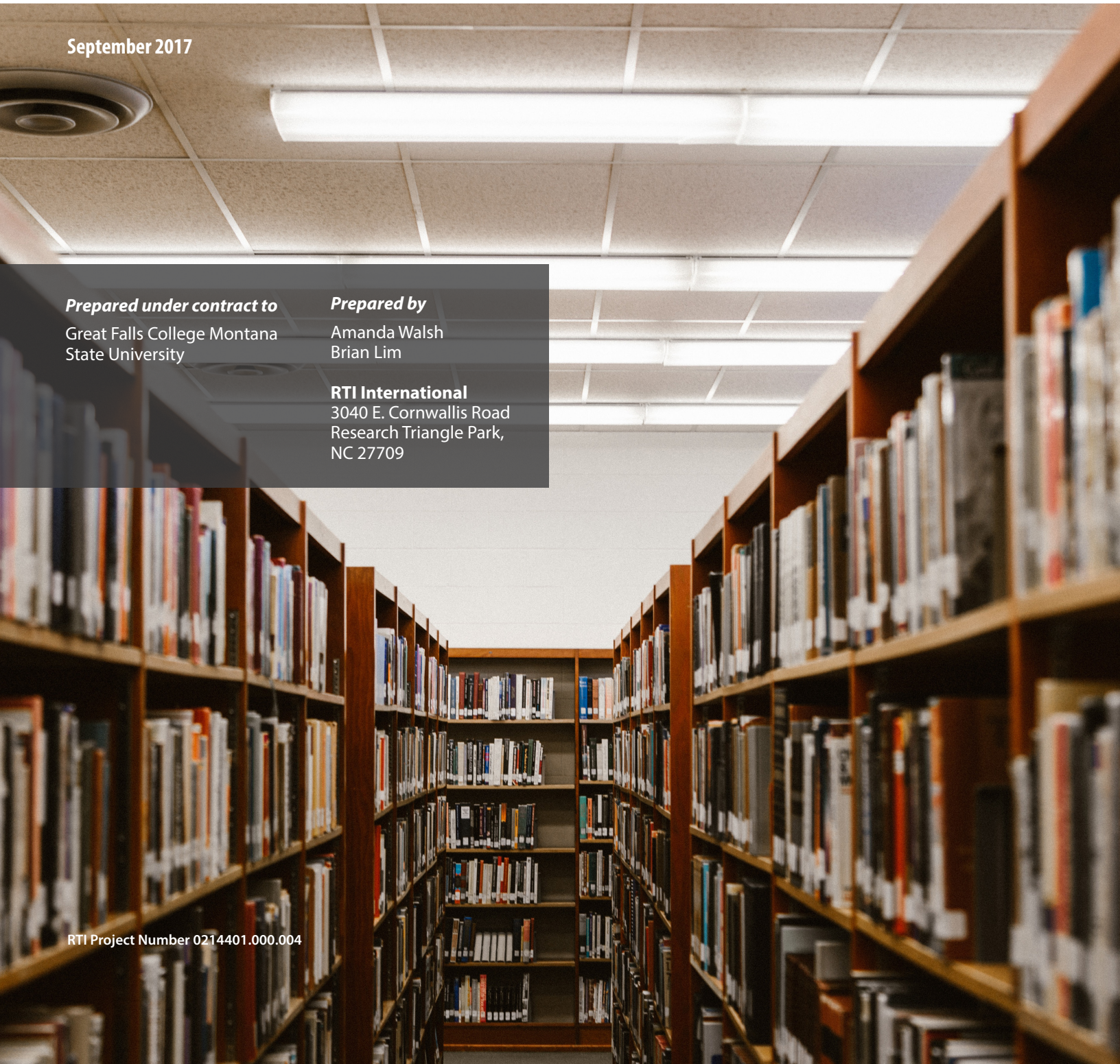
The Return on Investment in 2-Year College Credentials



September 2017

Prepared under contract to

Great Falls College Montana State University

Prepared by

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RTI Project Number 0214401.000.004

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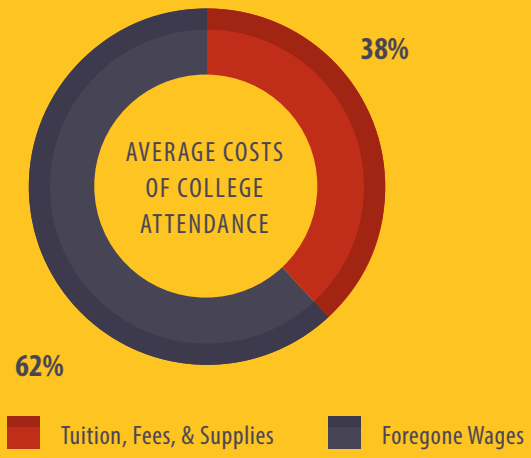
Executive Summary

This report examines the returns to public 2-year college education for students across six colleges in the state of Montana. The report accounts for the differential benefits and costs – including foregone wages – associated with varying certificate levels. For each type of 2-year college credential, we calculated the payback period, or how many years it takes to recover student investment. We also calculated the average return in the first 10 years after graduating to determine how the costs of educational attain¬ment compare to the benefits associated with each credential level. These measures provide performance indicators for students choosing to invest in 2-year college credentials.



Costs of 2-Year College Attendance

The total costs of attending college include:

1. the costs of tuition, fees, and supplies that are paid directly, and
2. foregone wages, or the money you could have made by working fulltime instead.

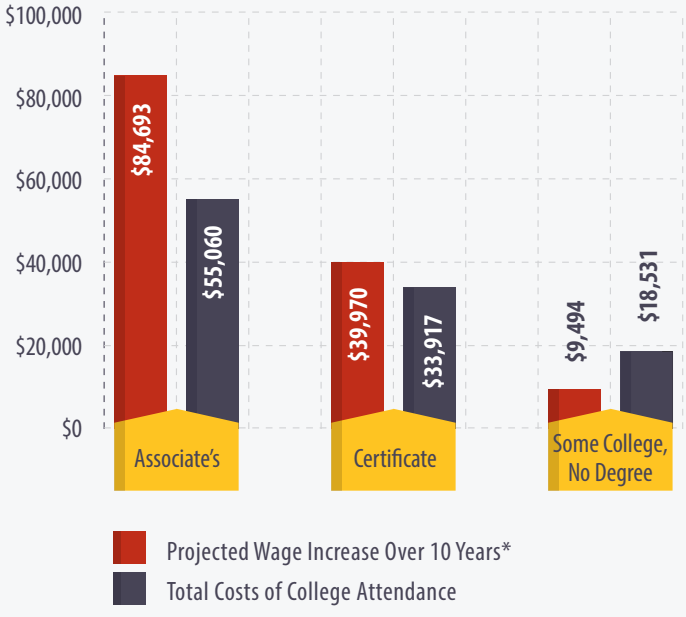
Foregone wages make up 62% of the costs of attending 2-year college in Montana. It is important to make sure that attending college is worth the costs of tuition, fees, and supplies as well as the time that it takes away from working full-time.

Returns to 2-Year College Attendance

We found strong, positive returns to attending a 2-year college in Montana. Those completing 2-year college credentials have projected wage increases over the first 10 years after graduation that are higher than the total costs associated with attending college. Despite having the highest average cost of completion, associate's degrees provide the strongest returns, with a yearly wage increase of approximately $7,600.[1] While the average cost of obtaining a certificate are lower, the returns from that credential are lower as well, with an average yearly wage increase of approximately $3,600.[2]

Attending some college, but not completing a degree is associated with the lowest returns. The costs of attending college are more than twice as high as the wage increases over the first 10 years for students who attend without completing a degree. The average yearly wage increase is approximately $1,200.[3]

COSTS AND BENEFITS OF 2-YEAR COLLEGE CREDENTIALS



*Projected wages increases are in comparison to each person's wages before attending college or to the average wages in Montana for those with a high school diploma or GED, whichever amount is higher.

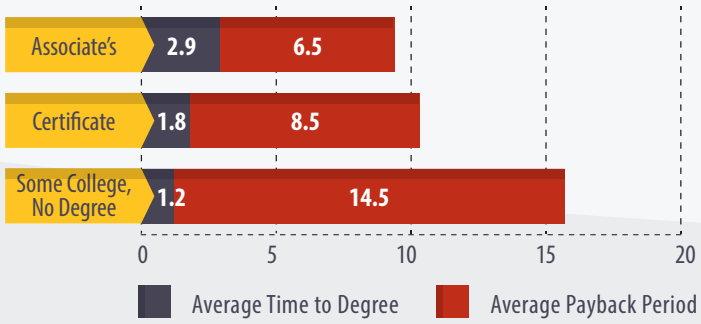
[1] 95% Confidence Interval: [$5,934.54 – $9,404.99]
[2] 95% Confidence Interval: [$1,539.86 – $5,801.3]
[3] 95% Confidence Interval: [$650.13 - $1,690.91]

Average Time-to-Degree and Payback Period

Higher-level credentials take longer to earn but are also associated with shorter payback periods once they are complete. Earning an associate's degree takes an average of about 3 years but has a relatively short payback period of 6.5 years[4]. Earning a certificate only takes about 2 years on average, but has a slightly longer payback period of 8.5 years[5]. Students who attend some college but earn no credential are typically enrolled for a little over 1 year and the average payback period for this educational time is 14.5 years[6].

