THE VALUE OF A COLLEGE EDUCATION AND THE BURDEN OF STUDENT LOAN REPAYMENT

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SUMMARY

For men, the net present value (NPV) of a four-year college degree is estimated to be $482,000. The annualized return on investment (ROI) is 14.2 percent. For women, the NPV of a bachelor's degree is $342,000 and the ROI is 13.9 percent. The average value of a four-year college degree is assessed by comparing those with a bachelor's degree but no further education to those with a high school diploma but no college attendance. These results are based on U.S. Census Bureau data from the period from 2014 through 2016 on the mean earnings of full-time, year-round U.S. workers.

Return on Investment by Major

Since 2009, the Census Bureau in its American Community Survey has included a question on major field of study for those who completed college. This makes it possible to estimate returns on a college education by major. Pooled data from the public use microdata sample (PUMS) of the ACS for the period from 2012 through 2016 are used to calculate the mean earnings of U.S. college-educated workers by major field of study, cross-tabulated by age and sex. An assessment of the value of a college degree is made for each of 40 majors by sex, with the list of majors differing between men and women.

From a strict financial perspective, college is a worthwhile investment if its ROI exceeds the long-run real interest rate. Using an interest rate of 4 percent as a benchmark threshold, 39 of the 40 majors evaluated for men have ROIs high enough to justify the time and money spent going to college. How much of a return college provides, however, varies greatly depending upon the major.

For men, the estimated ROIs range from a high of 17.4 percent for those with a bachelor's degree in economics to a low of 2.1 percent for those with a degree in elementary education. Majors with the highest ROIs are in STEM (science, technology, engineering, and mathematics) fields, such as engineering and computer science, and in business fields including economics, finance, and accounting. Majors with relatively low ROIs include education, the arts, and criminal justice.

For women, the estimated ROIs range from a high of 23.8 percent for those with a degree in chemical engineering to a low of 4.4 percent for those with a degree in early childhood education. Each of the 40 majors evaluated was estimated to have an ROI that would clear a financial threshold of 4 percent. As was the case with men, fields providing relatively high ROIs for women include engineering, computer science, and business. Some health-related fields, such as nursing and medical technology technicians, also provide high ROIs. Majors which yield relatively low ROIs include education and social work.

When comparing men and women with the same major field of study, the estimated ROIs for women are always higher than those estimated for men. Lifetime earnings within a common field are always lower for women than they are for men. But, in so far as return on investment is concerned, this disadvantage for women is more than offset by the fact that the alternative to going to college (finishing with a high school degree) pays much less for women than it does for men. The level of earnings with a four-year degree is lower for women, but the college-earnings premium is higher. The average return on a four-year college degree across all fields of study is

slightly higher for men than for women because men tend to more frequently choose majors with high ROIs, e.g., engineering or finance rather than psychology or education.

Individuals with a major in education have particularly low ROIs. For men, the three education majors that appear on the list of 40 common majors have the three lowest ROIs. For women, the five education majors that appear on the list of 40 common majors occupy five of the six lowest ranks.

Student Debt Repayment

If the net present value of a college education is positive and if the interest rate on student debt is no greater than the discount rate, a student can borrow at age 18 an amount of money equal to the full cost of attending college plus the NPV of the degree and be able to pay off the loan over his or her working life using the earnings premium that college provides. From this perspective, there would seem to be plenty of money in the work-life earnings of a college graduate to be able to pay off the kind of loans typically obtained by students. Of course, student loan markets are known to be imperfect. Lenders and students alike prefer loans that are limited to the out-of-pocket expenses of going to college (e.g., tuition) and are paid off over a short period of time (typically 10 years) beginning soon after graduation. With these restrictions, it is certainly possible that student loans present a cash flow problem, even for students whose majors provide economic value over the long run.

Data on college earnings by age and major make it possible to evaluate the potential burden of paying off student debt for alternative groups of college students. In a base case set of calculations, the student is assumed to incur debt at a rate of $10,000 per year for four years. The debt is then paid off at a real interest rate of 4 percent over a 10-year period between the ages of 25 and 34. Three alternative measures of the burden of student debt repayment are considered:

- The earnings of the college graduate net of outlays for debt repayment minus what the student would have earned had he or she only finished high school.
- Outlays for debt repayment as a percentage of college earnings.
- Outlays for debt repayment as a percentage of "disposable income," defined as earnings minus 150 percent of the official poverty level for individuals.

A rule of thumb among financial aid experts is that the probability of student debt default becomes significant when the ratio of debt repayment to disposable income rises above 20 percent (Hershbein, et al. November 2014). These three measures of debt burden are evaluated by sex for all college graduates collectively and for a set of 15 popular college majors, one set for men and another set for women.

For men who major in fields with high ROIs, such as finance, computer science, and engineering, paying off $40,000 worth of college debt would not seem to present much of a financial burden. Annual earnings net of debt payments are at least $15,000-to-$20,000 higher than what the individual would have been earning with only a high school degree. For men with these majors, student debt payments are never more than 10 percent of earnings, and debt payments as a percentage of disposable income are never higher than 15 percent. The potential burden of debt repayment is more serious, however, for majors with relatively low ROIs. For example, for men who major in English, psychology, or general education, earnings net of debt payments are $5,000 lower than high school earnings in some of the years of debt repayment, the

ratio of debt payments to earnings can reach 15 percent, and the ratio of debt payments to disposable income can be as high as 30 percent.

The potential burden of student debt is more serious for women than it is for men. Women pay the same tuition as men but earn less for any given major. When evaluating debt burdens using data on mean earnings across all college graduates, and looking at average values of debt burden measures over the 10-year payback period, the ratio of debt payments to college earnings is 8.7 percent for men but 11.3 percent for women. The ratio of debt payments to disposable income is 12.0 percent for men but 17.7 percent for women.

Average net tuition and fees at U.S. four-year colleges and universities are $8,300 per year. With room and board added in, the cash flow required to attend college full time approaches $20,000 per year. Borrowing in the amount of $10,000 per year doesn't come close to providing the funds necessary to attend college. Accordingly, this paper also considers an alternative level of student indebtedness — that created by borrowing $20,000 per year for four years. The burden of paying back this amount of debt is evaluated using the measure defined by the ratio of debt payments to disposable income.

If the debt is to be paid off over 10 years between the ages of 25 and 34, debt in this higher amount would impose serious financial hardship on virtually all college students, regardless of sex or major. The mean ratio of debt payments to disposable income over the 10-year payback period would be at least 20 percent for each of the individual majors considered, and would be over 30 percent for seven of the 15 male majors and for 14 of the 15 female majors.

