A COMPARATIVE STUDY OF THE IMPACT OF EDUCATION ON ECONOMIC GROWTH IN 49 SELECTED DEVELOPING COUNTRIES

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DEDICATION

I wholeheartedly dedicate this thesis to my family, whose immense support has been instrumental in helping me reach this milestone. Without their unwavering encouragement and assistance, it would not have been possible for me to accomplish this significant achievement. Their unwavering belief in me has been a constant source of motivation and strength throughout this journey, and for that, I am deeply grateful.

ABSTRACT

This paper estimates the potential impact of human capital, proxied by government expenditures on education, on economic growth. A panel data regression analysis is employed to investigate this association, utilizing yearly data from 2005 to 2010 across 49 selected developing countries. The regression model employs fixed effects and random effects and includes corrections for panel heteroskedasticity and serial correlation. A vector of other independent variables is utilized to account for other factors that could affect GDP growth based on those suggested by other studies. The fixed effects results suggest a positive but statistically insignificant relationship between government expenditure on education and GDP growth (annual %). Conversely, the random effects results suggest an insignificant *negative* relationship between government expenditure on education and GDP growth (annual %). These results raise questions regarding the productive utilization of education within society and prompt further inquiries into the efficiency of education in developing countries.

ACKNOWLEDGMENTS

I would like to extend my heartfelt appreciation to my thesis supervisor, Dr. Duane Rockerbie, for his invaluable assistance throughout this journey. Starting from a beginner's level in thesis writing and data analysis, his continuous guidance has taught me a great deal about conducting professional research.

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Chapter 1: Introduction

Education is one of the fundamental indicators of human resources, one of the key sources of rising economic growth. A common assumption about human capital and education is that these two are positively associated with each other. Human capital is often measured by a stock of education or the average level of education in the workforce, and the implementation of proper education increases the productivity of labor and thus the output of an economy through an economy-wide production function.

Since the period of the Greek philosopher Plato, the importance of education in economic growth and its transmission process has been the subject of public debate. Solow’s (1956) seminal contribution to the theory of economic growth suggests that increases in education will provide only a temporary boost to economic growth until the economy reaches a new steady state. The premise of the new growth theory is that a greater stock of human capital spills over into further investment in education and technology, comparable to an increase the social and physical marginal product of labour. The so-called “AK” model of economic growth suggests that the marginal product of labour is effectively not diminishing due to these spillovers, and higher growth rates can be sustained for extended periods (Dickens, 2006; Gylfason and Zoega,2003; Barro, 2001). Statistically testing whether human capital, proxied by education expenditures, contributes to economic growth is a test of these competing models.

In most countries, education through the childhood and teenage years is provided by governments that receive financing through taxation. Tax revenues may have other beneficial uses to society, such as providing infrastructure, health care, a legal system, and national defense that could also provide private and social contributions to economic growth. Therefore, it is an important question for fiscal policy whether government expenditure on education plays a role in or contributes to economic growth across the 49 selected countries in our sample.[1] According to Hanushek and Woessmann (2008), the relationship between education and economic growth is still debatable because of a number of conceptual and methodological issues, including the measurement of both education and economic growth as well as variations in education coefficients between nations or regions. As a result, this study will estimate the effect of government spending on education on economic growth utilizing secondary data and econometric analysis using panel fixed and random effects models.

Example: Educational Profile of South Asian Countries

According to IMF definition, there are 152 developing countries with the current population of around 6.82 billion. In this paper data has been explored from various developing countries in the World Bank dataset. But a subset of 49 countries has been chosen for analysis due to data limitation. This paper specifically focuses on developing countries, since these economies exhibit unique growth dynamics in which the role of education is pivotal.

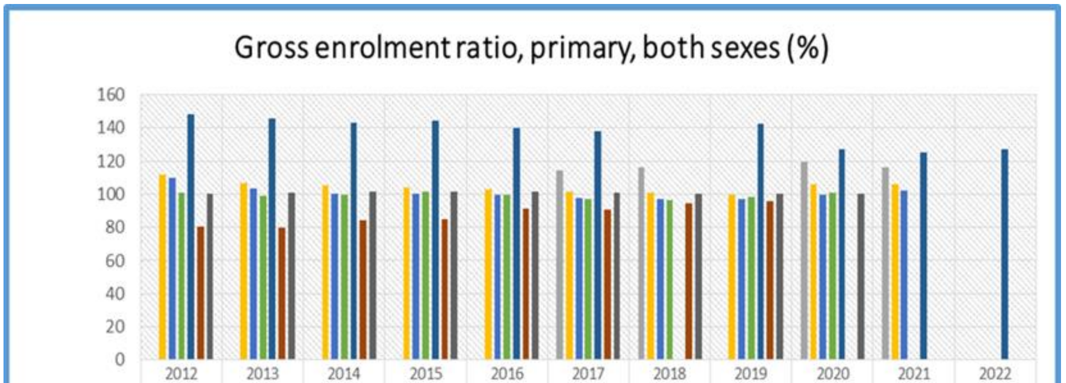
Providing a detailed analysis for each of the 49 countries in the panel data set would make for a very long chapter, so we motivate the research question by considering a subset of eight South Asian countries. Together with 1.94 billion people in 2022 based on the United Nations estimation, South Asia remains the most densely populated portion of the world with

Bangladesh, India, Pakistan, Nepal, Bhutan, Maldives, Sri Lanka and Afghanistan. Most of the South Asian countries are known as developing or underdeveloped countries. Simply a few

[1] These countries include Albania, Algeria, Argentina, Armenia, Azerbaijan, Bahamas, Bangladesh, Barbados, Belarus, Belize, Benin, Bhutan, Brazil, Bulgaria, Cambodia, Cameroon, Central African Republic, Chile, China, Colombia, Costa Rica, Egypt, Gambia, Ghana, Indonesia, Iran, Kazakhstan, Kuwait, Lebanon, Malaysia, Mauritius, Mexico, Nepal, Pakistan, Peru, Philippines, Poland, Qatar, Romania, Russian Federation, Saudi Arabia, South Africa, Sri Lanka, Senegal, Tajikistan, Tanzania, Thailand, Uganda, and Vietnam.

decades ago South Asia was considered to comprise world’s maximum number of poor people on the base of lower economic growth, poor per capita incomes, and small social indicator. Though in modern times all South Asian countries have prospered in almost every sector of growth, human capital accumulation through education has been a key driver for economic growth. South Asian countries educational growth and dependency of economic growth on education are now discussed along with the correspondence between them.

Figure 1: Gross Enrolment Ratio (%) at primary education



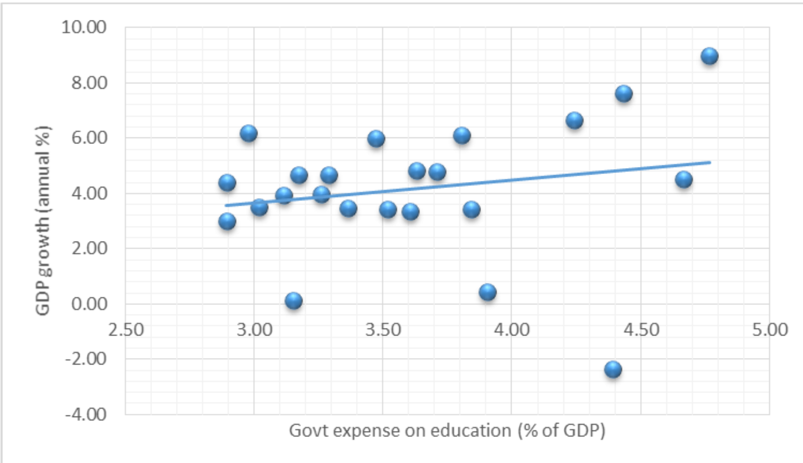
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Bangladesh	0	0	0	0	0	114.61563	116.46634	0	119.55645	115.94665	0
Bhutan	111.90103	106.94311	105.47682	104.23377	102.66068	101.33414	100.71803	99.54377	105.81169	105.72499	0
India	109.7613	103.44557	100.10411	100.11303	99.42524	97.64243	97.35143	96.82868	99.90046	102.05131	0
Maldives	101.18633	98.98123	99.73535	101.53494	99.4277	97.1098	96.59714	98.03816	100.83736	0	0
Nepal	148.18984	145.36263	143.24789	144.17768	140.0952	138.16878	0	142.14347	126.93477	125.37912	127.35675
Pakistan	80.37719	79.65858	84.30747	85.08992	91.31746	90.58917	94.3282	95.48414	0	0	0
Sri Lanka	99.95391	100.64361	101.35966	101.66147	101.47404	100.63271	100.16202	100.23006	100.30172	0	0

Source: UNESCO Institute for Statistics Database.

The gross enrollment ratio refers to the percentage of the total population within a specific age group that is enrolled in a particular level of education, regardless of age. Primary education plays a crucial role in providing children with fundamental skills in reading, writing, and mathematics. A higher gross enrollment ratio generally indicates a greater level of overall participation in education, regardless of whether students belong to the designated age group or not. When the gross enrolment ratio approaches or surpasses 100%, it implies that a country theoretically has the capacity to accommodate its entire school-age population, but it doesn't necessarily mean that all eligible children are currently enrolled. While achieving 100% is an important milestone, it is not the sole determinant of ensuring the enrollment of all eligible children in school. The limitation is that gross enrollment ratio can surpass 100% because it includes students who are either older or younger than the designated age group due to early or late entry into school, as well as grade repetition. In such cases, a thorough understanding of the process requires supplementary information to evaluate the prevalence of grade repetition, late entry, and other factors. This additional data helps provide a comprehensive assessment of the gross enrolment ratio and its implications (UNESCO Institute for Statistics). Based on the data presented in Figure 1, it is evident that in South Asian countries, the gross enrollment ratio for primary education has consistently remained above 95% and even surpassed 100% from 2012 to 2022. This signifies a noteworthy growth in primary level education within the region. Due to data limitations, the scenario of Afghanistan cannot be portrayed in this context.

