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The Effect of Education on GDP Growth: Present Phenomenon, Potential Impact, and Future Implications

Aining Li

School of Social Science, University of California, Irvine, USA
aininl1@uci.edu

Abstract. This research investigates the impact of education expenditure, labor force and literary rates on economic growth, measured by GDP per capita. Using panel data from a cross-country level covering 267 nations and regions, the study examines how human capital influence growth. The analysis reveals that education expenditure is highly associated with GDP per capita through all country groups, especially for non-OECD and developing countries, where institutional and educational systems are not that strong compared to advanced economies. Literary rates show positive relationships with more obvious in advanced economies. The finding emphasizes the crucial role of human capital in the economy field. And it should boost nations development: investment in education contributes growth on economy and fosters workforce quality and productivity for the country.

Keywords: education expenditure, economic growth, human capital, OECD, developing countries

1. Introduction

Education is widely recognized as one of the most crucial factors driving economic growth. As the developing tendency of globalization and technological development accelerate, the demand of high educated and skilled workforce becomes increasingly necessary. Broader education provide space for professional instruction and practical training, which cause improvements in productivity, innovation, and employment outcomes. Education has large proportion in the public's mind, people tend to experience in broader educational systems. It takes a great portion of GDP, a primary indicator of national economic performance [1].

The objective of this research is to analyze the correlation between education indicators (literary rate, labor force, the amount of investment on education) and per capita GDP growth. By analyzing the mechanism and challenges that the realistic outcomes exposed. This research provides great insights into how education factors impact macroeconomic performance, The findings could inform better education policies, potential solutions that may fix the problems brings by the education, especially for countries to discover inclusive and sustainable economic growth.

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2. Literature review

Scholars have long debated the pivotal character of education in economic growth. The relationship between education and economic growth induce causality, mechanisms and also challenges. Aghion et al. propose a detailed analysis of how education affects its growth in the United States, which emphasize the importance of clarifying variations in different education system [2]. They develop a multi-state endogenous growth model, which include “high brow” education that advance technological innovations, and “low brow” education that boost technological imitation [2]. The main hypothesis they insist is that innovation tends to depend heavily on a highly educated workforce, whereas imitation relies more on physical capital [2]. Combined with less educated labor. They argue that regions that are near the technological frontier benefit more from investments in higher education, as innovation depends heavily on high skilled labor [2]. Therefore, states farther from the technological frontier may spend more investments in primary and secondary education to guarantee technology adoption.

In contrast, Elizabeth Appiah focuses on developing countries and investigates how public investment on learning influences per capita GDP [3]. By analyzing panel data from 139 developing countries between 1975 and 2015, Appiah builds a system called General Method of Moments (GMM) [3]. Appiah follows with the human capital theory that investment on education field improves workforce productivity and contributes to GDP. Within the positive effect, education popularity simultaneously brings uniformity across regions [3]. The impact in SSA has same tendency of other developing countries, which exposed positive relationship [3]. Appiah believes that education enhance labor productivity and push the GDP growth.

Jungho Kim explores the relationship between female education attainment and fertility rates which has negative relationship, especially for developing nations [4]. The casual mechanisms are easily to be twisted by factors, which includes education duration [4]. Kim summarizes three main mechanisms, supply of children, demand for children and fertility control [4]. Supply of children means educated women have better biological bodies that may improve children survival, the opposite drawbacks may be the delay of marriage. Demand for children means the well-educated women desires less babies which can give them better living standard [4]. Fertility control means the education enhance public awareness for giving better birth.

3. Methodology

3.1. Data source and sample

The research uses quantitative approach of panel data to examine the effect of education on GDP. The research question investigates whether education significantly boost GDP per capita in both developing and developed countries. The collected data are obtained from the World Bank and UNESCO, covering 2009 to 2019 and including sample of 267 countries or regions across both OECD and non-OECD groups. These sources provide initial data to find the relationship under control variables impact. The data provides annual information on education expenditure, labor force participation, literary rates, and GDP per capita. While the study controls for key macroeconomic indicators, it was affected by unobserved policy variables. And not all nations had report data each year. The lack of data may influence the accuracy of the finding. All references are originated from Google Scholar. The research period concentrates in 2009-2019, which skip 2020-2024 due to the COVID 19 period. The data from this special period may not be reliable to the overall result.

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3.2. Variables

The dependence variable is log of GDP per capita, which measures the economics performance of a country in terms of the average income per person, adjusting for inflation.

The independence variable is log of education expenditure(lneduexp), which representing government investment in education as a part of GDP. This variable examines the extent to the proportion of the national expenditure that the investment of human capital take.

The research also includes other variables: Log of labor force(lnlabourforce), which measures the size of the active population in economies. Literary rate examines the percentage of the total adult population that can read and write, reflecting the average quality of human capital.

Table 1. Summary statistic table

Variable	Obs	Mean	Std. dev.	Min	Max
Lnpercapital [5]	2,309	26.550	3.744	17.600	37.234
Lneduexp	2,084	21.024	2.328	15.960	27.614
govspendp~y_	985	34.256	11.848	0.658	72.758
govspendse~_	1,003	33.903	9.064	0.829	71.587
govspendt~t_	1,088	20.288	8.188	0.000	68.135
lnlabourfo~e [6]	2,585	15.902	2.585	10.119	21.979
literaryra~_ [7]	911	81.041	16.748	22	100

3.3. Model

To inspect the significance of education expenditure and human capital factors on economic growth, I introduce a linear regression model in equation (1):

$$lnGDPpc_i = \beta_1 lneduexp_i + \beta_2 lnlabourforce_i + \beta_2 literacyrate_i + e_i \quad (1)$$

$where\ lnGDPpc_i$ means the log of GDP per capita for country i . $lneduexp_i$, is the log of education expenditure (the main variable). $lnlabourforce_i\ and\ literacyrate_i\ are\ control\ variables.$ We estimate this equation using OLS.

