (30) to better reflect their wages at their current age.[18] This calculation yields an average full earning potential of $25,679 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 forgone earnings. Overall, students attending TCUs in FY 2022-23 earned an average of 13.4 CHEs per student (excluding personal enrichment students and dual credit high school students), which is approximately equal to 45% of a full academic year.[19] We thus include no more than $11,513 (or 45%) of the students' full earning potential in the opportunity cost calculations.

Another factor to consider is the students' employment status while enrolled in postsecondary education. It is estimated that 65% of students are employed.[20] 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 $11,513). The total value of their forgone earnings thus comes to $92.9 million.

Working students are able to maintain all or part of their earnings while enrolled. However, many of them hold jobs that pay less than statistical averages, usually because those are the only jobs they can find that accommodate their course schedule. These jobs tend to be at entry level, such as restaurant servers or cashiers. To account for this, we assume that working students hold jobs that

[17] This is based on students who reported their prior level of education to TCUs. The prior level of education data was then adjusted to exclude dual credit high school students. For institutions unable to provide data, average values across AIHEC institutions were utilized as estimates.

[18] Further discussion on this adjustment appears in Appendix 7.

[19] Equal to 13.4 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.

[20] Lightcast provided estimates of the percentage of students employed for TCUs that were unable to provide data. This figure excludes dual credit high school students, who are not included in the opportunity cost calculations.

pay 82% of what they would have earned had they chosen to work full-time rather than go to college.[21] The remaining 18% comprises the percentage of their full earning potential that they forgo. Obviously, this assumption varies by person; some students forgo more and others less. Since we do not know the actual jobs that students hold while attending, the 18% in forgone earnings serves as a reasonable average.

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 TCUs 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 $2.1 million in loans was awarded to 326 students, averaging $6,398 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 TCUs are two-year TCUs, students will be indebted twice that amount, or $12,796 on average. According to the U.S. Department of Education, this level of indebtedness will take 15 years to pay back under the standard repayment plan.[22]

This indebtedness calculation is used solely to estimate the loan payback period. Students will be paying back the principal amount of $2.1 million over time. After taking into consideration the time value of money, this means that students will pay off a discounted present value of $1.3 million in principal over the 15 years. In order to calculate interest, we only consider interest on the federal loans awarded to students in FY 2022-23. Using the student discount rate of 4.9%[23] as our interest rate, we calculate that students will pay a total discounted present value of $717.2 thousand in interest on student loans throughout the first 15 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 4.2.

[21] The 82% 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).

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

[23] The student discount rate is derived from the three-year average of the baseline forecasts for the 10-year discount rate published by the Congressional Budget Office. See the Congressional Budget Office, Student Loan and Pell Grant Programs—May 2023 Baseline. https://www.cbo.gov/data/baseline-projections-selected-programs.

Table 4.1: Present value of student costs, FY 2022-23 (thousands)

Direct outlays in FY 2022-23	
Tuition and fees	$29,590
Less federal loans received	-$2,086
Books and supplies	$14,395
Less direct outlays of personal enrichment students	-$205
Total direct outlays	**$41,694**
Opportunity costs in FY 2022-23	
Earnings forgone by non-working students	$92,927
Earnings forgone by working students	$30,141
Less residual aid	-$67,803
Total opportunity costs	**$55,265**
Future student loan costs (present value)	
Student loan principal	$1,339
Student loan interest	$717
Total present value student loan costs	**$2,056**
Total present value student costs	**$99,015**

Source: Based on data provided by TCUs and outputs of the Lightcast impact model

The steps leading up to the calculation of student costs appear in Table 4.1. Direct outlays amount to $41.7 million, the sum of tuition and fees ($29.6 million) and books and supplies ($14.4 million), less federal loans received ($2.1 million) and $205.4 thousand in direct outlays of personal enrichment students (those students are excluded from the cost calculations). Opportunity costs for working and non-working students amount to $55.3 million, excluding $67.8 million in offsetting residual aid that is paid directly to students.[24] Finally, we have the present value of future student loan costs, amounting to $2.1 million between principal and interest. Summing direct outlays, opportunity costs, and future student loan costs together yields a total of $99.0 million 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 2.4, national mean earnings levels at the midpoint of the average-aged worker's career increase as people achieve higher levels of education. The differences between national earnings levels define the incremental benefits of moving from one education level to the next.

[24] Residual aid is the remaining portion of scholarship or grant aid distributed directly to a student after TCUs apply tuition and fees.

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 TCUs' FY 2022-23 students first by determining their average annual increase in earnings, equal to $52.2 million. This value represents the higher wages that accrue to students at the midpoint of their careers and is calculated based on the marginal wage increases of the CHEs that students complete while attending TCUs. Using national earnings, the marginal wage increase per CHE is $153. For a full description of the methodology used to derive the $52.2 million, see Appendix 7.

The second step is to project the $52.2 million annual increase in earnings into the future, for as long as students remain in the workforce. We do this by using the extended Mincer function to predict the change in earnings at each point in an individual's working career.[25] 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. Thus, to account for any upward bias, we conservatively incorporate a 10% reduction in our projected earnings, otherwise known as the ability bias.

Further, due to inconsistencies in the original quadratic Mincer specification,[26] as noted above, we use an enhanced version of the Mincer function—a quartic specification—that, besides the education level and work experience variables, factors in demographic characteristics such as sex and race/ethnicity to project, as precisely as possible, the former students' wage trajectories.[27] With the $52.2 million representing the students' higher earnings at the midpoint of their careers, we apply scalars from the Mincer function to yield a stream of projected future benefits that gradually increase from the time students enter the workforce, peak shortly after the career midpoint, and then dampen slightly as students approach retirement at age 67. This earnings stream appears in Column 2 of Table 4.2.

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

[26] Hamlen, S. S., & Hamlen, W. A. (2012). The inconsistency of the quadratic Mincer equation: A proof. *Theoretical Economics Letters*, 2(2), 115-120. https://doi.org/10.4236/tel.2012.22021

[27] Murphy, K. M., & Welch, F. (1990). Empirical age-earnings-profiles. *Journal of Labor Economics*, 8(2), 202-229.

Table 4.2: Projected benefits and costs, student perspective

1 Years out of school	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	$30.0	11%	$3.3	$97.0	-$93.6
1	$32.5	19%	$6.3	$0.2	$6.1
2	$35.1	28%	$9.9	$0.2	$9.7
3	$37.6	44%	$16.4	$0.2	$16.2
4	$40.0	65%	$26.2	$0.2	$26.0
5	$42.4	95%	$40.4	$0.2	$40.2
6	$44.7	95%	$42.5	$0.2	$42.4
7	$46.9	95%	$44.5	$0.2	$44.4
8	$49.0	95%	$46.4	$0.2	$46.2
9	$51.0	94%	$48.2	$0.2	$48.0
10	$52.9	94%	$49.8	$0.2	$49.6
11	$54.6	94%	$51.3	$0.2	$51.1
12	$56.2	94%	$52.7	$0.2	$52.5
13	$57.7	93%	$53.9	$0.2	$53.7
14	$59.0	93%	$54.9	$0.2	$54.7
15	$60.2	93%	$55.8	$0.2	$55.6
16	$61.2	92%	$56.6	<$0.1	$56.5
17	$62.1	92%	$57.2	<$0.1	$57.1
18	$62.9	92%	$57.7	<$0.1	$57.6
19	$63.6	91%	$58.0	<$0.1	$57.9
20	$64.1	91%	$58.2	<$0.1	$58.1
21	$64.6	90%	$58.3	$0.0	$58.3
22	$64.9	90%	$58.2	$0.0	$58.2
23	$65.1	89%	$58.0	$0.0	$58.0
24	$65.3	89%	$57.8	$0.0	$57.8
25	$65.3	88%	$57.4	$0.0	$57.4
26	$65.3	87%	$56.9	$0.0	$56.9
27	$65.2	86%	$56.3	$0.0	$56.3
28	$65.0	86%	$55.6	$0.0	$55.6
29	$64.8	85%	$54.8	$0.0	$54.8
30	$64.5	84%	$54.0	$0.0	$54.0
31	$63.8	83%	$52.7	$0.0	$52.7
32	$61.6	82%	$50.4	$0.0	$50.4
33	$57.5	81%	$46.6	$0.0	$46.6

Table 4.2: Projected benefits and costs, student perspective

1 Years out of school	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)
34	$52.9	80%	$42.4	$0.0	$42.4
35	$38.0	80%	$30.5	$0.0	$30.5
36	$31.6	80%	$25.1	$0.0	$25.1
37	$24.0	79%	$19.0	$0.0	$19.0
38	$16.7	79%	$13.2	$0.0	$13.2
39	$12.2	79%	$9.6	$0.0	$9.6
40	$9.2	78%	$7.2	$0.0	$7.2
41	$9.1	77%	$7.0	$0.0	$7.0
42	$1.1	77%	$0.9	$0.0	$0.9
43	$0.5	77%	$0.4	$0.0	$0.4
Present value			**$742.1**	**$99.0**	**$643.0**
Internal rate of return					**27.2%**
Benefit-cost ratio					**7.5**
Payback period (no. of years)					**4.9**

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

Percentages reflect aggregate values for all TCUs and are subject to fluctuations due to TCUs' varying time horizons.

Source: Lightcast impact model

As shown in Table 4.2, the $52.2 million in gross higher earnings occurs around Year 10, 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 $52.2 million and the gross higher earnings in the years after the midpoint are greater than $52.2 million.

