An Econometric Study of the Impact of Education on the Economic Development of Low-Income Countries

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Abstract:

This paper has two purposes. The primary purpose of this paper is to investigate the contribution that education brings to society and to analyze how the educational system of low-income countries affects their economic development. The second purpose is to provide recommendations that will incentivize the improvement of the education system in low-income countries. To achieve these two objectives, we used several econometric techniques to measure the validity of three hypotheses. The first hypothesis measures the impact of literacy rate on human development of low-income countries. The second hypothesis measures the means years of schooling on income per capita in low-income countries, and the third hypothesis measures the impact of education on employment.

Keywords: Econometrics, Applied Econometrics, Education Policy, Statistical Methods, Regression Analysis, Economic Development

1. Introduction

Nelson Mandela, the first President of post-Apartheid South Africa, once said that education was the most powerful weapon that one can use to change the world. Indeed, he was not wrong. It is undeniable that high-income countries have the highest living standards. The question is what is the foundational factor that allows a country to be rich? High-income countries generally have the highest level of education. One way to measure the level of education of a society is to examine its literacy rate. According to the latest available data provided by the UNESCO Institute of Statistics and the World Bank data, the literacy rate of the world population increased from 66 percent in 1975 to 87 percent in 2020 and the GDP per capita of the world population increased from $1,457 in 1975 to $11,381 in 2020. The more literate and educated a country becomes, the more its living standard increases because a higher level of education increases the level of productivity. More importantly, a key factor for a country to having a higher level of education is that it ensures a sustainable development of its economy.

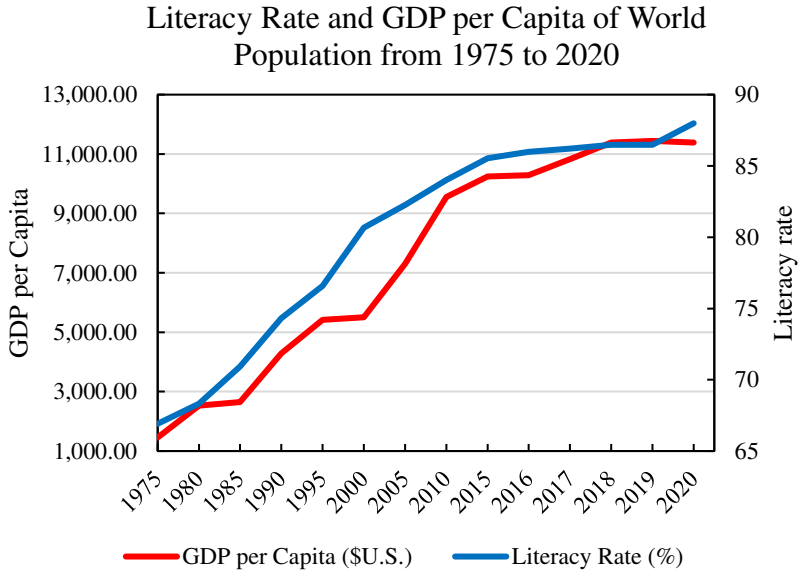

Figure 1. Source: UNESCO Institute of Statistics, World Bank

There are more children in school today than ever.[1] For example, in 1950, the average level of schooling in Africa was less than two years but today it is more than five years.[2] In East Asia and the Pacific, the schooling of the population went from two to seven years between 1950 and 2010, which is more than a 200 percent increase.[3] Globally, the average years of schooling are projected to rise to ten years by the year 2050, which is large than a five-fold increase within a century and a half.[4]

Theodore Schultz, co-winner of the 1979 Nobel Prize in Economic Science, developed a theory of human capital where he argued that education is the foundation of the economic development of a society. In his 1960 paper entitled "Capital Formation by Education," published by the *Journal of*

[1] Patrinos, Harry. "Why Education Matters For Economic Development." *World Bank.* (2016).
[2] *World Bank,* Ibid.
[3] *World Bank,* Ibid.
[4] *World Bank*, Ibid.

Political Economy, he argued that education was an investment in man and its consequences are a form of capital—since education becomes a part of the person receiving it, he shall refer to it as human capital.[5] Human capital, by definition, is the stock of skills that the labor force possesses and is regarded as a resource or asset and the flow of these skills is forthcoming when the investment return exceeds the cost.[6] Human capital encompasses the notion that there investments in people and that these investments increase an individual's productivity.[7] One of the reasons why low-income countries have a very slow process of economic development is that their return to investment in education does not exceed the cost. The educational system of low-income countries has been deficient because the quality of education offered to the local populations is limited.

Our purpose in this study is twofold. The first purpose is to examine how education directly impacts the economic development of low-income countries. The central idea of this study argues that low-income countries are indeed economically backward because their poorly maintained education system penalizes the development of their human capital. If the human capital is poorly developed, then its level of productivity to stimulate growth will only occur sporadically rather than sustainably. The general idea of our study is based on three hypotheses that we aim to measure. The first hypothesis seeks to test the relationship between literacy rate and human development. We argue that the human capital of a society is further developed when its people are literate. The second hypothesis we seek to measure is the relationship between years of schooling and income. Hence, we argue that more years of schooling contribute to higher income. The third hypothesis we attempt to measure is the relationship between educational attainment and unemployment. Based on the results obtained from our econometric models, we subsequently endeavor to propose a set of recommendations that, we believe, could provide a pathway to improve the education system in low-income countries.

