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# What Kind of Education is good For US Productivity? Community Colleges versus Universities

**Tam Bang Vu[1], Eric Iksoon Im[2], Ashley Bulseco-McKim[3]**

## Abstract

Community college education has been considered the most important mode of education in developing countries. In the US however, community colleges take a back seat in comparison to four-year colleges. Although more attention has been directed to community colleges recently, this mode of education is still considered good only for short term recovery from the recession. This paper performed data analysis on panel data for all fifty states in the US and Washington D.C. The results reveal that the aggregate effect on productivity of associate degree holders is much higher than that of bachelor degree holders. Since community college education results in a higher level of productivity than university education, the long term effect of the former is superior to that of the latter on the US economy.. We then compare and contrast the effects across different regions in the country.

**JEL classification:** O47, E23

**Keywords:** productivity growth, two way causality, education, three stages least squares.

## Introduction

Most governments worldwide assume that community colleges are important for developing countries but not for developed countries. Hence, high school graduates in developed countries often strive to gain access into universities, causing a surplus of university graduates and a consequent shortage of associate degree holders. Due to this biased preference, existing literature on the effect of education on labor productivity (henceforth called productivity)has focused on primary, secondary, and university education instead of comparing community colleges with universities. Additionally, the federal government seems to give less favorable consideration in its distribution of financial aid to community colleges. For example, in the 2012-2013 school year, only 16 percent of the federal work study funds and 21 percent of supplemental educational opportunity grants were allocated to community colleges (American Association of Community Colleges, 2014),even though community college enrollment accounted for 45 percent of all undergraduate enrollments.

However, there is no theoretical or empirical evidence that community college education is less important to the economy than university education in developed countries. Moreover, very few papers investigate the effect of increased labor productivity on school enrollments and the resulting numbers of graduates. Concerning US education, interest on community colleges has returned since the recession. Nevertheless, none of the existing papers investigate the different effects of community college graduates versus university graduates on productivity using panel data at the state level.

Figure 1 shows a map of Real Gross Domestic Product (GDP) in 2012 of the eight economic regions as defined by the US Bureau of Economic Analysis (BEA) used in this paper, while Table 1 provides a summary of the data on community college versus university degrees in these regions. The table reveals that

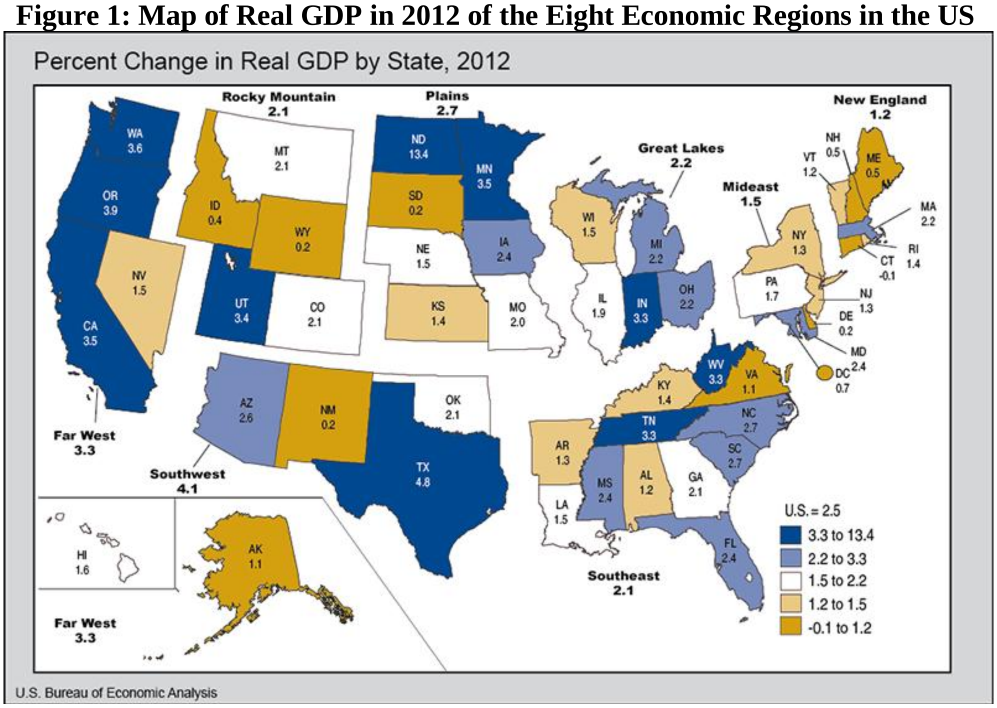
[1] College of Business and Economics, University of Hawaii-Hilo
[2] College of Business and Economics, University of Hawaii-Hilo
[3] School for the Environment, University of Massachusetts Boston