The final step in calculating the students' future benefits stream is to net out the potential benefits generated by students who are either not yet active in the workforce or who leave the workforce over time. This adjustment appears in Column 3 of Table 4.2 and represents the percentage of the FY 2022-23 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 TCUs 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 3, settling-in factors delay the onset of the benefits by one to three years for students who graduate with a certificate or a degree and by one to five years for degree-seeking students who do not complete during the analysis year.

Beyond the first five years of the time horizon, students will leave the workforce for any number of reasons, whether death, retirement, or unemployment. We estimate the rate of attrition using the same data and assumptions applied in the calculation of the attrition rate in the economic impact analysis of Chapter 3.[28] 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 4.2 shows the net higher earnings to students after accounting for both the settling-in patterns and attrition.

Return on investment for students

Having estimated the students' costs and their future benefits stream, the next step is to discount the results to the present to reflect the time value of money. For the student perspective we assume a discount rate of 4.9% (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.[29] 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 4.9% discount rate from the student perspective and a 0.7% discount rate from the perspectives of taxpayers and society.

[28] See the discussion of the alumni impact in Chapter 3. 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.

[29] The student discount rate is derived from the most recent three-year average baseline forecasts for the 10-year Treasury rate published by the Congressional Budget Office. See the Congressional Budget Office, Student Loan and Pell Grant Programs—May 2023 Baseline. https://www.cbo.gov/data/baseline-projections-selected-programs.

In Table 4.2, the net higher earnings of students yield a cumulative discounted sum of approximately $742.1 million, 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 2022-23 student body is rewarded for its investment in TCUs with a capital asset valued at $742.1 million.

The students' cost of attending TCUs is shown in Column 5 of Table 4.2, equal to a present value of $99.0 million. Comparing the cost with the present value of benefits yields a student benefit-cost ratio of 7.5 (equal to $742.1 million in benefits divided by $99.0 million in costs).

Another way to compare the same benefits stream and associated cost is to compute the rate of return. The rate of return indicates the interest rate that a bank would have to pay a depositor to yield an equally attractive stream of future payments.[30] Table 4.2 shows students of TCUs earning average returns of 27.2% 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 10.1% on stocks and bonds (30-year average return).

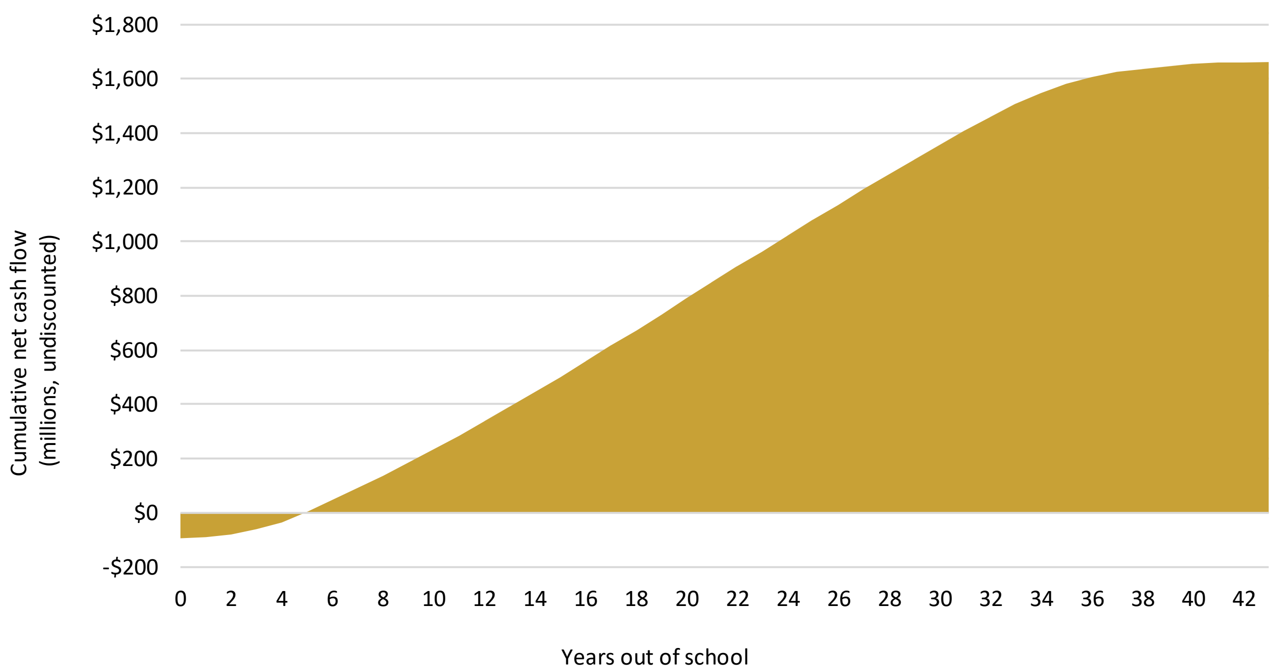
TCU students see an average rate of return of **27.2%** for their investment of time and money.

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 4.2, the 27.2% student rate of return is a real rate. With an inflation rate of 2.6% (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 29.8%, higher than what is reported in Table 4.2.

[30] 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.

The payback period is defined as the length of time it takes to entirely recoup the initial investment.[31] Beyond that point, returns are what economists would call pure costless rent. As indicated in Table 4.2, students at TCUs see, on average, a payback period of 4.9 years, meaning 4.9 years after their initial investment of forgone earnings and out-of-pocket costs, they will have received enough higher future earnings to fully recover those costs (Figure 4.1).

Figure 4.1: Student payback period



Source: Lightcast impact model

[31] 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.

Taxpayer perspective

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

Growth in tax revenues

As a result of their time at TCUs, students earn more because of the skills they learned while attending TCUs, 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 the government is able to apply tax rates to higher earnings.

Estimating the effect of TCUs on increased tax revenues begins with the present value of the students' future earnings stream, which is displayed in Column 4 of Table 4.2. 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 nation as students and businesses spend their higher earnings.[32] As labor income

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

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 U.S. gross domestic product to total labor income. Next, we apply the prevailing tax rates so we capture only the tax revenues attributable to the government from this additional revenue.

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 3 and is designed to account for the counterfactual scenario where TCUs do not exist. The assumption in this case is that any benefits generated by students who could have received an education even without TCUs 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 TCUs would have generated benefits anyway even without TCUs. 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 government costs of supporting TCUs. 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 government funding for TCUs did not exist and TCUs 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 taxpayer support to zero and progressively increasing student tuition and fees. As student tuition and fees increase, enrollment declines. For TCUs, the shutdown point adjustment is 0%, meaning that TCUs could not operate without taxpayer support. As such, no reduction applies. For more information on the theory and methodology behind the estimation of the shutdown point, see Appendix 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 nation, equal to $785.6 million. Recall from the discussion of the student return on investment that the present value represents the sum of the future benefits that accrue each year over the course of the time horizon, discounted to current year dollars to account for the time value of money. Given that the stakeholder in this case is the public sector, we use the discount rate of 0.7%. This is the three-year average of 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.[33]

[33] 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/2023/02/M-23-12-Appendix-C-Update_Discount-Rates.pdf. Last revised February 17, 2023.

Government efficiencies

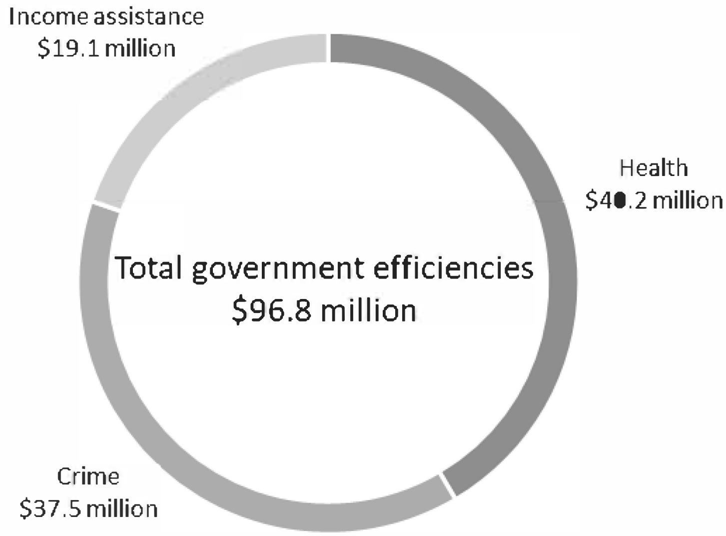
In addition to the creation of higher tax revenues to the government, education is statistically associated with a variety of lifestyle changes that generate social savings, also known as external or incidental benefits of education. These represent the avoided costs to the government that otherwise would have been drawn from public resources absent the education provided by TCUs. These efficiencies appear in Figure 4.2 and Table 4.3 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 the 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 government, education is statistically associated with a variety of lifestyle changes that generate **social savings**.

The model quantifies these efficiencies 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 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 TCUs, 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 by the associated costs of health, crime, and income assistance.[34] Finally, we apply the same adjustments for attrition, alternative education, and the shutdown point to derive the net savings to the government. Total efficiencies appear in Figure 4.2 and sum to $96.8 million.

[34] 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.

Figure 4.2: Present value of government efficiencies



Source: Lightcast impact model

Table 4.3 displays all benefits to taxpayers. The first row shows the added tax revenues created in the nation, equal to $785.6 million, from students' higher earnings and increases in non-labor income. The sum of the government efficiencies and the added income in the nation is $882.4 million, as shown in the bottom row of Table 4.3. These savings continue to accrue in the future as long as the FY 2022-23 student population remains in the workforce.