2. The Impact of Literacy on Human Development in Low-Income Countries

2.1. Purpose of the Analysis

Before we shall endeavor in any quantitative analysis, it is first and foremost essential to define the key terms of the variables we are going to measure and their relationship. What do literacy rate and human development stand for?

Literacy could be defined as the ability to read, write and count.[8] Literacy is a key skill and a key measure of a population's education.[9] Human development on the other hand, according to the Measure of America of the Social Science Research Council, is defined as the process of enlarging people's freedoms and opportunities and improving their well-being.[10] Human development is about the real freedom ordinary people have to decide, who to be, what to do, and how to live.[11]

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[5] Holden, Laura; Biddle, Jeff. *The Introduction of Human Capital Theory into Education Policy in the United States.* Working Paper. (2016). pp. 1-47.
[6] Goldin, Claudia. "Human Capital." *Handbook of Cliometrics.* (2014). pp. 1-42.
[7] Ibid. p. 1
[8] "Adult Literacy Rates, 2015 or most recent observations." *Our World in Data*. (2015). Retrieved
[9] *Our World in Data,* Ibid.
[10] "About Human Development." *Measure of America.*
[11] *Measure of America,* Ibid.

From the graph illustrated in the introduction, we could see that the level of income of the world population significantly increased as its literacy rate augmented as well. We can deduce then that literacy empowers people to have better access to education and this access to education increase their income, therefore it increases their living standard. Today, China is one of the most advanced economies in the world, while under the regime of Mao, it was considered a low-income country. Before the 1980s, China's adult literacy rate was less than 51 percent. By 2018, China's adult rate reached 96.8 percent.[12] This striking rise in the literacy rate in China implies that a great majority of the Chinese population has had access to better education. The question here is to comprehend how literacy impacts the human development of individuals in low-income countries?

2.2. The Data

To answer this question, we decided to build a cross-sectional dataset where the values of the dependent and independent variables were extracted from the Human Development Index (HDI), UNESCO Institute of Statistics, the World Population Review, respectively. All values used to build this dataset were from the latest data available. The values extracted from the Human Development Index were from the year 2020, and the values extracted from the UNESCO Institute of Statistics and the World Population Review were from the year 2020 and 2021. The countries selected are all considered low-income countries according to the standing of the Human Development Index. The Human Development Index has ranked countries according to their HDI score. A country is considered low-income when its HDI score is less than 0.55. The following list of countries that compose our dataset all has an HDI score below 0.55. Since our dataset contains 33 observations, we believe that we should include the whole dataset in this paper in order to be properly assessed.

[12] "Literacy Rate, adult total (% of people age 15 and above)." *World Bank.* (2020).

Dataset of the Impact of Literacy Rate on the Human Development of Low-Income Countries

Countries	HDI	Literacy Rate (%)
Mauritania	0.546	53.5
Benin	0.545	38.4
Uganda	0.544	73.9
Rwanda	0.543	70.5
Nigeria	0.539	62
Ivory Coast	0.538	47.2
Tanzania	0.529	77.9
Madagascar	0.528	74.8
Lesotho	0.527	79.4
Djibouti	0.524	67.9
Togo	0.515	63.7
Senegal	0.512	51.9
Afghanistan	0.511	38.2
Haiti	0.51	61.7
Sudan	0.51	60.7
Gambia	0.496	50.8
Ethiopia	0.485	51.8
Malawi	0.483	65.8
DRC	0.48	77
Guinea-Bissau	0.48	59.9
Liberia	0.48	48.3
Guinea	0.477	30.4
Yemen	0.47	70.1
Eritrea	0.459	76.6
Mozambique	0.456	60.7
Burkina Faso	0.452	41.2
Sierra Leone	0.452	43.2
Mali	0.434	35.5
Burundi	0.433	68.4
South Sudan	0.433	34.5
Chad	0.398	22.3
Central African Republic	0.397	37.4
Niger	0.394	19.1

Table 1. Source: Author's computation

2.3. Descriptive Statistics

The descriptive statistics presents the summary of the coefficients of the dependent variable.

HDI	
Mean	0.48727273
Standard Error	0.00791363
Median	0.485
Mode	0.48
Standard Deviation	0.04546033
Sample Variance	0.00206664
Kurtosis	-0.6151943
Skewness	-0.5424763
Range	0.152
Minimum	0.394
Maximum	0.546
Sum	16.08
Count	33
Largest(1)	0.546
Smallest(1)	0.394
Confidence Level(95.0%)	0.01611953

