The Economic Value of Selected Individual Programs at Mohave Community College
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Executive summary
Executive summary

This report assesses the impact of two of Mohave Community College’s (MCC) programs on the Mohave County economy, the return on investment to the programs’ students, and the benefits generated for Arizona taxpayers. Some of the key findings of this analysis are below.

Nursing Program

In fiscal year (FY) 2022-23, MCC enrolled 388 students in its Nursing Program, 145 of whom graduated with an associate degree during the year. Students who complete this program are expected to enter the workforce as registered nurses. In Mohave County, the total number of jobs for registered nurses\(^1\) in 2023 was 1,093, and over the next 10 years, the average number of jobs is expected to grow 10.1%. At the associate degree level and some college/no degree level, there were 22 annual job openings. In 2023, county employers published 599 unique job postings at the associate degree level for registered nurses in Mohave County.\(^2\) Comparing annual job openings to the 145 Nursing Program completers, there is a surplus of 123 program completers, meaning that the supply of trained workers in this area exceeds the need of county employers.

MCC’s Nursing Program alumni generated an estimated $16.7 million in added income to the Mohave County economy in FY 2022-23. The undiscounted lifetime earnings increase per student is $790,890. For every dollar current students invest in their education in MCC’s Nursing Program, they will receive on average $14.40 back over the course of their working lives. The corresponding internal rate of return for these students is 56.7%. Finally, students aren’t the only ones who receive benefits from completing the Nursing Program at MCC. Arizona taxpayers will also receive benefits from MCC’s Nursing Program students in the form of added tax revenues and government savings. In total, throughout the FY 2022-23 students’ working lifetime, Arizona taxpayers will receive $12.8 million in present value benefits.

Nursing Assistant Program

In FY 2022-23, MCC enrolled 96 students in its Nursing Assistant Program, including seven dually-enrolled high school students. Program students are prepared to take the Arizona Board of Nursing Assistant Certification Examination seeking state certification or licensure. Most of the Nursing Assistant Program students

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1 The Nursing Program (CIP 51.3801) is mapped to Registered Nurses (SOC 29-1141).
2 The number of job postings higher than the number of job openings may reflect intense job distribution and cross-posting of job advertisements across multiple job boards in different cities.
will enter the Mohave County workforce as nursing assistants.\(^3\) In Mohave County, the total number of nursing assistant jobs in 2023 was 432, and over the next 10 years, the average number of jobs is expected to grow 6.8%. At the some college/no degree level, there were 51 annual job openings. In 2023, county employers published 128 unique job postings below the associate degree level or not listing education requirements for nursing assistants in Mohave County. Comparing annual job openings to the 96 Nursing Assistant Program students, there is a surplus of 45 nursing assistants, meaning that the supply of trained workers in this area exceeds the need of county employers.

MCC's Nursing Assistant Program alumni generated an estimated $863,043 in added income to the Mohave County economy in FY 2022-23. The undiscounted lifetime earnings increase per student is $214,043. For every dollar current students invest in their education in MCC's Nursing Assistant Program, they will receive on average $7.20 back over the course of their working lives. The corresponding internal rate of return for these students is 36.7%. Finally, students aren't the only ones who receive benefits from completing the Nursing Assistant Program at MCC. Arizona taxpayers will also receive benefits from MCC's Nursing Assistant Program students in the form of added tax revenues and government savings. In total, throughout the FY 2022-23 students' working lifetime, Arizona taxpayers will receive $247,175 in present value benefits.

Acknowledgments

Lightcast gratefully acknowledges the excellent support of the staff at Mohave Community College in making this study possible. Special thanks go to Dr. Stacy Klippenstein, President, who approved the study, and to Shelly Castenada, Executive Director of Institutional Research; June Weiss, Dean of Health Professions, Public Safety, and Human Services Programs; and Amber Johnson, Nursing Program Evaluation Specialist, who collected much of the data and information requested. Any errors in the report are the responsibility of Lightcast and not any of the above-mentioned individuals.

\(^3\) The Nursing Assistant Program (CIP 51.3902) is mapped to Nursing Assistants (SOC 31-1131).
Chapter 1:

Introduction
Mohave Community College’s (MCC) region, for the purpose of this report, is Mohave County in Arizona. While MCC offers a variety of programs, this study is concerned with the economic impact and return on investment derived from the students of two programs: Nursing and Nursing Assistant.

The first component of this study analyzes the career outlook for each program. Each program maps to an occupation, which we use to measure the employer demand for graduates. We also provide annual median advertised salaries and top companies hiring in Mohave County.

The second component of the study measures the economic impact from the alumni of each program. While the programs each affect the county in a variety of ways, many of them difficult to quantify, this study is concerned with considering the economic benefits of their alumni. The programs are designed to help students achieve their individual potential and develop the knowledge, skills, and abilities they need to have fulfilling and prosperous careers. However, MCC’s value consists of more than simply influencing the lives of students. The college’s program offerings supply employers with workers to make their businesses more productive. To derive results, we rely on a specialized Multi-Regional Social Accounting Matrix (MR-SAM) model to calculate the added income created in the Mohave County economy as a result of the increased consumer spending and the added knowledge, skills, and abilities of MCC students.

The third component of the study measures the benefits generated by students of the programs. We perform an investment analysis to determine how the money spent by the programs’ students on their education performs as an investment over time. The students’ investment in this case consists of their out-of-pocket expenses and their opportunity cost of attending the college as opposed to working. In return for these investments, students receive a lifetime of higher earnings.

The fourth component of the study measures the benefits generated by program students for Arizona taxpayers. As students earn more because of the education they receive at MCC, the tax base in Arizona also will increase. In addition, savings will be generated to the public sector from reduced demand for government-funded social services in Arizona.

The study uses a wide array of data that are based on several sources, including the programs’ FY 2022-23 academic and student financial data from MCC; 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.

Important note

When reviewing the impacts estimated in this study, it is important to note that they are reported 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 county as it is spent at out-of-county businesses. Income, on the other hand, is a net measure that excludes these intermediary costs and leakages and is synonymous with gross regional product (GRP) and value added. For this reason, it is a more meaningful measure of new economic activity than sales.
Since the college was first established, it has been serving Mohave County in Arizona by enhancing the workforce, providing local residents with easy access to higher education opportunities and preparing students for highly-skilled, technical professions. Table 1.1 summarizes the breakdown of the county economy by major industrial sector ordered by total income, with details on labor and non-labor income. Labor income refers to wages, salaries, and proprietors’ income. Non-labor income refers to profits, rents, and other forms of investment income. Together, labor and non-labor income comprise the county's total income, which can also be considered the county's gross regional product (GRP).

Table 1.1: Income by major industry sector in Mohave County, 2022

<table>
<thead>
<tr>
<th>Industry sector</th>
<th>Labor income (millions)</th>
<th>Non-labor income (millions)</th>
<th>Total income (millions)**</th>
<th>% of total income</th>
<th>Sales (millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retail Trade</td>
<td>$516</td>
<td>$379</td>
<td>$895</td>
<td>15%</td>
<td>$1,489</td>
</tr>
<tr>
<td>Health Care &amp; Social Assistance</td>
<td>$685</td>
<td>$102</td>
<td>$786</td>
<td>13%</td>
<td>$1,291</td>
</tr>
<tr>
<td>Government, Non-Education</td>
<td>$401</td>
<td>$83</td>
<td>$484</td>
<td>8%</td>
<td>$2,241</td>
</tr>
<tr>
<td>Construction</td>
<td>$358</td>
<td>$77</td>
<td>$435</td>
<td>7%</td>
<td>$887</td>
</tr>
<tr>
<td>Accommodation &amp; Food Services</td>
<td>$249</td>
<td>$177</td>
<td>$426</td>
<td>7%</td>
<td>$825</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>$229</td>
<td>$180</td>
<td>$409</td>
<td>7%</td>
<td>$1,040</td>
</tr>
<tr>
<td>Wholesale Trade</td>
<td>$129</td>
<td>$202</td>
<td>$331</td>
<td>6%</td>
<td>$545</td>
</tr>
<tr>
<td>Transportation &amp; Warehousing</td>
<td>$222</td>
<td>$109</td>
<td>$331</td>
<td>6%</td>
<td>$674</td>
</tr>
<tr>
<td>Real Estate &amp; Rental &amp; Leasing</td>
<td>$280</td>
<td>$50</td>
<td>$330</td>
<td>6%</td>
<td>$837</td>
</tr>
<tr>
<td>Finance &amp; Insurance</td>
<td>$158</td>
<td>$114</td>
<td>$272</td>
<td>5%</td>
<td>$439</td>
</tr>
<tr>
<td>Professional &amp; Technical Services</td>
<td>$185</td>
<td>$42</td>
<td>$227</td>
<td>4%</td>
<td>$337</td>
</tr>
<tr>
<td>Administrative &amp; Waste Services</td>
<td>$170</td>
<td>$50</td>
<td>$219</td>
<td>4%</td>
<td>$429</td>
</tr>
<tr>
<td>Utilities</td>
<td>$45</td>
<td>$124</td>
<td>$169</td>
<td>3%</td>
<td>$283</td>
</tr>
<tr>
<td>Other Services (except Public Administration)</td>
<td>$146</td>
<td>$21</td>
<td>$167</td>
<td>3%</td>
<td>$269</td>
</tr>
<tr>
<td>Government, Education</td>
<td>$163</td>
<td>$0</td>
<td>$163</td>
<td>3%</td>
<td>$188</td>
</tr>
<tr>
<td>Information</td>
<td>$50</td>
<td>$65</td>
<td>$114</td>
<td>2%</td>
<td>$216</td>
</tr>
<tr>
<td>Mining, Quarrying, &amp; Oil and Gas Extraction</td>
<td>$22</td>
<td>$62</td>
<td>$84</td>
<td>1%</td>
<td>$151</td>
</tr>
<tr>
<td>Agriculture, Forestry, Fishing &amp; Hunting</td>
<td>$31</td>
<td>$19</td>
<td>$50</td>
<td>1%</td>
<td>$135</td>
</tr>
<tr>
<td>Educational Services</td>
<td>$36</td>
<td>$1</td>
<td>$37</td>
<td>1%</td>
<td>$44</td>
</tr>
<tr>
<td>Arts, Entertainment, &amp; Recreation</td>
<td>$26</td>
<td>$9</td>
<td>$36</td>
<td>1%</td>
<td>$58</td>
</tr>
<tr>
<td>Management of Companies &amp; Enterprises</td>
<td>$28</td>
<td>$2</td>
<td>$30</td>
<td>1%</td>
<td>$50</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$4,130</strong></td>
<td><strong>$1,867</strong></td>
<td><strong>$5,997</strong></td>
<td><strong>100%</strong></td>
<td><strong>$12,427</strong></td>
</tr>
</tbody>
</table>

