DALLAS COLLEGE

MAIN REPORT

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The Value of an Associate Degree at Dallas College

Emsi | burningglass

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ABOUT

Dallas College is a large, well-regarded community college comprised of seven campuses across Dallas County, Texas. Established in 1965 and originally known as Dallas County Community College District, Dallas College has a rich history of serving students and community members through flexible course offerings in relevant, in-demand fields. In FY 2019-20, Dallas College enrolled more than 122,000 credit students and 28,000 non-credit students.

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Emsi Burning Glass is a leading provider of labor market data to professionals in higher education, economic development, workforce development, talent acquisition, and site selection. Emsi Burning Glass data are used to solve a variety of problems: measure the impact of higher education institutions, align programs with regional needs, equip students with career visions, understand regional economic and workforce activity, and find and hire the right talent. Emsi Burning Glass serves clients across the U.S., UK, and Canada.

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Executive summary

INVESTMENT ANALYSIS is the practice of comparing the costs and benefits of an investment to determine whether or not it is profitable. This study considers Dallas College as an investment from the perspective of an average Dallas College student earning an associate degree at the college and shows that Dallas College generates a positive return on that investment for its students. Results are calculated based on data across a five-year period, FY 2015-16 to FY 2019-20.

Students invest their own money and time in their education to pay for tuition, books, and supplies. Many take out student loans to attend Dallas College, which they will pay back over time. While some students were employed while attending the college, students overall forewent earnings that they would have generated had they been in full employment instead of learning. Summing these direct outlays, opportunity costs, and future student loan costs yields a total of **$26,705** in present value costs for the average Dallas College's associate degree student. In return, this student will receive a present value of **$145,991** in increased earnings over their working lives.

The benefit-cost ratio is **5.5**, meaning that for every $1,000 students invest in their associate degree at Dallas College, they will receive $5,500 in higher future earnings. The corresponding annual rate of return for associate degree students' educational investment is **20.3%**. In addition, associate degree students at Dallas College see, on average, a payback period of **7.2 years**, indicating that 7.2 years after students' initial educational investment of foregone earnings and out-of-pocket costs, they will have received enough higher future earnings to fully recover all costs.

INTRODUCTION

Associate degree students will receive a lifetime of higher earnings.

During FY 2019-20, Dallas College, has today grown to serve over 122,000 credit students and 28,000 non-credit students. While Dallas College affects the state in a variety of ways, many of which are difficult to quantify, this study considers the college as an investment for its nearly 87,000 associate degree students who earned or continued their education at Dallas College in FY 2019-20.

Emsi Burning Glass assesses the benefits received by Dallas College associate degree students based upon the costs and benefits of investing in their own education. The students' investments are their out-of-pocket expenses, the cost of interest incurred on student loans, and the opportunity cost of attending the college as opposed to working. In return for these investments, students receive a lifetime of higher earnings.

The study uses a wide array of data that are based on the following sources: the academic and financial reports from Dallas College for the past five years; data on Dallas College alumni's employment outcomes from Emsi Burning Glass's recent Alumni Outcomes study; industry and employment data from the Bureau of Labor Statistics and Census Bureau; outputs of Emsi Burning Glass's impact model; and a variety of published materials relating education to increased earning potential.

CHAPTER 1:

Profile of Dallas College and the state economy

Dallas College is a comprehensive two-year college comprised of seven campuses across Dallas County, Texas. Dallas College has a rich history of serving students and community members through flexible course offerings in relevant, in-demand fields. Focusing on Texas, the college offers a variety of transfer, vocational, and community-based classes. In FY 2019-20, Dallas College served 87,252 students pursuing an associate degree.

Dallas College provides exceptional educational opportunities in a variety of formats including online and in-person options. With more than 300 academic and technical degrees and certificates across seven schools, Dallas College's flexible learning models and hands-on approach make it easy for students to explore their interests and gain valuable skills. The college's diverse program offerings include Accounting, Criminal Justice, Dental Hygiene, Education, World Languages, and more.

With more than 300 academic and technical degrees and certificates across seven schools, Dallas College's flexible learning models and hands-on approach make it easy for students to explore their interests and gain valuable skills.

ALUMNI OUTCOMES FINDINGS

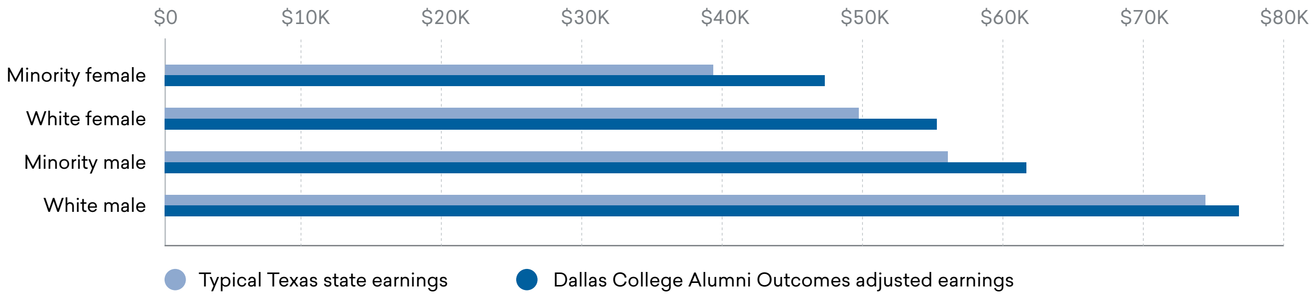
Emsi Burning Glass's Alumni Outcomes database has more than 125 million professional profiles filterable by education level, job title, employer, occupation, location, as well as other demographic parameters. The database contains an aggregate set of profiles from the open web, namely from all the major professional profile sites. Dallas College provided 193,091 unique records of individuals who have graduated from Dallas College; of these, 155,008 alumni are individuals who graduated from Dallas College with an associate degree. Emsi Burning Glass identified the current occupations of past alumni, combined with their programs of study while at Dallas College, graduation year, and more. Through this process, Alumni Outcomes matched a total of 35,117 profiles, or 21% of Dallas College's former students from as early as the class of 1966 to as recent as 2021.

The data are used to supplement the earnings in the student investment analysis. The alumni records used to inform Emsi Burning Glass's earnings data are limited to date of birth, gender, race/ethnicity, degree level, and place of residence. For example, for this analysis, we start with 32,608 unduplicated profiles for Dallas College associate degree alumni, of which 26,255 reside in the state of Texas. After filtering out Dallas College alumni profiles without the required demographic data fields, a sample of 21,129 alumni was used to further inform the Dallas College alumni earnings for the investment analysis.

Of the total 21,129 matched Dallas College alumni with the required demographic data, 41% are male and 59% are female. The breakdown by ethnicity is 48% white and 52% students of color. Matched alumni are, on average, 38 years old.

The adjusted earnings of the associate degree matched alumni are shown in Figure 1.1. For example, the typical associate degree earnings of a minority female in Texas are $39,429. However, the average earnings of Dallas College minority female associate degree graduates are $46,921. Thus, on average, Dallas College minority female associate degree graduates make more than the average minority female associate degree graduates in the state. The same trend holds true for the other specified demographic cohorts. Such results bode well for Dallas College associate degree graduates in Texas and are invaluable for the context of this study. Hereafter, the Alumni Outcomes adjusted state earnings are simply referred to as state earnings.

Figure 1.1: TYPICAL EARNINGS OF ASSOCIATE DEGREE GRADUATES AND ALUMNI OUTCOMES ADJUSTED EARNINGS OF DALLAS COLLEGE ASSOCIATE DEGREE GRADUATES BY DEMOGRAPHIC CHARACTERISTICS



Source: Emsi Burning Glass Alumni Outcomes and Emsi Burning Glass employment data.

DALLAS COLLEGE STUDENTS

Data pertaining to Dallas College students are sourced from Emsi Burning Glass's Alumni Outcomes database and the college's most current student data. Emsi Burning Glass's Alumni Outcomes are used to estimate students' earnings. More specifically, the data are used to estimate the earnings of Dallas College's students based on their demographics and current occupations.

