Education Expenditure and Average Income in Countries Around the World

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This study investigates the relationship between government expenditure in education and growth measured through gross domestic product per capita. The other variables that were considered include unemployment rate, foreign direct investment net inflow, savings, exports and agriculture. Expenditure on Education exhibited a positive and significant relationship in many different multiple regression models. One important thing to consider in this research is that many of these variables have a relationship with GDP per capita but there is no way to determine causality. GDP per capita could change as result of different variables or it could have an effect on the variables. Education expenditure has a relationship with GDP per capita according to this research, however, it is not known whether expenditure on education has an effect on GDP or the reverse.

I. Introduction

This article examines the effect that education expenditure has on gross domestic product per capita in 193 countries in the span of one year, 2011. The analysis later expands to look at a number of different multiple regression models which include unemployment rate, foreign direct investment net inflow, savings, exports, and agriculture. It also considers the option of looking at variables as percent of GDP per capita by taking the natural log, however some variables were already in percent of GDP per capita. The importance of this topic is the future. Ensuring that future generations succeed is based upon successful methods used today. If education expenditure is not actually improving education and increasing growth, other methods must be found and utilized.

The motivation behind research on education expenditure and growth is the sustainable development goal of quality education, which is the fourth goal. Based on widely accepted economic theory, education has a positive relationship to economic growth overall. Therefore, the goal of ensuring free and high quality primary and secondary education and ensuring equal access to tertiary education, should, if even successful in part, help pave the way to completing the other development goals. These goals are in many ways related to one another; a goal that is relatively successful, such as economic success, should facilitate in the success of some of the other goals. If any one of the goals could be considered the first domino in creating the successful culmination of the other goals, it is very possibly education. If education improves on a global scale, it should facilitate economic growth, making it easier to complete goals such as the eradication of world hunger, creating affordable and clean energy, improving sanitation, and so much more. Education is the foundation that growth uses as a foot hold.

The economic theory relating human capital and growth was widely recognized and inspected economically beginning in the 1950's. Gary Becker and Theodore Schultz were key figures in exploring and researching the role of human capital and growth theory. Today, a large amount of research has been done on the directly proportional relationship between human capital and economic growth and expounded upon through research into education and expenditure. Research suggests that as governments invest more on improvements in their education systems, the result should be an increase in growth, which can be measured in GDP per capita. Conversely, countries with little investment in education, should show low GDP per capita. Other variables might lessen the impact of investment in education, but should not remove presence of a positive relationship with GDP per capita.

II. Literature Review

One of the fundamental relationships in economic theory is that between human capital and economic growth and development. Human capital can be influenced by a number of different things, with several important factors being health, informal education, and formal education. Research on this subject became popular in the 1950's with the growth model and the human capital theory popularly voiced by Nobel Peace Prize winner Gary Becker. Later, Robert Lucas' growth model further emphasized the connection. More modern research on human capital and economic growth is fairly abundant especially when the search is widened to include education expenditures and enrollment rates.

Wang and Liu (2015) focus on the basic relationship between education, human capital and economic growth, finding a significant and positive impact on growth from education. This is not surprising as it reinforces the widely accepted idea that education creates economic expansion. They considered not only primary and secondary education but also higher education levels, finding that primary and secondary education had an uncertain relationship to growth. They admit that this may be because more modern technological growth requires higher and more specific skill levels. Although an uncertain relationship between early education levels might not always be the case, if examined differently or in a more focused study. Our analysis uses data on government expenditure without differentiating between education levels. This choice might merit further investigation. Wang and Liu took a similar approach to ours by considering a number of different countries, however, they also chose to probe differences between developed and undeveloped countries, finding that there remained a positive and significant link between education and economic growth in both.

One consideration often made when examining human capital is that of health, which [our] article has chosen to exclude and which Wang and Liu also considered, finding that life expectancy also had a positive effect on growth. Although health is also an important factor when examining human capital, [our] research looks to simplify and evaluate only government investment into education, and not life expectancy, healthcare, or any other related factors.