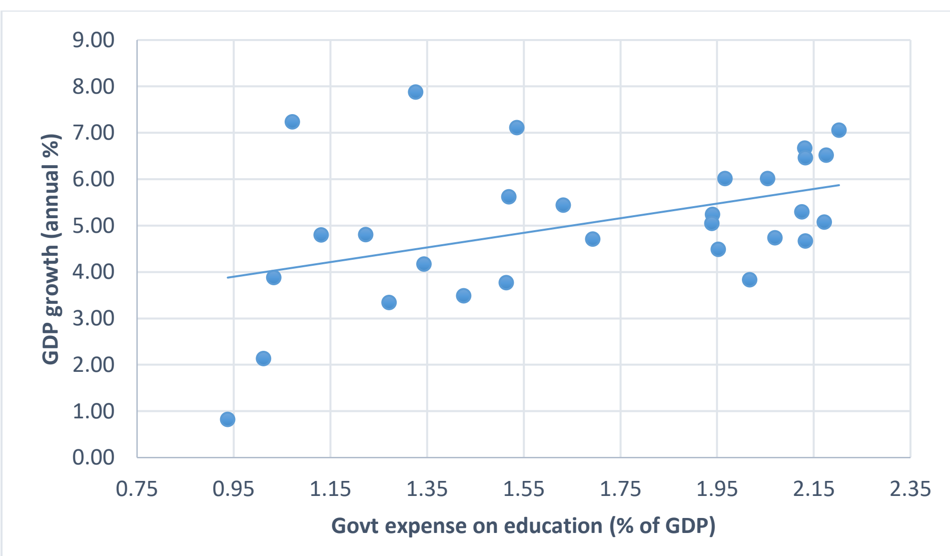
Since the 1960's, South Asia has achieved significant progress at increasing participation in primary level education. South Asian countries have recently invested in school supplies and oriented their efforts toward obtaining universal access to elementary education. These efforts have resulted in a greater number of students remaining in elementary school. Primary school attendance in South Asia increased from 75% in 2000 to 89% in 2010, putting it closer to East Asia and the Pacific (94.8%) and Latin America and the Caribbean regions (94%) ((Dundar et al. (2014)).

Figure 2: Nepal GDP growth (annual %) and government expenditure on education (% of GDP)



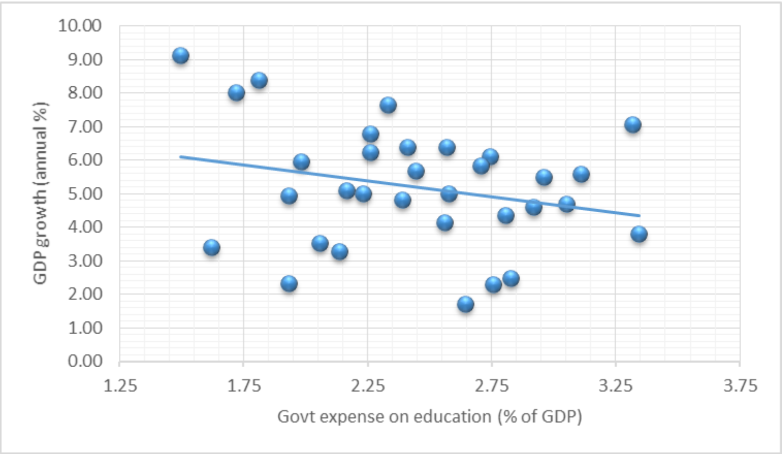
Source: World Development Indicators, World Bank

Figure 3: Bangladesh GDP growth (annual %) and government expenditure on education (% of GDP)



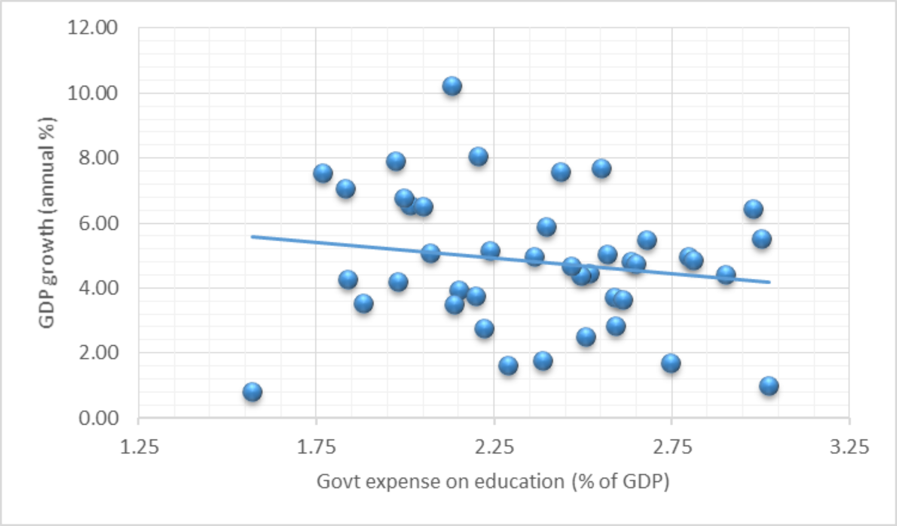
Source: World Development Indicators, World Bank

Figure 4: Sri Lanka GDP growth (annual %) and government expenditure on education (% of GDP)



Source: World Development Indicators, World Bank

Figure 5: Pakistan GDP growth (annual %) and government expenditure on education (% of GDP)



Source: World Development Indicators, World Bank

The displayed scatter plots in Figures 2, 3, 4 and 5 provide evidence of a broad association between government spending on education and GDP growth for South Asian countries, although not necessarily a positive association. Bangladesh and Nepal demonstrate positive correlation coefficients equal to 0.432 and 0.191 respectively, whereas the correlation coefficients for Sri Lanka and Pakistan are -0.253 and -0.167. Of course, these correlations can be unreliable as a definitive measure of association since other variables that could influence GDP growth are not being held constant. Notable, the insufficient availability of data sets for India and Bhutan renders it impossible to demonstrate the correlation between government expenditure on education and economic growth through a scatter plot.

To examine the potential influence of education on economic growth in developing nations, a panel regression analysis was conducted. The study examined data spanning from 2005 to 2010 because of its extensive data availability and continuity and the data has been sourced from World Bank's World Development Indicator. This analysis employed models, including fixed effects and random effects, to assess the relationship between education and economic growth. The outcomes of the fixed effect model indicated that the coefficient for government funding in education had an insignificant positive impact on real economic growth, suggesting a limited influence. Conversely, the random effects model demonstrated an insignificant negative correlation with GDP growth (annual %).

In the context of this study, it could entail assessing whether the government's expenditure on education is producing the expected results in terms of improved education quality skills development and subsequently it's impact on economy growth. It involves evaluating whether the allocation of funds to education is optimal and whether there is any wastage or misallocation of resources. The policy implications of this study are multifaceted. To enhance the efficiency of education spending, government should prioritize improving education quality by investing in teaching training, curriculum development and educational infrastructure. This ensures that resources are effectively directed towards meaningful educational outcomes, which is crucial for long term economic development. Additionally, policymakers must carefully allocate resources to education, taking into account regional disparities and the unique needs of different population. Moreover, addressing inefficiencies within education system is vital. Government should regularly assess and refine these systems to identify areas where resources can be allocated more efficiently, reducing waste and misallocation. It's also imperative for policymakers to exercise prudent fiscal management and avoid excessive borrowing to finance education expenditure as high levels of death can is train national finances and harm economic performance. Lastly, given the questions raised about the efficiency of traditional education systems, policymakers should explore alternative models such as vocational and technical training programs, which can be tailored to meet the specific demands of the labour market, potentially enhancing economic growth more effectively.

The rest of the paper is organized as follows: Chapter 2 provides a literature review; Chapter 3 discusses the theoretical effects of human capital accumulation on economic growth using the Solow and endogenous growth models; Chapter 4 reviews the panel data and the empirical strategy of the regression models; Chapter 5 discusses the econometric estimates and specification tests; and Chapter 5 provides a concluding section.

Chapter 2: Review of Literature

It is generally assumed that growth in the stock of human capital is one of the major indicators of a country's economic growth, however education is a type of human capital that not only enhances economic growth but also stimulates the affluence (standard of living) of an individual and household through economic transformation. Adam Smith was the first scholar to have discussed the causal nexus between education (more directly as human capital) and economic growth in his book, "An Inquiry into the Nature and Causes of the Wealth of Nations (1776)", however other classical economists highlighted the necessity of investing in human talents. More recently researchers have extended his analysis by including human capital, physical capital, health, political and international relationships, and government expenditure on education in GDP (Gross Domestic Product) and found positive associations.