Briefly, this section describes Dallas College associate degree students in terms of headcounts, demographics, and other student characteristics.[1] In the past five years, 39,857 students graduated with an associate degree from Dallas College, as shown in Table 1.1. In FY 2019-20, the breakdown of the student body by gender was 61% female and 39% male, the breakdown by ethnicity was 73% students of color, 22% white, and 5% unknown; the students' overall average age was 24 years old.

Table 1.1: BREAKDOWN OF ASSOCIATE DEGREE STUDENT HEADCOUNT, FY 2015-16 TO FY 2019-20

Fiscal year	Unduplicated headcount
Students who completed an associate degree	
2019-20	8,383
2018-19	8,320
2017-18	8,385
2016-17	7,342
2015-16	7,427
Total	**39,857**
All other associate degree students	
2019-20	78,869
2018-19	70,273
2017-18	63,942
2016-17	62,809
2015-16	62,138
All students who sought an associate degree	
2019-20	87,252
2018-19	78,593
2017-18	72,327
2016-17	70,151
2015-16	69,565

Source: Data provided by Dallas College.

1 Unduplicated headcount, gender, ethnicity, and age data provided by Dallas College.

THE TEXAS ECONOMY

Since the college was first established, it has been serving Texas by enhancing the workforce, providing local residents with easy access to higher education opportunities, and preparing students for highly skilled, in- demand professions. Table 1.2 summarizes the breakdown of the state economy by major industrial sector ordered by total income, with details on labor and non-labor income. Labor income refers to wages, salaries, and proprietors' income. Non-labor income refers to profits, rents, and other forms of investment income. Together, labor and non-labor income comprise the state's total income, which can also be considered as the state's gross state product (GSP). As shown in Table 1.2, the total income, or GSP, of Texas is approximately $1.9 trillion, equal to the sum of labor income ($1.1 trillion) and non-labor income ($754.1 billion).

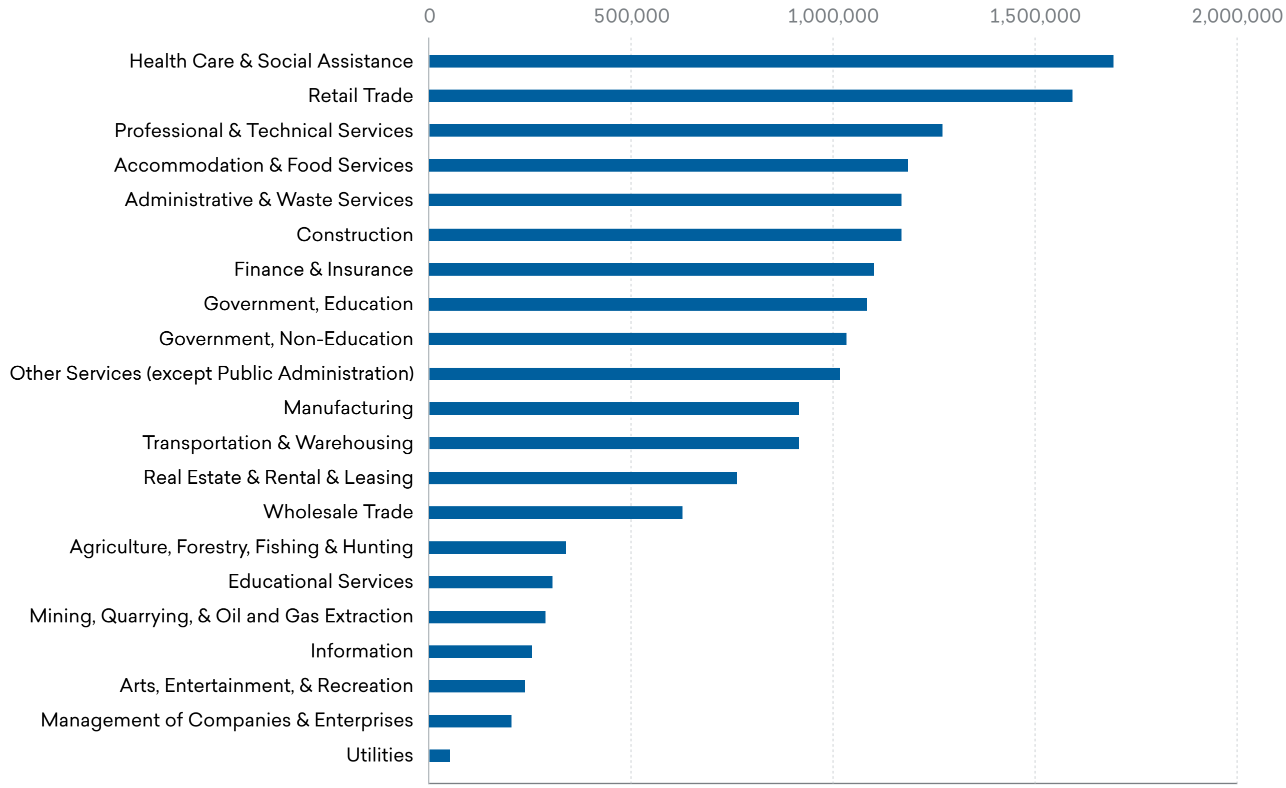
Table 1.2: INCOME BY MAJOR INDUSTRY SECTOR IN TEXAS, 2021*

Industry sector	Labor income (millions)	Non-labor income (millions)	Total income (millions)**	% of total income	Sales (millions)
Manufacturing	$89,448	$125,190	$214,638	11%	$496,789
Other Services (except Public Administration)	$32,106	$148,984	$181,090	10%	$258,952
Finance & Insurance	$101,396	$68,853	$170,248	9%	$305,162
Wholesale Trade	$64,510	$96,800	$161,310	9%	$246,876
Professional & Technical Services	$120,647	$19,562	$140,209	7%	$204,453
Government, Non-Education	$88,160	$35,888	$124,048	7%	$705,920
Health Care & Social Assistance	$105,964	$10,062	$116,025	6%	$189,339
Retail Trade	$66,055	$39,560	$105,615	6%	$175,344
Construction	$78,052	$19,794	$97,846	5%	$193,907
Information	$26,700	$49,119	$75,819	4%	$130,616
Real Estate & Rental & Leasing	$42,070	$32,193	$74,263	4%	$157,070
Government, Education	$70,935	$0	$70,935	4%	$82,070
Transportation & Warehousing	$50,455	$20,091	$70,546	4%	$138,398
Administrative & Waste Services	$56,927	$11,243	$68,169	4%	$116,711
Mining, Quarrying, & Oil and Gas Extraction	$35,539	$28,888	$64,427	3%	$160,801
Accommodation & Food Services	$30,996	$15,701	$46,697	2%	$88,477
Utilities	$9,186	$23,150	$32,335	2%	$48,134
Management of Companies & Enterprises	$29,108	$1,982	$31,090	2%	$51,692
Agriculture, Forestry, Fishing & Hunting	$12,897	$4,522	$17,418	1%	$45,059
Educational Services	$13,357	$858	$14,216	1%	$19,777
Arts, Entertainment, & Recreation	$7,982	$1,618	$9,600	1%	$14,879
Total	**$1,132,489**	**$754,055**	**$1,886,543**	**100%**	**$3,830,426**

* Data reflect the most recent year for which data are available. Emsi Burning Glass data are updated quarterly.
** Numbers may not add due to rounding.
Source: Emsi Burning Glass industry data.

Figure 1.2 provides the breakdown of jobs by industry in Texas. The Health Care & Social Assistance sector is the largest employer, supporting 1,719,560 jobs or 9.8% of total employment in the state. The second largest employer is the Retail Trade sector, supporting 1,621,151 jobs or 9.3% of the state's total employment. Altogether, the state supports 17.5 million jobs.[2]

Figure 1.2: JOBS BY MAJOR INDUSTRY SECTOR IN TEXAS, 2021*



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

2 Job numbers reflect Emsi Burning Glass's complete employment data, which includes the following four job classes: 1) employees who are counted in the Bureau of Labor Statistics' Quarterly Census of Employment and Wages (QCEW), 2) employees who are not covered by the federal or state unemployment insurance (UI) system and are thus excluded from QCEW, 3) self-employed workers, and 4) extended proprietors.