Table 2

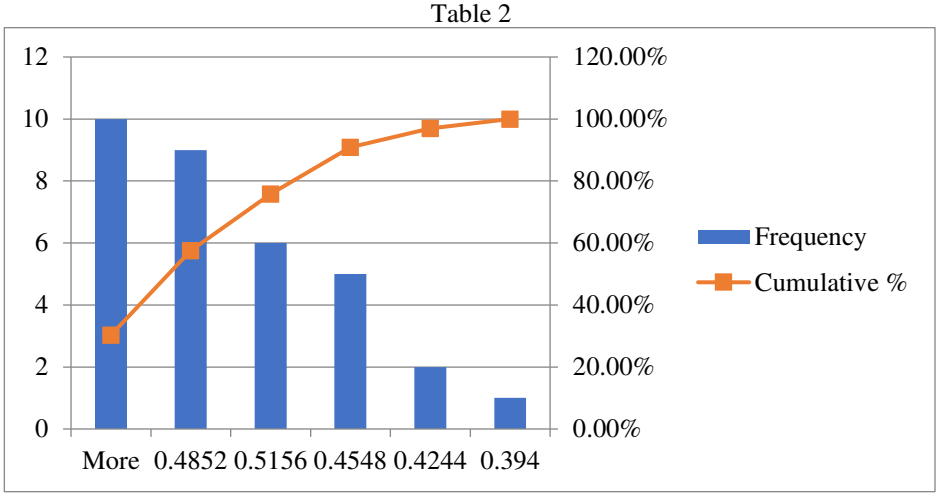

Figure 2

2.4. The Model

The appropriate model to test our hypothesis is the linear regression because there is a linear trend within the observation of the scatterplot. Moreover, there is no autocorrelation because we are only testing the dependent variable on one predictor. The residuals are the same for any value of the predictor and the values of the predictor are normally distributed. Therefore, we could write our model as the following equation:

$$HDI = \beta_0 + \beta_1 Literacy\ Rate + \varepsilon$$

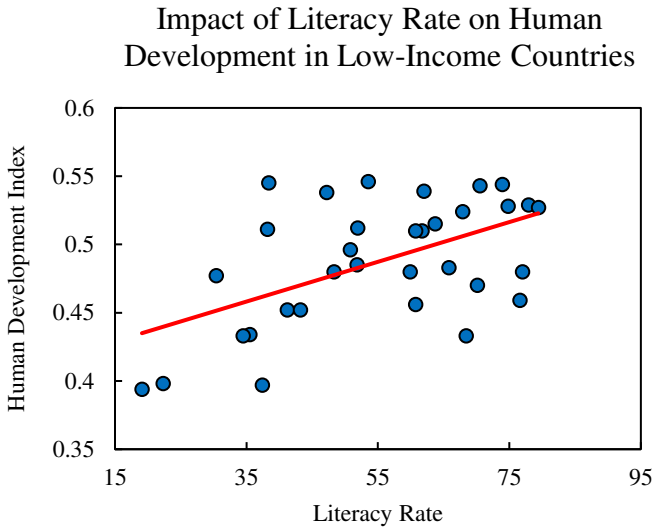

Figure 3

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0.54059364							
R Square	0.29224149							
Adjusted R Square	0.26941057							
Standard Error	0.038857							
Observations	33							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	1	0.01932667	0.01932667	12.8002503	0.00116265			
Residual	31	0.04680587	0.00150987					
Total	32	0.06613255						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.40720094	0.02338036	17.4163639	1.4586E-17	0.35951637	0.45488551	0.35951637	0.45488551
Literacy Rate (%)	0.00145609	0.00040699	3.57774375	0.00116265	0.00062604	0.00228614	0.00062604	0.00228614

Table 3

2.4.Results

The results of our regression analysis show that the correlation between literacy rate and human development in low-income countries is statistically significant, but to what extent? The R^2 illustrates that the correlation between the variable is relatively weak, but this does not mean that literacy does not affect the human development of individuals in these countries. A nation with high literacy rate is more likely to attract a large pool of investors and entrepreneurs as well as the inflow of money which in turn have a great impact on the nation's economy.[13] Literacy helps to spread awareness among the people of their rights—people with good literacy skills enjoy a higher living standard, have better opportunities of finding employment, and can continue to learn new

[13] Yeoh, Emile Kok-Kheng; Chu, Kah-Mun. "Literacy, Education and Economic Development in Contemporary China." *China-Asean Perspective Forum*. Vol. 2, No 1&2. (2012) pp. 11-83.

skills that will help them in the workplace.[14] The substantive impediment to the economic progress of low-income countries is their weak literacy rate. A lack of literacy could be translated as the inability of someone to understand his or her own rights. A person who does not understand his or her rights can therefore not understand the substance of contracts. Investors invest in a country through the use of contracts. If there are not sure to have a return on their investment, they will not move forward with the contract. It is important to fathom that literacy is both a tool and a concept.[15] As a tool, it has been used by humankind to facilitate interpersonal interaction for millennia; as a concept, it emerged with advancements in both human consciousness and civilization whereby at a stage in human history, yardsticks and criteria began to be fixed, albeit inaccurately, to profile a literate person.[16]

Human beings reach an understanding of their environment through the analysis of the many pieces of information that are received by them.[17] The analysis of the pieces of information forms the basis of action that human being take subsequently and the process of analyses and actions gradually help to enlarge the world view of the individual.[18] The lack of access to quality education in low-income countries significantly impedes the ability of individuals to have access to better economic opportunities. For example, Niger is the country that has the lowest literacy rate (19.1 percent) and this percent directly impacts the human development of its people because their limited education due to a substantive lack of literacy competency prevents them from bettering their economic condition. It is logically and realistically impossible for a society to be fully developed economically and socially if the people of that society have a weak literacy rate.

