



# QUANTITATIVE EXAMPLES OF THE FINANCIAL AND ECONOMIC BENEFITS OF HIGHER EDUCATION

March 2008

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**P<sup>3</sup>** | PRODUCTIVITY AND  
PROSPERITY PROJECT

**ASU** W. P. CAREY  
SCHOOL of BUSINESS  
ARIZONA STATE UNIVERSITY

# **QUANTITATIVE EXAMPLES OF THE FINANCIAL AND ECONOMIC BENEFITS OF HIGHER EDUCATION**

**A Report from the Productivity and Prosperity Project (P3),  
Supported by the Office of the University Economist**

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## **SUMMARY**

Universities provide numerous benefits to the community in which they are located. This report focuses on three of the financial/economic benefits.

### **Individual Financial Benefits of Higher Education**

Earnings increase with educational attainment. Over the working life of an individual, the financial benefits of additional educational attainment become large. For example, earnings of an individual with a bachelor's degree average \$17,000 per year higher than those with only a high school diploma even after netting out the cost of tuition and foregone earnings while in college. If an individual works for 44 years after graduating (from age 22 through 65), the net financial benefit of the university degree to the individual accumulates to around \$750,000.

If the comparison is made between those with a bachelor's degree and those with some college, the financial benefit of the bachelor's degree is somewhat less. However, a large increase in earnings occurs with the completion of the bachelor's degree (another large gain is realized with the completion of a postgraduate degree).

If 1,000 individuals per year received a bachelor's degree instead of stopping their education earlier and obtained a suitable job in Arizona, earnings in Arizona would be higher than under the status quo, with the impact rising over time. After 44 years, the additional earnings of those individuals who went on to complete a bachelor's degree versus those stopping with a high school diploma would be nearly \$750 million per year. For Arizona to realize the additional earnings, job quality in the state must improve such that instead of the creation of 1,000 jobs per year that are filled by less educated individuals, 1,000 jobs are created that require a bachelor's degree.

### **Social Financial Benefits of Higher Education**

While individuals particularly benefit financially from enhancing their educational attainment, the financial benefits of increased educational attainment "spillover" to all workers in the area. A 1 percent increase in the proportion of college-educated workers in an area has been estimated to raise wages by 1.9 percent among those with less than a high school diploma, 1.6 percent among high school graduates, 1.2 percent among those with some college, and 0.4 percent among university graduates (beyond the increase in wages realized by the new university graduates).

Based on the size of the Arizona workforce and estimated earnings per worker in 2006, overall earnings in Arizona would be \$2.1 billion per year higher if a 1 percentage point increase in the share of workers with a university degree were achieved. This is an increase of 1.7 percent in aggregate earnings. Currently, an additional 30,000+ college graduates are needed to achieve a 1 percent increase in the proportion of college-educated workers in Arizona.

An increase in the share of college-educated individuals in the Arizona workforce could be achieved through higher educational attainment of net migrants to Arizona and/or through improving the educational attainment of those already in the state. However, to retain more highly educated workers, a higher proportion of the jobs created in Arizona will need to require a bachelor's degree or more. Thus, any strategy to enhance the educational attainment of Arizonans needs to be paired with an economic development strategy to create a greater share of

higher-quality jobs. Whether the improvement in educational attainment results from migration or from more graduates from Arizona universities, an additional 30,000+ college graduates over and above the state's natural rate of growth in number of college graduates likely will take years to achieve.

### **The Economic Benefits of University Research**

Research grants and awards to the state's universities from sources such as the federal government and private foundations have an impact on the state economy in three ways. The first effect is the standard economic impact that results from the university's expenditure of the research funds. The second impact comes from private-sector companies that license university technology, and start-up and spinoff companies that originate with university research. The third effect is the result of spillovers from university research to the private sector other than to the spinoffs, start-ups, and licensees.

The total impact of university research in Arizona has not been determined with certainty. However, studies conducted elsewhere suggest that the multiplier could be as high as 7 or 8. Thus, a \$100 million research grant could have a total effect in the state of approximately \$750 million.