[4] 95% Confidence Interval: [5.5 – 8.5]
[5] 95% Confidence Interval: [5.5 - 20.5]
[6] 95% Confidence Interval: [9.5 – 28.5]

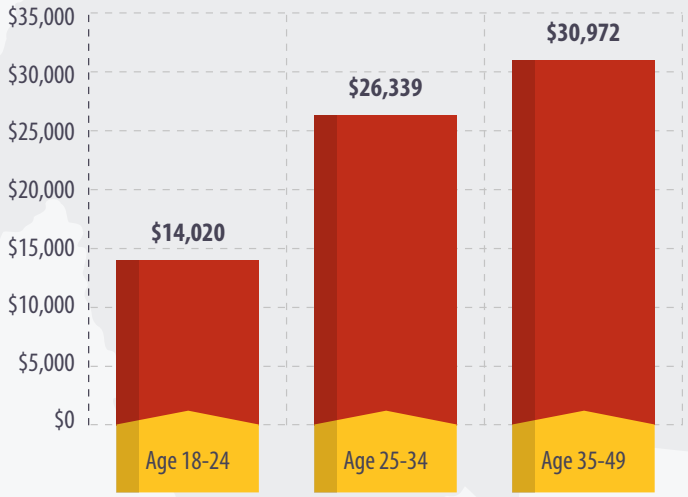
AVERAGE TIME-TO-DEGREE AND PAYBACK PERIOD OF 2-YEAR COLLEGE CREDENTIALS (YEARS)



Returns by Age Group

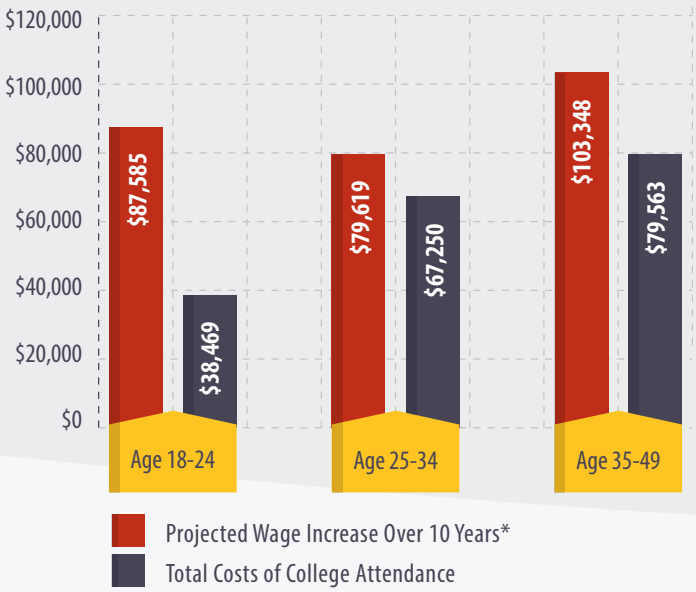
On average, students in all age groups experience positive returns to earning an associate's degree. However, the returns are highest for younger students. Older, more experienced workers generally earn higher wages than their younger counterparts, and so give up more in foregone wages when attending college. To realize the highest returns, students should attend college early, while their foregone wages are lowest.

AVERAGE YEARLY WAGES IN MONTANA WITH HIGH SCHOOL DIPLOMA OR GED BY AGE*



* Calculations based on the U.S. Census Bureau, 2010-2014 American Community Survey 5-Year Estimates and the U.S. Census Bureau, Current Population Survey, 2016 Annual Social and Economic Supplement.

COSTS AND BENEFITS OF EARNING AN ASSOCIATE'S DEGREE BY AGE GROUP



* Projected wages increases are in comparison to each person's wages before attending college or to the average wages in Montana for those with a high school diploma or GED, whichever amount is higher.

Methods

We assessed quarterly wage data from the Montana Department of Labor and Industry for students who attended college between 2003 and 2010. The data cover student wages 2 years before beginning enrollment to 5 years after ending enrollment. The data also include student-level education data like credential obtained, terms enrolled, grade point average (GPA), and personal demographics. We supplemented student-level education data with annual tuition and supplies costs reports from each college.

We estimated the change in each student's earnings after attending college to calculate the benefits associated with varying credential levels. The payback period is the amount of time it takes for a student's increase in wages after college to cover the costs associated with obtaining that college education. A shorter payback period is better. See the full report for more details on how the returns to 2-year college education were calculated.

Introduction

The body of research examining the return on investment for obtaining 2-year college credentials is relatively limited, especially for the State of Montana. Most existing studies focus on the benefits of obtaining credentials, in the form of increased earnings, without comparing those benefits to their associated costs. It is important to account not only for the explicit costs of educational attainment, like tuition and fees, but also the implicit costs of foregone wages to accurately reflect the money paid to attend school as well as the money lost while attending school.

This report examines findings on the returns to public 2-year college education for students across six colleges in Montana, while accounting for the differential benefits and costs—including foregone wages—associated with varying certificate levels. We assessed quarterly wage data from the Montana Department of Labor and Industry for students who attended college between 2003 and 2010. The data cover student wages 2 years before beginning enrollment to 5 years after ending enrollment. The data also include student-level education data like credential obtained, terms enrolled, grade point average (GPA), and personal demographics. We supplemented student-level education data with annual tuition and supplies cost reports from each college.

For each type of 2-year college credential, we calculated the payback period, or how many years after college completion it will take to recover student investment. We also calculated the rate of return for each credential to determine how the costs associated with various lengths of educational attainment compare to the differential benefits associated with each credential level. These measures provide performance indicators for students choosing to invest in 2-year college credentials.

We found strong, positive returns to attending a 2-year college in Montana. Associate's degrees have the strongest returns, including a relatively short payback period after college completion of 5.5–8.5 years and a rate of return of 7.3%–18.9%. The average returns to earning a certificate are also high, with an average payback period after college completion of 8.5 years and an average rate of return of 7.2%. However, the confidence intervals around the returns to obtaining a certificate are large, indicating a potentially long payback period or a negative rate of return. This assessment could be further improved with data on each student's primary field of study to determine if certificates in technical fields yield higher returns.

Background

PREVIOUS LITERATURE ON THE RETURN TO 2-YEAR COLLEGE EDUCATION

A review of existing research on returns to schooling revealed several findings. First, literature on returns to education is largely limited to studies focusing on high school and 4-year college education. Second, in the studies on 2-year college, there is a large knowledge gap regarding returns to 2-year college by the type of credential or degree earned. Only one study assesses the returns to a 2-year college education in Montana. Here, we review evaluations that consider the variation in returns to a 2-year college education by credential, including the study for Montana.

Dadgar and Trimble (2015) quantified the returns to earning a certificate or degree from a 2-year college in terms of increased wages, likelihood of employment, and number of work hours for 7 years following enrollment at a 2-year college. Variation in returns by field of study and type or length of certificate or degree were also evaluated. Jepsen and Troske (2014) examined the labor market returns to associate's degrees, certificates, and credits earned for 5.5 years following enrollment at a 2-year college. Both Jepsen and Troske and Dadgar and Trimble used a comparison group composed of students who earn some 2-year college credits but do not earn a credential. Both studies found that a 2-year college education corresponds to an increase in quarterly wages and that the level of returns varies across gender and credential level. However, the results of the two studies differed in estimated returns to short-term certificates or partial education. Dadgar and Trimble found no returns for short-term certificates, whereas Jepsen and Troske found small returns for attending some college without getting a degree.

Dadgar and Trimble found that the average wage growth for earning an associate's degree was 6.3% for women and 2% for men. The average wage growth for earning a long-term certificate was 15% for women, with no significant results for men. Neither men nor women saw significant returns for earning a short-term certificate. Jepsen and Troske found that returns for earning an associate's degree relative to <1 year of college were $5,513 for men and $6,624 for women. The returns for attending ≥1 year of college without earning a degree were $1,137 for women, with statistically insignificant returns of $804 for men.

Belfield and Bailey (2017), under the Center for Analysis of Postsecondary Education and Employment, summarized studies from eight states examining returns for completing associate's degrees and certificates. The studies used longitudinal student transcript data and quarterly earnings to examine the relationship between completed degrees or credit hours and earnings. The data covered students in Kentucky, Michigan, North Carolina, California, Ohio, Virginia, Washington, and Arkansas. Belfield and Bailey found that completing an associate's degree results in average annual earnings increases of $4,640 for men and $7,160 for women. Completing a certificate resulted in earning increases of $2,120 for men and $2,960 for women, but increases were not consistently found across studies, and evidence shows that this increase may diminish over time. Students who attended some college but did not receive a degree did see positive earnings changes, but the difference between the effect of earning a degree versus the effect of completing an equivalent number of hours without earning a degree varied.

