# Investing in North Dakota's Future Economy Through State Funded College Scholarships: A Return-on-Investment Analysis*

**RESEARCH BRIEF**

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# Introduction

North Dakota was experiencing persistent labor shortages prior to the Covid-19 pandemic, and the situation has worsened since the onset of the pandemic amidst a tightening national labor market. The state has launched recruiting efforts nationwide to attract out-of-state workers to fill job openings within the state, yet the effectiveness of these efforts and the contributions of these workers to the state's long-run economic growth remains largely uncertain.

In addition to recruiting workers from elsewhere, the state has invested in human capital acquisition through its universities and colleges. During the 63rd legislative assembly, the state launched the North Dakota Higher Education Challenge Grant Program. The program appropriates funds to universities for projects dedicated to the advancement of academics. The amount appropriated has varied each legislative session, with a high of $29 million granted in the 63rd legislative assembly (2013-2015) and a low of $2 million in the 65th legislative assembly (2017-2019). The recent 67th legislative assembly (2021-2023) approved $11.15 million for the program. The program operates as a matching fund, where one dollar is provided as a match "for every two dollars of nonstate, non-federal dollars raised by the institutional foundations of North Dakota public colleges and universities for funds dedicated to the advancement of academics" (NDUS). Since its inception, 62 percent of funds have been allocated to scholarships.

Higher education institutions are instrumental in building a steady supply of educated and skilled labor with the necessary qualifications to lay a strong foundation for future economic success and shared prosperity (Berger and Fisher, 2013). Providing increased access to high-quality, post-secondary education expands economic opportunity for residents and for graduates joining the state's workforce; it represents an important and viable strategy for state governments to strengthen their economies (Blank 2021). Economists and policy researchers have long recognized the importance of educational attainment to individuals' well-being and regional economic development, and, as a result, developed methods and tools to quantify the financial benefit of those outcomes. These accepted methods are used to estimate the return on investment the state can expect to realize from the scholarships provided by the Challenge Grant Program.

In an environment where policymakers grapple with competing uses for limited public resources, and when the state is actively seeking to address workforce development, it is an opportune time to evaluate the return the state realizes from the scholarship funding it allocates through the Higher Education Challenge Grant Program. Results of this study can be used to assess the desirability of continuing to fund this program.

# Approach

A common method for evaluating financial performance is return on investment (ROI). ROI measures the financial return in comparison to the cost of an investment. Estimating ROI for the scholarship portion of the Challenge Grant Program amounts to comparing the state investment in scholarships through the program to an estimate of the financial benefits accruing to private and public sectors of an economy over lengthy periods. Unlike other forms of state funding, a big advantage of this program is that it leverages private funding. The state captures the full benefits of providing these scholarships while only funding one-third of the costs.

> **What is Return on Investment (ROI):**
>
> In simple terms, return on investment examines cost/financial outlays with financial returns over a given period
>
> Financial receipts/gains are generally divided by the cost/financial outlays and ROI is expressed as an annual percentage.

Two key areas of emphasis include the effects on individuals and effects on local or regional economies. Benefits from individual earnings are highlighted first. However, an argument could be made that these benefits should not be considered, as such benefits represent a transfer from some taxpayers to others. To address this concern, ROI estimates that exclude private benefits are also provided. These estimates quantify the increased state GDP growth from enhanced productivity and increased tax revenue collections. Short descriptions of individual benefit categories are outlined below.

### Individual Earnings

Scholarship/grants can affect an individual's educational attainment, which in turn affects lifetime earnings. Key factors in evaluating these effects include:
- likelihood of employment upon graduation
- expected starting salary, college degree
- expected starting salary, high school diploma
- rate of earnings growth over time in the workforce

Differentials between those outcomes are measured for individuals with only a high school diploma and workers with a higher education degree. Earning differentials provide a basis for changes in fiscal revenues (e.g., income tax, sales tax) and economic output (e.g., household consumption).

### Economic Growth and Productivity

When assessing a scholarship or grant program's effect on local or regional economic growth, the most common approach is to estimate the marginal contribution to gross domestic product (GDP). A more educated workforce is more productive, leading to higher economic output. This effect is often captured using a metric of how GDP growth varies with the percentage of the workforce with at least a college or associate degree.

