THE IMPACT OF ARIZONA STATE UNIVERSITY GRADUATES EMPLOYED IN ARIZONA IN 2016

A Report from the Office of the University Economist

May 2018

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SUMMARY

Arizona State University (ASU) graduates are employed throughout the world. This paper examines only those graduates employed in Arizona — those contributing to the productivity and prosperity of the state.

Approximately 231,000 ASU graduates were working in Arizona in 2016. More than one-in-four of the state's working individuals who had earned at least a bachelor's degree had graduated from ASU. The aggregate earnings of the ASU graduates were around $13.8 billion. Based on these earnings, these individuals contributed between $982 million and $1.128 billion in state and local government taxes, including between $545 million and $626 million in state government taxes, depending on the tax rate assumed.

The estimate of the number of ASU graduates working in Arizona in 2016 is based on actual employment and wage data for 150,092 individuals who graduated from ASU between 1990 and 2016 and were covered by the state's unemployment insurance program. Estimates of those who graduated from ASU prior to 1990 and of ASU graduates who were not covered by the unemployment insurance program but were working in Arizona in 2016 were added to the 150,092 figure to reach the total of approximately 231,000.

The impact of ASU graduates working in Arizona increased between 2012 and 2014 and was little changed between 2014 and 2016. The share of the Arizona workforce who were ASU graduates was 6.17 percent in 2012 and 6.34 percent in 2016. The share of aggregate wages earned by ASU graduates increased more, from 8.28 percent in 2012 to 8.70 percent in 2016. The average wage of ASU graduates climbed from 134.3 percent of the average wage of all workers in 2012 to 137.2 percent in 2016. In 2012, graduates of ASU accounted for 25.6 percent of all Arizona workers who have earned at least a bachelor's degree. In 2016, the share was 25.9 percent.

DESCRIPTION OF DATA

University Graduates Employed in Arizona

For each year from 2012 through 2016, the Arizona Board of Regents (ABOR) has created a dataset of graduates of Arizona's three public universities who were employed in Arizona during the year. While the ABOR dataset includes the number of "degrees awarded," this number really refers to the number of individuals earning a degree. An individual earning more than one degree is counted only once in this dataset, categorized in the year of the most recent degree. Thus, the dataset's number of "degrees awarded" is less than the official number of degrees awarded.

The ABOR dataset is created by matching Social Security numbers of university graduates to the numbers in the unemployment insurance file maintained by the Arizona Department of Economic Security, which works in conjunction with the U.S. Department of Labor. Reporting from the unemployment insurance file — the Quarterly Census of Employment and Wages (QCEW) — is done quarterly, with annual average figures also produced.

Each quarter, every business that employs workers covered by the state's unemployment insurance program must report (1) employment in each of the three months of the quarter during the pay period that includes the 12th day of the month and (2) total wages paid by the business during the quarter. Federal government civilian workers covered by the comparable federal unemployment insurance program also are included in the reporting.

Various members of the workforce are not included in the QCEW: most agricultural workers on small farms, those self-employed, those in the Armed Forces, and various others. Reporting is by job, not by individual — an individual working more than one covered job will appear in the file more than once.

Since the unemployment insurance records are confidential, ABOR's dataset of graduates employed in Arizona includes only aggregate totals. There are two significant limitations to this dataset. First, the unemployment insurance file does not include a significant number of workers — in 2016, the employment count from the unemployment insurance file was only 74 percent of the total employment in Arizona, as reported by the U.S. Bureau of Economic Analysis (BEA). Second, the dataset of graduates employed in Arizona constructed by the Board of Regents only includes graduates since 1990. Thus, the number of graduates of Arizona's public universities who are working in Arizona is understated significantly. This understatement effectively becomes even larger when the number of *individuals* counted in the Board of Regents dataset is compared to the total number of *jobs* reported in the QCEW.

The dataset constructed by the Board of Regents is subdivided by various characteristics:

- university
- bachelor's degrees versus graduate degrees
- those who attended school as Arizona residents versus nonresidents

The analysis described in this paper uses a dataset specific to Arizona State University (ASU) provided by ASU's Office of the University Provost.

By year of graduation, the following data items are available from the dataset of university graduates employed in Arizona:

- number of graduates
- number employed in Arizona (in any quarter during the year)
- percent of graduates employed in Arizona
- total wages of graduates employed in Arizona
- estimated state taxes paid by graduates employed in Arizona
- number employed in Arizona in all four quarters
- median wage of those employed in Arizona in all four quarters

The number of graduates is reported by academic year — for example, for 2016, the sum of the number graduating in August 2015, December 2015, and May 2016. The employment data are for calendar year 2016.

While the median wage of those employed in all four quarters is a reasonable measure of the typical annual wage of graduates included in the dataset, use of the median wage is arithmetically quite limited. Thus, the average wage of those employed in any quarter during the year also is calculated, as total wages divided by the total number employed.

Employment

The employment figures reported in the QCEW are based on a census of all covered workers and therefore are highly accurate, but as noted above, a large number of workers are not covered by the unemployment insurance program. Thus, focusing only on those covered by the program significantly understates the contribution of university graduates to the Arizona economy.

Employment estimates are available from several sources, but these estimates are not consistent due to definitional differences (certain categories of workers may be excluded by one source but not by another), differences in the way the data are collected (such as a sample of employers versus a census), and timing differences in when the data are collected. In order to provide a more complete picture of the economic activity in Arizona of ASU graduates, more complete employment estimates from the BEA are used in this report.

Most of the employment estimates, including those of the QCEW and BEA, do not differentiate between a person working full time and one working fewer hours. Employment is categorized by the place of work, not by where the worker lives. For example, an Arizona resident of Bullhead City who works across the Colorado River in Laughlin, Nevada is counted in the Nevada employment figures. Further, most of the employment estimates report the number of jobs, not the number of people employed — an individual working two jobs is counted twice in the employment figures. This is an important distinction when comparing the number of ASU graduates (individuals) employed in Arizona to total employment (number of jobs).