* Data reflect the most recent year for which data are available. Lightcast data are updated quarterly.
** Numbers may not add due to rounding.
Source: Lightcast industry data.
As shown in Table 1.1, the total income, or GRP, of Mohave County is approximately $6.0 billion, equal to the sum of labor income ($4.1 billion) and non-labor income ($1.9 billion).

Figure 1.1 provides the breakdown of jobs by industry in Mohave County. The Retail Trade sector is the largest employer, supporting 12,397 jobs or 15.2% of total employment in the county. The second largest employer is the Health Care & Social Assistance sector, supporting 9,883 jobs or 12.1% of the county’s total employment. Altogether, the county supports 81,658 jobs.  

Figure 1.1: Jobs by major industry sector in Mohave County, 2022*  

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

4 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.
Nursing Program

The Nursing Program prepares students to become registered nurses. The registered nurses occupation supported 1,093 jobs across all educational levels in the Mohave County economy in 2023. Over the next 10 years, these jobs are expected to grow 10.1% (Figure 1.2). In 2023, there were 22 job openings mapped to the Registered Nurses occupation at the associate degree level and some college/no degree level.

The 22 job openings are being filled by the 145 MCC’s Nursing Program completers. Subtracting this supply of human capital from the 22 annual openings, we arrive at a surplus of 123 program completers. This means there is an oversupply of trained workers in Mohave County, exceeding the needs of county employers.

In 2023, county employers posted 599 unique job postings at the associate degree level for registered nurses in Mohave County. The median hourly earnings for registered nurses in Mohave County was $37.42. The top companies with the greatest number of unique postings were GEO Group, Kingman Regional Medical Center, and the United State Department of Veterans Affairs.

Figure 1.2: Projected job growth in Mohave County of Registered Nurses

Source: Lightcast.

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5 The Nursing Program (CIP 51.3801) is mapped to Registered Nurses (SOC 29-1141).

6 Job openings and job postings come from different data sources and can therefore differ from each other. They both provide insights into local employer demand. Job openings are from government data sources and, while lagged, can be more stable. Job postings reflect real-time employer demand but can have more fluctuations. The number of job postings higher than the number of job openings may reflect intense job distribution and cross-posting of job advertisements across multiple job boards in different cities.
Nursing Assistant Program

The Nursing Assistant Program prepares students to take the Arizona Board of Nursing Assistant Certification Examination seeking state certification or licensure to join the workforce as nursing assistants. The nursing assistants occupation supported 432 jobs across all educational levels in the Mohave County economy in 2023. Over the next 10 years, these jobs are expected to grow 6.8% (Figure 1.3). In 2023, there were 51 job openings mapped to the nursing assistants at the some college/no degree level.

The 51 job openings are being filled by the 96 MCC's Nursing Assistant Program learners. Subtracting this supply of human capital from the 51 annual openings, we arrive at a surplus of 45 nursing assistants. This means there is an oversupply of trained workers in Mohave County, exceeding the needs of county employers.

In 2023, county employers posted 128 unique job postings below the associate degree level or not listing education requirements for this occupation in Mohave County. The median hourly earnings for nursing assistants in Mohave County was $17.13. The companies posting nursing assistant job positions in Mohave County were the Gardens Rehab and Care Center, GEO Group, Integrate Senior Living, and Enilivant.

Figure 1.3: Projected job growth in Mohave County of nursing assistants

Source: Lightcast.

7 The Nursing Assistant Program (CIP 51.3902) is mapped to Nursing Assistants (SOC 31-1131).
Economic value of individual programs
Mohave Community College’s (MCC’s) Nursing Program was established in 1981. In FY 2022-23, MCC enrolled 388 students in the program. Of these students, 145 graduated with an associate degree. The remaining students were enrolled with the intent of returning the next year to finish their credential.

Career outlook

Most of the Nursing Program graduates will enter the Mohave County workforce as registered nurses.

Using the county number of annual job openings for registered nurses (22)\footnote{The job openings reported in this analysis are specific to students entering the workforce with an associate degree or some college/no degree.} and subtracting the graduates who may fill these openings (145), we arrive at a surplus of 123 program completers.

Alumni impact

Former students of MCC’s Nursing Program added $16.7 million in income to the Mohave County economy in FY 2022-23. This figure represents the increased wages collected by former students active in FY 2022-23 in the county workforce as a direct result of their education, the increased output of businesses that employ these students, and the multiplier effects that occur.

Student return on investment

To earn a degree in the program, students experience costs in the form of tuition and fees, books and supplies, and the opportunity cost of attending school instead of working. In return for this investment, students can earn higher wages. For every dollar students invest in their education in the program, they will receive $14.40 back over the course of their working lives. This investment can also be seen in terms of a rate

8 The job openings reported in this analysis are specific to students entering the workforce with an associate degree or some college/no degree.
9 Job openings and job postings come from different data sources and can therefore differ from each other. They both provide insights into local employer demand. Job openings are from government data sources and, while lagged, can be more stable. Job postings reflect real-time employer demand but can have more fluctuations. The number of job postings higher than the number of job openings may reflect intense job distribution and cross-posting of job advertisements across multiple job boards in different cities.
of return of 56.7%. This is an impressive return, especially when compared to the U.S. stock market 30-year average return of 10.1%.

**Taxpayer benefits**

Arizona taxpayers will receive an estimated present value of $12.6 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 $183,114 in benefits due to a reduced demand for government-funded social services in Arizona. Throughout the FY 2022-23 students’ working lives, Arizona taxpayers will receive a total of $12.8 million in present value benefits.
Mohave Community College’s (MCC’s) Nursing Assistant Program was established in 1974. In FY 2022-23, MCC enrolled 96 students in the program, including seven dually-enrolled high school students. Program students are prepared to take the Arizona Board of Nursing Assistant Certification Examination seeking state certification or licensure.

Career outlook

Most of the Nursing Assistant Program students will enter the Mohave County workforce as nursing assistants.

Using the county number of annual job openings for nursing assistants (51)\textsuperscript{10,11} and subtracting those program learners who may fill these openings (96), we arrive at a surplus of 45 nursing assistants.

Alumni impact

Former students of MCC’s Nursing Assistant Program added $863,043 in income to the Mohave County economy in FY 2022-23. This figure represents the increased wages collected by former students active in FY 2022-23 in the county workforce as a direct result of their education, the increased output of businesses that employ these students, and the multiplier effects that occur.

Student return on investment

To earn a degree in the program, students experience costs in the form of tuition and fees, books and supplies, and the opportunity cost of attending school instead of working. In return for this investment, students can earn higher wages. For every dollar students invest in their education in the program, they will receive $7.20 back over the course of their working lives. This investment can also be seen in terms of a

\textsuperscript{10} The job openings reported in this analysis are specific to students entering the workforce with some college/no degree level of education.

\textsuperscript{11} Job openings and job postings come from different data sources and can therefore differ from each other. They both provide insights into local employer demand. Job openings are from government data sources and, while lagged, can be more stable. Job postings reflect real-time employer demand but can have more fluctuations. The number of job postings higher than the number of job openings may reflect intense job distribution and cross-posting of job advertisements across multiple job boards in different cities.
rate of return of 36.7%. This is an impressive return, especially when compared to the U.S. stock market 30-year average return of 10.1%.

Taxpayer benefits

Arizona taxpayers will receive an estimated present value of $222,077 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 $25,098 in benefits due to a reduced demand for government-funded social services in Arizona. Throughout the FY 2022-23 students’ working lives, Arizona taxpayers will receive a total of $247,175 in present value benefits.
For the purpose of explaining the methodology, one program, Nursing, will be used as an example. The results for each program under study follows the same methodology outlined below.
Economic impact analysis

MCC provides its Nursing Program's students with the knowledge, skills, and abilities they need to become productive citizens and add to the overall output of the county. In this section, we describe the methodology in calculating the alumni impact, which measures the income added to the county as former students of the program expand the county economy's stock of human capital.

**Economic impact measures**

When estimating the alumni impact, we measure a net impact, not a gross impact. Gross impact represents an upper-bound estimate in terms of capturing all activity stemming from the alumni; however, a net impact reflects a truer measure since it demonstrates what would not have been generated in the county economy if not for the Nursing Program at MCC.

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 regional product (GRP). Income may be further broken out into the labor income impact, also known as earnings, which assesses the change in employee compensation; and the non-labor income impact, which assesses the change in business profits. Together, labor income and non-labor income sum to total income.