We use an estimate from previous literature that assumes GDP growth increases by 0.5 percent for every one-percentage increase in the proportion of the population aged 25 or older holding at least a college degree. Previous estimates have ranged from 0.2 to 1.86 percent; thus, 0.5 percent provides a conservative estimate.

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**Key Financial Benefits for ROI:**

For this evaluation, the key benefits include:

Lifetime earnings: Differences in lifetime earnings generate fiscal effects (change in taxes) and increase household spending (enhanced consumption of goods and services).

Productivity Growth in Statewide Economy:
As a result of greater skills acquisition, the state's economy grows more rapidly due to increased worker productivity. A larger and more productive economy also produces additional tax revenues and business volume.

Fiscal Measures: Taxes and collections of other government revenues combined with foregone outlays for unemployment programs.

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**Timeframe**

A key component in this evaluation is identifying the period over which educational attainment produces benefits to workers and the period where general growth in educational attainment maintains a marginal increase in the state's GDP. GDP productivity gains require longer periods to accrue; they also sustain benefits over a shorter duration. A period of 15 years is used to capture the marginal GDP gains from the Challenge Scholarships.[1]

Several studies have found that the degree premium in salaries tends to widen until one reaches the age range of 40-50 and then starts to narrow until retirement. We assume a 40-year work career, but use a constant percentage wage as a conservative estimate. The longitudinal benefits and the various rates of return of the program are subject to a net-of-inflation interest rate of 3 percent, typical of program evaluations sensitive to the time value of money. An annual inflation rate of 2 percent is used over the evaluation period.

# Data and Parameters

Data on the Challenge Scholarships awarded for each of the North Dakota University System's 11 institutions is obtained from NDUS publications and institution websites. From many of the same sources, information is also collected on educational attainment, tuition, and fees for each institution. In the case of missing data, values are estimated using information found for similar institution types (e.g., two-year or polytechnical college, four-year comprehensive university, or research university).

Government data on the size of the North Dakota economy is used to estimate a historical growth rate over the past four biennia. Annual earnings and unemployment rates for individuals with a high-school diploma as the highest degree are only available from the Census Bureau's Current Population Survey (CPS) and Bureau of Labor Statistics for national-level data. Other data include state demographics by age group during the Challenge Grant Program period.

**Data for the Study:**

- Public funds used in Challenge Grant Program
- Graduation rates in NDUS
- Starting salaries in ND for College graduates
- Economic output of state economy
- ND marginal income tax rate
- ND historical unemployment rates by educational attainment
- Historical performance of ND economy

**Key Parameters and Assumptions:**

- 50% of graduates finding employment and remaining in state workforce
- Lifetime earnings over 40-year career
- Accrual of economic growth over 15 years
- 0.5% increase in growth rate of economy for every 1% increase in population with college degrees
- 2% average annual inflation
- Net-of-inflation annual discount rate of 3%

# Findings

The North Dakota Higher Education Challenge Grant Program has awarded $62,774,501 to the 11 NDUS institutions since its initiation in 2013, with 62 percent (i.e., $38,725,520) approved for scholarships. The first two biennia witnessed the largest awards in scholarships, followed by a sharp decline in the 2017-2019 biennium (Figure 1). The scholarship award in the most recent biennium has rebounded from the lowest point to about half of its peak level. This program also has provided funds for non-scholarship uses, such as endowed chairs, educational infrastructure, research, and technology. The awarded amounts for these uses have experienced similar temporal changes as for scholarships.