One way to relieve the debt burden is to begin paying off the debt later in one's working life, when earnings are higher, say from ages 30 to 39. This alternative payment scheme provides only modest relief. More substantial debt relief is obtained if the payback period is extended, say from 10-to-15 years. In this case, the mean ratio of debt payments to disposable income falls from 24.0 percent to 15.6 percent for the average male graduate and is below 20 percent for eight of the 15 male majors considered. For women, the mean ratio of debt payments to disposable income over the payback period falls from 35.4 percent to 23.7 percent for the average graduate. The debt burden measure remains above 20 percent, however, for 14 of the 15 individual female majors evaluated.

THE AVERAGE RETURN ON INVESTMENT: ALL COLLEGE GRADUATES

This paper updates and expands the analysis of Hill (2013) to estimate, using the most recent data from the U.S. Census Bureau's Current Population Survey and American Community Survey (ACS), the return on investing in a bachelor's degree, both on average across all college graduates and by individual major. To assess the average value of a bachelor's degree across all college graduates, data from the U.S. Census Bureau's Current Population Survey on mean earnings of full-time, year-round U.S. workers from 2014 through 2016 by sex, level of education, and five-year age group are used. Specifically, individuals who completed high school but had no further education are compared to those who completed a bachelor's degree but had no graduate-level education. Differences in mean earnings between these two groups are used to quantify the increment in earnings a college graduate will receive if he or she decides to attend college.

There are two major issues with measuring the college earnings premium in this way. One is known among labor economists as the issue of "ability bias." It is possible that the simple positive correlation one observes in the data between earnings and level of education is partly a reflection of the fact that people who are successful in school are those with high innate abilities and these abilities also help them be successful in the job market. If so, the opportunity costs of attending college for those who have the abilities necessary to complete college are higher than the average earnings of high school graduates, and the calculated ROI will be upward biased. For some perspective on this issue, however, it is worth noting that in a survey article titled "The Causal Effect of Education on Earnings," noted labor economist David Card concluded, after reviewing the findings of 89 scholarly papers, that the true average return on education is not much below the estimate suggested by simple education-earnings correlations.

Another potential concern is that the earnings premium actually received 10 or 20 years from now by a would-be college graduate may be very different from the earnings premium currently received by older workers. The college earnings premium rose sharply across all age groups throughout the 1980s and 1990s. So if this concern had been raised circa 2000, the response might have been "Don't worry about it. By the time you get there, your college earnings premium is likely to be even greater than what the current numbers suggest." Since the early 2000s, the earnings premium received by those with only a four-year college degree has stopped rising and may have fallen some. However, as will be noted later in this section of the paper, the resulting declines in college ROIs have not been large.

The framework used to quantity the value of a bachelor's degree is a specific but straightforward characterization of the college investment decision. The individual is assumed to have completed high school and is faced with choosing between two alternative career paths:

- End the education process with a high school diploma and work from ages 18 to 65.
- Spend the next four years obtaining a bachelor's degree and then work from ages 22 to 65. If the college path is chosen, the student is assumed to attend college full time and to not work at all.

The outlay costs of attending college are tuition and fees, net of grants and other financial aid. According to information from the National Center for Education Statistics (2016), average tuition and fees at U.S. four-year public and private colleges and universities are $16,000 a year.

Deducted from this figure is $7,685, the average amount of financial aid received by full-time undergraduates from Federal Pell grants, state grants, and institutional tuition waivers (NCES 2018). Costs related to food and shelter are not considered as they arise whether college is attended or not. The benefits of going to college consist of the incremental increase in earnings made possible by a college education.

Tables 1 and 2 provide a cost-benefit analysis of the decision to invest in a four-year college education, one analysis for men and another for women. Costs and benefits are presented both as simple sums and, as required in standard financial analysis, in present value form. The full costs of attending college consist of net tuition and fees and the earnings foregone while the individual attends school (an opportunity cost of attending college). Foregone earnings are measured by the earnings received over the period from 2014 through 2016 by young workers who only had a high school education. Net tuition and fees for both men and women are $8,315 per year, or roughly $33,300 over four years. Earnings foregone are much larger than college tuition. Over the four years, they are $111,700 for men and $85,600 for women. Assuming the real long-run interest rate (the discount rate) is 4 percent, the present value at age 18 of the full costs of going to college is $136,400 for men and $112,000 for women.

The lifetime earnings benefit of going to college is $1,668,500 for men and $1,178,600 for women. Of course, these simple sums greatly exaggerate the value of a college education because they fail to account for the time value of money. The earnings benefits of a college education are much more distant than the costs. With a 4 percent discount rate, the present value of the lifetime college earnings premium is $618,800 for men and $453,900 for women.

The investment value of a bachelor's degree is measured by the present value of the incremental earnings college provides minus the full costs of going to college, i.e., the net present value (NPV). Calculations based on recent tuition rates and data on earnings by education indicate that, at a discount rate of 4 percent, the NPV of a college investment is currently around $480,000 for men and $342,000 for women. Any male, for example, who could have successfully attended college but, for whatever reason, chose not to do so, would effectively be turning down a gift of $480,000 at age 18.

The net present value of a college education can also be represented as the present value of lifetime college earnings (working from ages 22 to 65) net of tuition, fees, etc. minus the present value of lifetime high school earnings (working from ages 18 to 65). The present value of four years of net tuition and fees, for both men and women, is $31,400. The present value of lifetime high school earnings for a man is $950,000. Thus the NPV in Table 1 implies that the present value of lifetime college earnings for men is $1,464,000. The present value of lifetime high school earnings for a woman is $680,000. The NPV figure in Table 2 then implies that the present value of lifetime college earnings for women is $1,053,000.

Another way of expressing the value of a college education is to calculate the implied return on investment (ROI). Here ROI is measured as an "internal rate of return," the discount rate that would equate the present value of benefits with the present value of costs. Recent tuition and earnings data indicate that the ROI for college is currently 14.2 percent for the average male graduate and 13.9 percent for the average female graduate. Since these returns are calculated

TABLE 1
VALUE OF A BACHELOR'S DEGREE TO MEN IN THE UNITED STATES, 2014 THROUGH 2016
Based on Mean Earnings of Full-Time, Year-Round Male Workers

Costs (Ages 18-21):	
Net Tuition and Fees	$33,300
Foregone Earnings	111,700
Total Costs	144,900
Total Costs Discounted at 4 Percent Real Interest	136,400
Benefits (Ages 22 to 65):	
Earnings for High School Graduates	2,169,600
Earnings for Holders of a Bachelor’s Degree	3,838,100
Differential in Earnings	1,668,500
Earnings Differential Discounted at 4 Percent Real Interest	618,800
Net Present Value of a Bachelor's Degree (NPV)	482,400
Return on Investment (ROI)	14.2%

Source: Calculated from data of the U.S. Department of Commerce, Census Bureau.