Unlike other employment estimates, the employment data reported from the American Community Survey (ACS) reflects the number of individuals working and workers are classified by place of residence. The ACS is an ongoing survey of households conducted by the U.S. Census Bureau that is the source of a wide variety of socioeconomic data. The main shortcoming of the ACS is that it is based on a relatively small number of households. Sampling error can be a

significant concern. The accuracy of self-reporting, particularly for questions related to wages and income, also is an issue. Various ACS tables provide insight on employment in Arizona. The ACS employment figures are based on an individual's employment status at the time the questionnaire is completed.

Educational Attainment

In order to provide context on the contribution of ASU graduates employed in Arizona, the educational attainment of the Arizona workforce is examined. The ACS is the best source of data on educational attainment at a subnational level. In this report, Arizona's educational attainment is compared to the nation using three ACS tables: attainment for the population age 25 or older, attainment in each of five age groups, and attainment by labor force status among those 25-to-64 years old.

While ACS data for five years often are combined to reduce sampling error, the ACS data from 2015 are used in this analysis in order to be consistent with the Board of Regents dataset. For Arizona, sampling error for a single year of ACS data ranges from insignificant for broad measures to significant for small subsets of the population. Thus, the attainment data for the entire population at least 25 years of age is more reliable than the data for each of five age groups.

The Impact of College Graduates on the Workforce

Educational attainment is strongly correlated to an individual's earnings, with a bachelor's degree in particular causing a boost in earnings. The higher earnings realized over a lifetime of work greatly exceeds the costs of attending college.[1] Society also benefits from an educated populace in various ways, such as the lower crime rates of educated individuals.[2]

One of the benefits of having highly educated individuals in the workforce is to raise the wages of the entire workforce. Enrico Moretti specified this relationship in his 2004 *Journal of Econometrics* paper, "Estimating the Social Return to Higher Education: Evidence From Longitudinal and Repeated Cross-Sectional Data."[3] The spillover of benefits to all workers can be traced to the enhanced worker productivity associated with greater educational attainment. Improved productivity results from 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.[4]

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[1] See "Has the Return to Investing in a College Education Declined?," December 2013, and earlier papers at http://economist.asu.edu/p3/education.
[2] See "Benefits From Improving Educational Attainment in Arizona," August 2012, and earlier papers at http://economist.asu.edu/p3/education.
[3] Accessible from http://economist.asu.edu/p3/education.
[4] See "The Economic Impact of Raising the Educational Attainment of Arizona's Workforce," May 2015, at https://wpcarey.asu.edu/sites/default/files/uploads/center-competitiveness-and-prosperity-research/impactedattain05-15.pdf.

ARIZONA STATE UNIVERSITY GRADUATES EMPLOYED IN ARIZONA IN 2016

Employment

According to the QCEW, annual average Arizona employment in 2016 totaled 2,680,065. The BEA's wage and salary employment estimate was 2,818,420, meaning that 138,355 wage and salary workers were not covered by unemployment insurance. The BEA estimates that the number of proprietors (self-employed, also not included in the QCEW) was 823,518, for a total employment figure of 3,641,938.

According to the ACS, an estimated 3,031,781 Arizonans were employed in 2016 in civilian jobs; an additional 16,793 were members of the armed forces. The total of 3,048,574 is 84 percent of the BEA's total number of jobs, suggesting that many workers (1) are employed by more than one business and/or (2) hold a wage and salary job as well as report self-employment income. Other data from the ACS indicates that 23 percent of employed Arizonans worked less than 35 hours per week.

Educational Attainment

Most commonly, educational attainment is expressed for those at least 25 years old. Though the age of 25 is arbitrary, a high proportion of individuals have completed their educations by that age. In 2016, Arizona's educational attainment in this large cohort was inferior to the nation. The share without either a high school diploma or a GED (general education development) certificate was higher in Arizona: 13.3 percent versus 12.5 percent nationally. Relative to the nation, lesser shares of Arizonans had earned a graduate degree (10.8-versus-11.9 percent nationally) and a bachelor's degree (18.1-versus-19.3 percent).

An examination of educational attainment by age group reveals that Arizona was particularly far below the nation among those younger than 35 in 2016. Arizona also was below average among those 35-to-64 years old. In contrast, the educational attainment of those 65 or older was higher in Arizona than nationally. Since few of those age 65 or older are working, the standard statistics on the entire 25-or-older population understate Arizona's educational disadvantage as it applies to the workforce.

Data on educational attainment by labor force status indicate that among those in the workforce, the educational attainment in Arizona of those 25-to-64 years old was below the national figure in 2016. The proportion of those working in a civilian job who had earned at least a bachelor's degree was 33 percent in Arizona and 37 percent nationally.

Arizona State University Graduates Employed in Arizona

Detailed figures from the dataset of 1990-through-2016 graduates of Arizona State University who were employed in Arizona during 2016 are provided in the appendix. Data are shown by undergraduate versus graduate degree and by residency status while a student.

ABOR's data for graduates in the most recent academic year need to be interpreted carefully. A significant proportion of those graduating in academic year 2016 graduated in May 2016. The employment and wage information for these individuals in calendar year 2016 may reflect part-time employment prior to graduation and/or full-time employment after graduation. In the latter

case, the wage data are for less than a year of full-time employment. For those graduating in academic year 2016, the average wage and median wage is very low and the percentage employed in all four quarters is very low compared to those graduating in prior years.

The following are among the basic conclusions that can be reached using the dataset of ASU graduates from academic years 1990 through 2016:

- The number of individuals earning a degree has increased significantly over time, by 210 percent overall between 1990 and 2016.
- The increase in the number of individuals earning a degree has been higher for graduate students than undergrads, and much higher for those who were classified as nonresidents while attending school than among those classified as residents.
- In 2016, the shares of the total number of graduates were 49.2 percent for resident undergraduates, 19.2 percent for nonresident undergraduates, 13.4 percent for resident graduate students, and 18.2 percent for nonresident graduate students.
- The percentage of graduates employed in Arizona is much higher for residents than nonresidents.
- The share of graduates employed in Arizona decreases significantly with the number of years since graduation, regardless of residency status while students.
- The percentage employed in all four quarters was less than 80 percent among recent graduates but generally was greater than 80 percent among older graduates.
- The average wage and the median wage increase significantly with the number of years elapsed since graduation, though this effect weakens with the number of years elapsed.
- The median wage and the average wage are somewhat higher for those who were classified as nonresidents.
- The average wage (of all graduates employed at some point during the year) was less than the median wage (of graduates employed in all four quarters) among recent graduates, likely due to those not employed in all four quarters lowering the calculated average wage. Among older graduates, the average wage exceeds the median wage, presumably because of a small number of graduates earning very high wages that boosts the average but not the median.