### **THE INDIVIDUAL FINANCIAL RETURN TO HIGHER EDUCATION**

Individual earnings are directly related to educational attainment. Those with a high school diploma earn more than those who did not graduate from high school, those who received some college credits earn more than those whose education ended with a high school diploma, those with a bachelor's degree earn more than those with some college credits, and those with a graduate degree earn more than those with a bachelor's degree as their highest attainment. In particular, those with a bachelor's degree earn substantially more than those with some college credits. A postgraduate degree provides an additional boost in earnings.

Earnings vary widely with educational attainment. For example, 2000 census data revealed that average annual earnings of individuals with a bachelor's degree was from 74 to 87 percent higher (depending on age) than the earnings of individuals whose maximum educational attainment was a high school diploma. Over a career, an individual with a bachelor's degree earns on average in excess of \$1 million more than a counterpart with only a high school diploma. Based on a cost-benefit analysis over a person's working life, the expected net return from an individual's payment of tuition and fees and foregone income while obtaining a bachelor's degree is in excess of 11 percent, a rate that compares favorably with real returns on most financial assets.

The differential in earnings based on educational attainment has increased over time. For example, for full-time male workers between the ages of 35 and 44, the earnings differential between those having a bachelor's degree and those with a high school diploma has risen from 38 percent in the 1980-84 period to 94 percent in 2000-03. This rising differential constitutes the principal evidence for the emerging "knowledge economy."

### **Calculation of the Return**

In order to calculate the financial benefit of obtaining a bachelor's degree, it is necessary to consider the expenses of college tuition and foregone earnings while attending college as well as the higher earnings realized after completing the degree. Because the costs and benefits occur at different times over a long span of years, the figures must be discounted to present value. A 4 percent inflation-adjusted annual discount rate is assumed. The result of these calculations is an annualized net benefit of about \$17,000 per year in obtaining a bachelor's degree relative to a high school diploma being the highest attainment. If an individual works for 44 years after graduating (from age 22 through 65), the benefit of the university degree accumulates to around \$750,000. A lower assumed discount rate results in a lesser net benefit.

If the comparison is made between those with a bachelor's degree and those with some college, the financial benefit of the bachelor's degree is somewhat less. However, a large increase in earnings occurs with the completion of the bachelor's degree (another large gain is realized with the completion of a postgraduate degree).

If 1,000 individuals per year received a bachelor's degree instead of stopping their education earlier and obtained a suitable job in Arizona, earnings in Arizona would be higher than under the status quo, with the impact rising over time. After 44 years, the additional earnings of those individuals who went on to complete a bachelor's degree versus those stopping with a high school diploma would be nearly \$750 million per year.

### **Discussion**

For Arizona to realize the additional earnings, job quality in the state must improve such that instead of the creation of 1,000 jobs per year that are filled by less educated individuals, 1,000 jobs are created that require a bachelor's degree. Further, since some individuals do not participate in the workforce, at least consistently for the 44 years, more than 1,000 additional college graduates would be needed to realize an addition of 1,000 college-educated members of the workforce.

The aggregate financial benefit to the area that eventually would reach \$750 million per year is a net figure in that tuition costs and foregone earnings while in school have been included. However, the analysis does not consider additional costs realized by the universities and economic development organizations to implement a program that provides a university education to more people and provides more jobs suitable to those with a bachelor's degree. Thus, this figure is an aggregate of the individual return but not a measure of the societal return.

### **THE SOCIAL FINANCIAL RETURN TO HIGHER EDUCATION**

In his 2004 *Journal of Econometrics* paper, "Estimating the Social Return to Higher Education: Evidence from Longitudinal and Repeated Cross-Sectional Data," Enrico Moretti estimated the effect on the earnings of all working adults from increasing the proportion of the workforce with a university degree. He used the Public Use Microdata Sample (PUMS) from the 1980 and 1990 censuses, classifying the maximum educational attainment reported by individuals into four groups: less than a high school diploma, high school graduate, some college, and bachelor's degree or more.

Moretti found that a 1 percentage point increase in the share of college graduates (alternatively, a “1 percent increase in the proportion of college-educated workers”) raised wages in each educational attainment group:

- 1.9 percent among those with less than high school diploma
- 1.6 percent among high school graduates
- 1.2 percent among those with some college
- 0.4 percent among college graduates.

In other words, it is not just individuals who benefit financially from enhancing their educational attainment. Instead, the benefits “spill over” to all workers.