Table 4.3: Present value of added tax revenue and government efficiencies (thousands)

Added tax revenue	**$785,642**
Government efficiencies	
Health-related savings	$40,215
Crime-related savings	$37,498
Income assistance savings	$19,087
Total government efficiencies	**$96,800**
Total taxpayer benefits	**$882,441**

Source: Lightcast impact model

Return on investment for taxpayers

Taxpayer costs are reported in Table 4.4 and come to $568.6 million, equal to the contribution of local, state, and federal government to TCUs. In return for their public support, taxpayers will receive an investment benefit-cost ratio of 1.6 (= $882.4 million ÷ $568.6 million), indicating a profitable investment.

Table 4.4: Projected benefits and costs, taxpayer perspective

1 Years out of school	2 Benefits to taxpayers (millions)	3 Local, state, and federal gov't costs (millions)	4 Net cash flow (millions)
0	$2.1	$568.6	-$566.4
1	$4.0	$0.0	$4.0
2	$6.1	$0.0	$6.1
3	$10.0	$0.0	$10.0
4	$15.8	$0.0	$15.8
5	$24.2	$0.0	$24.2
6	$25.3	$0.0	$25.3
7	$26.4	$0.0	$26.4
8	$27.3	$0.0	$27.3
9	$28.2	$0.0	$28.2
10	$29.1	$0.0	$29.1
11	$29.8	$0.0	$29.8
12	$30.5	$0.0	$30.5
13	$31.1	$0.0	$31.1
14	$31.7	$0.0	$31.7
15	$32.1	$0.0	$32.1
16	$32.5	$0.0	$32.5
17	$32.8	$0.0	$32.8
18	$33.1	$0.0	$33.1
19	$33.2	$0.0	$33.2
20	$33.3	$0.0	$33.3
21	$33.3	$0.0	$33.3
22	$33.3	$0.0	$33.3
23	$33.2	$0.0	$33.2
24	$33.0	$0.0	$33.0
25	$32.8	$0.0	$32.8
26	$32.5	$0.0	$32.5
27	$32.2	$0.0	$32.2
28	$31.8	$0.0	$31.8
29	$31.4	$0.0	$31.4
30	$30.9	$0.0	$30.9
31	$30.3	$0.0	$30.3
32	$28.9	$0.0	$28.9
33	$26.9	$0.0	$26.9
34	$24.5	$0.0	$24.5
35	$17.5	$0.0	$17.5

Table 4.4: Projected benefits and costs, taxpayer perspective

1 Years out of school	2 Benefits to taxpayers (millions)	3 Local, state, and federal gov't costs (millions)	4 Net cash flow (millions)
36	$14.7	$0.0	$14.7
37	$11.1	$0.0	$11.1
38	$8.0	$0.0	$8.0
39	$5.8	$0.0	$5.8
40	$4.4	$0.0	$4.4
41	$4.3	$0.0	$4.3
42	$0.4	$0.0	$0.4
43	$0.2	$0.0	$0.2
Present value	**$882.4**	**$568.6**	**$313.9**
Internal rate of return			**3.2%**
Benefit-cost ratio			**1.6**
Payback period (no. of years)			**21.5**

Numbers reflect aggregate values for all TCUs and are subject to fluctuations due to TCUs' varying time horizons.

Source: Lightcast impact model

At 3.2%, the rate of return to taxpayers is favorable. Given that the stakeholder in this case is the public sector, we use the mentioned earlier discount rate of 0.7%, the three-year average of the real Treasury interest rate reported by the Office of Management and Budget for 30-year investments. This is the return governments are assumed to be able to earn on generally safe investments of unused funds, or alternatively, the interest rate for which governments, as relatively safe borrowers, can obtain funds. A rate of return of 0.7% would mean that TCUs just pay their own way. In principle, governments could borrow monies used to support TCUs and repay the loans out of the resulting added taxes and reduced government expenditures. A rate of return of 3.2%, on the other hand, means that TCUs not only pay their own way, but also generate a surplus that the government can use to fund other programs.

A benefit-cost ratio of **1.6** means TCUs are a good public investment since the taxes from TCU student higher earnings and reduced government expenditures not only recover taxpayer costs but grow the U.S. tax base.

Additionally, a benefit-cost ratio greater than 1.0 indicates a good public investment since the taxes from TCU student higher earnings and reduced government expenditures not only recover taxpayer costs but grow the U.S. tax base.

Social perspective

The U.S. benefits from the education that TCUs provide through the earnings that students create in the nation and through the savings that they generate through their improved lifestyles. To receive these benefits, however, members of society must pay money and forgo services that they otherwise would have enjoyed if TCUs did not exist. Society's investment in TCUs stretches across a number of investor groups, from students to employers to taxpayers. We weigh the benefits generated by TCUs to these investor groups against the total social costs of generating those benefits. The total social costs include all federal, state, and local taxpayer support, all student expenditures (including interest on student loans) less tuition and fees, and all student opportunity costs, totaling a present value of $668.4 million.

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

Beekeeper analogy

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

But from society's standpoint, there is more. Flowers provide the nectar that bees need for honey production, and smart beekeepers locate near flowering sources such as orchards. Nearby orchard owners, in turn, benefit as the bees spread the pollen necessary for orchard growth and fruit production. This is an uncompensated external benefit of beekeeping, and economists have long recognized that society might actually do well to subsidize 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. In an effort to provide a more comprehensive report of the benefits generated by education, the model accounts for many of these external social benefits.

Growth in national economic base

In the process of absorbing the newly acquired skills of students who attend TCUs, not only does the productivity of the U.S. workforce increase, but so does the productivity of its physical capital and assorted infrastructure. Students earn more because of the skills they learned while attending TCUs, 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 TCUs on the nation's economic base follows a similar process used when calculating increased tax revenues in the taxpayer perspective. However, instead of looking at just the tax revenue portion, we include all of the added earnings and business output. First, we calculate the students' future higher earnings stream. We factor in student attrition and alternative education opportunities to arrive at net higher earnings. We again apply multipliers derived from Lightcast's MR-SAM model to estimate the added labor and non-labor income created in the nation 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 4.3). The shutdown point does not apply to the growth of the economic base because the social perspective captures not only the taxpayer support to TCUs, 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 nation, equal to $3.0 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 0.7%.

Social savings

Similar to the government efficiencies 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 TCUs. Social benefits appear in Table 4.5 and break down into three main categories: 1) health savings, 2) crime savings, and 3) income assistance savings. These are similar to the categories from the taxpayer perspective above, although health savings now also include lost productivity and other effects associated with smoking, obesity, depression, and substance 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 comprise the avoided government costs due to the reduced number of welfare and unemployment insurance claims.

Table 4.5: Present value of the future increased economic base and social savings in the nation (thousands)

Increased economic base	$3,010,121
Social savings	
Health	
Smoking	$104,680
Obesity	$30,102
Depression	-$2,644
Substance abuse	$6,061
Total health savings*	**$138,200**
Crime	
Criminal justice system savings	$37,057
Crime victim savings	$747
Added productivity	$3,935
Total crime savings	**$41,739**
Income assistance	
Welfare savings	$15,094
Unemployment savings	$3,993
Total income assistance savings	**$19,087**
Total social savings	**$199,026**
Total, increased economic base + social savings	**$3,209,147**

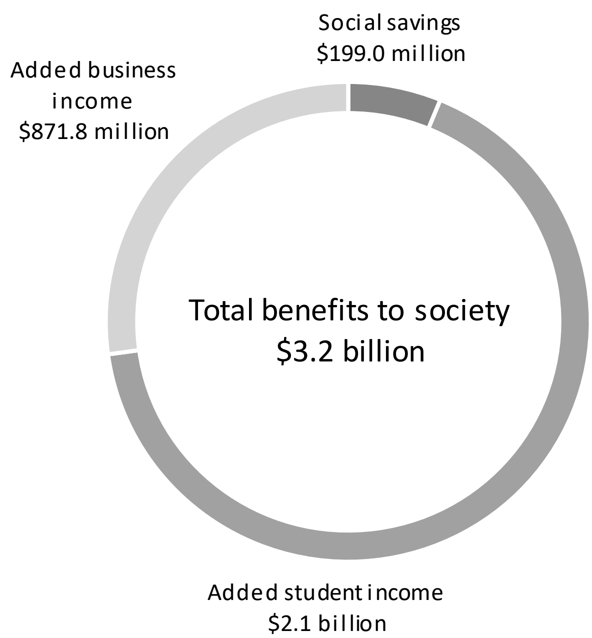
*In some cases, health savings may be negative. This is due to increased prevalence rates at certain education levels.

Source: Lightcast impact model

Table 4.5 displays the results of the analysis. The first row shows the increased economic base in the nation, equal to $3.0 billion, from students' higher earnings and their multiplier effects and increases in non-labor income. Social savings appear next, beginning with a breakdown of savings related to health. These include savings due to a reduced demand for medical treatment and social services, improved worker productivity and reduced absenteeism, and a reduced number of vehicle crashes and fires induced by alcohol or smoking-related incidents. Although the prevalence of these health conditions generally declines as individuals attain higher levels of education, prevalence rates are sometimes higher for individuals with certain levels of education. For example, adults with college degrees may be more likely to spend more on illicit substances and alcohol and become dependent on them. Thus, in some cases the social savings associated with a health factor can be negative. Nevertheless, the overall health savings for society are positive, amounting to $138.2 million. Crime savings amount to $41.7 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 amounts to $19.1 million, stemming from a reduced number of persons in need of welfare or unemployment benefits. All told, social savings amounted to $199.0 million in benefits to communities and citizens in the U.S.