In the realm of theoretical growth studies, several mechanisms are highlighted to explain how education can influence economic growth. Firstly, education has the potential to enhance the human capital of the workforce, thereby boosting labor productivity. This leads to a transitional growth towards a higher equilibrium level of economic output. This perspective aligns with augmented neoclassical growth theories, as exemplified by Mankiw et al. (1992). Secondly, education can stimulate the innovative capacity of an economy. The acquisition of new knowledge pertaining to technologies, products, and processes plays a pivotal role in driving growth. This concept is aligned with theories of endogenous growth, as outlined by scholars such as Lucas (1988), Romer (1990), and Aghion and Howitt (1998). Thirdly, education facilitates the diffusion and transmission of knowledge necessary for comprehending and implementing new technologies and information. This knowledge dissemination fosters economic growth, an idea consistent with research by scholars like Nelson and Phelps (1966) and Benhabib and Spiegel (1994). However, despite these theoretical frameworks, empirical evidence on the impact of education on economic growth has long been inconclusive.

Applying cross-sectional and time series methods, most of the empirical and theoretical studies have derived and estimated a positive association between the country's education level of the population and real economic growth ((Tilak (2005); Landau (1986); Ismail and Selvaratnam (1999); Nunes (2001); Selvaratnam, Syathi & Subramaniam (2011)). Schultz (1961) and Denison (1962) have shown that education contributes directly to the growth of national GDP by nourishing labour force skills and productive capacity. Yogish (2006) found that increases in education yield a productive return for the growing development of an economy as well as improving living standards. Using an ARDL (Autoregressive Distributed Lag) approach, Obradović and Lojanica (2016) found a positive association between higher education and real economic growth for Sweden for the sample period 1971-2013. The Toda-Yamamoto procedures of a Granger non-causality test were used to estimate the unidirectional causality of higher education and earnings. Benhabib and Spiegel (1994) found that education and real growth are positively related in Chinese Taipei. Loening (2005) found that a labor force with higher education has a positive significant influence on real economic growth by using an error-correction method. Babatuned (2005) estimated the relationship between real growth and education in the long run in Nigeria by using a Vector Error Correction methodology and Johansen Cointegration test.

Some of the literature suggests that the returns to education have been falling in several countries. Moll (1996) estimated that primary education returns fell in South Africa between 1960 and 1975. Appleton et al. (1999) showed that in Kenya there was a fall in the returns to education between 1978 and 1995. Söderbom et al. (2006) also confirms the findings of

Appleton et al. using data from 1993 to 2001.Several literatures estimate an increasing return to education; Canagarajah and Thomas (1997) documents that there was an increasing return to education in Ghana between 1987 and 1991, Appleton et al. (1999) finds rising returns to education in Uganda from 1992 to 1999. Söderbom et al. (2006) for Tanzania in the 1990s and Sackey (2008) for Ghana from 1992-99 also found the same result on returns to education.

Booth and Kee (2008) found that higher birth sequence has a significant and inverse relation on children's education as higher birth order in terms of educational acquirement, children receive a smaller share of household resources. By using cross-country and panel-regression, Klasen (2002) found that the average stock of human capital is falling because of gender inequality in education. Additionally, gender inequality has an effect on investment and population growth, thus it influences the growth of the entire economy indirectly. Fox and Oviedo (2008) estimated increasing returns to age. They found that in Africa older employees in the labour force receive higher returns to education than new entrants, in civil-law countries the returns to elderly workers are bonuses after a particular age and that the presence of a labour union only helps to increase older worker's wages. Söderbom et al. (2006) have similar findings. Rankin et al. (2010) uses data of urban workers and estimates that in the big firms there are linear and higher returns to education. For the small firms and self-employed in Ghana and Tanzania he further suggests the convexity of wages. A steep age-earning outline for Ghana was also found by Fox and Oviedo (2008).

Clearly there exists a large literature on the economic returns to education or the education-earning relationship. Earnings do not solely depend on education, but can also be affected by other factors, hence the concept of returns to education is not precise enough, especially in South-African countries.

Foreign direct investment (FDI) in developed and developing nations has become an important source of superficial funding. FDI can provide financing for education that can lead to the establishment of new schools, universities and training centers. It can also contribute to the development of human capital by providing training and development opportunities for local workers. There have been many researchers who have analyzed the effects of FDI on economic growth. The results have been that FDI has both positive and negative impacts on the development of countries. Moreover, many economists and policymakers suggest that FDI enhances the capital stock, increases opportunities for employment, and stimulates development in technology. Some concerns, however, are that FDI causes a crowding out effect on domestic investment and reduces competition in the territorial markets. According to the 'Development Centre Studies' of the OECD, it has been shown that because of greater competition and sustained prosperity attained by foreign investment there has been a positive relationship with the productivity of labor and the productivity of multination industries. Foreign direct investment is beneficial not only for foreign enterprises but also to various local enterprises that received spillover effects from the development of human capital and technology. FDI favors a host nation by added employment, developed technologies and exchange of knowledge. Also, it energized the level of domestic investment (Caves (1971); Rappaport (2000) and Borensztein at el 1998).

However, there have been some negative effects of FDI on the receiver country. Foreign industries invest funds only if the investment is productive and profitable. But this activity replaces local industries that reduces that nation's welfare. According to the study on Morocco and Venezuela researchers found that the effect of FDI is quite small on the growth of economy

((Aitekn & Hurrison (1999) and Mansfield & Romeo (1980)). Hence there is an expectation for the preface of FDI on the rate of economic growth but there have some disappointments as well.

International trade also fosters a positive relationship with education and economic growth. Trade can stimulate education by creating employment opportunities, increasing access to educational resources, and promoting cultural exchange. Several empirical papers confirm the finding that freedom of trade results in higher welfare of the economy. According to the study on Bangladesh, the growth of the economy of Bangladesh and international trade share a strong significant bond ((Ahamad, MD. Hasnain (2018)). Researchers have found that there is a positive and significant relationship between exports and economic growth in Bangladesh. In this case, the Johansen and Juselius cointegration test with the Granger causality tests with annual data from 1969 to 1991 was used to investigate the direction of relationship of exports and economic growth (Chaudhary, M.A., Shirazi, N.S., & Choudhary M.A.S., (2007)). In another study (Sinha, T. and Sinha, D. (1999)), economists use time series data from 124 countries to investigate the causality relationship of trade and real GDP using unit root and cointegration tests. It was found that trade flows and real GDP are either cointegrated or zero I(0) integrated. Other studies do not support the findings that there is a positive relationship between opening trade and economic growth. On the basis of non-stationary time series data from 1971 to 1990, Narayan & Smyth (2005), Abhayaratne (1996), and Islam & Ifthekharuzzaman (1996) found no significant relationship exists between economic growth and exports of Bangladesh.

Inflation is related to education and economic growth in different ways. Inflation can cause the cost of education to increase, making it more difficult for students to afford. There are a number of empirical and theoretical studies that attempt to determine the association between inflation and economic growth in both forward and growing countries, however there are some controversies on this association. Tobin (1965) and Mundell (1965) determined that inflation and the rate of capital accumulation should be positively linked. They argued that because money and capital are interchangeable, raising inflation means boosting capital accumulation by converting money to capital and so enhancing economic growth (Gregorio, 1996). Dornbusch et al. (1996) supports the link between inflation and the growth rate of the economy as positive in the short run because producers are encouraged to create higher prices, which causes economic expansion. Using models of new growth theory, Fischer and Modigliani (1978) estimated an inconsistent and negative link between inflation and economic growth ((Barro (1995), Bruno & Easterly (1995), Malla (1997), Faria & Carneiro (2001), and Michael (2008)). They argue that inflation significantly limits economic growth by lowering the effectiveness of investment in comparison to its magnitude. Notably, some economists such as Wai (1959), Bhatia (1960), Dorrance (1963, 1966), and Johansen (1967) failed to establish compelling evidence of either a positive or negative association between inflation and economic growth.

Mallik and Chowdhury (2001) also estimated the long run and short run progressive relationship of inflation and real growth for South Asian countries. For the methodology, they used error correction and cointegration models using data ((Bangladesh 1974-1997), (India 1961-1997), (Pakistan 1957-1997), (Sri Lanka 1966-1997)) taken from the International Monetary fund (IMF). Two results emerged: that inflation and real economic growth are positively and statistically significantly associated to each other and the sensitivity of inflation to the variation of economic growth is greater than that of growth to the variation in inflation. This empirical analysis implicates that moderate inflation enhances economic growth, but that higher inflation reduces growth.

Other factors could play a role in determining GDP growth, such as government final consumption expenditure, gross capital formation, life expectancy at birth and the labor force participation rate. To summarize, the majority of the research agrees that education is critical for a nation’s or region’s economic progress. Regardless of common perception that human capital development is a crucial factor of economic growth, empirical estimates are yet not clear. This is due in part to how education is measured - amount of education or quality of education.

Chapter 3: Education and Economic Growth Theories

New growth theory is a growth model that treats knowledge and technological advancement as endogenous. The neoclassical Solow (1956) growth model the factors that affect economic growth as exogenous, such that consistent economic growth cannot be achieved without consistent exogenous technological advancement. Whereas the endogenous model treats technological advancement that increases total factor productivity as determined coincidentally with growth in the capital stock. The AK model also considers that besides technological advancement, economic growth can be attained if there is a boost in human capital that increases total factor productivity.

Solow Growth Model/ Exogenous Growth Model

According to the Solow model, education can play a key role as a determinant of technological progress and workforce growth, which in turn drives economic growth in the short run by increasing efficiency and productivity.

