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Investment Returns to College Education in the United States

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Abstract

The research examines the earnings of associate's degree versus bachelor's degreeholders in the U.S. A panel dataset on the number of graduates from the two modes of educationfor fifty states and Washington D.C.during 2004-2012is used.The results show that there is no statistical difference between the two levels of education. The paper then report the results from a non-regression approach of calculating thefinancial costs of attending two more school years and opportunity cost of income. The financial costs areaverage income forgonedivided by the number of yearsand subtracted from the average per capita income. The results confirm the regression results that these adjusted per capita incomes for the two levels of education appear not to be statistically different from each other for any time horizon between nine to twelve years. For the time horizon less than nine years, the adjusted per capita income of a bachelor's degree holder seems to be lower than that of an associate's degree holder.

Keywords: community colleges, universities, per capita income, financial costs, opportunity costs.

1. Introduction

The slow recovery from the 2008 financial crisis has raised concerns on the returns of education to income and employment. In the meantime, facing financial constraints, many firms are looking for job candidates with practical skills instead of deep knowledge in liberal art education. The federal and state governmentsalso seem to shift its attention and plans to give more favorable consideration in its distribution of financial aids to community colleges. This raisesthe question of whether four-year college education is stillthe staple of investment in human capital for most households in the U.S.

Existing literature does not investigate this issue using panel data at the state level.Table 1 provides the descriptive statistics of the data on these two levels of education. The table reveals that the number of bachelor degree holders is more than twice that of associate degree holders. The question is whether the US really need so many university graduates to improve its living standard.

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Table 1. Number of Associate's Degree versus Bachelor's Degree Holders in the U.S.

Period	2004-2006		200-2009		2010-2012	
Region	Associate	Bachelor	Associate	Bachelor	Associate	Bachelor
United States	1995832	4241247	2263326	4682634	2724754	4744656
New England	87165	278645	87034	28906	91423	299654
Mideast	309732	743121	342522	816574	386098	848548
Great Lakes	286067	698312	353573	765870	389302	778365
Plains	164967	345736	196213	389725	202317	401725
Southeast	463745	898734	543361	997946	601234	1102865
Southwest	194586	398649	245734	482673	341397	496683
Rocky Mountain	81394	178945	89241	198945	117646	198573
Far West	386684	578896	398934	642673	434792	667894

Source: National Center for Education Statistics, https://nces.ed.gov/

Table 2 shows the distribution of average earning by education attainment in the U.S. It appears that four-year college graduates earn substantially more than the community-college graduates. However, this observation might not hold once the adjusted income is in present, including opportunity cost of the two-year salary forgone while attending a university and the financial costs, including tuition, fees, room, and board.In addition, several authors have found that vocational education increases productivity more than university education does. Since increase in productivity often leads to increase in per capita income, the results might imply that vocational education can increase per capita income more than university education at certain time horizon.

This paper attempts to settle these issues. Section two of the paper provides a brief review of the existing literature. Section three introduces a regression model and discusses data issues. Section four of the paper analyzes the results including a non-regression calculation as an intuitive explanation of the regression results and section five concludes.

Table 2. Mean Earning by Education Attainment (in U.S. Dollars)

Education Attainment	2004-6		2007-09		2010-12	
Level of Highest Degree	Mean	STDEV	Mean	STDEV	Mean	STDEV
Not a high school graduate	19,564	148	20,012	189	21,132	213
High school graduate	27,546	452	30,453	768	32,143	412
Some college, no degree	30,645	343	32,425	879	33,956	398
Associate's	35,318	758	38,163	976	40,058	243
Bachelor's	52,144	376	55,412	989	58,326	1,034
Master's	63,254	1,065	69,535	1,121	72,437	1,124
Professional	110,965	2,067	117,856	2,215	125,588	3,013
Doctorate	89,165	2,004	98,978	2,143	101,634	2,435

Note: "mean" denotes average income per year, and "STDEV" is the standard deviation.
Source: U.S. Census Bureau, http://www.census.gov/hhes/socdemo/education/

2. Existing Literature

Theoretical literature on education or human capital and productivity growth are plentiful. The neoclassical model on this subject is the Solow (1957) growth model, where labor productivity, defined as output per worker, depends solely on capital per worker. From this model comes the concept of total factor productivity (TFP) or the Solow residual, defined as the growth of output per worker minus one-third of the growth of capital per worker. This Solow model is extended to allow for human capital by Lucas (1998), Romer (1990), and Aghion and Howitt (1992) in the so called "new growth" theory.