The sum of the social savings and the increased national economic base is $3.2 billion, as shown in the bottom row of Table 4.5 and in Figure 4.3. These savings accrue in the future as long as the FY 2022-23 student population of TCUs remains in the workforce.

Figure 4.3: Present value of benefits to society



Source: Lightcast impact model

Return on investment for society

Table 4.6 presents the stream of benefits accruing to the U.S. society and the total social costs of generating those benefits. Comparing the present value of the benefits and the social costs, we have a benefit-cost ratio of 4.8. This means that for every dollar invested in an education from TCUs, whether it is the money spent on operations of TCUs or money spent by students on tuition and fees, an average of $4.80 in benefits will accrue to society in the U.S.[35]

[35] 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 4.6: Projected benefits and costs, social perspective

1 Years out of school	2 Benefits to society (millions)	3 Social costs (millions)	4 Net cash flow (millions)
0	$7.4	$665.5	-$658.1
1	$13.9	$0.2	$13.7
2	$21.5	$0.2	$21.4
3	$35.3	$0.2	$35.1
4	$56.1	$0.2	$55.9
5	$86.6	$0.2	$86.4
6	$90.8	$0.2	$90.6
7	$94.8	$0.2	$94.6
8	$98.5	$0.2	$98.3
9	$102.0	$0.2	$101.8
10	$105.2	$0.2	$105.0
11	$108.1	$0.2	$108.0
12	$110.8	$0.2	$110.6
13	$113.2	$0.2	$113.0
14	$115.2	$0.2	$115.1
15	$117.0	$0.2	$116.8
16	$118.5	<$0.1	$118.5
17	$119.7	<$0.1	$119.7
18	$120.7	<$0.1	$120.6
19	$121.3	<$0.1	$121.3
20	$121.7	<$0.1	$121.6
21	$121.8	$0.0	$121.8
22	$121.7	$0.0	$121.7
23	$121.3	$0.0	$121.3
24	$120.7	$0.0	$120.7
25	$119.9	$0.0	$119.9
26	$118.9	$0.0	$118.9
27	$117.7	$0.0	$117.7
28	$116.3	$0.0	$116.3
29	$114.7	$0.0	$114.7
30	$113.0	$0.0	$113.0
31	$110.5	$0.0	$110.5
32	$105.7	$0.0	$105.7
33	$98.2	$0.0	$98.2
34	$89.7	$0.0	$89.7
35	$64.2	$0.0	$64.2
36	$54.0	$0.0	$54.0

Table 4.6: Projected benefits and costs, social perspective

1 Years out of school	2 Benefits to society (millions)	3 Social costs (millions)	4 Net cash flow (millions)
37	$40.7	$0.0	$40.7
38	$29.3	$0.0	$29.3
39	$21.5	$0.0	$21.5
40	$16.1	$0.0	$16.1
41	$15.7	$0.0	$15.7
42	$1.6	$0.0	$1.6
43	$0.6	$0.0	$0.6
Present value	**$3,209.1**	**$668.4**	**$2,540.8**
Benefit-cost ratio			**4.8**
Payback period (no. of years)			**9.6**

Numbers reflect aggregate values for all TCUs and are subject to fluctuations due to TCUs' varying time horizons.

Source: Lightcast impact model

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 TCUs. 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 4.4 and Table 4.6 are inclusive of social benefits reported as attributable to TCUs. Recognizing the other point of view, Table 4.7 shows rates of return for both the taxpayer and social perspectives exclusive of social benefits. As indicated, returns are still above threshold levels (a 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 TCUs.

Table 4.7: Taxpayer and social perspectives with and without social savings

	Including social savings	Excluding social savings
Taxpayer perspective		
Net present value (millions)	$313.9	$217.1
Benefit-cost ratio	1.6	1.4
Internal rate of return	3.2%	2.5%
Payback period (no. of years)	21.5	24.7
Social perspective		
Net present value (millions)	$2,541	$2,342
Benefit-cost ratio	4.8	4.5

Source: Lightcast impact model

Chapter 5:

Conclusion

While TCUs add value to the U.S. beyond the economic impact outlined in this study, the value of their impact in terms of dollars and cents is an important component of TCUs' value as a whole. In order to fully assess the value of TCUs to the national economy, this report has evaluated TCUs from the perspectives of economic impact analysis and investment analysis.

From an economic impact perspective, and more specifically, from the alumni impact perspective, we calculated that TCUs generate a total economic impact of **$3.8 billion** in total added income for the national economy. This impact is equivalent to supporting **40,732 jobs.**

TCUs generate a total economic impact of **$3.8 billion** in total added income for the national economy.

Since TCUs' activity represents an investment by various parties, including students, taxpayers, and society as a whole, we also evaluated TCUs as an investment to see the value they provide to these investors. For each dollar invested by students, taxpayers, and society, TCUs offer a benefit of **$7.50**, **$1.60**, and **$4.80**, respectively. These results indicate that TCUs are an attractive investment to students with rates of return that exceed alternative investment opportunities. At the same time, the presence of TCUs expands the national economy and creates a wide range of positive social benefits that accrue to taxpayers and society in general within the U.S.

Modeling the impact of TCUs 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 TCUs.

Resources and appendices

Resources and references

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Appendix 1: Tribal Colleges and Universities

Institution	Location
Aaniiih Nakoda College	Harlem, Montana
Bay Mills Community College	Brimley, Michigan
Blackfeet Community College	Browning, Montana
Cankdeska Cikana Community College	Fort Totten, North Dakota
Chief Dull Knife College	Lame Deer, Montana
College of Menominee Nation	Keshena, Wisconsin
College of the Muscogee Nation	Okmulgee, Oklahoma
Diné College	Tsaile, Arizona
Fond du Lac Tribal and Community College	Cloquet, Minnesota
Fort Peck Community College	Poplar, Montana
Haskell Indian Nations University	Lawrence, Kansas
Iḷisaġvik College	Barrow, Alaska
Institute of American Indian Arts	Santa Fe, New Mexico
Keweenaw Bay Ojibwa Community College	Baraga, Michigan
Lac Courte Oreilles Ojibwe University	Hayward, Wisconsin
Leech Lake Tribal College	Cass Lake, Minnesota
Little Big Horn College	Crow Agency, Montana
Little Priest Tribal College	Winnebago, Nebraska
Navajo Technical University	Crownpoint, New Mexico
Nebraska Indian Community College	Macy, Nebraska
Northwest Indian College	Bellingham, Washington
Nueta Hidatsa Sahnish College	New Town, North Dakota
Oglala Lakota College	Kyle, South Dakota
Red Lake Nation College	Red Lake, Minnesota
Saginaw Chippewa Tribal College	Mount Pleasant, Michigan
Salish Kootenai College	Pablo, Montana
Sinte Gleska University	Mission, South Dakota
Sisseton Wahpeton College	Agency Village, South Dakota
Sitting Bull College	Fort Yates, North Dakota
Southwestern Indian Polytechnic Institute	Albuquerque, New Mexico
Stone Child College	Box Elder, Montana
Tohono O’odham Community College	Sells, Arizona
Turtle Mountain College	Belcourt, North Dakota
United Tribes Technical College	Bismarck, North Dakota
White Earth Tribal and Community College	Mahnomen, Minnesota

AIHEC Tribal Colleges and Universities

BAY MILLS Community College

BLACKFEET COMMUNITY COLLEGE

CANKDESKA CIKANA COMMUNITY COLLEGE
Spirit Lake Tribe

CHIEF DULL KNIFE COLLEGE 1979

COLLEGE OF MENOMINEE NATION KESHENA - GREEN BAY

COLLEGE of the MUSCOGEE NATION EST. 2004

Diné College

Fond du Lac Tribal & Community College

FORT PECK COMMUNITY COLLEGE

HASKELL INDIAN NATIONS UNIVERSITY

IḶISAĠVIK COLLEGE

IAIA INSTITUTE of AMERICAN INDIAN ARTS
THE UNIVERSITY FOR INDIGENOUS CREATIVE EXCELLENCE

Keweenaw Bay Ojibwa Community College
KBOCC

LAC COURTE OREILLES OJIBWE UNIVERSITY

LEECH LAKE TRIBAL COLLEGE

LITTLE PRIEST TRIBAL COLLEGE
OUR MISSION: "BE STRONG AND EDUCATE MY CHILDREN"

LITTLE BIG HORN COLLEGE

NTU NAVAJO TECHNICAL UNIVERSITY

NEBRASKA INDIAN COMMUNITY COLLEGE

NHS COLLEGE

OGLALA LAKOTA COLLEGE

NORTHWEST INDIAN COLLEGE
Xwlemi Elh > Tal > Nexw > Squl

RED LAKE NATION COLLEGE MIGIZI

SAGINAW CHIPPEWA TRIBAL COLLEGE

SINTE GLESKA UNIVERSITY ROSEBUD, SD

SALISH KOOTENAI COLLEGE

SIPI SOUTHWESTERN INDIAN POLYTECHNIC INSTITUTE

SITTING BULL COLLEGE

STONE CHILD COLLEGE ESTABLISHED 1984

Tohono O'odham Community College

Turtle Mountain Community College

UNITED TRIBES TECHNICAL COLLEGE

WHITE EARTH TRIBAL & COMMUNITY COLLEGE

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 student employment variables, and 3) the discount rate.