In the Solow model, investments in education can lead to the more widespread adoption of new technologies, further boosting economic growth. A steady state is defined when the amount of savings per unit of labour is just equal to the amount of investment spending necessary to maintain a constant capital-labour ratio. Investments in education result in total factor productivity increases that shift the production and savings curves upward in Figure 6 from y to y' and sy to s'y', where y is output per unit of labour and s is the savings rate. As a result, there is growth in output and capital of the economy. However, the growth rate of output equals the growth rate of the population in each steady state (k* and k**), such that there is only a temporary boost to output growth.

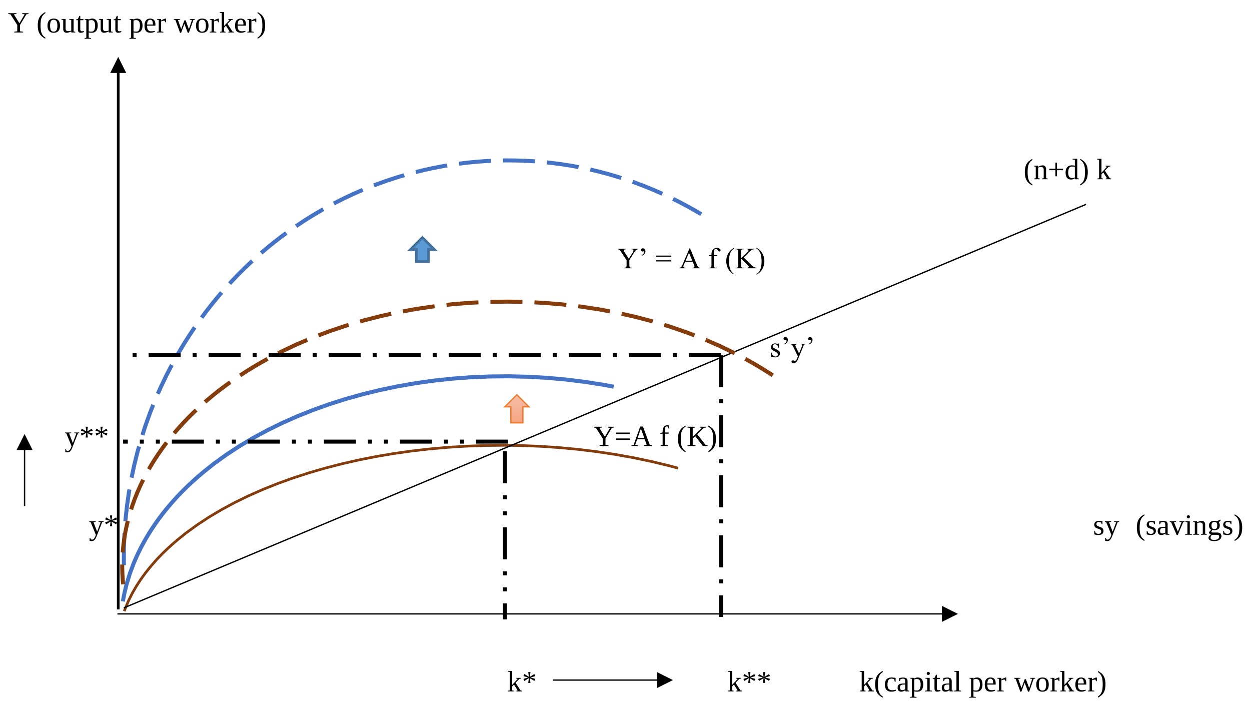


Figure 6: Total factor productivity gains in the Solow model

Education gains in the Solow growth model

- The rate of technological progress is exogenous and there are diminishing return to capital accumulation.
- The economy eventually converges to a steady state where output per worker and capital per worker are constant over time, although output is growing at the rate of population growth.

- An increase in education or any other factors, that affects the rate of technological progress and total factor productivity will have a temporary effect on economic growth, as the economy will eventually converge to a new steady state.

The Solow growth model fails to explain the consistent high growth rates experienced in many Asian countries over the last three decades without resorting to consistent increases in total factor productivity, although this may have been the case. It has also failed to explain why countries at different stages of economic development have not converged to the same standards of living, as measured by output per capita, although that is not a research question in this paper.

AK Model/ Endogenous Growth Model

This model due to Romer (1986) assumes that internal factors like human capital and investment in knowledge of people plays an important role in the growth of economy. An increase in human capital (measured by factors such as education, skills and knowledge) can lead to an increase in productivity and output, and therefore to permanently higher economic growth, contrary to the Solow model. Like the Solow model, output is determined by the level of physical capital (K). The stock of labour exists in the background but is assumed constant to simplify the exposition.

$$Y = AK^{\alpha} \qquad (1)$$

An increase in physical capital in this model, would lead to an increase in output as the level of K increases. This increase in output could lead to further investment in physical and human capital, creating a positive feedback loop that generates sustained economic growth. Although the marginal product of capital is diminishing with $\alpha < 1$, an increase in K increases the stock of human capital contained in the A term. Assuming that K and education are complementary inputs, the marginal product schedule of capital shifts upward by such an extent that the net marginal product is not diminishing, but instead, a constant. Hence the production function can be written in a stylized form as $Y = AK$ with a constant slope equal to A.

This model relies on the idea that the rate of technological progress is endogenous. An increase in education or any other factor that affects the rate of technological progress will have a permanent effect on economic growth. To see this, recall that in a closed economy, domestic savings equals investment. Savings is equal to $sY = sAK$ and investment is equal to $\Delta K + dK$, where d is a depreciation rate of capital. Setting savings equal to investment, dividing by K and rearranging gives

$$\frac{\Delta K}{K} = sA - d \quad (2)$$

From the production function $Y = AK$, the rate of output growth is just equal to rate of growth of the capital stock. Unlike the Solow model, the economy may continue to grow at a rate higher than the rate of population growth with increases in total factor productivity A. The transition from education to convert to human capital is illustrated below. The upshot is that a statistically significant positive association between government spending on education and economic growth suggests confirmation of the endogenous growth model and a rejection of the Solow model. The main limitation of the model is its inability to provide a well-defined mechanism for generating endogenous technological progress. It assumes that technological progress is solely driven by investment and does not provide a detailed explanation for how innovation occurs or how it is sustained over time. This oversimplified view of technological change limits the model's ability to fully capture the complexities of real-world economic growth dynamics and innovation process. As will be noted in the next chapter, limitations in the sample data for developing countries have proven to make any definitive choice between these two competing models impossible, although we find some suggestive evidence.

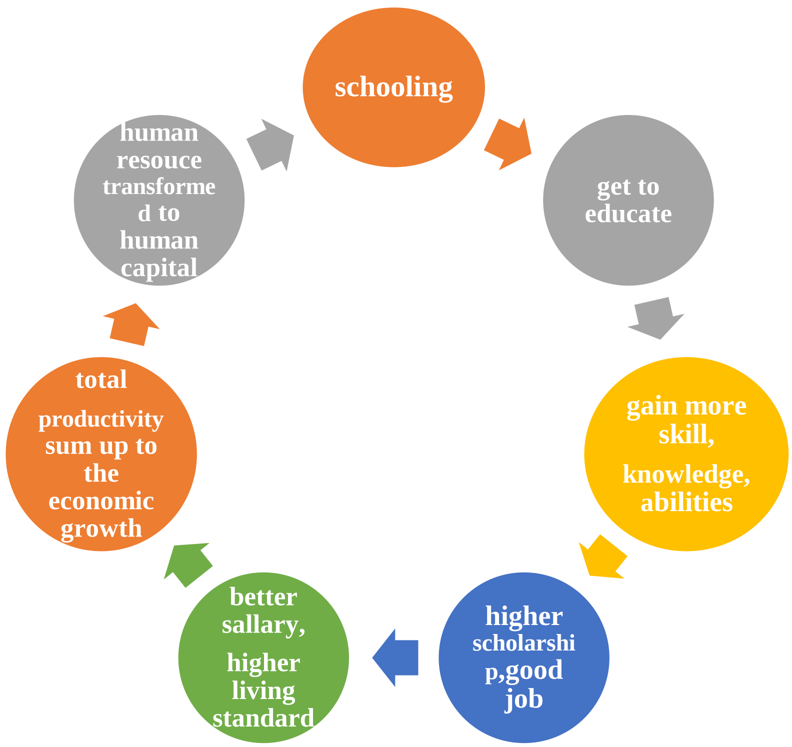


Figure 7: Transformation of Human Resources to Human Capital

Alternatively,

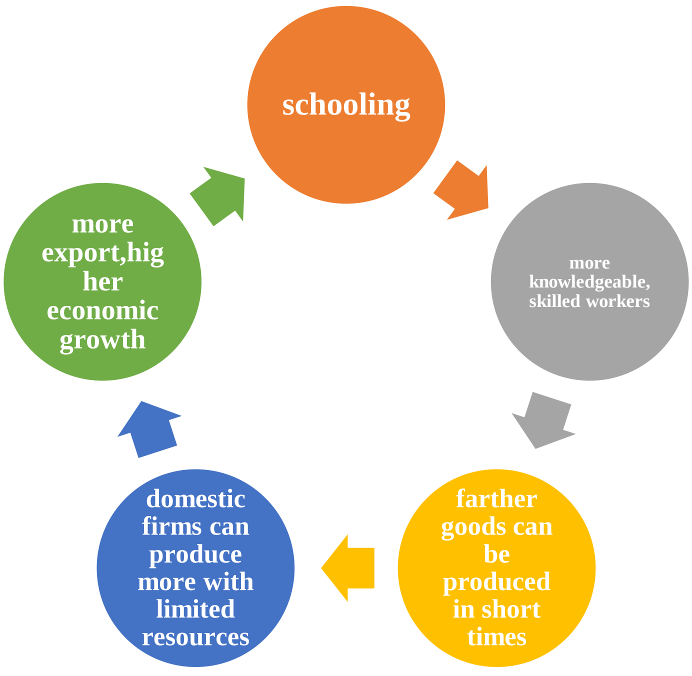


Figure 8: Transformation of Human Resources to Skilled Labor

Chapter 4: Data and Empirical Strategy of the Model

Table 1 describes the variables used in this paper and gives a summary of their anticipated outcomes on nominal GDP growth. The data of 49 countries from 2005 to 2010 for all variables was obtained in secondary form from the acknowledged data source, the World Development Indicators compiled by the World Bank. The justification for the inclusion of these variables in the model is based on the previous studies noted in Chapter 2.