Moretti was not as specific as needed to be able to confidently interpret his results. He mentions using PUMS records for working adults, without specifying the age range used to define adults. Similarly, he appears to measure earnings in terms of hourly wages (in log form in the regression), but does not specify how he calculated the hourly wage. Thus, the readily available measures of earnings used below may not exactly correspond to the data he used in his calculations. It is assumed that his general finding that enhanced educational attainment benefits all workers, not just those achieving the greater education, can be generalized to all measures of earnings and to all age groups.

### **2000 Census for Arizona**

The Census Bureau provided mean earnings (in 1999) by educational attainment in their special file PHC-T-39. Figures were produced for the 18-to-64 age group, both for all individuals who worked during 1999 and for full-time, year-round workers. These data were produced from the entire one-in-eight sample of households who completed the long-form of the census questionnaire, rather than from the 5 percent PUMS sample.

More categories of educational attainment were produced by the Census Bureau than used by Moretti, so the data are collapsed into the four Moretti categories in Table 1. Of all workers 18-to-64 years old, 23.95 percent had at least a bachelor’s degree in Arizona in 1999, not much different from the 23.53 percent of all individuals 25 or older, the standard Census Bureau presentation of educational attainment. (Of those 18-to-64 who worked full-time year-round, the share was higher at 26.3 percent.)

Without changing the overall number of workers, in order to meet the Moretti specification of a 1 percentage point increase in share with a bachelor’s degree, the state would have needed an additional 24,514 workers with a college degree (a 4.2 percent increase in the number with at least a bachelor’s degree). Based on the earnings figures in the table and the percentage increases in earnings specified by Moretti, annual earnings would have been between \$346 and \$388 higher in each of the three categories of educational attainment less than a college degree and \$205 higher for those with at least a bachelor’s degree.

Looking at only full-time, year-round workers, the required increase in number with a university degree would be 14,721, a 3.8 percent increase in the number with at least a bachelor’s degree. The increases in earnings would have been between \$449 and \$490 in the three categories of educational attainment less than a bachelor’s degree, and \$245 for college graduates.

**TABLE 1**  
**NUMBER OF WORKERS AGE 18 TO 64 AND EARNINGS**  
**BY EDUCATIONAL ATTAINMENT IN ARIZONA IN 1999**

<b>Educational Attainment</b>	<b>All Who Worked During 1999</b>		<b>Full-Time, Year-Round Workers</b>	
	<b>Number of Workers</b>	<b>Mean Earnings</b>	<b>Number of Workers</b>	<b>Mean Earnings</b>
Total	2,451,367	\$31,638	1,472,067	\$40,482
Less than High School	391,114	18,200	183,220	24,194
High School Graduate	559,841	24,271	335,228	30,655
Some College	913,312	29,343	566,048	37,380
Bachelor's Degree or More	587,100	51,185	387,571	61,209

Source: U. S. Department of Commerce, Census Bureau, PHC-T-39.

### **Updating the 2000 Census Data**

The American Community Survey (ACS) for 2005 and 2006 can be used to update some of the 2000 census data, but ACS sampling error is large. Some of the detailed data are not readily available and estimating such figures from the PUMS files for the ACS would not result in reasonable results due to very substantial sampling error.

Overall, for the population 25 and older, educational attainment is higher in the 2005 and 2006 ACS than in the 2000 census. While some increase is expected due to the deaths of older individuals from cohorts in which relatively little educational attainment was the norm, the accuracy of the 2 percentage point gain in the share of college graduates between 2000 and 2005 is questionable. Similarly, the earnings data show questionable changes between 1999 and 2005 and between 2005 and 2006.

Thus, reasonably accurate updated data do not exist for the number of workers by educational attainment and the mean earnings by attainment category. It is assumed that educational attainment among the workforce did not change between 2000 and the current time (which is not inconsistent with a gain in the entire 25-and-older population since the educational attainment of retirees is assumed to have increased since 2000). Further, it is assumed that average earnings rose at the same rate in each of the educational attainment categories.