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

12 See Appendix 4 for an example of the intermediary costs included in the sales impact but not in the income impact.
The initial effect is the exogenous shock to the economy caused by the initial spending of money, for example, increased wages of the Nursing Program’s alumni.

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.

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.

<table>
<thead>
<tr>
<th></th>
<th>Lightcast</th>
<th>Initial</th>
<th>Direct</th>
<th>Indirect</th>
<th>Induced</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMPLAN</td>
<td>Direct</td>
<td></td>
<td>Indirect</td>
<td></td>
<td>Induced</td>
</tr>
</tbody>
</table>

Multiplier effects in this analysis are derived using Lightcast Multi-Regional Social Accounting Matrix (MR-SAM) input-output model that captures the interconnection of industries, government, and households in the county. 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. The multi-regional capacity of the MR-SAM allows impacts to be measured in the county and state simultaneously, accounting for the Nursing Program’s alumni in each area, as well as each area’s economic characteristics. In this analysis, impacts on the county include impacts from the program’s county alumni, as well as the indirect and induced multiplier effects that reach the county from

**Net impacts** reflect a truer measure of economic impact since they demonstrate what would not have existed in the county economy if not for the program.
the program's alumni in the rest of the state. For more information on the Lightcast MR-SAM model and its data sources, see Appendix 5.

**Alumni impact**

In this section, we estimate the economic impacts stemming from the added labor income of MCC Nursing Program's alumni in combination with their employers' added non-labor income. This impact is based on the number of students who have attended MCC's Nursing Program through its history. We 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 are considered alumni.

While attending MCC's Nursing Program, 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 MCC's Nursing Program alumni enjoy the fruits of this increased productivity in the form of additional non-labor income (i.e., higher profits).

The alumni impact is the result of years of 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 MCC Nursing Program's students. The second component of the initial effect is comprised of the added non-labor income of the businesses that employ MCC Nursing Program's alumni.

We begin by estimating the portion of alumni who are employed in the workforce. To estimate the historical employment patterns of alumni in the county, 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;\(^\text{13}\) 2) death, retirement, and unemployment rates from the National Center for Health Statistics, the Social Security Administration, and the Bureau of Labor Statistics; and 3) state and county migration data from the Internal Revenue Service.\(^\text{14}\) The result is the estimated portion of alumni from each previous year who were still actively employed in the county as of FY 2022-23.

The next step is to quantify the skills and human capital that alumni acquired from the Nursing Program at MCC. We use the students' production of credits as a proxy for accumulated human capital.\(^\text{15}\) The average number of credits completed per student in FY 2022-23 was 14.2. To estimate the number of credits present in the workforce during the analysis year, we use the college's historical Nursing Program student headcount over the past 37 years, from FY 1986-87 to FY 2022-23. We apply

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\(^{13}\) 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.

\(^{14}\) According to a study performed by Pew Research Center, people who have already moved are more likely to move again than people who do not move. Therefore, migration rates are dampened to account for the idea that if they do not move in the first two years after leaving the college, then they are less likely to migrate out compared to the average person.

\(^{15}\) One credit is equal to 15 contact hours of classroom instruction per semester.
a 37-year time horizon to include all alumni active in the county 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 MCC Nursing Program students’ average age from the retirement age of 67.

We multiply the 14.2 average credits per student by the headcounts that we estimate are still actively employed from each of the previous years. Students who enroll in the Nursing Program at the college more than one year are counted at least twice in the historical enrollment data. However, credits remain distinct regardless of when and by whom they were earned, so there is no duplication in the credit counts. We estimate there are approximately 50,368 credits from alumni active in the workforce.

In order to capture the impact at the program level, we must map the program to the occupations students are likely to enter upon completion of the program. This is done by mapping the Classification of Instructional Programs (CIP) for the program to the appropriate Standard Occupational Classification (SOC) codes and then to the appropriate industries. CIP codes are how the National Center for Education Statistics (NCES) categorizes and tracks an enrollee’s field of study. SOC codes are used by the Bureau of Labor Statistics (BLS) to categorize and track employment trends for jobs with similar duties, skills, and/or education. The link between CIPs and SOCs was provided by Lightcast and reviewed by MCC. This mapping provides the basis for calculating and attributing earnings to a program.

To calculate the wage earned by the Nursing Program’s alumni, we use a CIP to SOC mapping and the earnings associated with the occupations that alumni of the Nursing Program are likely to enter. We also use College Scorecard data to ensure the earnings are reflective of those registered nurses with an associate degree, and not a bachelor’s degree. The earnings data is specific to the education level being trained.

Next, we estimate the value of credits, or the skills and human capital acquired by alumni of the Nursing Program. This is done using the incremental added labor income stemming from the students’ higher wages. The incremental added labor income is the difference between the wage earned by the Nursing Program’s alumni and the alternative wage they would have earned had they not attended MCC’s Nursing Program.

Using the county incremental earnings, credits required, and distribution of credits at each level of study, we estimate the average value per credit to equal $459. This value represents the county average incremental increase in wages that alumni of the Nursing Program received during the analysis year for every credit they completed.

Because workforce experience leads to increased productivity and higher wages, the value per credit varies depending on the students’ workforce experience, with the highest value applied to the credits of students who had been employed the longest by FY 2022-23, and the lowest value per credit applied to students who were just entering the workforce. More information on the theory and calculations behind the

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16 This assumes the average credit load and level of study from past years is equal to the credit load and level of study of students today.
value per credit appears in Appendix 6. In determining the amount of added labor income attributable to alumni, we multiply the credits of former students in each year of the historical time horizon by the corresponding average value per credit for that year, and then sum the products together. This calculation yields approximately $23.1 million in undiscounted 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 MCC Nursing Program credits in workforce and the initial labor income created in Mohave County, FY 2022-23

<table>
<thead>
<tr>
<th>Number of credits in workforce</th>
<th>50,368</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average value per credit</td>
<td>$459</td>
</tr>
<tr>
<td>Initial labor income, gross</td>
<td>$23,098,230</td>
</tr>
<tr>
<td>Adjustments for counterfactual scenarios</td>
<td></td>
</tr>
<tr>
<td>Percent reduction for alternative education opportunities</td>
<td>15%</td>
</tr>
<tr>
<td>Percent reduction for adjustment for labor import effects</td>
<td>50%</td>
</tr>
<tr>
<td>Initial labor income, net</td>
<td>$9,816,748</td>
</tr>
</tbody>
</table>

Source: Lightcast impact model.

The next two rows in Table 3.1 show two adjustments used to account for counterfactual outcomes. 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 MCC's Nursing Program and subsequent influx of skilled labor into the county economy. The first counterfactual scenario that we address is the adjustment for alternative education opportunities. In the counterfactual scenario where the program does not exist, we assume a portion of the program's alumni would have received a comparable education elsewhere in the county or would have left the county and received a comparable education and then returned to the county. The incremental added labor income that accrues to those students cannot be counted toward the added labor income from the Nursing Program's alumni. The adjustment for alternative education opportunities amounts to a 15% reduction of the $23.1 million in added labor income. This means that 15% of the added labor income from MCC's Nursing Program alumni would have been generated in the county anyway, even if the program did not exist. For more information on the alternative education adjustment, see Appendix 7.

The other adjustment in Table 3.1 accounts for the importation of labor. Suppose the Nursing Program did not exist and in consequence there were fewer skilled workers in the county. Businesses could still satisfy some of their need for skilled labor by recruiting from outside Mohave County. We refer to this as the labor import effect. Lacking information on its possible magnitude, we assume 50% of the jobs that students fill at county businesses could have been filled by workers recruited from outside the county if the Nursing Program did not exist. Consequently, the gross labor income must be adjusted to account for the importation of this labor, since it would have happened.

A similar assumption is used by Walden (2014) in his analysis of the Cooperating Raleigh Colleges.
regardless of the presence of the program. We conduct a sensitivity analysis for this assumption in Appendix 1. With the 50% adjustment, the net added labor income added to the economy comes to $9.8 million, as shown in Table 3.1.

The $9.8 million 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 students of MCC’s Nursing Program 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 ($9.8 million) to the six-digit NAICS industry sectors where students exiting the program are most likely to be employed. This allocation entails the process outlined above that maps the Nursing Program completers to the occupation for which those graduates have been trained, and then maps this occupation to the six-digit industry sectors in the MR-SAM model. Finally, we apply a matrix of wages by industry and by occupation from the MR-SAM model to map the occupational distribution of the $9.8 million in initial labor income effects to the detailed industry sectors in the MR-SAM model.18

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 $1.8 million in added non-labor income attributable to the alumni of MCC’s Nursing Program. Summing initial labor and non-labor income together provides the total initial effect of alumni productivity in the Mohave County economy, equal to approximately $11.7 million. To estimate multiplier effects, we convert the industry-specific income figures generated through the initial effect to sales using sales-to-income ratios from the MR-SAM model. We then run the values through the MR-SAM’s multiplier matrix.

Table 3.2 shows the multiplier effects of the Nursing Program’s 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

| Table 3.2: MCC Nursing Program alumni impact, FY 2022-23 |
|-----------------|---------------|---------------|-------------|--------------|---------------|
| Labor income (thousands) | Non-labor income (thousands) | Total income (thousands) | Sales (thousands) | Jobs supported |
| Initial effect | $9,817 | $1,848 | $11,665 | $22,721 | 131 |
| Multiplier effect | | | | | |
| Direct effect | $1,320 | $257 | $1,576 | $2,904 | 17 |
| Indirect effect | $296 | $57 | $353 | $648 | 4 |
| Induced effect | $2,649 | $490 | $3,139 | $5,961 | 36 |
| Total multiplier effect | $4,265 | $804 | $5,069 | $9,512 | 57 |
| Total impact (initial + multiplier) | $14,081 | $2,652 | $16,734 | $32,233 | 188 |

Source: Lightcast Impact Model.

