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THE ECONOMIC BENEFITS OF EDUCATIONAL ATTAINMENT

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The Economic Benefits of Educational Attainment

Executive Summary

Education is vital for a highly skilled and productive labor force. This study seeks to quantify the relationships between additional educational attainment and employment opportunities, wage rates, and aggregate economic growth. We find that increasing education attainment would have powerful positive effects on the economy.

Specifically:

- As individuals attain greater education, their probability of employment rises;
- Greater education, including certification for those without a high-school or college degree, also increases workers' ability to command higher wages; and
- For every 1 percentage-point increase in the growth rate of the portion of a state's population with at least a bachelor's degree, the state's real gross domestic product growth rate increases by about 0.08 percentage points. Consequently, if every state had increased its bachelor's degree attainment growth rate by just 1 percentage point over the last decade, then nationwide economic growth would have increased by about $130.5 billion.

In sum: Greater post-secondary educational attainment of all types would not just increase employment opportunities and wages in the labor market, but would also spur widespread and stronger economic growth.

Introduction

Post-secondary education has clear benefits for those looking for a job: College-educated workers, for example, face lower unemployment and obtain higher wages than their less-educated counterparts. Unfortunately, education levels are not rising to match the economy's demands. In the aftermath of the Great Recession, the unemployment rate has decreased from a high of 9.9 percent to about 3.8 percent.[1] Despite this overall improvement, the rise in U.S. education levels has not kept up with the rise in demand for highly skilled workers. This relative shortfall of skilled workers inhibits the ability of firms to meet demand, expand, and augment levels of productivity. For the state or national economy, the cascading effects of lower educational attainment translate into lower rates of aggregate growth.

In this study, we quantify the economic benefits of increasing education levels. Specifically, the study measures how attaining various levels of post-secondary education beyond a high-school diploma

can positively affect workers' chances of being employed and their wages. We then expand the scope of the analysis and examine the effect that raising the proportion of college graduates would have on the nation's economy.

Compared to workers with at most high school diplomas, those with associate/vocational degrees for example, are about 8.47 percent more likely to be employed. Workers with associate/vocational degrees also make about 18.68 percent more than workers with at most high school diplomas.

With regard to impacts on economic growth, a 1 percentage-point increase in the growth rate of the portion of adult population with at least a bachelor's degree (relative to the overall growth of the whole population) is associated with about a 0.08-percentage point increase in the real gross domestic product (GDP) growth rate. This association means that if each state raised the growth rate of the population with bachelor's degrees by just 1 percentage point, then real GDP would increase by about $103.5 billion nationwide. We also compute the impact for each individual state.

These results suggest that there are real economic benefits that come from policy strategies to increase the accessibility of additional education.

Data and Methods

At the heart of this study is the relationship between a worker's educational level, his or her chances of being employed, and the wages that employment commands. To investigate this relationship, we used data from the National Bureau of Economic Research (NBER) Current Population Survey (CPS) supplemental data from March 2018.

Our first focus is on the link between a respondent's employment status and educational attainment. We included indicator variables for each measure of educational attainment, with high school graduates being the base category. Specifically, we have binary variables for dropouts, dropouts with certifications, high-school graduates with certifications, some college, some college with certifications, associate/vocational-degree holders, bachelor's degree holders, master's degree holders, and doctorate degree holders. Notice that this approach measures how the attainment of a certification (e.g. a welding certification) improves the employment prospects of those who have not attained a college education. In addition, our empirical techniques also control for gender, race, ethnicity, and whether a respondent lives in a metropolitan area.[2]

We adopt a logit model and account for heteroscedasticity[3] and other possibilities by using robust standard errors to estimate our model. We also have included binary variables to control for unobservable differences between states (state fixed effects). (For the model, see Equation 1 in the Appendix.)

The second relationship of interest is between wages and education. Our dependent variable is the natural logarithm of weekly earnings of workers. We again included binary variables for each level of education attainment, given that high school graduates are the base category. In addition to the same controls used in the above model, we included controls for industry of worker, occupation, union membership/representation, immigration status, school enrollment status, marital status, disability, and number of children. The binaries for each state are also included. (For the model, see Equation 2 in the Appendix.)