3. The Level of Education on Income per capita in Low-Income Countries (The Case of India)

3.1. The Goal of the Analysis

In this part, we are interested in analyzing the effect of education on GDP per capita in low-income countries. In this sense, we decided to choose India to represent low-income countries from 1990 to 2017. It is important to note that India is considered to be among the most advanced countries within low-income nations.

The level of education in a country can be measured in several ways. Some may argue that it is enough to use the average years of education of the population, whereas for others it is also important to consider the quality of education in countries. For example, in the estimations made by Alan Kruger and Mikael Lindahl (2001), the results show a significant correlation between economic growth and human capital which is measured by the years of education. On the other hand, Eric Hanushek and Ludger Woessman (2008) estimated not the time but the quality of education using PISA tests which are conducted by the OECD. In this sense, they show that

[14] Ibid. p. 11
[15] Idowu Biao, Kebadire Mogotsi, Tonic Maruatona, Wapula Raditloaneng, Flora Tladi, Morgan Chawawa, Obakeng Kheru. "The Contribution of the Human Development Index Literacy Theory to the Debate on Literacy and Development." *World Journal of Education.* Vol. 4, No.3 (2014). Sciedu Press. pp. 1-12.
[16] Ibid. p. 5
[17] Ibid. p. 6
[18] Ibid. p. 6

economic growth is rather correlated with the quality of education and that the coefficient measuring the years of education is not significant.

In this paper, we will measure the level of education as the average years of education. We do not use PISA tests or any other variable that measures the quality of education because, in most low-income countries, this kind of data is barely collected. The PISA tests, for example, are only available for the OECD countries. We have chosen to study the case of India, in which there is no available data to measure the quality of education.

3.2. The Data

We use data from the World Data Bank for GDP per capita and In Our World Data for Mean Years of Schooling. For this last one, data are collected from several sources. In the case of our sample which corresponds to the period of 1990 to 2017, for the population over 25 years old, data is collected from The United Nations Developed program.

Correlative Dataset of the Impact of the level of education on Income

Country	Year	schooling	GDP	schooling_sq
India	_1990	2.96	367.5566093	8.7616
India	_1991	3.1	303.0556053	9.61
India	_1992	3.2	316.9539279	10.24
India	_1993	3.3	301.1590042	10.89
India	_1994	3.4	346.1029503	11.56
India	_1995	3.5	373.76648	12.25
India	_1996	3.7	399.9500768	13.69
India	_1997	3.9	415.493797	15.21
India	_1998	4	413.2989342	16
India	_1999	4.2	441.9987596	17.64
India	_2000	4.4	443.3141934	19.36
India	_2001	4.5	451.5730011	20.25
India	_2002	4.6	470.9867859	21.16
India	_2003	4.7	546.7266145	22.09
India	_2004	4.7	627.7742473	22.09
India	_2005	4.8	714.8610135	23.04
India	_2006	4.9	806.7532806	24.01
India	_2007	5	1028.334771	25
India	_2008	5.2	998.522339	27.04
India	_2009	5.3	1101.96084	28.09
India	_2010	5.4	1357.563719	29.16
India	_2011	5.4	1458.103527	29.16
India	_2012	5.6	1443.879529	31.36
India	_2013	5.8	1449.605912	33.64
India	_2014	6.1	1573.881492	37.21
India	_2015	6.3	1605.605434	39.69

India	_2016	6.4	1732.564262	40.96
India	_2017	6.4	1981.65105	40.96

Table 4*:* Source: The World Data Bank, Our World in Data.

Table: Statistics Of The Variables GDP Per Capita, Schooling (1990 – 2017)

Variable	Number of Observations	Mean	Variation	Minimum	Maximum
Schooling	28	4.67	1.05	2.96	6.40
GDP per capita	28	838.32	529.97	301.16	1981.65

Table 5

This model is built with a balanced sample of 28 observations for India for 27 years. We observe that the average years of education across periods is approximately 5 years, with a variation of around 1 year.

However, GDP per capita has an average of almost 840 dollars which varies considerably (almost 530 dollars). This is because, although there is only one country in this sample, their GDP per capita may vary yearly due to periods of crisis, expansion, or many other economic factors. We could have chosen several low-income countries to have more observations, but the level of education is different in each country, which could bias our estimations.

3.3. Estimation of the model

The relationship between GDP per capita and the average years of education is given by the polynomial regression. We estimate the following model:

$$GDP\ per\ capita_t = \beta_0 + \beta_1 Schooling_t + \beta_2 Schooling_t^2 + \varepsilon_t$$

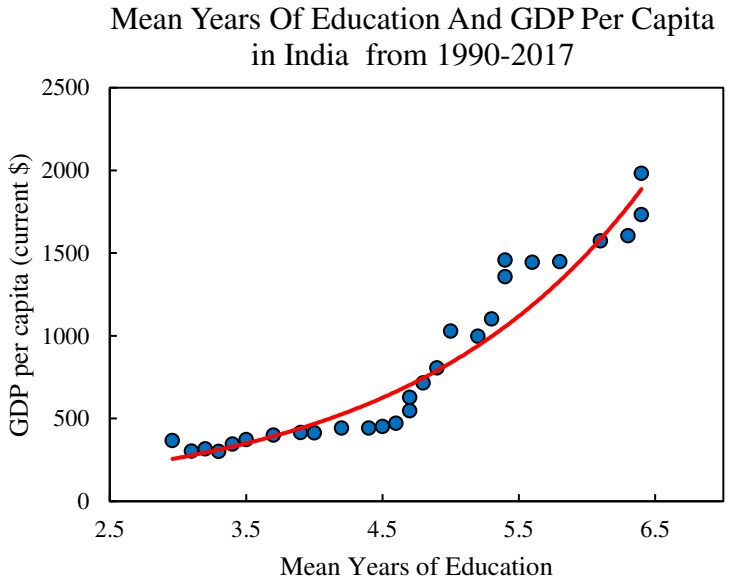

Figure 4

We assume that one additional year of schooling will increase the GDP per capita, which will prove that education can improve the economy of low-income countries.