For example, if the MR-SAM model indicates that 70% of jobs in SOC 29-1141 (Registered Nurses) occur in NAICS 622110 (General Medical and Surgical Hospitals) in the given region, we allocate 70% of the initial labor income effect under SOC 29-1141 to NAICS 622110.
are employed increase their output, there is a corresponding increase in the demand for input from the industries in the employers’ supply chain. Together, the incomes generated by the expansions in business input purchases and household spending constitute the multiplier effect of the increased productivity of the program’s alumni. The final results are $4.3 million in added labor income and $804.5 thousand in added non-labor income, for an overall total of $5.1 million in multiplier effects. The grand total of the Nursing Program alumni impact is $16.7 million in total added income, the sum of all initial and multiplier labor and non-labor income effects. This is equivalent to supporting 188 jobs in Mohave County.
Investment analysis is the process of evaluating total costs and measuring these against total benefits to determine whether or not a proposed venture will be profitable. If benefits outweigh costs, the investment is worthwhile. If costs outweigh benefits, the investment will lose money and is thus considered non-profitable.

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

### Calculating student costs

Nursing Program 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 $621.6 thousand. Direct outlays also include the cost of books and supplies. On average, full-time students spent $720 each on books and supplies during the reporting year. Multiplying this figure by the number of full-time equivalents (FTEs) produced by MCC in FY 2022-23 generates a total cost of $132.6 thousand for books and supplies.

In order to pay the cost of tuition, many students had to take out loans. These students not only incur the cost of tuition from the college but also incur the interest cost of taking out loans. In FY 2022-23, students received a total of $513.3 thousand in federal loans to attend MCC’s Nursing Program. 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.

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19 Based on the data provided by MCC.

20 A single FTE is equal to 30 credits, so there were 184 FTEs produced by students in FY 2022-23, equal to 5,523 credits divided by 30.

21 Loan data was provided by MCC. Due to data limitations, only federal loans are considered in this analysis.
counting, the $513.3 thousand 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, Nursing Program 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 attend the program’s classes rather than work. To calculate it, we need to know the difference between the students’ full earning potential and what they actually earn while enrolled in the program.

We derive the students’ full earning potential by weighting the average annual earnings levels according to the education level breakdown of the student population at the start of the analysis year.\(^\text{22}\) However, the earnings levels reflect what average workers earn at the midpoint of their careers, not while attending the college. 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.\(^\text{23}\) This calculation yields an average full earning potential of $26,601 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’ credit production of the Nursing Program’s students as a proxy for time, under the assumption that the more credits students earn, the less time they have to work, and, consequently, the greater their forgone earnings. Overall, students attending MCC’s Nursing Program in FY 2022-23 earned an average of 14.2 credits per student, which is approximately equal to 47% of a full academic year.\(^\text{24}\) We thus include no more than $12,622 (or 47%) of the students’ full earning potential in the opportunity cost calculations.

Another factor to consider is the employment status of the MCC Nursing Program’s students while enrolled in postsecondary education. MCC estimates that 64% of its Nursing Program students were employed in FY 2022-23. For the remainder of students, we assume that they were either seeking work or planning to seek work once they complete their educational goals. By choosing to enroll, therefore, non-working students give up everything that they can potentially earn during the academic year (i.e., the $12,622). The total value of their forgone earnings thus comes to $1.8 million.

Working students are able to maintain all or part of their earnings while enrolled. However, many of them hold jobs that pay less than statistical averages, usually because those are the only jobs they can find that accommodate their course schedule. These jobs tend to be at entry level, such as restaurant servers or cashiers. To account for this, we assume that working students hold jobs that pay 88% of what they would have

\(^{22}\) MCC provided the prior level of education for the FY 2022-23 Nursing Program student population.

\(^{23}\) Further discussion on this adjustment appears in Appendix 6.

\(^{24}\) Equal to 14.2 credits divided by 30, the assumed number of credits in a full-time academic year.
earned had they chosen to work full-time rather than go to college.\textsuperscript{25} The remaining 12% 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 12% in foregone earnings serves as a reasonable average. For working students, therefore, their total opportunity cost is $391.3 thousand.

Thus far we have discussed student costs during the analysis year. However, recall that some students take out 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 college 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 $513.3 thousand in loans was awarded to 180 students, averaging $2,851 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 MCC is a two-year college, students will be indebted twice that amount, or $5,703 on average. According to the U.S. Department of Education, this level of indebtedness will take up to 10 years to pay back under the standard repayment plan.\textsuperscript{26}

This indebtedness calculation is used solely to estimate the loan payback period. Students will be paying back the principal amount of $513.3 thousand over time. After taking into consideration the time value of money, this means that students will pay off a discounted present value of $391.2 thousand in principal over the 10 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%\textsuperscript{27} as our interest rate, we calculate that students will pay a total discounted present value of $113.4 thousand in interest on student loans throughout the first 10 years of their working lifetime. The stream of these future interest costs together with the stream of loan payments is included in the costs of Column 5 of Table 3.4.

The steps leading up to the calculation of the Nursing Program’s student costs appear in Table 3.3. Direct outlays amount to $240.9 thousand, the sum of tuition and fees ($621.6 thousand) and books and supplies ($132.6 thousand), less federal loans received ($513.3 thousand). Opportunity costs for working and non-working students amount to $1.7 million, excluding $417.1 thousand in offsetting residual aid that is paid directly to students.\textsuperscript{28} Finally, we have the present value of future student loan costs, amounting to $504.6 thousand between principal and interest. Summing direct outlays,

\textsuperscript{25} The 79% assumption is based on the average hourly wage of jobs commonly held by working students divided by the Mohave County average hourly wage. Occupational wage estimates are published by the Bureau of Labor Statistics (see http://www.bls.gov/oes/current/oes_nat.htm).


\textsuperscript{27} 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.

\textsuperscript{28} Residual aid is the remaining portion of scholarship or grant aid distributed directly to a student after the college applies tuition and fees.
opportunity costs, and future student loan costs together yields a total of $2.5 million in present value student costs.

Table 3.3: Present value of student costs, FY 2022-23 (thousands)

<table>
<thead>
<tr>
<th>Direct outlays in FY 2022-23</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuition and fees</td>
<td>$622</td>
</tr>
<tr>
<td>Less federal loans received</td>
<td>-$513</td>
</tr>
<tr>
<td>Books and supplies</td>
<td>$133</td>
</tr>
<tr>
<td><strong>Total direct outlays</strong></td>
<td><strong>$241</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Opportunity costs in FY 2022-23</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Earnings forgone by non-working students</td>
<td>$1,763</td>
</tr>
<tr>
<td>Earnings forgone by working students</td>
<td>$391</td>
</tr>
<tr>
<td>Less residual aid</td>
<td>-$417</td>
</tr>
<tr>
<td><strong>Total opportunity costs</strong></td>
<td><strong>$1,737</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Future student loan costs (present value)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Student loan principal</td>
<td>$391</td>
</tr>
<tr>
<td>Student loan interest</td>
<td>$113</td>
</tr>
<tr>
<td><strong>Total present value student loan costs</strong></td>
<td><strong>$505</strong></td>
</tr>
</tbody>
</table>

| **Total present value student costs** | **$2,483** |

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

Linking education to earnings

Having estimated the costs of education to students of the Nursing Program, 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. State mean earnings levels at the midpoint of the average-aged worker’s career increase as people achieve higher levels of education. The differences between state earnings levels define the incremental benefits of moving from one education level to the next.

A key component in determining the students’ return on investment is the value of their future benefits stream; i.e., what they can expect to earn in return for the investment they make in education. We calculate the future benefits stream to MCC’s FY 2022-23 Nursing Program students first by determining their average annual increase in earnings, equal to $2.6 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 credits that students complete while attending the college. Using the state of Arizona earnings for the mapped occupation, the average marginal wage increase per credit is $477. For a full description of the methodology used to derive the $2.6 million, see Appendix 6.
The second step is to project the $2.6 million annual increase in earnings into the future, for as long as students remain in the workforce. We do this using the Mincer function to predict the change in earnings at each point in an individual’s working career. 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. We use state-specific and education level-specific Mincer coefficients. With the $2.6 million representing the students’ higher earnings at the midpoint of their careers, we apply scalars from the Mincer function to yield a stream of projected future benefits that gradually increase from the time students enter the workforce, peak shortly after the career midpoint, and then dampen slightly as students approach retirement at age 67. This earnings stream appears in Column 2 of Table 3.4.

As shown in Table 3.4, the $2.6 million in gross higher earnings occurs around Year 12, 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 $2.6 million and the gross higher earnings in the years after the midpoint are greater than $2.6 million. On a per student basis, the total undiscounted increase in lifetime earnings of students that complete the program is $790,890 (Figure 3.1).

Figure 3.1: Lifetime earnings of a Nursing Program graduate compared to a high school graduate

Source: Lightcast impact model.