4. Findings

Table 2. The effect of education expenditure and related controls on log of GDP per capita [5,8-12]

Dependent carriable: ln GDP per capita	(1)	(2)	(3)
lneduexp	0.783***	-0.208	0.141***
	(0.028)	(0.133)	(0.019)
Lnlabourforce [6]		1.427***	0.239***
		(0.145)	(0.062)
literaryratetotal_ [7]		-0.009	0.003***
		(0.009)	(0.001)
_cons	10.601***	10.988***	21.115***

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Table 2. (continued)

	(0.600)	(1.399)	(0.973)
Country	No	No	Yes
Year	No	No	Yes
N	2070	456	419
R-sq	0.269	0.383	1.000

(Notes: Estimates are obtained using OLS, with standard errors reported in parentheses.)

In this table, the influence of aggregate education spending on GDP per capita is sensitive to specification but generally shows a positive relation when broader controls are included. Education expenditure (lneduexp) has a significant and positive effect on GDP per capita. The coefficient 0.783 implies that the 1% increase in education expenditure is associated with a 0.78% increase in GDP per capita. This result represents the importance of education investment pushing economic growth. Under country and year fixed effects, the coefficient on education expenditure remains 0.783***. Fixed effects control for unobserved difference across countries and years, such as institutional difference, cultural shock. It reinforces the robustness of the relationship between education expenditure and GDP per capita. The phenomenon of countries number gap is caused by the unsteady report from different countries. Also, labor force and literary rate contribute significantly to explain the economic performance.

Table 3. The relationship of countries groups (OECD, non-OECD, developed countries, developing countries) and other controls on log of GDP per capita

Dependent v.	inpercapital			
	(1)	(2)	(3)	(4)
	OECD	Non-OECD	developed	developing
Lneduexp [8]	0.129*	0.134***	0.152*	0.133***
	(0.068)	(0.020)	(0.086)	(0.020)
Lnlabourforc [6]	1.037***	0.193***	0.928***	0.195***
	(0.333)	(0.064)	(0.304)	(0.064)
Literaryrateto_[7]	0.026*	0.003***	0.032**	0.003***
	(0.014)	(0.001)	(0.015)	(0.001)
_cons	6.793	21.840***	5.511	22.066***
	(4.163)	(1.023)	(3.477)	(1.011)
Country	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
N	43	376	31	388
R-sq	1.000	1.000	0.999	1.000

Notes: estimates are obtained using OLS, with standard errors reported in parentheses.

The results demonstrate that education expenditure, labor force, and literary rates play pivotal roles in classifying countries into different groups. For OECD and developed countries, labor force size emerges as the dominant factor. The coefficients above 0.92 and have significant relationships. It leads to the workforce expansion and boost productivity in advanced economies due to their

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steady foundation ---strong institutions and existing education systems. Therefore, education expenditure in these two groups show a positive but weaker effect under the literary rate (0.026-0.032), which means the small improvements in human capital led to obvious increase in productivity.

However, in non-OECD and developing countries, education expenditure has more robust and significant effect, emphasizing the importance of investment on education for long-run economic growth which build the structural foundations. Labor force also shows positive, but the effect is smaller compared to OECD countries. In order to transform the present economic situation in non-OECD and developing countries, it is crucial to increase the investment in education and skills than maintaining the workforce expansion.

Overall, economic growth relies more on labor force and productivity in advanced economies; education expenditure mainly influences economic growth in developing countries.

5. Conclusion

5.1. Conclusion

The research demonstrates that education expenditure, labor force, and literary rates each contribute to the economic growth, but the influence extent differ across diverse country groups. From these tables, education expenditure shows a positive relationship with GDP per capita, which its effect being robust and significant in non-OECD and developing countries, literary rates contribute positively across all groups. The transformation of this group of economies needs more concentration on investments in education for long-term growth. By contrast, labor force size is a main factor in OECD and developed economies, their existing institution and education systems has strong impact to productivity.

5.2. Discussion

These findings reflect the difference in stages of development of different countries. In OECD countries, their education condition has the characteristics that more completed institution and education systems, which these well-established infrastructures make obvious increase of well-educated human capital and high productivity. Their development already alters to purchase labor force size and productivity. By contrast, in non-OECD and developing countries, education expenditure has stronger effect due to the investment on schooling to expand growth. The result from Table 2 and Table 3 conform to Rahman's finding that the government can readily implement appropriate measures for flourishing the country, such as expand public investment in education and mandate secondary schooling, etc. [13]. By these actions, the literacy rate may increase and boost the per capita GDP to fostering the country development.

5.3. Suggestions

These results suggest further policy strategies and direct the way that counties may use. For developing and non-OECD countries, government should prioritize increasing more investment in education and improving access to schooling for the long-term economic development. The increase of better human capitals may directly drive economic growth and reduce the long-term inequality; For developed and OECD countries, their policies should focus more on enhancing the labor market participation, improving productivity, and boosting innovation capacity, for example through

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lifelong learning. Across all country groups, sustaining improvements in literary and human capital quality remains the base for fostering productivity.

5.4. Limitations

The study also faces limitations. First, the data across countries and years restrict the sample size, which cause the rapid reduction of the number of countries in the model. Additionally, the study uses national data, which may ignore the difference of education expenditure in specific provinces or states. Third, the results also influenced by the unobserved heterogeneity of country fixed effects.

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