Finally, to quantify the effect of increasing educational attainment on the U.S. economy, we compiled panel data from 2007 to 2017 for the 50 states and the District of Columbia. We used a fixed-effects model to control for all unobservable state and time differences. Our dependent variable is the real GDP growth rate and our independent variable of interest is the change in the proportion of a state's population (aged 25 and over) that has at least a bachelor's degree. We experimented with a measure of the fraction of the state's population that attained an associate degree but found no statistically reliable relationship.[4]

One can think of the basic relationship as being between the log-level of output and the level of human capital, which is transformed into growth rates. From this perspective, it is important to control for other time-varying components of human capital. We include the state's high-school graduation rate, average score on math portion of the National Assessment of Educational Progress, proportion of the labor force in the manufacturing sector, and proportion of employed workers represented by unions. We proxied additional impacts on demand using average student debt of degree holders. We also use robust standard errors to account for possible heteroscedasticity in our data. (For the model, see Equation 3 in the Appendix.)

Results

The results of estimating Equation 1 are reported in Table 1 (below). Because logit models are based on logged odds, their coefficients can be difficult to interpret. Therefore, we have also calculated the average marginal effects (AME) of each variable and included them as well. Only the variables of interest have been reported to conserve space.

The key result is that various levels of education beyond high school diplomas lead to statistically significant increased opportunities in the labor market.

The results of Table 1 are relative to workers with at most high school diplomas or GEDs. The far right column, labeled Effect of Education on Employment Status, provides the most relevant results. For example, the top two rows indicate that:

- A high school dropout is 29.8 percent less likely to be employed than a worker with at most a high school diploma; and
- A high school dropout with a professional certification is 19.36 percent more likely to be employed than a high school graduate without a professional certification.

Table 1: Dependent Variable: Employed?

Level of Education	**Coefficient (Standard Error)**	**Effect of Education on Employment Status**
Dropout	-1.56*** (.022)	-29.8%
Dropout w/ Cert.	1.02*** (.107)	19.36%
HS Grad w/ Cert.	1.37*** (.024)	26.03%
Some College	-0.02 (.019)	-0.37%
Some College w/ Cert.	0.13** (.058)	2.51%
Assoc./Voc.	0.44*** (.023)	8.47%
Bachelor	0.68*** (.018)	12.96%
Mast/Prof.	0.68***	12.98%

	(.024)	
Doctorate	0.79*** (.053)	15.16%
Constant	1.84*** (.049)	NA
Pseudo R^2	0.1664	NA

***$p < 0.01$, **$p < 0.05$, *p < 0.10

Further, those with bachelor's degrees are 12.96 percent more likely to be employed than those with at most a high school diploma or GED. Notably, this is actually less significant than the employment impacts of having a professional certification. Workers that earn higher than a bachelor's degree are between 12.98 percent and 15.16 percent more likely to be employed than those with at most a high school diploma or GED. Note that the effect of having some college is statistically insignificant (or in other words, inconclusive) and should not be seriously considered.

Similarly, our estimated version of Equation 2 shows a statistically significant relationship between the education variables and the natural log of weekly earnings. The results of this model are reported in Table 2. Because the specification is in log-levels, we can interpret our coefficients as the percentage impact on weekly earnings.

The results of Table 2 are relative to workers with at most high school diplomas or GEDs. Again, the far-right column provides the interpreted results. The top two rows indicate that

- A high school dropout will make about 35.18 percent less than a worker with at most a high school diploma or GED; and
- A high school dropout with a certification will make about 19.59 percent more than a worker with at most a high school diploma or GED.

Table 2: Dependent Variable: Natural Log of Weekly Earnings

Variable	**Coefficient (Standard Error)**	**Effect of Education on Wages**
Dropout	-0.3518*** (.0352)	-35.18%
Dropout w/ Cert.	0.1959* (.105)	19.59%
HS Grad w/ Cert.	0.1015*** (.023)	10.15%
Some College	0.0237 (.027)	2.37%
Some College w/ Cert.	0.1649*** (.049)	16.49%
Assoc./Voc.	0.1868*** (.030)	18.68%
Bachelor	0.4467***	44.67%

	(.025)	
Mast/Prof.	0.6362*** (.034)	63.62%
Doctorate Degree	0.8265*** (.060)	82.65%
Constant	7.0421*** (.080)	NA
Pseudo R^2	0.3321	NA

***$p < 0.01$, **$p < 0.05$, *p < 0.10

Those with an associate degree earn on average 18.68 percent more per week than those with at most a high school diploma, and for those attaining a bachelor's degree that figure jumps to 44.7 percent. Workers that earn higher than a bachelor's degree make about 63.6 percent to 81.7 percent more than those with at most a GED/high-school diploma. Note the effect of having some college is statistically insignificant (or in other words, inconclusive) and should not be seriously considered.