Only one study (Watson et al., n.d.) estimated the returns to 2-year college education in Montana, but this study underestimated the costs and overstated the benefits of education, resulting in unrealistically high returns. The study found that 83% of graduates of Missoula College found employment in Montana within 1 year of completing the program, and that 100% of graduates recovered the costs of the program within 1 year. However, this calculation was based solely on an average program cost of $11,034 and did not consider implicit costs associated with foregone wages during schooling nor any other additional costs of attendance. Moreover, the study considered the full value of wages earned rather than the additional wages earned after a degree was obtained. Thus, the estimated return to education was overstated.

We improved on the methods of the Watson et al. study by estimating the returns to 2-year college education while accounting for all costs of educational attainment, including implicit costs. We also measured educational benefits based on the increase in wages realized by students after they earn their degree rather than their total wages.

CALCULATING RETURN ON INVESTMENT

Costs and Benefits of Educational Attainment

The costs of educational attainment include all explicit costs such as tuition, room and board, and books and supplies. The costs of education also include the implicit costs associated with foregone wages during one's college attendance. A student's earnings may be less than that of an employee who does not attend school because the student cannot work as many hours as a full-time employee. In addition, the employment opportunities available to part-time employees may pay lower wages than those available to full-time employees. It is important to account for these implicit costs associated with educational attainment to accurately reflect not only the money paid to attend school, but also the money lost while attending school.

The implicit costs of attending college increase with age as wages increase with experience. Table 1 shows the average income of those with a high school diploma or GED in Montana by age group. The average annual wages of high school graduates or General Education Diploma (GED) holders who are 25–34 years of age are nearly twice as high as those 18–24 years of age. The average annual wages of those 35–49 or 50 years and older continue to increase, but by a much smaller amount. Thus, those aged 18–24 years of age generally sacrifice the least in lost earnings when attending college, given their relatively low average earnings with a high school degree or GED.

Table 1. Average Yearly Wages in Montana with High School Diploma or GED by Age

AGE RANGE	AVERAGE YEARLY WAGES IN MONTANA FOR THOSE WITH A HIGH SCHOOL DIPLOMA OR GED[1]
18-24	$14,020
25-34	$26,339
35-49	$30,972

[1] Calculations based on the U.S. Census Bureau, 2010-2014 American Community Survey 5-Year Estimates and the U.S. Census Bureau, Current Population Survey, 2016 Annual Social and Economic Supplement.

The benefits associated with educational attainment are the earnings premiums realized by individuals with varying credential levels. For example, one would expect that, on average, an individual with a 4-year college degree would earn more than one with a high school diploma. As discussed above, the earnings premium associated with varying certificate levels within the 2-year college environment has not been thoroughly assessed, and is the key outcome to be measured in this study.

We estimated the earnings premiums associated with 2-year college credentials using a variation of the Mincer Equation. The equation takes the form:

$$(1)\quad \ln(Earnings) = \ln(\text{Baseline Earnings}) + r_1\, Certificate + r_2\, \text{Associates} + \beta_1\,(Age\ 25\ to\ 34) + \beta_2\,(Age\ 35\ to\ 49) + \varepsilon$$

where *Earnings* measures a student's earnings after college enrollment and *Baseline Earnings* captures his/her earnings before completing school. Because *Earnings* are in log form, the exponentiated coefficients show the percent change in earnings based on changes in each variable. The exponentiated values of r_1 and r_2 measure the returns to schooling in the form of the percent increase in wages realized from obtaining a certificate or associate's degree rather than no degree. The exponentiated values of β_1 and β_2 measure the percent change in wages for individuals in older age groups compared to those who are 18-24 years of age, and ε is the error term.

Comparing the Benefits and Costs of Educational Attainment

Several methods are available to compare the benefits and costs associated with varying levels of educational attainment. The two measures assessed in this study are: (1) the rate of return and (2) the payback period associated with varying 2-year college credentials.

For all calculations, benefits and costs are converted to their net present value, or the value associated with all of the benefits and costs being realized at the present time. The equation for this calculation is provided below:

$$(2a)\quad NPV\ Benefits = \sum_{t=1}^{Tb} \frac{B_t}{(1+r)^t}$$

$$(2b)\quad NPV\ Costs = \sum_{t=1}^{Tc} \frac{C_t}{(1+r)^t}$$

The net present value of both benefits (B_t) and costs (C_t) are calculated using the discount rate (r) based on the time at which each benefit ($t = 1,\ldots Tb$) and cost ($t = 1,\ldots Tc$) is realized.

The rate of return to obtaining a given level of education answers the following question: If you deposited the same amount of money as your educational costs into a bank, what would the interest rate have to be to yield the same stream of benefits realized from that education? This is calculated by determining the interest rate at which the net present value of the benefits and costs are equal. A strong rate of return would be higher than the discount rate, typically estimated at 4%. Here, we estimate the rate of return over a 10-year period after graduation ($T_b = 10$, $T_c = 1$). The equation for this calculation is provided below:

$$(3)\quad \sum_{t=1}^{Tb} \frac{B_t}{(1+r)^t} = \sum_{t=1}^{Tc} \frac{C_t}{(1+r)^t}$$

The payback period provides the amount of time after college completion required for a person to fully recoup

[1] See Mincer (1974), Willis (1986), and Card (1999) for reviews.

the costs associated with obtaining their certificate/degree, given the stream of benefits—in the form of an earnings premium—resulting from obtaining that certificate/degree. A shorter payback period is more desirable. The equation for this calculation is the same as Equation 3 above, but entails solving for t rather than r, which is assumed to equal the discount rate of 4%.

Data Description

We obtained wage data from the Montana Department of Labor and Industry for students who attended any one of six 2-year colleges in Montana between 2003 and 2010. Quarterly wage data were captured for these students from 2001 (at least 2 years before beginning enrollment) to 2015 (at least 5 years after ending enrollment), including while a student is enrolled. The wage data included total quarterly earnings but not work hours.

The data included student education data like credential obtained (if any), the total number of terms enrolled, the dates of first and last enrollment, the number of college credits earned, and college GPA. The education data also included student demographics like age group, gender, and ethnicity. The education data do not include information on whether students transferred to another institution after completing their enrollment. We supplemented the student-level education data with annual tuition and supplies costs reports from each college.

The appendix provides detailed information about our sample selection process. We limited our sample to those between 18 and 49 years of age. We excluded individuals with extended gaps in their college enrollment because this complicates estimates of wage increases after enrollment. Finally, we excluded those who did not work for ≥2 years or who appeared to work less than part time for ≥3 years in the 5 years after ending enrollment. This is because we were unable to identify students who transfer to other institutions of higher education after graduating, and low work hours may be an indication of continued educational attainment.

Table 2 shows the number of students in the sample from each college earning each type of 2-year college credential. Most students in the sample (81.2%) attended college without obtaining any form of credential. Most students who earned a credential attained the associate's degree (15.2%) rather than a short-term certificate (3.6%).

Table 2. Sample Coverage by College and Credential for Montana Students Age 18 to 49

COLLEGE	CREDENTIAL ACQUIRED			FULL SAMPLE	
	NONE	CERTIFICATE	ASSOCIATE'S	TOTAL	PERCENT
City College	1,117	44.0	315	1,476	19.4
Great Falls College	2,090	65.0	153	2,308	30.3
Helena College	777	34.0	196	1,007	13.2
Highlands College	480	17.0	89	586	7.7
MSU-Northern	855	8.0	122	985	12.9
Missoula College	872	107	282	1,261	16.5
Total	**6,191**	**275**	**1,157**	**7,623**	
Percent	**81.2**	**3.6**	**15.2**		

Tuition at the university level is reported in Table 3. Average tuition from 2003 to 2010 ranges from about $2,900 to $4,100 per semester for state residents, with a mean of $3,259 per semester. Costs for nonresidents are substantially higher, with a mean of $7,983 across colleges. Tuition costs are used to calculated the costs of obtaining various 2-year college credentials.

Table 4 presents summary statistics for student gender, age group, and ethnicity by college for our sample. The ratio of males to females for the full sample (43:57) is similar to the national average. Great Falls College has the largest proportion of female students (37:63 split), while Helena College has the largest proportion of male students (52:48 split). Most students in the sample (60%) are 18-24 years of age, and 23% are 25-34 years of age and 17% are 35-49 years of age. The percentage of white students in the sample is high at each institution, ranging from about 74%-90%. MSU-Northern has the largest proportion of Native American students in the sample, at about 14%. Other colleges have about 2%-5% Native American students in the sample.

Table 3. Average Tuition per Semester at Each College from 2003 to 2010

	COLLEGE	
	RESIDENT	NONRESIDENT
City College	3.489	6,218
Great Falls	2,901	7,578
Helena College	2,912	6,986
Highlands College	2,966	6,937
MSU-Northern	4,142	12,412
Missoula College	3,145	7,765
Full Sample	3,259 (485.7)	7,983 (2,237.6)

Note: Average semester tuitions for residents and nonresidents are obtained from available university statistics.