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 publicly-funded TCUs in the nation. 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 3.16% to 3.09%. Likewise, a decrease of 10% (from 10% to 9%) in the assumption increases the rate of return from 3.16% to 3.23%.

Based on this sensitivity analysis, the conclusion can be drawn that TCU 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 threshold levels (a 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.

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)	$362.9	$338.4	$323.7	$313.9	$304.1	$289.4	$264.9
Rate of return	3.48%	3.32%	3.23%	3.16%	3.09%	2.99%	2.83%
Benefit-cost ratio	1.64	1.60	1.57	1.55	1.53	1.51	1.47
Social perspective							
Net present value (millions)	$2,719	$2,630	$2,576	$2,541	$2,505	$2,452	$2,362
Benefit-cost ratio	5.07	4.93	4.85	4.80	4.75	4.67	4.53

Table A2.2 presents the results of the sensitivity analysis for the alternative education variable for the alumni impact. As explained earlier, the assumption increases and decreases relative to the base case of 10% by the increments indicated in the table. Alumni productivity impacts attributable to TCUs, for example, range from a high of $4.0 billion at a -50% variation to a low of $3.6 billion at a +50% variation from the base case assumption. This means that if the alternative education variable increases, the impact that we claim as attributable to alumni decreases. Even under the most conservative assumptions, the alumni impact on the U.S. economy still remains sizable.

Table A2.2: Sensitivity analysis of alternative education variable

% variation in assumption	-50%	-25%	-10%	Base case	10%	25%	50%
Alternative education variable	5%	8%	9%	10%	11%	13%	15%
Alumni impact (millions)	$3,983	$3,878	$3,815	$3,773	$3,731	$3,668	$3,564

Student employment variables

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

Students incur substantial expense by attending TCUs 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 65% of students are employed.[36] 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 TCUs earn only 82%, on average, of the earnings that they statistically would have received if not attending TCUs. This suggests that many students hold part-time jobs that accommodate their attendance at TCUs, though it is at an additional cost in terms of receiving a wage that is less than what they otherwise might make. The 82% variable is an estimation based on the average hourly wages of the most common jobs held by students while attending college relative to the average hourly wages of all occupations in the U.S.. The model captures this difference in wages and counts it as part of the opportunity cost of time. As above, the 82% 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 65% and *B* equal to 82%. 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 = 65%, B = 82%	$643.0	27.2%	7.5
Scenario 1: A = 100%, B = 82%	$719.3	78.3%	32.6
Scenario 2: A = 65%, B = 100%	$673.2	34.9%	10.8
Scenario 3: A = 100%, B = 100%	$766.1	n/a*	n/a*
Scenario 4: A = 0%, B = 0%	$504.9	14.5%	3.1

Note: A = percent of students employed; B = percent earned relative to statistical averages.
*In this scenario, costs are so low it is not appropriate to measure an internal rate of return or benefit-cost ratio.

- **Scenario 1:** Increasing the percentage of students employed (*A*) from 65% to 100%, the net present value, internal rate of return, and benefit-cost ratio improve to $719.3 million, 78.3%, and

[36] Lightcast provided estimates of the percentage of students employed for TCUs that were unable to provide data. This figure excludes dual credit high school students, who are not included in the opportunity cost calculations.

32.6, 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 82% to 100%, the net present value, internal rate of return, and benefit-cost ratio results improve to $673.2 million, 34.9%, and 10.8, respectively, relative to base case results; this strong improvement, again, is attributable to a lower opportunity cost of time.

- **Scenario 3:** Increasing both assumptions *A* and *B* to 100% simultaneously, the net present value improves yet further to $766.1 million, relative to the 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 $504.9 million, 14.5%, and 3.1, respectively, relative to base case results. These results are reflective of an increased opportunity cost; none of the students are employed in this case.[37]

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 4 are realistic, indicating that investments in TCUs 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 forgo 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.

[37] 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.

In this study, we assume a 4.9% discount rate for students and a 0.7% discount rate for taxpayers and society.[38] 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%.

Table A2.4: Sensitivity analysis of discount rate

% variation in assumption	-50%	-25%	-10%	Base case	10%	25%	50%
Student perspective							
Discount rate	2.4%	3.7%	4.4%	4.9%	5.4%	6.1%	7.3%
Net present value (millions)	$1,010	$801.8	$701.6	$643.0	$590.3	$520.5	$424.6
Benefit-cost ratio	11.2	9.1	8.1	7.5	7.0	6.3	5.3
Taxpayer perspective							
Discount rate	0.37%	0.55%	0.66%	0.73%	0.81%	0.92%	1.10%
Net present value (millions)	$379.6	$346.0	$326.6	$313.9	$301.4	$283.2	$253.9
Benefit-cost ratio	1.67	1.61	1.57	1.55	1.53	1.50	1.45
Social perspective							
Discount rate	0.37%	0.55%	0.66%	0.73%	0.81%	0.92%	1.10%
Net present value (millions)	$2,781	$2,658	$2,587	$2,541	$2,495	$2,429	$2,322
Benefit-cost ratio	5.2	5.0	4.9	4.8	4.7	4.6	4.5

As demonstrated in Table A2.4, an increase in the discount rate leads to a corresponding decrease in the expected returns, and vice versa. For example, increasing the student discount rate by 50% (from 4.9% to 7.3%) reduces the students' benefit-cost ratio from 7.5 to 5.3. Conversely, reducing the discount rate for students by 50% (from 4.9% to 2.4%) increases the benefit-cost ratio from 7.5 to 11.2. The sensitivity analysis results for taxpayers and society show the same inverse relationship.

[38] These values are based on the three-year average of 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 May 2023 Baseline" and the Office of Management and Budget "Discount Rates for Cost-Effectiveness, Lease Purchase, and Related Analyses."

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 TCUs under analysis did not exist. An estimate of 10%, for example, means that 10% of students do not depend directly on the existence of TCUs in order to obtain their education.

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

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

Attrition rate Rate at which students leave the workforce due to 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 1.0, 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 TCUs 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.

AIHEC National Tribal Colleges & Universities Economic Impact Report

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 domestic product	Measure of the final value of all goods and services produced in the nation after netting out the cost of goods used in production. Alternatively, gross domestic product (GDP) 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 domestic 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 TCUs 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 nation, 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 TCUs and their students spend money. It consists of the income created by the supply chain of the industries initially affected by the spending of TCUs 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 establishments 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 forgone from alternative B once a decision is made to allocate resources to alternative A. Or, if individuals choose to attend college, they forgo earnings that they would have received had they chosen instead to work full-time. Forgone earnings, therefore, are the "price tag" of choosing to attend college.
Payback period	Length of time required to recover an investment. The shorter the period, the more attractive the investment. The formula for computing payback period is: *Payback period = cost of investment/net return per period*

Appendix 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 TCUs—on the economy of a specified region.

What is investment analysis?

Investment analysis is a standard method for determining whether 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 TCUs. Therefore, model results for TCUs are specific to the given region.

How does my consortium's rates of return compare to that of others?

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 TCUs' control. It is best to compare the rate of return to the discount rates of 4.9% (for students) and 0.7% (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 consortium several 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 3,000 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 TCUs provides 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.

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 domestic product (GDP). 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.

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 regional 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 TCUs in FY 2022-23 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 TCUs, 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 2.4. For example, the difference in national earnings between a high school diploma and an associate degree is $9,400. We spread this $9,400 wage differential across the 60 CHEs that occur between a high school diploma and an associate degree, applying a ceremonial "boost" to the last CHE in the stage to mark the achievement of the degree.[39] We repeat this process for each education level in the ladder.

Next, we map the CHE production of the FY 2022-23 student population to the education ladder. Table 2.2 provides information on the CHE production of students attending TCUs, broken out by

[39] 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).

educational achievement. In total, students completed 340,481 CHEs during the analysis year, excluding personal enrichment students. We map each of these CHEs to the education ladder depending on the students' education level and the average number of CHEs they completed during the year. For example, bachelor's degree graduates are allocated to the stage between the associate degree and the bachelor's degree, and the average number of CHEs they completed informs the shape of the distribution curve used to spread out their total CHE production within that stage of the progression.

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

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

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

Table A7.1 displays the result for the students' aggregate annual increase in income (*ΔE)*, a total of $52.2 million. By dividing this value by the students' total production of 340,481 CHEs during the analysis year, we derive an overall value of $153 per CHE.

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

Aggregate annual increase in income	$52,168,979
Total credit hour equivalents (CHEs) in FY 2022-23*	340,481
Value per CHE	$153

*Excludes the CHE production of personal enrichment students.