3.4. Results

Results of the OLS estimation

Variable	OLS[1]	IV[2]	GMM[3]
Schooling	-771.99 (236.83)	-714.37 (259.30)	-714.37 (314.20)
Schooling^2	132.75 (25.18)	127.75 (30.53)	127.75 (33.31)
Constant	1408.70 (539.24)	1248.18 (694)	1248.18 (701.50)
R^2	0.9374	0.9340	0.9340
N	28	28	28

Table 6

In the first OLS estimation, we only regress the mean years of schooling on the GDP per capita. The result is significant at the 5% level for the only independent variable. This result shows a positive correlation between the level of education squared and the GDP per capita. An increase in one additional year in the average level of education increases GDP per capita by approximately 132.75 dollars.

However, it is important to highlight that the OLS model might not be appropriate due to the presence of endogeneity. This issue may come from a problem of simultaneity, which occurs when the dependent variable is correlated to one (or several) independent variable(s). In the case of this study, we could think that the average years of schooling in a country may also be impacted by the GDP per capita. Not only it increases GDP per capita, but the level of education can also be improved when GDP per capita increases.

For this, we can do an exogeneity test using the augmented regression method (also called the Durbin-Wu-Hausman test) with the following hypothesis:

$$\begin{cases} H0: schooling\ is\ exogenous \\ H1: schooling\ is\ not\ exogenous \end{cases}$$

This method consists in:
1. Regressing the variable which is supposed to be endogenous.
2. Collecting the residual.
3. Regressing the standard model with the residual collected.

If the residual collected is significantly different from zero, then the variable is indeed endogenous.

In our case, we get the following result:

Durbin-Wu-Hausman test for exogeneity of Schooling and Schooling Squared

Variable	t-value	Probability
Residual Schooling	2335529	<0.0001
Residual Schooling Squared	-3.21E6	<0.0001

Table 7

With the p-value being inferior to 5%, we can reject the null hypothesis. The average years of education are endogenous in this model.

To correct this issue, the better way is to estimate using the IV or GMM regression in which we will add lagged variables of schooling and schooling squared.
Since this is a time series model, serial correlation is probably another issue that may affect the efficiency of the OLS estimator. To verify this issue, we can run a Breusch-Godfrey's Test in which we test the null hypothesis that there is no serial correlation.

$$\begin{cases} H0: no\ serial\ correlation \\ H1: serial\ correlation \end{cases}$$

Table: Breusch-Godfrey test for serial correlation

Number of lags	LM statistic	Probability > LM
1	14.16	0.0002
2	17.21	0.0002

Table 8

Since the p-value is inferior to 5%, we can reject the null hypothesis. Therefore, there is a serial correlation in the model. To correct this issue, we can regress using the Generalized Moments Method which considers issues such as serial correlation and/or heteroskedasticity. In this case, the estimator is asymptotically consistent according to Newey and West (1987)[19]:

$$p \lim_{N\to\infty} \hat{b}_{GMM} = b.$$

We can choose lags of the endogenous variables of orders 1 and 2. We get the results in Table (to put the number) IV[2] and GMM[3]. We see that the coefficients are significant at the 5% level for the variables Schooling and Schooling Squared. We can also notice that IV and GMM give similar results. This is because in the estimations we corrected for serial correlation using the Newey and West estimator with one lag for serial correlation. So, we can conclude that both estimators are valid in the case of our model.

[19] Newey, W. K., & West, K.D. "a Simple, Positive Semi-Definite, Heteroskedasticity and Autocorrelation Consistent Covariance Matrix. *Econometrica.* (1987). 55(3), 703. Doi: 10.2307/1913610

3.5. Conclusions and limits

Finally, we can conclude that the average years of education can increase the GDP per capita in low-income countries. These results show that education is a very important tool to improve the economy of a country. Through education, individuals become more productive and develop more abilities to contribute to the labor market. Furthermore, education allows for creativity which leads to innovation, which is also a factor that contributes to the growth of countries and the improvement of the economy. However, it is important to highlight the fact that this is a small sample of only one country, which may not be representative of the population we want to study. However, since India is a large country, we may consider that the results are not invalidated by the limited number of observations.