TABLE 2
VALUE OF A BACHELOR'S DEGREE TO WOMEN IN THE UNITED STATES, 2014 THROUGH 2016
Based on Mean Earnings of Full-Time, Year-Round Female Workers

Costs (Ages 18-21):	
Net Tuition and Fees	$33,300
Foregone Earnings	85,600
Total Costs	118,900
Total Costs Discounted at 4 Percent Real Interest	112,000
Benefits (Ages 22 to 65):	
Earnings for High School Graduates	1,538,800
Earnings for Holders of a Bachelor’s Degree	2,717,400
Differential in Earnings	1,178,600
Earnings Differential Discounted at 4 Percent Real Interest	453,900
Net Present Value of a Bachelor's Degree (NPV)	341,900
Return on Investment (ROI)	13.9%

Source: Calculated from data of the U.S. Department of Commerce, Census Bureau.

using costs and benefits from the same time period, the returns are inflation-adjusted. The estimated returns on college are very high. For perspective, since the early 20th century, the average annual real return on U.S. equities has been around 7 percent.

The return on a four-year college education appears to have fallen since the early 2000s, but not by much. Using data on tuition and earnings from the period of 2000 through 2002, Hill (2013) calculated an ROI for male college graduates of 14.2 percent. In that calculation, deductions from gross tuition rates were limited to Federal Pell grant awards and did not include grants from state governments or tuition waivers from institutions. If the analysis using earnings data from 2014 through 2016 had been done with tuition figures net only of Pell grants, the resulting ROI for men would have been 12.9 percent, a bit lower than the 14.2 percent figure estimated for the earlier period.

The financial analysis presented here is based on a characterization of the college investment process in which the student attends college full time, does not work while going to college, and takes only four years to complete the degree. Many students today, however, especially those attending state universities, work part time while attending school and end up taking longer to complete the degree. What would a financial assessment of the college investment decision look like for a nontraditional student? The model was modified to assume that the student works one-third time while attending college, attends college on a two-thirds time basis and takes six years to finish. What happens to the NPV depends on how long the student works after graduating from college. If the working life of the college graduate ends at age 65, as in the previous analysis, the NPV for a male student falls from $482,000 for someone who finishes college in four years and does not work to $396,000 for one that works part time and finishes in six years. If the college graduate who takes six years to finish works through age 67 (and consequently enjoys a shorter retirement period), the NPV would be $423,000. The results of this alternative analysis clearly show that working part time and delaying the completion of college subtracts from the long-run value of a college education. The choice to work part time and delay graduation is made by students to help them manage the cash flow demands of schooling, not to get more value out of the degree.

COLLEGE EARNINGS BY MAJOR

Since 2009, respondents in the Census Bureau's annual American Community Survey have been asked to identify their undergraduate college major, if they had completed a bachelor's degree or higher. This makes it possible to cross-tabulate the individual earnings of surveyed college graduates by major, as well as by demographic characteristics such as age and sex. ACS survey results on earnings by major have been summarized by a number of authors. A few of these papers and their findings are reviewed below.

T. Julian (2012) from the Census Bureau uses results from the 2011 ACS to calculate undiscounted lifetime earnings for each of 15 aggregated groups of majors. The calculations are based on a 40-year work life running from ages 25 to 64. The sample is restricted to full-time, year-round workers whose highest degree is a bachelor's degree. The sexes are combined. Her results show that the work-life earnings of those with a bachelor's degree range from a high of $3.5 million for those who majored in engineering to a low of $1.8 million for those with a degree in education. Major groups with above-average work-life earnings are engineering, computers and math, science, and business. Major groups with below-average lifetime earnings include liberal arts, fine arts, psychology, and education.

B. Hershbein, et al. (September 2014) use data from the ACS for 2009 through 2012 to calculate for each of 80 college majors the present value of median earnings over the first 40 years of a career, beginning at age 22. Earnings are discounted using a real interest rate of 3 percent. The sample is limited to those with no more than a bachelor's degree. All workers are included, both full-time and part-time. The sexes are combined. The calculated lifetime earnings range from a high of over $2 million for chemical engineering majors to a low of $800,000 for those who majored in early childhood education. Hershbein, et al. find that the majors with the highest lifetime earnings are engineering, computer science, and finance. Majors with the lowest lifetime earnings include fine arts, elementary education, social work, and early childhood education.

Using the same database as in their earlier paper, B. Hershbein et al. (November 2014) calculate by major the percentage growth in earnings during the first five years of one's career. Earnings growth during this period is over 50 percent for most majors and over 25 percent for almost all majors. The authors use this information to argue that repayment of student loans would be much less burdensome for the student if the repayment period were to start after the graduate had been working for several years.

The analysis in this paper is based on data from the public use microdata sample (PUMS) of the American Community Survey pooled over the years from 2012 through 2016. The primary data used are the mean earnings by five-year age group from ages 25 through 64 of employed individuals who had completed a bachelor's degree but had no graduate-level education. The samples were restricted to those with full-time, year-round employment status. Earnings were cross-tabulated by college major, age, and sex. Mean earnings by individual age were estimated using linear interpolations of the mean earnings for the five-year age groups, with splines centered on the median age in each group. Data on the mean earnings of workers between the ages of 22 and 24 were combined with the mean earnings of those between the ages of 25 to 29 to estimate earnings by individual age for workers from ages 22 to 29.

A total of 40 majors were selected for analysis by sex, with 30 majors common to each sex. The majors selected were popular with young cohorts and had a significant number of observations throughout the age distribution, including people 55 and over. To convey the size of the samples, consider the 280 observation cells defined by the cross-tabulating of 40 majors by the seven five-year age groups that range from ages 25 to 59. For men, there were at least 200 observations in each of the 280 cells. The average number of observations across the seven age groups ranged from a low of 358 for those who had majored in elementary education to a high of 6,872 for business management majors. For women, there were at least 100 observations in each of the 280 cells. The average number of observations across the seven age groups ranged from a low of 197 for chemical engineering to a high of 5,390 for nursing.

Measures of key characteristics of the estimated work-life earnings profiles are presented in the first three columns of Tables 3 and 4. The first column of numbers is the mean annual earnings of workers between the ages of 25 and 29 — a measure of the earnings received by workers very early in their careers ("early-career" earnings). The second column of numbers is the ratio of mean annual earnings between the ages of 30 and 39 to mean annual earnings between the ages of 25 and 29. These ratios indicate the size of the growth trajectory in earnings during the first third of a person's career. The third column is the undiscounted sum of individual earnings from ages 22 through 65.

Beginning with Table 3 for male workers, early-career earnings range from a high of nearly $74,000 per year for workers with degrees in chemical engineering to a low of $37,000 per year for those who majored in physical and health education teaching. Majors with early-career earnings that exceed $65,000 include most of the engineering fields, economics, finance, and computer science. Majors with initial earnings less than $45,000 per year include education, fine arts, liberal arts, and psychology.