the number of bachelor degree holders is roughly twice that of associate degree holders. The Northeastern region shows the greatest disparity, with the number of bachelor holders three times greater than that of associate degree holders. Since productivity is the most important factor in determining economic development, the question is: does the US really need so many university graduates to improve its productivity? This paper attempts to answer this question. Section two of the paper provides a review of the existing literature. Section three introduces an empirical model and discusses data issues. Section four reports the results and analyzes the implications, and section five concludes.

## 2. Existing Literature

The importance of community college education has continued to grow. In 2012, 45 percent of the US undergraduate population was enrolled in a two-year institution (American Association of Community Colleges, 2014), up from 26% in 1992 (Kasper, 2003), and 770,797 students earned associate degrees (Schneider, 2013). Projections show that more than 46 million additional jobs will need to be filled by 2018 (Carnevale et al., 2010), with roughly 30% of those requiring post-secondary education less than a bachelor's degree (Mullin et al., 2011). Despite these forecasts, more emphasis and support has been directed towards four-year institutions with the assumption that they can increase productivity more than community colleges can.

**Figure 1: Map of Real GDP in 2012 of the Eight Economic Regions in the US**




Source: Bureau of Economic Analysis, http://www.bea.gov/

As a result, 48 percent of college graduates end up with jobs that require less than a four-year degree (Vedder, 2013), suggesting a surplus of bachelor degree holders and a shortage of associate degree holders. It is clear that we need to gain a better understanding of how community colleges and universities contribute to the US economy.

However, literature on the value of community college credentials in comparison to university education is severely limited, and most studies focus on the earnings and returns to each degree independently using cross-sectional data (Belfield & Bailey, 2011; Dadgar & Weiss, 2012). Kane and Rouse (1995) present some of the first direct evidence to address queries regarding the value of a community college education. The authors use data from the National Longitudinal Survey of Youth and the National Longitudinal Survey of the High School Class of 1972, and attempt to control for confounding variables related to the individual's family history or ability. They find that on average, students experience a 4 to 7 percent return to one year of community college, as opposed to a 6 to 9 percent return to a year university education. These results contradict a study by Monk-Turner (1995) using data from the Parnes National Longitudinal Study on Labor Market Experiences, which finds the rate of return for each additional year of education for community college students to be 5.4%, as opposed to the 7.9% of four year students.

**Table 1: Regional Distribution of Community College vs University Education in the US**

| Period | 2002-2004 | | 2005-2007 | | 2008-2010 | |
|---|---|---|---|---|---|---|
| Region | Associate | Bachelor | Associate | Bachelor | Associate | Bachelor |
| United States | 1894890 | 4040253 | 2160124 | 4487575 | 2524708 | 4649679 |
| New England | 81084 | 262904 | 81125 | 285170 | 89356 | 294575 |
| Mideast | 303661 | 734036 | 335245 | 805483 | 375972 | 827693 |
| Great Lakes | 277937 | 685294 | 331640 | 742903 | 367297 | 760277 |
| Plains | 153839 | 344630 | 180139 | 376616 | 198238 | 391666 |
| Southeast | 444613 | 887434 | 513275 | 988830 | 596150 | 1032946 |
| Southwest | 181629 | 390257 | 239885 | 458863 | 332486 | 484929 |
| Rocky Mountain | 79297 | 167768 | 83190 | 190086 | 105757 | 195398 |
| Far West | 372830 | 567930 | 395625 | 635936 | 427951 | 654991 |

