THE ECONOMIC IMPACT OF RAISING THE EDUCATIONAL ATTAINMENT OF ARIZONA'S WORKFORCE

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

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SUMMARY

The educational attainment of Arizona's workforce is below the national average. In particular, a smaller proportion of Arizona's workers have a bachelor's degree or an advanced degree. Moreover, annual increases in the share with at least a bachelor's degree continue to be less in Arizona than the national average, so the state's share of workers with university degrees keeps falling further behind the national average.

A policy initiative that results in a greater share of workers with a university degree could have significant economic impacts. Presumably, the policy would encompass programs to produce, attract, and retain university graduates and incorporate a plan to increase the number of Arizona jobs that require a bachelor's degree.

Educational attainment and earnings are closely correlated. Nationally in 2013, those 25 and older with a bachelor's degree earned on average 55 percent more than those whose maximum attainment was some college. Thus, one part of the economic impact of a policy initiative would be the "direct" effect of the higher wages realized by an individual who completes a bachelor's degree.

A larger benefit results from the "spillover" effects of increasing the percentage of workers with university degrees. The more educated workforce leads to increases in productivity among all workers due to the sharing of knowledge and skills across workers and from shifts in the industrial mix to knowledge-based activities. These productivity gains translate into higher output and earnings for all workers.

A static analysis based on data for the 2009-to-2013 period indicates that had the share of the Arizona workforce with a bachelor's degree been 1 percentage point higher, the direct effect on earnings in Arizona would have been about $200 million while the spillover effect would have exceeded $1.1 billion. Thus, the total effect would be greater than $1.3 billion.

Over time, the policy initiative would have substantially greater effects. These effects can be simulated by making a series of assumptions. The first assumption is that the most efficient policy would encourage the completion of a university degree among some of Arizona's above-average share of workers with some college as their maximum educational attainment. A second key assumption is the pace at which more university graduates could be produced and retained. Assuming that a policy initiative raises the percentage of workers with a bachelor's degree by one-sixth of 1 percent per year, Arizona's share of workers with at least a bachelor's degree would equal the national average in 31 years.

At that time, the direct effect would be $10.1 billion and the spillover effect would be $12.5 billion, for a total effect of $22.6 billion. State government general fund revenue would be nearly $1.1 billion higher than if the policy initiative had not been put in place. These dollar values indicate that earnings and government revenues could be nearly 5 percent higher simply by changing the composition of the Arizona workforce to better match the 21st-century economy.

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INTRODUCTION

The educational attainment of Arizona's workforce is below the national average. As seen in Table 1, an above-average share of Arizonans between the ages of 25 and 64 who were employed in 2013 did not graduate from high school, while a below-average share had a maximum attainment of a high school diploma (or alternatively, had passed tests of general educational development — GED). While the percentage with some college was higher than average, a lesser proportion of Arizona's workers had a bachelor's degree or an advanced degree.

Undocumented immigrants account for a disproportionate share of Arizona's workers who have not graduated from high school. Between 2005 and 2013, the proportion of workers who do not have a high school diploma fell by more in Arizona than the national average. This likely is a result of the Legal Arizona Workers Act ("employer sanctions" law) that was passed in 2007 and took effect at the beginning of 2008. The employer sanctions law caused a large number of undocumented immigrants to leave the state — in addition to those who left Arizona due to the state's deep recession, which began at the same time as the implementation of the employer sanctions law.[1] The law likely will continue to greatly restrict the number of undocumented immigrants entering the state, contributing to a decline in the percentage of workers without a high school diploma.

In contrast, the share of the Arizona workforce with a bachelor's degree or more did not rise as much as the national average between 2005 and 2013. Thus, Arizona's deficit of workers with high educational attainment continued to grow larger.

TABLE 1
EDUCATIONAL ATTAINMENT OF EMPLOYED INDIVIDUALS
BETWEEN THE AGES OF 25 AND 64, EXPRESSED AS A SHARE OF THE TOTAL

	United States	Arizona	Difference	Rank*
2013:				
Less Than High School Graduate	8.8%	10.7%	1.9	4
High School Graduate	24.3	21.9	-2.4	42
Some College or Associate's Degree	31.1	35.4	4.3	12
Bachelor's Degree or Higher	35.7	32.1	-3.6	33
Percentage-Point Change Between 2005 and 2013:				
Less Than High School Graduate	-1.2	-1.8	-0.6	38
High School Graduate	-3.0	-1.8	1.2	6
Some College or Associate's Degree	1.0	0.9	-0.1	35
Bachelor's Degree or Higher	3.2	2.8	-0.4	39

* Rank of Arizona among the 50 states and the District of Columbia, with the highest proportion or change in proportion receiving a rank of 1.