The figures in the second column on the growth trajectory of earnings are useful as an indicator of how much more affordable repayment of student debt can be if repayment is delayed until the employed college graduate is well into his career (a topic discussed later in the paper). The ratio of mean annual earnings from ages 30 to 39 to mean earnings from ages 25 to 29 ranges from a high of 1.60 and over for journalism, finance, and chemistry to a low of 1.31 and below for general and elementary education, nursing, and general engineering. Interestingly, there is a significant negative correlation between the numbers in the first two columns. Majors with high initial earnings, for example, tend to have low earnings growth over the first third of their career. Majors that are highly quantitative and provide specific and technical skills, such as engineering and computer science, have high initial earnings but low earnings growth. On the other hand, graduates with majors in journalism, communications, chemistry, and biology have low initial earnings but see their earnings grow quickly during the early part of their careers.

Column three shows the simple undiscounted sum of lifetime earnings for each of the 40 majors. Lifetime earnings range from a high of $5.0 million in economics and finance to a low of less than $3.0 million in music and education. In general, engineering and business majors have lifetime earnings that are well above the average. Majors with below-average lifetime earnings include arts, education, criminal justice, forestry and natural resource management, and agriculture and animal husbandry.

TABLE 3
FINANCIAL STATISTICS ASSESSING THE VALUE OF A BACHELOR'S DEGREE, BY MAJOR FIELD OF STUDY: MEN

Major	Average Annual Earnings, Ages 25-29	Ratio of Average Annual Earnings, Ages 30-39 to Ages 25-29	Lifetime Earnings (Not Dis-counted)	Net Present Value (NPV)	Return on Invest-ment (ROI)
Economics	$69,602	1.59	$5,022,407	$893,196	17.4%
Chemical Engineering	73,857	1.36	4,967,377	833,777	17.3
Computer Science	69,489	1.35	4,308,307	664,492	16.9
Finance	67,235	1.61	5,006,141	866,101	16.7
Electrical Engineering	70,542	1.33	4,446,861	684,525	16.4
Mechanical Engineering	67,146	1.37	4,411,839	661,000	15.6
Industrial & Manufacturing Engineering	68,621	1.37	4,385,242	642,613	14.9
Mathematics	62,073	1.44	4,298,605	613,677	14.5
Construction Services	59,371	1.40	4,165,069	560,075	14.3
Civil Engineering	60,951	1.42	4,314,403	596,040	14.0
General Engineering	63,234	1.31	3,925,256	494,610	13.9
Accounting	57,724	1.48	4,412,484	600,670	13.0
Marketing & Marketing Research	56,747	1.59	4,255,993	578,774	13.0
General Business	56,271	1.51	4,055,996	509,472	12.5
Political Science & Government	54,114	1.58	4,147,780	531,735	12.4
Computer & Information Systems	57,325	1.33	3,628,464	388,532	12.1
Business Management & Administration	54,455	1.47	3,825,883	422,047	11.4
Nursing	59,072	1.29	3,528,846	328,479	10.7
Communications	47,976	1.59	3,719,172	371,138	10.2
Journalism	46,744	1.62	3,606,418	332,984	9.9
Architecture	50,925	1.39	3,612,046	321,866	9.7
History	47,409	1.54	3,596,675	324,624	9.6
Chemistry	45,715	1.60	3,624,780	321,849	9.4
Commercial Art & Graphic Design	46,896	1.45	3,394,301	265,669	9.3
Biology	46,124	1.59	3,549,994	298,067	9.1
Sociology	47,630	1.49	3,396,482	268,028	9.1
Philosophy & Religious Studies	48,556	1.54	3,350,026	257,557	9.0
English Language & Literature	44,073	1.58	3,589,464	303,811	8.9
Agriculture & Animal Husbandry	49,919	1.41	3,192,868	211,986	8.6
Liberal Arts	44,029	1.54	3,330,951	241,346	8.6
Psychology	44,581	1.54	3,370,546	244,819	8.5
Hospitality Management	44,308	1.53	3,340,406	226,317	8.0
Criminal Justice & Fire Protection	47,534	1.40	3,152,463	178,080	7.7
Forestry, Natural Resources & the Environment	43,956	1.46	3,166,397	161,028	7.1
Fine Arts	42,880	1.46	3,005,568	133,564	6.9
Music	43,667	1.41	2,972,166	115,986	6.5
Physical Fitness, Parks, Recreation & Leisure	43,099	1.47	3,043,424	122,197	6.5
Physical & Health Education Teaching	36,995	1.53	2,815,540	51,376	5.2
General Education	42,737	1.31	2,707,583	15,422	4.4
Elementary Education	39,158	1.27	2,478,594	-71,079	2.1

Source: Calculated from the U.S. Department of Commerce, Census Bureau, 2012-16 American Community Survey Five-Year Public Use Microdata Sample.

Table 4 provides measures of key characteristics of the work-life earnings profiles of female workers. The relative performances of alternative majors are similar to those of men. But the level of earnings, irrespective of age or major, is uniformly lower for women. Early-career earnings range from highs of approximately $61,000 to $71,000 per year for women who majored in chemical or electrical engineering, economics or computer science to lows of less than $40,000 per year for 13 of the 40 majors including all fields of education, social work, and psychology.

The percentage growth in earnings over the first third of a career is generally less for women than it is for men. The figures in column two exceed 1.40 in only six of the 40 majors including journalism, communications, treatment therapy professions, and biology. On the other hand, the measure of earnings growth is below 1.30 in 16 of the 40 majors including education, nursing, social work, and business management.

Undiscounted lifetime earnings for women range from a high of nearly $4.2 million in chemical engineering to a low of $1.9 million in early childhood education. Majors with lifetime earnings that exceed $3.0 million include chemical and electrical engineering, computer science, various business fields, and mathematics. Majors with lifetime earnings that are less than $2.5 million include education, social work, the arts, and psychology.

Women have lower earnings growth and lower overall lifetime earnings than men in part because women are more likely to have extended periods of absence from the labor force while raising a family. A woman who is working at the age of 45 is less likely than a man to have 20 years of work experience. Earnings are strongly related to work experience.

