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# **An Empirical Analysis of Higher Education and Economic Growth in West Virginia**

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# **An Empirical Analysis of Higher Education and Economic Growth in West Virginia**

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## **Abstract**

Investment in education to increase economic growth, as one form of human development strategy, has gained economists' and policy makers' interest. It establishes human capital that makes a substantial contribution to economic and income growth. Its contribution returns in the form of skilled labor which leads to increased development and improved quality of life. Different theories and models have been used to examine the relationship between education and economic growth. Most of them concentrated on human capital accumulation as source of acceleration in economic growth. Some of them used human capital as an engine of economic growth to technological change. But for human accumulation, a country should invest more on education. Thus, the main objective of the study is to analyze the relationship between higher education growth and economic growth in West Virginia. A set of simultaneous equations with three endogenous variables namely, per capita income change, education change and population change were used for the analysis. Empirical results indicate that income growth and education growth are positively related while education growth reduces population growth in West Virginia.

Key Words: Higher Education, Income, Growth, West Virginia

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## **1. Introduction**

Investment in education to increase economic growth, as one form of human development strategy, has gained economists' and policy makers' interest (Johnson, 2011). Investment in education preserves returns in the form of skilled labor which leads to increased development and improved quality of life (Yogish, 2006). Investment in education not only benefits individuals through income but also benefit economy as a whole through skilled labor who increase competition and economic growth (Alam, 2009).

The relationship between education and economic growth was first developed by Adam Smith, followed by Marshall, Schultz, Bowman and others (Pradhan, 2009). Empirical estimation of the relationship dated back to 1957 when Robert Solow estimated the contribution of labor, capital and technological change to economic growth in the United States over the period 1909-1949 (Chaudhary et al., 2009; Matsushita et al., 2006). Different theories and models have used to examine the relationship between education and economic growth (Romer, 1990; Chakraborty, 2005). Most of them concentrated on human capital accumulation as a source of acceleration in economic growth. Some of them used human capital as an engine of economic growth to technological change. Individuals and society gained economic benefits because of higher education gained by individuals (Krueger and Lingahl, 2001). It benefits to society both on micro and macro level. It affects the economic system directly and indirectly, where a rise in individual's wage is a direct effect and an increase in education is an indirect effect (Heckman and Klenow, 1997; Pradhan, 2009).

Economists and policy makers face the problem of low level of skilled labor in countries which are trying to increase their economic growth (McClelland, 1966). According to policy

makers and economists, countries or states should spend a significant amount on education for their population, which will increase income significantly and leads to strengthen the economy (Krueger and Lingahl, 2001). Thus, the main objective of this study is to analyze the relationship between economic growth and higher education in West Virginia.

The paper is organized into six sections. Section 2 describes the background information of West Virginia. Section 3 provides the literature review. Section 4 covers the methodology and data sources. Section 5 describes the empirical results and analysis. Section 6 presents the summary and conclusions.

## **2. Background of the study area**

West Virginia, one of the rural states, has low educational attainment and high unemployment rate (US Census Bureau, 2010). Nearly 44 percent of the population lives in rural areas. The average population density is about 75 people per square mile and the per capita personal income was \$32,219 in 2009, which was 17.7 percent below the national per capita income of \$39,138 (Hammond, 2012). The average per capita income in the rural area was \$29,200 compared to \$33,578 in the urban area in 2008 (ERS-USDA, 2008). Nearly 24 percent of the total land area is used for farming (ERS, 2011). Approximately 3.7 million acres are farmlands with 23,200 farms and average farm size is 159 acres (USDA/NASS, 2010). Apart from agriculture, manufacturing, services, mining and tourism (an emerging sector) are currently the major economic sectors in West Virginia (ERS, 2011).