The number of individuals who graduated from ASU between academic years 1990 and 2016 who worked at jobs in Arizona that were covered by the unemployment insurance program in calendar year 2016 was 150,092. ASU graduates between 1990 and 2016 accounted for 5.6 percent of the QCEW total number employed, but this share is understated since it compares *individuals* with ASU degrees to the *number of jobs*.

The aggregate wages of individuals who graduated from ASU between academic years 1990 and 2016 ($9.4 billion) accounted for 7.2 percent of the QCEW total. ABOR estimates that “state tax revenue” (really, state and local government tax revenue in Arizona) in 2016 by those who graduated from ASU between 1990 and 2016 — based only on wages earned as part of the unemployment insurance program — was $671 million: 7.14 percent of aggregate wages.

A summary of the ASU graduates from 1990 through 2016 is provided in the top portion of Table 1. The bottom portion of Table 1 focuses on academic year 2015 graduates.[5] Table 1 needs to be interpreted carefully. Student characteristics vary by residency status and by undergraduate and graduate programs. For example, the magnitude of the difference in the average wage between undergraduate and graduate degrees in 2015 reflects not only the wage premium of the graduate degree but also the greater number of years of work experience prior to graduation among those with a graduate degree. The differential in the average wage of those with undergraduate and graduate degrees declines with the number of years of work experience. Among graduates from academic year 2015, the average wage in 2016 of those with a graduate degree was 60 percent higher than those with a bachelor's degree, but the differential for graduates over the entire 1990-to-2016 period was 39 percent. According to the 2016 ACS, all Arizona workers with a graduate degree (including those graduating before 1990) earned 23 percent more than those who had earned a bachelor's degree.

Alternative Estimates of Taxes Paid

ABOR estimates state and local government tax payments based on the following income levels and tax rates:

- Less than $25,001: 12.6 percent
- $25,001 to $75,000: 6.8 percent
- $75,001 to $100,000: 7.2 percent
- More than $100,000: 6.9 percent

The average tax rate of ASU graduates between 1990 and 2016 who worked in Arizona in 2016 was 7.14 percent.

ABOR's tax rates come from the 2007 edition of an annual study of tax burdens produced by the government of the District of Columbia.[6] The latest study is for 2016. Since the tax rates from this study fluctuate from year to year with changes in methodology, it is preferable to use the median rates over several years. The last major tax change in Arizona for individuals was fully implemented in 2008. Based on the 2009-through-2016 reports, the median combined state and local government tax rates in Arizona are higher than used by ABOR for those with incomes of $50,000 or more. The median rate at each of four incomes between $50,000 and $150,000 is between 8.1-and-8.25 percent. Since the District of Columbia study does not measure every state and local tax — though it includes income taxes, sales taxes, property taxes, and automobile-related taxes — the overall tax rate would be slightly higher.

A study by the Institute on Taxation and Economic Policy (ITEP), which includes all taxes, reports a similar state and local government tax burden in Arizona.[7] The figure is 8.2 percent for those earning between $52,000 and $87,000; the average wage of ASU graduates employed in Arizona reported by the ABOR is within this range. Using the 8.2 percent tax rate and the aggregate wage figures from the ABOR dataset, Arizona state and local government taxes paid

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[5] Graduates from 2015 instead of 2016 are used since the statistics for those graduating in May 2016 are affected by part-time wages earned while a student and less than full-year wages after graduation.

[6] "Tax Rates and Tax Burdens in the District of Columbia — A Nationwide Comparison," Government of the District of Columbia, http://cfo.dc.gov/node/215912.

[7] Institute on Taxation & Economic Policy, *Who Pays? A Distributional Analysis of the Tax Systems in All 50 States*, January 2015, http://www.itep.org/whopays/.

TABLE 1
ARIZONA STATE UNIVERSITY GRADUATES

	Total	Total Under-grad Degrees	Resident Under-grad Degrees	Non-resident Undergrad Degrees	Total Graduate Degrees	Resident Graduate Degrees	Non-resident Graduate Degrees
Graduates From 1990 Through 2016:							
Number Graduating From Arizona State University	313,088	224,299	176,877	47,422	88,789	54,670	34,119
Employed in Arizona and Covered by the Unemployment Insurance Program in 2016:							
Number	150,092	113,447	104,366	9,081	36,645	30,821	5,824
Share of Graduates (Percent)	48	51	59	19	41	56	17
Aggregate Wages (Dollars, Millions)	9,402	6,492	5,966	526	2,910	2,471	439
Average Wage (Dollars)	62,641	57,222	57,161	57,921	79,415	80,176	75,387
Estimated State and Local Government Tax Payments (Dollars, Millions)	671	466	428	38	205	174	31
Graduates From 2015:							
Number Graduating From Arizona State University	19,588	13,501	10,015	3,486	6,087	2,758	3,329
Employed in Arizona and Covered by the Unemployment Insurance Program in 2016:							
Number	11,323	8,528	7,578	950	2,795	2,087	708
Share of Graduates (Percent)	58	63	76	27	46	76	21
Aggregate Wages (Dollars, Millions)	448	294	264	31	154	114	40
Average Wage (Dollars)	39,606	34,511	34,776	32,398	55,152	54,625	56,708
Estimated State and Local Government Tax Payments (Dollars, Millions)	33	22	20	2	11	8	3

Source: Arizona Board of Regents from Arizona State University, Office of the University Provost.

on QCEW wages by those who graduated from ASU between 1990 and 2016 was approximately $771 million in 2016, compared to ABOR's estimate of $671 million.