U.S. Bureau of Economic Analysis (BEA) data can be used as a proxy to estimate increases in the size of the overall workforce and changes in overall earnings since 1999; the latest BEA data are for 2006. However, instead of measuring working individuals, the BEA employment figure is a count of jobs (including proprietors as well as wage and salary workers); some individuals work more than one job and thus are counted more than once in the BEA data. BEA employment rose 23.69 percent in Arizona between 1999 and 2006. Assuming that the relationship between jobs and working individuals did not change between 1999 and 2006, the number working in 2006 also was 23.69 percent higher than in 1999, or an increase of 580,661 from 2,451,367 to 3,032,028. Assuming the inflation-adjusted increase between 1999 and 2006 in BEA average earnings by job of 8.9 percent also held for average earnings by individual, mean earnings rose from \$31,638 in 1999 (\$37,682 in 2006 dollars) to \$41,036. The estimated number of workers and earnings in 2006 are shown in Table 2.

**TABLE 2**  
**ESTIMATED NUMBER OF WORKERS AGE 18 TO 64 AND EARNINGS**  
**BY EDUCATIONAL ATTAINMENT IN ARIZONA IN 2006**

<b>Educational Attainment</b>	<b>All Who Worked During 2006</b>		<b>Full-Time, Year-Round Workers</b>	
	<b>Number of Workers</b>	<b>Mean Earnings</b>	<b>Number of Workers</b>	<b>Mean Earnings</b>
Total	3,032,028	\$41,036	1,820,759	\$52,507
Less than High School	483,758	23,606	226,620	31,381
High School Graduate	692,452	31,481	414,634	39,760
Some College	1,129,650	38,059	700,129	48,483
Bachelor's Degree or More	726,168	66,390	479,376	79,391

Source: Estimated, see text.

The results of a 1 percentage point increase in the share of workers with a university degree are presented in Table 3. An additional 30,320 individuals with at least a bachelor's degree are assumed to come from the "some college" category. Mean earnings in Table 3 reflect the spillover effects estimated by Moretti by attainment category applied to the earnings in Table 2.

Table 4 shows the aggregate earnings figures calculated from the number of workers and mean earnings in Table 2 ("before") and Table 3 ("after"). Based on the size of the workforce in 2006, overall earnings in Arizona would be \$2.1 billion per year — \$126.551 billion less \$124.422 billion — higher if a 1 percentage point increase in the share of workers with a university degree occurred. This is an increase of 1.7 percent. Among full-time, year-round workers, the increase would be \$1.5 billion (1.6 percent).

### **Discussion**

An increase in the share of college-educated individuals in the Arizona workforce could be achieved through higher educational attainment of net migrants to Arizona or through improving the educational attainment of those already in the state. An increase in the share of more highly educated in-migrants and/or a decrease in the share of highly educated out-migrants would raise educational attainment in Arizona. However, to achieve a more highly educated workforce, a higher proportion of the jobs created in Arizona will need to require a bachelor's degree or more.

Similarly, an increase in the share of college-educated individuals in the Arizona workforce could result from enhanced educational attainment of Arizona's youths and young adults. As with migrants, however, job quality in Arizona needs to be enhanced in order to retain these more highly qualified individuals. While an improvement in the educational attainment of workers in Arizona might result in somewhat better overall job quality, this would occur only with a lag. Further, it is unlikely that improving educational attainment alone would have the effect of creating enough high-quality jobs to meet the demand of the increased number of college graduates. Thus, any strategy to enhance the educational attainment of Arizonans needs to be paired with an economic development strategy to create a greater share of higher-quality jobs.

**TABLE 3**  
**SIMULATED NUMBER OF WORKERS AGE 18 TO 64 AND EARNINGS BY**  
**EDUCATIONAL ATTAINMENT IN ARIZONA IN 2006 ASSUMING A 1 PERCENTAGE**  
**POINT INCREASE IN THE SHARE WITH A BACHELOR'S DEGREE OR MORE**

<b>Educational Attainment</b>	<b>All Who Worked During 2006</b>		<b>Full-Time, Year-Round Workers</b>	
	<b>Number of Workers</b>	<b>Mean Earnings</b>	<b>Number of Workers</b>	<b>Mean Earnings</b>
Total	3,032,028	\$41,738	1,820,759	\$53,339
Less than High School	483,758	24,055	226,620	31,977
High School Graduate	692,452	31,985	414,634	40,396
Some College	1,099,330	38,516	681,921	49,065
Bachelor's Degree or More	756,488	66,656	497,584	79,709

Source: Estimated, see text.