4. The Level of Education on Employment in Low-Income Countries (The Case of Gambia)

4.1. Purpose of the Analysis

The purpose of this part of our analysis is to understand the correlation between education and employment in low-income countries. To be more precise, what we are mainly interested in is to measure the impact that education exert on employment. It is, evidently, fair to assume that a society where educational attainment is higher is also a society that has a high percentage of its population engaged in the labor force. Logically, a society that has a large portion of its population engaged in the labor force creates more goods and services for its country, which means that the level of economic output would significantly increase. Economic development in low-income countries goes at a slower pace because they are many endogenous factors that are not properly utilized to stimulate growth. As we explained in the first part of this paper, education is an investment in human capital. low-income countries that invest in education tend to have a much faster development. In this analysis, we chose the Gambia as the country to analyze this correlation. Gambia is a small country located in West Africa. It is precisely the smallest country within mainland Africa, and it is surrounded by Senegal (the same way Lesotho is surrounded by South Africa).[20] Gambia has made some economic progress over the last three decades as we can see in figure 5 with their income per capita.

[20] Hoare, Ben. *The Kingfisher A-Z Encyclopedia*. (2002) Kingfisher Publications. p. 11 ISBN 0-7534-5569-2

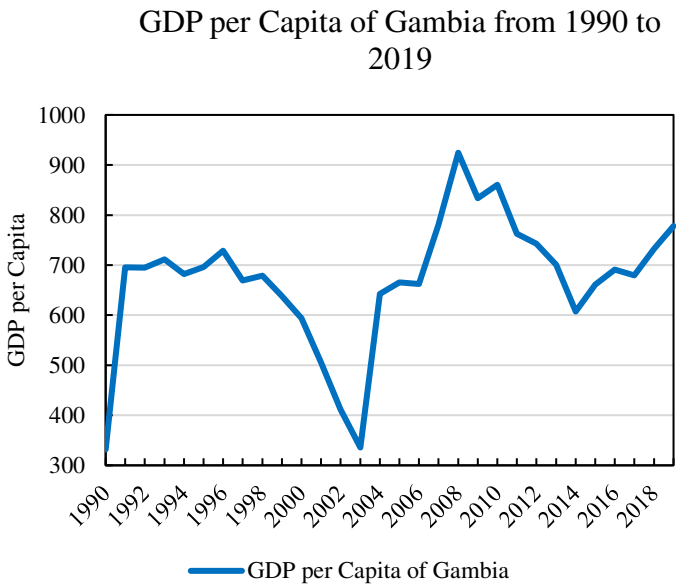

Figure 5. Source: World Bank Data

4.2. The Data

The dataset we built to measure our assumption was mainly extracted from the Human Development Index. However, it is important to notify that the sources of the data extracted from the Human Development Index were, in fact, from the UNESCO Institute of Statistics and the International Labor Organization (ILO), respectively. The Human Development Index is merely the platform upon which the values of both variables are accessible.

The dependent variable is represented by employment. One way to measure employment is by quantifying the labor force participation (% ages 15 and older). According to the Human Development Index, labor participation rate is the percentage of a country's working-age population that engages actively in the labor market, either by working or looking for work—it provides an indication of the relative size of the supply of labor available to engage in the production of goods and services.[21] The independent variable is represented by the level of education. Education could be measured by quantifying the means years of schooling. The Human Development Index defines the means year of schooling as the average number of years of education received by people ages 25 and older, converted from education attainment levels using official durations of each level.[22]

[21] "Labor Force Participation Rate (% ages 15 and older)." *Human Development Index.* (2020)
[22] *Human Development Index*. Ibid.

Correlative Data of the Impact of Education on Employment in the Gambia from 1990 to 2019

Years	Labor force participation	Means years of school
1990	57.6	1.2
1991	57.85	1.25
1992	57.9	1.3
1993	58.25	1.4
1994	58.33	1.5
1995	58.4	1.6
1996	58.39	1.7
1997	58.41	1.8
1998	58.4	1.8
1999	58.4	1.9
2000	58.4	2
2001	58.45	2
2002	58.5	2.1
2003	58.55	2.2
2004	58.57	2.3
2005	58.6	2.4
2006	58.7	2.5
2007	58.73	2.5
2008	58.77	2.6
2009	58.79	2.7
2010	58.8	2.8
2011	58.9	3.1
2012	58.9	3.2
2013	59	3.4
2014	59	3.5
2015	59.1	3.5
2016	59.2	3.5
2017	59.2	3.7
2018	59.3	3.8
2019	59.4	3.9

Table 9: Author’s computation

4.3. Descriptive Statistics

The descriptive statistics presents the summary of the coefficients of the dependent variable.

Labor force participation	
Mean	58.6263333
Standard Error	0.0775716
Median	58.585
Mode	58.4
Standard Deviation	0.42487713
Sample Variance	0.18052057
Kurtosis	0.15066111
Skewness	-0.3262213
Range	1.8
Minimum	57.6
Maximum	59.4
Sum	1758.79
Count	30
Largest (1)	59.4
Smallest (1)	57.6
Confidence Level (95.0%)	0.15865173