In order to estimate the amount of taxes paid just to state government, U.S. Census Bureau data were used. In fiscal year 2015, state tax collections accounted for 55.5 percent of combined state and local government tax collections in Arizona.[8] Applying this percentage to the estimates of state and local government taxes paid on QCEW wages by those who graduated from ASU between 1990 and 2016, the result is $373 million based on ABOR's estimate of state and local government taxes and $428 million based on the 8.2 percent state and local government tax rate.

Extending the Analysis to Include Those Who Graduated From ASU Before 1990

In order to provide an estimate of the number of individuals who graduated from ASU before 1990 and who were working in Arizona in 2016, actual data on the number of degrees awarded by ASU before 1990 were collected, with the earliest data from 1971. The official graduation data from ASU count number of degrees — individuals with more than one ASU degree are counted more than once. These data are not consistent with the figures used in the Arizona Board of Regents dataset, which counts individuals, not number of degrees. Thus, in order to estimate the number of individuals who had earned a degree from ASU before 1990, the historical graduation data for the years before 1990 were adjusted, using the ratio from the 1990-through-1999 period of the number of graduates counted in the Board of Regents database to the official count of degrees granted. The ratio was 88.9 percent for those with an undergraduate degree, 91.3 percent for those with a graduate degree, and 89.5 percent for all graduates.

In order to estimate the number of ASU graduates from before 1990 who were working in Arizona in 2016 and counted in the unemployment insurance program, a "backward projection" was made of the percentage of ASU graduates who were employed in Arizona in 2016. The percentage drops with the number of years since graduation; the rate of decline is rapid among recent grads but is lower and relatively stable among earlier graduates. The average annual decrease of 1.23 percentage points between 1990 and 1999 was used for the pre-1990 period. Using the adjusted graduation figures and the estimated percentage of graduates employed in Arizona, the number of employed ASU graduates was calculated by year for the pre-1990 period.

The average wage for graduates in the pre-1990 period was backward projected in the same manner as the percentage employed. The average wage rises significantly by the number of years since graduation for relatively recent graduates. Among earlier graduates, the increase in the average wage by year is lower and more stable. The annual average increase from the 1990-through-1999 period was 0.75 percent; this figure was applied to the pre-1990 period.

Using these backward projections, the number of individuals who graduated from ASU through academic year 2016 who worked at jobs in Arizona that were covered by the unemployment insurance program in 2016 is estimated to be 169,998 — 13.3 percent higher than the number of those who graduated from 1990 through 2016. Due to the high average wage of individuals who graduated prior to 1990, the differential in the aggregate wage of the entire set of ASU graduates relative to the 1990-to-2016 group was greater at 20.4 percent.

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[8] U.S. Department of Commerce, Census Bureau, State and Local Government Finance, http://www.census.gov/govs/local/.

This methodology does not directly address the increasing share of retirees among older ASU graduates. While the percentage of ASU graduates working in Arizona declines with the number of years since graduation over the 1990-to-2016 period, this decrease presumably occurs mostly due to out-migration. Few ASU graduates since 1990 — most of whom were less than 50 years old in 2016 — are likely to have retired. In contrast, retirement becomes increasingly likely among those who graduated during the 1970s. Thus, the estimates of the numbers employed in Arizona of graduates from this time period may be overstated. However, the results of the methodology that was used results in only 8 percent of 1971 undergraduates, and 5 percent of those who earned a graduate degree in 1971, employed in Arizona in 2016. Any overstatement of graduates from the 1970s working in Arizona is partially offset by the exclusion of graduates from before 1971, a few of whom likely were still part of the workforce in 2016. Further, it seems unlikely that the rate of out-migration from Arizona for job-related reasons would be as high among those approaching retirement age as among those who are younger. Thus, the estimated number of older ASU graduates working in Arizona is believed to be reasonable.

Those who have graduated from ASU accounted for 6.3 percent of the QCEW number of jobs in Arizona in 2016, but again this share is understated since it compares *individuals* with ASU degrees to the *number of jobs*. The aggregate wage of individuals who have graduated from ASU accounted for 8.7 percent of the QCEW total. The 2016 average wage of $66,575 of those who have graduated from ASU was 40.7 percent higher than the average of the rest of the QCEW file (a group that includes those without a bachelor's degree and those who earned a degree from another institution). Based on the 7.14 percent tax rate and estimated QCEW wages, ASU graduates paid $808 million in state and local government taxes in 2016, of which $448 million was paid to state government. Using the 8.2 percent tax rate, state and local government taxes paid amounted to $928 million, of which $515 million was paid to state government.

Estimates from the ACS for 2016 indicate that 801,725 Arizona residents between the ages of 25 and 64 who had received at least a bachelor's degree were employed in civilian jobs. Based on various data from the ACS, the estimated total number of people working in civilian jobs in Arizona in 2016 who have earned a bachelor's or higher degree is 891,158. The estimated number of ASU graduates employed in the state and covered by the unemployment insurance program accounts for 19.1 percent of the estimated number of civilian workers with at least a bachelor's degree.

Extending the Analysis to Include ASU Graduates Employed in Arizona but Not Covered by the Unemployment Insurance Program

In order to estimate the number of ASU graduates working in Arizona in wage and salary jobs not covered by unemployment insurance or as proprietors (self-employed), the ASU shares of the QCEW total (6.34 percent of employment and 8.70 percent of wages) were applied to the BEA's total employment figure. The result is a total of 231,010 ASU graduates working in Arizona in 2016 (see Table 2). This figure is understated because the 6.34 percent figure is based on individuals with ASU degrees and the number of QCEW jobs.