If, as so many theories and an abundance of research maintains, education increases human capital and in turn growth, the question remains as to whether investment in education can also increase economic growth. There is abundant research to support that it does, especially when targeting one country over a span of time. One article that demonstrates this is by Jorgenson and Fraumeni (1989), who suggest that both human capital investment and physical capital investment are the key to increasing growth. They inspect the issue closely, by focusing on the United States, an interesting choice because it is a developed country with a large economy. They examine education investment as inputs into capital like buildings and equipment for schools and labor such as teachers and non-instructional employees. Their approach is probably the right one when examining only one country, however these methods might

be too tightly focused for research on multiple countries. Our examination uses more broad and monetary figures to analyze educational investment and the relationship it has with overall economic growth. One thing that Jorgenson and Fraumeni do not consider in their concentrated research is the investment of time. This factor is something that our research also does not test due to difficulty finding variables or quantifying input of time, and one that might be important in measuring the effectiveness of education and its effects on growth.

Another interesting look at expenditure on education's effect on economic growth is more recently presented by Mallick and Dash (2015) who scrutinize the relationship between these two variables in India from 1981-2012. Their choice of country is much different from that of Jorgenson and Fraumeni because it is not a developed country with an extremely large population, which might make expenditure on education less effective. Like us, they chose to use total government expenditure on education, however they also look at expenditure on training. This is useful in their conclusion as they find that India's economic growth might also benefit from investment in more vocational training. Much like Jorgenson and Fraumeni, they take focused approach, examining one country. This choice makes sense in both papers for finding more specific outcomes. Mallick and Dash for instance infer that India's investment might need more focus on secondary and postsecondary education in the future to drive innovation closer to India's goal to become a developed nation by 2022.

We are examining education's effect on gross domestic product per capita on a larger scale by looking at the effect that government expenditure can have on growth in many countries all over the world. This expanded view sacrifices some of the smaller details like specific policy, private versus public school investments, or education level differentiation. This is done in order to examine a larger view of education expenditure on a world scale. Taking a step back and looking at the fundamental relationship between education expenditure and gross domestic product per capita in a large number of countries at one time, allows us to analyze the importance of investment in education relative to the sustainable development goals. It explores the question of whether education expenditure effectively creates education of high enough quality and standards to impact growth in most countries.

III. Data Review

The data obtained is from the World Bank.The World Development Indicators are used to understand the relationship between education expenditure the effect of various economic factors such as GDP per capita, unemployment rate, exports, savings, and more. A simple linear regression was run between GDP per capita and government expenditure on education and the result was a significant and positive relationship. The main goal of this data analysis was to see if there was a positive or negative correlation between these independent variables and annual GDP growth/GDP per capita. The use of each variable was decided based on theoretical relationship to GDP per capita and significance after each model was regressed weighed beside loss of observations.

Data Source: World Bank

Year: 2011

Variable Type	Variable	Abbreviation	Units
Dependent	GDP per capita	perCapitaGDP	In US Dollars
Independent	Government expenditure on education, total	govExpendEdu	% of GDP
Independent	Unemployment Rate	unemploymentR	% of labor force looking for employment
Independent	Foreign Direct Investment (inflow)	FDInetInflow	% of GDP
Independent	Gross savings	savings	% of GDP
Independent	Agriculture, value added	agriculture	% of GDP
Independent	Exports	exports	% of GDP

Dependent Variable - GDP Per Capita (perCapitaGDP) or GDP Per Capita as a log (logGDP)

GDP per capita is important in the measurement of the general welfare and standard of living in a country. The prediction is that the more educated a country is, the higher economic productivity and therefore a higher standard of living. In later multiple regressions, log of GDP per capita was used as a better measure because many of the independent variables were in terms of percent of GDP per capita. This variable was chosen over GDP annual growth rate because in the year 2011, GDP annual growth rate had a negative relationship to education expenditure which might be accounted for because of the global recession. There were a large number of observations for this variable, but there was also a large variance

between different countries. This was not unexpected because there is large range between standard of living in the countries of the world.