29 Appendix 6 provides more information on the Mincer function and how it is used to predict future earnings growth.
Table 3.4: Projected benefits and costs, Nursing Program student perspective, FY 2022-23

<table>
<thead>
<tr>
<th>Year</th>
<th>Gross higher earnings to students (millions)</th>
<th>% active in workforce*</th>
<th>Net higher earnings to students (millions)</th>
<th>Student costs (millions)</th>
<th>Net cash flow (millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>$1.7</td>
<td>18%</td>
<td>$0.3</td>
<td>$2.0</td>
<td>-$1.7</td>
</tr>
<tr>
<td>1</td>
<td>$1.8</td>
<td>29%</td>
<td>$0.5</td>
<td>&lt;$0.1</td>
<td>$0.4</td>
</tr>
<tr>
<td>2</td>
<td>$1.9</td>
<td>40%</td>
<td>$0.7</td>
<td>&lt;$0.1</td>
<td>$0.7</td>
</tr>
<tr>
<td>3</td>
<td>$2.0</td>
<td>55%</td>
<td>$1.1</td>
<td>&lt;$0.1</td>
<td>$1.0</td>
</tr>
<tr>
<td>4</td>
<td>$2.0</td>
<td>74%</td>
<td>$1.5</td>
<td>&lt;$0.1</td>
<td>$1.4</td>
</tr>
<tr>
<td>5</td>
<td>$2.1</td>
<td>96%</td>
<td>$2.0</td>
<td>&lt;$0.1</td>
<td>$2.0</td>
</tr>
<tr>
<td>6</td>
<td>$2.2</td>
<td>95%</td>
<td>$2.1</td>
<td>&lt;$0.1</td>
<td>$2.0</td>
</tr>
<tr>
<td>7</td>
<td>$2.3</td>
<td>95%</td>
<td>$2.2</td>
<td>&lt;$0.1</td>
<td>$2.1</td>
</tr>
<tr>
<td>8</td>
<td>$2.4</td>
<td>95%</td>
<td>$2.2</td>
<td>&lt;$0.1</td>
<td>$2.2</td>
</tr>
<tr>
<td>9</td>
<td>$2.4</td>
<td>95%</td>
<td>$2.3</td>
<td>&lt;$0.1</td>
<td>$2.2</td>
</tr>
<tr>
<td>10</td>
<td>$2.5</td>
<td>95%</td>
<td>$2.4</td>
<td>&lt;$0.1</td>
<td>$2.3</td>
</tr>
<tr>
<td>11</td>
<td>$2.6</td>
<td>94%</td>
<td>$2.4</td>
<td>$0.0</td>
<td>$2.4</td>
</tr>
<tr>
<td>12</td>
<td>$2.6</td>
<td>94%</td>
<td>$2.5</td>
<td>$0.0</td>
<td>$2.5</td>
</tr>
<tr>
<td>13</td>
<td>$2.7</td>
<td>94%</td>
<td>$2.5</td>
<td>$0.0</td>
<td>$2.5</td>
</tr>
<tr>
<td>14</td>
<td>$2.7</td>
<td>94%</td>
<td>$2.6</td>
<td>$0.0</td>
<td>$2.6</td>
</tr>
<tr>
<td>15</td>
<td>$2.8</td>
<td>93%</td>
<td>$2.6</td>
<td>$0.0</td>
<td>$2.6</td>
</tr>
<tr>
<td>16</td>
<td>$2.8</td>
<td>93%</td>
<td>$2.6</td>
<td>$0.0</td>
<td>$2.6</td>
</tr>
<tr>
<td>17</td>
<td>$2.9</td>
<td>92%</td>
<td>$2.7</td>
<td>$0.0</td>
<td>$2.7</td>
</tr>
<tr>
<td>18</td>
<td>$2.9</td>
<td>92%</td>
<td>$2.7</td>
<td>$0.0</td>
<td>$2.7</td>
</tr>
<tr>
<td>19</td>
<td>$2.9</td>
<td>92%</td>
<td>$2.7</td>
<td>$0.0</td>
<td>$2.7</td>
</tr>
<tr>
<td>20</td>
<td>$3.0</td>
<td>91%</td>
<td>$2.7</td>
<td>$0.0</td>
<td>$2.7</td>
</tr>
<tr>
<td>21</td>
<td>$3.0</td>
<td>91%</td>
<td>$2.7</td>
<td>$0.0</td>
<td>$2.7</td>
</tr>
<tr>
<td>22</td>
<td>$3.0</td>
<td>90%</td>
<td>$2.7</td>
<td>$0.0</td>
<td>$2.7</td>
</tr>
<tr>
<td>23</td>
<td>$3.0</td>
<td>90%</td>
<td>$2.7</td>
<td>$0.0</td>
<td>$2.7</td>
</tr>
<tr>
<td>24</td>
<td>$3.0</td>
<td>89%</td>
<td>$2.7</td>
<td>$0.0</td>
<td>$2.7</td>
</tr>
<tr>
<td>25</td>
<td>$3.0</td>
<td>88%</td>
<td>$2.6</td>
<td>$0.0</td>
<td>$2.6</td>
</tr>
<tr>
<td>26</td>
<td>$3.0</td>
<td>88%</td>
<td>$2.6</td>
<td>$0.0</td>
<td>$2.6</td>
</tr>
<tr>
<td>27</td>
<td>$3.0</td>
<td>87%</td>
<td>$2.6</td>
<td>$0.0</td>
<td>$2.6</td>
</tr>
<tr>
<td>28</td>
<td>$2.9</td>
<td>86%</td>
<td>$2.5</td>
<td>$0.0</td>
<td>$2.5</td>
</tr>
<tr>
<td>29</td>
<td>$2.9</td>
<td>85%</td>
<td>$2.5</td>
<td>$0.0</td>
<td>$2.5</td>
</tr>
<tr>
<td>30</td>
<td>$2.9</td>
<td>84%</td>
<td>$2.4</td>
<td>$0.0</td>
<td>$2.4</td>
</tr>
<tr>
<td>31</td>
<td>$2.8</td>
<td>83%</td>
<td>$2.3</td>
<td>$0.0</td>
<td>$2.3</td>
</tr>
<tr>
<td>32</td>
<td>$2.8</td>
<td>82%</td>
<td>$2.3</td>
<td>$0.0</td>
<td>$2.3</td>
</tr>
<tr>
<td>33</td>
<td>$2.7</td>
<td>81%</td>
<td>$2.2</td>
<td>$0.0</td>
<td>$2.2</td>
</tr>
<tr>
<td>34</td>
<td>$2.7</td>
<td>80%</td>
<td>$2.1</td>
<td>$0.0</td>
<td>$2.1</td>
</tr>
<tr>
<td>35</td>
<td>$2.6</td>
<td>79%</td>
<td>$2.0</td>
<td>$0.0</td>
<td>$2.0</td>
</tr>
<tr>
<td>36</td>
<td>$2.5</td>
<td>77%</td>
<td>$2.0</td>
<td>$0.0</td>
<td>$2.0</td>
</tr>
</tbody>
</table>

Present value

| Present value | $35.8 | $2.5 | $33.4 |

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

Source: Lightcast impact model.

<table>
<thead>
<tr>
<th>Benefit-to-cost ratio</th>
<th>14.4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal rate of return</td>
<td>56.7%</td>
</tr>
<tr>
<td>Payback period (years)</td>
<td>2.5</td>
</tr>
</tbody>
</table>
The final step in calculating the future benefits stream of the Nursing Program’s students is to net out the potential benefits generated by students who are either not yet active in the workforce or who leave the workforce over time. This adjustment appears in Column 3 of Table 3.4 and represents the percentage of the FY 2022-23 Nursing Program student population that will be employed in the workforce in a given year. Note that the percentages in the first five years of the time horizon are relatively lower than those in subsequent years. This is because many students delay their entry into the workforce, either because they are still enrolled at the college or because they are unable to find a job immediately upon graduation. Accordingly, we apply a set of “settling-in” factors to account for the time needed by students to find employment and settle into their careers. As discussed under the alumni impact, 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 alumni impact. The likelihood of leaving the workforce increases as students age, so the attrition rate is more aggressive near the end of the time horizon than in the beginning. Column 4 of Table 3.4 shows the net higher earnings to Nursing Program 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 for the Nursing Program’s students, 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

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**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 perspective of taxpayers.

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30 See the discussion of the alumni impact in the previous section. The main sources for deriving the attrition rate are the National Center for Health Statistics, the Social Security Administration, and the Bureau of Labor Statistics. Note that we do not account for migration patterns in the student investment analysis because the higher earnings that students receive as a result of their education will accrue to them regardless of where they find employment.
are negative savers—their discount rate is based upon student loan interest rates. In Appendix 1, we conduct a sensitivity analysis of this discount rate. The present value of the benefits is then compared to student costs to derive the investment analysis results, expressed in terms of a benefit-cost ratio, rate of return, and payback period. The investment is feasible if returns match or exceed the minimum threshold values; i.e., a benefit-cost ratio greater than 1.0, a rate of return that exceeds the discount rate, and a reasonably short payback period.

In Table 3.4, the net higher earnings of students yield a cumulative discounted sum of approximately $35.8 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 MCC’s Nursing Program with a capital asset valued at $35.8 million.

The Nursing Program’s student costs are shown in Column 5 of Table 3.4, equal to a present value of $2.5 million. Comparing the cost with the present value of benefits yields a student benefit-cost ratio of 14.4 (equal to $35.8 million in benefits divided by $2.5 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. Table 3.4 shows students of the Nursing Program earning average returns of 56.7% 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).

Note that returns reported in this study are real returns, not nominal. When a bank promises to pay a certain rate of interest on a savings account, it employs an implicitly nominal rate. Bonds operate in a similar manner. If it turns out that the inflation rate is higher than the stated rate of return, then money is lost in real terms. In contrast, a real rate of return is on top of inflation. For example, if inflation is running at 3% and a nominal percentage of 5% is paid, then the real rate of return on the investment is only 2%. In Table 3.4, the 56.7% 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 59.3%, higher than what is reported in Table 3.4.