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

Spetz (2002) looks at the nursing degree programs, which offer a certificate, associate's degree (AD), or Bachelor of Science degree (BS), and considers the pros and cons of each. She finds that financially, those who take longer to obtain the BS do not benefit, but the BS is still a favorable mode of education over the AD. Spetz and Bates (2013) follow up on the 2002 paper by examining the return to the baccalaureate education in particular. Using data from the National Sample Survey of Registered Nurses, they examine the lifetime earnings for nurses. Their findings show that in general, associates degrees (AD) are acceptable and in many cases, result in greater earnings than the Bachelor of Science Degree in Nursing (BSN). Specifically, the lifetime earnings for nurses who hold a BSN are higher than those of just an associate's degree only if the associate's degree requires three years to complete. Otherwise, the associate's degree holders earn more. However, policy still encourages the BSN over the AD, so students continue to prefer the former.

In a more recent study using Kentucky's administrative data, Jepsen et al. (2014) estimate labor-market returns to community college certificates and diplomas by gender in two cohorts from 2002 to 2004. They also use panel-data to control for potential differences in labor-market outcomes among students who complete various levels of schooling, thus taking student intentions into account. The authors find a significant gender difference, with high school women experiencing 40 percent higher earnings after attaining an associate's degree, and high school men experiencing only 18 – 20 percent. It has been made clear that the returns to investment in community college are high (Carnevale et al., 2013; Belfield & Jenkins, 2014), though further studies are needed to reinforce this conclusion.

While these papers use returns and earnings as the measure of economic stability in response to education level, fewer papers have investigated labor productivity, despite the fact that it is a key element towards determining the success of an economy (Krugman, 1997). Kurre and St. Andrews (2013) use single equation estimationsto understand what factors contribute towards labor productivity in metropolitan manufacturing sectors using education level (percentage associates versus bachelor's degrees per location) along with many other independent variables. They find a positive relationship between the percentage of residents with a bachelor's degree and productivity in all supersectors of interest. On the contrary, the percentage of people with only an associate's degree has a negative relationship with all supersectors, indicating that productivity is lower in those metro areas. The authors conclude that it seems more important to attain a bachelor's degree, as the associate degree did not show a positive effect on labor productivity.However, the estimated coefficients might suffer from simultaneity bias if there is a two-way causality between education and productivity.

Bils and Klenow (2000) develop a theoretical paper on this feedback effect between school enrollments and economic growth. They introduce a dynamic optimization model in which a firm maximizes its profits, subjecting to the constraint that the human capital equals the aggregate product of the number of workers in the firm and level of human capital. The consumer maximizes his utility subject to the constraint so that his wage is at least as great as his sum of lifetime consumption and his expenditures on education at an early age. With economic growth defined as growth of per capita income or productivity, they show that the relations are positive both ways. Bils and Klenow (2000) also carry out empirical studies on this two-way causality. However, they decide to use single equation estimations citing thatit is very difficult to find appropriate instruments for the endogenous variables with their cross-sectional data. Employing Ordinary Least Squares (OLS) regressions, they find that the effect of education on economic growth is very weak. They then examine the reverse causality and find that economic growth affects school enrollments in a strongly positive manner.

Similar to Bils and Klenow (2000), Kumar (2003) also develops a model to examinethe possible two-way causality between school enrollments and factor productivity (TFP). He has been the only authorto attemptan estimation of a system of equations using a two-stage least-squares (2SLS) approach. He shows that education has a positive effect on TFP growth. The reverse causality shows that the response of interest rate to this growth in TFP causes school enrollments to fall. In other words, the effect of productivity growth on the school enrollments is negative. However, his 2SLS approach does not control for the simultaneous feedback effects among variables in the system, which a three-stage least-squares (3SLS) approach as employed in our paper will address.

Neither paper by Bils and Klenow (2000) nor Kumar (2003) examines the issue of community colleges versus universities. This study adds to the small collection of papers that investigates the relationship between education and productivity, and is the first (to our best knowledge) that compares university vs. community college education using panel data at the state level.