**Figure 1 State Funding of the Challenge Grant Program by Use, by Biennium**
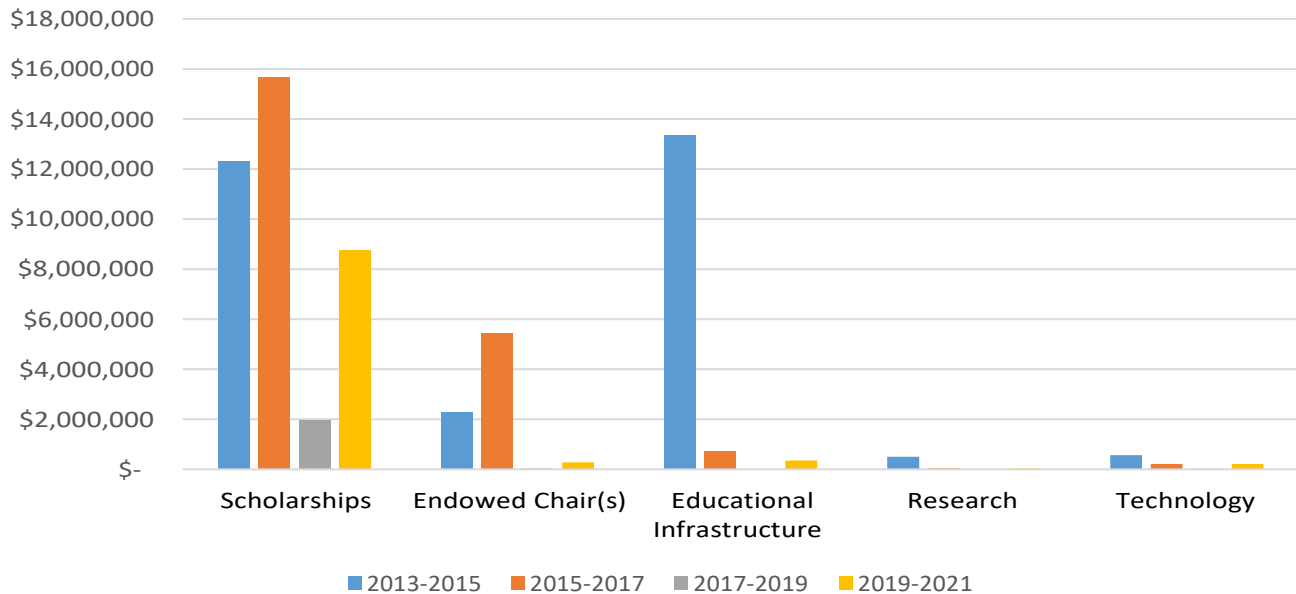


Three commonly used investment and program analysis measures are used to assess the payoffs to the Challenge Scholarship Program. The measures include discounted benefits less costs (known as net present value), discounted benefits/costs (known as benefit-cost ratio), and annual rate of return (modified internal rate of return). If benefits of a project exceed its costs, benefits less costs will be positive and benefit/cost ratio will be above one. The annual rate of return provides an ROI measure that can be compared to alternative investments.[2]

Table 1 shows these measures when considering the three types of benefits resulting from the program individually: (1) benefits resulting from increased state tax revenues, (2) benefits resulting from increased incomes of residents as a result of receiving a college degree; and (3) benefits resulting from an increase in state GDP growth rate. The table also shows these measures when combining benefits of additional state revenues and GDP growth rate, and for all three sources of benefits combined.

When only quantifying benefits as a result of generating increased tax revenues, Challenge Grant Program benefits do not exceed costs. The bulk of the program benefits accrue from an increase in the state's economic growth and result from increased incomes of residents. Program benefits are 20 times the costs when combining all benefits. Moreover, the annual return on investment exceeds investments with similar risks. Even when only considering the additional tax revenue and the increased rate of economic growth (excluding benefits from increased lifetime earnings), ROIs are substantially above those of alternative investments with similar risk.

**Table 1 Returns on Investment of Challenge Grant Program (2013-2021)**

|  | Benefits as a result of an increase in state revenues only | Benefits as a result of an increase in lifetime earnings only | Benefits as a result of an increase in the growth rate of state GDP only | Benefits as a results of increased state revenues and increased GDP growth rate | All Benefits combined |
|---|---|---|---|---|---|
|  | (1) | (2) | (3) | (1) + (3) | (1) + (2) + (3) |
| **Benefits - Costs** (in billions) | ($0.02) | $0.24 | $0.30 | $0.31 | $0.59 |
| **Benefits/Costs** | 0.29 | 8.98 | 10.92 | 11.21 | 20.20 |
| **Annual Rate of Return** | 2.70% | 9.39% | 9.31% | **9.40%** | **10.94%** |

*Note: All benefits and costs are in present values – discounted by 5 percent (3 percent real rate plus expected inflation of 2 percent). If Benefits minus Costs are positive, the program provides discounted benefits that exceed discounted costs, and the project more than breaks even. The ratio of benefits/costs shows benefits as multiples of costs (e.g. benefits/costs = 9 means that discounted benefits are 9 times the discounted costs). The annual rate of return used is Modified Internal Rate of Return, the preferred measure of calculating the rate of return for a public investment. An annual rate of return of 11 percent suggests that a $100 investment will yield $11 in returns per year for the life of the investment.*