West Virginia has relatively low higher education rates, high unemployment rates (Gebremariam et al., 2006), low per capita income compared to other states in Appalachian region (Appalachian Regional Commission, 2010<sup>a</sup>). The economic status of 22 counties is “Transitional,” 20 counties “At Risk”, 11 counties “Distressed,” and 2 counties “Competitive” in

West Virginia. Thirty – four of total 55 counties are located within rural (non-metropolitan) areas (Appalachian Regional Commission, 2010<sup>a</sup>). The slow growth of income and employment, large out-migration are the major reflections of persistently high rates of poverty in West Virginia (US Census Bureau, 2010). This is related to less job opportunities and is a hazard to economic growth of West Virginia (D’Souza and Gebremedhin, 1999). According to Herndon (2008), expenditures on investment in education for human capital formation have increased in West Virginia, but the number of higher education graduates working within the state have decreased over time (Hammond, 2012).

### **3. Literature Review**

The role of education has been acknowledged widely by economists and policy makers (Gilead, 2012). The utilization of infrastructure and technology requires a leading role of higher education system in regional economic development (Schlottmann, 2010). Economists believe that investment on education or human capital increases output and labor productivity. Investment in human capital is crucial in the future because the economy is turning into knowledge-based from post-industrial economy (Dickens et al., 2006). Teles and Andrade (2004) estimated the relationship between government spending on basic education and economic growth. Results revealed that economic decision makings of an agent are affected by his/her educational level. Jorgenson and Fraumeni (1992) estimated the impact of investment in education on U.S. economic growth. They used data from 1948 to 1969. Results revealed that an appropriate value of investment in education was given by its impact on lifetime labor income of an individual.

Hanushek and Wobmann (2007) examined the role of education in promoting economic well-being focusing on the role of educational quality. Results showed that cognitive skills of

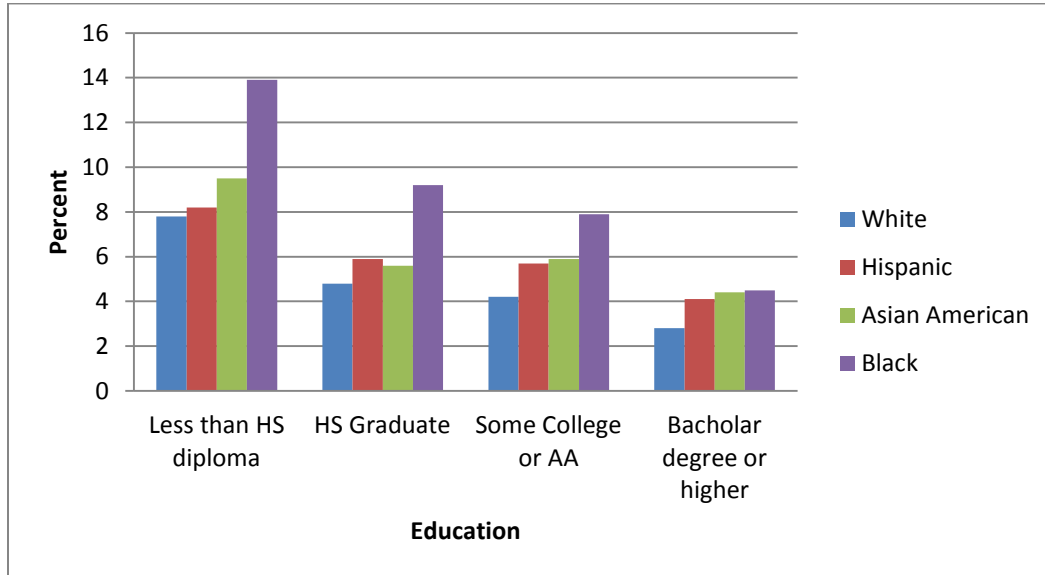
population have strong relationship with individual earnings, distribution of income, and economic growth. Barro (2001) studied on education as a measure of human capital in his study. Results showed that economic growth is positively related to starting level of average years of school attainment of adult males at the secondary and higher level. Results further revealed that the quality of school education and its impact on economic growth is different among rich and poor countries. Investment in education and health services are the major factors for human capital development and the subsequent impact on economic growth. However, economic growth is also the main source for human capital development. Ranis et al. (2000) estimated the effects of economic growth as the result of human capital development and the effects of human capital development as the result of economic growth. Results showed that economic growth had positive and strong impact on human capital development. Results also showed that significant and strong GDP per capita income growth leads to higher human capital development.