Table 1. Regression model variables

Variable	Description	Expected outcome	Type of variable
GDPCG	Nominal GDP growth (annual %)		Dependent variable
GOVEXEDU	Government expenditure on education (% of GDP)	+	Main focused independent variable
GOVFINC	Government final consumption expenditure (% of GDP)	+	Independent variable
TRD	Trade (% of GDP)	+	Independent variable
INFLA	Inflation, GDP deflator (annual %)	+	Independent variable
GROSSCF	Gross capital formation (% of GDP)	+	Independent variable
FDI	Foreign Direct Investment, net inflows (% of GDP)	+	Independent variable
POPG	Population Growth rate, ages 15-64, total	+	Independent variable
LIFEX	Life expectancy at birth (total years)	+	Independent variable

The form of data used in this paper is a panel data set. Panel data links the cross-sectional and time series data into a single multidimensional data set. Under the panel data analysis, the observations of different countries (i =1, 2, .., n) are taken on the same time at identical intervals (t =1, 2,..., T). Due to limited data, each country has only 6 years of time series observations. Unfortunately, this prevents the use of a dynamic panel model that could show how education spending impacts human capital and economic growth over both the short and long term. Education spending likely takes several years to influence these factors properly. Plaintively, in the analysis there are seven missing observations of some countries, causing the panel data set to be somewhat disordered. Apropos of solving this problem, some values of the missing data have been approximated with the preceding year's observation or using the period average for each country. There are a number of methods to deal with missing observations. It was thought that truncating the data set was an undesirable method due to the number of years of observations that would be omitted, resulting in a small sample size.

Description of Variables

This paper considered government spending on education as the primary independent variable of interest which is provided by the annual government expenditures on education as a percentage of GDP. The World Bank does not make it clear at what level of government these expenditures occur (local, regional, national) or what types of education expenditure they are (infrastructure, salaries, supplies, etc.), a shortcoming in the analysis. However, the data is complete and available for every country in the sample. Nominal GDP growth (annual %) is the dependent variable and refers to the percentage change in a country's Gross Domestic Product (GDP) over a specific period, typically one year. It is used as a measure to assess the rate at which a country's economy is expanding or contracting. The additional independent variables used in this analysis can be grouped between socio-economic factors and human capital factors.

Socio-Economic Factors:

- Government final consumption expenditure as % of GDP measures country's spending on consumption in terms of final goods and services and spending on defense and security that does not include capital investments. As this variable is a component in the measurement of GDP, it should have a strong positive association with GDP growth, although measured as a percentage of GDP, its affect is uncertain.
- Total trade as percentage of GDP includes the sum of an individual country's exports and imports of goods and services as a percentage of GDP. Net exports are also a component in the measurement of GDP, but exports + imports is not, resulting in an uncertain effect on GDP growth. Economics suggests that a greater openness to trade should allow a nation to move beyond its own production possibilities frontier and encourage growth.
- Inflation rate measures the yearly percentage change in the cost of purchasing a standardized basket of goods and services. The inflation rate calculated from the GDP deflator is used instead of a consumer price index as it is utilizing a larger basket and is available for all countries in the sample. Nominal GDP growth is strongly affected by the inflation rate since it is measured using current prices, however high inflation imposes welfare costs on the economy that could reduce economic growth, thus the net effect is uncertain.
- Gross Capital Formation in the form of a percentage of annual GDP, is a measure of the total value of new physical capital created in an economy. Depreciation is not deducted from this measure as net capital formation is not available from the World Bank. This variable is also a component in the measurement of GDP so it should be strongly

associated with GDP growth, although measured as a percentage of GDP, its affect is uncertain.

- Foreign direct investment (% of GDP), net inflows, is the direct investment compiled by nonresident investors in the recounted economy. Strong foreign direct investment is usually an indicator of confidence in the domestic economy and its economic policies, in particular it fiscal position and the lack of capital controls.

Human Capital Factors:

Since good heath is positively related with a country's productivity, this paper uses the life expectancy at birth as another indicator of human capital. It measures the average time a new-born is expected to live in years following the existing mortality rate at the time and other demographic factors. (The World Bank, 2015).

The annual population growth rate, specifically referring to ages 15-64 total, measures the percentage change in the population of individuals aged 15 to 64.

Looking back to the Solow growth model, an increase in population growth would have a predictable effect on economic growth. The model suggests that when population growth increases, the economy's overall output or GDP (gross domestic product) will also increase in the short run. This is because a larger population leads to more workers available for production, which can boost output. However, in the long run, the Solow growth model predicts that the impact of population growth on economic growth will diminish. This is due to the diminishing returns to capital and labor. As the population grows, the capital and resources available per worker decrease, resulting in a decrease in productivity and economic growth. In the long run, the Solow growth model suggests that population growth has a neutral effect on economic growth, as any initial increase in output per capita eventually dissipates.

The AK endogenous growth model does not address the effects of population growth on economic growth since the production function excludes labor as an input. However, more complex endogenous growth models predict that higher population growth will increase economic growth if there exist increasing returns to scale to human capital (Heintz and Folbre, 2022). These models feature endogenous population growth that goes beyond the scope of this paper.

Empirical Strategy

The Basic Panel Data Model with Fixed Effects

The reason for using panel data for this paper is that panel data comprises a substantial number of observations for several countries over a long period. The expression of this concept can be augmented through the basic "Unobserved Effects Model" where country i is observed at time t:

$$Y_{it} = \alpha_i + \beta X_{it} + e_{it} \qquad (3)$$

The fixed effects model is generally considered when the analysis includes panel data of different countries that vary over time. Countries have some fundamental differences that are reflected in the mean of the dependent variable and those differences can bias the estimated intercept and slope coefficients. A fixed effect model controls these time-invariant differences with the insertion of a constant term, α_i, that is allowed to differ across cross section units (countries in this case).

An option is to account for time-variant intercepts by including the term α_t. The comparison to the base period is provided by the estimate of this parameter (Greene, 2011). In this analysis the fixed effects model reduces the potential bias from omitted variables since unobserved country effects and time effects can be captured by this method. Omitted variables have influence on the data but remain as unobserved variables in the data set. (Wooldridge, 2010).

The full fixed effects regression model is given by (4) below and involves the inclusion of a dummy variable for each country less one and each time period less one, as well as the set of independent variables listed in Table 1.

$$Y_{it} = \alpha_i + \alpha_t + \beta_1 X_{1it} + \cdots + \beta_8 X_{8it} + e_{it} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

The form of the regression model with random effects is the same as in (4), however the estimation technique is more complex and is discussed in the next section. Statistical checks for violations of the least squares assumptions, namely heteroskedasticity and autocorrelation, will be performed and any necessary adjustments made.

Chapter 5: Econometric Estimates

Summary Statistics

In this study, annual panel data is utilized from 49 economies over the period of 2005 to 2010. Table 2 displays the descriptive statistics of the variables that will be included in the regression model in (4) in the last chapter. The dependent variable is GDP growth (annual %), which has a mean of 5.42%, a minimum value of -14.1%, and a maximum value of 34.5% with a standard deviation of 4.87%. In the case of the independent variables, the key variable of interest is government expenditure on education as a percentage of GDP, with a mean of 3.74%, a minimum of -0.692%, a maximum of 7.42%, and a standard deviation of 1.28%. There are some notable extreme values for a number of the independent variables. Malaysia is a very open economy with a trade openness value of 204.0% in 2005, falling to 158% in 2010, but still well above the other sample countries. In comparison, Kazakhstan experienced a trade openness value of just 7.58% in 2007, largely due to depressed oil and mineral prices, the country's two major exports in 2007.[2] Qatar experienced an inflation rate (GDP deflator) of -24.2% in 2009, while Uganda suffered an inflation rate of 85.4% in 2009, largely attributed to a domestic food shortage in Uganda's case that pushed up food prices.[3] Qatar also experienced an increase in population of 25.1% in 2007 due to a rapid expansion in immigration to facilitate construction projects that continued through 2010. Endemic poverty and poor health conditions resulted in a

[2] https://wits.worldbank.org/CountryProfile/en/Country/KAZ/Year/2007/Summarytext. Accessed on June 13, 2023.
[3] https://allafrica.com/stories/201001041388.html. Accessed on June 13, 2023.

life expectancy in the Central African Republic that was less than 50 years for the 2005-10 sample period and is just over 50 years old today.[4]

It is important that the variables possess enough variability to provide reliable estimates of the slope coefficients in the regression model in (4). The coefficient of variation (C.V.) is provided in the last column of Table 2. It is the standard deviation divided by the mean for each variable. GDP growth (annual %) displays significant variation with a C.V. of 0.899, a promising result for the regression model. However, government spending on education as a percentage of GDP (GOVEDU) has only a modest amount of variation with a C.V. of 0.342, suggesting that there is not much variation in GOVEDU across countries over the sample period. This could result in an unreliable slope estimate. Life expectancy (LIFEX) has the lowest C.V. at 0.102. It is not necessarily the case that a low C.V. will result in a statistically insignificant slope coefficient, but greater relative variation in a regression variable is always desirable.