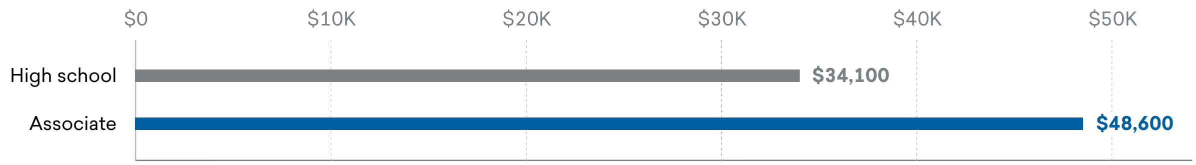
Table 1.3 and Figure 1.3 present the mean earnings by education level in Texas at the midpoint of the average-aged worker's career. These numbers are derived from Emsi Burning Glass's complete employment data on average earnings per worker in the state.[3] The numbers are then weighted by the Alumni Outcomes adjusted demographic profiles of Dallas College associate degree students. As shown, students have the potential to earn more upon completion of an associate degree compared to maintaining a high school diploma. For instance, students who earn an associate degree from Dallas College can expect approximate earnings of $48,600 per year in Texas, approximately $14,500 more than someone with a high school diploma.

Table 1.3: AVERAGE EARNINGS BY EDUCATION LEVEL AT A DALLAS COLLEGE STUDENT'S CAREER MIDPOINT

Education level	State earnings	Difference from high school diploma
High school or equivalent	$34,100	n/a
Associate degree	$48,600	$14,500

Source: Emsi Burning Glass employment data and Dallas College Alumni Outcomes data.

Figure 1.3: AVERAGE STATE EARNINGS BY EDUCATION LEVEL AT A DALLAS COLLEGE STUDENT'S CAREER MIDPOINT



Source: Emsi Burning Glass employment data and Dallas College Alumni Outcomes data.

3 Wage rates in the Emsi Burning Glass's multi-regional social accounting matrix (MR-SAM) model (see Appendix 4) combine state and federal sources to provide earnings that reflect complete employment in the state, including proprietors, self-employed workers, and others not typically included in regional or state data, as well as benefits and all forms of employer contributions. As such, Emsi Burning Glass industry earnings-per-worker numbers are generally higher than those reported by other sources.

CHAPTER 2:

Investment analysis

THE BENEFITS GENERATED by Dallas College affect the lives of many people. The most obvious beneficiaries are the college's students; they give up time and money to go to the college in return for a lifetime of higher wages and improved quality of life.

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

In this chapter, Emsi Burning Glass considers Dallas College as a worthwhile investment from the perspective of its associate degree students. To enroll in postsecondary education, students pay tuition and forego earned income had they chosen to work instead of attend college. From the perspective of students, education is the same as an investment. Students incur a cost, or put up a certain amount of money, with the expectation of receiving benefits in return. The benefits are the higher earnings that students receive as a result of their education. Results are calculated based on the average Dallas College associate degree student across a five-year period, FY 2015-16 to FY 2019-20.

STUDENT COSTS

Out-of-pocket expenses

Opportunity costs

STUDENT BENEFITS

Higher earnings from education

Calculating student costs

Student costs consist of three main items: direct outlays, opportunity costs, and future principal and interest costs incurred from student loans. Direct outlays include tuition and fees, equal to $948 per student. Direct outlays also include the cost of books and supplies. On average, students spent $738 each on books and supplies annually.[4] The cost of tuition and books and supplies is multiplied by 3.7, accounting for the average number of years spent at Dallas College.

4 Cost data for books and supplies were provided by Dallas College and then adjusted by Emsi Burning Glass to the percent of full-time equivalency of associate degree students.

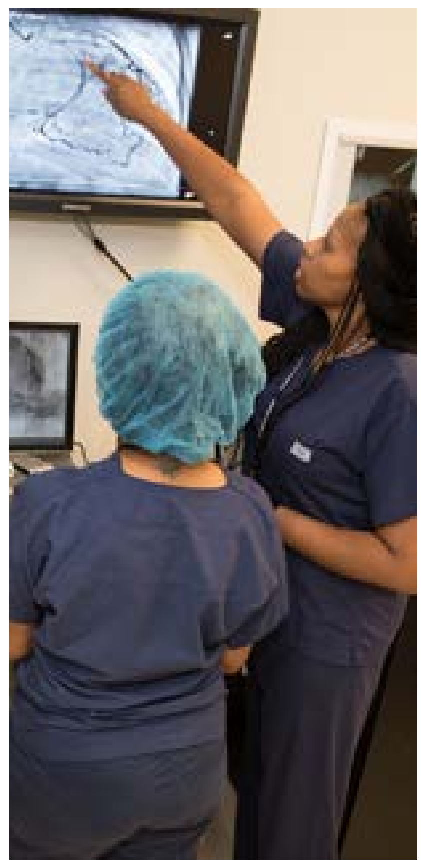
In order to pay the cost of tuition, many students took out loans. These students not only incur the cost of tuition from the college but also incur the interest cost of taking out loans. The average annual amount of federal loans received by students to attend Dallas College during the last five fiscal years was $582.[5] Students pay back these loans along with interest over the span of several years in the future. Since students pay off these loans over time, they accrue no initial cost during the analysis year. Hence, to avoid double counting, the $582 in federal loans is subtracted from the costs incurred by students during the same period.

In addition to the cost of tuition, books, and supplies, students also experienced an opportunity cost of attending the college during the length of their degree. Opportunity cost is the most difficult component of student costs to estimate. It measures the value of time and earnings foregone by students who go to the college rather than work. To calculate it, we need to know the difference between the average Dallas College associate degree student's full earning potential and what they earn while attending the college.

We derive the average Dallas College associate degree student's full earning potential by weighting the average annual earnings levels in Table 1.3 according to the education level breakdown of the student population when they first enrolled.[6] However, the earnings levels in Table 1.3 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 (24) to better reflect their wages at their current age.[7] This calculation yields an average full annual earning potential of $23,925 per student (Table 2.1).

In determining how much students earn while enrolled in postsecondary education, an important factor to consider is the time they spend on postsecondary education, since this is the only time that they are required to give up a portion of their earnings. Emsi Burning Glass works under the assumption that full-time students have less time to work, relative to part-time students. Consequently, a full-time student yields a large amount of foregone earnings and a part-time student yields less forgone earnings. Dallas College associate degree students took an average credit load equivalent to 45% of a full academic year. We therefore include no more than $10,764 (or 45%) of the average associate degree student's full earning potential in the opportunity cost calculations (Table 2.1).

Another factor to consider is the students' employment status while enrolled in postsecondary education. It is estimated that 59% of students are employed.[8] For the remainder of students, we assume that they are 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 time they spend at Dallas College (i.e., the $23,925). The



5 Due to data limitations, only federal loans are considered in this analysis.
6 This is based on students who reported their prior level of education to Dallas College.
7 Further discussion on this adjustment appears in Appendix 5.
8 Based on data provided by Dallas College.

total value of their foregone earnings thus comes to $10,764 per full non-working student, which translates into a weighted average of $4,413 with 41% of students being unemployed during their studies (Table 2.1).

Working students can maintain all or part of their earnings while enrolled. However, many of them hold jobs that pay less than statistical averages. These are typically entry-level jobs, such as restaurant servers or cashiers, that will accommodate their course schedule. To account for this, we assume that working students hold jobs that pay 69% of what they would have earned had they chosen to work full-time rather than go to college.[9] The remaining 31% comprises the percentage of their full earning potential that they forego. This assumption varies by person; some students forego more and others less. Since we do not know the actual jobs that students hold while attending, the 31% in foregone earnings serves as a reasonable average.

Working students also give up a portion of their leisure time in order to attend higher education institutions. According to the Bureau of Labor Statistics American Time Use Survey, students forego up to 0.5 hours of leisure time per day.[10] Assuming that an hour of leisure is equal in value to an hour of work, we derive the total cost of leisure by multiplying the number of leisure hours foregone during the length of the degree by the average hourly pay of the average Dallas College associate degree student's full earning potential. For working students, therefore, their total opportunity cost is $2,371, equal to the sum of their foregone earnings ($1,954) and foregone leisure time ($418).