Originally developed to study the effect of research and development (R&D) on output growth in a closed economy, it is further modified by Kremer (1993) for productivity growth in a closed economy and by Barro et al. (1995) for an open economy.

Baumol (1990) argues that the effect of knowledge on output might depend on some specific characteristics of a country, such as political and economic stability. This motivates us to add these country specific variables to our econometric model. In Kremer's (1993) model for productivity growth, defined as output per worker, the augmented production function with knowledge and land added is divided through by labor. The results show that knowledge always affects productivity growth positively even with diminishing returns to knowledge itself. Barro et al. (1995) examines an open economy and find that education increases output per worker only if a nation can finance its education with its own savings instead of borrowing from foreigners.

There are only a handful ofempirical papers on the topic of education and per capita income.Using OLS on two single equation estimations for cross sectional data of 81 to 93 countries, Bils and Klenow (2000) find that education only has a very weak effect on GDP per capita, but this GDP increase in turn has a positive effect on school enrollments.Hojo (2003) uses the country-specific residual from the regression by Caselli et al. (1996) as a proxy for productivity. Employing the GMM procedure introduced by Arellano and Bond (1991) on a single equation for cross sectional data of 90 countries, he finds that education has positive effect on productivity. Since higher productivity is related to a higher GDP per capita as shown in Islam (1995), Hojo's results imply that education can indirectly affect GDP per capita through productivity improvement at national level.

Since all aforementioned papers use single equation estimations, their coefficient estimates will be biased if a two-way causality between education and GDP per capita exists. Kumar (2003) develops a model that addresses this problem. Employing the two stage least squares (2SLS) approach for a system of equations, he uses cross sectional data with 68 to 91 observations. In contrast to Bils and Klenow (2000) and in accordance with Hojo (2003), he finds that education clearly increases productivity growth, but this growth in turn has a negative effect on enrollments instead of a positive one as in Bils and Klenow. However, the 2SLQ estimations are only asymptotically consistent, so large sample sizes are called for instead of Kumar's 68 to 91 observation data sets at national level.

Vu at al. (2012) address Kumar's problem by using larger panel data set and a more advanced econometric method of three stage least squares (3SLS). They find that the two way causality are both positive. They also find that that vocational education increases labor productivity more than university education. On the reverse causality, they find that the effect ofproductivity growth on vocational-school enrollments is higher than on university enrollments. Vu and Im (2011) look at the case of Vietnam as a specific developing country. They find that vocational education helped regional development in Vietnam more than university education. On the reverse causality, they find that the effect of regional development on university enrollments is higher than on vocational-school enrollments. This paper looks for answers to the US as one of the most developed countries.

3. Model and Data

The empirical model used in this paper is based on an augmented production function introduced in Romer (2006):

$$PERCA_{it} = ASPER_{i,t-k}^{\alpha} BAPER_{i,t-k}^{\beta} \prod_{j=1}^{n} C_{j,t-k}^{\phi_j} e^{u_i} e^{v_t} e^{\varepsilon_{it}} \tag{1}$$

k = 0, 1, 2…m,

with m to be determined by the Akaike Information Criterion (AIC) procedure
where PERCAis used alternatively as per capita income or employment ratio to population for each of the fifty states and Washington D.C.,ASPER is the ratio of the associate's degree holders to the population, BAPERis the ratio of bachelor's degree holders to the population.C is a vector of control variables that might affect the per capita income or employment rate, such as investment in physical capital, infrastructure, etc. Log-linearizing both sides of Equation (1) yields:

$$\ln PERCA_{it} = \alpha \ln ASPER_{i,t-k} + \beta \ln BAPER_{i,t-k} + \sum_{j=1}^{n} \phi_j \ln C_{i,t-k} + u_i + v_t + \varepsilon_{it} \tag{2}$$

Data on the numbers of associate's and bachelor's degrees conferred for fifty states and Washington D.C. during the school years 2004-2012are from the National Center for Education Statistics(NCES) website.