MCC’s Nursing Program students see an average rate of return of 56.7% for their investment of time and money.

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31 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.

32 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. Beyond that point, returns are what economists would call pure costless rent. As indicated in Table 3.4, Nursing Program students at MCC see, on average, a payback period of 2.5 years, meaning 2.5 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 3.2).

Figure 3.2: Student payback period

Source: Lightcast impact model.

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

**Growth in state tax revenues**

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

Estimating the effect of MCC’s Nursing Program on increased tax revenues begins with the present value of the students’ future earnings stream, which is displayed in Column 4 of Table 3.4. To these net higher earnings, we apply a multiplier derived from Lightcast’s MR-SAM model to estimate the added labor income created in the state as students and businesses spend their higher earnings. As labor income increases, so does non-labor income, which consists of monies gained through investments. To calculate the growth in non-labor income, we multiply the increase in labor income by a ratio of the Arizona gross state product to total labor income in the state.

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

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34 For a full description of the Lightcast MR-SAM model, see Appendix 5.
We apply another reduction factor to account for the students’ alternative education opportunities. This is the same adjustment that we use in the calculation of the alumni impact and is designed to account for the counterfactual scenario where the Nursing Program does not exist. The assumption in this case is that any benefits generated by Nursing Program students who could have received a similar education even without the program cannot be counted as new benefits to taxpayers. For this analysis, we assume an alternative education variable of 15%, meaning that 15% of the Nursing Program student population would have generated benefits anyway even without the program. For more information on the alternative education variable, see Appendix 7.

After adjusting for attrition and alternative education opportunities, we calculate the present value of the future added tax revenues that occur in the state, equal to $12.6 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 1, we conduct a sensitivity analysis of this discount rate.

**Government savings**

In addition to the creation of higher tax revenues to the state government, education is statistically associated with a variety of lifestyle changes that generate social savings, also known as external or incidental benefits of education. These represent the avoided costs to the government that otherwise would have been drawn from public resources absent the education provided by MCC’s Nursing Program. Government savings appear in Figure 3.3 and Table 3.5 and break down into three main categories: 1) health savings, 2) crime savings, and 3) income assistance savings.

Health savings include avoided medical costs that would have otherwise been covered by state government. Crime savings consist of avoided costs to the justice system (i.e., police protection, judicial and legal, and corrections). Income assistance benefits comprise avoided costs due to the reduced number of welfare and unemployment insurance claims.

The model quantifies government savings by calculating the probability at each education level that individuals will have poor health, commit crimes, or claim welfare and unemployment benefits. Deriving the probabilities involves assembling data from a variety of studies and surveys analyzing the correlation between education and health, crime, and income assistance at the national and state level. We spread the

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probabilities across the education ladder and multiply the marginal differences by the number of students who achieved credits at each step. The sum of these marginal differences counts as the upper bound measure of the number of students who, due to the education they received at the college, will not have poor health, commit crimes, or demand income assistance. We then multiply the marginal effects of education by the associated costs of health, crime, and income assistance. Finally, we apply the same adjustments for attrition and alternative education to derive the net savings to the government. Total government savings appear in Figure 3.3 and sum to $183.1 thousand.

Table 3.5 displays all benefits to taxpayers. The first row shows the added tax revenues created in the state, equal to $12.6 million, from students’ higher earnings and increases in non-labor income. The sum of the government savings and the added income in the state is $12.8 million, as shown in the bottom row of Table 3.5. These savings continue to accrue in the future as long as the FY 2022-23 Nursing Program student population of MCC remains in the state workforce.

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

<table>
<thead>
<tr>
<th>Added tax revenue</th>
<th>$12,600</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government savings</td>
<td></td>
</tr>
<tr>
<td>Health-related savings</td>
<td>$67</td>
</tr>
<tr>
<td>Crime-related savings</td>
<td>$48</td>
</tr>
<tr>
<td>Income assistance savings</td>
<td>$67</td>
</tr>
<tr>
<td>Total government savings</td>
<td>$183</td>
</tr>
<tr>
<td>Total taxpayer benefits</td>
<td>$12,783</td>
</tr>
</tbody>
</table>

Source: Lightcast impact model.

For a full list of the data sources used to calculate the social externalities, see the Resources and References section. See also Appendix 9 for a more in-depth description of the methodology.


Appendix 1: Sensitivity analysis

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

Alternative education variable

The alternative education variable (15%) accounts for the counterfactual scenario where students would have to seek a similar education elsewhere absent the Nursing Program at the college in the county. Given the difficulty in accurately specifying the alternative education variable, we test the sensitivity of the taxpayer benefits analysis results to its magnitude. Variations in the alternative education assumption are calculated around base case results listed in the middle column of Table A1.1. Next, the model brackets the base case assumption on either side with a plus or minus 10%, 25%, and 50% variation in assumptions. Analyses are then repeated introducing one change at a time, holding all other variables constant. For example, an increase of 10% in the alternative education assumption (from 15% to 17%) reduces the taxpayer present value benefits from $12.8 million to $12.6 million. Likewise, a decrease of 10% (from 15% to 14%) in the assumption increases the present value benefits from $12.8 million to $13.0 million.

Based on this sensitivity analysis, the conclusion can be drawn that MCC’s Nursing Program taxpayer benefits are not very sensitive to relatively large variations in the alternative education variable. Thus, even though the assumption is difficult to specify, its impact on taxpayer benefits is not very sensitive.

<table>
<thead>
<tr>
<th>% variation in assumption</th>
<th>-50%</th>
<th>-25%</th>
<th>-10%</th>
<th>Base case</th>
<th>10%</th>
<th>25%</th>
<th>50%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternative education variable</td>
<td>8%</td>
<td>11%</td>
<td>14%</td>
<td>15%</td>
<td>17%</td>
<td>19%</td>
<td>23%</td>
</tr>
<tr>
<td>Present value taxpayer benefits (million)</td>
<td>$13.9</td>
<td>$13.3</td>
<td>$13.0</td>
<td>$12.8</td>
<td>$12.6</td>
<td>$12.2</td>
<td>$11.7</td>
</tr>
</tbody>
</table>

Labor import effect variable

The labor import effect variable only affects the alumni impact calculation in Table 3.1. In the model we assume a labor import effect variable of 50%, which means that 50% of the county’s labor demands would have been satisfied without the presence of MCC’s Nursing Program. In other words, businesses that hired MCC Nursing Program
students could have substituted some of these workers with equally-qualified people from outside the county had there been no MCC Nursing Program students to hire. Therefore, we attribute only the remaining 50% of the initial labor income generated by increased alumni productivity to the program.

Table A1.2 presents the results of the sensitivity analysis for the labor import effect variable. As explained earlier, the assumption increases and decreases relative to the base case of 50% by the increments indicated in the table. Alumni productivity impacts attributable to MCC, for example, range from a high of $25.1 million at a -50% variation to a low of $8.4 million at a +50% variation from the base case assumption. This means that if the labor import effect variable increases, the impact that we claim as attributable to alumni decreases. Even under the most conservative assumptions, the alumni impact on the Mohave County economy still remains sizeable.

Table A1.2: Nursing Program sensitivity analysis of labor import effect variable

<table>
<thead>
<tr>
<th>% variation in assumption</th>
<th>-50%</th>
<th>-25%</th>
<th>-10%</th>
<th>Base case</th>
<th>10%</th>
<th>25%</th>
<th>50%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labor import effect variable</td>
<td>25%</td>
<td>38%</td>
<td>45%</td>
<td>50%</td>
<td>55%</td>
<td>63%</td>
<td>75%</td>
</tr>
<tr>
<td>Alumni impact (millions)</td>
<td>$25.1</td>
<td>$20.9</td>
<td>$18.4</td>
<td>$16.7</td>
<td>$15.1</td>
<td>$12.6</td>
<td>$8.4</td>
</tr>
</tbody>
</table>

Student employment variables

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

Students incur substantial expense by attending MCC 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 64% of students are employed.\(^\text{37}\) 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 enrolled in the Nursing Program at the college earn only 88%, on average, of the earnings that they statistically would have received if not attending MCC. This suggests that many students hold part-time jobs that accommodate their MCC attendance, though it is at an additional cost in terms of receiving a wage that is less than what they otherwise might make. The 88% 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 Mohave County. The model captures this difference in wages and counts it as part of the opportunity cost of time. As above, the 88% estimate is tested in the sensitivity analysis by changing it to 100% and then to 0%.

\(^{37}\) Based on data provided by MCC.
The changes generate results summarized in Table A1.3, with $A$ defined as the percent of students employed and $B$ defined as the percent that students earn relative to their full earning potential. Base case results appear in the shaded row; here the assumptions remain unchanged, with $A$ equal to 64% and $B$ equal to 88%. Sensitivity analysis results are shown in non-shaded rows. Scenario 1 increases $A$ to 100% while holding $B$ constant, Scenario 2 increases $B$ to 100% while holding $A$ constant, Scenario 3 increases both $A$ and $B$ to 100%, and Scenario 4 decreases both $A$ and $B$ to 0%.