Table 4. Percent of Students in Sample at Each College with Various Demographic Traits

STUDENT DEMOGRAPHICS	COLLEGE						FULL SAMPLE
	CITY COLLEGE	GREAT FALLS	HELENA COLLEGE	HIGHLANDS COLLEGE	MSU-NORTHERN	MISSOULA COLLEGE	
Male	45.5	37.2	52.3	48.3	43.6	42.8	43.4
Age Range							
18-24	61.4	64.4	58.9	63.0	50.5	57.7	60.1
25-34	24.3	22.1	22.3	23.0	23.7	24.3	23.2
35-49	14.3	13.5	18.8	14.0	25.9	18.0	16.7
Ethnicity							
White	86.1	87.7	82.7	89.6	74.2	85.6	84.8
Black	0.7	0.4	0.0	1.0	0.5	0.3	0.5
Hispanic	4.2	1.9	2.0	1.4	0.8	1.7	2.1
Asian, Pacific Islander, Hawaiian	0.9	1.2	0.7	0.5	0.5	1.1	0.9
Native American, Alaskan Native	4.8	4.6	2.4	2.7	13.9	3.8	5.3
Missing	3.1	4.0	11.5	4.6	9.5	7.1	6.1
Other	0.2	0.2	0.7	0.2	0.5	0.5	0.3
Observations	1,476	2,308	1,007	586	985	1,261	7,623

Note: These statistics do not necessarily represent each college's full student body. See the appendix for college demographics based on the original student sample, including all students enrolled from 2001 to 2010.

Table 5 shows descriptive statistics for key outcome and control variables by credential earned. Unsurprisingly, earning higher-level credentials takes longer. Students who earn an associate's degree are enrolled for about 6-7 terms, on average, over a span of about 3 years. Students who earn a certificate are enrolled for about 4-5 terms, on average, over about 2 years. Students who do not earn a credential are enrolled for about 2-3 terms, on average, over a little more than 1 year. Students earning higher-level credentials obviously complete more credit hours.

Students who do not earn a credential have significantly lower GPAs than students who go on to earn either a certificate or associate's degree, which may indicate that differences in ability affect a student's propensity to earn a 2-year college credential. The same differences in ability may account for some of the difference in work outcomes after school, rather than the credentials earned. We address this issue in the appendix.

The additional time that it takes to earn higher-level credentials accounts for most of the educational costs. Tuition is obviously more expensive when the student is enrolled for more terms. Because many 2-year college students enroll part time, we calculated tuition and supplies costs for each student using college reports of costs-per-credit-

Table 5. Summary Statistics of Key Variables by Credential Earned

VARIABLE	COLLEGE CREDENTIAL EARNED			FULL SAMPLE
	NONE	CERTIFICATE	ASSOCIATE'S	
Terms enrolled	2.84 $_{a}$ (2.40)	4.32 $_{b}$ (2.49)	6.68 $_{c}$ (2.42)	3.48 (2.77)
Quarters from start to end of college enrollment	4.67 $_{a}$ (4.69)	7.32 $_{b}$ (4.82)	11.63 $_{c}$ (4.72)	5.82 (5.33)
Hours earned	24.17 $_{a}$ (29.60)	47.73 $_{b}$ (22.42)	74.09 $_{c}$ (20.39)	32.60 (33.47)
College GPA	2.28 $_{a}$ (1.33)	3.26 $_{b}$ (0.48)	3.36 $_{b}$ (0.43)	2.48 (1.29)
College tuition and supplies costs[1]	6,970.50 $_{a}$ (8,380.48)	13,265.65 $_{b}$ (7,626.23)	21,403.10 $_{c}$ (9,032.93)	9,388.14 (9,935.12)
Implicit costs of college attendance[2]	11,565.12 $_{a}$ (19,589.91)	20,651.15 $_{b}$ (21,202.45)	33,657.00 $_{c}$ (31,660.61)	15,249.81 (23,313.53)
Total college costs[3]	18,530.59 $_{a}$ (24,988.71)	33,916.80 $_{b}$ (25,129.51)	55,060.10 $_{c}$ (33,690.87)	24,636.42 (29,598.82)
Average yearly wages 5 years after college	25,237.34 $_{a}$ (15,037.28)	30,520.32 $_{b}$ (13,224.19)	38,226.88 $_{c}$ (16,424.41)	27,399.45 (15,899.10)
Observations	6,19	275	1,157	7,623

Note: Standard deviations are provided in parentheses. Means with different subscripts are significantly different from each other at the 5% level ($p < .05$).

[1] Tuition and supplies costs = [(average tuition per credit hour for each college/university) + (supplies per credit hour for each college/university)] * (total hours earned for each student). Note that this excludes the implicit cost of foregone wages.

[2] Implicit costs = (average wages earned by a person with a high school degree in Montana or average wages earned by student before attending college, whichever is larger) – (average wages earned by student while attending college).

[3] Total costs = (tuition and supplies costs) + (implicit costs).

hour enrolled. We then calculated the average credit hours per term that each student completes based on their total credit hours earned and total terms enrolled to determine their average level of enrollment. We excluded room and board from our cost estimates because (1) many students likely commute from home, and (2) we assumed that living expenses need to be paid regardless of college attendance.

The implicit costs of completing a higher-level credential are also significantly higher for students who earn higher-level credentials. This is important because we find that implicit costs account for more than 60% of total education costs. We determined the amount of earnings that students give up to attend college based on the average yearly wages that students report earning in the 2 years before enrolling in college. Because many students are 18-24 years of age, many of them likely enroll in college shortly after attending high school and before establishing substantial yearly earnings. Thus, we also considered the average earnings of people in Montana with a high school diploma or GED by age (see Table 1) if that amount is higher than a student's reported earnings. We compared this amount to what a student reports earning while in college. Box 1 describes how implicit costs were calculated in greater detail.

Our key outcome measure was the average yearly wages that students earn in the 5 years after ending enrollment. While the sample means indicate significant differences in this measure by credential earned, it is important to also account for student demographics and academic performance to determine the isolated impact of the credential earned. We estimated earnings after college using Equation 1 above, with results reported below.

Box 1: Calculating Implicit Costs

Implicit costs equal the difference between

1. the potential wages that a student could likely earn during the time in which they were enrolled in college, and
2. the actual wages that a student did earn during the time in which they were enrolled in college.

Implicit Cost = Potential Wages While in College – Actual Wages While in College

Potential wages were calculated based on the average yearly wages that students reported earning in the two years before they began their college enrollment. We assumed that students' minimum potential earnings equaled the average yearly wages of those in Montana with a high school diploma or GED (see Table 1). We used students' actual reported earnings if they were higher than this amount.

Examples:

- **STUDENT A** is 18-24 years old and earned $10,500 per year on average in the two years before he began his college enrollment. He earned $8,000 per year on average while in college. He was enrolled in college for 2 years.
  - Because his average earnings before college were lower than the average wages of those who are 18-24 years old in Montana with a high school diploma or GED, we assumed that his potential earnings while in college were the average of $14,020 per year enrolled (see Table 1).
  - His actual earnings were $8,000 per year enrolled.

Student A Implicit Costs = ($14,020 - $8,000) x 2 years enrolled = $12,040

- **STUDENT B** is 25-34 years old and earned $35,000 per year on average in the two years before she began her college enrollment. She earned $15,000 per year on average while in college. She was enrolled in college for 3 years.
  - Because her average earnings before college were higher than the average wages of those who are 25-34 years old in Montana with a high school diploma or GED, we assumed that her potential earnings while in college were her reported earnings of $35,000 per year enrolled (see Table 1).
  - Her actual earnings were $15,000 per year enrolled.

Student B Implicit Costs = ($35,000 - $15,000) x 3 years enrolled = $60,000

Results

INCREASES IN EARNINGS AFTER 2-YEAR COLLEGE EDUCATION

Table 6 shows the regression results for the log of average yearly earnings in the 5 years after college enrollment. Because the dependent variable is in log form, the exponentiated coefficients can be interpreted as percent changes in earnings based on each variable. The regressions include controls for the college attended, the year of each student's last term enrolled, and the log earnings of students while in school. The results for these controls are reported in the appendix.

The results indicate that men earn 16.3% more per year than women. White people earn 3.9% more than their non-white counterparts. Regardless of credential earned, older

Table 6. Regression Results for Average Wages 5 Years after College Enrollment

INDEPENDENT VARIABLE	DEPENDENT VARIABLE: LOG AVERAGE YEARLY WAGE 5 YEARS AFTER COLLEGE			
	FULL SAMPLE	AGE 18-24	AGE 25-34	AGE 35-49
Credential Earned				
None (Omitted)	—	—	—	—
Certificate	0.092** (3.22)	0.208*** (5.42)	0.028 (0.50)	-0.063 (-0.99)
Associate's	0.228*** (13.03)	0.261*** (11.33)	0.205*** (6.20)	0.189*** (4.43)
Age Range				
18-24 (Omitted)	—	—	—	—
25-34	0.138*** (10.64)	—	—	—
35-49	0.289*** (19.34)	—	—	—
College GPA	0.072*** (15.28)	0.032*** (5.35)	0.111*** (10.69)	0.102*** (8.66)
Credit hours earned	0.002*** (9.71)	0.004*** (14.95)	0.001 (1.57)	0.000 (0.05)
Gender-Male	0.151*** (14.20)	0.149*** (11.65)	0.129*** (5.66)	0.160*** (5.49)
Race-White	0.038** (2.62)	0.024 (1.20)	0.091** (3.20)	0.032 (0.95)
Observations	7,623	4,579	1,768	1,276
Adjusted R^2	0.310	0.302	0.233	0.256

Note: t-statistics in parentheses: * p <0.05 ** p <0.01 *** p <0.001. Additional controls included for college attended, year of last term enrolled, and log average wages while in school.

students earn more than younger ones. Students 25-34 years of age earn 14.8% more than those 18-24 years, and those 35-49 years of age earn 33.5% more. This likely reflects the longer work experience of older individuals.