Source: Lightcast impact model

Mincer function

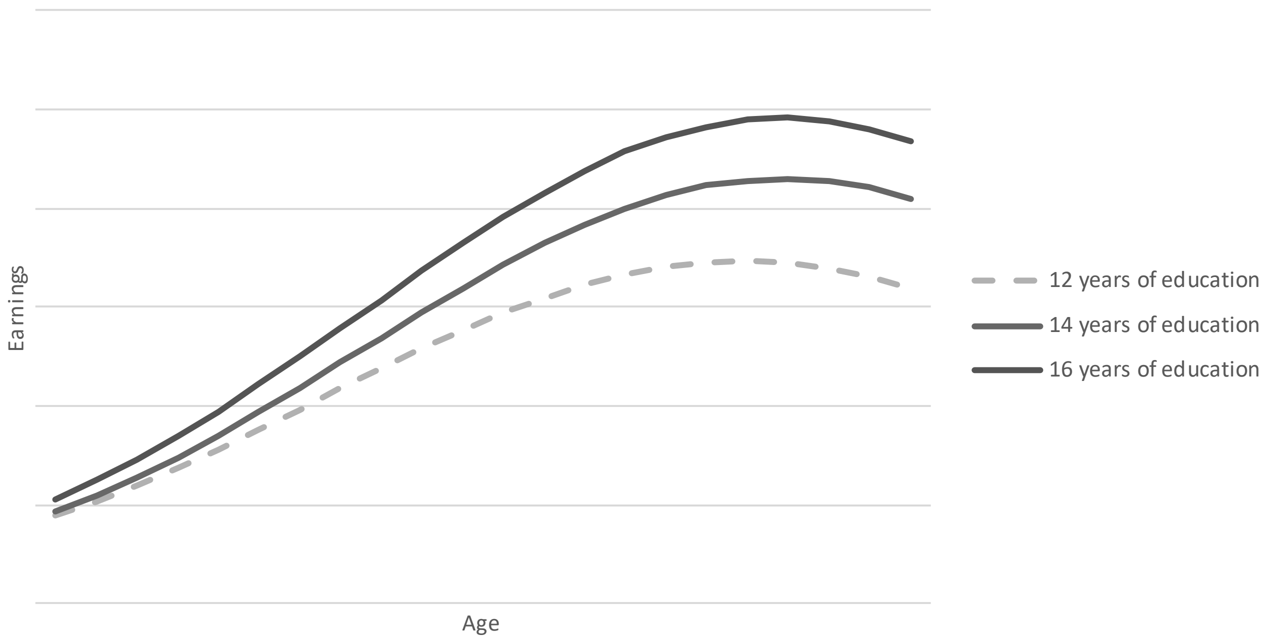
The $153 value per CHE in Table A7.1 only tells part of the story, however. Human capital theory holds that earnings levels do not remain constant; rather, they start relatively low and gradually increase as the worker gains more experience. Research also shows that the earnings increment between educated 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.[40] 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 such, we reduce the estimated benefits by 10%.

We use IPUMS (originally the "Integrated Public Use Microdata Series") data to calculate Mincer coefficients. The database contains over 60 integrated, high precision samples of the American population drawn from 16 federal census, from the American Community Surveys of 2000-present, and from the Puerto Rican Community Surveys of 2005-present. By using this data, we are able to create demographic and education level-specific Mincer coefficients. These coefficients are used in a quartic equation, which explains earnings with the years of education and work experience variables accounting for demographic characteristics through interaction terms with sex and race and ethnicity.

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 grow at an increasing rate, then grow 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.

[40] See Mincer (1958 and 1974).

Figure A7.1: Lifecycle change in earnings



In calculating the alumni impact in Chapter 3, we use the slope of the curve in Mincer's earnings function to condition the $153 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 $153 value per CHE applies only to the CHE production of students precisely at the midpoint of their careers during the analysis year.

In Chapter 4 we again apply the Mincer function, this time to project the benefits stream of the FY 2022-23 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 TCUs 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 nation even in the absence of TCUs. The alternative education variable accounts for these students and is used to discount the benefits we attribute to TCUs.

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

In the absence of TCUs, we assume 10% of TCU students would find alternative education opportunities and remain in or return to the country. We account for this by discounting the alumni impact, the benefits to taxpayers, and the benefits to society in the nation in Chapters 3 and 4 by 10%. In other words, we assume 10% of the benefits created by TCU students would have occurred anyway in the counterfactual scenario where TCUs 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.[41]

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

Assumptions are as follows:

- Benefits and costs are projected out 10 years into the future (Column 1).
- The student attends TCUs for one year, and the cost of tuition is $1,500 (Column 2).
- Earnings forgone while attending TCUs for one year (opportunity cost) come to $20,000 (Column 3).
- Together, tuition and earnings forgone cost sum to $21,500. This represents the out-of-pocket investment made by the student (Column 4).

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

- 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 forgo post-secondary education and maintain his present employment. If he decides to enroll, certain economic implications unfold. Tuition and fees must be paid, and earnings will cease for one year. In exchange, the student calculates that with post-secondary education, his 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 forgone) are felt immediately because they are incurred today, in the present. Benefits, on the other hand, occur in the future. They are not yet available. All future benefits must be discounted by the going rate of interest (referred to as the discount rate) to be able to express them in present value terms.[42]

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.

[42] 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 forgone). 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 10.1% 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 forgone) 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 forgone while attending TCUs. 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

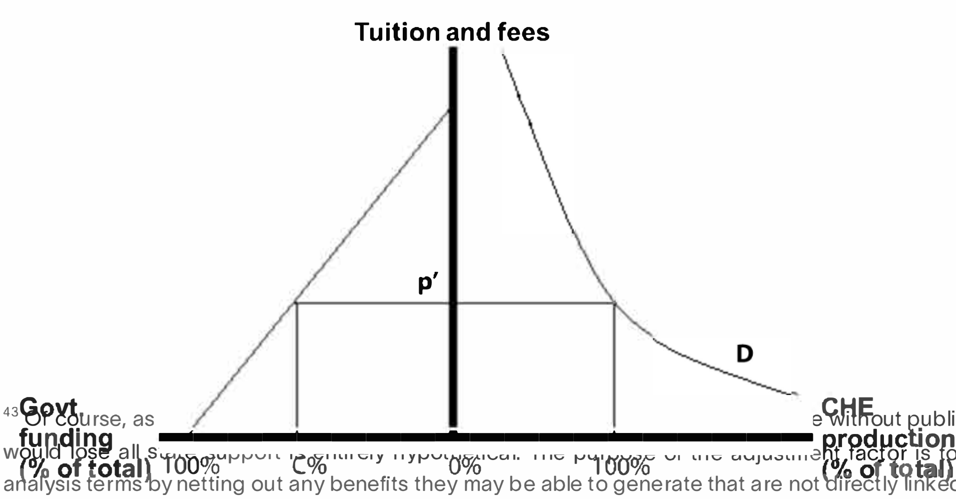
The investment analysis in Chapter 4 weighs the benefits generated by TCUs against the federal, state, and local taxpayer funding that TCUs receive to support their operations. An important part of this analysis is factoring out the benefits that TCUs would have been able to generate anyway, even without taxpayer support. This adjustment is used to establish a direct link between what taxpayers pay and what they receive in return. If TCUs are able to generate benefits without taxpayer support, then it would not be a true investment.[43]

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

Government support versus student demand for education

Figure A10.1 presents a simple model of student demand and 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 TCUs' current CHE production. Current student tuition and fees are represented by *p'*, and government support covers *C%* of all costs. At this point in the analysis, it is assumed that TCUs have only two sources of revenues: 1) student tuition and fees and 2) government support.

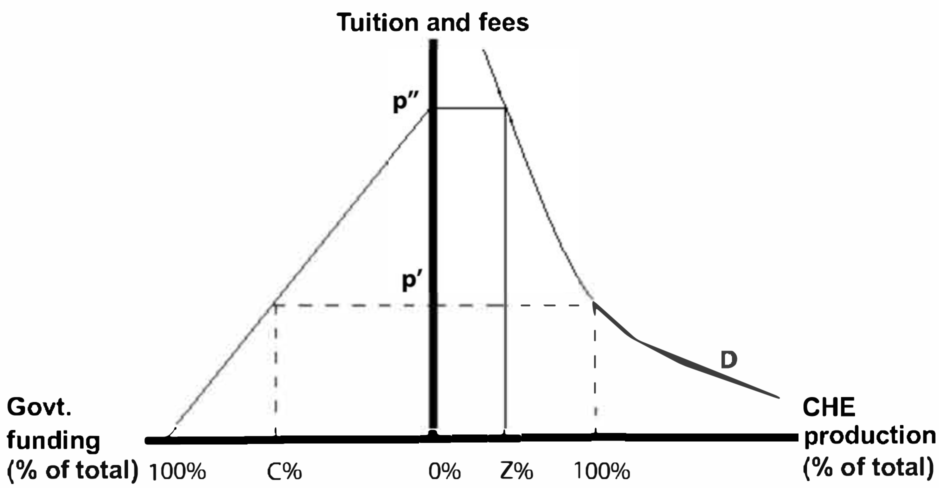
Figure A10.1: Student demand and government funding by tuition and fees



[43] Of course, as [illegible] e without public funding, so the situation in which they would lose all s[illegible] support is entirely hypothetical. The purpose of the adjustment factor is to examine TCUs 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.

Figure A10.2 shows another important reference point in the model—where 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 TCUs is affected by the change in tuition and fees. Ignoring for the moment those issues concerning TCUs' 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 the government must be adjusted to net out the benefits that TCUs can provide absent government support, represented as *Z%* of TCUs' current CHE production in Figure A10.2.