Source: U.S. Department of Commerce, Census Bureau, American Community Survey, one-year estimates for 2005 and 2013, Table B23006, obtained from American FactFinder, http://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml.

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[1] See the March 2011 paper "Lessons From the 2007 Legal Arizona Workers Act" produced by the Public Policy Institute of California, http://www.ppic.org/main/publication.asp?i=915.

The focus of this paper is to estimate the economic effects that would result from increasing the share of Arizona workers who have earned a bachelor's degree. The increase is assumed to come from an unspecified policy initiative that encourages some of Arizona's above-average share of workers with some college as their maximum educational attainment to complete a bachelor's degree. To be successful, any initiative designed to boost the educational attainment of Arizona workers must also incorporate a plan to increase the number of Arizona jobs that require a bachelor's degree — that is, to improve the state's substandard job quality.

If the only focus of an initiative is to boost the number of university graduates, the supply of highly educated people likely would exceed the number of jobs in Arizona suitable for these educated individuals, forcing some of the new graduates to leave the state to find appropriate jobs. This would result in limited gains in educational attainment in the Arizona workforce.

In contrast, if the only focus of an initiative is to improve job quality by creating jobs that require high educational attainment, the supply of highly educated people in Arizona likely would be less than the number of available jobs. Highly skilled workers from outside the state would have to be attracted to fill the new jobs. While the in-migration of educated workers would raise the educational attainment of the Arizona workforce, the gains would not be as large as the improvement would be if Arizona residents improved their education and filled the jobs.

Since workforce quality and availability is the most important business location factor,[2] a significant positive effect on the state's economy would result from a policy initiative that simultaneously would encourage more Arizonans to complete a bachelor's degree and would increase the number of jobs in Arizona that are suitable to educated workers. The impact is quantified in this paper in two ways. First, a "static analysis" using current data estimates the effects had such policies already been put into place. Second, a simulation model is developed to estimate the long-term effects if such a set of policies were to be put into effect today. The simulation model is particularly useful since the percentage of the population earning a university degree is slow to respond to policy initiatives.

THE LINK BETWEEN EDUCATIONAL ATTAINMENT AND THE ECONOMY

Educational attainment and earnings are closely correlated. Nationally, those 25 and older with a bachelor's degree who had earnings in 2013 earned an average of $50,000, compared to less than $32,400 for those whose maximum attainment was some college.[3] Thus, one part of the overall economic impact from an initiative to raise the educational attainment of the workforce and increase the number of jobs requiring a university degree comes from the higher wages realized by the additional individuals who complete a bachelor's degree.

A larger benefit results from the "spillover" effects of increasing the percentage of workers with university degrees. A more educated workforce leads to increases in productivity among all

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[2] See the November 2014 University Economist paper "Overview of Economic Competitiveness: Business and Individual Location Factors, With a Focus on Arizona," https://wpcarey.asu.edu/sites/default/files/uploads/center-competitiveness-and-prosperity-research/competitiveness11-14.pdf.

[3] U.S. Department of Commerce, Census Bureau, American Community Survey, one-year estimates for 2013, Table B20004, obtained from American FactFinder, http://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml.

workers due to the sharing of knowledge and skills across workers and from shifts in the industrial mix to activities requiring greater educational attainment. These productivity gains translate into higher output and earnings.

Economists have speculated for at least a century that the social return to education (benefits beyond those accruing to individuals who enhance their educational attainment) may exceed the private return (to those increasing their educational attainment). Enrico Moretti was the first to quantify this,[4] estimating the effect on the earnings of all workers from increasing the proportion of the workforce with a university degree. According to Moretti, a 1-percentage-point increase in the share of college graduates in the workforce raises wages throughout the workforce, 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
- 0.4 percent among college graduates

STATIC ANALYSIS

Various estimates of the economic effects of increasing the percentage of university graduates have been made by the Office of the University Economist over the last several years, with variations present in the methodological assumptions and data sources. A standard methodology and set of data are specified in this section.