Incremental college completion is significantly correlated to higher earnings after college. Each 12 college credit hours completed (one term of full-time enrollment) is associated with 2.4% higher earnings regardless of credential earned. Also, each additional point in a student's GPA is associated with 7.5% higher earnings after college. This could indicate either that higher ability is associated with higher earnings or that the labor market values higher college GPAs.

Earning a 2-year college credential is correlated with substantially higher earnings after college. Students who complete a short-term certificate earn 9.6% more than those who do not earn a credential. Students who complete an associate's degree earn 25.6% more than those who do not earn a credential. Below, we compare these increased wages to the costs of attendance.

The benefits to college education are lower for older students. Separate regressions for each age group indicate that older individuals do not gain significant increases in income when obtaining a certificate versus obtaining no degree. Similarly, older individuals see no significant increase in earnings based on incremental college attainment as indicated by completing additional credit hours. Although the increase in wages from earning an associate's degree is lower for older individuals, it is still high and statistically significant. Those 18-24 years of age who obtain an associate's degree earn 29.8% more than those obtaining no degree. The increase in wages is 22.8% for those 25-34 years and 20.8% for those 35-49 years of age.

Differences in the benefits from obtaining 2-year college credentials among older individuals are important because, as reported in Table 1, the baseline earnings of older individuals are higher, increasing their implicit costs of college attendance. The benefits and costs of college attendance for individuals in each age group are compared in greater detail in the appendix.

RETURN ON INVESTMENT FOR 2-YEAR COLLEGE EDUCATION

Understanding the benefits of college enrollment is important, but it does not provide students with complete information on the returns to college enrollment. For students to properly assess the returns to obtaining varying levels of 2-year college credentials, these benefits must be compared to the costs of attendance. Table 7 summarizes our calculations of the returns to college enrollment based on the credential obtained.

Baseline wages are based on students' earnings while attending college or on the average earnings of a person in Montana with a high school diploma or GED, whichever amount is higher. Baseline wages are compared with the average wage of students in the first 5 years after college. The average wage after college for students who obtain no credential is taken from the sample mean reported in Table 5. This amount is multiplied by the exponentiated coefficients for earning a certificate or associate's degree reported in Table 6 to calculate the earnings of those obtaining each credential. These calculated earnings isolate the impact of earning a credential from other confounding factors like student age, gender, ethnicity, and academic performance.

Wages are projected to increase over time using coefficients for the Mincer Equation provided by Willis (1986). Figure 1 shows the projected earnings over 10 years by 2-year college education. The increase in earnings after college compared to baseline earnings provides the annual benefit associated with college attendance. The rate of return and payback period are calculated using Equation 3 as described above.

We find that, on average, those obtaining an associate's degree receive the highest returns. Associate's degrees are the only credential consistently associated with strong, positive returns across the 95% confidence interval. The costs of college attendance are recouped in about 6.5 years for those earning an associate's degree, with a confidence interval of 5.5-8.5 years. For those earning a certificate, costs are recouped in about 8.5 years on average, with a broad confidence interval of 5.5-20.5 years.

Table 7. Calculated Rate of Return and Payback Period on 2-Year College Credentials

	CREDENTIAL EARNED		
	NONE	CERTIFICATE	ASSOCIATE'S
Baseline wages[1]	24,066.82 [23,921.01–24,212.63]	24,066.82 [23,921.01–24,212.63]	24,066.82 [23,921.01–24,212.63]
Average wage after college[2]	25,237.34 [24,862.76–25,611.92]	27,669.33 [25,752.48–29,722.31]	31,700.25 [30,147.17–33,326]
Difference[3]	1,170.52 [650.13–1,690.91]	3,602.51 [1,539.86–5,801.3]	7,633.43 [5,934.54–9,404.99]
Total college costs[4]	18,530.59 [17,969.62–19,091.56]	33,916.80 [33,352.67–34,480.93]	55,060.10 [54,303.78–55,816.42]
Rate of return (over 10 years)[5]	— [-11.05%–4.81%]	7.16% [-7.41%–19.04%]	12.83% [7.32%–18.92%]
Payback period (years)[6]	14.5 [9.5–28.5]	8.5 [5.5–20.5]	6.5 [5.5–8.5]

Note: 95% confidence intervals are provided in brackets. For the rate of return and payback period, confidence intervals are determined by combining minimum benefits with maximum costs and vice versa.

[1] Baseline wages are a student's earnings while attending college or the average earnings of a person in Montana with a high school diploma or GED, whichever amount is higher.

[2] The average wage after college for students who obtain no credential is taken from the sample mean reported in Table 5. This amount is multiplied by the exponentiated coefficients for earning a certificate or associate's degree reported in Table 6 to calculate the earnings of those obtaining each credential.

[3] The difference in earnings is the difference between the average earnings after college and baseline wages.

[4] Total college costs are taken from the sample means for each credential level reported in Table 5.

[5] The rate of return is calculated by finding the rate of return that equates the costs of college attendance with projected earnings over 10 years using Equation 3 and as shown in Figure 1.

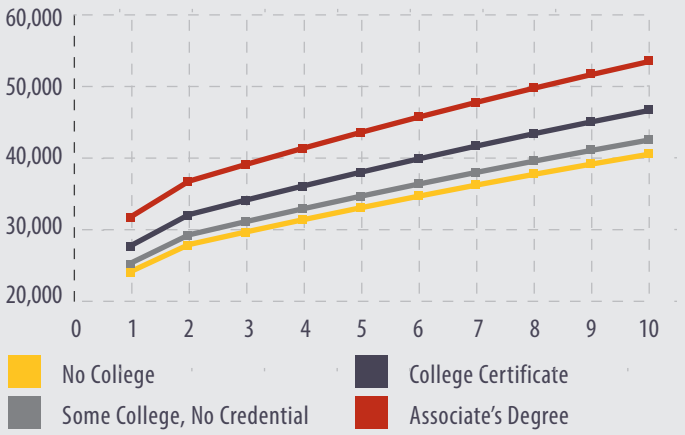
[6] The payback period is calculated by determining the amount of time that it takes to recoup the costs of college attendance based on projected earnings discounted at a rate of 4% as in Equation 3.

Costs are recouped in about 14.5 years for students who do not earn a credential, again with a broad confidence interval of 9.5-28.5 years.

It should be noted that these payback periods are calculated from the end of college enrollment. Although associate's degrees have shorter payback periods than certificates, they also take longer to complete (see Table 5). The average time until students earn positive returns on their education is about 9.4 years for those earning associate's degrees and about 10.3 years for those earning a certificate. Figure 2 shows the average time-to-positive-returns for each type of credential earned, accounting for both the payback period and time-to-degree of each credential.

Over the course of 10 years, we find that there is a higher rate of return to obtaining higher-level credentials. Those earning an associate's degree receive an average rate of return of 12.8% with an estimated confidence interval of 7.3%-18.9%. This entire range lies well above the discount rate of 4%, displaying consistently strong returns. The average rate of return associated with earning a certificate is 7.2%, but the confidence interval includes potentially

Figure 1. Projected Earnings over 10 Years by 2-Year College Education

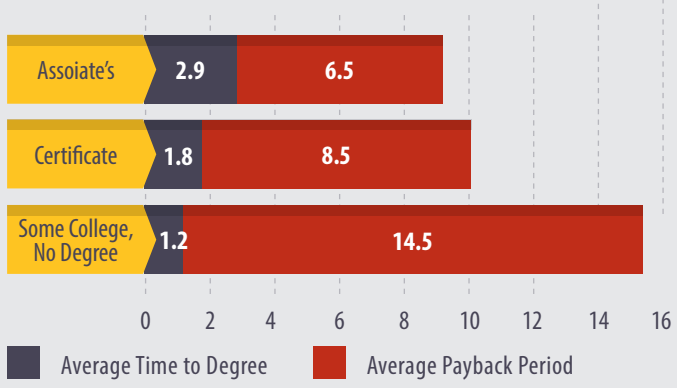


Note: Earnings projections are calculated using the initial wages provided in Table 7 and the Mincer Equation coefficients for experience reported in Willis (1986).

negative returns, with a maximum average estimate of 19.0%. The average return to attending a 2-year college without earning a credential is negative, with a maximum estimated average return of 4.8%.