Independent Variable - Government Expenditure on Education (govExpendEdu)

A country's government expenditure on education (as a percentage of total GDP with the education level not being specified) is important because it shows how much the government invests in its future workers, and therefore the economy as well. Human capital is essential to a functioning economy which makes expenditure on education also essential. Because it was taken as a percentage of GDP, there was no need to take the natural log of this variable. The average amount spent on education in the countries observed was roughly 4% which is not surprising. It is important when theorizing the impact education expenditure might have, to compare that value with the average of 47% of GDP made up by exports, and average of 30% of GDP made up by savings.

Unemployment Rate (unemploymentR)

Unemployment rate was chosen because theoretically, it should have a negative relationship with GDP per capita. It is possible that unemployment might decrease the impact of expenditure on education, but much like expenditure on education, it is a relatively small percentage of GDP, with an average of roughly 9% of GDP.

Foreign Direct Investment

FDI net inflows was chosen because it is thought to have a significant effect on GDP per capita while not being highly correlated with government expenditure on education. Net inflow is calculated and reported by the IMF and World Bank by calculating the sum of equity capital, reinvestment of earnings, other long-term capital, and short-term capital. Net inflows is then divided by GDP in order to report the data as a percent of GDP. Because it was taken as a percentage of GDP, there was no need to take the natural log of this variable. The average of this variable was only 6% of GDP.

Agriculture

The World Bank definition of agriculture includes forestry, hunting, fishing, cultivation of crops, and livestock. The average among countries observed was 11% of GDP. This was expected to have a negative relationship to GDP because as agricultural commerce falls, countries might be more likely to have large profitable industries like technology or aeronautics.

Savings

Savings is calculated as GNI minus total consumption, plus net transfers and is important because of it theoretical relationship to consumption, and in turn GDP. This made up a very large percentage of GDP, almost 23%. It is interesting, however, that savings and FDI net inflow, which theoretically should be related, were very different and not highly correlated.

Exports

Export are presented as a percent of GDP, which is the value of all goods and services sold to the rest of the world. Theoretically, exports have a positive impact on GDP, which is why they were considered. Exports had a mean of 47% of GDP, which was very large.

Summary Statistics

Variable Abbreviation	**Obs.**	**Mean**	**St. Dev.**	**Min**	**Max**
perCapitaGDP	249	15,518.47	23,723.14	260.48	162,009.9
govExpendEdu	161	4.415	1.472	.805	9.257
unemploymentR	153	8.659	5.608	.2	31.38
FDInetInflow	180	6.119	11.430	-43.463	84.946
savings	156	22.953	25.604	-10.371	298.080
exports	179	47.2169	37.5111	6.1073	339.0186
agriculture	168	11.990	11.724	.037	56.716
developed	182	.280	.450	0	1

Correlation Table

	GDPlog	govExpendEdu	savings	agriculture
GDPlog	1.00			
govExpendEdu	0.3030	1.00		
savings	0.2901	-0.1005	1.00	
agriculture	-0.8592	-0.2226	-0.2123	1.00

Gauss Markov Assumptions

We believe our data meets all of the requirements of the Gauss Markov assumptions in order to assume our estimators are unbiased and are the "best linear unbiased estimates." The first assumption maintains that the models are linear in parameters and that the dependent variable is related to the independent variable in the form of $y = \beta_0 + \beta_1 x + u$ where u represents the unobservable variables. By obtaining our data through the World Bank, a trustworthy and well-reputed source, we believe the data is completely random and have to assume that the World Bank effectively obtained a random sample when finding their data. By choosing every country possible rather than individually hand picking one or a small number of countries we believe it is as random and unbiased as possible. The correlations of variables were low between the variables of the final model , so there was no multicollinearity. In order to do an analysis on the data we have, we must assume that the expected value of u will always be zero and that the variance of u is always constant, given any explanatory variables.