Dowrick (2002) reviewed empirical studies that examined the relationship between economic growth and education and R&D (Research and Development). These studies showed that education and R&D are substantial sources to promote economic growth. Participation in education and public expenditures on education increased during 19<sup>th</sup> and 20<sup>th</sup> centuries. Enrolment in public education system has increased by 40 percent from 1870 to 2001 whereas public expenditure on education increased from 0.86 percent to 4.85 percent of GDP during the same time period. GDP also increased nine times in the same time period (Carpentier, 2006).

Previous studies revealed that investment in education resulted in economic benefits. However, the size and margin of these benefits vary by race, gender, and ethnicity. Graph 1 below represents unemployment rate by race. Unemployment rate decreases from 13.9 percent to 4.5 percent in black population if individuals completed their bachelor degrees or higher. There

is 5 per cent reduction in unemployment rate in white population for completing the same degree (Williams and Swail, 2005).

**Graph 1: Unemployment Rate by Race**



**Source: Williams and Swail, 2005**

Education has an influence on crime rate in several ways. First, education increases the opportunity cost of crime due to higher wage rate. Second, educated people are more patient and less risk takers. Third, attending school keeps young people busy and reduces criminal participation (Lochner and Moretti, 2003). One good reason to increase policymakers’ interest in education to raise the economy of metro areas is to encourage students to stay in the region or attract others to come from outside to the region (Bartik and Erickcek, 2007).

**4. Methodology**

A model with a system of simultaneous equations is used for analysis. Change in per capita income, change in higher education and change in population density are the interdependent variables. A simultaneous equations approach accounts for interactions among the interdependent variables and gives a comprehensive estimation. Also, simultaneity helps in



overcoming inconsistency and bias and leads to efficient estimation. As the intention of this analysis is to examine the impact analysis, average values of income, employment, education and all other variables are applied at the county level.

Three-stage least squares (3SLS) estimations are used to solve the simultaneous equations. A system of equations estimates all the identified structural equations together as a set. The most important advantage of this method is to have a small asymptotic variance. Three-stage least squares is consistent and generally more efficient than a two-stage least squares (2SLS) estimator (Zellener and Thiel, 1962). Also, the method can take account of restrictions on parameters in different structural equations.

#### ***4.1 Empirical Model***

As indicated above, the focus of this study is to analyze the relationship between higher education and economic growth represented by change in population density, change in per capita income and change in higher education. Higher education is represented by percentage of population with bachelor degree or higher. This study uses three- simultaneous equation model. The general form of the three simultaneous equations model is specified as:

$$\begin{aligned}
 (1a) \quad & INC = f(EDU, POP / X^{INC}) \\
 (1b) \quad & EDU = f(INC, POP / X^{EDU}) \\
 (1c) \quad & POP = f(INC, EDU / X^{POP})
 \end{aligned}$$

Where *INC*, *EDU*, and *POP* represent per capita income, higher education, and population density, respectively in the *ith* county;  $X^{INC}$ ,  $X^{EDU}$ , and  $X^{POP}$  are a set of exogenous variables that have either direct or indirect effects on per capita income, higher education, and population density. The empirical model for estimation is as follows;