Data for the school years 2004-2006 are from Table 3a01, “Number of degrees conferred in Title IV institutions, by award level, gender, and state.” Data for the school years 2006-2008 are from Table 335, “Degrees conferred by degree-granting institutions, by level of degree and state or jurisdiction.” Data for the school year 2008-2009 are from Table 332, “Degrees conferred by degree-granting institutions, by control, level of degree, and state or jurisdiction.” Data for 2009-2012 are from the “State Education Data Profiles,” also published by the NCES.

Data on the gross state products, employment, federal government expenditures on education, investment on physical capital, expenditures on medical facilities (as a proxy for health care), domestic trade, expenditures on transportation and warehousing(as a proxy for infrastructure), state and local government expenditures, household expenditures on education, information technology, and expenditures on social assistances for fifty states and Washington D.C. during 2004-2012are from theBureau of Economic Analysis(BEA).All measures are in current dollars and therefore data on the price indices for GDP (implicit GDP deflators) from the BEA are used to convert them to real values. There are missing observations in the remaining data, so we have an unbalanced panel.

4. Results and Analysis

We start with the model for per capita income as dependent variable, using all available variables to avoid omitted variables and performing the Variance Inflation Factors (VIF) tests on the possible multicollinearity as discussed in Kennedy (2006). After several rounds of the VIF tests to eliminate variables with VIF > 10, we end up with seven variables for analyses: lnASPER, lnBAPER, log of expenditures on social assistances (SOASI), log of infrastructure (INFRAS), log of information technology (INFOR), log of federal government expenditures on education (FEDAID), and log of investment on physical capital (INVEST). The results for the last two rounds of the VIF tests are reported in Table 3.

Table 3. Results for the VIF Tests

Next to Last Round			Last Round		
Variable	VIF	1/VIF	Variable	VIF	1/VIF
SOASI	18.35	0.0545	SOASI	8.89	0.1126
EDEX	15.65	0.0689	-	-	-
INFOR	5.87	0.1878	INFRAS	4.97	0.2004
INFRAS	5.96	0.1889	INFOR	4.79	0.2094
FEDAID	4.54	0.2395	FEDAID	4.18	0.2405
LnBAPER	1.99	0.5187	LnBAPER	1.89	0.5422
LnASPER	1.63	0.7016	LnASPER	1.39	0.7301
INVEST	1.45	0.7881	INVEST	1.29	0.7881
Mean VIF	6.76		Mean VIF	3.95	

Next, weperform the AIC procedures and find that model without lag value is the best with the smallestACI value. In the following step, we carry out the Granger Causality tests to investigate the possible two-way causality. The results show that lnPERCA does not Granger causes lnASPER or lnBAPER: all p-values are greater than 0.20. Hence, single-equation estimations are appropriate. We then perform the endogeneityHauman test, called the second variant of the Hausman test in Kennedy (2008), and find that the variable lnBAPER has an endogenous problem: the p-value of the residual collected from regressing lnBAPER on all exogenous variables is 0.001, so two stage least squares estimations are needed.Different from cross sectional estimations, in which finding an instrumental variable (IV) is very difficult, the panel-data estimations enable the use of lagged variables as IVs. In the first stage, we regress lnBAPER on all exogenous variables using the Blundell-Bond System GMM procedure as described in Bond (2002) to control for the lagged dependent variable problem.In the second stage, the predicted value of this regression (BAHAT) is used in lieu of lnBAPER in Equation (2). The original Hausman tests performed for model selection indicates that a fixed effect (FE) model is more suitable than random effect (RE) one for either model with per capita income or employment ratio: p-values are less than 0.05 for both models, implying that the null hypotheses of random effect estimations are rejected.

Thus, all estimations are carried out using fixed effect approach of least squares dummy variables (LSDV) with both country dummies and time dummies added as discussed in Greene (2012). The Ramsey RESET test shows that the models do not have any important omitted variable with the p-value = 0.385. However, the White tests reveal that there are heteroskedasticity problems on both models: p-values are consistently less than 0.05.

Therefore, the subsequent regressions are performed using the Stata robust commands to obtain corrected standard errors. Table 4 reports the results for model with per capita income as dependent variable.Hojo (2003) finds that education increases productivity and uses the results in Islam (1995) to argue that higher productivity will lead to higher per capita income. Vu at al.(2012), and Vu at al.(2014) find that vocational education increase productivity more than university education. Based on Hojo (2003), they argue that vocational education might increase per capita income more than university education.