Thus far we have discussed student costs incurred during the years needed to complete the degree. However, recall that students take out student loans to attend the college during the study period, which they will have to pay back over time. The amount they will be paying in the future must be a part of their decision to attend the 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 average Dallas College associate degree student's loan interest cost is to determine the payback time for the loans. There was an average of $582 in loans per student awarded for each of the 3.7 years it takes to achieve an associate degree. This sums to a total loan amount of $2,152 for the average student. According to the U.S. Department of Education, this level of indebtedness will take at most 10 years to pay back under the standard repayment plan.[11]

This indebtedness calculation is used solely to estimate the loan payback period. Students will be paying back the principal amount of $2,152 over time. After

9 The 69% assumption is based on the average hourly wage of jobs commonly held by working students divided by the national average hourly wage. Occupational wage estimates are published by the Bureau of Labor Statistics (see http://www.bls.gov/oes/current/oes_nat.htm).

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

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

taking into consideration the time value of money, this means that students will pay off a discounted present value of $1,464 in principle over 10 years. In order to calculate interest, we only consider interest on the federal loans awarded to students during their 3.7 years in college. Using the student discount rate of 4.5%[12] as our interest rate, we calculate that Dallas College students will pay a total discounted present value of $390 in interest on student loans throughout the first 10 years of their working lifetime. Students generally do not start paying back their loan amounts until after graduation, thus loan costs are applied the year after they finish their degree. The stream of these future interest costs together with the stream of loan payments is included in the costs of Column 5 of Table 2.3.

The steps leading up to the calculation of student costs appear in Table 2.1 and Table 2.2. Direct outlays amount to $1,104, the sum of tuition and fees ($948) and books and supplies ($738), less federal loans received ($582). Opportunity costs for working and non-working students amount to $6,031, excluding $753 in offsetting residual aid that is paid directly to students.[13] Finally, we have the present value of future student loan costs, which amount to $1,854 between principal and interest. Summing direct outlays, opportunity costs, and future student loan costs together yields a total of $26,705 in present value student costs per associate degree student.

Table 2.1: VALUE OF EARNINGS FOREGONE BY AN AVERAGE DALLAS COLLEGE ASSOCIATE DEGREE STUDENT

Associate degree student earning potential	
Student average annual earnings	$23,925
% of full academic year in attendance	45%
Student average earnings during analysis year	**$10,764**
Working and non-working student earning potential	
Percentage of non-working students	41%
Earnings foregone by non-working students	**$4,413**
Percentage of working students	59%
Percentage of earnings foregone by working students	31%
Earnings foregone by working students	**$1,954**
Sum of the earnings foregone by working and non-working students	**$6,367**

* Numbers may not add due to rounding.
Source: Based on data provided by Dallas College and outputs of the Emsi Burning Glass impact model.

12 The student discount rate is derived from the baseline forecasts for the 10-year discount rate published by the Congressional Budget Office. See the Congressional Budget Office, Student Loan and Pell Grant Programs—May 2019 Baseline. https://www.cbo.gov/system/files?file=2019-05/51310-2019-05-studentloan.pdf.

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

Table 2.2: PRESENT VALUE OF COSTS PER AVERAGE DALLAS COLLEGE ASSOCIATE DEGREE STUDENT

Annual direct outlays	
Tuition and fees	$948
Less federal loans received	-$582
Books and supplies	$738
Total annual direct outlays	**$1,104**
Annual opportunity costs	
Earnings foregone by working and non-working students	$6,367*
Value of leisure time foregone by working students	$418
Less residual aid	-$753
Total annual opportunity costs	**$6,031**
Grand total direct outlays and opportunity costs per student during attendance, present value	**$24,851**
Future student loan costs (present value)	
Total student loan principal	$1,464
Total student loan interest	$390
Grand total loan cost per student, present value	**$1,854**
Grand total cost per student, present value	**$26,705**

* See Table 2.1 for a breakdown of the total foregone earnings.
* Grand total costs refer to the entire study period.
Source: Based on data provided by Dallas College and outputs of the Emsi Burning Glass impact model.

Linking education to earnings

Having estimated the average cost of a Dallas College associate degree education to students, we weigh these costs against the benefits the average Dallas College associate degree student receives in return. The relationship between education and earnings is well documented and forms the basis for determining student benefits. As shown in Table 1.3, 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 average Dallas College associate degree student's return on investment is the value of their future benefits stream; i.e., what they can expect to earn in return for the investment they make in education. We calculate the future benefits stream to the college's students first by determining their average annual increase in earnings, which is equal to $11,900 per student. This value represents the higher wages that accrue to associate degree students at the midpoint of their careers and is based on the Alumni Outcomes informed marginal wage increases between a high school diploma and an associate degree.

The second step is to project the $11,900 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.[14] The Mincer function originated from Mincer's seminal work on human capital (1958). The function estimates earnings using an individual's years of education and post-schooling experience. While some have criticized Mincer's earnings function, it is still upheld in recent data and has served as the foundation for a variety of research pertaining to labor economics. Card (1999 and 2001) addresses a number of these criticisms using U.S. based research over the last three decades and concludes that any upward bias in the Mincer parameters is on the order of 10% or less. We use state-specific and education level-specific Mincer coefficients. To account for any upward bias, we incorporate a 10% reduction in our projected earnings, otherwise known as the ability bias. After applying the 10% reduction for ability bias, the $10,700. representing the average Dallas College associate degree student's 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 2.3.

As shown in Table 2.3, the $10,700 in gross higher earnings occurs around Year 17, which is the approximate midpoint of the average Dallas College associate degree student's 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 $10,700 and the gross higher earnings in the years after the midpoint are greater than $10,700.

The final step in calculating the students' future benefits stream is to net out the potential benefits generated by students who are either not yet active in the workforce or who leave the workforce over time. This adjustment appears in Column 3 of Table 2.3 and represents the percentage of Dallas College associate degree student population that will be employed in the workforce in a given year after finishing their degree. Note that after students finish their associate degree on average at 44 months (3.7 years), the percentages in the initial years following in the time horizon are relatively lower than those in subsequent years. This is because some students delay their entry into the workforce, 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. Settling-in factors delay the onset of the benefits by several years for graduates.

14 Appendix 5 provides more information on the Mincer function and how it is used to predict future earnings growth.

Table 2.3: PROJECTED BENEFITS AND COSTS OF THE AVERAGE DALLAS COLLEGE ASSOCIATE DEGREE STUDENT

1	2	3	4	5	6
Years out of school	**Gross higher earnings to students**	**% active in workforce***	**Net higher earnings to students**	**Student costs**	**Net cash flow**
0	$5,349.4	<1%	$0.0	$7,135.0	-$7,135.0
1	$5,662.1	<1%	$0.0	$7,135.0	-$7,135.0
2	$5,980.9	<1%	$0.0	$7,135.0	-$7,135.0
3	$6,305.0	15%	$919.0	$4,979.4	-$4,060.4
4	$6,633.2	72%	$4,796.6	$268.0	$4,528.6
5	$6,964.6	87%	$6,038.3	$268.0	$5,770.3
6	$7,297.8	96%	$7,023.9	$268.0	$6,755.9
7	$7,631.7	96%	$7,338.1	$268.0	$7,070.1
8	$7,964.9	96%	$7,650.4	$268.0	$7,382.4
9	$8,295.9	96%	$7,959.4	$268.0	$7,691.4
10	$8,623.5	96%	$8,263.7	$268.0	$7,995.7
11	$8,946.0	96%	$8,561.8	$268.0	$8,293.8
12	$9,262.1	96%	$8,852.1	$268.0	$8,584.1
13	$9,570.3	95%	$9,133.3	$268.0	$8,865.3
14	$9,868.9	95%	$9,403.9	$0.0	$9,403.9
15	$10,156.7	95%	$9,662.7	$0.0	$9,662.7
16	$10,431.9	95%	$9,908.1	$0.0	$9,908.1
17	$10,693.4	95%	$10,138.5	$0.0	$10,138.5
18	$10,939.5	95%	$10,352.3	$0.0	$10,352.3
19	$11,169.1	94%	$10,547.9	$0.0	$10,547.9
20	$11,380.9	94%	$10,723.9	$0.0	$10,723.9
21	$11,573.6	94%	$10,879.0	$0.0	$10,879.0
22	$11,746.3	94%	$11,012.1	$0.0	$11,012.1
23	$11,897.9	93%	$11,122.1	$0.0	$11,122.1
24	$12,027.5	93%	$11,208.0	$0.0	$11,208.0
25	$12,134.5	93%	$11,268.8	$0.0	$11,268.8
26	$12,218.2	93%	$11,303.9	$0.0	$11,303.9
27	$12,278.1	92%	$11,312.7	$0.0	$11,312.7
28	$12,313.9	92%	$11,294.3	$0.0	$11,294.3
29	$12,325.4	91%	$11,248.2	$0.0	$11,248.2
30	$12,312.5	91%	$11,174.4	$0.0	$11,174.4
31	$12,275.3	90%	$11,073.2	$0.0	$11,073.2
32	$12,214.1	90%	$10,945.5	$0.0	$10,945.5
33	$12,129.1	89%	$10,792.0	$0.0	$10,792.0
34	$12,021.0	88%	$10,613.5	$0.0	$10,613.5
35	$11,890.4	88%	$10,411.1	$0.0	$10,411.1
36	$11,738.0	87%	$10,185.6	$0.0	$10,185.6
37	$11,564.7	86%	$9,938.4	$0.0	$9,938.4
38	$11,371.6	85%	$9,671.2	$0.0	$9,671.2
39	$11,159.6	84%	$9,386.1	$0.0	$9,386.1
40	$10,930.1	83%	$9,084.7	$0.0	$9,084.7
41	$10,684.1	82%	$8,768.8	$0.0	$8,768.8
42	$10,423.2	81%	$8,439.3	$0.0	$8,439.3
Present value			**$145,991.4**	**$26,704.6**	**$119,286.8**