## 3. Model and Data

The empirical model used in this paper comprises a system of two equations. The first treats education as human capital, a factor of production, based on an augmented Solow model as in Romer (2006), and the second treats education as a dependent variable similar to Vu *at al*. (2012) to investigate the possible feedback effects between the two variables:

$$
\begin{aligned}
PRO_{it} &= \alpha_1 EDU_{i,t-k} + \sum_{k=2}^{m} \alpha_k C_{it} + u_i + v_t + \varepsilon_{it} \\
EDU_{it} &= \beta_1 PRO_{i,t-k,} + \sum_{k=2}^{m} \beta_k A_{it} + w_i + z_t + \phi_{it}
\end{aligned}
\quad (1)
$$

where *PRO* is the productivity, which is defined as real output per worker and measured by the ratio of real gross state product to the number of employed people.*EDU* is the education level, which defined as the number of graduates per worker and measured by the ratio of either associate degrees or bachelor degrees to the number ofemployment (ASSO or BACH, respectively).*C'*s are control variables that might affect the state productivity, such as physical capital, infrastructure, healthcare, etc. *A'*s are auxiliary variables that might affect school enrollments, such as productivity, expenditures on educations, domestic interest rates (as an opportunity cost to education), etc.

Data on numbers of associate degrees conferred as proxy for community college education and numbers of bachelor degrees conferredas proxy for university education for fifty states and Washington D.C. during the school years 2002-2010 are from the National Center for Education Statistics(NCES) website. Data for the school years 2002-2006 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 2009-2010 are from the "State Education Data Profiles," also published by the NCES.

Data on the real interest rate (as the opportunity cost of education) is from *economagic.com.* Data on the federal aids to the state and local government are from *US Census Bureau.* Data on the real interest rates (RINT) of the three-month treasury bonds for the US is from *economagic.com.*We multiply RINT with each state indicator variable to control for the differences in financial conditions and state government policies.

Data on the gross state products, employment, federal government expenditures on education, investment, 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, and expenditures on social assistances for fifty states and Washington D.C. during 2002-2010are from the*Bureau of Economic Analysis*(BEA).All measures are in current dollars and therefore data on the price indices for GDP 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 all available variables and perform Variance Inflation Factor tests (VIF) to check multicollinearity. These tests and subsequent preliminary tests are performed with the White correction for standard heteroscedasticity and with time dummies to control for autocorrelation problems. Kennedy (2006) recommends the elimination of a variable from a specific equation that has a VIF index of 10 or higher. The test reveals that ASSO and BACH are highly correlated to each other (VIF values equal 11.94 and 14.29, respectively); therefore, we have to estimate them in two separate systems instead of estimating them simultaneously. Distributing these variables into two separate systems result in VIF values between 1.09 to 5.49 for all variables and so all remaining variables are qualified to be included in subsequent regressions.

Since a theoretical model for a possible two way causality between productivity and education were not developed in this paper, we perform the augmented Granger causality tests and confirm that a two-way causality exists as shown in Kumar (2003). Hence, we employ the fixed-effect three-stage least-square estimations (FE3SLS) for System (1).In panel data analysis, lagged values of dependent variables can be used as instrumental variables (IVs). The inclusion of lagged dependent variables calls for the use of the System Generalized Method of Moments (SGMM) technique introduced by Bond (2002) in the reduced forms. We also carry out the Akaike Information Criterion (AIC) procedure to make a decision on the number of lagged values. The results reveal that only the first lagged values are needed, and so the second lagged values can be used as the IVs for each system and the first step is to estimate the reduced form:

$$
\begin{aligned}
EDU_{i,t-1} &= \gamma_0 + \gamma_1 EDU_{i,t-2} + \sum_{j=1}^{n} \chi_j C_{jt} + \phi_{it} \\
PRO_{it,-1} &= \kappa_0 + \kappa_1 PRO_{i,t-2} + \sum_{k=1}^{m} \eta_k A_{kt} + \theta_{it}
\end{aligned}
\tag{2}
$$

Employing the SGMM estimations for System (2), we obtain the predicted values of *EDU (AHAT* for *ASSO*, and *BHAT* for *BACH)* and predicted value of *PRO (PHAT)* to be used as IVs for the structural form shown in system (1). We then perform the FE3SLS estimations for system (1) and eliminate the variables with p-values greater than 0.5. Finally, the RESET Ramsey test as discussed in Kennedy (2006) is performed to ensure there are no omitted variables. This yields the final structural forms with system (3.1) for ASSO:

$$PRO_{it} = \alpha_{11}AHAT_{i,t-1} + \alpha_{12}HEAL_{it} + \alpha_{13}CAP_{it} + \alpha_{14}INFR_{it} + u_{1i} + v_{1t} + \varepsilon_{1it}$$