The raw data come from the American Community Survey (ACS), which has been conducted on an ongoing basis by the U.S. Census Bureau since 2005. While the Census Bureau produces a large number of standard tables of results from the ACS that are accessible from American FactFinder (http://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml), the standard tables do not provide all of the data needed for this static analysis. Thus, the public use microdata sample (PUMS) file must be accessed. Sampling error from the PUMS file is larger than the error in the standard tables.[5] To reduce sampling error, the PUMS records are combined over a five-year period. Static economic effects were calculated for each of the five five-year time periods that are available from the ACS, from 2005-09 through 2009-13.

Only three variables from the PUMS file were used: age, educational attainment, and person earnings. Any person who reported earnings during a 12-month period was considered to have been employed. Earnings include wages, salaries, commissions, bonuses, tips, and self-employment income. From these variables, the number of Arizonans employed, mean annual earnings, and aggregate annual earnings were calculated for each category of the cross-tabulation of age group and educational attainment. The results for the 2009-13 period are shown in Table 2.

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[4] Enrico Moretti, "Estimating the Social Return to Higher Education: Evidence From Longitudinal and Repeated Cross-Sectional Data," *Journal of Econometrics*, 2004 (accessible from http://economist.asu.edu/p3/education).
[5] U.S. Department of Commerce, Census Bureau, American Community Survey, http://www.census.gov/acs/www/data_documentation/public_use_microdata_sample/.

TABLE 2
EMPLOYMENT AND EARNINGS IN ARIZONA, 2009-13

Age and Maximum Educational Attainment	Number of Individuals Employed	Share of Employment	Mean Annual Earnings	Aggregate Earnings in Millions
All Ages				
Total	3,099,428		$38,698	$119,943
Not a High School Graduate	376,859	12.2%	18,704	7,049
High School Graduate	712,090	23.0	27,473	19,563
Some College	1,159,162	37.4	33,787	39,165
Bachelor's Degree	550,800	17.8	55,967	30,826
Advanced Degree	300,517	9.7	77,664	23,339
Ages 15-21				
Total	276,373		8,766	2,423
Not a High School Graduate	71,111	25.7	5,674	404
High School Graduate	83,853	30.3	10,455	877
Some College	118,781	43.0	9,302	1,105
Bachelor's Degree	2,349	0.8	12,852	30
Advanced Degree	279	0.1	26,804	7
Ages 22-24				
Total	205,569		17,907	3,681
Not a High School Graduate	21,129	10.3	13,223	279
High School Graduate	54,234	26.4	17,203	933
Some College	94,107	45.8	17,664	1,662
Bachelor's Degree	33,442	16.3	22,146	741
Advanced Degree	2,657	1.3	24,743	66
Ages 25-34				
Total	684,328		33,452	22,892
Not a High School Graduate	75,473	11.0	19,730	1,489
High School Graduate	154,540	22.6	26,044	4,025
Some College	258,964	37.8	31,224	8,086
Bachelor's Degree	141,668	20.7	44,347	6,282
Advanced Degree	53,683	7.8	56,065	3,010
Ages 35-44				
Total	661,447		46,085	30,482
Not a High School Graduate	81,845	12.4	22,527	1,844
High School Graduate	140,172	21.2	32,389	4,540
Some College	232,695	35.2	40,477	9,419
Bachelor's Degree	132,553	20.0	62,980	8,348
Advanced Degree	74,182	11.2	85,355	6,332
Ages 45-54				
Total	651,685		50,335	32,803
Not a High School Graduate	73,855	11.3	24,372	1,800
High School Graduate	148,466	22.8	35,175	5,222
Some College	233,718	35.9	43,853	10,249
Bachelor's Degree	123,886	19.0	71,426	8,849
Advanced Degree	71,760	11.0	93,123	6,682

(continued)

TABLE 2 (continued)
EMPLOYMENT AND EARNINGS IN ARIZONA, 2009-13

Age and Maximum Educational Attainment	Number of Individuals Employed	Share of Employment	Mean Annual Earnings	Aggregate Earnings in Millions
Ages 55-64				
Total	463,708		$48,245	$22,371
Not a High School Graduate	39,633	8.5%	23,738	941
High School Graduate	96,313	20.8	33,603	3,236
Some College	170,089	36.7	42,538	7,235
Bachelor's Degree	88,510	19.1	61,246	5,421
Advanced Degree	69,163	14.9	80,073	5,538
Ages 65+				
Total	156,318		33,846	5,291
Not a High School Graduate	13,813	8.8	21,152	292
High School Graduate	34,512	22.1	21,159	730
Some College	50,808	32.5	27,728	1,409
Bachelor's Degree	28,392	18.2	40,696	1,155
Advanced Degree	28,793	18.4	59,185	1,704

Source: Calculated from U.S. Department of Commerce, Census Bureau, American Community Survey, five-year estimates for 2009-13, obtained from Public Use Microdata Sample.