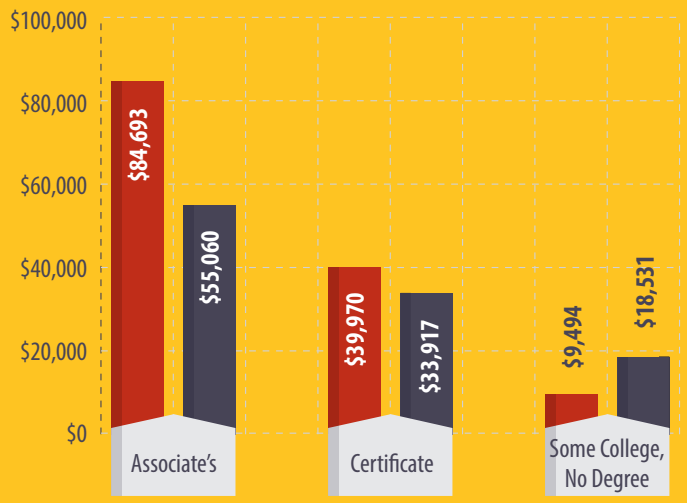
In addition to calculating the rate of return for various 2-year college credentials, it is possible to estimate the total increased wages that a student can expect to earn in the first 10 years after college enrollment. These results are presented in Box 2.

Figure 2. Average Time-to-Degree and Payback Period of 2-Year College Credentials (Years)



Note: Average time-to-degree was calculated from the average number of quarters from the start to the end of college enrollment as reported in Table 5. Average payback period was taken from the means reported in Table 7.

Box 2: Costs and Benefits of 2-Year College Attendance



*Projected wages increases are in comparison to each person's wages before attending college or to the average wages in Montana for those with a high school diploma or GED, whichever amount is higher.

Those completing 2-year college credentials have projected wage increases over the first 10 years after graduation that are higher than the total costs associated with attending college. Despite having the highest average cost of completion, associate's degrees provide the strongest returns. The projected benefits over the first 10 years after earning an associate's degree are $29,633 higher than the average costs of earning that degree. While the average cost of obtaining a certificate is lower, the returns from that credential are lower as well. The projected benefits over the first 10 years after earning a certificate are $6,053 higher than the average costs of earning that credential. Attending some college, but not completing a degree is associated with the lowest returns. The wage increases over the first 10 years are only about half of the costs for those who attend without completing a degree.

Discussion

We found substantial returns to attending a 2-year college in Montana. Benefits, in the form of increased earnings, are higher for students obtaining higher-level college credentials. Associate's degrees are associated with strong returns in the form of a relatively short payback period after college completion of 5.5-8.5 years and a rate of return of 7.3%-18.9%, which is well above the discount rate of 4%. The average returns to earning a certificate are strong, with an average payback period after college completion of 8.5 years and an average rate of return of 7.2%. However, the confidence intervals around these returns are large, indicating potentially long payback periods or a negative rate of return.

In addition, the associate's degree is the only credential that is consistently associated with large, statistically significant increases in wages among all age groups. Certificates are associated with large and statistically significant increases in wages only among those 18-24 years of age. In the appendix, we provide estimates of the returns to each credential for students in each age group. We found that the strongest returns to 2-year college education are experienced by individuals 18-24 years of age, but that associate's degrees are associated with strong returns across all age groups.

There are a few important limitations to these estimates. First, these results do not account for differences in the main field of study for each student. Previous literature suggests that the field of study may impact the return on 2-year college credentials (Belfield & Bailey, 2017). For example, the return on receiving a short-term certificate in a technical field such as welding may be higher than the return on receiving a short-term certificate in a non-technical field. More data on short-term certificate holders and on a student's field of study could help illuminate the value of receiving a technical certificate.

Results could be further improved with data on which students transfer to other institutions after graduation. Belfield and Bailey (2017) note that as many as one-third of certificate holders and half of those receiving an associate's degree go on to receive further education. The ability to identify these students would allow for more accurate assessments of the impact on wages of receiving 2-year credentials alone.

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Appendix A

SAMPLE SELECTION

The initial sample included quarterly earnings information for 19,959 students enrolled in 2-year colleges in Montana from 2001-2010. Table A1 summarizes the original sample by credential earned, along with the exclusions that we make in arriving at our final sample for the analysis.

We removed students younger than 17 years of age because many high school students take college courses to supplement their high school education before attending another tertiary institution. We excluded those older than 50 years of age because many in this group are of retirement age and may be taking college courses as a form of leisure. Excluding this age group likely removes some who attend college to achieve late career advancement, but due to a lack of more detailed information on age, we are unable to distinguish them from the rest of the group. Removing these students dropped 1,790 observations from the sample.

Table A1. Sample Size by Credential Earned

COLLEGE	CREDENTIAL EARNED			FULL SAMPLE
	NONE	CERTIFICATE	ASSOCIATE'S	
Original Sample	17,093 85.6%	577 2.9%	2,289 11.5%	19,959
Sample after removing students:				
With missing data, whose first term was before 2003, or earned a bachelor's degree or GED	16,496 87.0%	522 2.8%	1,953 10.3%	18,971
Younger than 18 and older than 49 years of age	14,874 86.6%	460 2.7%	1,847 10.8%	17,181
With gaps in their enrollment	13,647 85.9%	445 2.8%	1,802 11.3%	15,894
With no earnings for ≥2 years of the first 5 years after college	7,360 83.3%	290 3.3%	1,191 13.5%	8,841
Working less than part time for 3 or more of the first 5 years after college (Final Sample)	6,191 81.2%	275 3.6%	1,157 15.2%	7,623

We excluded students whose first semester was earlier than 2003 to ensure that we have at least 2 years of wage data for each student before they begin enrollment. Wages before college were used to calculate the implicit cost of attendance. Removing these students dropped 928 observations from the sample. We excluded 24 students with missing age or gender information. We also excluded 26 students who reported earning bachelor's degrees and 10 students who reported earning a GED because we were focused on the return on investment to 2-year college credentials.

We flagged students for extended gaps in enrollment because this clouds the differentiation between earnings

during and after college completion. Dropping these students removes 1,287 observations from the sample. We identify problematic gaps in enrollment if:

- students are enrolled for less than one term per year, on average, based on the time between the first and last term of enrollment versus the total number of terms enrolled;
- there is a longer gap than 28 quarters or 7 years between the first and last term enrolled;
- the gap between the first and last term enrolled is more than 16 quarters or 4 years longer than the total number of terms the student was enrolled.

We excluded those who report no positive earnings for ≥2 years in the 5 years after their enrollment, dropping 7,053 observations from the sample. Without information on which students transfer to other institutions for additional education, we risk attributing student earnings information when they do work to their 2-year college education rather than any extended education they may earn.

The same issue of identifying transfer students applies to those with low earnings. We identified those working less than part time in each year as those who report earnings less than what one would earn working 20 hours per week for 50 weeks per year at Montana's minimum wage. We excluded those who reported below part-time earnings for ≥3 years in the 5 years after their enrollment, dropping an additional 1,218 observations from the sample.

The final sample included 7,623 individuals. Although it is much smaller than the original sample, the sample distribution by credential earned remained largely the same, with slightly larger representation from those who earn a certificate or associate's degree. The age distribution of the sample also remained largely unchanged. Table A2 summarizes the original and final samples by age group.

Robustness Checks for Regressions on Earnings after College

Although we accounted for student demographics and academic performance in the main analysis to isolate the impact of a 2-year college education on earnings, it is still possible that unobservable student characteristics play a role in job market outcomes after graduation. For example, students who are more likely to obtain an associate's degree may also be more likely to enjoy higher earnings after college because they are especially ambitious, rather than as a direct result of their college credential. We account for these potential biases here by reporting regression results for the change in earnings experienced by each student, which accounts for differences in baseline workforce performance due to unobserved student traits.

Table A2. Sample Size by Age Range

SAMPLE	AGE RANGE					
	0-17	18-24	25-34	35-49	50+	FULL SAMPLE
Original sample	761 3.8%	10,886 54.5%	4,473 22.4%	2,695 13.5%	1,143 5.7%	19,958
Original sample 18-49 years of age		10,886 60.3%	4,473 24.8%	2,695 14.9%		18,054
Final sample		4,579 60.1%	1,768 23.2%	1,276 16.7%		7,623

Table A3 shows the results of regressions on a student's average earnings 5 years after college as well as the difference between these earnings and a student's baseline earnings. Estimates of a student's change in earnings account for unobservable differences in student aptitude because these factors should equally impact their earnings before completing their education. For ease of interpretation, we report the direct estimates on earnings rather than estimates of log earnings. The results of both regressions for the returns on 2-year college credentials are very similar. In the main text, we relied on estimates of log earnings after college rather than on the change in earnings to more easily calculate the return to attending college without earning a credential.