TABLE 4
FINANCIAL STATISTICS ASSESSING THE VALUE OF A BACHELOR'S DEGREE, BY MAJOR FIELD OF STUDY: WOMEN

Major	Average Annual Earnings, Ages 25-29	Ratio of Average Annual Earnings, Ages 30-39 to Ages 25-29	Lifetime Earnings (Not Dis-counted)	Net Present Value (NPV)	Return on Invest-ment (ROI)
Chemical Engineering	$70,959	1.31	$4,159,513	$909,692	23.8%
Electrical Engineering	66,359	1.25	3,756,191	759,123	22.0
Computer Science	61,138	1.21	3,462,319	630,663	20.5
Economics	63,712	1.29	3,384,628	630,375	19.3
Finance	57,725	1.36	3,329,715	586,837	17.8
Nursing	54,789	1.20	2,986,749	433,904	15.6
Mathematics	54,332	1.31	3,243,564	512,496	15.5
Accounting	51,386	1.32	3,044,661	450,147	14.9
Computer & Information Systems	53,215	1.27	2,951,100	423,772	14.9
Marketing & Marketing Research	49,383	1.39	3,018,642	438,668	14.5
Political Science & Government	48,132	1.40	3,157,711	474,772	14.4
Medical Technologies Technicians	49,574	1.16	2,729,318	335,737	13.7
General Business	48,724	1.31	2,826,819	368,205	13.5
Journalism	44,782	1.51	2,966,166	409,004	13.2
Communications	45,770	1.44	2,918,217	391,226	13.2
Chemistry	44,982	1.39	2,902,724	370,262	12.6
Business Management & Administration	45,258	1.29	2,698,270	309,403	12.1
Human Resources & Personnel Management	43,020	1.36	2,725,045	315,672	12.1
English Language & Literature	41,625	1.42	2,735,383	311,796	11.5
Foreign Language Studies	41,314	1.40	2,815,094	326,438	11.3
Commercial Art & Graphic Design	43,534	1.33	2,596,828	276,878	11.3
History	42,311	1.37	2,673,603	290,514	11.2
Treatment Therapy Professions	40,940	1.47	2,732,827	306,380	11.1
Biology	40,911	1.43	2,733,910	298,689	10.9
Hospitality Management	42,128	1.31	2,495,950	237,992	10.5
Health & Medical Administrative Services	42,739	1.21	2,565,139	240,070	10.5
Sociology	40,941	1.36	2,440,876	218,194	10.1
Liberal Arts	39,818	1.35	2,477,150	220,277	9.8
Psychology	38,861	1.38	2,471,531	212,829	9.6
Fine Arts	36,941	1.46	2,388,022	193,018	9.4
Criminal Justice & Fire Protection	39,595	1.28	2,278,333	162,009	9.0
Physical Fitness, Parks, Recreation & Leisure	38,950	1.34	2,329,142	170,875	8.9
Agriculture & Animal Husbandry	38,954	1.27	2,253,246	150,397	8.8
Family & Consumer Sciences	36,553	1.33	2,258,615	138,919	8.0
General Education	38,673	1.16	2,075,995	86,487	7.2
Special Needs Education	36,431	1.21	2,058,058	74,526	6.6
Social Work	34,662	1.26	2,058,666	67,571	6.3
Art & Music Education	36,171	1.22	2,020,363	60,146	6.2
Elementary Education	35,703	1.19	1,979,767	43,009	5.6
Early Childhood Education	33,680	1.26	1,903,984	10,212	4.4

Source: Calculated from the U.S. Department of Commerce, Census Bureau, 2012-16 American Community Survey Five-Year Public Use Microdata Sample.

RETURN ON INVESTMENT BY MAJOR

The methodology used to calculate returns on college investment by major is similar to the one used to calculate the average ROI across all college graduates. The work-life earnings streams of college graduates vary by major, as described in the previous section. The opportunity cost of going to college, on the other hand, is assumed to be the same for each male and the same for each female, regardless of major. The alternative earnings associated with a terminal high school degree are the averages across all high school graduates, as used in the calculations behind Tables 1 and 2. If individuals who choose and complete majors with high ROIs, say engineers, would have earned more than the average high school graduate had they not decided to attend college, then the ROIs estimated for them will be upward biased. Similarly, if individuals who choose low-ROI majors, say those who become primary or secondary school teachers, would have earned below-average high school wages, then the ROIs estimated for them will be downward biased.

Estimates of NPVs and ROIs by college major are presented in the fourth and fifth columns of Tables 3 and 4. NPVs are again calculated assuming the real long-term interest rate (the discount rate) is 4 percent. College majors that provide positive net present value are those with ROIs that exceed 4 percent.

Beginning with men, the estimated ROIs have an extremely wide variance, ranging from a high of 17.4 percent for economics to a low of 2.1 percent for elementary education. Thirty-nine of the 40 majors have an ROI that exceeds 4 percent and so, strictly speaking, represent a worthwhile investment. Nevertheless, some majors are much more lucrative than others. All fields of engineering and many business disciplines have an ROI of 13 percent or more. On the other hand, education, the arts, forestry and natural resource management, and criminal justice have ROIs of 8 percent or lower.

The ROIs estimated for women also show a large variance, ranging from a high of 23.8 percent for chemical engineering to a low of 4.4 percent for early childhood education. Each of the 40 majors has an ROI that exceeds 4 percent and so represents a worthwhile investment at a real interest rate of 4 percent. Majors with an ROI of at least 14 percent include chemical and electrical engineering, computer science, economics, finance, nursing, and accounting. Majors with relatively low ROIs include education, social work, and criminal justice.

When comparing ROIs between men and women with a common major, the ROI for women is always higher than the ROI for men (see Table 5). The lifetime earnings of female college graduates are lower than those of male graduates in each major. But, in calculating the ROI, this disadvantage for women is more than offset by the fact that the alternative to going to college (entering the workforce after completing high school) pays much less for women than it does for men.

While female ROIs are higher than male ROIs within a common major, the average ROI across all female college graduates is slightly lower than the average for men (see Tables 1 and 2). The reason for this disparity in results is that women more frequently choose majors with low ROIs (e.g., education or psychology rather than engineering or finance).

TABLE 5
COMPARING RETURNS ON INVESTMENT BETWEEN MEN AND WOMEN WITH THE SAME MAJOR FIELD OF STUDY

	Return on Investment		Lifetime Earnings	
Major	**Male**	**Female**	**Male**	**Female**
Accounting	13.0%	14.9%	$4,412,484	$3,044,661
Agriculture & Animal Husbandry	8.6	8.8	3,192,868	2,253,246
Biology	9.1	10.9	3,549,994	2,733,910
Business Management & Administration	11.4	12.1	3,825,883	2,698,270
Chemical Engineering	17.3	23.8	4,967,377	4,159,513
Chemistry	9.4	12.6	3,624,780	2,902,724
Commercial Art & Graphic Design	9.3	11.3	3,394,301	2,596,828
Communications	10.2	13.2	3,719,172	2,918,217
Computer & Information Systems	12.1	14.9	3,628,464	2,951,100
Computer Science	16.9	20.5	4,308,307	3,462,319
Criminal Justice & Fire Protection	7.7	9.0	3,152,463	2,278,333
Economics	17.4	19.3	5,022,407	3,384,628
Electrical Engineering	16.4	22.0	4,446,861	3,756,191
Elementary Education	2.1	5.6	2,478,594	1,979,767
English Language & Literature	8.9	11.5	3,589,464	2,735,383
Finance	16.7	17.8	5,006,141	3,329,715
Fine Arts	6.9	9.4	3,005,568	2,388,022
General Business	12.5	13.5	4,055,996	2,826,819
General Education	4.4	7.2	2,707,583	2,075,995
History	9.6	11.2	3,596,675	2,673,603
Hospitality Management	8.0	10.5	3,340,406	2,495,950
Journalism	9.9	13.2	3,606,418	2,966,166
Liberal Arts	8.6	9.8	3,330,951	2,477,150
Marketing & Marketing Research	13.0	14.5	4,255,993	3,018,642
Mathematics	14.5	15.5	4,298,605	3,243,564
Nursing	10.7	15.6	3,528,846	2,986,749
Physical Fitness, Parks, Recreation & Leisure	6.5	8.9	3,043,424	2,329,142
Political Science & Government	12.4	14.4	4,147,780	3,157,711
Psychology	8.5	9.6	3,370,546	2,471,531
Sociology	9.1	10.1	3,396,482	2,440,876

Source: Calculated from data of the U.S. Department of Commerce, Census Bureau.