The estimate of 231,010 ASU graduates working in Arizona accounts for 25.9 percent of the estimated number of employed Arizonans with at least a bachelor's degree in 2016. Thus, more

TABLE 2
ARIZONA STATE UNIVERSITY GRADUATES EMPLOYED IN ARIZONA IN 2016 COMPARED TO TOTAL EMPLOYMENT IN ARIZONA

	Employment	Aggregate Earnings*	Average Earnings
Employment in Arizona:			
QCEW Wage and Salary	2,680,065	$130,046	$48,523
Other Wage and Salary From BEA	138,355	9,275	67,038
Total Wage and Salary From BEA	2,818,420	139,321	49,432
Proprietors From BEA	823,518	18,776	22,800
Total From BEA	3,641,938	158,096	43,410
ASU Graduates Employed in Arizona:			
QCEW Wage and Salary, 1990 Through 2016	150,092	9,402	62,641
Estimate From Before 1990	19,906	1,916	96,241
Total QCEW Wage and Salary	169,998	11,318	66,575
Other Wage and Salary Plus Proprietors	61,012	2,441	40,012
Total	231,010	13,759	59,560
ASU Share of Total Employment in Arizona	6.34%	8.70%	137.2%

* In millions. Consists of wages and salaries and proprietors' Income.

Sources: U.S. Department of Labor, Bureau of Labor Statistics (QCEW: Quarterly Census of Employment and Wages); U.S. Department of Commerce, Bureau of Economic Analysis (BEA); and Arizona Board of Regents from Arizona State University, Office of the University Provost.

than one-in-four working individuals in Arizona who had earned at least a bachelor's degree had graduated from ASU. The aggregate earnings of the ASU graduates were around $13.8 billion. Based on the 7.14 percent tax rate and $13.8 billion in earnings, ASU graduates paid $982 million in state and local government taxes in 2016, of which $545 million was paid to state government. Using the 8.2 percent tax rate, state and local government taxes paid amounted to $1,128 million, of which $626 million was paid to state government.

The Impacts of ASU Graduates on the Workforce

The estimates of 231,010 ASU graduates working in Arizona, earning $13.8 billion, and paying between $982 million and $1.128 billion in state and local government taxes do not provide a complete accounting of the impacts of ASU graduates on the Arizona economy. College graduates in the workforce boost the productivity of all workers, which results in an increase in wages for all workers. This is discussed in the May 2015 University Economist Paper, "The Economic Impact of Raising the Educational Attainment of Arizona's Workforce," https://wpcarey.asu.edu/sites/default/files/uploads/center-competitiveness-and-prosperity-research/impactedattain05-15.pdf.

ARIZONA STATE UNIVERSITY GRADUATES EMPLOYED IN ARIZONA, 2012 THROUGH 2016

The estimated number of ASU graduates (including those graduating prior to 1990) working in Arizona and covered by unemployment insurance accounted for 6.17 percent of all workers in the unemployment insurance program in 2012. The share increased over the next two years to 6.35 percent but dipped in 2015 to 6.31 percent before partially recovering to 6.34 percent in 2016 (see Table 3). Similarly, the share of aggregate wages earned by ASU graduates increased between 2012 and 2014, from 8.28 percent to 8.71 percent. The share dipped in 2015 to 6.68 percent then partially recovered to 6.70 percent in 2016. The decline in the shares in 2015 can be traced to an unusually small increase in the number of ASU graduates, primarily among resident undergraduates.

The average wage of ASU graduates climbed from 134.3 percent of the overall average in 2012 to 137.6 percent in 2015. The 2016 figure dipped to 137.2 percent. The average wage of ASU graduates working in Arizona rose less in 2016 than in prior years.

The estimated share of Arizona workers holding at least a bachelor's degree who are a graduate of ASU also climbed from 25.6 percent in 2012 to 26.9 percent in 2014 and 2015; however, the share dropped to 25.9 percent in 2016. While the one-year percentage increase in ASU graduates working in Arizona was similar in 2016 to the gains in the three prior years, the annual percentage increase in the total number of employed university graduates in Arizona was much higher in 2016 than in the three prior years, based on ACS data. It is highly likely that the large annual change in 2016 in the total number of employed university graduates in Arizona is a result of sampling error in the ACS — the percent change in Arizona relative to the national average went from less in each of the three prior years to considerably more in 2016. However, the reported percent change over the three prior years may have been below the actual change, again due to sampling error.

TABLE 3
SUMMARY OF ARIZONA STATE UNIVERSITY GRADUATES EMPLOYED IN ARIZONA, 2012 THROUGH 2016

	Employment		Aggregate Earnings		Average Earnings		Tax Payments Estimated Range for State and Local Governments in Millions of 2016 Dollars		Share of Workforce With a University Degree
	Number	Share of Total	Millions of 2016 Dollars	Share of Total	2016 Dollars	Share of Total			
2012	203,372	6.17%	$11,573	8.28%	$56,905	134.3%	$832	$949	25.6%
2013	211,576	6.27	12,283	8.55	58,054	136.4	881	1,007	26.4
2014	219,106	6.35	12,803	8.71	58,431	137.2	916	1,050	26.9
2015	223,985	6.31	13,295	8.68	59,359	137.6	950	1,090	26.9
2016	231,010	6.34	13,759	8.70	59,560	137.2	982	1,128	25.9

Source: Calculated by authors.

APPENDIX
ARIZONA STATE UNIVERSITY GRADUATES FROM 1990 THROUGH 2016 EMPLOYED IN ARIZONA IN 2016: DETAIL BY CATEGORY OF DEGREE

Source: Arizona Board of Regents, from Arizona State University, Office of the University Provost.