The annual rate of return estimate of 10.94 percent (9.4 percent when only including GDP growth and tax revenue benefits) implies that the program is generating about $11 (or $9.50) annually for every $100 investment, and the returns are expected to accrue in the same capacity over the next few decades. Comparing this ROI to a much riskier investment, the 20-year average or 30-year average return of the S&P stock market index (shown in Table 2: 9.51% 20-year average, 10.66% 30-year average), the Challenge Grant Program is comparable. However, the rate of return compares more favorably to alternatives that would have similar risks to the Challenge Grant Program. Because the number of possible alternatives for public funding are large, comparisons of risk are complex, and the rates of return to such alternatives are likely to vary widely, we do not provide alternative comparisons outside of the S&P 500 Index.

**Table 2 Return on Investment, Stock Market S&P: 1992 through 2021**

|  | **Average Return on Investment** |
|---|---|
| **5-Year (2017-2021)** | 18.55% |
| **10-Year (2012-2021)** | 16.58% |
| **20-Year (2002-2021)** | 9.51% |
| **30-Year (1992-2021)** | 10.66% |

In nominal terms, annual contribution to GDP growth is multiple times the contemporary annual contribution to individual earnings, and both contributions far exceed the annual benefits to state revenues. When comparing the different types of benefits over the entire evaluation period, however, the total benefits to GDP growth and to lifetime earnings of individuals arrive at the same order of magnitude (i.e., $0.88 billion and $1.08 billion). Adjustments for time value of money and inflation do not change the relative importance, since benefits accruing in the distant future are heavily discounted. Unless drastic changes are made to key assumptions, the GDP growth effects and the contribution to lifetime earnings remain as the two largest contributors to the estimated ROIs.

A sensitivity analysis is conducted on modeling parameters associated with GDP growth effects and lifetime earnings effects. Some parameter values (e.g., constant percentage degree premium in salaries throughout career) used in this assessment already represent conservative values compared to those used in the literature. Values for other parameters are adjusted over a fairly wide range while remaining conceptually and practically plausible.

According to the sensitivity analysis (Table 3), the percentage of scholarship recipients staying in North Dakota after graduation has the largest impact on the rate of return estimates and represents an important conclusion in this study. It might seem surprising that the rate of return is 10.09 percent in spite of an assumed annual state GDP growth rate of -7.16 percent (the growth rate experienced in 2015-2016). However, the rate of return depends on the marginal rate of change in the economy. The rate of return of 10.09 percent is the result of the economy contracting less due to the higher percentage of people with college degrees. The benefits associated with marginal changes in GDP remain present whether the economy is expanding or contracting. Another reason for the robust ROI estimates is the degree premia in lifetime earnings remain substantial under almost all economic situations.

**Table 3 Sensitivity in Return on Investment Estimates to Variations in Key Model Parameters**

| Key Model Parameters | Possible Values | Rate of return, all benefits combined | Rate of return, excluding benefits of salary differentials |
|---|---|---|---|
| **Growth rate of annual salary** | **3.00%** | **10.94%** | **9.40%** |
| | 2.00% | 10.81% | 9.39% |
| | 1.00% | 10.69% | 9.39% |
| | 0.00% | 10.60% | 9.39% |
| **Annual ND nominal GDP growth rate** | **6.40%** | **10.94%** | **9.40%** |
| | 4.00% | 10.73% | 9.03% |
| | 2.00% | 10.59% | 8.73% |
| | 1.00% | 10.52% | 8.58% |
| | 0.00% | 10.45% | 8.44% |
| | -7.16% | 10.09% | 7.48% |
| **Marginal GDP growth effect (in percentage points) for every 1% increase in population aged 25+ with college diplomas** | 1.25 | 12.07% | 11.08% |
| | 1.00 | 11.76% | 10.67% |
| | 0.75 | 11.39% | 10.14% |
| | **0.50** | **10.94%** | **9.40%** |
| | 0.25 | 10.34% | 8.17% |
| | 0.00 | 9.46% | 2.70% |
| **Percentage of Graduates Staying in ND** | 85% | 12.53% | 11.37% |
| | 75% | 12.14% | 10.90% |
| | **50%** | **10.94%** | **9.40%** |
| | 25% | 9.17% | 6.95% |
| | 0% | -100.00% | -100.00% |
| **Number of years for the GDP growth effects of more college diplomas** | **15** | **10.94%** | **9.40%** |
| | 10 | 10.53% | 8.61% |
| | 5 | 10.05% | 7.36% |
| | 1 | 9.59% | 4.89% |
| | 0 | 9.46% | 2.70% |