In order to estimate the effect of an initiative that enhanced the educational attainment of Arizona workers and created more jobs requiring bachelor's degrees, 1 percent of the workforce (30,994 individuals in 2009-13) was shifted from the some college to bachelor's degree educational attainment categories. In 2009-13, the number with some college drops from 1,159,162 to 1,128,168 while the number with a bachelor's degree rises from 550,800 to 581,794.

If policies were put in place to encourage individuals with some college to complete their bachelor's degree, it is likely that young people would disproportionately participate. Moreover, if an older person were to enhance his/her education, it is unlikely that obtaining a degree would cause his/her earnings to make the large jump present in the average earnings between those with some college and those with a bachelor's degree. For example, in the 2009-13 period, those 22-to-24 years old with a bachelor's degree earned $4,482 (25%) more than those with some college, but in the 55-to-64 age group, the difference was $27,573 (63%).

Data on the age at which a bachelor's degree is earned are very limited. A study by the National Center for Education Statistics (NCES)[6] in 2008 found that two-thirds of bachelor's degree holders had received the degree by age 23 and another 20 percent before age 30. Since more age detail is desired than is available in the NCES study, the percentage with a bachelor's degree was calculated by single year of age from the 2013 national ACS PUMS file. Based on the results from these two sources, the following distribution was used regarding the age at which participants in the initiative would receive a bachelor's degree:

- 15-21: 9 percent (2,789 individuals in 2009-13)
- 22-24: 71 percent (22,006 individuals in 2009-13)
- 25-34: 15 percent (4,649 individuals in 2009-13)
- 35-44: 2 percent (620 individuals in 2009-13)
- 45-54: 2 percent (620 individuals in 2009-13)
- 55-64: 1 percent (310 individuals in 2009-13)
- 65 or older: none

Aggregate earnings in each age group, and overall, were recalculated based on this shifting of individuals from the some college to bachelor's degree categories. The difference between the recalculated overall aggregate earnings and the original figures represents the "direct effect" of the policy initiative: the higher earnings of those individuals who complete a bachelor's degree.

The "spillover effect" is the increase in wages that occurs throughout the labor force due to a productivity gain resulting from enhanced educational attainment. The spillover effect is calculated using Moretti's estimates of the gain in earnings by educational attainment. The total effect is the sum of the direct effect and the spillover effect.

The ACS data on earnings, like all self-reported income data, are not very reliable. The Census Bureau imputes the value for the 15-to-20 percent of the respondents who refuse to provide this information. Misreporting is likely among a not-insignificant proportion of the respondents who do report this information. Thus, the initial estimates from the ACS data of the effects of the policy initiative are controlled to U.S. Bureau of Economic Analysis (BEA) data on net earnings by place of residence less supplements to wages.[7] Over the five five-year time periods, aggregate earnings calculated from the ACS were 0.3-to-3.3 percent higher than reported by the BEA.

Table 3 shows the economic effects after controlling the initial estimates calculated from the ACS data to the BEA data. The spillover effect is much greater than the direct effect in the static analysis. The inflation-adjusted estimated effects decline over time since the five-year averages for employment and real earnings per worker each dropped over the five time periods. While the dollar effect of increasing the share of university graduates among the workforce by 1 percentage point is large — $1.331 billion in 2009-13 — the percentage impact is small. The increase in earnings is only 0.8 percent.

An increase in earnings will result in higher government revenues. Looking specifically at the state government general fund, not only will individuals realizing a boost in earnings pay more in income tax, they will use their extra earnings to increase their purchases subject to the sales tax. The increase in general fund revenues would have been $61.5 million (0.8 percent). This is calculated as the total effect of $1,331 million in 2009-13 multiplied by 4.62 percent — the average of general fund revenue as a percentage of earnings over the five years.

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[7] U.S. Department of Commerce, Bureau of Economic Analysis, http://www.bea.gov/regional/index.htm.