(3.1)

$$ASSO_{it} = \beta_{11}PHAT_{i,t-1} + \beta_{12}FEDA_{it} + \beta_{13}RINT_{it} + \beta_{14}STALO_{it} + w_{1i} + z_{1t} + \psi_{1it}$$

and system (3.2) for BACH:

$$PRO_{it} = \alpha_{21}BHAT_{i,t-1} + \alpha_{22}HEAL_{it} + \alpha_{23}CAP_{it} + \alpha_{24}INFR_{it} + u_{2i} + v_{2t} + \varepsilon_{2it}$$

(3.2)

$$BACH_{it} = \beta_{21}PHAT_{i,t-1} + \beta_{22}FEDA_{it} + \beta_{23}RINT_{it} + \beta_{24}STALO_{it} + w_{2i} + z_{32} + \psi_{2it}$$

Where *HEAL* is healthcare, *CAP* is physical capital, *INFR* is infrastructure, *FEDA* the ratio of federal government aids on education to its overall aids to each state (hereby called the federal aid ratio), *RINT* is the real interest rate, and *STALO* is the state and local expenditures.

Table 2reports the aggregate results for systems (3.1) and (3.2) with panel (2.A) for the effects of the two levels of education on productivity and panel (2.B) for the reversed causalities. Column 1 presents community colleges and column 2 for universities with suffix (a) and (b) for the effects on the levels in dollars and in percentage changes in productivity, respectively. For example, the first row of column 1(a) reports the level value as 224.42, implying that with one percent increase in the ratio of associate degree holders to employment, ASSO appears to increase the productivity by $224.42, whereas column 1(b) reports the percentage change as 0.31, implying that one percent increases in ASSO seems to increase the productivity by 0.31 percent.

The results reveal that community college education appears to havea higher impact than university education on productivity, as the respective value for BACH is $ 121.82 or 0.18 percent, roughly 42% lower than that of ASSO. A Wald test confirms that this difference is statistically significant. The positive and significant effects of both educational levels are similar to those in Kumar (2003), who estimates for overall college level. The interpretation of other variables can be carried out in the same manner.

In panel (2.B), the negative and significant effects of productivity on both educational levels are similar to those in Kumar (2003), and in contrast to Bils and Klenow (2000). Specifically, a $100 increase in productivity is associated with 0.07 percent and 0.02 percent decrease in the ratio of the associate/bachelor degree holders to the population (ASSO/BACH), respectively.

**Table 2: Aggregate Effects: Two-Way Causality between Education and Productivity**

| Panel (2.A). Dependent Variable: Productivity | | | | |
|---|---|---|---|---|
| | Community Colleges (ASSO) | | Universities (BACH) | |
| | 1(a) | 1(b) | 2(a) | 2(b) |
| Variable | Level ($) | Percentage | Level ($) | Percentage |
| EDU | 224.42** | .31** | 121.82*** | .18** |
| | (.03) | (.03) | (.04) | (.04) |
| CAP | 553.80*** | .78*** | 547.15** | .77** |
| | (.01) | (.01) | (.02) | (.02) |
| HEAL | 463.73** | .65** | 434.98** | .64** |
| | (.04) | (.04) | (.03) | (.03) |
| INFR | 361.49*** | .49*** | 355.48*** | .49*** |
| | (.00) | (.00) | (.01) | (.01) |

| Panel (2.B). Dependent Variable: education levels (ASSO in column 1, BACH in column 2) | | | | |
|---|---|---|---|---|
| PRO | -.07** | -.38** | -.02** | -.11 |
| | (.02) | (.02) | (.03) | (.03) |
| STALO.29* | | .98* | .74** | 1.86** |
| | (.09) | (.07) | (.05) | (.05) |
| FEDA | .02* | .14* | .08** | .74** |
| | (.08) | (.08) | (.04) | (.04) |
| RINT | -.02*** | -.12*** | -.02*** | -.13*** |
| | (.01) | (.01) | (.00) | (.00) |

| | | |
|---|---|---|
| Number of observations: | 306 | 306 |
| Average RMSE: | .018 | .017 |
| p-value for the model: | .00 | .00 |
| p-value for AR(1) | .463 | .375 |
| p-value for AR(2) | .647 | .624 |

Note: *, **, and *** indicate 10%, 5%, and 1% statistically significant, respectively.
p-values are in parentheses.