Education Majors

Three education majors are on the list of common majors for men in Table 3. They provide the lowest ROIs of the 40 listed majors, with the ROI for elementary education not reaching the 4 percent threshold.

For women, each of the five education majors on the list of common majors in Table 4 provide a ROI in excess of the 4 percent discount rate, but the education majors occupy five of the six lowest spots in the table. The other major in this group is social work, a field in which philanthropy is understood to be an important part of worker compensation.

These findings are certainly consistent with the experiences of some school districts in the nation who have a hard time finding and retaining high-quality teachers. To improve the financial

attractiveness of education degrees and the occupations of primary or secondary school teachers, some combination of tuition credits or voter-mandated pay increases have been proposed. To gain a sense of perspective on the effectiveness of these policy options, consider a woman with the average earnings stream of someone who majors in general education. As per Table 4, the NPV of this degree is currently $86,500 and the ROI is 7.2 percent. If the net tuition for this program were cut in half, from $8,315 per year to $4,158 per year, the new NPV would be $102,200 and the ROI would be 8.2 percent. Alternatively, if instead of a tuition reduction, the education graduate were to receive a 10-percent pay increase throughout her working life, the resulting NPV would be $246,100 and the ROI would be 11.7 percent.

ALTERNATIVE MEASURES OF THE BURDEN OF STUDENT LOAN REPAYMENT

If the net present value of a college education is positive and if the interest rate on student debt is no greater than the discount rate, a student can borrow at age 18 an amount of money equal to the full cost of attending college plus the NPV of the degree and be able to pay off the loan over his or her working life using the earnings premium that a four-year degree provides. To be specific, consider a male student who majors in biology. The net present value of this degree is estimated to be $298,000. If the student could borrow at a real annualized interest rate of 4 percent, there would be enough of a lifetime earnings premium generated by the degree to pay off a loan acquired at age 18 in the amount of $434,000! — the NPV of the degree plus $136,000 which is the present value of four years' worth of tuition payments plus foregone high school earnings. The average annual amount of new loans actually acquired by full-time undergraduate students is $8,700 (NCES 2018), for a total over four years of $35,000. From this perspective, there would seem to be plenty of money in the work-life earnings of a college graduate to be able to pay off the kind of loans typically obtained by students.

Of course, student loan markets are known to be imperfect, owing in part to an inherent lack of collateral for this kind of investment. Lenders and students alike prefer loans that are limited to the out-of-pocket expenses of going to college (e.g., tuition) and are paid off over a short period of time (typically 10 years) beginning soon after graduation. With these restrictions, it is certainly possible that student loans present a cash flow problem, even for students whose majors provide economic value over the long run.

Data on college earnings by age and major make it possible to evaluate the potential burden of paying off student debt for alternative groups of college students. In a base case set of calculations, the student is assumed to incur debt at a rate of $10,000 per year (roughly the average rate of borrowing for students attending four-year colleges and universities) for four years. The debt is then assumed to be paid off at a real interest rate of 4 percent over a 10-year period beginning early in the graduate's working life, e.g., from ages 25 to 34 (a schedule of repayment representative of those commonly selected by students). Three alternative measures of the resulting burden of student debt repayment are considered:

- The earnings of the college graduate net of outlays for debt repayment minus what the student would have earned had he or she only finished high school.
- Outlays for debt repayment as a percentage of college earnings.
- Outlays for debt repayment as a percentage of "disposable income," defined as earnings minus 150 percent of the official poverty level for individuals.

A rule of thumb among financial aid experts is that the probability of student debt default becomes significant when the ratio of debt repayment to disposable income rises above 20 percent (Hershbein, et al. November 2014). Tables 6 and 7 show these three measures of debt burden by sex for all college graduates collectively and for a set of 15 popular college majors, one set for men and another for women.

For men who major in fields with high ROIs, such as finance, computer science, and engineering, paying off $40,000 worth of college debt would hardly seem to present much of a financial burden. During the ages of 25 to 34 when the debt is assumed to be paid off, earnings net of debt payments are at least $15,000-to-$20,000 higher than what the individual would have been earning with only a high school degree, and they are on average over this 10-year period

$25,000 to $30,000 higher. For men with these majors, student debt is never higher than 10 percent of earnings, and debt payments as a percent of disposable income are never higher than 15 percent.

The potential burden of debt repayment is more serious, however, for majors with relatively low ROIs. For example, for men who major in English, psychology, or general education, earnings net of debt payments are $5,000 lower than high school earnings in some of the years of debt repayment, the ratio of debt payments to earnings can reach 15 percent, and the ratio of debt payments to disposable income can be as high as 30 percent.

The potential burden of student debt is more serious for women than it is for men. Women pay the same tuition as men but earn less for any given major. When evaluating debt burdens using data on mean earnings across all college graduates, and looking at average values of debt burden measures over the 10-year payback period, the ratio of debt payments to college earnings is 8.7 percent for men and 11.3 percent for women. The ratio of debt payments to disposable income is 12.0 percent for men and 17.7 percent for women.

TABLE 6
ALTERNATIVE MEASURES OF THE AFFORDABILITY OF STUDENT DEBT REPAYMENT, ALL COLLEGE GRADUATES AND SELECTED MAJORS: MEN

Major	College Earnings Premium Less Debt Payment, Ages 25 to 34		Debt Payment as a Share of College Earnings, Ages 25 to 34		Debt Payment as a Share of College Earnings Minus 1.5*poverty level, Ages 25 to 34	
	Minimum	Mean	Maximum	Mean	Maximum	Mean
Finance	$13,184	$33,040	10.5%	7.6%	15.5%	10.1%
Computer Science	19,213	28,942	9.4	7.8	13.4	10.3
Electrical Engineering	18,082	28,271	9.6	7.8	13.8	10.4
Mechanical Engineering	15,035	26,569	10.1	8.0	14.8	10.8
Accounting	5,199	16,567	12.2	9.3	19.7	13.4
General Business	4,337	17,133	12.4	9.3	20.3	13.4
Political Science & Government	2,522	16,381	12.9	9.5	21.6	13.8
Business Management & Administration	2,557	13,686	12.9	9.8	21.6	14.3
Communications	-2,999	9,437	14.7	10.6	27.1	16.5
History	-3,648	7,002	14.9	11.0	27.9	17.3
Biology	-5,324	6,035	15.6	11.3	30.4	18.0
English Language & Literature	-5,956	2,847	15.8	11.9	31.4	19.6
Psychology	-4,407	3,637	15.2	11.7	29.0	18.9
Criminal Justice & Fire Protection	-4,219	4,817	15.1	11.4	28.7	18.1
General Education	-6,096	-3,503	15.9	13.3	31.6	23.1
All College Graduates	$13,271	$20,566	10.4	8.7	15.5	12.0

Note: Calculations assume debt is incurred at a rate of $10,000 per year for four years and paid back over 10 years from ages 25 to 34 at a real interest rate of 4 percent.