*Note: Rows in boldface are the baseline parameter values and MIRR estimates.*

The sensitivity analysis provides confidence that the ROI for the Challenge Grant Program will likely generate overall returns many times the value of state-invested funds, even under a range of very unlikely economic situations. The only factor that may bring the investment below its breakeven level is the percentage of graduates remaining in North Dakota. That value must drop below 13 percent for the program to fall below the breakeven level. As the sensitivity analysis shows, under reasonable and likely economic conditions, the program generates ROI's above alternatives that would have similar risk to the program. When considering only the benefits from increased GDP and tax revenues, the rate of return is above alternatives as long as the following conditions hold:

- GDP increases by at least 0.25 percent for every 1 percent increase in population with college degrees
- at least half of North Dakota college graduates stay in the state, and
- the productivity effects of college degrees last for at least five years.[3]

# Takeaways

This study provides an estimate of the return on investment the state should receive from funding scholarships through the North Dakota Higher Education Challenge Grant Program. An annual rate of return to the state, given current conditions, is estimated at 9.4 percent. If higher lifetime earnings to individuals are included, the rate of return is nearly 11 percent. Some uncertainty exists in the assumed conditions, such as the length of time and the percentage of NDUS graduates remaining employed in the state. Due to some uncertainty in those factors, a sensitivity analysis examines a range of conditions to further clarify expected ROI. If 60 to 80 percent of graduates remain in the state between 5 and 20 years, the rate of return from this program ranges between 8.0 and 11.9 percent.

While this study uses very conservative parameters, sensitivity analysis reveals favorable ROIs under even more conservative parameters. Current estimates of ROI are only for the public portion of the scholarship investment. To the extent that the private dollars going into this program are incentivized by the public investment, the ROI to the public sector is even larger. Under an extreme assumption that no private dollars would be invested without the state program, the benefits realized would be upwards of three times higher, while the public outlay would remain the same. This would result in a rate of return of 13.04 percent (11.54 percent when only including GDP growth and tax revenue benefits). Generally, private funding often is easier to obtain when public funding provides the mechanism to leverage private donations. Strengthening of private donations to the NDUS, as result of the Program being available, should not be underestimated.

Another important consideration not explored in this study is the consequence of discontinuing this investment as it relates to the competitive position of the NDUS with peer institutions in neighboring states. Other states are increasing their investments in scholarships, luring students away from North Dakota colleges and universities, placing even greater emphasis on the value this program makes to North Dakota.

Remaining competitive with scholarship funding available in neighboring states is a potential concern as lagging enrollment at NDUS colleges and universities can be partially attributable to what other states are doing. Discontinuing this investment, without corresponding substitutes, would likely result in a decrease in the percentage of North Dakota residents with a college degree, with the state realizing reduced economic benefits. Extending and expanding funding for this program could help North Dakota colleges and universities retain more in-state students after graduation and attract more students from other states to study and work in North Dakota, contributing to the state economy.

Future work should explore other aspects of the Challenge Grant Program. In addition to scholarships, the program has helped fund infrastructure (e.g. NDSU's state-of-the-art Commodity Trading Room), research and technology, and other academic activities. Without this program, some major impactful infrastructure to train the best students in the nation might not exist. Return on investment for those shares of the program were not evaluated in this study, and if included, would provide a more comprehensive evaluation for policymakers. Another crucial benefit of the program for further assessment would be the impact on reducing stress levels for students who work multiple jobs to put themselves through college. The cost of college education is rising, making college less attractive and more stressful. Contributing to relieving such stress for students is invaluable. In addition, the reduction in debt incurred by students as a result of this program allows them to spend their income on productive alternatives.

# References and Information Sources

Aghion, P., L. Boustan, C. Hoxby, and J. Vandenbussche. (2009). "The causal impact of education on economic growth: Evidence from U.S.," Working paper, Harvard University.