Similarly, one percent increases in productivity are associated with a 0.38 percent and 0.11 percent decrease in ASSO and BACH, respectively. Since an increase in productivityis highly correlated to an increase in per capita income as discussed in Islam (1995), this implies that higher economic growth is associated with lower enrollments and subsequent graduates in higher education. The results are also compliant with the fact that during the recession, college enrollments increased.The interpretations of other variables are in the same manner.

It is interesting to see that the negative effect on community colleges is 3.5 times greaterthan that on universities.This might suggest that the more prosperous people become, the less they wish to send their children to community colleges. This reflects another characteristic of the US society, where there is a surplus of bachelor degree holders, a shortage of associate degree holders, and a near disappearance of vocational students with less than two year schooling. Another interesting result to point out is that the effect of state and local government expenditures on university education ishighly significant,as opposed to community colleges, which is only weakly significant. The same are true for the federal aid ratios. This might imply that most states allocate their funds to their four year colleges instead of two year colleges. The results for the other variables are as expected.

As discussed in Greene (2003), an adjusted R-squared in an IV estimation does not have a meaningful interpretation.  Hence, we report the root mean square error (RMSE) instead of an adjusted R-squared in each of our tables. Defined as:

$$RMSE = \sqrt{\frac{1}{n}\sum_{i}(y_i - \hat{y}_i)^2}\ ,$$

where a smaller RMSE implies greater prediction power of the model.

We then generate seven dummies for the seven regions, leaving the Far West as the base dummy. Tables 3 and 4 report the results for the benchmark variables for each region in levels and percentage changes, respectively. The first row in each panel presents the estimated coefficients of the base region. For example, the estimated coefficient for the base in panel 3(A) is 315.5, implying that one percent increases in the ratio of associate degree holders to the employment (ASSO) in the Far West is associated with an increase the productivity of $315.50. The effect of bachelor degree holders on the productivity is $160.30.

The remaining rows present the estimated coefficients of other regions. Column (a) reports the value of each region compared to that of the base (comparative value), and the p-value indicates whether or not the value of each region is statistically different from that of the base. Column (b) sums the value of the base region and the value for each region (absolute value), and the p-value indicates whether or not the value of each region is significantly different from zero. For example, the estimated coefficient for New England in Table 3 is 3.96, and the p-value is 0.54, implying that the value is not statistically different from that of the base. That is, the difference between the two regions is zero. The sum then remains at $315.5 (= 315.5+ 0.0), and the p-value of 0.03 indicates that the sum is statistically different from zero. The estimated coefficient for the Plains is – 109.5, and the p-value of 0.10 indicates that this value is statistically different from that of the base at 10% significant level. Hence, the sum is $425 (= 315.5 – 109.5), implying that a one percent increase in the ratio of associate degree holders to the employment (ASSO) in the Plains is associated with a $425.00 increase in productivity. The interpretations for the other regions are in the same manner.

Although the estimated coefficients are mostly different across regions, they are all positive and significant. These results imply that community college education is at least as important to developed countries as university education. In reality, the former provides direct working skills, so it may increase productivity more than the latter.