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

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

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

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

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

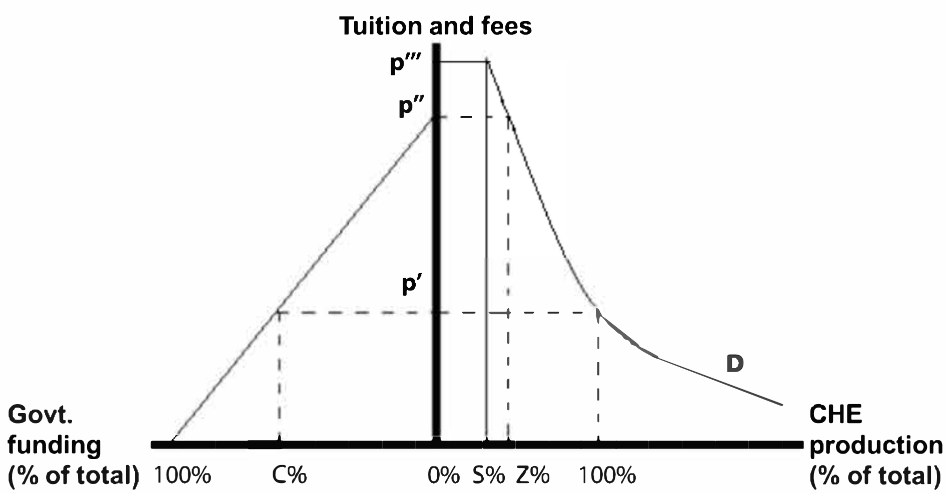
Inasmuch as the benefits in equation 2 occur with or without government support, the benefits appropriately attributed to government support are given by equation 3 as follows:

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

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.[44] The shutdown point is introduced graphically in Figure A10.3 as *S%*. The location of point S% indicates that TCUs can operate at an even lower enrollment level than *Z%* (the point at which TCUs receive zero government funding). Government support at point *S%* is still zero, and student tuition and fees have been raised to *p'''*. 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'''*, TCUs would no longer be able to attract enough students to keep their doors open, and they would shut down.

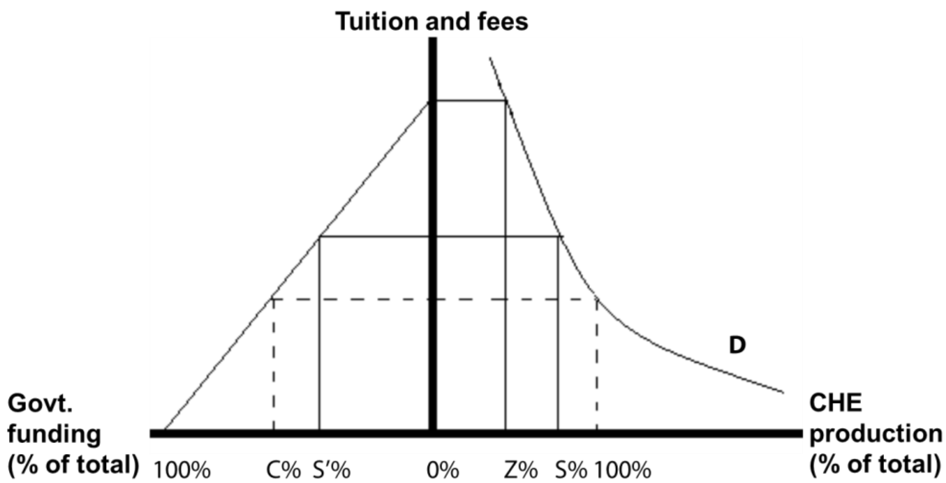
Figure A10.3: Shutdown point after zero government funding



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

Figure A10.4 illustrates yet another scenario. Here, the shutdown point occurs at a level of CHE production greater than *Z%* (the level of zero government support), meaning some minimum level of government support is needed for TCUs 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, government support is appropriately credited with all the benefits generated by TCUs' CHE production, or *B = B (100%)*.

Figure A10.4: Shutdown point before zero government funding



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 nation, 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, obesity, depression, and substance 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.

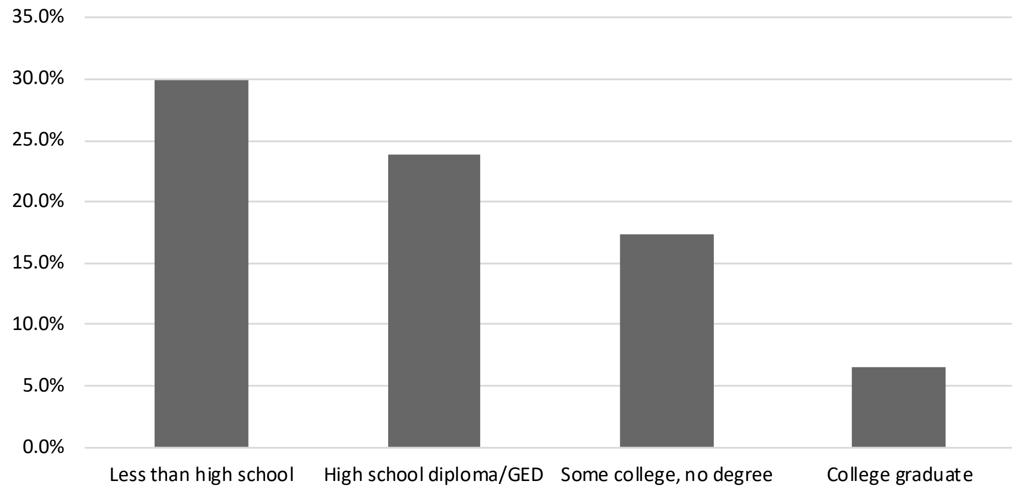
Smoking

Despite a marked decline over the last several decades in the percentage of U.S. residents who smoke, a sizable 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, 21 years and over, based on data provided by the National Survey on Drug use and Health.[45] The data include adults who reported smoking in the last month. As indicated, prevalence of cigarette smoking declines after high school diploma or high school equivalency level of education.

[45] National Survey on Drug Use and Health. "Table 2.18B—Cigarette Use in Past Month: Among People Aged 12 or Older; by Age Group and Demographic Characteristics, Percentages, 2021 and 2022."

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



Source: National Survey on Drug Use and Health

The National Survey on Drug Use and Health also reports the percentage of adults who are current smokers by state.[46] We use this information to create an index value by which we adjust the national prevalence data on smoking to each state. For example, 16.7% of the U.S. adults were smokers in 2022, relative to 16.7% for the nation. We thus apply a scalar of 1.00 to the national probabilities of smoking in order to adjust them to the state of the U.S.

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.[47]

Data for Figure A11.2 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.[48] 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

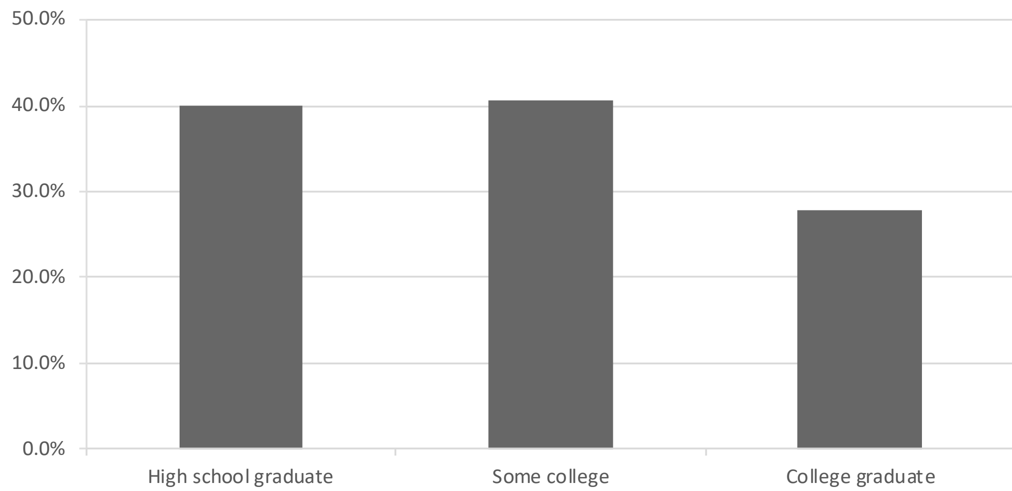
[46] National Survey on Drug Use and Health. "Table 20. Cigarette Use in the Past Month: Among People Aged 12 or Older, by Age Group and State, Annual Average Percentages, 2021 and 2022."

[47] 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.

[48] 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).

with just a high school diploma. In general, though, obesity tends to decline with increasing levels of education.

Figure A11.2: Prevalence of obesity by education level



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

Depression

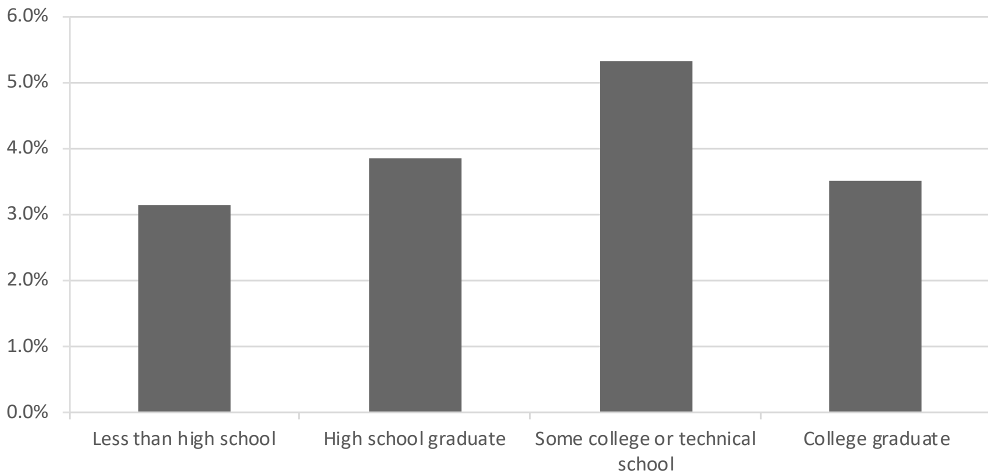
Capturing the full economic cost of mental illness is difficult because not all mental disorders have a correlation with education. For this reason, we only examine the economic costs associated with major depressive disorder (MDD), which comprise medical and pharmaceutical costs, workplace costs such as absenteeism, and suicide-related costs.[49]

Figure A11.3 summarizes the prevalence of major depressive episodes (MDE) with severe impairment and treatment for depression among adults by education level, based on data provided by the National Survey on Drug Use and Health.[50] As shown, people with some college education are most likely to have an MDE with severe impairment and seek treatment for depression 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.