Table A1.3: Nursing Program sensitivity analysis of student employment variables

<table>
<thead>
<tr>
<th>Variations in assumptions</th>
<th>Net present value (millions)</th>
<th>Internal rate of return</th>
<th>Benefit-cost ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base case: $A = 64%$, $B = 88%$</td>
<td>$33.4$</td>
<td>$56.7%$</td>
<td>$14.4$</td>
</tr>
<tr>
<td>Scenario 1: $A = 100%$, $B = 88%$</td>
<td>$34.9$</td>
<td>n/a*</td>
<td>$38.1$</td>
</tr>
<tr>
<td>Scenario 2: $A = 64%$, $B = 100%$</td>
<td>$33.8$</td>
<td>$71.1%$</td>
<td>$17.8$</td>
</tr>
<tr>
<td>Scenario 3: $A = 100%$, $B = 100%$</td>
<td>$35.6$</td>
<td>n/a*</td>
<td>$176.2$</td>
</tr>
<tr>
<td>Scenario 4: $A = 0%$, $B = 0%$</td>
<td>$30.6$</td>
<td>$29.2%$</td>
<td>$6.9$</td>
</tr>
</tbody>
</table>

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

* In these scenarios, costs are so low that it is not appropriate to measure an internal rate of return.

- **Scenario 1**: Increasing the percentage of students employed ($A$) from 64% to 100%, the net present value and benefit-cost ratio improve to $34.9$ million and 38.1, 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 88% to 100%, the net present value, internal rate of return, and benefit-cost ratio results improve to $33.8$ million, 71.1%, and 17.8, 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 and benefit-cost ratio improve yet further to $35.6$ million and 176.2, respectively, relative to base case results. This scenario assumes that all students are fully employed and earning full salaries (equal to statistical averages) while attending classes.

- **Scenario 4**: Finally, decreasing both $A$ and $B$ to 0% reduces the net present value, internal rate of return, and benefit-cost ratio to $30.6$ million, 29.2%, and 6.9, respectively, relative to base case results. These results are reflective of an increased opportunity cost; none of the students are employed in this case.

It is strongly emphasized in this section that base case results are very attractive in that results are all above their threshold levels. As is clearly demonstrated here, results of the first three alternative scenarios appear much more attractive, although they overstate benefits. Results presented in Chapter 3 are realistic, indicating that investment

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38 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 MCC’s Nursing Program generates 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.

In this study, we assume a 4.9% discount rate for students and a 0.7% discount rate for taxpayers. Similar to the sensitivity analysis of the alternative education variable, we vary the base case discount rates for students and taxpayers on either side by increasing the discount rate by 10%, 25%, and 50%, and then reducing it by 10%, 25%, and 50%. Note that, because the payback period is based on the undiscounted cash flow, it is unaffected by changes in the discount rate.

As demonstrated in the table, an increase in the discount rate leads to a corresponding decrease in the expected returns, and vice versa. For example, increasing the student discount rate by 50% (from 4.9% to 7.3%) reduces the Nursing Program students’ benefit-cost ratio from 14.4 to 10.4. Conversely, reducing the discount rate for students by 50% (from 4.9% to 2.4%) increases the benefit-cost ratio from 14.4 to 21.2. The sensitivity analysis results for taxpayers show the same inverse relationship between the discount rate and the benefits.

Table A1.4: Nursing Program sensitivity analysis of discount rate

<table>
<thead>
<tr>
<th>% variation in assumption</th>
<th>-50%</th>
<th>-25%</th>
<th>-10%</th>
<th>Base case</th>
<th>10%</th>
<th>25%</th>
<th>50%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Student perspective</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discount rate</td>
<td>2.4%</td>
<td>3.7%</td>
<td>4.4%</td>
<td>4.9%</td>
<td>5.4%</td>
<td>6.1%</td>
<td>7.3%</td>
</tr>
<tr>
<td>Net present value (millions)</td>
<td>$50.2</td>
<td>$40.7</td>
<td>$36.1</td>
<td>$33.4</td>
<td>$30.9</td>
<td>$27.7</td>
<td>$23.3</td>
</tr>
<tr>
<td>Benefit-cost ratio</td>
<td>21.21</td>
<td>17.37</td>
<td>15.52</td>
<td>14.44</td>
<td>13.46</td>
<td>12.16</td>
<td>10.37</td>
</tr>
<tr>
<td><strong>Taxpayer perspective</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discount rate</td>
<td>0.37%</td>
<td>0.55%</td>
<td>0.66%</td>
<td>0.73%</td>
<td>0.81%</td>
<td>0.92%</td>
<td>1.10%</td>
</tr>
<tr>
<td>Present value benefits (millions)</td>
<td>$13.7</td>
<td>$13.2</td>
<td>$13.0</td>
<td>$12.8</td>
<td>$12.6</td>
<td>$12.4</td>
<td>$12.0</td>
</tr>
</tbody>
</table>

39 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.”
Alternative education: A "with" and "without" measure of the percent of students who would still be able to avail themselves of education if the program under analysis did not exist. An estimate of 10%, for example, means that 10% of students do not depend directly on the existence of the program in order to obtain their education.

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

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

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

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

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

Discounting: Expressing future revenues and costs in present value terms.

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

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

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

Initial effect: Income generated by the initial injection of monies into the economy through the higher earnings of alumni.

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 region, they also generate earnings in all sectors of the economy, thereby increasing the demand for goods and services and jobs. Moreover, as students enter or rejoin the workforce with higher skills, they earn higher salaries and wages. In turn, this generates more consumption and spending in other sectors of the economy.

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

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

NAICS: The North American Industry Classification System (NAICS) classifies North American business 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 enroll in the program, 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:

\[
\text{Payback period} = \frac{\text{cost of investment}}{\text{net return per period}}
\]
This appendix provides answers to some frequently asked questions about the results.

What is economic impact analysis?

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

What is investment analysis?

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

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

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

How do my college’s rates of return compare to that of other institutions?

In general, Lightcast discourages comparisons between institutions since many factors, such as regional economic conditions, institutional differences, and student demographics are outside of the college’s control. It is best to compare the rate of return to the discount rates of 4.9% (for students) and 0.7% (for 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.

**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.
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 regional product (GRP). Sales include all the intermediary costs associated with producing goods and services. Income is a net measure that excludes these intermediary costs:

\[ \text{Income} = \text{Sales} - \text{Intermediary Costs} \]

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

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

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

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

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

Typically, the educational achievements of students are marked by the credentials they earn. However, not all students who attended MCC’s Nursing Program in the 2022-23 analysis year obtained a degree or certificate. Some returned the following year to complete their education goals, while others took a few courses and entered the workforce without graduating. As such, the only way to measure the value of the students’ achievement is through their credits. This approach allows us to see the benefits to all students enrolled in the program, not just those who earned a degree.

To calculate the value per credit, we first determine how many credits are required to complete each education level. For example, assuming that there are 30 credits in an academic year, a student generally completes 120 credits in order to move from a high school diploma to a bachelor's degree, another 60 credits to move from a bachelor's degree to a master's degree, and so on. This progression of credits 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 credits in the education ladder based on the wage differentials. For example, the difference in county earnings between a high school diploma and an associate degree is $21,500. We spread this $21,500 wage differential across the 60 credits that occur between a high school diploma and an associate degree, applying a ceremonial “boost” to the last credit in the stage to mark the achievement of the degree. We repeat this process for each education level in the ladder.

The value per credit is different between the economic impact analysis and the investment analysis. The economic impact analysis uses the region as its background and, therefore, uses regional earnings to calculate value per credit, while the investment analysis uses the state as its backdrop and, therefore, uses state earnings. The methodology outlined in this appendix will use regional earnings; however, the same methodology is followed for the investment analysis when state earnings are used.

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).
Next, we map the credit production of the FY 2022-23 student population to the education ladder. In total, students completed 5,523 credits during the analysis year. We map each of these credits to the education ladder depending on the students’ education level and the average number of credits they completed during the year. For example, associate degree graduates are allocated to the stage between the certificate degree and the associate degree, and the average number of credits they completed informs the shape of the distribution curve used to spread out their total credit production within that stage of the progression.

The sum product of the credits earned at each step within the education ladder and their corresponding value yields the students’ aggregate annual increase in income ($\Delta E$), 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 credits completed at step $i$.

Table A6.1 displays the result for the students’ aggregate annual increase in income ($\Delta E$), a total of $2.6$ million. By dividing this value by the students' total production of 5,523 credits during the analysis year, we derive an overall value of $479$ per credit.

<table>
<thead>
<tr>
<th>Table A6.1: Aggregate annual increase in income of students and value per credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggregate annual increase in income</td>
</tr>
<tr>
<td>Total credits in FY 2022-23</td>
</tr>
<tr>
<td>Value per credit</td>
</tr>
</tbody>
</table>

Source: Lightcast impact model.

**Mincer function**

The $479$ value per credit in Table A6.1 only tells part of the story, however. Human capital theory holds that earnings levels do not remain constant; rather, they start relatively low and gradually increase as the worker gains more experience. Research also shows that the earnings increment between educated and non-educated workers grows through time. These basic patterns in earnings over time were originally identified by Jacob Mincer, who viewed the lifecycle earnings distribution as a function with the key elements being earnings, years of education, and work experience, with age serving as a proxy for experience.\(^{42}\) We use state-specific and education level-specific Mincer coefficients.

Figure A6.1 illustrates several important points about the Mincer function. First, as demonstrated by the shape of the curves, an individual's earnings initially increase at an increasing rate, then increase at a decreasing rate, reach a maximum somewhere well after the midpoint of the working career, and then decline in later years. Second,

\(^{42}\) See Mincer (1958 and 1974).
individuals with higher levels of education reach their maximum earnings at an older age compared to individuals with lower levels of education (recall that age serves as a proxy for years of experience). And third, the benefits of education, as measured by the difference in earnings between education levels, increase with age.

**Figure A6.1: Lifecycle change in earnings**

In calculating the alumni impact, we use the slope of the curve in Mincer’s earnings function to condition the $479 value per credit to the students’ age and work experience. To the students just starting their career during the analysis year, we apply a lower value per credit; to the students in the latter half or approaching the end of their careers we apply a higher value per credit. The original $479 value per credit applies only to the credit production of students precisely at the midpoint of their careers during the analysis year.