Thus far, we have shown that there are strong economic incentives for individuals to pursue not only college degrees, but also other forms of post-secondary education and certification. These incentives include greater probabilities of employment at higher wages. We now turn to the relationship that policymakers may also care about – educational attainment and economic performance.

The estimated results of Equation 3 (Table 3, below) show a significant relationship between the fraction of the population that has a bachelor's degree and economic prosperity. Specifically, our estimated coefficient indicates that increasing the growth rate of the population with at least a bachelor's degree (relative to the population as a whole) is associated with an increase in a state's GDP growth rate by an average of 0.08 percentage points. The real GDP growth rate for 2018 was 2.9 percent. With an additional 0.08 percentage points in real GDP growth, the real GDP growth rate would have been about 2.98 percent. Using the growth rate of the population with associate/vocational degrees did not result in a statistically significant relationship with real GDP growth. Because of this inconclusive relationship, we have not included that model.

In terms of interpreting the coefficients of our model, looking at the top two rows,

- A 1 percentage-point increase in the growth rate of a state's population with bachelor's degrees is associated with about a 0.08 percentage-point increase in the state's real GDP growth rate; and
- A 1 percentage-point increase in the growth rate of a state's high school graduation rate is associated with about a 0.05-percentage point increase in the state's real GDP growth rate. (See past AAF research for more on growth impacts of higher graduation rates).

Table 3: Dependent Variable: RGDP Growth

Variable in Growth Rates	**Coefficient in Percentage Points (Standard Error)**
Proportion with Bachelor's	0.08* (.045)
High School Graduation Rate	0.05 (.044)

Average Student Debt	0.02 (.017)
Score on Math portion of NAEP	-0.08 (.067)
Population	0.16 (.107)
Proportion of Labor Force in Manufacturing	0.12* (.064)
Percent of Employed Workers Represented by a Union	-0.003 (.007)
Constant	0.007 (.005)
R^2 Overall	0.2757

***$p < 0.01$, **$p < 0.05$, *$p < 0.10$

Implications

Our results indicate that there are broad economic benefits to more people attaining a college education, associate degree, vocational school training, or other professional certification. In this section, we spell out those benefits.

Using the results from Tables 1 and 2, consider a scenario where every member of the non-institutional civilian population who has at most a high school diploma or GED received an associate or vocational degree. The results suggest that 5.9 million more people would be employed. Of these 5.9 million people, their annual wages would increase by about $291 billion, in aggregate. In addition, of the already-employed persons with high school diplomas or GEDs who now hypothetically have an associate or vocational degree, their annual wages would increase by about $301 billion, in aggregate. Combining these figures, if all members of the non-institutional civilian population that had at most high school diplomas or GEDs now had an associate or vocational degree, their annual wages would increase by nearly $600 billion, in aggregate. Table 4 contains these figures for each level of education, considering high school diploma or GED to be the base category.

Note that the Some College column is statistically insignificant (or in other words, inconclusive) from the regression model. Even though the effect has been estimated to be negative, we cannot confidently believe in those figures.

Table 4: Employment and Wage Implications of Educational Attainment

Category	**Dropout with Cert**	**HS Grad with Cert**	**Some College**	**Some College with Cert**	**Assoc/ Voc.**	**Bachelor**	**Mast/ Prof.**	**Doct.**
Employment Change								
Employment (Millions)	13.5	18.2	-0.2	1.8	5.9	9.1	9.1	10.6

Wages Total (Billions)	$670.6	$830.3	-$10.9	$84.7	$291.1	$543.0	$615.3	$801.6
Wage Change of People With Jobs								
Average Wage	$156	$81	$19	$132	$149	$357	$508	$660
Total Wages (Billions)	$315.8	$163.6	$38.2	$265.8	$301.2	$720.2	$1,025.7	$1,332.5
Total (Billions)	$986.4	$993.9	$27.4	$350.5	$592.3	$1,263.2	$1,641.0	$2,134.2