$$\begin{aligned}
(2a) \quad INCC &= \alpha_{0INC} + \beta_{1INC} CHEDU + \beta_{2INC} CHPOP + \beta_{3INC} INCBASE + \\
&\beta_{4INC} EDUBASE + \beta_{5INC} POPBASE + \sum \delta_{1INC} X^{INC} + \varepsilon_1 \\
(2b) \quad EDUC &= \alpha_{0EDU} + \beta_{1EDU} CHINC + \beta_{2EDU} CHPOP + \beta_{3EDU} INCBASE + \\
&\beta_{4EDU} EDUBASE + \beta_{5EDU} POPBASE + \sum \delta_{1EDU} X^{EDU} + \varepsilon_2 \\
(2c) \quad POPC &= \alpha_{0POP} + \beta_{1POP} CHINC + \beta_{2POP} CHEDU + \beta_{3POP} INCBASE + \\
&\beta_{4POP} EDUBASE + \beta_{5POP} POPBASE + \sum \delta_{1POP} X^{POP} + \varepsilon_3
\end{aligned}$$

The endogenous variables *INCC*, *EDUC*, and *POPC* indicate a change in county's per capita income, higher education, and population density, respectively. Error terms are shown by  $\varepsilon_1$ ,  $\varepsilon_2$ , and  $\varepsilon_3$  and an exogenous variable vector is represented by *X*. Initial period is the year of 2000.  $\alpha$ ,  $\beta$ , and  $\delta$ 's are coefficient parameters.

#### 4.2 Data Collection

The empirical model, explained as a system of equations with endogenous variables, is function of human capital, accessibility, economic, and demographic variables. Endogenous variables include county level data from 2000 to 2010. County-level data for higher education and income are collected from the US Census Bureau and County, USDA-ERS, and City Data Book (C&CDB) covering the years 2000 to 2010. Definitions of all endogenous and exogenous variables at county level used in this study are given in Table 1.

**Table 1: Definition of Endogenous and Exogenous Variables**

Variable	Variable Definitions	Source
INCC	Change in per capita income from 2000 to 2010	C&CDB
EDUC	Change in higher education from 2000 to 2010	US Census
POPC	Change in population density from 2000 to 2010	C&CDB
INCBASE	Per capita income in 2000	C&CDB
EDUBASE	Higher education in 2000	US Census
POPBASE	Population density in 2000	C&CDB
POVERTY	Percentage of all age population below poverty	US Census
CRIME	Serious crime rate	C&CDB
GEXN	Per capita government expenditures on education	C&CDB
UNEMP	Unemployment rate	C&CDB

METRO	Dummy variable, 1 if county is metro 0 otherwise	USDA-ERS
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## 5. Results and Discussion

**Table 2: Results of System of Simultaneous Equations**

Variable	Income Change		Education Change		Population Change	
	Coefficient	P> Z	Coefficient	P> Z	Coefficient	P> Z
INCC			1.7047*	0.09		
EDUC	0.3153***	0.01			-0.1918*	0.06
POPC	0.3385*	0.10	-1.5834***	0.01		
INCBASE	-0.0314*	0.06	0.0604**	0.05		
EDUBASE	0.0456	0.30	-0.1850*	0.06	-0.0373*	0.09
POPBASE					0.0206	0.16
GEXN	0.0241	0.18				
CRIME	-0.0131	0.20			-0.0102	0.23
POVERTY	0.0029**	0.03	-0.0051	0.19		
METRO			-0.0038	0.81	-0.0113	0.19
UNEMP					0.0079***	0.00

Number of observations = 55.

R<sup>2</sup> values: INCC = 0.86; EDUC = 0.67; POPC = 0.32.

Chi<sup>2</sup> values: INCC = 672.07; EDUC = 137.04; POPC = 27.13.

\*\*\*, \*\*, \* are significant at 1%, 5% and 10% respectively

A system of three simultaneous equations was used to examine the relationship between education and economic growth in West Virginia. The variables used and the results obtained are presented in Table 2. The first column of the Table shows the exogenous variables used in each equation. Columns 2 and 3 indicate results for the income change (INCC) equation while columns 4 and 5 present results for education change (EDUC). Result for the population change (POPC) equation is shown in columns 6 and 7.