Table 2. Summary statistics

Variable	Mean	Median	S.D.	Min	Max	C.V.
GDPCG	5.42	5.42	4.87	-14.1	34.5	0.899
GOVEXEDU	3.74	3.76	1.28	0.692	7.42	0.342
GOVFINC	12.6	12.4	3.85	3.46	22.5	0.306
TRD	74.8	69.6	33.4	22.1	204.	0.462
INFLA	8.52	6.55	9.65	-24.2	85.4	1.133
GROSSCF	25.6	23.6	8.71	9.86	63.2	0.383
FDI	4.75	3.65	4.35	-0.193	33.8	0.916
POPG	2.21	1.92	2.65	-1.88	25.1	1.200
LIFEX	69.4	72.1	7.07	46.4	78.7	0.102

[4] https://reliefweb.int/report/central-african-republic/state-silent-crisis. Accessed on June 13, 2023.

Unit Root Test

In studies that utilize time series data, it has become a standard practice to compute a unit root test for each of the variables to determine if each is stationary. A stationary series has a constant mean and variance over time. Although many time series variables are not stationary in mean and/or variance, that problem is easily handled detrending the series or using first differences. Time series variables can be highly correlated but suffer from the spurious regression problem in which they do not share the same time series process, suggesting that they are not really associated. In this panel study, the first-generation IPS panel unit root test could be employed, which was developed by Im et al. (2003). The Im-Pesaran-Shin (IPS) unit root test relies on the (augmented) Dicky-Fuller test and focuses on a more heterogeneous panel and does not require the use of a balanced panel (Im et al., 2003). Moreover, when dealing with the heterogeneity of individual observations, such as countries, the IPS unit root test is more advantageous (Adeneye et al., 2021). All unit root tests suffer from low power[5] if the number of time series observations is small which the case here is with only six years of data for each country. Although the IPS test can be computed, the results cannot be relied upon so the presence of a spurious regression result cannot be ignored.

[5] Power is equal to 1 – P(Type II error), the probability of not committing a Type II error, that is, rejecting the alternative hypothesis when it is actually true. Hence, unit root tests of all types will often conclude that a time series is difference stationary (I(1)) when it is actually trend stationary (I(0)).

Multicollinearity Test

Exact multicollinearity is a problem that arises when there is a linear association between one or more of the independent variables utilized in a regression. This is a violation of one of the least squares assumptions, the result being that it is not possible to estimate slope coefficients. However, even if exact multicollinearity does not exist, strong multicollinearity can be a problem. The issue with such a relationship is that if the explanatory variables are strongly correlated with one another, it is difficult to isolate and estimate their effects on the dependent variable. The least squares slope estimator is still the best linear unbiased estimator (BLUE) but the variance is inflated, resulting in low t-statistics. A correlation analysis has been conducted to check for multicollinearity among variables by computing a correlation coefficient for each pair of independent variables. Wooldridge (2015) recommends that a correlation coefficient of less than 0.7 be allowed, implying a lower level of multicollinearity. Table 3 and Figure 9 display the results of the correlation matrix. All of the correlation values are well under 0.7, indicating a lower level of multicollinearity across variables. As a result, multicollinearity is not issue for future investigation.

Table 3. Result of correlation analysis.

	GDPCG	GOVEXEDU	GOVFINC	TRD	INFLA	GROSSCF	FDI	POPG	LIFEX
GDPCG	1.00								
GOVEXEDU	-0.15	1.00							
GOVFINC	-0.13	0.57	1.00						
TRD	0.15	0.22	0.09	1.00					
INFLA	0.22	0.06	-0.13	0.02	1.00				
GROSSCF	0.29	0.15	0.15	0.21	0.08	1.00			
FDI	0.28	-0.04	-0.01	0.35	-0.01	0.11	1.00		
POPG	0.28	0.01	-0.06	0.07	0.04	0.06	-0.06	1.00	
LIFEX	0.01	0.34	0.31	0.36	-0.05	0.31	0.21	-0.01	1.00

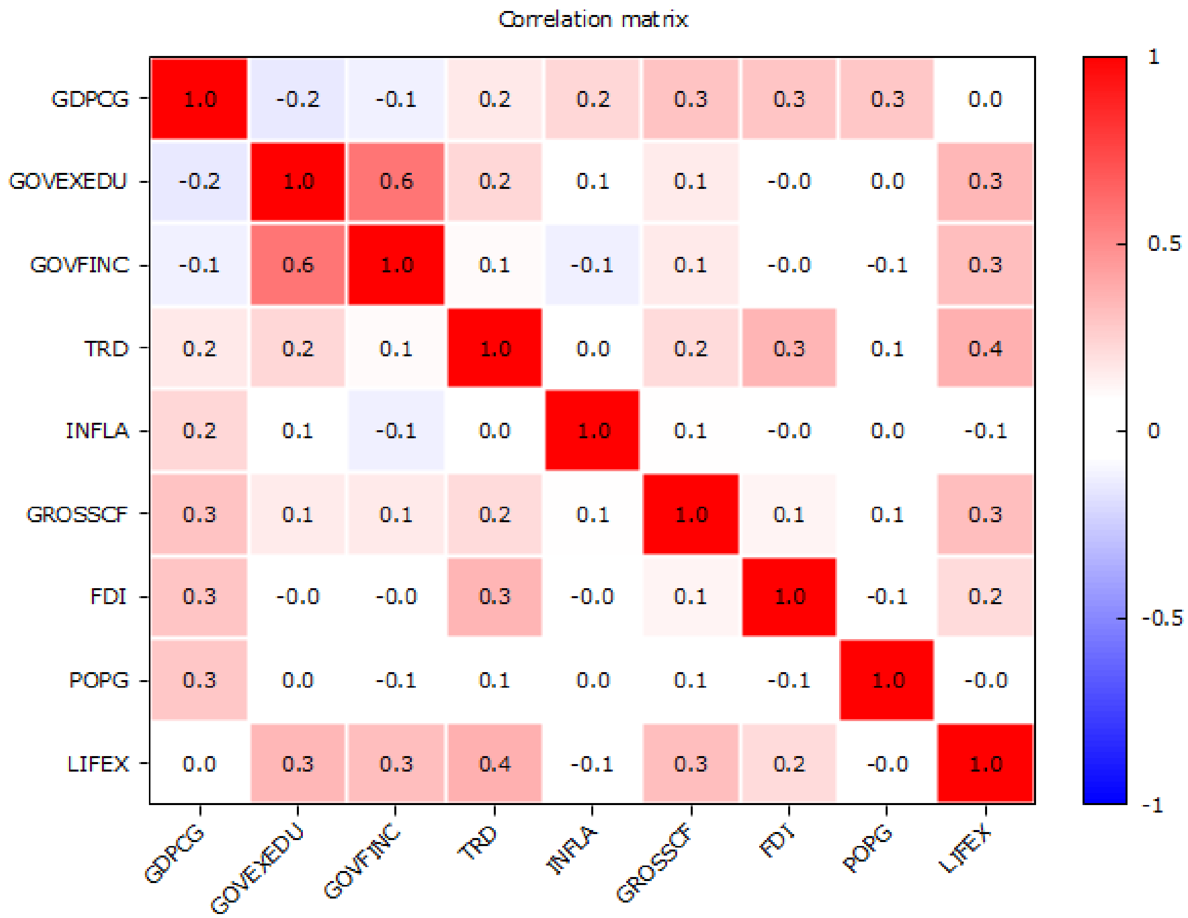


Figure 9: Correlation matrix

Fixed Effects and Random Effects Estimators

The primary objective of this research is to estimate the association between government expenditure on education and economic growth using data from 49 selected economies from 2005 to 2010. Let *N* denote the number of cross-section units (*N* = 49) and *T* denote the number of time-series observations for each cross-section unit (*T* = 6). The fixed-effects model has been applied to equation (4) to estimate the association between the dependent and independent variables summarized in Table 5 of the last chapter. The Fixed-Effects estimator is commonly used with panel data. The GDP growth (annual %) in each cross-section unit may be affected by an unknown fixed factor that is time-invariant. Not accounting for this fixed effect could bias the slope coefficients if the fixed effect is correlated with any one or all of the independent variables, as discussed in the last chapter. It is assumed that time-invariant individual-specific dummy variables may capture the effects of unchanging unmeasured factors. The advantages of this model are it controls unobserved heterogeneity, removes time-invariant confounders, and handles endogeneity. The actual method used by econometrics software to estimate the fixed effects model is to subtract the mean value of each of the independent variables for each country from the sample observations. The same is done for the dependent variable. For example, the transformed observation for the inflation rate for country j in year i is $\widetilde{infla_{ij}} = infla_{ij} - \overline{infla_j}$. Note that the mean is computed for country *j* using all of the time series observations for that country. These transformed observations are then used to estimate the regression model using least squares. The appropriateness of the Fixed Effects estimator is tested using an F test that compares the sum of squared errors between the least squares estimator and the Fixed Effects estimator. The null hypothesis is that the Fixed Effects estimator is not superior to the least squares estimator. The degrees of freedom are *N*-1 and *NT*-*N*-*K* where *K* is the number of independent variables in the regression model.