Amato, L.H., R.J. Cebula, and J.E. Connaughton. (2022). "State productivity and economic growth," *Regional Studies*, *Regional Science*, *9*(1), 180-203.

Berger, N., and P. Fisher. (2013). "A well-educated workforce is key to state prosperity," Economic Analysis and Research Network Report, Economic Policy Institute.

Blank, R. (2021). "For a competitive economy, we need a skilled workforce." *Issues in Science and Technology*, October Issue.

Bureau of Labor Statistics (1993). "Labor composition and U.S. productivity growth, 1948-90," Bulletin no. 2426, U.S. Government Printing Office.

Humphreys, D. (2020). "The economic impact of University System of Georgia Institutions on their regional economies in FY 2019," Selig Center for Economic Growth, University of Georgia.

Jorgenson, D.W., and Z. Griliches. (1967). "The Explanation of Productivity Change," *Review of Economic Studies*, *34*, 249-83.

Jorgenson, D.W., M.S. Ho, and B.M. Fraumeni. (1994). "Quality of U.S. work force 1948-90," Unpublished manuscript, Harvard University.

Mies, V., M. Tapia, and I. Loeser. (2016). "The causal impact of human capital on R&D and productivity: Evidence from the United States," Meeting Papers 102, Society for Economic Dynamics.

North Dakota University System (November 2019). NDUS graduate retention in North Dakota. NDUS publication. https://www.slds.nd.gov/sites/www/files/documents/pdfs/NDUS%20Retention%2011-2019.pdf

Savvides, A., and T. Stengos. (2009). "Human capital and economic growth: Linear specifications," Book chapter in *Human Capital and Economic Growth* edited by Savvides and Stengos, Stanford University Press.

# Technical Appendix

To evaluate the economic impact of North Dakota's Challenge Scholarship Program using the data we compiled, we estimated the economic benefits accrued to individual scholarship recipients, the state government, and the state economy using the respective methodologies that have been well documented in the literature. Meanwhile, we realize this program will likely generate far-reaching impact that extends beyond the state borders (e.g., productivity gains that will spill-over to neighboring states) and can hardly be fully quantified in economic terms (e.g., improvement in life quality due to better education). At a minimum, the evaluation in this study will estimate a fiscal rate of return for the state legislature to evaluate the program's impact on the state budget, and this study will also derive a "social" rate of return for state policy-makers to discuss the best use of public funds to address urgent and emerging economic issues facing the State.

A key input into estimating the benefits of the program is the impact that scholarships have on the number of graduates from NDUS institutions. Scholarships are likely to increase university and college enrollment by making a college education more affordable for students and by making NDUS institutions more competitive with those in other states. However, we do not have information about the impact of scholarships on the choice to attend higher education in general or on the choice to attend an NDUS institution.

Moreover, although we know that a large percentage of students start a college or university education without graduating, we do not know what percentage of tuition each scholarship is funding. Thus, even if only half of the students that enroll at a particular college as freshmen graduate, if a scholarship equivalent to 4-years of tuition funds four students (each receiving one-quarter of their tuition through a scholarship) who wouldn't go to an NDUS institution without the scholarship, the scholarship has generated an additional two students (four start and two drop out). Because the literature does not provide a clear path on how to deal with this issue, we estimate the number of graduates generated at each institution by dividing total scholarship dollars by the total four-year tuition at NDUS institutions.

The primary benefit of the Challenge Scholarship Program accruing to NDUS graduates is the increased earnings owing to their college or associate degrees compared to their counterparts who hold a high-school diploma as their highest degree. To estimate these benefits, we calculated the annual salary premia of these degrees for an assumed work career of forty years. Several studies have found that the degree premium in salaries tends to widen until one reaches the age range of 40-50 and then starts to narrow until retirement. Given no consensus on the life-cycle variations in degree premia, this study assumes the degree premium remains constant over people's lives. This assumption results in a conservative estimate of this benefit. The earnings premium for those obtaining degrees through the scholarship program is multiplied by the probability of being employed and remaining in the state to obtain the estimated earnings benefit.

A college or associate degree will also reduce the degree holder's risk of unemployment. This second benefit is calculated as the number of reduced unemployed individuals among the scholarship recipients, multiplied by the corresponding average annual salary that is assumed to grow at an annual rate of three percent for a career of forty years. The number of individuals avoiding unemployment as a result of the scholarship program is relatively small, but the increased lifetime earnings for those who could have been unemployed are not insignificant.