ALL DEGREES

		2016						
Academic Year of Graduation	Number Earning a Degree	Number Employed in Arizona	Percent Employed in Arizona	Aggregate Wages in Millions	Average Wage	Estimated State and Local Government Tax Payments in Millions	Number Employed in Arizona During All Four Quarters	Percent Employed in All Four Quarters
1990	6,754	2,064	30.6%	$187.6	$90,884	$13.2	1,630	79.0%
1991	7,128	2,434	34.1	226.0	92,857	15.9	1,956	80.4
1992	7,104	2,485	35.0	222.1	89,396	15.6	2,032	81.8
1993	7,660	2,669	34.8	233.4	87,430	16.4	2,183	81.8
1994	7,754	2,879	37.1	259.6	90,182	18.2	2,365	82.1
1995	8,100	3,172	39.2	281.5	88,749	19.8	2,554	80.5
1996	8,066	3,268	40.5	279.4	85,487	19.6	2,703	82.7
1997	8,575	3,511	40.9	301.4	85,857	21.2	2,861	81.5
1998	9,125	3,785	41.5	315.7	83,409	22.2	3,113	82.2
1999	9,237	3,848	41.7	319.1	82,915	22.5	3,143	81.7
2000	9,665	4,144	42.9	349.3	84,300	24.6	3,424	82.6
2001	9,402	3,990	42.4	324.5	81,327	22.8	3,255	81.6
2002	9,911	4,497	45.4	354.1	78,745	24.9	3,688	82.0
2003	10,501	4,813	45.8	377.5	78,424	26.6	3,959	82.3
2004	11,112	5,173	46.6	384.3	74,299	27.1	4,269	82.5
2005	11,371	5,418	47.6	383.9	70,855	27.1	4,476	82.6
2006	11,706	5,677	48.5	399.1	70,295	28.2	4,617	81.3
2007	12,110	5,897	48.7	396.6	67,249	28.0	4,841	82.1
2008	12,796	6,213	48.6	406.0	65,344	28.7	5,158	83.0
2009	13,859	6,662	48.1	408.7	61,343	28.9	5,409	81.2
2010	14,599	7,530	51.6	431.4	57,287	30.7	6,105	81.1
2011	15,153	7,934	52.4	433.7	54,668	31.0	6,355	80.1
2012	15,919	8,589	54.0	429.0	49,947	30.7	6,801	79.2
2013	16,923	9,431	55.7	445.5	47,239	32.2	7,375	78.2
2014	18,017	10,061	55.8	445.9	44,319	32.5	7,759	77.1
2015	19,588	11,323	57.8	448.5	39,606	33.3	8,579	75.8
2016	20,953	12,625	60.3	358.2	28,369	29.4	7,318	58.0
1990-2016	313,088	150,092	47.9	9,401.9	62,641	671.3	117,928	78.6

ALL UNDERGRADUATE DEGREES

		2016						
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1990	5,028	1,618	32.2%	$143.2	$88,502	$10.1	1,291	79.8%
1991	5,273	1,927	36.5	176.8	91,727	12.4	1,572	81.6
1992	5,347	1,973	36.9	167.9	85,121	11.8	1,640	83.1
1993	5,652	2,065	36.5	175.5	84,978	12.4	1,711	82.9
1994	5,622	2,226	39.6	196.2	88,124	13.8	1,868	83.9
1995	5,741	2,405	41.9	202.8	84,306	14.3	1,949	81.0
1996	5,796	2,476	42.7	197.9	79,914	13.9	2,075	83.8
1997	6,105	2,665	43.7	216.4	81,217	15.2	2,193	82.3
1998	6,590	2,896	43.9	224.3	77,442	15.8	2,387	82.4
1999	6,600	2,875	43.6	219.8	76,459	15.5	2,354	81.9
2000	7,033	3,170	45.1	247.7	78,144	17.4	2,632	83.0
2001	6,840	3,074	44.9	227.5	74,002	16.0	2,525	82.1
2002	7,122	3,357	47.1	245.1	73,017	17.3	2,778	82.8
2003	7,527	3,578	47.5	255.0	71,279	18.0	2,965	82.9
2004	7,977	3,908	49.0	265.1	67,835	18.7	3,227	82.6
2005	8,508	4,197	49.3	271.4	64,666	19.2	3,470	82.7
2006	8,724	4,430	50.8	281.5	63,538	20.0	3,590	81.0
2007	8,895	4,564	51.3	278.5	61,029	19.8	3,732	81.8
2008	9,318	4,674	50.2	272.1	58,214	19.3	3,870	82.8
2009	9,703	4,850	50.0	264.4	54,518	18.8	3,931	81.1
2010	10,297	5,516	53.6	283.3	51,355	20.3	4,440	80.5
2011	10,622	5,831	54.9	284.1	48,730	20.4	4,618	79.2
2012	11,343	6,453	56.9	285.1	44,178	20.6	5,055	78.3
2013	12,059	7,087	58.8	293.7	41,442	21.5	5,490	77.5
2014	12,747	7,582	59.5	292.4	38,560	21.6	5,793	76.4
2015	13,501	8,528	63.2	294.3	34,511	22.3	6,407	75.1
2016	14,329	9,522	66.5	229.7	24,128	19.7	5,592	58.7
1990-2016	224,299	113,447	50.6	6,491.7	57,222	466.2	89,155	78.6

RESIDENT UNDERGRADUATE DEGREES

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1990	4,113	1,519	36.9%	$134.5	$88,540	$9.5	1,211	79.7%	$76,758	115.4%
1991	4,280	1,814	42.4	166.1	91,588	11.7	1,480	81.6	75,811	120.8
1992	4,347	1,862	42.8	157.1	84,351	11.1	1,545	83.0	72,938	115.6
1993	4,500	1,918	42.6	161.6	84,263	11.4	1,588	82.8	73,791	114.2
1994	4,538	2,070	45.6	179.6	86,761	12.6	1,742	84.2	75,538	114.9
1995	4,737	2,268	47.9	187.8	82,821	13.2	1,834	80.9	72,375	114.4
1996	4,855	2,342	48.2	186.5	79,613	13.1	1,965	83.9	71,228	111.8
1997	4,975	2,484	49.9	197.9	79,654	13.9	2,041	82.2	72,067	110.5
1998	5,147	2,682	52.1	206.7	77,060	14.6	2,216	82.6	68,448	112.6
1999	5,125	2,635	51.4	199.4	75,687	14.1	2,160	82.0	67,869	111.5
2000	5,413	2,885	53.3	222.5	77,119	15.7	2,398	83.1	70,900	108.8
2001	5,292	2,824	53.4	205.5	72,777	14.5	2,319	82.1	66,425	109.6
2002	5,684	3,110	54.7	224.1	72,058	15.8	2,581	83.0	63,844	112.9
2003	6,009	3,303	55.0	231.6	70,109	16.4	2,728	82.6	63,666	110.1
2004	6,403	3,625	56.6	243.1	67,054	17.2	3,000	82.8	61,097	109.7
2005	6,781	3,891	57.4	249.5	64,132	17.6	3,228	83.0	60,067	106.8
2006	7,032	4,140	58.9	261.3	63,118	18.5	3,357	81.1	59,668	105.8
2007	7,151	4,226	59.1	255.5	60,454	18.1	3,464	82.0	56,723	106.6
2008	7,421	4,346	58.6	252.2	58,037	17.9	3,612	83.1	55,698	104.2
2009	7,654	4,512	58.9	244.7	54,242	17.4	3,680	81.6	53,257	101.8
2010	8,242	5,135	62.3	262.5	51,124	18.8	4,132	80.5	52,226	97.9
2011	8,508	5,413	63.6	264.2	48,802	19.0	4,317	79.8	48,991	99.6
2012	9,100	5,990	65.8	263.2	43,947	19.0	4,720	78.8	45,860	95.8
2013	9,562	6,551	68.5	270.7	41,328	19.8	5,085	77.6	44,300	93.3
2014	9,691	6,900	71.2	266.7	38,647	19.7	5,307	76.9	41,444	93.3
2015	10,015	7,578	75.7	263.5	34,776	19.9	5,759	76.0	38,610	90.1
2016	10,302	8,343	81.0	207.6	24,887	17.6	5,093	61.0	28,933	86.0
1990-2016	176,877	104,366	59.0	5,965.7	57,161	428.3	82,562	79.1	52,951	108.0