Table A4 shows the results of regressions of log average earnings for each of the first 5 years after ending college enrollment. The results indicate that the additional earnings of people with 2-year college credentials compared to those who attended college but did not obtain a credential are large at first and then decrease over time. Those who obtain an associate's degree earn 46.4% more than those with no credential 1 year after college, and earn 20.7% more 5 years after college. While this constitutes a

Table A3. Regression Results for Average Wages 5 Years after College Enrollment

INDEPENDENT VARIABLE	DEPENDENT VARIABLES	
	AVERAGE YEARLY WAGE 5 YEARS AFTER COLLEGE	CHANGE IN WAGES (AVERAGE YEARLY WAGE 5 YEARS AFTER COLLEGE-BASELINE WAGES)
Credential Earned		
None (Omitted)	—	—
Certificate	2,699.15*** (3.73)	1,387.31 (1.59)
Associate's	7,815.31*** (17.67)	7,604.60*** (14.30)
Age Range		
18-24 (Omitted)	—	—
25-34	-350.39 (-1.04)	3,755.15*** (9.59)
35-49	1,252.03** (3.11)	6,829.20*** (15.14)
College GPA	1,128.12*** (9.31)	2,074.34*** (14.41)
Credit hours earned	79.45*** (15.11)	34.20*** (5.45)
Gender-Male	3,840.25*** (14.26)	4,226.55*** (13.05)
Race-White	840.59* (2.27)	1,348.40** (3.03)
Observations	7,623	7,615

Note: t-statistics in parentheses: * p <0.05 ** p <0.01 *** p <0.001. Additional controls included for college attended, year of last term enrolled, and average wages while in school (for first regression only).

large decrease over time, the increase in earnings among those with an associate's degree 5 years after graduating compared to those with no credential is still substantial. For those obtaining a certificate, the earnings impacts decrease more substantially. Those with a college certificate earn 25.0% more than those with no credential 1 year after college, but only 10.6% more 4 years after college. By 5 years after college, those with a certificate do not have significantly higher earnings than those with no credential.

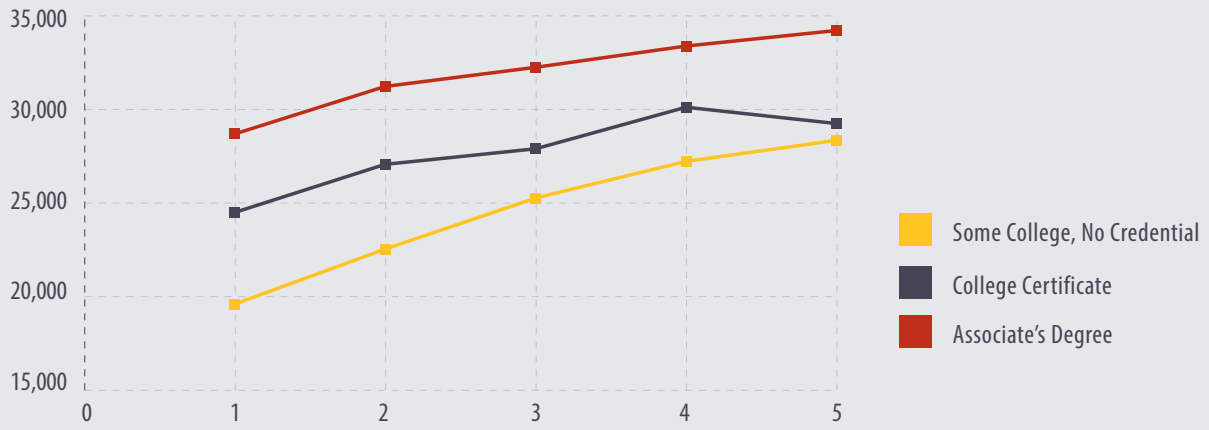
The results do not imply that earnings are decreasing over time, but rather that the difference in earnings between those with and without 2-year college credentials is decreasing. Figure A1 shows the estimated earnings of those in the sample for each of the first 5 years after completing college by credential earned. As expected, earnings among all credential levels generally increase at a declining rate over time. However, the difference in earnings among those with a certificate or an associate's degree compared to those with no credential also decreases. This contrasts with the projected earnings using the Mincer Equation as shown in Figure 1, for which the difference in earnings among those with higher-level credentials are assumed to increase with time. The results may indicate longer payback periods and lower rates of return for those obtaining 2-year college credentials, especially for those obtaining a certificate.

Table A4. Regression Results for Average Wages Each Year after College Enrollment

INDEPENDENT VARIABLE	DEPENDENT VARIABLE: LOG AVERAGE YEARLY WAGE EACH YEAR				
	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
Credential Earned					
None (Omitted)	—	—	—	—	—
Certificate	0.223*** (5.19)	0.183*** (4.28)	0.099* (2.44)	0.101* (2.41)	0.031 (0.70)
Associate's	0.381*** (14.53)	0.326*** (12.48)	0.244*** (9.89)	0.204*** (7.98)	0.188*** (6.87)
Age Range					
18-24 (Omitted)	—	—	—	—	—
25-34	0.230*** (11.78)	0.183*** (9.43)	0.159*** (8.68)	0.115*** (6.08)	0.055** (2.68)
35-49	0.461*** (20.54)	0.402*** (18.00)	0.337*** (15.96)	0.260*** (11.84)	0.145*** (6.22)
College GPA	0.031*** (4.36)	0.048*** (6.83)	0.073*** (10.91)	0.082*** (11.73)	0.107*** (14.32)
Credit hours earned	0.003*** (8.16)	0.002*** (7.50)	0.003*** (8.70)	0.002*** (7.37)	0.002*** (5.02)
Gender-Male	0.110*** (6.88)	0.122*** (7.68)	0.155*** (10.32)	0.155*** (9.93)	0.181*** (10.80)
Race-White	0.029 (1.30)	0.025 (1.12)	0.019 (0.90)	0.054* (2.51)	0.088*** (3.80)
Observations	7,295	7,477	7,500	7,530	7,202
Adjusted R^2	0.323	0.235	0.204	0.160	0.146

Note: t-statistics in parentheses: * p <0.05 ** p <0.01 *** p <0.001. Additional controls included for college attended, year of last term enrolled, and log average wages while in school.

Figure A1. Estimated Earnings over 5 Years by 2-Year College Education



Note: Estimated yearly wages for students who obtain no credential is taken from the sample means. These amounts are multiplied by the exponentiated coefficients for earning a certificate or associate's degree reported in Table A4 to calculate the earnings of those obtaining each credential.

Returns to a 2-Year College Education by Age

Table A5 shows descriptive statistics for key outcome and control variables by credential earned for each age group. The means of key variables follow similar patterns across age groups with a few important differences. Older students attend school for slightly longer periods and obtain more credits, resulting in slightly higher tuition and supplies costs; they also have higher baseline wages because they have more work experience, so their implicit costs for college attendance are substantially higher.

As in the report above, our key outcome measure is the average yearly wages that students earn in the 5 years after ending enrollment. The average yearly wages of students 25-34 or 35-49 years of age who obtain a certificate are not significantly different than those of students in the same age group who obtain no credential. This is also indicated in the regression results presented in Table 6 of the report above, which show no significant difference in earnings among those in older age groups who obtain certificates.

Table A6 summarizes our calculations of the returns to college enrollment based on the credential obtained for each age group. Baseline wages equal students' earnings while attending college or the average earnings of a person in Montana in the same age group with a high school diploma or GED, whichever amount is higher. Average wages are not available for subsets of the 18-24 age group, for which average wages are lowest. To estimate the baseline wages of these students in the first 5 years after they leave school, we took the average of the wage measures for those 18-24 and those 25-34 years of age (see Table 1). Baseline wages were compared to the average wage of students in the first 5 years after college. The average wages after college for students who obtain no credential in each age group were taken from the sample means reported in Table A5. These amounts were multiplied by the exponentiated coefficients for earning a certificate or associate's degree for each age group reported in Table 6 in the main text.

Wages were projected to increase over time using coefficients for the Mincer Equation provided by Willis (1986) as in Figure 1 in the main text, but with updated starting wages for each age group. The increase in earnings after college compared to baseline earnings provides the annual benefit associated with college attendance for each age group. The rate of return and payback period were calculated using Equation 3 as described in the report above.