TABLE 3
ECONOMIC EFFECT OF 1 PERCENT OF THE ARIZONA WORKFORCE
RAISING THEIR MAXIMUM EDUCATIONAL ATTAINMENT
FROM SOME COLLEGE TO A BACHELOR'S DEGREE

	Inflation-Adjusted Effect in Millions*		
	Direct	**Spillover**	**Total**
2005-09	$205	$1,243	$1,447
2006-10	216	1,205	1,422
2007-11	219	1,174	1,394
2008-12	224	1,143	1,367
2009-13	206	1,126	1,331

* Since the Census Bureau inflation adjusts the ACS data using the U.S. Consumer Price Index, All Urban Consumers, Research Series (CPI-U-RS), this measure was used to adjust the effects.

Source: Calculated from U.S. Department of Commerce, Census Bureau, American Community Survey, five-year estimates, obtained from Public Use Microdata Sample. The CPI-U-RS is from the U.S. Department of Labor, Bureau of Labor Statistics, http://www.bls.gov/cpi/cpirsai1978-2014.pdf.

SIMULATION

In order to project the effects of a policy initiative to boost the number of university graduates and the number of jobs requiring a bachelor's degree, the five-year averages from the 2009-13 period need to be converted to current figures. Calendar year 2014 is assumed to be the base year of the simulation, with the first effects of the policy change occurring in 2015.

For simplicity, the policy initiative is assumed to have an equal effect in each year, but the effects should not be assumed to last indefinitely. An end date to the simulation has been set as the year in which the share of the workforce with at least a bachelor's degree is equal in Arizona to the national average. The key assumption is that an annual increase of one-sixth of 1 percentage-point in the share with a bachelor's degree will occur due to the policy initiative.[8] An additional assumption is that the annual average increase in the share with a bachelor's degree (without any policy change) will continue to be slightly lower in Arizona than the nation. These assumptions and other assumptions/estimates detailed below can be changed to create alternative simulations.

Total Number of Individuals Employed

Employment from the ACS is defined differently from the employment estimates produced by the BEA and U.S. Bureau of Labor Statistics (BLS). The ACS estimates the number of working individuals by place of residence while the BEA and BLS estimate the number of jobs by place of work. The BEA and BLS figures are higher than the ACS figure primarily due to some individuals holding more than one job.

For this simulation, an employed individual is defined as any individual who reported earnings over a 12-month period. This differs from the definition used in the standard ACS tables, which

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[8] For perspective, the percentage with at least a bachelor's degree among those 25 and older has been falling about one-tenth of 1 percentage point per year in Arizona relative to the national average since 1980.

is limited to those who worked in the week prior to the completion of the ACS questionnaire. In the 2009-13 period, the employment estimate of those who worked at any time during a year was 3,099,428, compared to the published ACS employment figure of 2,721,866.[9]

The employment figure calculated from the ACS PUMS for each five-year period is less than the average of the five years of BEA employment, due primarily to the ACS counting individuals and the BEA counting jobs. The ACS-to-BEA ratio over the five five-year periods ranged from 0.935 in 2006-10 to 0.954 in 2005-09.

In order to start the simulation, the 2009-13 ACS PUMS employment figure must be brought forward to 2014. The annual BEA total employment series is used to create this 2014 estimate, but since the latest actual BEA figure is for 2013, a projection of the BEA figure for 2014 must be made. Based on an increase of 2.3 percent from 2013 to 2014, the projected BEA employment figure for 2014 is 3,471,000. The most recent ACS-to-BEA ratio of 0.942 was applied to this projection, resulting in a starting point of 3,270,000 individuals employed.

To forecast employment growth beyond 2014, the BEA time series on total employment was used. An economic cycle was imputed through 2020, with an annual average employment gain over the cycle of about 65,000: approximately equal to the average of the 1983-91 cycle (65,262) and a little less than the average (68,590) of the two cycles from 1992 through 2010 combined. For subsequent years, a steady numeric increase of 65,000 was assumed. Holding the numeric change constant causes the annual percent change to decline over time; for example, an increase of 65,000 in 2021 equates to a 1.7 percent gain, while an increase of 65,000 in 2045 equates to a 1.1 percent gain. The number of working individuals is assumed to grow at the same pace as BEA total employment.