IV. Results

Simple and Multiple Linear Regressions

Model 1	$perCapitaGDP = \beta_0 + \beta_1 govExpendEdu + u$
Model 2	$perCapitaGDP = \beta_0 + \beta_1 govExpendEdu + \beta_2 unemploymentR + \beta_3 FDInetInflow + \beta_4 savings + \beta_5 exports + \beta_6 agriculture + u$
Model 3	$perCapitaGDP = \beta_0 + \beta_1 govExpendEdu + \beta_4 savings + \beta_6 agriculture + u$ *(101 obs)*
Final Model	$erCapitaGDP = \beta_0 + \beta_1 govExpendEdu + \beta_4 savings + \beta_6 agriculture + u$ *(76 obs)*

Dependent Variable: GDP per capita in Log Form				
Independent Variables	**Model #1**	**Model #2**	**Model #3**	**Final Model**
govExpendEdu (β_1)	.2363** (.0935)	.1334** (.0559)	.0720 (.0530)	.1293** (.0551)
unemploymentR (β_2)		-.0053 (.0168)		
FDInetInflow (β_3)		-.0070 (.0071)		

savings (β_4)		.0159* (.0085)	-.0035 (.0027)	.0171** (.0075)
exports (β_5)		.0011 (.0028)		
agriculture (β_6)		-.1257*** (.0099)	-.1127*** (.00649)	-.1260*** (.0094)
Intercept	7.7090	9.3806	9.9246	9.3459
# of Observations	117	76	101	76
R-Squared	0.0526	0.7717	0.7765	0.7681

Summary and Interpretation of Model #1

The first regression done was a simple linear regression with the dependent variable of the log of GDP per capita and the independent variable government expenditure on education as a percent of GDP. With 117 observations, we found that the coefficient for government expenditure was significant at a 10% significance level and a 5% significance level where our hypothesis was H_o: $\beta_1 = 0$ and H_1: $\beta_1 \neq 0$. In this case we were able to reject the null hypothesis, meaning government expenditure on education was in fact significant in our simple regression. Although the R-Squared is low, adding more independent variables should naturally increase the R-squared in future models.

Hypothesis Test

Hypothesis (5%)	**P-Value**	**T-Statistic**	**Conclusion**
H_o: $\beta_1 = 0$ and H_1: $\beta_1 \neq 0$	0.013	2.53	Reject null hypothesis

Summary of Model #2

In the second model, all independent variables that were thought to have a relationship to GDP were included in order to see which variables appeared most significant, according to their P-values and t-statistics. Government expenditure remained significant at both the 5% and 10% significance levels. The only other variables with any significance were savings and agriculture, which was surprising because variables like unemployment and FDI net inflow were predicted to be the most significant throughout this report. After this model, variables savings and agriculture were explored more in depth.

Summary and Interpretation of Model #3

Adding onto the simple linear regression and keeping the same dependent variable, the independent variables savings and agriculture were added in order to make a multiple linear regression. These variables were investigated because of their significance levels in Model 2. In this model, government expenditure on education is no longer significant, nor is savings. The coefficient of government expenditure decreased significantly, making the coefficient closer to zero than it was in the simple regression. On the other hand, agriculture is significant at 1% significance, which is why we wanted agriculture to eventually be included in our final model. Agriculture remained significant in all models, which suggests that its relationship to GDP is strong even if not impactful.

Hypothesis (5%)	**P-Value**	**T-Statistic**	**Conclusion**
H_o: $\beta_1 = 0$ and H_1: $\beta_1 \neq 0$	0.177	1.36	Fail to reject null hypothesis
H_o: $\beta_4 = 0$ and H_1: $\beta_4 \neq 0$	0.197	-1.30	Fail to reject null hypothesis
H_o: $\beta_6 = 0$ and H_1: $\beta_6 \neq 0$	0.000	-17.37	Reject the null hypothesis

Summary and Interpretation of Final Model

In the final model chosen independent variables from the third model (government expenditure, savings, and agriculture) were kept. However, not all of the variables were significant in the third model even despite the fact that all were significant in the second model. This was attributed to the missing observations within independent variables left out of this model that could have been affecting the results of the multiple regression in model two. In order to see if the missing observations were in fact affecting the regression, the countries that did not have values for each variable were dropped. This meant going from 101 observations to seventy-six, which was a significant drop in observations in order to see if there was any significance of the variables savings and agriculture. From dropping down to seventy-six observations that did not have missing values, it was discovered that each of the independent variables were now significant in some way. This difference might be because the countries where data was available for variables like FDI net inflow, are more likely to be more developed. It is important to note that the loss of observations did not decrease the R-Squared value by a large amount, and that it was .76 even with only seventy-six countries.