Table A5. Summary Statistics of Key Variables by Credential Earned

VARIABLE	COLLEGE CREDENTIAL EARNED			FULL SAMPLE
	NONE	CERTIFICATE	ASSOCIATE'S	
Sample 18-24 years of age				
Terms enrolled	2.50 $_{a}$ (2.04)	4.19 $_{b}$ (2.56)	6.22 $_{c}$ (2.27)	3.03 (2.44)
Quarters from start to end of college enrollment	4.09 $_{a}$ (4.07)	7.45 $_{b}$ (5.26)	11.09 $_{c}$ (4.45)	5.09 (4.79)
Hours earned	21.60 $_{a}$ (27.98)	46.20 $_{b}$ (21.53)	72.82 $_{c}$ (16.88)	28.90 (31.79)
College GPA	2.06 $_{a}$ (1.30)	3.15 $_{b}$ (0.50)	3.28 $_{b}$ (0.42)	2.25 (1.28)
College tuition and supplies costs[1]	6,338.65 $_{a}$ (7,975.96)	12,605.97 $_{b}$ (7,829.83)	20,880.62 $_{c}$ (8,739.51)	8,390.79 (9,447.98)
Implicit costs of college attendance[2]	6,779.92 $_{a}$ (9,650.69)	13,069.43 $_{b}$ (14,160.49)	17,587.93 $_{c}$ (16,146.76)	8,353.23 (11,463.86)
Total college costs[3]	13,118.57 $_{a}$ (15,486.66)	25,675.40 $_{b}$ (18,828.13)	38,468.55 $_{c}$ (19,148.02)	16,744.02 (18,258.95)
Average yearly wages 5 years after college	21,678.75 $_{a}$ (11,625.42)	30,995.45 $_{b}$ (14,083.01)	37,443.25 $_{c}$ (15,690.00)	23,977.79 (13,430.17)
Observations	3,856	135	588	4,579
Sample Aged 25-34				
Terms enrolled	3.48 $_{a}$ (2.77)	4.30 $_{b}$ (2.33)	7.05 $_{c}$ (2.42)	4.20 (3.03)
Quarters from start to end of college enrollment	5.84 $_{a}$ (5.48)	7.15 $_{a}$ (4.64)	12.38 $_{b}$ (5.27)	7.15 (5.99)
Hours earned	30.17 $_{a}$ (32.42)	51.26 $_{b}$ (24.93)	76.08 $_{c}$ (23.48)	39.88 (35.58)
College GPA	2.49 $_{a}$ (1.28)	3.29 $_{b}$ (0.47)	3.43 $_{b}$ (0.41)	2.71 (1.20)
College tuition and supplies costs[1]	8,527.36 $_{a}$ (9,223.06)	14,447.49 $_{b}$ (8,378.91)	22,505.38 $_{c}$ (9,854.01)	11,463.23 (10,821.40)
Implicit costs of college attendance[2]	18,923.11 $_{a}$ (24,781.80)	25,469.28 $_{a}$ (22,502.79)	44,745.07 $_{b}$ (32,018.14)	24,177.73 (28,122.77)
Total college costs[3]	27,442.25 $_{a}$ (31,112.96)	39,916.77 $_{b}$ (27,812.82)	67,250.45 $_{c}$ (3,4061.20)	35,642.99 (35,225.86)
Average yearly wages 5 years after college	28,018.25 $_{a}$ (15,088.30)	29,882.76 $_{a}$ (11,305.48)	38,333.10 $_{b}$ (17,261.28)	30,079.92 (15,909.92)
Observations	1,354	74	340	1,768

continued

Table A5. Summary Statistics of Key Variables by Credential Earned (continued)

	COLLEGE CREDENTIAL EARNED			FULL SAMPLE
	NONE	CERTIFICATE	ASSOCIATE'S	
Sample Aged 35-49				
Terms enrolled	3.30 $_{a}$ (2.86)	4.59 $_{b}$ (2.55)	7.32 $_{c}$ (2.55)	4.09 (3.18)
Quarters from start to end of college enrollment	5.34 $_{a}$ (5.37)	7.24 $_{b}$ (4.09)	11.91 $_{c}$ (4.38)	6.62 (5.72)
Hours earned	26.01 $_{a}$ (30.43)	46.92 $_{b}$ (21.10)	74.39 $_{c}$ (23.31)	35.77 (34.34)
College GPA	2.80 $_{a}$ (1.33)	3.44 $_{b}$ (0.40)	3.49 $_{b}$ (0.43)	2.96 (1.22)
College tuition and supplies costs[1]	7,305.26 $_{a}$ (8,419.78)	13,289.89 $_{b}$ (6,118.62)	21,108.09 $_{c}$ (8,371.05)	10,091.97 (9,860.55)
Implicit costs of college attendance[2]	20,282.69 $_{a}$ (31,180.84)	30,757.07 $_{b}$ (25,756.69)	58,454.67 $_{c}$ (37,682.12)	27,692.51 (35,330.58)
Total college costs[3]	27,576.55 $_{a}$ (36,905.61)	44,046.96 $_{b}$ (27,859.70)	79,562.76 $_{c}$ (39,389.61)	37,782.27 (41,955.91)
Average yearly wages 5 years after college	35,386.76 $_{a}$ (20,461.56)	30,263.31 $_{a}$ (13,556.28)	40,081.28 $_{b}$ (16,907.96)	35,964.27 (19,679.42)
Observations	981	66	229	1,276

Note: Standard deviations are provided in parentheses. Means with different subscripts are significantly different from each other at the 5% level ($p < .05$).

[1] Tuition and supplies costs = [(average tuition per credit hour for each college/university) + (supplies per credit hour for each college/university)] * (total hours earned for each student). Note that this excludes the implicit cost of forgone wages.

[2] Implicit costs = (average wages earned by a person with a high school degree in Montana or average wages earned by student before attending college, whichever is larger) – (average wages earned by student while attending college)

[3] Total costs = (tuition and supplies costs) + (implicit costs)

Consistent with the main results, we found that, on average, those obtaining an associate's degree receive the highest returns to their education. The associate's degree is the only credential consistently associated with strong, positive returns across all age groups. Still, the returns to earning an associate's degree are highest for those in the 18-24 age group. The costs of college attendance are recouped in about 4.5 years for those 18-24 years of age who earn an associate's degree. Costs of earning an associate's degree are recouped in about 8.5 years for those 25-34 years of age, and in about 7.5 years for those 35-49 years of age. Over the course of 10 years, the rate of return associated with earning an associate's degree is 22.8% for the 18-24 age group, 7.3% for the 25-34 age group, and 9.1% for the 35-49 age group.

Only students in the 18-24 age group realize strong positive benefits to attending a 2-year college without

Table A6. Rate of Return and Payback Period on 2-Year College Credentials by Age

	CREDENTIAL EARNED		
	NONE	CERTIFICATE	ASSOCIATE'S
Age 18-24			
Baseline wages [1]	20,249.86	20,249.86	20,249.86
Average wage after college [2]	21,678.75	26,691.16	28,143.95
Difference [3]	1,428.89	6,441.30	7,894.09
Total college costs [4]	13,118.57	25,675.40	38,468.55
Rate of return (over 10 years) [5]	7.66%	28.87%	22.78%
Payback period (years) [6]	8.5	3.5	4.5
Age 25-34			
Baseline wages [1]	27,216.97	27,216.97	27,216.97
Average wage after college [2]	28,018.25	28,813.85	34,393.10
Difference [3]	801.28	1,596.88	7,176.13
Total college costs [4]	27,442.25	39,916.77	67,250.45
Rate of return (over 10 years) [5]	—	—	7.25%
Payback period (years) [6]	—	—	8.5
Age 35-49			
Baseline wages [1]	33,433.79	33,433.79	33,433.79
Average wage after college [2]	35,386.76	33,226.17	42,748.66
Difference [3]	1,952.97	-207.62	9,314.87
Total college costs [4]	27,576.55	44,046.96	79,562.76
Rate of return (over 10 years) [5]	—	—	9.14%
Payback period (years) [6]	—	—	7.5

[1] Baseline wages are a student's earnings while attending college or the average earnings of a person in Montana with a high school diploma or GED, whichever amount is higher.

[2] The average wage after college for students who obtain no credential is taken from the sample mean reported in Table A5. This amount is multiplied by the exponentiated coefficients for earning a certificate or associate's degree for each age group reported in Table 6 to calculate the earnings of those in each age group obtaining each credential.

[3] The difference in earnings is the difference between the average earnings after college and baseline wages.

[4] Total college costs are taken from the sample means for each credential level reported in Table 5.

[5] The rate of return is calculated by finding the rate of return that equates the costs of college attendance with projected earnings over 10 years using Equation 3 and as shown in Figure 1.

[6] The payback period is calculated by determining the amount of time that it takes to recoup the costs of college attendance based on projected earnings discounted at a rate of 4% as in Equation 3.

earning a degree and to earning a certificate. The returns to earning a certificate are actually higher than the returns to earning an associate's degree for younger students. This is because the increase in wages for earning an associate's degree rather than a certificate is not very large among younger students, while the time to earn a certificate is substantially shorter, decreasing the costs of attendance.

As alluded to in the main report above, older students receive lower returns to 2-year college credentials because wages increase with work experience. Older students have been in the labor force for longer and already have higher wages than their younger counterparts. As a result, they sacrifice more money in the form of lost earnings to attend college. It is also likely that, to a certain extent, work experience substitutes for education so that the increased wages associated with higher-education credentials are lower for older students.

Two important caveats should be noted. First, as explained in the discussion section of the main report, these results do not account for differences in outcomes depending on the main field of study for each student. It is likely premature to assume that no 2-year college certificates elicit positive returns for older students because certificates in high-demand fields with specific technical training requirements may elicit positive returns even if certificates in other fields of study do not. Second, college credentials are not always sought to increase a person's income potential in their current field. Students may obtain a 2-year college credential to train for a different field than the one they currently work in, either because they seek a more rewarding or enjoyable career, or because market changes force them to acquire new skills. In either case, for some people, the benefits to a 2-year college education may extend beyond the desire to earn more than they did before attending school. Benefits for some may include greater job satisfaction or a smoother career transition if they are forced to change careers.