On the other hand, the Random Effects model, also called the variance components model, is a particular type of hierarchical linear model that implies the cross-section data being analyzed are taken from a hierarchy of several populations whose differences are related to that hierarchy. The idea is that the unknown factor affecting each cross-section unit is not fixed, but rather drawn at random from a distribution that is typically assumed to be Normal. The task is to estimate a factor $\beta \leq 1$ that is used to transform the sample data: $\widetilde{infla_{ij}} = infla_{ij} - \beta\overline{infla_j}$ Wooldridge (2010) stated that when the heterogeneity is stable throughout time as well as that not correlated with explanatory variables, it contributes to controlling for unobserved heterogeneity. The levels of the components utilized in the experiment are randomly chosen from a population of potential levels in a random effects model for the experiment (Ott & Longnecker, 2015). The counterpart to the F test described above for the Fixed Effects estimator is the Breusch-Pagan test that is distributed as a chi-squared with one degree of freedom. Again, the null hypothesis is that the Random Effects estimator is not superior to the least squares estimator.

Hausman's (1978) specification test is performed to choose between the Fixed-Effect and Random-Effect estimators. In a regression model, the Hausman Test is a general test used to detect endogenous regressors. This occurs when the values of one or more of the independent variables are assigned by other unknown variables in the system. The resulting correlation between the independent variable and the error term biases the least squares slope estimator. Before choosing the optimal regression method, it is necessary to determine whether one or more of the predictor variables is endogenous. The presence of a fixed effect can result in endogenous predictor variables, whereas the random effect does not since it is assumed to be random. The null hypothesis of the test is that the Fixed Effects model is not superior to the Random Effects model and therefore the choice of either method is arbitrary. The test is distributed as a chi-squared with K degrees of freedom.

Heteroskedasticity and Serial Correlation

Heteroskedasticity is a violation of the least squares assumption that the variance of the error term in (4) is not constant across cross-section observations. The slope coefficients are still unbiased but not efficient, resulting in erroneous standard errors and t-statistics. Errors that are correlated across time series observations within each cross-section unit (country) is referred to as serial correlation. This is also a violation of a least squares assumption resulting in an unbiased estimator in large samples that is not efficient. The presence of heteroskedasticity and serial correlation results in the least squares slope estimator no longer being the BLUE, although the correction for serial correlation could prove unreliable with only $T = 6$ years. Heteroskedasticity-consistent standard errors, or simply robust standard errors, were introduced by Ecker (1963) to deal with heteroskedasticity and serial correlation. Robust standard errors are a method of calculating the standard errors of the regression coefficients that are efficient when there is the presence of heteroscedasticity or serial correlation in the panel data (Cui et al., 2022).[6] Therefore, in this study, robust standard errors are computed and reported in Table 5.

[6] The variance-covariance matrix of the errors is computed using the least squares regression model. This matrix is then used to compute the standard errors of the slope coefficients in a subsequent matrix calculation that we don't review here.

Regression Results: Fixed Effects Model

Table 5 shows the outcome of the Fixed Effects and Random Effects models with and without dummy variables to account for any time trend. Focusing on the fixed effects regression model, it is estimated that government funding for education maintains an insignificant positive coefficient with economic growth in the 49 selected economies, with a coefficient equal to 0.41. If statistically significant, this result would suggest that a 1% increase in the ratio of government spending on education to GDP increases the economic growth by 0.41%, holding the other independent variables constant. This is an inelastic response, but not statistically significant based on a computed t-statistic of 0.683 (0.37/0.60) at any reasonable level of confidence. It is calculated that government final consumption expenditure has a noteworthy negative effect on GDP growth, with a coefficient of -0.68. According to these findings, a 1% increase in the share of expenditure on government final consumption reduces GDP growth by 0.68%, holding the other independent variables constant. This response is statistically significant based on a computed p value of 0.00. Moreover, this study finds a positive relationship between trade and GDP growth (annual %), with a coefficient of 0.06. This outcome suggests that a 1% increase in trade is associated with a 0.06 percentage point increase in GDP growth (annual %). The calculated p-value for this response is less than 0.05, making it statistically significant. However, with a coefficient of 0.04, inflation has an insignificant effect on GDP growth (annual %). If statistically significant, this result would indicate that a one percentage point increase in inflation would add 0.04 percentage points to economic growth over a six-year period. Based on a calculated p-value of 0.23, this response is statistically insignificant.

Findings also show that there is an insignificant association between gross capital formation and GDP growth (annual %) with an estimated coefficient is 0.10. If it is significant at any level, this outcome would suggest that a 1% increase in the inflation rate increases economic growth by 0.04%. In addition, foreign direct investment inflows have a positive association with GDP growth (annual %) , with a coefficient of 0.26. The outcome indicates that 1% increase in the ratio of foreign direct investment inflows to GDP increases the growth by 0.26%, other independent variables held constant. This response is statistically significant based on a computed p-value of 0.00. As well as that, with a coefficient of 0.11, this study found that population growth has no significant association with GDP growth (annual %). If it is significant at any level, this result would suggest that a 1% increase in the population growth rate is associated with an increase in the GDP growth by 0.11%. A p-value of 0.48 indicates that this result is not statistically significant. Life expectancy in the selected 49 economies has a significant negative association with the GDP growth (annual %) growth rate, with a coefficient of -0.95. A one-percentage-point increase in life expectancy results in a 0.95-percentage-point decrease in GDP growth (annual %). This response is statistically significant based on a computed p-value of 0.01.

Focusing on the Fixed Effects regression model with time dummy variables, it is estimated that the government final consumption expenditure has a noteworthy negative effect on GDP growth (annual %). This result would suggest that a 1% increase in the ratio of government final consumption expenditure to GDP decreases the growth by 0.53%, holding the other independent variables constant. This response is statistically significant based on a computed p value of 0.02. In addition, foreign direct investment inflows have a positive association with GDP growth (annual %), with coefficient of 0.26. The outcome indicates that 1% increase in the ratio of foreign direct investment inflows to GDP increases the growth by 0.28%, holding the other independent variables constant. This response is statistically insignificant based on a computed p-value of 0.05 but is statistically significant at 90% confidence. Moreover, for time dummies, when contrasted against the reference category (2007), GDP growth (annual %) decreased by an average of 1.49% in 2008 and 3.96% in 2009. This could be attributed to the worldwide financial crisis that began in 2008 in the United States and rapidly spread to the rest of the world.

The R-squared statistic estimates the percentage of the dependent variable's variance that is explained by the explanatory variables. In other words, R-squared measures the goodness of fit—how effectively the data fit in the regression model. The goodness of fit for the Fixed Effects model is 58% for the fixed effect without the time trend variables and 66% with the time trend variables. As a result, the higher LSDV R^2 value suggests this model is a reasonable fit for a panel study but could be improved by identifying additional independent variables.

Regression Results: Random Effects Model

Focusing on the Random Effects regression model, with a coefficient of -0.51, this study found government spending on education has an insignificant negative association with the GDP growth (annual %). If it is significant at any reasonable confidence level, this result would suggest that a 1% increase in the ratio of government spending on education to GDP raises the growth rate by 0.51%, holding all other independent variables constant. This response is statistically insignificant based on a computed p value of 0.13. Government final consumption expenditure has an insignificant negative association on GDP growth, with a coefficient of -0.11. If this result is statistically significant, it implies that a 1% increase in the ratio of government final consumption expenditure to GDP reduces the GDP growth (annual%) by

0.11% while holding the other independent variables constant. This response is statistically insignificant based on a calculated p-value of 0.22. Moreover, there is a significant positive association between trade and the GDP growth (annual %). A one-point increase in trade results in a 0.02 percent increase in GDP growth (annual %). Based on a p-value of 0.08, this response is statistically significant. Over a six-year period, a one-percentage-point increase in inflation would add 0.08 percentage points to economic growth. Based on a p-value of 0.03 calculated, the outcome is statistically significant. Gross fixed capital formation has a 0.14 coefficient of correlation with GDP growth (annual %). The results show that increasing the ratio of gross fixed capital formation to GDP by 1% raises the growth rate by 0.26% while holding the others independent variables constant. Based on a p-value of 0.00, this response is statistically significant.

Furthermore, the ratio of foreign direct investment inflows to GDP has a positive association with the annual percentage of GDP growth. Over a six-year period, a one-percentage-point increase in FDI to GDP adds 0.29 percentage points to economic growth. This response is statistically significant based on a computed p-value of 0.07. The findings suggest that there is a significant positive association between the population growth rate and the annual percentage of GDP growth rate. A one-point rise in population growth rate leads to a 0.43-point increase in GDP growth (annual %). Based on a p-value of 0.00, this coefficient is statistically significant. Furthermore, with a coefficient of -0.07, this study suggests that life expectancy has an insignificant negative association with the GDP growth (annual %). If this result is significant at any reasonable level, a 1% rise in life expectancy to GDP reduces the growth rate by 0.07%, ceteris paribus. Based on a calculated p value of 0.13, this response is statistically insignificant.