NONRESIDENT UNDERGRADUATE DEGREES

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1990	915	99	10.8%	$8.7	$87,907	$0.6	80	80.8%	$62,373	140.9%
1991	993	113	11.4	10.6	93,956	0.7	92	81.4	86,994	108.0
1992	1,000	111	11.1	10.9	98,045	0.8	95	85.6	84,933	115.4
1993	1,152	147	12.8	13.9	94,300	1.0	123	83.7	82,832	113.8
1994	1,084	156	14.4	16.6	106,201	1.2	126	80.8	91,667	115.9
1995	1,004	137	13.6	14.9	108,881	1.0	115	83.9	80,599	135.1
1996	941	134	14.2	11.4	85,167	0.8	110	82.1	80,894	105.3
1997	1,130	181	16.0	18.6	102,665	1.3	152	84.0	81,643	125.7
1998	1,443	214	14.8	17.6	82,229	1.2	171	79.9	77,338	106.3
1999	1,475	240	16.3	20.4	84,931	1.4	194	80.8	73,883	115.0
2000	1,620	285	17.6	25.2	88,512	1.8	234	82.1	85,537	103.5
2001	1,548	250	16.1	22.0	87,833	1.5	206	82.4	73,985	118.7
2002	1,438	247	17.2	21.0	85,100	1.5	197	79.8	73,949	115.1
2003	1,518	275	18.1	23.5	85,331	1.6	237	86.2	74,068	115.2
2004	1,574	283	18.0	22.0	77,836	1.6	227	80.2	71,611	108.7
2005	1,727	306	17.7	21.9	71,456	1.5	242	79.1	67,848	105.3
2006	1,692	290	17.1	20.2	69,535	1.4	233	80.3	68,404	101.7
2007	1,744	338	19.4	23.1	68,227	1.6	268	79.3	65,802	103.7
2008	1,897	328	17.3	19.9	60,569	1.4	258	78.7	59,925	101.1
2009	2,049	338	16.5	19.7	58,198	1.4	251	74.3	61,510	94.6
2010	2,055	381	18.5	20.8	54,468	1.5	308	80.8	53,743	101.4
2011	2,114	418	19.8	20.0	47,793	1.4	301	72.0	52,561	90.9
2012	2,243	463	20.6	21.8	47,172	1.6	335	72.4	50,150	94.1
2013	2,497	536	21.5	23.0	42,843	1.7	405	75.6	46,000	93.1
2014	3,056	682	22.3	25.7	37,686	1.9	486	71.3	43,100	87.4
2015	3,486	950	27.3	30.8	32,398	2.4	648	68.2	39,828	81.3
2016	4,027	1,179	29.3	22.1	18,758	2.0	499	42.3	27,434	68.4
1990-2016	47,422	9,081	19.1	526.0	57,921	37.9	6,593	72.6	55,000	105.3

ALL GRADUATE DEGREES

		2016						
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1990	1,726	446	25.8%	$44.4	$99,525	$3.1	339	76.0%
1991	1,855	507	27.3	49.3	97,151	3.5	384	75.7
1992	1,757	512	29.1	54.2	105,869	3.8	392	76.6
1993	2,008	604	30.1	57.9	95,814	4.1	472	78.1
1994	2,132	653	30.6	63.5	97,199	4.5	497	76.1
1995	2,359	767	32.5	78.8	102,679	5.5	605	78.9
1996	2,270	792	34.9	81.5	102,910	5.7	628	79.3
1997	2,470	846	34.3	85.0	100,473	6.0	668	79.0
1998	2,535	889	35.1	91.4	102,848	6.4	726	81.7
1999	2,637	973	36.9	99.2	101,989	7.0	789	81.1
2000	2,632	974	37.0	101.6	104,337	7.1	792	81.3
2001	2,562	916	35.8	97.0	105,911	6.8	730	79.7
2002	2,789	1,140	40.9	109.0	95,612	7.6	910	79.8
2003	2,974	1,235	41.5	122.4	99,124	8.6	994	80.5
2004	3,135	1,265	40.4	119.2	94,268	8.4	1,042	82.4
2005	2,863	1,221	42.6	112.5	92,128	7.9	1,006	82.4
2006	2,982	1,247	41.8	117.6	94,300	8.2	1,027	82.4
2007	3,215	1,333	41.5	118.0	88,543	8.3	1,109	83.2
2008	3,478	1,539	44.2	133.9	86,998	9.4	1,288	83.7
2009	4,156	1,812	43.6	144.3	79,611	10.1	1,478	81.6
2010	4,302	2,014	46.8	148.1	73,532	10.4	1,665	82.7
2011	4,531	2,103	46.4	149.6	71,133	10.5	1,737	82.6
2012	4,576	2,136	46.7	143.9	67,373	10.1	1,746	81.7
2013	4,864	2,344	48.2	151.8	64,765	10.7	1,885	80.4
2014	5,270	2,479	47.0	153.5	61,931	10.8	1,966	79.3
2015	6,087	2,795	45.9	154.2	55,152	11.0	2,172	77.7
2016	6,624	3,103	46.8	128.4	41,384	9.7	1,726	55.6
1990-2016	88,789	36,645	41.3	2,910.2	79,415	205.1	28,773	78.5