* Includes the "settling-in" factors and attrition.
Source: Emsi Burning Glass impact model.

Benefit-cost ratio	Internal rate of return	Payback period (years)
5.5	20.3%	7.2

Beyond the first years of the time horizon, students will leave the workforce for any number of reasons, whether death, retirement, or unemployment. Emsi Burning Glass estimates the rate of attrition using the data and assumptions from Emsi Burning Glass's impact model.[15] 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 2.3 shows the net higher earnings to students after accounting for both the settling-in patterns and attrition.

Return on investment for students

Having estimated the average Dallas College associate degree student's costs and their future benefits stream, the next step is to discount the results to the present to reflect the time value of money. For the student perspective we assume a discount rate of 4.5% (see below). Because students tend to rely upon debt to pay for education—i.e. they are negative savers—their discount rate is based upon student loan interest rates.[16] 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.

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 4.5% discount rate.

In Table 2.3, the net higher earnings of the average Dallas College associate degree student yield a cumulative discounted sum of approximately $145,991, 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 average Dallas College associate degree student's higher earnings stream.

15 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.

16 The student discount rate is derived from the baseline forecasts for the 10-year Treasury rate published by the Congressional Budget Office. See the Congressional Budget Office, Student Loan and Pell Grant Programs—May 2019 Baseline. https://www.cbo.gov/system/files?file=2019-06551310-2019-05-studentloan.pdf.

In effect, the average Dallas College associate degree student is rewarded for their investment in with a capital asset presently valued at $145,991.

The students' cost of attending the college is shown in Column 5 of Table 2.3, equal to a present value of $26,705. Comparing the cost with the present value of benefits yields a student benefit-cost ratio of 5.5 (equal to $145,991 in benefits divided by $26,705 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.[17] Table 2.3 shows Dallas College associate degree students earning average returns of 20.3% on their investment of time and money.

Dallas College associate degree students see an average rate of return of **20.3%** for their investment of time and money.

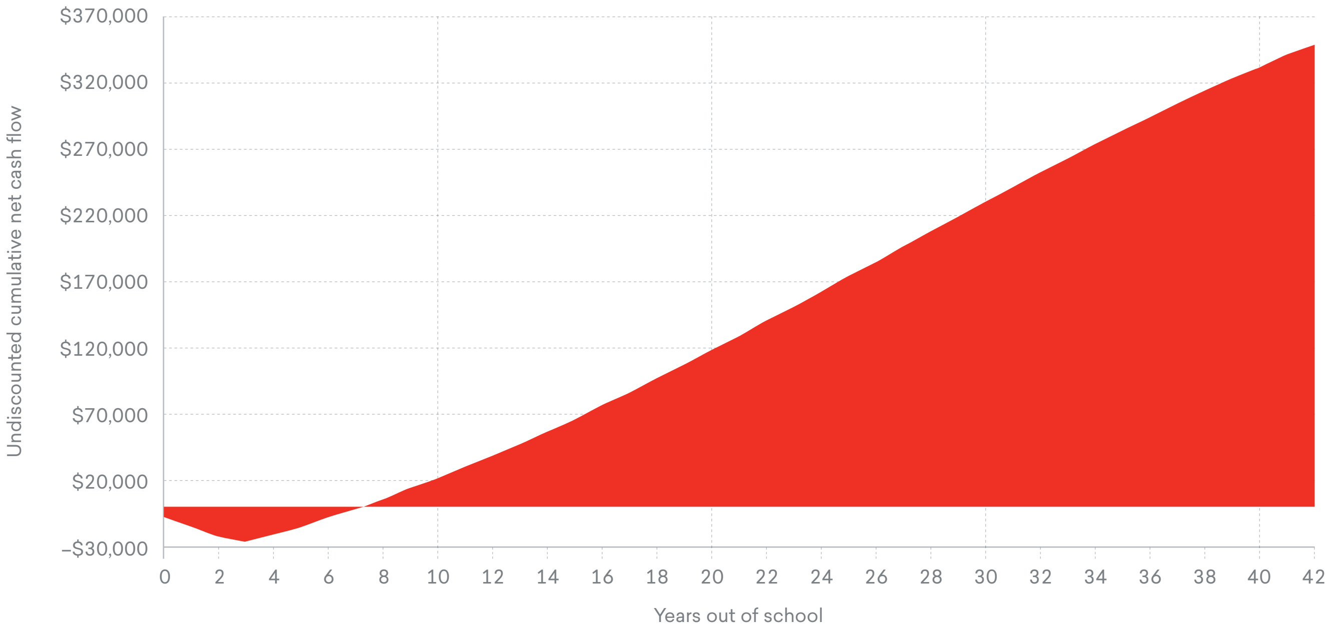
Note that returns reported in this study are real returns, not nominal. When a bank promises to pay a certain rate of interest on a savings account, it employs an implicitly nominal rate. Bonds operate in a similar manner. If it turns out that the inflation rate is higher than the stated rate of return, then money is lost in real terms. In contrast, a real rate of return is on top of inflation. For example, if inflation is running at 3% and a nominal percentage of 5% is paid, then the real rate of return on the investment is only 2%. In Table 2.3, the 20.3% student rate of return is a real rate. With an inflation rate of 2.1% (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 22.4%, higher than what is reported in Table 2.3.

The payback period is defined as the length of time it takes to entirely recoup the initial investment.[18] Beyond that point, returns are what economists would call pure costless rent. As indicated in Table 2.3, Dallas College associate degree students see, on average, a payback period of 7.2 years, meaning 7.2 years after their initial investment of foregone earnings and out-of-pocket costs, they will have received enough higher future earnings to fully recover those costs (Figure 2.1).

17 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.

18 Payback analysis is generally used by the business community to rank alternative investments when safety of investments is an issue. Its greatest drawback is it does not take into account the time value of money. The payback period is calculated by dividing the cost of the investment by the net return per period. In this study, the cost of the investment includes tuition and fees plus the opportunity cost of time; it does not take into account student living expenses.

Figure 2.1: ASSOCIATE DEGREE STUDENT PAYBACK PERIOD



Source: Emsi Burning Glass impact model.

CHAPTER 3:

Conclusion

TO ASSESS DALLAS COLLEGE'S VALUE to associate degree students, this study has evaluated the college as an educational investment. For every $1,000 invested by Dallas College associate degree students in their education, Dallas College offers a benefit of $5,500. These results indicate that Dallas College is an attractive investment to associate degree students with rates of return that exceed alternative investment opportunities. Modeling the college as an investment is subject to many factors, the variability of which is considered in the sensitivity analysis (Appendix 1). With this variability accounted for, Emsi Burning Glass presents the findings of this study as a robust picture of the college's value to current and future associate degree students.