Table 10

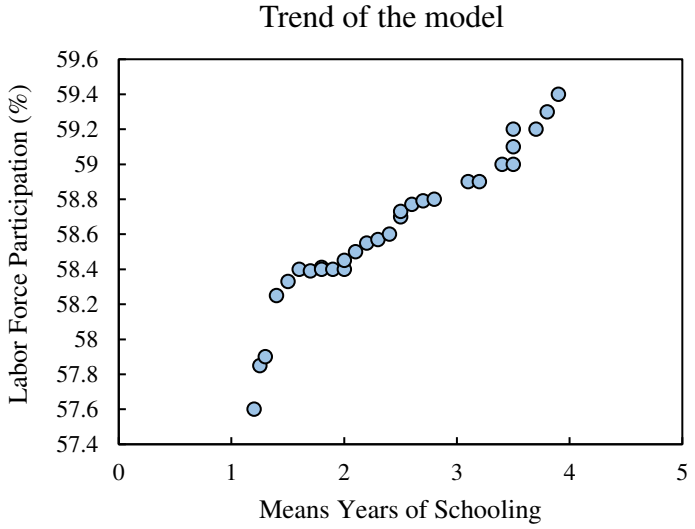

Figure 6

4.4. Estimation of the Model

The dataset we built was essentially based on two variables, mainly an outcome variable and one predictor. From our observation of the scatterplot, it is fairly obvious to determine that there is a linear trend between the values of Education, represented by the Means Years of Schooling, and

Employment represented by the Labor Force Participation. Therefore, let us use the linear regression model to estimate the relationship:

$$Employment = \beta_0 + \beta_1 Education + \varepsilon$$

4.5. Results

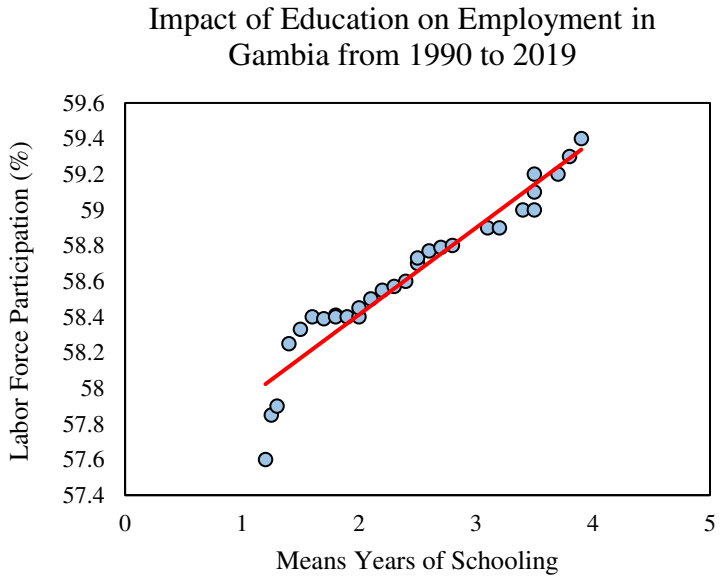

Figure 7

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0.95848739							
R Square	0.91869807							
Adjusted R Square	0.91579443							
Standard Error	0.12329167							
Observations	30							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	1	4.80947323	4.80947323	316.395288	8.5711E-17			
Residual	28	0.42562344	0.01520084					
Total	29	5.23509667						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	57.4385645	0.07046742	815.108103	8.3257E-63	57.2942186	57.5829105	57.2942186	57.5829105
Means years of school	0.48712323	0.0273857	17.7875037	8.5711E-17	0.43102617	0.5432203	0.43102617	0.5432203

Table 11

The results of the regression show that the two variables are statistically significant and there is a strong positive correlation between Means years of schooling and labor force employment. The p-value of our regression analysis is 8.571×10^{-17} and the $R^2 = 0.9186$. At first glance, we may be tempted to claim that the model validates our hypothesis, but it is essential to test for any potential autocorrelation. Before testing for autocorrelation, let us assess the residual plot of the means years of schooling.

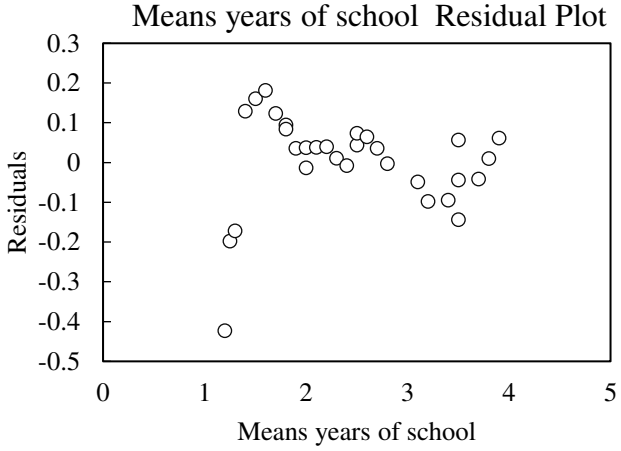

Figure 8

To test for autocorrelation, we can apply the Breusch-Godfrey test to detect any possible autocorrelation: The Breusch-Godfrey test is based on the following assumption that the null hypothesis has no serial correlation. This could be written as the following formula:

$$H_0: \rho_1 = \rho_2 = \cdots = \rho_\rho = 0$$

However, since our model is based on one predictor, we will then write the null hypothesis formula as

$$\rho_1 = 0$$

Consequently, the application of the Breusch-Godfrey could be written as the following auxiliary model:

$$u_t = \beta_0 + \beta_1 X_{1t} + \rho_1 u_{t-1} + \varepsilon_t$$

This auxiliary equation is known as autoregression because the explanatory variable, which is the lagged residual, is the lagged value of the dependent variable, which is the actual residual value. As we apply the Lagrange Multiplier testing following the regression of the residuals, from the following formula:

$$LM = (n - p) \times R^2_{aux} \sim \chi^2_p$$

Here are the results we obtained:

	df	*SS*	*MS*	*F*	*Significance F*	*LM*	*Significance LM*
Regression	1	0.12697087	0.12697087	11.6320966	0.0020541	8.73187919	0.00312694
Residual	27	0.29472017	0.01091556				
Total	28	0.42169103					

Table 12

We have a p-value of less than 5 percent, which grants us the rejection of the null hypothesis. Nonetheless, the results show that there is a positive autocorrelation between residuals. To correct this very issue, we can proceed by using the same statistical method used in the previous part of our analysis, which is the General Moment Methods. Through the application of the GMM, we will find results close to the ones we found in the previous part of our analysis, in the case of India. By following this very same procedure, the results obtained should then validate our model.