The above two sources of increased earnings will not only benefit individual degree holders, but also add to North Dakota's state income tax revenue. A constant marginal tax rate of 2.04% is multiplied by the earnings premium realized by degree holders to calculate the extra revenue. Added to the additional tax revenue is the saved unemployment compensation for the state government. Currently the State allows a maximum weekly unemployment claim of $673 for up to 26 weeks. Based upon the actual claims in the past few years, we assumed the average claim lasts for 12 weeks to estimate the savings for the state government.

The contribution of the Scholarship Program to the state economy is estimated as its effect on state GDP growth rate as a result of a higher proportion of the state population having received higher education. With no prior estimates available for North Dakota, we reviewed the reported estimates of this relationship in other contexts. Based on these estimates, we assume that each one percent increase in the population 25 and older with a college degree results in a one-half percent increase in state GDP growth, providing a conservative estimate of the benefits (Humphreys, 2020). [4] If we divide the number of scholarship awardees each year in 2013-2021 by the state population in each year, we will get very small numbers that can be easily overwhelmed by rounding errors etc.

Instead, we assume the scholarships in the past four biennia increased the proportion of state population with college diplomas in one shot. Then we assumed the improved labor productivity due to a more educated workforce starts to boost the state GDP in 2024, when the most recent recipients of the Scholarships graduate and enter the labor market; these effects are assumed to last for 15 years. Compared to those reported in the literature for other regions or economies, these assumptions imply that the productivity gains will take a longer time to start to accrue and last a shorter period, thereby resulting in a conservative estimate of benefits of the Scholarship Program.

Lastly, when calculating the longitudinal benefits and the various rates of return of the Challenge Grant Program, we adopted a net-of-inflation interest rate of three percent that is typical in project or program evaluation to account for the time value of money and assumed the average inflation rate over the project period in this study to be at two percent.

[1] The share of all North Dakota college graduates that remain in the state one year after graduation has been around 50 percent over the past several years. During the same period, between 70 and 75 percent of North Dakota college graduates who came from North Dakota high schools stayed in the state (NDUS, 2019). No longitudinal assessments are available. Considering graduates may move to work in other states in the long run, we made the conservative assumption that productivity effects of college degrees (and their impact on GDP) last for 15 years, as opposed to much longer durations reported in the literature.

[2] We use modified internal rate of return (MIRR) instead of the commonly used internal rate of return (IRR) measure because of its superior qualities. According to Hurley, Rao, and Pardey (2014 and 2017), the MIRR measure has better analytical properties especially when used for publicly-funded projects that have long project terms, such as the Challenge Program. Policymakers can use the MIRR to clearly interpret the past performance of public projects and make reliable comparisons to other investment alternatives.

[3] The assumption of 0.5 percent increase in GDP for every one percent increase in the population in the population with a college degree is very conservative. Many studies have reported an estimate of this effect to be greater than one (e.g., Amato, Cebula and Connaughton 2022; Aghion et al. 2009; Savvides and Stengos 2009). We adopted the assumption of 0.5 used in a study conducted by the University of Georgia's Selig Center for Economic Growth (Humphrey 2020) which estimated the economic impact of the University System of Georgia institutions on the regional economy. Marginal reduction in GDP from increasing shares of population with college degrees over time was not considered, as the share of ND population with college education remains near 30 percent in 2020, and has only increased about 10 percent over the past two decades.

[4] Previous estimates of the percentage change in GDP growth resulting from a one percent change in the proportion with a college degree have ranged from 0.2 to 1.86. The Bureau of Labor Statistics (1993) and Jorgenson, Ho, and Fraumeni (1994) reported estimates of approximately 0.2 to 0.3 for the 1970s and 1980s when there were pronounced slowdowns in total factor productivity growth. More recent estimates (Mies, Tapia, and Loeser, 2016) have estimated this elasticity to be 1.86 for the 1977 through 2000 period and 1.02 for the 2000 through 2019 period. We use a value of 0.5 that was adopted by Humphreys (2020) in looking at the economic impact of the University of Georgia Institutions on the state economy. Humphreys (2020) adopted this estimate based on a widely-cited study by Jorgenson and Grilliches (1967).