**Table 3: Estimation Results for Each Region: Changes in Levels of Productivity**

| Panel (3.A). Dependent Variable: Productivity | | | | |
|---|---|---|---|---|
| | Community Colleges (ASSO) | | Universities (BACH) | |
| | 1(a) | 1(b) | 2(a) | 2(b) |
| Region | Comparative | Absolute Value | Comparative | Absolute Value |
| Far West | 315.5** | 315.5** | 160.3*** | 160.3*** |
| | (.00) | (.00) | (.01) | (.01) |
| New England | -3.96 | 315.5** | 13.2 | 160.3** |
| | (.54) | (.03) | (.59) | (.02) |
| Mideast | 5.47 | 315.5** | 13.8 | 160.3*** |
| | (.93) | (.03) | (.63) | (.00) |
| Great Lake | 3.68 | 315.5** | -3.10 | 160.3*** |
| | (.57) | (.02) | (.48) | (.01) |
| Plains | 109.5* | 425** | 5.91 | 160.3*** |
| | (.10) | (.05) | (.35) | (.00) |
| Southeast | 192.6*** | 508.1*** | 161.2*** | 321.5*** |
| | (.01) | (.01) | (.00) | (.00) |
| Southwest | -127.4*** | 188.1*** | -130*** | 30.3** |
| | (.00) | (.01) | (.01) | (.03) |
| Rocky Mountain | -188.3* | 127.2** | -140.2* | 20.1** |
| | (.10) | (.04) | (.10) | (.02) |
| Panel (3.B). Dependent Variable: education levels (ASSO in column 1, BACH in column 2) | | | | |
| Far West | -.08* | -.08* | -.02* | -.02* |
| | (.10) | (.10) | (.10) | (.10) |
| New England | -.01* | -.09* | -.01 | -.02* |
| | (.09) | (.07) | (.38) | (.09) |
| Mideast | -.01 | -.08* | -.01 | -.02 |
| | (.13) | (.08) | (.18) | (.10) |
| Great Lake | -.01 | -.08* | -.02* | -.04** |
| | (.23) | (.10) | (.07) | (.05) |
| Plains | -.02*** | -.10** | -.03** | -.05*** |
| | (.01) | (.02) | (.02) | (.01) |
| Southeast | -.02** | -.10** | -.03** | -.05** |
| | (.02) | (.04) | (.02) | (.02) |

| | | | | |
|---|---|---|---|---|
| Southwest | -.03*** | -.11*** | -.06*** | -.08*** |
| | (.00) | (.01) | (.01) | (.00) |
| Rocky Mountain | -.02*** | -.10** | -.04*** | -.06** |
| | (.01) | (.02) | (.01) | (.03) |
| Number of observations: | | 306 | 306 | |
| Average RMSE: | | .482 | .491 | |
| p-value for the model: | | .00 | .00 | |
| p-value for AR(1) | | .336 | .402 | |
| p-value for AR(2) | | .523 | .615 | |

Note: *, **, and *** indicate 10%, 5%, and 1% statistically significant, respectively.
p-values are in parentheses.

In panel 3(B), a $100 increase in productivity of the Far West is associated with 0.08 percent decrease in the ratio of associate degree holders to the population (ASSO). The estimated coefficient is only weakly significant (at 10% significant level). The comparative coefficient for New England is 0.01 percent lower than that of the base, so the absolute value is 0.09 (0.08 + 0.01), implying a $100 increase in productivity in New England is associated with 0.09 percent decrease in ASSO. The estimated coefficients for the Mideast and Great Lakes are not statistically different from that of the base. The estimated coefficients for the remaining regions are more negative than that of the base.

Tables 4 reports the results for the benchmark variables per region in percentage changes. In panel 4(A), the value for the base is 0.39, implying that a one percent increase in ASSO is associated with an increase of the productivity by 0.39 percent in the Far West. The estimated coefficients for New England, Mideast, and Great Lake are not statistically different from that of the base. The estimated coefficient for the Plains is 0.14. This suggests thatin this region, the effect is 0.14% higher than that of the base, and the absolute value is 0.53 (0.39 + 0.14), implying that a one percent increase in ASSO is associated with an increase of the productivity by 0.53 percent in the Plains.

In panel 4 (B), a one percent increase in productivity of the Far West is associated with a 0.44 percent and 0.18 percent decrease in ASSO and BACH, respectively. The estimated coefficients for the Mideast and Great Lake are not statistically different from that of the base. The estimated coefficients for the remaining regions are more negative than that of the base.

Overall, the increase in productivity has a much more negative effect on ASSO than on BACH for all regions. This again can serve as a warning on the surplus of the bachelor degree holders and the subsequent shortage of appropriate jobs for them in the future. Hence, the federal government might want to provide more financial aid to states with the specific goal of funding community colleges. Additionally, the state and local governments should also support a private sector establishing more community colleges and providing favorable grants to students whose ultimate goal is to obtain an associate degree.