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Emsi Burning Glass provides colleges and universities with labor market data that help create better outcomes for students, businesses, and communities. Our data, which cover more than 99% of the U.S. workforce, are compiled from a wide variety of government sources, job postings, and online profiles and résumés. Hundreds of institutions use Emsi Burning Glass to align programs with regional needs, drive enrollment, connect students with in-demand careers, track their alumni's employment outcomes, and demonstrate their institution's economic impact on their region. Visit economicmodeling.com/higher-education to learn more or connect with us.

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APPENDIX 1: SENSITIVITY ANALYSIS

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

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 attending the college 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 Dallas College 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 59% of students are employed.[19] 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 associate degree students who are working while attending the college earn only 69%, on average, of the earnings that they statistically would have received if not attending Dallas College. This suggests that many students hold part-time jobs that accommodate their Dallas College attendance, though it is at an additional cost in terms of receiving a wage that is less than what they otherwise might make. The 69% variable is an estimation based on the average hourly wages of the most common jobs held by students while attending college relative to the average hourly wages of all occupations in the U.S. The model captures this difference in wages and counts it as part of the opportunity cost of time. As above, the 69% estimate is tested in the sensitivity analysis by changing it to 100% and then to 0%.

19 Based on data provided by Dallas College.

The changes generate results summarized in Table A1.1, with *A* defined as the percent of students employed and *B* defined as the percent that Dallas College 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 59% and *B* equal to 69%. 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 A1.1: SENSITIVITY ANALYSIS OF STUDENT EMPLOYMENT VARIABLES

Variations in assumptions	Net present value	Internal rate of return	Benefit-cost ratio
Base case: A = 59%, B = 69%	$119,286.8	20.3%	5.5
Scenario 1: A = 100%, B = 69%	$128,917.3	28.1%	8.6
Scenario 2: A = 59%, B = 100%	$126,092.0	25.1%	7.3
Scenario 3: A = 100%, B = 100%	$140,451.6	64.2%	26.4
Scenario 4: A = 0%, B = 0%	$105,428.2	14.9%	3.6

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

- **Scenario 1:** Increasing the percentage of students employed (A) from 59% to 100%, the net present value, internal rate of return, and benefit-cost ratio improve to $128,917.3, 28.1%, and 8.6, respectively, relative to base case results. Improved results are attributable to a lower opportunity cost of time; all students are employed in this case.
- **Scenario 2:** Increasing earnings relative to statistical averages (B) from 69% to 100%, the net present value, internal rate of return, and benefit-cost ratio results improve to $126,092.0, 25.1%, and 7.3, respectively, relative to base case results; a strong improvement, again attributable to a lower opportunity cost of time.
- **Scenario 3:** Increasing both assumptions *A* and *B* to 100% simultaneously, the net present value, internal rate of return, and benefit-cost ratio improve yet further to $140,451.6, 64.2%, and 26.4, 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 $105,428.2, 14.9%, and 3.6, respectively, relative to base case results. These results are reflective of an increased opportunity cost; none of the students are employed in this case.[20]

20 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.

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 2 are realistic, indicating that investments in Dallas College generate excellent returns.

Discount rate

The discount rate is a rate of interest that converts future monies to their present value. In investment analysis, the discount rate accounts for two fundamental principles: 1) the time value of money, and 2) the level of risk that an investor is willing to accept. Time value of money refers to the value of money after interest or inflation has accrued over a given length of time. An investor must be willing to forego the use of money in the present to receive compensation for it in the future. The discount rate also addresses the investors' risk preferences by serving as a proxy for the minimum rate of return that the proposed risky asset must be expected to yield before the investors will be persuaded to invest in it. Typically, this minimum rate of return is determined by the known returns of less risky assets where the investors might alternatively consider placing their money.

In this study, we assume a 4.5% discount rate for students. Similar to the sensitivity analysis of the employment variable, we vary the base case discount rates for students on either side by increasing the discount rate by 10%, 25%, and 50%, and then reducing it by 10%, 25%, and 50%. Note that, because the rate of return and the payback period are both based on the undiscounted cash flows, they are unaffected by changes in the discount rate. As such, only variations in the net present value and the benefit-cost ratio are shown for students in Table A1.2.

Table A1.2: SENSITIVITY ANALYSIS OF THE DISCOUNT RATE

% variation in assumption	-50%	-25%	-10%	Base case	10%	25%	50%
Student perspective							
Discount rate	2.3%	3.4%	4.1%	4.5%	5.0%	5.7%	6.8%
Net present value	$199,770	$153,643	$131,860	$119,287	$108,048	$93,340	$95,307
Benefit-cost ratio	8.5	6.8	5.9	5.5	5.0	4.5	4.6

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 4.5% to 6.8%) reduces the average Dallas College associate degree student's benefit-cost ratio from 5.5 to 4.6. Conversely, reducing the discount rate for students by 50% (from 4.5% to 2.3%) increases the benefit-cost ratio from 5.5 to 8.5.

APPENDIX 2: GLOSSARY OF TERMS

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

Attrition rate: The rate at which students leave the workforce due to 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.

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).

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

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.

NAICS: The North American Industry Classification System (NAICS) classifies North American business establishment in order to better collect, analyze, and publish statistical data related to the business economy.

Net cash flow: Benefits minus costs, i.e., the sum of revenues accruing from an investment minus costs incurred.

Net present value: Net cash flow discounted to the present. All future cash flows are collapsed into one number, which, if positive, indicates feasibility. The result is expressed as a monetary measure.

Non-labor income: The income received from investments, such as rent, interest, and dividends.

Opportunity cost: Benefits foregone from alternative B once a decision is made to allocate resources to alternative A. Or, if individuals choose to attend college, they forego earnings that they would have received had they chose instead to work full-time. Foregone earnings, therefore, are the "price tag" of choosing to attend college.

Payback period: Length of time required to recover an investment. The shorter the period, the more attractive the investment. The formula for computing payback period is:

Payback period = cost of investment/net return per period

APPENDIX 3: FREQUENTLY ASKED QUESTIONS (FAQs)

This appendix provides answers to some frequently asked questions about the results.

What is 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.

How does my college's associate degree students' rates of return compare to that of other institutions?

In general, Emsi Burning Glass discourages comparisons between institutions since many factors, such as regional economic conditions, institutional differences, and student demographics are outside of the institution's control. It is best to compare the rate of return to the student discount rate of 4.5%, which can also be seen as the opportunity cost of the investment (since these stakeholders 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 can expect to receive a positive return on their educational investment.

Emsi Burning Glass recognizes that some institutions may want to make comparisons. As a word of caution, if comparing to an institution that had a study commissioned by a firm other than Emsi Burning Glass, 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.

APPENDIX 4: EMSI BURNING GLASS MR-SAM

Emsi Burning Glass's MR-SAM represents the flow of all economic transactions in a given region. It replaces Emsi Burning Glass's previous input-output (IO) model, which operated with some 1,000 industries, four layers of government, a single household consumption sector, and an investment sector. The old IO model was used to simulate the ripple effects (*i.e.*, multipliers) in the state economy as a result of industries entering or exiting the region. The MR-SAM model performs the same tasks as the old IO model, but it also does much more. Along with the same 1,000 industries, government, household, and investment sectors embedded in the old IO tool, the MR-SAM exhibits much more functionality, a greater amount of data, and a higher level of detail on the demographic and occupational components of jobs (16 demographic cohorts and about 750 occupations are characterized).

This appendix presents a high-level overview of the MR-SAM. Additional documentation on the technical aspects of the model is available upon request.

Data sources for the model

The Emsi Burning Glass MR-SAM model relies on a number of internal and external data sources, mostly compiled by the federal government. What follows is a listing and short explanation of our sources. The use of these data will be covered in more detail later in this appendix.

Emsi Burning Glass Data are produced from many data sources to produce detailed industry, occupation, and demographic jobs and earnings data at the local level. This information (especially sales-to-jobs ratios derived from jobs and earnings-to-sales ratios) is used to help regionalize the national matrices as well as to disaggregate them into more detailed industries than are normally available.