**TABLE 4**  
**TOTAL EARNINGS IN ARIZONA IN 2006 BEFORE AND AFTER A 1 PERCENTAGE**  
**POINT INCREASE IN THE SHARE WITH A BACHELOR'S DEGREE OR MORE**  
**(Dollars in Billions)**

<b>Educational Attainment</b>	<b>Before</b>	<b>After</b>	<b>Before</b>	<b>After</b>
Total	\$124.422	\$126.551	\$95.603	\$97.117
Less than High School	11.420	11.637	7.112	7.247
High School Graduate	21.799	22.148	16.486	16.750
Some College	42.993	42.342	33.944	33.458
Bachelor's Degree or More	48.210	50.424	38.058	39.662

Source: Estimated, see text.

Whether the improvement in educational attainment results from migration or from more graduates from Arizona universities, an additional 30,000+ college graduates over and above the state's natural rate of growth in number of college graduates likely will take years to achieve.

#### **THE ECONOMIC RETURN TO UNIVERSITY RESEARCH**

University research expenditures spill over to private-sector activities, having significant impacts on both the level of industrial research and development (R&D) and industrial patents within the same geographic area in which the university research occurs. These research activities, in turn, create innovations and higher-paying jobs in the area. The average real wage in urban areas with research universities was nearly \$3,300 higher than the average of all urban areas. The real per capita income differential was about \$2,800. (These figures reflect cross-city cost-of-living adjustments using The Council for Community and Economic Research Cost of Living Index.) Urban areas endowed with research universities have displayed economic growth over the past three decades that has outstripped that of their surrounding regions.

A distinction should be made between assessing the impacts of university research spending and the knowledge created by a university. Most university and university research impact studies

assess only the spending, but even using this “follow the money” approach, which is the narrowest means to assess university research, a substantial economic impact is realized.

In addition to money circulating through the economy — creating jobs, wages and sales — a substantial amount of knowledge is created by university research, as measured by inventions, patents and licenses. This knowledge, in turn, creates jobs.

Licensees, start-ups and spinoff companies can have a substantial and long-lasting impact on the economy. There is evidence that these activities can have an economic impact each year that is at least as large as the direct economic impact of the research expenditures.

University research expenditures spill over to private-sector research activities, having significant impacts on both the level of industrial R&D and industrial patents within the same geographic area where the university research occurs. These research activities then create innovations and jobs in the area.

University research funding has been shown to positively affect overall economic growth or well-being. Some studies have found a direct link between university research and growth, while others have found the link through human capital formation or via the effect of research on new firm formation. University research also has been linked to increases in productivity and wage rates.

### **Calculation of the Impact**

Funding for research that comes to the state’s universities from outside sources, such as the federal government and private institutions in the form of research grants and awards has an impact on the state economy in three ways. The first effect is the standard economic impact that results from the university’s expenditure of the research funds. Based on a study at the University of Arizona, this effect is relatively modest, with a multiplier of 1.35. That is, a research grant of \$100 million results in a \$135 million impact on the Arizona economy from the expenditures undertaken by the university.

The second impact comes from private-sector companies that license university technology and start-up and spinoff companies that originate with university research. A study at the University of Utah found that for each \$100 million in university research grants, wages at these private-sector companies increased \$54 million. Using the multiplier in the Utah study, the \$54 million multiplies to \$223 million.

The third effect is the result of spillovers from university research to the private sector other than to the spinoffs, start-ups, and licensees. According to a 1989 article in *The American Economics Review* by Jaffe, university research dollars increase the level of corporate R&D expenditures and the number of patents received by corporations in the same state. A 10 percent increase in university research dollars results in an increase in corporate R&D of 7 percent in the same state, on average. Given that corporate R&D expenditures are on average six times higher than university expenditures, the effect of university research is substantial.

These studies suggest that the university research multiplier could be as high as 7 or 8. Thus, a \$100 million research grant could have a total effect in the state of approximately \$750 million.

### **Discussion**

The total impact of university research in Arizona has not been determined with certainty. Studies conducted elsewhere suggest that the multiplier could be as high as 7 or 8. However, the size of the multiplier is highly dependent on (1) the degree of university licensing, spinoffs and start-ups, which varies substantially by university, and (2) the general presence of corporate R&D operations, which also vary by state.

# 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.

## THE CENTER FOR COMPETITIVENESS AND PROSPERITY RESEARCH

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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