Hypothesis Tests

Hypothesis (5%)	P-Value	T-Statistic	Conclusion
H_o: $\beta_1 = 0$ and H_1: $\beta_1 \neq 0$	0.022	2.35	Reject the null hypothesis
H_o: $\beta_4 = 0$ and H_1: $\beta_4 \neq 0$	0.025	2.28	Reject the null hypothesis
H_o: $\beta_6 = 0$ and H_1: $\beta_6 \neq 0$	0.000	-13.33	Reject the null hypothesis

V. Extensions

Robustness Tests (F-Test)

The possibility that some variables from Model 2 were correlated with other independent variables was explored. Two independent variables that are theoretically highly correlated were savings and FDI net inflow, however they had very low correlation in this data and a very low F-Statistic. Two variables that had an unexpectedly high correlation were FDI net inflow and exports. When an F- test was run on these two variables, it showed that they are significant together.

Hypothesis	Degrees of Freedom	F-Stat	Critical Value	Conclusion
H_o: $\beta_3 = 0$, $\beta_5 = 0$ H_1: H_o is not true	72	38.25	3.15	Reject the null hypothesis

Different Functional Forms

The dependent variable GDP per capita was used in its logorithmic form in the first regressions because so many of the independent variables were already in percentage of GDP. All variables apart from unemploymentR were in terms of percent of GDP.

Dummy Variable

The dummy variable created is based on the World Bank GNI atlas method of whether or not a country is developed or not. The threshold used by the World Bank is $12,236 for the year of 2018, therefore this is how the data is separated into developed versus undeveloped countries, where the variable developed is equal to one if their GNI is equal to or above this threshold. Keeping in mind our data is from 2011, this threshold may not be completely accurate, however the amount of developed countries has not significantly changed in the past ten years.

The dummy variables were useful when looking at the relationship between GDP per capita and government expenditure on education. The relationship was stronger between the two variables in developed countries, however, this might be because there are tight qualifications for being considered a developed nation. Unlike the research by Wang and Liu, here there seems to be a difference in developed and developing nations.

VI. Conclusions

This research examined the relationship between government expenditure on education and average income in countries throughout the world. Economic theory as well as a number of academic papers suggests that improvements to education will increase human capital, and in turn increase gross domestic product. This paper investigated the possibility that countries could invest in education as a means to increase growth or standard of living. The hypothesis stated at the beginning of this paper was that investment in education *would* in fact increase average income in a country and this would be measured by the relationship between GDP per capita and government expenditure on education.

In a number of different multiple linear regressions, the independent variable government expenditure on education showed a positive and significant relationship with GDP per capita. The size of that relationship decreased, as predicted, from a simple linear regression including only GDP per capita and government expenditure to a multiple linear regression which included the significant independent variables of savings and agriculture. This suggests that education expenditure has a positive relationship with average income in a country, however, this relationship is predictably diminished by other variables that are important factors in GDP, such as savings and agriculture. Savings is shown to have a positive and significant relationship with GDP per capita, which makes sense because of the theoretical relationship between savings and consumption. Agriculture has a negative and significant relationship with GDP per capita, which also makes sense because nations with more industries surrounding agriculture tend to be less developed and have less involvement with more lucrative industries. There is no way to know through these regression models the direction or the causality of the relationship that these independent variables have with GDP per capita. It could be the case that as GDP per capita increases, it could cause savings, agriculture, and expenditure on education to change. What can be definitively said is that the relationship exists and its significance does not fluctuate with the addition of other theoretically significant variables.

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