RESIDENT GRADUATE DEGREES

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1990	1,111	368	33.1%	$36.1	$98,233	$2.6	277	75.3%	$80,864	121.5%
1991	1,328	447	33.7	45.0	100,622	3.2	337	75.4	88,053	114.3
1992	1,248	464	37.2	50.7	109,316	3.6	354	76.3	80,341	136.1
1993	1,416	556	39.3	53.2	95,633	3.7	434	78.1	82,076	116.5
1994	1,538	615	40.0	59.8	97,243	4.2	469	76.3	85,681	113.5
1995	1,711	715	41.8	72.5	101,351	5.1	560	78.3	88,925	114.0
1996	1,630	727	44.6	74.9	102,983	5.2	574	79.0	87,858	117.2
1997	1,718	741	43.1	74.2	100,110	5.2	581	78.4	84,554	118.4
1998	1,767	780	44.1	78.9	101,153	5.5	627	80.4	83,774	120.7
1999	1,844	875	47.5	88.3	100,879	6.2	710	81.1	86,085	117.2
2000	1,780	846	47.5	88.1	104,161	6.2	682	80.6	92,431	112.7
2001	1,705	805	47.2	85.9	106,675	6.0	642	79.8	90,000	118.5
2002	1,972	1,025	52.0	98.5	96,103	6.9	820	80.0	84,014	114.4
2003	2,045	1,097	53.6	108.6	99,020	7.6	884	80.6	82,819	119.6
2004	2,009	1,075	53.5	101.9	94,771	7.1	894	83.2	83,434	113.6
2005	1,981	1,090	55.0	99.6	91,338	7.0	900	82.6	80,006	114.2
2006	1,891	1,085	57.4	102.8	94,723	7.2	890	82.0	81,938	115.6
2007	2,059	1,171	56.9	99.5	84,992	7.0	973	83.1	73,614	115.5
2008	2,331	1,366	58.6	117.7	86,178	8.2	1,149	84.1	72,757	118.4
2009	2,463	1,536	62.4	119.4	77,734	8.4	1,256	81.8	70,436	110.4
2010	2,702	1,724	63.8	123.3	71,502	8.7	1,423	82.5	65,968	108.4
2011	2,778	1,766	63.6	124.2	70,356	8.7	1,483	84.0	63,474	110.8
2012	2,655	1,742	65.6	115.1	66,046	8.1	1,443	82.8	62,542	105.6
2013	2,733	1,915	70.1	120.8	63,077	8.5	1,555	81.2	61,975	101.8
2014	2,691	1,946	72.3	120.2	61,770	8.5	1,556	80.0	58,610	105.4
2015	2,758	2,087	75.7	114.0	54,625	8.1	1,642	78.7	53,505	102.1
2016	2,806	2,257	80.4	98.1	43,447	7.4	1,387	61.5	47,374	91.7
1990-2016	54,670	30,821	56.4	2,471.1	80,176	174.0	24,502	79.5	70,000	114.5

NONRESIDENT GRADUATE DEGREES

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1990	615	78	12.7%	$8.2	$105,621	$0.6	62	79.5%	$72,042	146.6%
1991	527	60	11.4	4.3	71,293	0.3	47	78.3	66,680	106.9
1992	509	48	9.4	3.5	72,548	0.3	38	79.2	71,594	101.3
1993	592	48	8.1	4.7	97,909	0.3	38	79.2	92,791	105.5
1994	594	38	6.4	3.7	96,499	0.3	28	73.7	86,806	111.2
1995	648	52	8.0	6.3	120,934	0.4	45	86.5	121,081	99.9
1996	640	65	10.2	6.6	102,099	0.5	54	83.1	98,506	103.6
1997	752	105	14.0	10.8	103,035	0.8	87	82.9	97,327	105.9
1998	768	109	14.2	12.5	114,976	0.9	99	90.8	107,669	106.8
1999	793	98	12.4	11.0	111,901	0.8	79	80.6	106,130	105.4
2000	852	128	15.0	13.5	105,503	0.9	110	85.9	96,012	109.9
2001	857	111	13.0	11.1	100,368	0.8	88	79.3	104,791	95.8
2002	817	115	14.1	10.5	91,239	0.7	90	78.3	90,565	100.7
2003	929	138	14.9	13.8	99,954	1.0	110	79.7	100,273	99.7
2004	1,126	190	16.9	17.4	91,419	1.2	148	77.9	89,511	102.1
2005	882	131	14.9	12.9	98,700	0.9	106	80.9	101,349	97.4
2006	1,091	162	14.8	14.8	91,465	1.0	137	84.6	95,855	95.4
2007	1,156	162	14.0	18.5	114,217	1.3	136	84.0	105,109	108.7
2008	1,147	173	15.1	16.2	93,466	1.1	139	80.3	97,538	95.8
2009	1,693	276	16.3	24.9	90,060	1.7	222	80.4	89,862	100.2
2010	1,600	290	18.1	24.8	85,602	1.7	242	83.4	79,325	107.9
2011	1,753	337	19.2	25.3	75,208	1.8	254	75.4	74,195	101.4
2012	1,921	394	20.5	28.9	73,239	2.0	303	76.9	70,004	104.6
2013	2,131	429	20.1	31.0	72,299	2.2	330	76.9	72,528	99.7
2014	2,579	533	20.7	33.3	62,517	2.4	410	76.9	64,500	96.9
2015	3,329	708	21.3	40.1	56,708	2.9	530	74.9	60,062	94.4
2016	3,818	846	22.2	30.4	35,882	2.4	339	40.1	47,517	75.5
1990-2016	34,119	5,824	17.1	439.1	75,387	31.1	4,271	73.3	75,523	99.8