[49] 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 (2019)." *Adv Ther* 40, 4460-4479 (2023).

[50] National Survey on Drug Use and Health. "Table 6.43A—Receipt of Treatment for Depression in Past Year: Among People Aged 18 or Older with Major Depressive Episode (MDE) and among People Aged 18 or Older with MDE with Severe Impairment in Past Year; by Geographic, Socioeconomic, and Health Characteristics, Numbers in Thousands, 2021 and 2022."

Figure A11.3: Prevalence of major depressive episode with severe impairment and treatment for depression by education level



Source: National Survey on Drug Use and Health

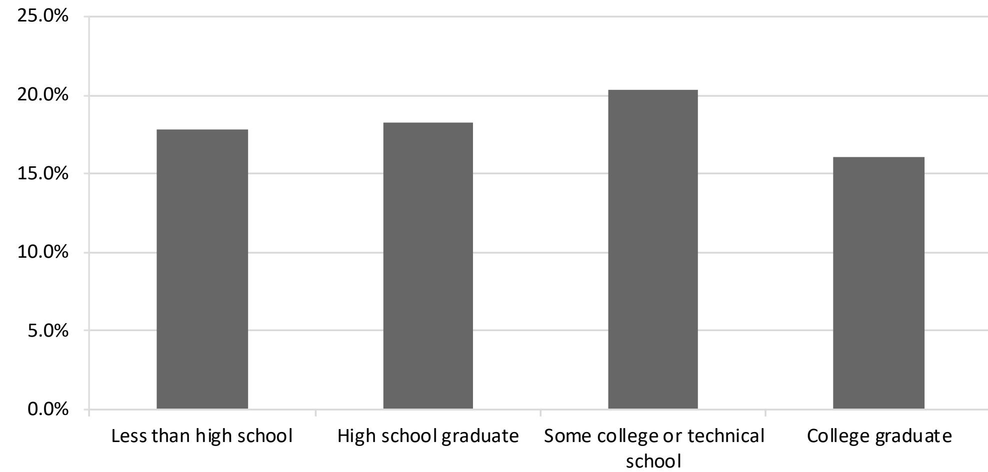
Substance abuse

The burden and cost of substance 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 substances 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 or alcohol is 17.8%, slightly larger than the probability of substance abuse for college graduates (16.1%). This relationship is presented in Figure A11.4 based on data supplied by the National Survey on Drug Use and Health.[51] Prevalence does not strictly decline at every education level. Health Costs associated with substance abuse include health, productivity, traffic collisions, fire, and research and prevention.[52]

[51] National Survey on Drug Use and Health. "Table 5.10B—Substance Use Disorder in Past Year: Among People Aged 12 or Older; by Age Group and Demographic Characteristics, Percentages, 2021 and 2022."

[52] Marwood Group. "Economic Cost of Substance Abuse Disorder in the United States, 2019." *Recovery Centers of America*.

Figure A11.4: Prevalence of substance dependence or abuse by education level



Source: Substance Abuse and Mental Health Services Administration

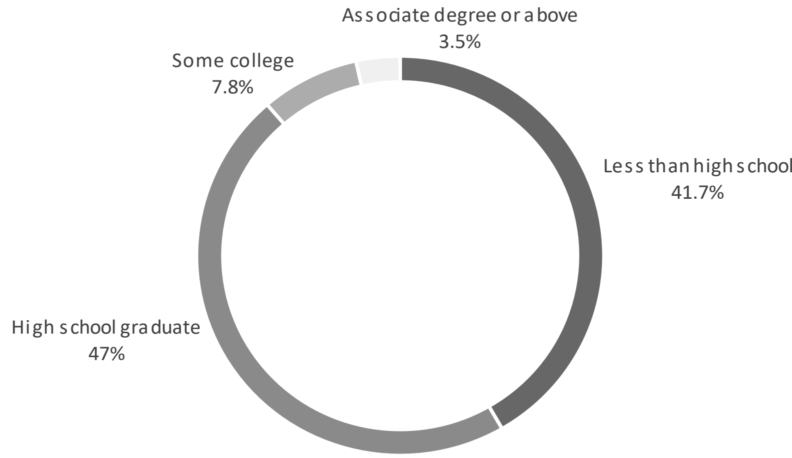
Crime

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

Figure A11.5 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. Bureau of Justice Statistics.[53]

[53] Nowotny, Kathryn, Ryan Masters, and Jason Boardman, 2016. "The relationship between education and health among incarcerated man and women in the United States" BMC Public Health. September 2016.

Figure A11.5: Educational attainment of the incarcerated population



Source: Derived from data provided by the U.S. Bureau of Justice Statistics

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.[54]

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

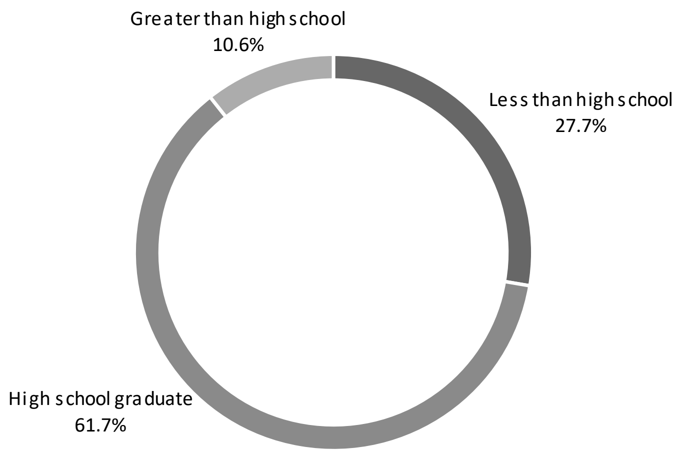
Statistics show that as education levels increase, the number of applicants for government-funded income assistance such as welfare and unemployment benefits declines. Welfare and unemployment claimants can receive assistance from a variety of different sources, including Temporary Assistance for Needy Families (TANF), Supplemental Nutrition Assistance Program (SNAP), Medicaid, Supplemental Security Income (SSI), and unemployment insurance.[55]

[54] 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.

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

Figure A11.6 relates the breakdown of TANF recipients by education level, derived from data provided by the U.S. Department of Health and Human Services.[56] As shown, the demographic characteristics of TANF recipients are weighted heavily toward the less than high school and high school categories, with a much smaller representation of individuals with greater than a high school education.

Figure A11.6: Breakdown of TANF recipients by education level



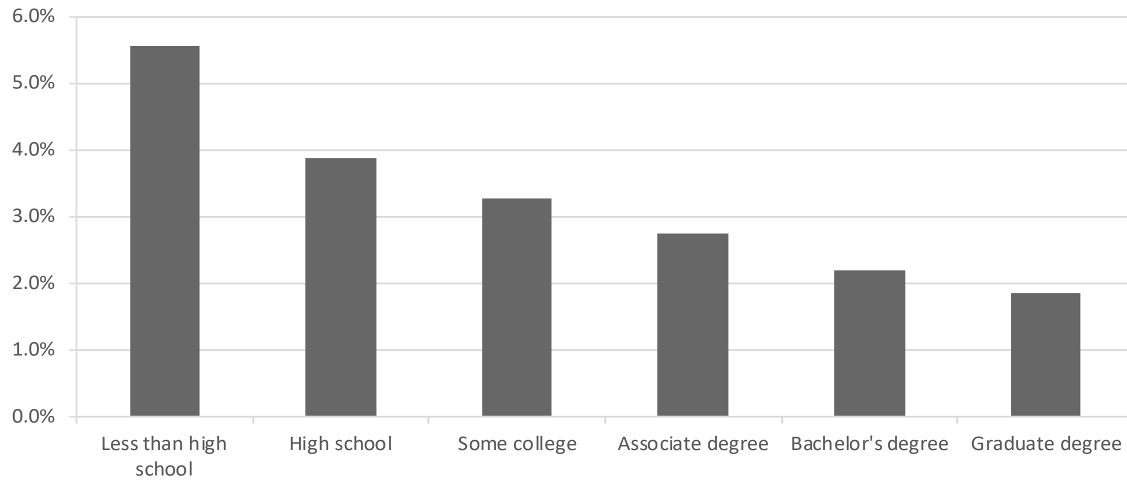
Source: US. Department of Health and Human Services, Office of Family Assistance

Unemployment rates also decline with increasing levels of education, as illustrated in Figure A11.7. These data are provided by the Bureau of Labor Statistics.[57] As shown, unemployment rates range from 5.6% for those with less than a high school diploma to 1.8% for those at the graduate degree level or higher.

[56] U.S. Department of Health and Human Services, Office of Family Assistance. “Characteristics and Financial Circumstances of TANF Recipients, Fiscal Year 2022.”

[57] 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, 2023.

Figure A11.7: Unemployment by education level



Source: Bureau of Labor Statistics