Our econometric analysis showed that education is an important factor in the economic development of The Gambia. As a matter of fact, the patterns of the data showed that the percentage of the population who participate in the labor force, increases by one year of the means years of schooling. In other words, the more the years of schooling are extended, the higher the percentage of the population engaged in the labor force augments. This is the sign of important economic progress for a country whose overall production of goods and services is essentially low.

5. Recommendations

It would be judicious of us, after this lengthy analysis, to provide a set of recommendations that we believe could potentially improve the educational system of most low-income countries. We are not guaranteeing that we proposed measures will necessarily lead to those results, but we believe that these results show an important pattern that if followed correctly, could lead to an important positive outcome.

5.1. Recommendation 1

In low-income countries, it must be recognized that government has a role to play in the development of their education system. This role is primarily based on increasing the budget to allocate resources in the education system. There are promising interventions that work showed results in the past when it comes to improving the education system of low-income countries. These interventions had the goal to increase student's time in school in communities with low student attendance and enrollment, but more research is still needed to determine whether they are effective across various social, economic, and cultural contexts.[23] Promising interventions that work by increasing the demand for schooling include: (1) Providing information directly to students and parents on the returns to education; (2) Providing school counseling to students; (3) Merit-based scholarship; (4) Labeled cash transfers; (5) Unconditional cash transfers; (7) Matching remittances for educational purposes.[24] There are of course many more proposals, but the seven ones that we proposed have been tried before and have worked.

One important measure that needs to be implemented is the reduction of the cost of complements. Reducing the cost of complements is another strategy to increase school enrollments.[25] Increasing school enrollments would lower the costs of complements to schooling.[26] Such interventions have

[23] Damon, Amy; Giewwe, Paul; Wisniewski, Suzanne; Sun, Bixuan. "VIII. Policy Recommendations: A Priorities for Education Intervention to Increase Time in School."*Education in Developing Countries: What Policies and Programmes Affect Learning and Time in School?* (2016). p. 103. Report.
[24] Ibid. p. 103
[25] Ganimian, Alejandro; Murnane, Richard. "Improving Educational Outcomes in Developing countries: Lessons from Rigorous Impact Evaluations." *NBER Working Papers Series.* (2014). Working Paper 20284. p.10 National Bureau of Economic Research.
[26] Ibid. p. 10

had positive impacts on students who take advantage of these cost reductions.[27] Covering the costs of complements to schooling can be budget neutral in terms of the cost per student if the number of students per classroom is allowed to increase.[28] In a study conducted by Kremer, Moulin, and Namunyu in 2003, their results assessed the impact of an initiative in Busia and Teso, Kenya in 1995 that covered the cost of textbooks, classroom constructions, and school uniforms.[29] The program led to a sharp reduction in dropout rates and an influx of new students into participating schools.[30]

5.2. Recommendation 2

Although education is costly, it must be considered an investment. Indeed, in this paper, we have proven that returns on education are economically beneficial for individuals. In this sense, one way to improve the educational system in low-income countries is to increase investment from public and private institutions. The increase in public education institutions gives access to low-income households who cannot afford high costs to invest in education. The case of South Korea, where economic development is mainly attributable to educational reforms is one example to prove this.

According to the *Asia Society Organization*, 3.4 percent of the South Korean GDP is only spent in formal schooling, and it accounts for 10 percent when adding private and informal education.[31] Nonetheless, it is important to highlight the fact that public institutions must not create barriers to entry for private institutions, since this allows for better education quality, and it can also be accessible to low-income individuals through scholarship programs and loans.[32] As a matter of fact, decreasing loan fees for students (or students' parents) is another mechanism through which low-income households can further invest in education. Knowing that there is a positive relationship between wages and education, individuals will have incentives to invest and accumulate human capital.[33]

5.3. Recommendation 3

Another important issue that must be considered when dealing with the improvement of the educational system in low-income countries is to provide better health conditions for citizens. Studies show that education can be negatively affected if students do not live in suitable sanitary conditions. Many experimental data on this subject show a positive correlation between school attendance and health. For example, a randomized experiment led by Bobonis et al. (2006) in 200 preschools located in Delhi showed that school attendance was increased by 5.8 percentage points after offering children iron supplements and deworming medicines.[34] In this sense, improving the

[27] Ibid. p. 10
[28] Ibid. p. 11
[29] Ibid. p. 11
[30] Ibid. p. 11
[31] Asia Society. *South Korean Education Reforms*. Retrieved on February17, 2021.
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educational system must be combined with health prevention, especially in low-income countries where there is more probability to have diseases due to the lower sanitary conditions.

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