Source: Calculated from data of the U.S. Department of Commerce, Census Bureau.

TABLE 7
ALTERNATIVE MEASURES OF THE AFFORDABILITY OF STUDENT DEBT REPAYMENT, ALL COLLEGE GRADUATES AND SELECTED MAJORS: WOMEN

Major	College Earnings Premium Less Debt Payment, Ages 25 to 34		Debt Payment as a Share of College Earnings, Ages 25 to 34		Debt Payment as a Share of College Earnings Minus 1.5*poverty level, Ages 25 to 34	
	Minimum	Mean	Maximum	Mean	Maximum	Mean
Computer Science	$24,754	$28,913	10.2%	9.1%	15.0%	12.8%
Nursing	14,524	20,605	12.4	10.4	20.3	15.6
Accounting	11,191	19,076	13.3	10.8	22.9	16.5
Marketing & Marketing Research	8,904	19,536	14.1	10.8	25.2	16.7
General Business	8,776	16,058	14.1	11.4	25.3	18.0
Communications	5,660	16,171	15.3	11.5	29.2	18.5
Business Management & Administration	5,974	12,555	15.1	12.2	28.8	20.1
English Language & Literature	2,552	10,766	16.6	12.8	34.5	22.0
Commercial Art & Graphic Design	3,929	11,348	16.0	12.6	31.9	21.2
Biology	927	9,866	17.4	13.1	38.2	23.0
Sociology	1,516	8,980	17.1	13.3	36.8	23.3
Psychology	279	6,982	17.7	13.9	39.8	25.3
Criminal Justice & Fire Protection	1,178	6,221	17.3	14.0	37.5	25.5
General Education	1,688	3,242	17.0	15.0	36.4	28.4
Elementary Education	-1,337	977	18.6	15.9	44.7	32.2
All College Graduates	11,198	16,097	13.3	11.3	22.9	17.7

Note: Calculations assume debt is incurred at a rate of $10,000 per year for four years and paid back over 10 years from ages 25 to 34 at a real interest rate of 4 percent.

Source: Calculated from data of the U.S. Department of Commerce, Census Bureau.

THE BURDEN OF STUDENT DEBT
UNDER ALTERNATIVE TERMS OF REPAYMENT

Average net tuition and fees at U.S. four-year colleges and universities is roughly $8,300 per year. With room and board added in, the cash flow required to attend college full time approaches $20,000 per year. Borrowing in the amount of $10,000 per year doesn't come close to providing all of the funds necessary to attend college. The student has several options: work part time and take more than four years to finish college; obtain financial or in-kind (room and board) assistance from parents or relatives; or borrow more than $10,000 per year. This paper considers an alternative level of student indebtedness—one created by borrowing $20,000 per year for four years. Tables 8 and 9 show what the burden of paying off this amount of debt would be using the measure of financial burden defined by the ratio of debt payments to disposable income.

If the debt is to be paid off over 10 years from ages 25 through 34, debt in this higher amount would seem to impose serious financial hardship on virtually all college students, regardless of sex or major. The mean ratio of debt payments to disposable income over the 10-year payback period would be at least 20 percent for each of the individual majors considered, and would be over 30 percent for seven of the 15 male majors and for 14 of the 15 female majors. One way to relieve the debt burden is to begin paying off the debt later in one's working life, when earnings are higher, say from ages 30 to 39. This alternative payment scheme provides some but only modest relief. Looking at averages across all male college graduates, the mean ratio of debt payments to disposable income only falls from 24.0 percent to 22.5 percent.

More substantial debt relief is obtained if the payback period is extended, say from 10-to-15 years. In this case, the mean ratio of debt payments to disposable income falls from 24.0 percent to 15.6 percent for the average male graduate and is below 20 percent for eight of the 15 male majors. For women, the mean ratio of debt payments to disposable income over the payback period falls from 35.4 percent to 23.7 percent for the average graduate. The debt burden measure remains above 20 percent, however, for 14 of the 15 individual female majors evaluated.

TABLE 8
THE AFFORDABILITY OF STUDENT DEBT UNDER ALTERNATIVE TERMS OF REPAYMENT, ALL COLLEGE GRADUATES AND SELECTED MAJORS: MEN

Major	Debt Paid Back Over 10 Years, Ages 25 to 34		Debt Paid Back Over 10 Years, Ages 30 to 39		Debt Paid Back Over 15 Years, Ages 25 to 39	
	Maximum	Mean	Maximum	Mean	Maximum	Mean
Finance	31.1%	20.2%	21.9%	16.3%	22.7%	12.6%
Computer Science	26.8	20.6	23.8	19.3	19.6	13.5
Electrical Engineering	27.5	20.8	24.0	19.7	20.1	13.6
Mechanical Engineering	29.7	21.6	24.6	20.0	21.6	14.1
Accounting	39.4	26.7	30.0	22.6	28.7	16.7
General Business	40.6	26.7	29.3	22.3	29.6	16.8
Political Science & Government	43.3	27.6	29.7	22.0	31.5	17.1
Business Management & Administration	43.2	28.7	31.7	24.3	31.5	18.1
Communications	54.2	32.9	34.7	25.6	39.5	20.3
History	55.9	34.6	37.2	27.5	40.7	21.4
Biology	60.7	36.1	38.3	27.6	44.2	22.1
English Language & Literature	62.8	39.1	42.5	29.9	45.7	23.8
Psychology	58.0	37.9	41.5	29.9	42.3	23.3
Criminal Justice & Fire Protection	57.4	36.2	39.3	31.2	41.9	23.1
General Education	63.2	46.2	53.9	41.5	46.1	29.3
All College Graduates	31.0	24.0	27.8	22.5	22.6	15.6

Notes:
The affordability measure being evaluated is debt payments as a percentage of earnings minus 150 percent of the poverty level.
Calculations assume debt is incurred at a rate of $20,000 per year for four years and paid back at a real interest rate of 4 percent.

Source: Calculated from data of the U.S. Department of Commerce, Census Bureau.