Share With a Bachelor's Degree or More

For this project, educational attainment is calculated for those of any age who worked at any time during a year. This differs from published ACS figures. The primary measure of educational attainment reported by the Census Bureau is for the entire population 25 or older. The ACS also reports in a standard table the attainment of those between the ages of 25 and 64 who were employed in the prior week.[10]

Of those of any age who worked at any time during a year, the share with at least a bachelor's degree was 27.5 percent in Arizona in the 2009-13 period. Since this share has been increasing over time, the 2009-13 figure must be adjusted to the 2014 base year and a growth rate must be included in the projection period. To estimate the existing annual growth rate, three ACS time series were examined:

- From the five-year PUMS, the share in Arizona rose from 25.5 percent in 2005-09 to 27.5 percent in 2009-13, or an average of 0.5 percentage points per period.

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[9] U.S. Department of Commerce, Census Bureau, American Community Survey, five-year estimates for 2009-13, Table B23001, obtained from American FactFinder, http://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml.

[10] U.S. Department of Commerce, Census Bureau, American Community Survey, Tables B15003 (individuals 25 and older) and B23006 (employed individuals between 25 and 64 years of age), obtained from American FactFinder, http://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml.

- From the standard one-year ACS table for the population 25 and older, the annual average increase in Arizona between 2005 and 2013 was 0.24 percentage points, slightly less than the national average of 0.30.
- From the standard one-year ACS table for employed individuals between 25 and 64 years of age, the annual average increase in Arizona between 2005 and 2013 was 0.35 percentage points, slightly less than the national average of 0.40.

Of the two series coming from standard ACS tables, the measure of employed individuals is more relevant to this project than the series of the entire 25+ population. The series from the PUMS is limited in two ways: changes in consecutive five-year periods is not the same as annual changes, and the PUMS results have more sampling error than the figures from the standard tables. Thus, the simulation includes a 0.35 percentage-point per year increase in Arizona, and a 0.4 per year gain nationally, based on the 2005-through-2013 figures for employed individuals between 25 and 64 years of age.

The percentage of the Arizona workforce with at least a bachelor's degree in 2014 is estimated to be 28.515 percent. This was calculated by setting 2011 equal to the 27.465 percent figure for the 2009-13 period, and adding 0.35 in each year from 2012 through 2014. Nationally, the percentage of the workforce with at least a bachelor's degree is assumed to be 32.2 percent in 2014. This was derived from the 2013 difference of 3.6 percentage points between Arizona and the nation in the share of workers 25-to-64 years old, which puts the 2013 percentage of all workers with at least a bachelor's degree at 31.8 percent nationally. The trend increase of 0.4 percentage points per year was added to obtain the 2014 estimate.

The growth in the bachelor's degree share due to the policy change is assumed to be exactly equal to 1 percentage point over a span of six years. Thus, the total increase in the bachelor's share is 0.517 (0.35 + 0.167) per year. The share in Arizona with at least a bachelor's degree becomes equal to the national average in 2045, the 31st year of the simulation, based on annual growth of 0.517 in Arizona and 0.4 nationally. The forecasted values are shown in Chart 1.

Number With a Bachelor's Degree or More

This number is calculated by multiplying the projection of the number of people employed by the projected share with a bachelor's degree or more. Two values are calculated: one based only on the trend in the share and the other including the policy effect. The difference between the two figures is due to the policy initiative.

Earnings Differential Between Some College and Bachelor's Degree
of Those Earning Degree Due to Policy Initiative

In order to determine the overall earnings differential between the some college and bachelor's degree educational attainment categories, the observed earnings differential by age group from the 2009-13 PUMS is weighted by the proportion of those increasing their educational attainment due to the policy change — the same proportions reported earlier in the "Static Analysis" section. The result is $6,658 for the 2009-13 period. Due to the stagnancy in earnings during the recession and early recovery period, the 2013 differential is assumed to be the same as that of the 2009-13 period. After 2013, an increase in real earnings (and in the earnings