## 5. Conclusion

Community colleges have not received an honorable place it deserves in the US. Literature on community colleges therefore is very limited, and none of the existing papers investigates the different effects of community college graduates versus university graduates on the labor productivity. Additionally, those studies that investigate the two-way causality between education and productivity use cross-sectional data and simple methods of either single equation of estimations or two-stage least-squares. This paper is the first to employ an advanced method that combines the SGMM and FE3SLS to control for all possible problems that might arise in the existing literature.

The aggregate results show that an increase in the number of associate degrees conferred has higher impact on productivity growth than that of bachelor degrees; although, both effects are positive and statistically significant. Regarding the reverse causality, the negative effect of productivity increases on community college graduates is much larger than that on the university graduates.

**Table 4: Estimation Results for each Region: Percentage Change of Productivity**

Panel (4.A). Dependent Variable: Productivity

| | Community Colleges (ASSO) | | Universities (BACH) | |
|---|---|---|---|---|
| | 1(a) | 1(b) | 2(a) | 2(b) |
| Region | Comparative | Absolute Value | Comparative | Absolute Value |
| Far West | .39*** | .39*** | .22*** | .22*** |
| | (.00) | (.00) | (.01) | (.01) |
| New England | -.02 | .39** | .01 | .22** |
| | (.54) | (.03) | (.59) | (.02) |
| Mideast | .03 | .39** | .04 | .22*** |
| | (.93) | (.03) | (.63) | (.00) |
| Great Lake | .01 | .39** | -.02 | .22*** |
| | (.57) | (.02) | (.48) | (.01) |
| Plains | .14* | .53** | .03 | .22*** |
| | (.10) | (.05) | (.35) | (.00) |
| Southeast | .24*** | .63*** | .22*** | .44*** |
| | (.01) | (.01) | (.00) | (.00) |
| Southwest | -.16*** | .23*** | -.16*** | .06** |
| | (.00) | (.01) | (.01) | (.03) |
| Rocky Mountain | -.24* | .15** | -.17* | .05** |
| | (.10) | (.04) | (.10) | (.02) |
| Panel (4.B). Dependent Variable: education levels (ASSO in column 1, BACH in column 2) | | | | |
| Far West | -.44* | -.44* | -.18* | -.18* |
| | (.10) | (.10) | (.10) | (.04) |
| New England | -.05* | -.49* | -.05 | -.23* |
| | (.09) | (.07) | (.38) | (.09) |
| Mideast | -.04 | -.44* | -.04 | -.18* |
| | (.13) | (.08) | (.18) | (.10) |
| Great Lake | -.05 | -.44* | -.11* | -.29** |
| | (.23) | (.10) | (.07) | (.05) |
| Plains | -.10*** | -.54** | -.15*** | -.33*** |
| | (.01) | (.02) | (.02) | (.01) |
| Southeast | -.11** | -.55** | -.16*** | -.34** |
| | (.02) | (.04) | (.02) | (.02) |
| Southwest | -.15*** | -.49*** | -.29*** | -.47*** |
| | (.00) | (.01) | (.01) | (.00) |
| Rocky Mountain | -.09*** | -.53** | -.19*** | -.37** |
| | (.01) | (.02) | (.01) | (.03) |
| Number of observations: | | 306 | | 306 |
| Average RMSE: | | .442 | | .450 |
| p-value for the model: | | .00 | | .00 |
| p-value for AR(1) | | .354 | | .412 |
| p-value for AR(2) | | .587 | | .657 |

Note: *, **, and *** indicate 10%, 5%, and 1% statistically significant, respectively.
p-values are in parentheses.

The most severe limitation of this paper is the data. Data from 2002 to 2006 are provided in one set, but data from 2006-2010 are provided in several scattered tables on the NCES website. Data for the years 2010-2013 are not available. This inconsistency and lack of more recent data might cause some bias in our results. When data become available in one single set, repeated exercises should be performed to improve the consistency of these estimations.

Additionally, the paper focuses on community college versus university education and ignores the effects of vocational schools with less than two year training in the US, mainly because data are not comprehensive. Future research can focus on vocational schools when data become available. Researchers should also investigate the effect of specialized universities versus general universities in the US. Currently, comprehensive data on different types of universities are not available; hence,it is challenging to quantify practicality of a university so that estimations can be carried out. This is a complicated task that is beyond scope of this paper.

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