TABLE 9
THE AFFORDABILITY OF STUDENT DEBT UNDER ALTERNATIVE TERMS OF REPAYMENT, ALL COLLEGE GRADUATES AND SELECTED MAJORS: WOMEN

Major	Debt Paid Back Over 10 Years, Ages 25 to 34		Debt Paid Back Over 10 Years, Ages 30 to 39		Debt Paid Back Over 15 Years, Ages 25 to 39	
	Maximum	Mean	Maximum	Mean	Maximum	Mean
Computer Science	30.0%	25.5%	30.2%	26.0%	21.9%	17.2%
Nursing	40.6	31.2	36.1	31.5	29.6	21.0
Accounting	45.9	33.0	37.6	30.5	33.4	21.4
Marketing & Marketing Research	50.3	33.3	36.4	29.4	36.7	21.5
General Business	50.6	36.0	40.9	33.1	36.9	23.3
Communications	58.4	37.1	39.9	31.3	42.6	23.5
Business Management & Administration	57.5	40.2	45.2	37.3	41.9	26.3
English Language & Literature	69.0	44.0	47.7	36.7	50.3	27.7
Commercial Art & Graphic Design	63.9	42.4	46.7	38.0	46.6	27.4
Biology	76.3	46.0	49.1	37.5	55.6	28.8
Sociology	73.5	46.7	50.9	40.2	53.6	29.8
Psychology	79.6	50.6	55.0	42.7	58.0	32.0
Criminal Justice & Fire Protection	75.1	51.0	57.0	46.5	54.7	33.1
General Education	72.7	56.8	66.4	57.0	53.0	37.9
Elementary Education	89.4	64.4	73.2	62.5	65.2	42.7
All College Graduates	45.9	35.4	40.9	35.3	33.4	23.7

Notes:
The affordability measure being evaluated is debt payments as a percentage of earnings minus 150 percent of the poverty level.
Calculations assume debt is incurred at a rate of $20,000 per year for four years and paid back at a real interest rate of 4 percent.

Source: Calculated from data of the U.S. Department of Commerce, Census Bureau.

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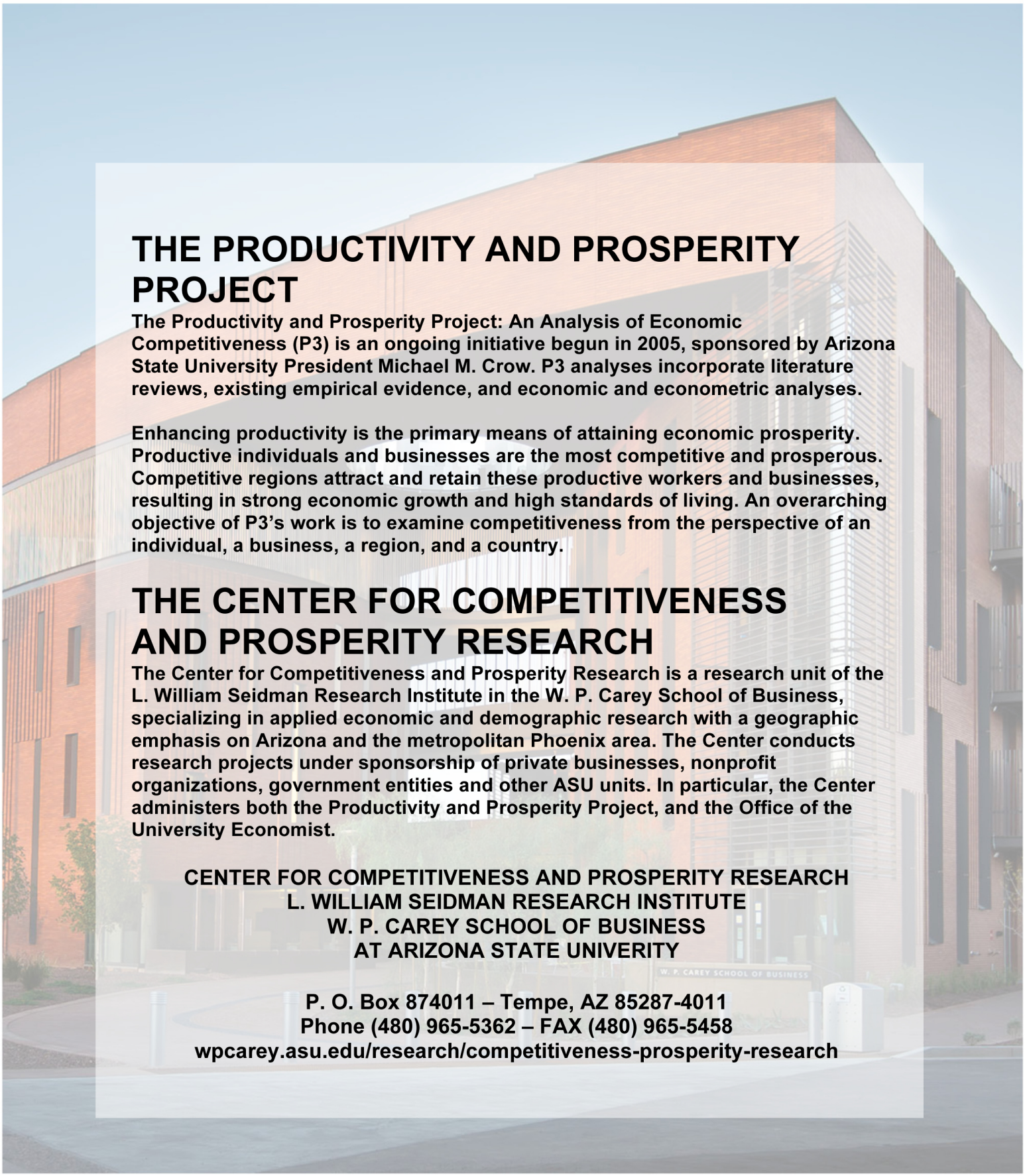

THE PRODUCTIVITY AND PROSPERITY PROJECT

The Productivity and Prosperity Project: An Analysis of Economic Competitiveness (P3) is an ongoing initiative begun in 2005, sponsored by Arizona State University President Michael M. Crow. P3 analyses incorporate literature reviews, existing empirical evidence, and economic and econometric analyses.

Enhancing productivity is the primary means of attaining economic prosperity. Productive individuals and businesses are the most competitive and prosperous. Competitive regions attract and retain these productive workers and businesses, resulting in strong economic growth and high standards of living. An overarching objective of P3's work is to examine competitiveness from the perspective of an individual, a business, a region, and a country.

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The Center for Competitiveness and Prosperity Research is a research unit of the L. William Seidman Research Institute in the W. P. Carey School of Business, specializing in applied economic and demographic research with a geographic emphasis on Arizona and the metropolitan Phoenix area. The Center conducts research projects under sponsorship of private businesses, nonprofit organizations, government entities and other ASU units. In particular, the Center administers both the Productivity and Prosperity Project, and the Office of the University Economist.

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