CHART 1
SIMULATED PERCENTAGE OF WORKFORCE
WITH AT LEAST A BACHELOR'S DEGREE
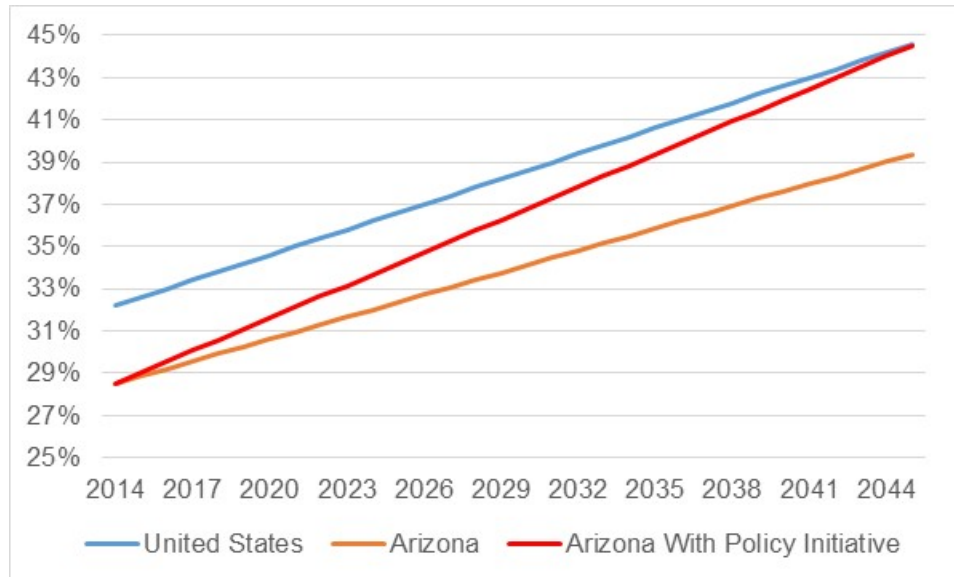
Source: Calculated by authors.

differential) of 1 percent per year is assumed, as a result of productivity gains. This puts the earnings differential at $6,725 in 2014 and $6,793 in 2015.

The earnings differential will increase over time, as those earning a bachelor's degree due to the initiative become older and their earnings rise faster than they would have had they not completed their degree. In 2009-13, the differential was $3,550 (38 percent) in the 15-21 age group, rising with age to $27,573 (63 percent) in the 45-54 age group. Assuming the difference in 2013 in the 45-54 age group was equal to that of the 2009-13 period ($27,573) and an increase in the earnings differential of 1 percent per year after 2013 due to productivity gains, the differential would be $37,911 in 2045, the 31st year of the simulation. To go from a differential of $28,127 (27,573 * 1.01 * 1.01) in 2015 to $37,911 30 years later requires an annual increase in the earnings differential of 4.85 percent.

Average Earnings

The calculation of the spillover effect requires average earnings for each of the five educational attainment categories. Average earnings by educational attainment category in 2013 are assumed to be equal to the 2009-13 figures. The 2014 figures are set 1 percent higher in each category.

For the simulated period, the average earnings figure in each category is increased by 1 percent per year to account for productivity gains. Equal gains in earnings by educational category generally match the national experience since 2000, but differ from the historical record. During the 1980s and 1990s, real earnings rose for men with high educational attainment but fell for men with limited educational attainment.

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Educational Attainment Shares

The calculation of the spillover effect requires shares for each of the five educational attainment categories. The educational attainment shares for 2014 were estimated by first assuming that the 2011 figures were equal to the 2009-13 averages, then by adding three years of changes based on the annual average changes during the 2005-13 period.

Effects of the Policy Initiative on Earnings in Dollars

The direct effect is calculated as the product of two values:

- The number earning a bachelor's degree due to the policy change.
- The earnings differential between the some college and bachelor's degree categories of those earning a bachelor's degree as a result of the policy initiative.

The spillover effect is calculated as the sum of the effects on individuals in each of the five educational attainment categories. In each category, the dollar value is calculated as the product of four values:

- The number of workers.
- Average earnings.
- The Moretti percentage (e.g. 1.9 percent for those with less than a high school diploma).
- The cumulative effect of the policy change (expressed as the increase in share of those with at least a bachelor's degree).

The total effect is the sum of the direct and spillover effects.

### Effect of the Policy Initiative on General Fund Revenue

The share of individual earnings paid in state government general fund taxes varies with the economic cycle, as seen in Chart 2. In addition, a downward trend in the share has occurred as a result of the ongoing policy of the state legislature to reduce tax burdens. In recent years, ongoing revenues as a share of earnings has been about 4.8 percent. That value was held constant through the simulation period.

Results

The results of the simulation are highlighted in Table 4, showing the effects in the first and last years and in the sixth year, in which the percentage of the workforce earning a bachelor's degree due to the initiative reaches 1 percent. The effects in year 6 are comparable to those of the static analysis shown in Table 3. The effects are larger in Table 4 due to increases in the number employed and in earnings between 2009-13 and 2020 (year 6).