The empirical results show that income change (INCC) is significantly and positively related to education change (EMPC) such that a one percent increase in education increases income by 0.3 percent in West Virginia. This result is supported by the findings of Chen and Wu (2007) which shows that development of higher education creates positive effects on the

employment and income. The result also is supported by the findings of Ranis et al. (2000), Jorgenson and Fraumeni (1992), and Barro (2001). Population change (POPC) is significant and positively related to income change (INCC) indicating that when population change increases by one percent, income change increases by 0.3 percent. This may be due to creating more income opportunities with increasing population at county level. The initial value of income (INCBASE) has a negative and significant relationship with employment change; thus, counties that reported high initial percentages of income had lower growth rates of income. Poverty indicates significant and a positive relationship with income change; but impacts are minimal.

Results for the education change equation indicate that a one percent change in income growth increases educational growth by 1.7 percent. One reason for this could be that high income leads to more savings and investment which increases opportunities for education. Also, high income in a county may lead to improved educational facilities, healthcare facilities and other local amenities that increase the number of jobs Created. The result is supported by the study of Gyimah-Brempong et al. (2006) which shows that all levels of education for human capital development, including higher education for human capital development, are statistically significant and have a positive effect on the growth rate of per capita income in African counties. Results further indicate that growth in population (POPC) has a negative relationship with education change. This is a common trend with higher education people to control family size. Also it is a general trend with higher education people to out-migrate from poor counties in West Virginia (ARC, 2010<sup>b</sup>). The initial level of income (INCBASE) has a positive relationship with education growth. Thus, the counties that reported high initial percentages of income had higher growth rates of education compared to the other counties. This means that higher investment in education occurs with higher income level. The initial level of education (EDUBASE) indicates

a significant and negative relationship with education change. This means that the counties which reported high initial percentages of education had lower growth of education in West Virginia.

The empirical results for the population change (POPC) equation indicate that increasing education change (EDUC) decreases population growth in West Virginia. Results also show that education in 2000 (EDUBASE) has a negative relationship with population change. This means that the counties reported higher rates of education at 2000 were less populated compared to others. The significant and positive relationship of unemployment rate (UNEMP) with changing population may indicate that lower income and education together with high unemployment rate leads to bigger family sizes in West Virginia. With high unemployment and poverty rates people may tend to be less educated and have less accessibility to birth control facilities and family planning and other related educational programs.

## **6. Summary and Conclusions**

The main purpose of this study was to examine the relationship between education and economic growth in West Virginia. County level analysis based on the changes of income, education and population, highlight two important points. First, empirical analysis reveals that both education growth and income growth positively affect each other. Thus, more attempts to increase job or income generation opportunities would be beneficial.

According to the ARC (2010<sup>b</sup>), only 35 of the 420 counties in Appalachia reported positive employment growth from 2007 to 2010. However, according to the strategic plan of Appalachia, the region is expected to create 120,000 new jobs from 2011-2016 (ARC, 2011). This would enhance education growth as well as income growth of West Virginia. Educational attainment raises productivity, increases income earnings, reduces poverty risk and improves

living standards. Thus, investment in education, particularly targeting to the poor counties, would be essential for income growth.

Second, the empirical analysis reveals the impact of higher education on population growth. Thus adequate policy measures are needed to control out migration and create employment opportunities within the state. One way of maintaining economic development is to create ‘occupational competitiveness’ with a higher share of the workforce employed in ‘creative class’ positions – those who specialize in knowledge-based and idea creation, such as engineers, designers, business managers and scientists (ARC, 2011).

Overall, the empirical results and analysis highlights the need for a comprehensive set of policies to enhance economic growth of West Virginia. These policies should adequately improve and increase educational facilities, income earning opportunities, along with development in basic infrastructure. According to the ARC (2010<sup>b</sup>), the Appalachian region lacks the infrastructure to take full advantage of emerging economic gains and to create sustainable local economic development. Thus, any policy intervention without physical development in infrastructure in West Virginia will be less effective.

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