BEA Make and Use Tables (MUT) are the basis for input-output models in the U.S. The *make* table is a matrix that describes the amount of each commodity made by each industry in a given year. Industries are placed in the rows and commodities in the columns. The *use* table is a matrix that describes the amount of each commodity used by each industry in a given year. In the use table, commodities are placed in the rows and industries in the columns. The BEA produces two different sets of MUTs, the benchmark and the summary. The benchmark set contains about 500 sectors and is released every five years, with a five-year lag time (e.g., 2002 benchmark MUTs were released in 2007). The summary set contains about 80 sectors and is released every year, with a two-year lag (e.g., 2010 summary MUTs were released in late 2011/early 2012). The MUTs are used in the Emsi Burning Glass MR-SAM model to produce an industry-by-industry matrix describing all industry purchases from all industries.

BEA Gross Domestic Product by State (GSP) describes gross domestic product from the value added (also known as added income) perspective. Value added is equal to employee compensation, gross operating surplus, and taxes on production and imports, less subsidies. Each of these components is reported for each state and an aggregate group of industries. This dataset is updated once per year, with a one-year lag. The Emsi Burning Glass MR-SAM model makes use of this data as a control and pegs certain pieces of the model to values from this dataset.

BEA National Income and Product Accounts (NIPA) cover a wide variety of economic measures for the nation, including gross domestic product (GDP), sources of output, and distribution of income. This dataset is updated periodically throughout the year and can be between a month and several years old depending on the specific account. NIPA data are used in many of the Emsi Burning Glass MR-SAM processes as both controls and seeds.

BEA Local Area Income (LPI) encapsulates multiple tables with geographies down to the county level. The following two tables are specifically used: CA05 (Personal income and earnings by industry) and CA91 (Gross flow of earnings). CA91 is used when creating the commuting submodel and CA05 is used in several processes to help with place-of-work and place-of-residence differences, as well as to calculate personal income, transfers, dividends, interest, and rent.

Bureau of Labor Statistics Consumer Expenditure Survey (CEX) reports on the buying habits of consumers along with some information as to their income, consumer unit, and demographics. Emsi Burning Glass utilizes this data heavily in the creation of the national demographic by income type consumption on industries.

Census of Government's (CoG) state and local government finance dataset is used specifically to aid breaking out state and local data that is reported in the MUTs. This allows Emsi Burning Glass to have unique production functions for each of its state and local government sectors.

Census' OnTheMap (OTM) is a collection of three datasets for the census block level for multiple years. **Origin-Destination (OD)** offers job totals associated with both home census blocks and a work census block. **Residence Area Characteristics (RAC)** offers jobs totaled by home census block. **Workplace Area Characteristics (WAC)** offers jobs totaled by work census block. All three of these are used in the commuting submodel to gain better estimates of earnings by industry that may be counted as commuting. This dataset has holes for specific years and regions. These holes are filled with Census' Journey-to-Work described later.

Census' Current Population Survey (CPS) is used as the basis for the demographic breakout data of the MR-SAM model. This set is used to estimate the ratios of demographic cohorts and their income for the three different income categories (i.e., wages, property income, and transfers).

Census' Journey-to-Work (JtW) is part of the 2000 Census and describes the amount of commuting jobs between counties. This set is used to fill in the areas where OTM does not have data.

Census' American Community Survey (ACS) Public Use Microdata Sample (PUMS) is the replacement for Census' long form and is used by Emsi Burning Glass to fill the holes in the CPS data.

Oak Ridge National Lab (ORNL) County-to-County Distance Matrix (Skim Tree) contains a matrix of distances and network impedances between each county via various modes of transportation such as highway, railroad, water, and combined highway-rail. Also included in this set are minimum impedances utilizing the best combination of paths. The ORNL distance matrix is used in Emsi Burning Glass's gravitational flows model that estimates the amount of trade between counties in the country.

Overview of the MR-SAM model

Emsi Burning Glass's MR-SAM modeling system is a comparative static model in the same general class as RIMS II (Bureau of Economic Analysis) and IMPLAN (Minnesota Implan Group). The MR-SAM model is thus not an econometric model, the primary example of which is PolicyInsight by REMI. It relies on a matrix representation of industry-to-industry purchasing patterns originally based on national data which are regionalized with the use of local data and mathematical manipulation (i.e., non-survey methods). Models of this type estimate the ripple effects of changes in jobs, earnings, or sales in one or more industries upon other industries in a region.

The Emsi Burning Glass MR-SAM model shows final equilibrium impacts—that is, the user enters a change that perturbs the economy and the model shows the changes required to establish a new equilibrium. As such, it is not a dynamic model that shows year-by-year changes over time (as REMI's does).

NATIONAL SAM

Following standard practice, the SAM model appears as a square matrix, with each row sum exactly equaling the corresponding column sum. Reflecting its kinship with the standard Leontief input-output framework, individual SAM elements show accounting flows between row and column sectors during a chosen base year. Read across rows, SAM entries show the flow of funds into column accounts (also known as receipts or the appropriation of funds by those column accounts). Read down columns, SAM entries show the flow of funds into row accounts (also known as expenditures or the dispersal of funds to those row accounts).

The SAM may be broken into three different aggregation layers: broad accounts, sub-accounts, and detailed accounts. The broad layer is the most aggregate and will be covered first. Broad accounts cover between one and four sub-accounts, which in turn cover many detailed accounts. This appendix will not discuss detailed accounts directly because of their number. For example, in the industry broad account, there are two sub-accounts and over 1,000 detailed accounts.

MULTI-REGIONAL ASPECT OF THE MR-SAM

Multi-regional (MR) describes a non-survey model that has the ability to analyze the transactions and ripple effects (i.e., multipliers) of not just a single region, but multiple regions interacting with each other. Regions in this case are made up of a collection of counties.

Emsi Burning Glass's multi-regional model is built off of gravitational flows, assuming that the larger a county's economy, the more influence it will have on the surrounding counties' purchases and sales. The equation behind this model is essentially the same that Isaac Newton used to calculate the gravitational pull between planets and stars. In Newton's equation, the masses of both objects are multiplied, then divided by the distance separating them and multiplied by a constant. In Emsi Burning Glass's model, the masses are replaced with the supply of a sector for one county and the demand for that same sector from another county. The distance is replaced with an impedance value that takes into account the distance, type of roads, rail lines, and other modes of transportation. Once this is calculated for every county-to-county pair, a set of mathematical operations is performed to make sure all counties absorb the correct amount of supply from every county and the correct amount of demand from every county. These operations produce more than 200 million data points.

Components of the Emsi Burning Glass MR-SAM model

The Emsi Burning Glass MR-SAM is built from a number of different components that are gathered together to display information whenever a user selects a region. What follows is a description of each of these components and how each is created. Emsi Burning Glass's internally created data are used to a great extent throughout the processes described below, but its creation is not described in this appendix.

COUNTY EARNINGS DISTRIBUTION MATRIX

The county earnings distribution matrices describe the earnings spent by every industry on every occupation for a year—i.e., earnings by occupation. The matrices are built utilizing Emsi Burning Glass's industry earnings, occupational average earnings, and staffing patterns.

Each matrix starts with a region's staffing pattern matrix which is multiplied by the industry jobs vector. This produces the number of occupational jobs in each industry for the region. Next, the occupational average hourly earnings per job are multiplied by 2,080 hours, which converts the average hourly earnings into a yearly estimate. Then the matrix of occupational jobs is multiplied by the occupational annual earnings per job, converting it into earnings values. Last, all earnings are adjusted to match the known industry totals. This is a fairly simple process, but one that is very important. These matrices describe the place-of-work earnings used by the MR-SAM.

COMMUTING MODEL

The commuting sub-model is an integral part of Emsi Burning Glass's MR-SAM model. It allows the regional and multi-regional models to know what amount of the earnings can be attributed to place-of-residence vs. place-of-work. The commuting data describe the flow of earnings from any county to any other county (including within the counties themselves). For this situation, the commuted earnings are not just a single value describing total earnings flows over a complete year but are broken out by occupation and demographic. Breaking out the earnings allows for analysis of place-of-residence and place-of-work earnings. These data are created using Bureau of Labor Statistics' OnTheMap dataset, Census' Journey-to-Work, BEA's LPI CA91 and CA05 tables, and some of Emsi Burning Glass's data. The process incorporates the cleanup and disaggregation of the OnTheMap data, the estimation of a closed system of county inflows and outflows of earnings, and the creation of finalized commuting data.