Similarly, using the results from our panel data model (Equation 3, reported in Table 3), we can estimate the effect on the economy of increasing the growth rate of the proportion of a state's population with at least a bachelor's degree. From 2010 to 2017, the actual real GDP growth rate was about 2.11 percent. Had every state increased the growth rate at which people receive bachelor's degrees by 1 percentage point for the past decade, the growth rate would have increased from about 2.11 percent to about 2.19 percent, which translates to about a $103.5 billion increase in real GDP. Of course, the impacts will show up in state economies, too. These estimates can be found in the map, below.

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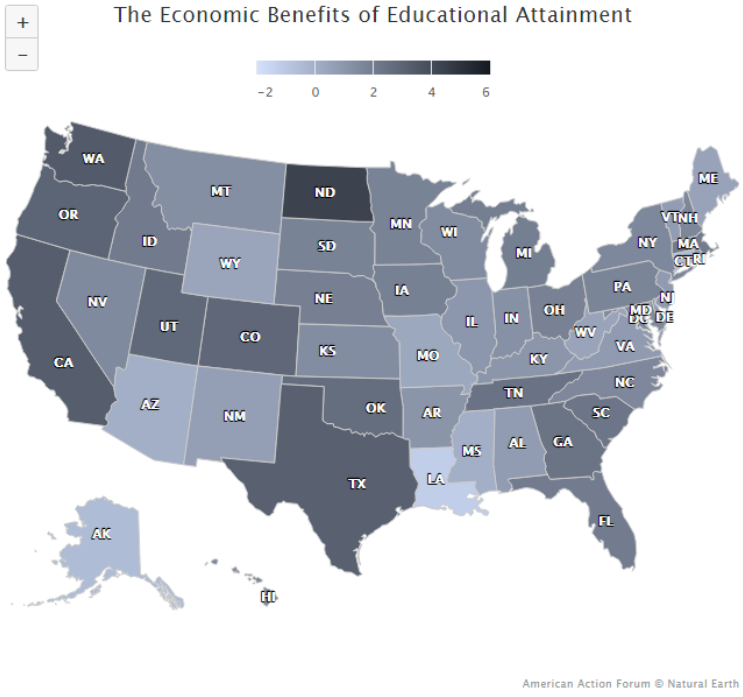

Conclusion

State	RGDP GR	Alternate GR	Alternate RGDP - Actual RGDP ($)
AL	0.8	0.89	1134
AK	-0.5	-0.41	312
AZ	0.02	2.15	1726
AR	1.04	1.13	669
CA	3.26	3.34	14798
CO	2.89	2.98	1864
CT	-0.5	-0.41	1424
DC	1.52	1.61	714
DE	0.9	0.98	376
FL	2.05	2.13	5133
GA	2.39	2.47	2959
HI	1.62	1.71	464
ID	2.11	2.19	389
IL	1	1.09	4377

State	RGDP GR	Alternate GR	Alternate RGDP - Actual RGDP ($)
IN	1.21	1.3	1882
IA	1.87	1.87	986
KS	1.37	1.46	869
KY	1.02	1.1	1084
LA	-1.24	-1.16	1361
ME	0.48	0.56	328
MD	1.49	1.58	2122
MA	2.07	2.16	2848
MI	1.94	2.03	2669
MN	1.78	1.87	1879
MS	0.02	0.11	594
MO	0.31	0.39	1630
MT	1.31	1.39	260
NE	1.88	1.96	649

State	RGDP GR	Alternate GR	Alternate RGDP - Actual RGDP ($)
NV	1.49	1.57	835
NH	1.63	1.72	434
NJ	0.81	0.89	3216
NM	0.64	0.72	536
NY	1.56	1.64	8260
NC	1.6	1.68	2827
ND	4.35	4.44	289
OH	1.81	1.89	3441
OK	2.63	2.71	1103
OR	2.99	3.07	1196
PA	1.71	1.79	4087
RI	0.54	0.63	315
SC	2.29	2.37	1156
SD	1.79	1.87	265