Focusing on the Random Effects regression model with time trend dummy variables, a one percentage point increase in inflation would add 0.05 percentage points to economic growth over a 6-year period. This response is statistically significant based on a computed p-value of 0.06. A 1% increase in the ratio of gross fixed capital formation to GDP increases the growth (annual %) by 0.16%, ceteris paribus. This response is statistically significant based on a computed p-value of 0.00. Over a six-year period, a one-percentage-point increase in foreign direct investment inflows would add 0.28 percentage points to GDP growth (annual %). Based on a p-value of 0.00, this coefficient is statistically significant. A one-point rise in the population growth rate is associated with a 0.46-point increase in GDP growth (annual %). Based on a p-value of 0.00, this reaction is statistically significant. Furthermore, when compared to the reference category (2007), the GDP growth (annual %) in 2008 falls by 1.56%. Following a similar pattern, in 2009, the annual percentage of GDP growth falls by an average of 4.21%.

A higher R^2 value indicates that the Fixed Effects model is a better fit since the goodness of fit for the Random Effects model is only 41% for the random effect with time trend and 30% for the random effect without time trend. Measures of goodness of fit must be used with caution when using fixed or random effects models since the fit is measured using the transformed variables, not the original data. However, we use these measures for comparing the performance of our competing models.

Based on the results of the Hausman (1978) specification test, a Fixed Effects model is more suitable for this dataset at 99% confidence. In addition, the outcome of the Fixed Effects regression is evaluated with the additional of a time fixed effect model to assess the robustness of the results. Greene (2011) stated that the presence of fixed time effects allows for a comparison to the base period and reflects the contrast one period to the next period. The Fixed Effects model with time dummy variables is the preferred model.

Regression models using panel data exhibit cross-sectional dependence when the errors for the same time period are correlated across the cross-section units (countries). This could occur if the sample countries experience a common unexpected shock to GDP growth that is not accounted for by the independent variables. This does not bias the slope coefficients but does result in a loss of efficiency (higher standard errors for the slope coefficients). The Pesaran CD test (2004) is used to detect cross-sectional dependence.[7]

Table 4. Outcome of Cross-sectional Dependence Test

Statistics	Probability
17.49	0.00***

*** denotes 1% level of significance.

Table 4 demonstrates that the null hypothesis of "no cross-sectional dependence" is rejected at the 1% level of significance. Consequently, it is needed to move forward with estimation methods that consider cross-sectional dependence. In this case, I employed fixed-effects estimator.

[7] The CD test statistic is computed as $\sqrt{\frac{2T}{N(N-1)}}\left(\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\rho_{ij}\right)$ where ρ_{ij} is the estimated correlation coefficient between the errors of country i and country j. The CD test is normally distributed if N and T are sufficient large.

Table 5. The results of Fixed Effect and Random Effect model.

Variable	**Fixed Effects**	**Fixed Effects (Time Trend)**	**Random Effects**	**Random Effects (Time Trend)**
GOVEXEDU	0.41 (0.60)	0.46 (0.53)	−0.51 (0.13)	−0.29 (0.39)
GOVFINC	−0.68*** (0.00)	−0.53** (0.02)	−0.11 (0.22)	−0.12 (0.19)
TRD	0.06** (0.04)	0.01 (0.83)	0.02* (0.08)	−0.00 (0.90)
INFLA	0.04 (0.23)	0.03 (0.32)	0.08** (0.03)	0.05** (0.06)
GROSSCF	0.10 (0.20)	0.15 (0.12)	0.14*** (0.00)	0.16*** (0.00)
FDI	0.26* (0.07)	0.28* (0.05)	0.29* (0.07)	0.28* (0.08)
POPG	0.11 (0.48)	0.08 (0.64)	0.43*** (0.00)	0.36*** (0.00)
LIFEX	−0.95** (0.01)	0.23 (0.62)	−0.07 (0.13)	−0.04 (0.38)
2008		−1.49** (0.04)		−1.56** (0.01)
2009		−3.96*** (0.00)		−4.21*** (0.00)
Constant	69.34** (0.01)	20.81 (0.43)	6.10** (0.02)	4.96 * (0.06)
No. of Observation	294	294	294	294
LSDV R-squared	0.58	0.66		
R-squared			0.30	0.41
F	6.57*** (0.00)	3.32*** (0.00)		
Breusch-Pagan test			26.83*** (0.00)	53.16** (0.00)
Standard Error	3.49	3.17	4.13	3.84
Durbin-Watson	1.54	1.48	1.54	1.49
Hausman Test			32.64*** (0.00)	32.89*** (0.00)

***, **, and * are signs that show a 1%, 5%, and 10% significance level, respectively

Consistency with Previous Research

The findings in Table 5 regarding government spending on education and its association with GDP growth (annual %) are consistent with the broader empirical literature. The findings indicate a positive correlation between education spending and economic growth, but they also reveal statistical insignificance, which aligns with the results reported by Appiah (2017) and Ifa & Guetat (2018). This consistency suggests a recurring trend in the literature where government expenditure on education tends to exhibit a positive relationship with economic growth, yet this relationship often lacks statistical significance.

Moreover, the study's findings are in harmony with the empirical literature, emphasizing the complexities of the education-economic growth relationship. Barro's study in 2001, which found an insignificant relationship between economic growth and schooling attainment for both females at the secondary and higher levels and males at the primary level, further underscores that the impact of education on economic growth is multifaceted. It highlights the necessity of considering various factors, including gender-specific education, when analyzing the relationship between education and economic growth.

In summary, these results are in agreement with the empirical literature, revealing the mixed and nuanced nature of the relationship between education spending and economic growth. While education is widely recognized as a potential driver of economic development, the specific impact and statistical significance can vary across different studies and contexts, emphasizing the importance of considering a range of factors in such analyses.

The findings also suggest that government final consumption expenditure has a noteworthy negative effect on GDP growth (annual %). Akpokerere & Ighoroje (2013) claimed that increased public spending has not resulted in substantive advancement. Moreover, this study finds a positive association between trade and GDP growth (annual %). This outcome is similar to Iyidoğan et al. (2017) and Dufrenot et al. (2010). The inflation rate has an insignificant positive association with GDP growth (annual %) and there is an insignificant positive association between gross fixed capital formation and annual percentage of GDP growth. In addition, foreign direct investment inflows have a positive association to GDP growth (annual %). This result is consistent with Sahu (2021). As well as that, this study found that population growth has no significant relationship with GDP growth (annual %) growth. However, the life expectancy of the selected 49 economies has a significant negative association with their GDP growth (annual %) rate. According to Acemoglu & Johnson (2007), the influence of life expectancy on the overall GDP growth rate is substantially less. This could be due to the observation that more developed economies have longer life expectancies but lower growth rates that lesser developed economies.

Chapter 6: Conclusions

In conclusion, this study utilized annual panel data from 49 economies over the period of 2005 to 2010 to examine the relationship between government expenditure on education and real economic growth. The statistical analysis was conducted using econometric methods, including fixed effects and random effects estimators.

The descriptive statistics of the variables showed that GDP growth (annual %) had a mean of 5.42% with a standard deviation of 4.87%, while government expenditure on education as a percentage of GDP had a mean of 3.74% with a standard deviation of 1.28%. The variables exhibited sufficient variability, except for government expenditure on education, which had relatively low variation.

Upon conducting the multicollinearity test, it was observed that all correlation values exhibit a considerable deviation from 0.7. This finding indicates a negligible level of multicollinearity among the variables under examination. Therefore, there is no concern of multicollinearity for future investigation.

The presence of heteroskedasticity and serial correlation was addressed by using robust standard errors, which provided efficient standard error estimates for the regression coefficients. The fixed effects model was employed to estimate the association between government expenditure on education and real economic growth. The results showed that government funding for education had an insignificant positive coefficient on real economic growth, indicating a limited impact. Whereas, the random effects model yielded insignificant negative association with the GDP growth (annual %). The findings suggest that the Fixed Effects model with time dummy variables is the preferred model, providing a better fit for the dataset. The use of time fixed effects allows for a comparison between periods and enhances the robustness of the results. The selection of the Fixed Effects model is supported by the Hausman specification test conducted at a 99% confidence level.

The aim of this thesis was to investigate the relationship between education spending and economic growth, specifically examining whether government expenditure on education has a positive and significant impact. While education spending is generally believed to contribute positively to long-term economic growth and GDP, the results of this study indicate that its influence on real economic growth is limited compared to other factors such as government consumption expenditure, trade, foreign direct investment inflows, and life expectancy. These findings emphasize the need to consider a range of variables beyond education spending when analyzing the determinants of economic growth. Further research could explore additional independent variables to enhance the model's accuracy and gain a more comprehensive understanding of the factors influencing economic growth.

The findings of this study have implications for the Solow and AK growth models. Both models aim to explain economic growth by considering various factors, including inputs such as physical capital, labor, and human capital. In the Solow growth model, government expenditure on education is considered as a form of investment in human capital, which contributes to long-term economic growth. Similarly, in the AK growth model, education is a key driver of technological progress and productivity growth. The model suggests that increasing investment in education leads to higher levels of human capital, which in turn stimulates economic growth. It is important to note that excessive or inefficient government spending on education can have adverse effects on GDP in certain situations. Issues such as inefficiencies in education spending, misallocation of resources, and the fiscal burden of heavy borrowing to finance education expenditure can negatively impact economic performance. Consequently, this study raises questions regarding the validity of using education spending as a sole indicator for measuring human capital development and whether employment opportunities align with the level of investment in education. These findings also prompt further exploration into the efficiency of traditional education systems, suggesting a need for reforms in education expanding to ensure that investments lead to tangible improvement in human capital.

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