NATIONAL SAM

The national SAM as described above is made up of several different components. Many of the elements discussed are filled in with values from the national Z matrix—or industry-to-industry transaction matrix. This matrix is built from BEA data that describe which industries make and use what commodities at the national level. These data are manipulated with some industry standard equations to produce the national Z matrix. The data in the Z matrix act as the basis for the majority of the data in the national SAM. The rest of the values are filled in with data from the county earnings distribution matrices, the commuting data, and the BEA's National Income and Product Accounts.

One of the major issues that affect any SAM project is the combination of data from multiple sources that may not be consistent with one another. Matrix balancing is the broad name for the techniques used to correct this problem. Emsi Burning Glass uses a modification of the "diagonal similarity scaling" algorithm to balance the national SAM.

GRAVITATIONAL FLOWS MODEL

The most important piece of the Emsi Burning Glass MR-SAM model is the gravitational flows model that produces county-by-county regional purchasing coefficients (RPCs). RPCs estimate how much an industry purchases from other industries inside and outside of the defined region. This information is critical for calculating all IO models.

Gravity modeling starts with the creation of an impedance matrix that values the difficulty of moving a product from county to county. For each sector, an impedance matrix is created based on a set of distance impedance methods for that sector. A distance impedance method is one of the measurements reported in the Oak Ridge National Laboratory's County-to-County Distance Matrix. In this matrix, every county-to-county relationship is accounted for in six measures: great-circle distance, highway impedance, rail miles, rail impedance, water impedance, and highway-rail-highway impedance. Next, using the impedance information, the trade flows for each industry in every county are solved for. The result is an estimate of multi-regional flows from every county to every county. These flows are divided by each respective county's demand to produce multi-regional RPCs.

APPENDIX 5: THE MINCER FUNCTION

At an associate degree student's working midpoint, they can expect to earn $14,500 more than what they would have earned if they only had a high school diploma. This 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.[21] While some have criticized Mincer's earnings function, it is still upheld in recent data and has served as the foundation for a variety of research pertaining to labor economics. Those critical of the Mincer function point to several unobserved factors such as ability, socioeconomic status, and family background that also help explain higher earnings. Failure to account for these factors results in what is known as an "ability bias." Research by Card (1999 and 2001) suggests that the benefits estimated using Mincer's function are biased upwards by 10% or less. As such, we reduce the estimated benefits by 10%. We use state-specific and education level-specific Mincer coefficients.

Figure A5.1: LIFECYCLE CHANGE IN EARNINGS

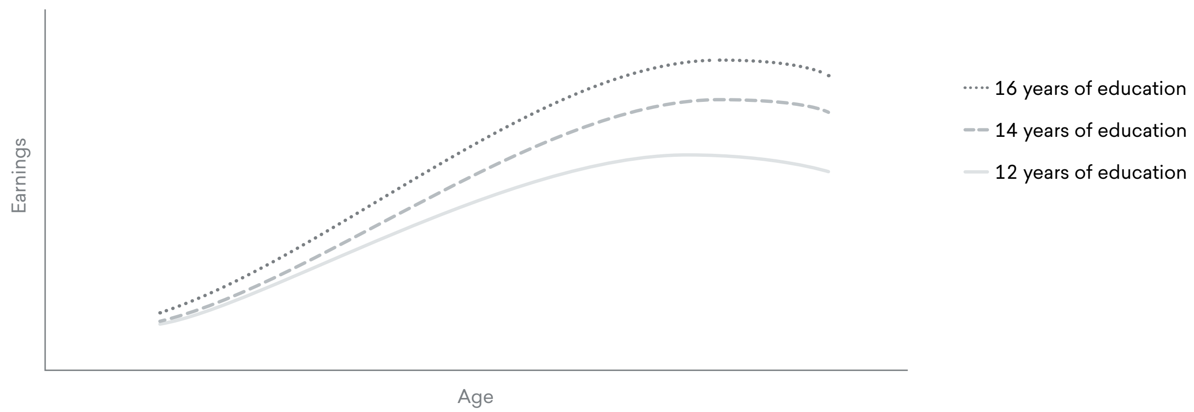

Figure A5.1 illustrates several important points about the Mincer function. First, as demonstrated by the shape of the curves, an individual's earnings initially increase at an increasing rate, then increase at a decreasing rate, reach a maximum somewhere well after the midpoint of the working career, and then decline

21 See Mincer (1958 and 1974).

in later years. Second, individuals with higher levels of education reach their maximum earnings at an older age compared to individuals with lower levels of education (recall that age serves as a proxy for years of experience). And third, the benefits of education, as measured by the difference in earnings between education levels, increase with age.

In Chapter 2 we apply the Mincer function to project the benefits stream into the future. The incremental earnings are 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 A5.1.

APPENDIX 6: OVERVIEW OF INVESTMENT ANALYSIS MEASURES

The appendix provides context to the investment analysis results using the simple hypothetical example summarized in Table A6.1 below. The table shows the projected benefits and costs for a single student over time and associated investment analysis results.[22]

Table A6.1: EXAMPLE OF THE BENEFITS AND COSTS OF EDUCATION FOR A SINGLE STUDENT

1	2	3	4	5	6
Year	**Tuition**	**Opportunity cost**	**Total cost**	**Higher earnings**	**Net cash flow**
1	$1,500	$20,000	$21,500	$0	-$21,500
2	$0	$0	$0	$5,000	$5,000
3	$0	$0	$0	$5,000	$5,000
4	$0	$0	$0	$5,000	$5,000
5	$0	$0	$0	$5,000	$5,000
6	$0	$0	$0	$5,000	$5,000
7	$0	$0	$0	$5,000	$5,000
8	$0	$0	$0	$5,000	$5,000
9	$0	$0	$0	$5,000	$5,000
10	$0	$0	$0	$5,000	$5,000
Net present value			**$21,500**	**$35,753**	**$14,253**

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

Assumptions are as follows:

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

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

- 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 A6.1.

Net present value

The student in Table A6.1 can choose either to attend college or to forego post-secondary education and maintain his present employment. If he decides to enroll, certain economic implications unfold. Tuition and fees must be paid, and earnings will cease for one year. In exchange, the student calculates that with post-secondary education, his earnings will increase by at least the $5,000 per year, as indicated in the table.

The question is simple: Will the prospective student be economically better off by choosing to enroll? If he adds up higher earnings of $5,000 per year for the remaining nine years in Table A6.1, the total will be $45,000. Compared to a total investment of $21,500, this appears to be a very solid investment. The reality, however, is different. Benefits are far lower than $45,000 because future money is worth less than present money. Costs (tuition plus earnings foregone) are felt immediately because they are incurred today, in the present. Benefits, on the other hand, occur in the future. They are not yet available. All future benefits must be discounted by the going rate of interest (referred to as the discount rate) to be able to express them in present value terms.[23]

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.

23 Technically, the interest rate is applied to compounding—the process of looking at deposits today and determining how much they will be worth in the future. The same interest rate is called a discount rate when the process is reversed—determining the present value of future earnings.

The goal is to express all future higher earnings in present value terms so that they can be compared to investments incurred today (in this example, tuition plus earnings foregone). As indicated in Table A6.1 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 A6.1. 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 A6.1. 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.

Benefit-cost ratio

The benefit-cost ratio is simply the present value of benefits divided by present value of costs, or $35,753 ÷ $21,500 = 1.7 (based on the 4% discount rate). Of course, any change in the discount rate would also change the benefit-cost ratio. Applying the 18.0% internal rate of return discussed above would reduce the benefit-cost ratio to 1.0, the breakeven solution where benefits just equal costs. Applying a discount rate higher than the 18.0% would reduce the ratio to lower than 1.0, and the investment would not be feasible. The 1.7 ratio means that a dollar invested today will return a cumulative $1.70 over the ten-year time period.

Payback period

This is the length of time from the beginning of the investment (consisting of tuition and earnings foregone) until higher future earnings give a return on the investment made. For the student in Table A6.1, it will take roughly 4.2 years of $5,000 worth of higher earnings to recapture his investment of $1,500 in tuition and the $20,000 in earnings foregone while attending the 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.