Table 4. Estimation Results for the Effect of Education on Per Capita Income

Dependent variable: Log of Per Capita Income				
Variable	Coefficient	p-value	[95% Conf. Interval]	
LnASPER	.1657**	.003	.0891	.2342
BAHAT	.1288**	.006	.0624	.1554
FEDAID	.0053**	.009	.0015	.0087
SOASI	.0025	.554	.0362	.0245
INFRAS	.0041**	.005	.0019	.0074
INFOR	.1658	.367	.3934	.8785
INVEST	.0687**	.004	.0319	.1242
Number of observations		= 408		
F(59, 348)		= 1067		
Prob> F		= .001		
RMSE		= .0412		

Note: * and ** denotes five percent and one percent statistically significant, respectively.

In contrast to these arguments, we find that the two levels of education seem to affect per capita income with equal magnitude: an F-test performed on the hypothesis that the difference of the estimated coefficients is zero yields a p-value of 0.276. As discussed in Greene (2012) the value R-squared does not convey any meaningful interpretation. Hence, we report the Root Mean Squared Error (RMSE) values in Table 4 and 5. The smaller the RMSE, the better fit the model. We then repeat the same exercise with the model for employment ratio and display the results in Table 5. The results again show that the two levels of education also appear to affect employment ratio with equal magnitude: another F-test performed on the hypothesis that the difference of the estimated coefficients is zero again yields a p-value of 0.452.

Table 5. Estimation Results for the Effect of Education on Employment

Dependent variable: Log of Employment Ratio to Population					
Variable	Coefficient	p-value	[95% Conf. Interval]		
LnASPER	.0482**		.009	.0257	.0948
BAHAT	.0473**		.002	.0209	.0762
FEDAID	.0021*	.027	.0012	.0039	
SOASI	.0154*	.045	.0013	.0319	
INFRAS	.0008	.546		.0026	.0013
INFOR	.1024	.612		-.1879	.5254
INVEST	.1575**		.001	.1254	.1837
Number of observations		= 408			
F(59, 348)		= 1047			
Prob> F		= .001			
RMSE		= .0276			

Note:* and ** denotes five percent and one percent statistically significant, respectively.

Next, a non-regression approach of calculating the financial costs of attending two more school years and opportunity cost of income foregone is employed. Data for financial costs of attending a four-year university versus a community collegeare from the College Board Annual Survey of Colleges website.

In calculating the financial costs, we follow a conservative approach of assuming a low student loan rate of six percent although the current rate is seven to eight percent. The average income forgone and financial costs are divided by the number of years and subtracted from the average per capita income. Table 6 reports the results.

Table 6. Earning Comparison: Average Per Capita Income (in US Dollars)

Panel (6.a). Unadjusted Earning						
Time Horizon	5-year	8-year	9-year	12-year	13-year	14-year
Associate's	36,867	37,978	38,635	38,856	39,154	40,076
Bachelor's	53,132	53,967	54,954	56,756	57,863	58,957
Panel (6.b). Adjusted Earning						
Time Horizon	5-year	8-year	9-year	12-year	13-year	14-year
Associate's	36,867	37,978	38,653	38,856	39,154	40,076
Bachelor's	30,956	34,547	38,586	38,903	42,956	44,834

From this table, the adjusted per capita incomes for the two levels of education seem indeed not statistically different from each other for any time horizon between nine to twelve years. For the time horizon less than nine years, the adjusted per capita income of a bachelor's degree holder is statistically lower than that of an associate's degree holder.

5. Conclusion

In this research, we examine the returns of two-year college education versus that of four-year college education. The regression results show that four-year college education does not yields higher return on education when panel data for fifty states and Washing D.C. in nine years from 2004 to 2012 are used. A non-regression approach confirms the regression results that for the time horizon of nine to twelve year, there is no difference between the two levels of education. In addition, the non-regression results also reveal that the return to university education is lower than the return to community-college education for the first nine years after graduation.This is also in line with the results reported in Vu et al. (2012). When a person has more than twelve years after graduation to enjoy, however, then university education yields a higher return economically. Lack of comprehensive data might render small biases in the results and so the interpretation should focus on significant levels and interval estimates instead of exact magnitude of the point estimates in the regression approach. When data that are more comprehensive become available, the same exercise should be repeated and new interpretation can be drawn.

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