Over time, the direct effects become an increasingly larger share of the total effects as the number of people earning bachelor's degrees due to the initiative grows and as the earnings of these individuals increase with the number of years of work experience. Since the typical person benefitting from the initiative is assumed to earn a bachelor's degree at about 23 years old, none of these individuals are assumed to have retired from the workforce 31 years later. Direct effects would become smaller as beneficiaries of the initiative retire. These results assume that any of the beneficiaries of the initiative who would move from Arizona are replaced by an in-migrant with comparable characteristics.

CHART 2
ARIZONA STATE GOVERNMENT GENERAL FUND ONGOING REVENUES
AS A SHARE OF EARNINGS
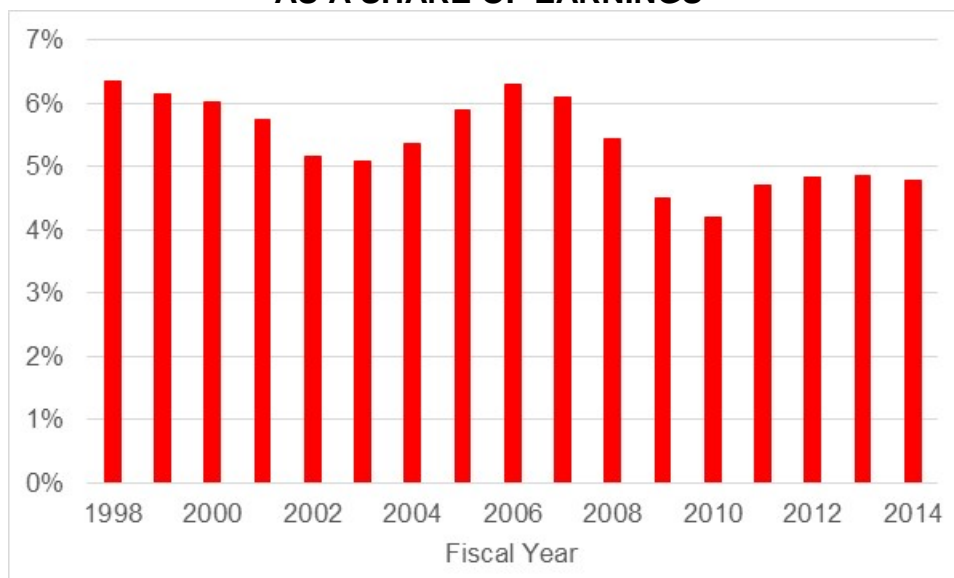
Sources: Arizona Joint Legislative Budget Committee (revenue, http://www.azleg.gov/jlbc/fiscal.htm) and U.S. Department of Commerce, Bureau of Economic Analysis (earnings, http://www.bea.gov/regional/index.htm).

TABLE 4
SIMULATION RESULTS

	Number of Individuals*	Effect in Millions in Constant Dollars			General Fund Revenue
		Direct	Spillover	Total	
Year 1 (2015)	5,607	$ 38	$ 208	$ 246	$ 12
Year 6 (2020)	36,328	329	1,402	1,731	83
Year 31 (2045)	266,792	10,113	12,523	22,636	1,087

* Earning a bachelor's degree due to the initiative.

Source: Calculated by authors.

At the end of the simulation in 2045, the number of individuals earning a bachelor's degree due to the policy initiative exceeds 266,000, accounting for more than 5 percent of the entire workforce. The total impact of the initiative is $22.6 billion, with an increase in state government general fund revenue of nearly $1.1 billion. Thus, over the span of 31 years, the general fund cost of the policy initiative could exceed $1 billion with the state still experiencing a net gain in revenue.

Between 2014 and the end of the simulation in 2045, the number of employed individuals increases 57.9 percent. This provides the basis for making a long-term projection of the Arizona economy, so that the effects shown in Table 4 can be put into perspective. Using the REMI

model, total earnings in 2045 is projected to be $483 billion in the baseline forecast that does not consider the policy initiative. The $22.6 billion impact of the initiative would increase earnings by 4.7 percent. The increase in state government general fund revenue due to the policy initiative also would be 4.7 percent.

The simulation assumes that the policy initiative will improve the educational attainment of the workforce without causing any increase over time in the size of the workforce beyond that in the baseline forecast. In contrast, the REMI model is dynamic, showing that the total effect on earnings from the policy initiative would cause employment and other economic indicators to rise by more than in the baseline. In 2045, employment would be about 91,000 (1.7 percent) higher than the baseline. This increase in employment would result from an increase in consumer demand for goods and services stemming from the higher earnings produced by the policy initiative.

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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