State	RGDP GR	Alternate GR	Alternate RGDP - Actual RGDP ($)
TN	2.41	2.5	1825
TX	3.13	3.22	9291
UT	2.84	2.93	865
VT	0.72	0.81	174
VA	0.84	0.92	2727
WA	3.37	3.46	2759
WV	0.44	0.52	417
WI	1.42	1.5	1709
WY	0.41	-0.32	230

Conclusion

Education is essential to a highly skilled and productive labor force, and increasing the rate at which people graduate from college would have powerful effects on the economy. This study finds that for every 1 percentage-point increase in the portion of a state's population with at least a bachelor's degree, the state's real GDP growth rate increases by about 0.08 percentage points. Consequently, if every state had increased its bachelor's degree-attainment growth rate by just 1 percentage point over the last decade, then nationwide country economic growth would have increased by about $130.5 billion.

Even for those who do not obtain a bachelor's degree, the employment and wage impacts of obtaining a certification, associate degree, or vocational qualification are significant enough to merit increased policy attention. In fact, each of these levels of post-secondary training have a greater impact on a person's wages and prospects for employment on average than if they had attended a four-year college without obtaining a bachelor's degree. Thus, greater post-secondary educational attainment of all types would not only increase employment opportunities and wages in the labor market, but would also spur widespread and stronger economic growth.

Appendix

Equation 1 corresponds with Table 1.

We adopt a logit model and account for heteroscedasticity and other possibilities by using robust standard errors to estimate our model. We also have included binary variables to control for unobservable differences between states (state fixed effects).

Equation 1

$$Prob(employment) = \beta_0 + \beta_1(dropout) + \beta_2(certdrop) + \beta_3(cert) + \beta_4(some) + \beta_5(asocvoc) + \beta_6(certsome) + \beta_7(ba) + \beta_8(mastprof) + \beta_9(fem) + \beta_{10}(age) + \beta_{11}(race) + \beta_{12}(hisp) + \beta_{13}(urban) + \beta_{14}(Alabama) + \ldots + \beta_{65}(Wyoming) + \varepsilon$$

Equation 2 corresponds with Table 2.

Similarly, our estimated version of Equation 2 shows a statistically significant relationship between the education variables and the natural log of weekly earnings. The results of this model are reported in Table 2. Because the specification is in log-levels, we can interpret our coefficients as the percentage impact on weekly earnings.

Equation 2

$$ln(Weekly\ Earnings) = \beta_0 + \beta_1(dropout) + \beta_2(certdrop) + \beta_3(cert) + \beta_4(some) + \beta_5(certsome) + \beta_6(some) + \beta_7(certsome) + \beta_8(asocvoc) + \beta_9(ba) + \beta_{10}(mastprof) + \beta_{11}(doc) + \beta_{12}(fem) + \beta_{13}(age) + \beta_{14}(race) + \beta_{15}(hisp) + \beta_{16}(urban) + \beta_{17}(indust) + \beta_{18}(occu) + \beta_{19}$$

Equation 3 corresponds with Table 3.

Finally, to quantify the effect of increasing educational attainment on the U.S. economy, we compiled panel data from 2007 to 2017 for the 50 states and the District of Columbia. We used a fixed-effects model to control for all unobservable state and time differences. Our dependent variable is the real GDP growth rate and our independent variable of interest is the change in the proportion of a state's population (aged 25 and over) that has at least a bachelor's degree. We experimented with a measure of the fraction of the state's population that attained an associate degree but found no statistically reliable relationship.

Equation 3

$$Real\ GDP\ Growth_i = \beta_0 + \beta_1(bag_i) + \beta_2(gradrateg_i) + \beta_3(avgstudebtg_i) + \beta_4(mathscoreg_i) + \beta_5(populg_i) + \beta_6(manuRatiog_i) + \beta_7(percuniong_i) + \beta_8(oNine) + \ldots + \beta_{16}(seventeen) + \varepsilon$$

[1] https://data.bls.gov/timeseries/LNS14000000

[2] Summary Statistics are available from the authors upon request.

[3] Random variables are heteroscedastic when their subpopulations have unequal variability across different values of those variables. Heteroscedasticity can invalidate hypothesis tests.

[4] These results are available from the authors upon request.

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