When calculating the student return on investment, 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 credit is lower for students at the start of their career and higher near the end of it, in accordance with the scalars derived from the slope of the Mincer curve illustrated in Figure A6.1.
Appendix 7: Alternative education variable

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

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

In the absence of the program, we assume 15% of the program's students would find alternative education opportunities and remain in or return to the county. We account for this by discounting the alumni impact and the benefits to taxpayers by 15%. In other words, we assume 15% of the benefits created by the program's students would have occurred anyway in the counterfactual scenario where the program did not exist. A sensitivity analysis of this adjustment is presented in Appendix 1.
Appendix 8: Overview of investment analysis measures

The appendix provides context to the investment analysis results using the simple hypothetical example summarized in Table A8.1 below. The table shows the projected benefits and costs for a single student over time and associated investment analysis results.\(^\text{43}\)

Table A8.1: Example of the benefits and costs of education for a single student

<table>
<thead>
<tr>
<th>Year</th>
<th>Tuition</th>
<th>Opportunity cost</th>
<th>Total cost</th>
<th>Higher earnings</th>
<th>Net cash flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$1,500</td>
<td>$20,000</td>
<td>$21,500</td>
<td>$0</td>
<td>-$21,500</td>
</tr>
<tr>
<td>2</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$5,000</td>
<td>$5,000</td>
</tr>
<tr>
<td>3</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$5,000</td>
<td>$5,000</td>
</tr>
<tr>
<td>4</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$5,000</td>
<td>$5,000</td>
</tr>
<tr>
<td>5</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$5,000</td>
<td>$5,000</td>
</tr>
<tr>
<td>6</td>
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Net present value

<table>
<thead>
<tr>
<th>Benefit-to-cost ratio</th>
<th>Internal rate of return</th>
<th>Payback period (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.7</td>
<td>18.0%</td>
<td>4.2</td>
</tr>
</tbody>
</table>

Assumptions are as follows:

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

\(^{43}\) Note that this is a hypothetical example. The numbers used are not based on data collected from an existing college.
Together, tuition and earnings forgone cost sum to $21,500. This represents the out-of-pocket investment made by the student (Column 4).

In return, the student earns $5,000 more per year than he otherwise would have earned without the education (Column 5).

The net cash flow (NCF) in Column 6 shows higher earnings (Column 5) less the total cost (Column 4).

The assumed going rate of interest is 4%, the rate of return from alternative investment schemes for the use of the $21,500.

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

Net present value

The student in Table A8.1 can choose either to attend college or to 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 A8.1, the total will be $45,000. Compared to a total investment of $21,500, this appears to be a very solid investment. The reality, however, is different. Benefits are far lower than $45,000 because future money is worth less than present money. Costs (tuition plus earnings 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.44

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.

44 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 A8.1 the cumulative present value of $5,000 worth of higher earnings between years 2 and 10 is $35,753 given the 4% interest rate, far lower than the undiscounted $45,000 discussed above.

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

Internal rate of return

The internal rate of return is another way of measuring the worth of investing in education using the same cash flows shown in Table A8.1. In technical terms, the internal rate of return is a measure of the average earning power of money used over the life of the investment. It is simply the interest rate that makes the net present value equal to zero. In the discussion of the net present value above, the model applies the going rate of interest of 4% and computes a positive net present value of $14,253. The question now is what the interest rate would have to be in order to reduce the net present value to zero. Obviously, it would have to be higher—18.0% in fact, as indicated in Table A8.1. Or, if a discount rate of 18.0% were applied to the net present value calculations instead of the 4%, then the net present value would reduce to zero.

What does this mean? The internal rate of return of 18.0% defines a breakeven solution—the point where the present value of benefits just equals the present value of costs, or where the net present value equals zero. Or, at 18.0%, higher earnings of $5,000 per year for the next nine years will earn back all investments of $21,500 made plus pay 18.0% for the use of that money ($21,500) in the meantime. Is this a good return? Indeed, it is. If it is compared to the 4% going rate of interest applied to the net present value calculations, 18.0% is far higher than 4%. It may be concluded, therefore, that the investment in this case is solid. Alternatively, comparing the 18.0% rate of return to the long-term 9.6% 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-to-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 A8.1, it will take roughly 4.2 years of $5,000 worth of higher earnings to recapture his investment of $1,500 in tuition and the $20,000 in earnings forgone while attending the college. Higher earnings that occur beyond 4.2 years are the returns that make the investment in education in this example economically worthwhile. The payback period is a fairly rough, albeit common, means of choosing between investments. The shorter the payback period, the stronger the investment.
Appendix 9: 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 county, including taxpayers. In this appendix we discuss the following three main benefit categories: 1) improved health, 2) reductions in crime, and 3) reduced demand for government-funded income assistance.

It is important to note that the data and estimates presented here should not be viewed as exact, but rather as indicative of the positive impacts of education on an individual’s quality of life. The process of quantifying these impacts requires a number of assumptions to be made, creating a level of uncertainty that should be borne in mind when reviewing the results.

Health

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

Smoking

Despite a marked decline over the last several decades in the percentage of U.S. residents who smoke, a 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 A9.1 shows the prevalence of cigarette smoking among adults, 25 years and over, based on data provided by the National Health Interview Survey. The data include adults who reported smoking more than 100 cigarettes during their lifetime and who, at the time of interview, reported smoking every day or some days. As indicated, the percent of who smoke begins to decline beyond the level of high school education.

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

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which we adjust the national prevalence data on smoking to each state. For example, 14.0% of Arizona adults were smokers in 2018, relative to 15.9% for the nation. We thus apply a scalar of 0.88 to the national probabilities of smoking in order to adjust them to the state of Arizona.

Alcohol dependence

Although alcohol dependence has large public and private costs, it is difficult to measure and define. There are many patterns of drinking, ranging from abstinence to heavy drinking. Alcohol abuse is riddled with social costs, including health care expenditures for treatment, prevention, and support; workplace losses due to reduced worker productivity; and other effects.

Figure A9.2 compares the percentage of adults, 18 and older, that abuse or depend on alcohol by education level, based on data from the Substance Abuse and Mental Health Services Administration (SAMHSA). These statistics give an indication of the correlation between education and the reduced probability of alcohol dependence. Adults with an associate degree or some college have higher rates of alcohol dependence than adults with a high school diploma or lower. Prevalence rates are lower for adults with a bachelor's degree or higher than those with an associate degree or some college. Although the data do not maintain a pattern of decreased alcohol dependence at every level of increased education, we include these rates in our model to ensure we provide a comprehensive view of the social benefits and costs correlated with education.

Obesity

The rise in obesity and diet-related chronic diseases has led to increased attention on how expenditures relating to obesity have increased in recent years. The average cost of obesity-related medical conditions is calculated using information from the Journal of Occupational and Environmental Medicine, which reports incremental medical expenditures and productivity losses due to excess weight.

Data for Figure A9.3 is derived from the National Center for Health Statistics which shows the prevalence of obesity among adults aged 20 years and over by education, gender, and ethnicity. As indicated, college graduates are less likely to be obese than individuals with a high school diploma. However, the prevalence of obesity among adults with some college is actually greater than those with just a high school diploma. In general, though, obesity tends to decline with increasing levels of education.

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


Depression

Capturing the full economic cost of mental illness is difficult because not all mental disorders have a correlation with education. For this reason, we only examine the economic costs associated with major depressive disorder (MDD), which are comprised of medical and pharmaceutical costs, workplace costs such as absenteeism, and suicide-related costs.50

Figure A9.4 summarizes the prevalence of MDD among adults by education level, based on data provided by the CDC.51 As shown, people with some college are most likely to have MDD compared to those with other levels of educational attainment. People with a high school diploma or less, along with college graduates, are all fairly similar in the prevalence rates.

Drug abuse

The burden and cost of illicit drug abuse is enormous in the U.S., but little is known about the magnitude of costs and effects at a national level. What is known is that the rate of people abusing drugs is inversely proportional to their education level. The higher the education level, the less likely a person is to abuse or depend on illicit drugs. The probability that a person with less than a high school diploma will abuse drugs is 3.9%, twice as large as the probability of drug abuse for college graduates (1.7%). This relationship is presented in Figure A9.5 based on data supplied by SAMHSA.52 Similar to alcohol abuse, prevalence does not strictly decline at every education level. Health costs associated with illegal drug use are also available from SAMSHA, with costs to state government representing 40% of the total cost related to illegal drug use.53

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.


51 National Survey on Drug Use and Health. “Table 8.40B: Major Depressive Episode (MDE) or MDE with Severe Impairment in Past Year among Persons Aged 18 or Older, and Receipt of Treatment for Depression in Past Year among Persons Aged 18 or Older with MDE or MDE with Severe Impairment in Past Year, by Geographic, Socioeconomic, and Health Characteristics: Numbers in Thousands, 2017 and 2018.”

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

Figure A9.6 displays the educational attainment of the incarcerated population in the U.S. Data are derived from the breakdown of the inmate population by education level in federal, state, and local prisons as provided by the U.S. Census Bureau.54 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.55 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.56 Figure A9.7 relates the breakdown of TANF recipients by education level, derived from data provided by the U.S. Department of Health and Human Services.57 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.

Unemployment rates also decline with increasing levels of education, as illustrated in Figure A9.8. These data are provided by the Bureau of Labor Statistics.58 As shown, unemployment rates range from 5.4% for those with less than a high school diploma to 1.9% for those at the graduate degree level or higher.

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